The Distribution and Abundance of Juvenile Salmonids and Other Species in the Courtenay River Estuary and Baynes Sound, 2000

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THE DISTRIBUTION AND ABUNDANCE OF JUVENILE SALMONIDS AND OTHER SPECIES IN THE COURTENAY RIVER ESTUARY AND BAYNES SOUND, 2000

by

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ABSTRACT

Jenkins, J.A., Bravender, B.A., Beggs, C., Munro, B., and Miller, D. 2006. The distribution and abundance of juvenile salmonids and other species in the Courtenay River estuary and Baynes Sound, 2000. Can. Tech. Rep. Fish. Aquat. Sci. 2659: xiv + 77 p.

Field sampling of the distribution of juvenile salmonids within the Courtenay River and estuary in 1998 showed low numbers of salmon to be rearing in the area. Many of the sites exhibited temperatures above those recommended for rearing of salmon. It was hypothesized that, in response to the high temperatures and lack of low tide refuges in the estuary, the salmon were migrating into Baynes Sound to rear.

In 2000 this study was organized to test this hypothesis. Sampling took place in the Courtenay River, estuary and Baynes Sound area between early July and early September to document the water properties and distribution of the juvenile salmonids. Analysis of the salinity data identified six statistically significant habitats within the area sampled. Most juvenile salmonids had already left the area or died by the time this project started and only 350 chinook, coho, chum, cutthroat, rainbow and steelhead were captured. The majority of these were found to be rearing in the upper and lower river regions, between the confluence of the Puntledge and Tsolum rivers and the viewing stand on the east side of the estuary. Chinook dispersed throughout the study area, occurring at all but 3 of the sites sampled. Coho occurred only in the upper and lower river regions as did steelhead, cutthroat and rainbow.

Future sampling in this area should include the early spring to further document the rearing patterns of the juvenile salmonids. The river and estuary lack sufficient low tide refuges and any enhancement undertaken should be in the upper and lower river regions.

RÉSUMÉ

Jenkins, J.A., Bravender, B.A., Beggs, C., Munro, B., and Miller, D. 2006. The distribution and abundance of juvenile salmonids and other species in the Courtenay River estuary and Baynes Sound, 2000. Can. Tech. Rep. Fish. Aquat. Sci. 2659: xiv + 77 p.

L'échantillonnage de terrain de 1998 visant à déterminer la répartition des salmonidés juvéniles dans la rivière Courtenay et son estuaire a révélé de faibles effectifs de saumons en croissance dans la région. Nombre des sites affichaient des températures au-dessus de celles recommandées pour la croissance des saumons. L'hypothèse formulée était la suivante : à cause des températures élevées et du manque de refuges à marée basse dans l'estuaire, les saumons ont migré dans la baie Baynes pour croître.

En 2000, on a prévu une étude pour confirmer l'hypothèse. L'échantillonnage a été réalisé dans la région de la rivière Courtenay, de son estuaire et de la baie Baynes entre le début de juillet et le début de septembre. Il avait pour objet de documenter les propriétés de l'eau et la répartition des salmonidés juvéniles. L'analyse des données sur la salinité a permis l'identification de six habitats statistiquement significatifs au sein de la zone échantillonnée. La plupart des salmonidés juvéniles avaient déjà quitté la zone ou étaient déjà morts au moment où le projet a été lancé, et seuls 350 poissons (saumons quinnats, saumons cohos, saumons kétas, truites fardées, saumons arc-en-ciel et truites arc-en-ciel) ont été capturés. La majorité de ces poissons en croissance ont été observés dans des régions des cours supérieur et inférieur de la rivière, soit entre le confluent des rivières Puntledge et Tsolum et la plate-forme d'observation située du côté est de l'estuaire. Les quinnats étaient dispersés dans toute la zone d'étude; ils étaient absents de seulement trois des sites échantillonnés. Les saumons cohos, les truites arc-en-ciel, les truites fardées et les saumons arc-en-ciel se trouvaient seulement dans des régions des cours supérieur et inférieur de la rivière.

D'autres échantillonnages dans cette zone doivent être effectués au début du printemps pour approfondir les données sur les tendances de croissance des salmonidés juvéniles. La rivière et son estuaire n'offrent pas assez de refuges à marée basse. Tout projet d'amélioration devrait être entrepris dans les régions des cours supérieur et inférieur de la rivière.

INTRODUCTION

The Courtenay River estuary is located on the east coast of Vancouver Island close to the City of Courtenay at 49° 40' latitude and 124° 55' longitude (Fig. 1). The Courtenay River is formed by the joining of the Puntledge and Tsolum rivers 2.6 km from the ocean. Within this watershed mining, logging and power generation have altered the flows, water quality and habitats in both the Tsolum and Puntledge rivers (B.C. Hydro 2006; Canada Department of Fisheries 1958; Deniseger 1995). Historically this system has supported natural runs of chinook (*Oncorhynchus tshawytscha*), chum (*Oncorhynchus keta)*, pink (*Oncorhynchus gorbuscha*), coho (*Oncorhynchus kisutch*) steelhead (*Salmo gairdneri*) and cutthroat trout (*Salmo clarki clarki*). However, many of these stocks have declined dramatically over recent years.

In 1997, in response to concerns over the future of this watershed, the Department of Fisheries and Oceans, in partnership with local government and First Nations, drafted up the first management plan for this estuary (Adams and Asp 2000). In 1998, the first survey of the juvenile salmonids in this estuary was carried out in support of this management plan by staff from Science Branch, Pacific Biological Station, Nanaimo and the Habitat and Enhancement Branch located at South Coast, Nanaimo and the Puntledge River Hatchery in Courtenay. Results of this survey may be found in MacDougall et al. (1999) and Bravender et al. (2002).

Tidal height and inflow of both salt and fresh water determine the physical characteristics found in the lower river and estuary. Based on the salinities and temperatures recorded in the estuary during the 1998 survey, two distinctly different types of habitat were distinguished. The upper region included eight sampling sites and the lower region consisted of nine. One-way analysis of variance showed a significant difference in all salinities ($p<0.01$), surface salinities ($p<0.01$) and surface temperatures ($p<0.05$) between these two regions of the estuary during 1998 (Bravender et al. 2002). In contrast, one-way analysis of variance of all temperatures, surface dissolved oxygen and all oxygen values to depth showed no significant difference between the upper and lower regions of the estuary.

The temperatures recorded during the 1998 survey ranged between 12 ° C and 24.8 ° C, with 53% of the values between 16 ° C and 20 ° C. Of concern was that the temperatures recorded at many of these sites exceeded those that are widely accepted as being acceptable for juvenile salmonids. Walthers and Nener (1997) suggest that temperatures above 16 °C may be detrimental to salmonids and the preferred temperature range for Pacific salmonids as determined by Brett (1952) is between 12 ° C and 14 ° C.

During the 1998 survey 176 beach seines were completed in both the upper and lower regions of the estuary, capturing a total of 734 juvenile salmonids. Results showed that the salmonids tended to migrate down the east side of the estuary, which is dominated by the freshwater flow from the river, while only a few were captured at sites along the west side of the estuary. Low tide refuges were shown to be lacking, with most consisting of man made pockets such as marinas and sloughs. In addition, the sites on the western side of the estuary exhibited temperatures which were well above those recommended for the rearing of juvenile salmonids.

As a result of the work carried out in 1998, it was decided to undertake another survey of the estuary and to expand the sampling program into Baynes Sound in an effort to document the migration patterns of the juvenile salmon as they left the Courtenay River and estuary. It was hypothesized that, in response to the high temperatures and lack of suitable refuges in the estuary, the majority of the juveniles were migrating through the estuary to rear in Baynes Sound. To test this hypothesis, a second survey was undertaken in 2000. Sampling sites were established in Baynes Sound on both shores as far south as Denman Point and in the marine area on the east side of Denman Island (Fig. 2). Sampling included the use of beach seines as well as purse seines which allowed assessment of the populations of juvenile salmonids in the deeper waters offshore. Pole seines were also used to sample five shallow sites in the estuary.

METHODS

Sampling methods used for the 2000 survey are outlined in detail in Jenkins et al. (2001). All salmonids captured were counted and identified. Where large numbers of non-salmonids were caught, sub samples were taken with a dip net, counted, and then multiplied by the number of dip nets required to empty the seine.

Hatchery chinook and hatchery chum salmon were usually distinguished from the wild populations by size and were further identified as marked (adipose fin clipped) or unmarked. Occasionally small fry were also captured which were judged to be wild based on size. In order to measure length and weight, all or a sub sample of salmonids were anaesthetized with Alka Seltzer© on shore at the site. Where possible, ten salmonids of each species were weighed and measured. Fork lengths to the nearest mm and weights to the nearest 0.1 g were recorded and the fish were allowed to recover in a bucket of water and then released.

A YSI 85 oxygen, conductivity, salinity and temperature meter was used to record temperature, salinity and dissolved oxygen at the surface and at one metre intervals, either to the bottom or to a maximum depth of five metres. Measurements were continued across both the ebb and flood stages of the tide. An Eagle Explorer and Motorola TRAXAR GPS Navigator GPS locators were used during the survey to locate the sites sampled.

Onset Corporation Stowaway Tidbit Data Loggers were used to record the temperatures at various locations within the Courtenay River estuary (Fig. 1) and the Puntledge River (Fig. 5) and Tsolum River (Fig. 7) watersheds. The results were then averaged to give a daily value and graphed by two week averages.

Condition factors for all salmonids were determined using the equation:

$$K = \frac{W}{L^3} \times 10^5$$

where K is the condition factor, W is the wet weight of the fish in grams, and L is the fork length of the salmon in millimetres (Meehan and Miller 1978).

Analysis of variance tests were carried out using Microsoft Excel software. The salinity and temperature measurements were analyzed as well as the juvenile salmonid data. These tests were designed to determine the significance of region on the occurrence of salmonids in the 2000 survey and to determine if statistically significant differences existed between the distribution and abundance and the lengths, weights and condition factors of the juvenile salmonids in the various regions sampled during the 2000 field surveys.

RESULTS

PUNTLEDGE AND TSOLUM RIVER WATERSHEDS

Flow regimes

Flows varied widely from 1996 to 2000 in both the Puntledge and Tsolum rivers as illustrated by the five day averages graphed in Figs. 3 and 4. During this time flows in the Puntledge River were up to four times higher than the highest flows recorded in the Tsolum River in both 1997 and 1999 (Fig. 3). Minimum flows in the Tsolum River in 2000 were among the lowest flows recorded for the five year period and were well below the flows recorded in this river in both 1997 and 1999 (Fig. 4). During this project, flows in the Puntledge River dropped from mid July to late August and flows in the Tsolum River were at the lowest level recorded during the year.

Temperatures

Six data loggers located in the Puntledge River watershed (Fig. 5) and four data loggers in the Tsolum River watershed (Fig. 7) recorded temperatures between May 14th and October 1st. This data is graphed as two week averages in Figs. 6 and 8.

The temperatures recorded in the Puntledge River watershed showed very little variation at the six sites which ranged from Comox Lake to the 5th St. Bridge (Figs. 5 and 6). Slightly more variation in temperature was found in the Tsolum River watershed (Figs. 7 and 8). Nevertheless, both graphs show a warming trend from the middle of May until early August. During this period the temperatures rose from 12 º C to approximately 18 º C in the Tsolum and reached 20 º C in the Puntledge River. Temperatures then slowly declined during September.

Escapements and releases of salmon

Escapement of salmon to the Puntledge River has fluctuated from 1953 to 2000. Pink and chum have shown an increase in numbers, coho have stayed approximately the same and chinook have declined somewhat (Figs. 30 and 31). In 1999 a total of 308 summer and 800 fall chinook returned to this river to spawn along with 8,500 coho, 91,000 chum and 100,000 pink.

In 2000, the Puntledge River Hatchery released 735,000 summer chinook, 2.2 million fall chinook, 2.2 million coho, 3.9 million chum, 2.1 million pink, 4,773 summer steelhead and 4,671 cutthroat for a total release of almost 11.2 million juvenile salmonids (Figs. 72 and 73). Juvenile pink were released starting March 15th and by March 30th 90% had left the hatchery. Release of chum juveniles began on May

5th and 90% had left the hatchery by May 12th. Ninety percent of the coho juveniles were released from the hatchery between May 16th and May 26th. Release of fall chinook started on May 30th and 90% had left by June 12th while ninety percent of the cutthroat had left the hatchery between May 31st and June 5th. The steelhead juveniles were taken from the hatchery by truck and released down river on June 10th.

COURTENAY RIVER ESTUARY

Temperatures

Between May 14th and October 1st 2000, three data loggers recorded temperatures within the Courtenay River estuary, one at the cement silo (T2) and two at the seapens outside the Comox Marina (T1) (Fig. 1). The results show a warming trend with temperatures approaching 20 °C in the surface waters by mid July and then decreasing toward the end of September (Fig. 9). Temperatures were only slightly cooler at the 5 metre depth at the seapens.

REGIONS IN THE STUDY AREA

A total of 47 sites were sampled in the Courtenay river, estuary, Baynes Sound and offshore area combined during the 2000 field study (Figs. 1 and 2). Descriptions and the GPS location of each site are listed in Jenkins et al. 2001.

One-way analysis of variance (ANOVA) of all the salinities recorded at each site was used to test for any significant differences between sites and to determine if the sites could be grouped into discrete habitat types. All but one of the comparisons carried out yielded a value of $p \leq 0.001$ and showed six distinctly different regions in the study area as described below (Table 1).

Courtenay River and estuary

Based on salinities recorded at all depths, three types of habitat were identified in the river and estuary. The upper river group included sites 1, 1A, 17 and 24. Sites 11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, and 45 made up the lower river group. Sites 4, 6, 8, 40 and 46 were designated as the estuary group (Table 1) (Fig. 1).

Baynes Sound

Analysis of variance of the salinities recorded at the 19 sites in Baynes Sound revealed two more habitats in this area. Sites closest to shore, including sites 15, 25, 26, 28, 29, 30, 31, 32, 34, 52 and 55 were found to be significantly different from those offshore including sites 27, 33, 47, 48, 49, 50, 51, and 53 (Table 1) (Fig. 2).

Outside

Analysis of variance of the salinities recorded at sites 36, 37 and 54 indicated that these sites were significantly different from all other station groupings including those

in Baynes Sound (Table 1) (Fig. 2). As no physical variables were recorded at site 35 it was excluded from the analysis.

WATER PROPERTIES BY REGION

Range and mean values ± 1SE for temperature, salinity and dissolved oxygen levels recorded during the 2000 field survey are listed by site and region in Table 3. Mean values ± 1SE for each physical parameter by site and region are also illustrated in Figs. 10 to 29. Standard errors are shown on the graphs wherever enough samples were collected for this to be calculated. However, some standard errors were too small to show on many of the graphs.

Upper river

Twenty-one samples of the water properties were recorded at the four sites in this region (1, 1A, 17 and 24). Salinities between surface and two meters depth were all 0 ‰, indicating that the salt wedge did not reach this part of the river on high tide during the study (Table 3). Temperatures varied from 16.8 ° C (sites 1 and 17) to 21.3 ° C (site 1A) with means ± 1SE by site varying from 18.7 ± 0.6 ° C to 21.3 ° C (Fig. 16). The mean temperature ± 1SE for all sites combined in the region was 19.7 ± 0.3 ° C (Fig. 22). Dissolved oxygen levels ranged from 7.6 mgL^{-1} (site 1A) to 10.9 mgL^{-1} (site 1) (Table 3) and the mean oxygen (mgL^{-1}) ± 1SE by site for this region varied from 7.8 mgL^{-1} to 10.1± 0.6 mgL^{-1} (Fig. 23). The mean dissolved oxygen level ± 1SE for all sites combined was 9.4 ± 0.2 mgL^{-1} (Fig. 29).

Lower river

Fifty-four samples of the water quality were recorded at the fifteen sites in this zone (11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, and 45) (Table 3). Salinities ranged from 0 ‰ (site 42) to 20.0 ‰ (site 39) (Table 3) and the highest mean salinities ± 1SE were recorded at sites 23 (10.3 ± 0.8 ‰) and 39 (10.4 ± 4.2 ‰) (Fig. 10). The mean salinity for all sites in the region ± 1SE was 3.1 ± 0.7 ‰ (Fig. 15). Temperatures varied between 16.4 ° C (site 41) and 28.3 ° C (site 23) (Fig. 17) with a mean temperature for this region of 20.0 ± 0.3 ° C (Fig. 22). Dissolved oxygen values by site varied from a low of 3.4 mgL^{-1} (site 41) to 10.9 mgL^{-1} (site 12) (Fig. 24) with a mean ± 1SE for the region of 9.1 ± 0.2 mgL^{-1} (Fig. 29).

Upper and lower river regions combined

The temperatures for the river region as a whole varied from 16.4 ° C (site 41) to 28.3 ° C (site 23) and the mean temperature ± 1SE for both the river habitats combined was 19.9 ± 0.2 ° C. Minimum and maximum salinities were 0 ‰ (sites 1, 1A, 17, 24, 42) and 20 ‰ (site 39) with a mean value ± 1SE for the salinity in this area of 2.2 ± 0.5 ‰. Dissolved oxygen levels were recorded from 3.4 mgL^{-1} (site 41) to 10.9 mgL^{-1} (sites 1, 12) while the mean ± 1SE for this area was 9.2 ± 0.2 mgL^{-1} (Table 3).

Estuary

The estuary region was comprised of five sites (4, 6, 8, 40 and 46) and thirty samples of the water properties were recorded in this region (Table 3). Salinities varied between 13.4 ‰ (site 46) and 27.9 ‰ (site 6), with a mean ± 1SE for this region of 23.9 ± 0.5 ‰ (Figs. 11 and 15). Measurements of the temperatures at these sites showed a range of 14.1 ° C (site 6) to 26.1 ° C (site 40) and a mean ± 1SE for all sites combined of 18.7± 0.5 ° C (Figs. 18 and 22). Dissolved oxygen levels were the lowest at site 40 (6.0 mgL^{-1}) and the highest at sites 8 and 46 (10.3 mgL^{-1}) with a mean ± 1SE for the region of 8.6 ± 0.2 mgL^{-1} (Figs. 25 and 29).

Baynes Sound nearshore

Sixty-two samples were taken of the water properties at the eleven sites in this region (15, 25, 26, 28, 29, 30, 31, 32, 34, 52 and 55) (Table 3). Salinities ranged from 18.3 ‰ (site 32) to 27.7 ‰ (site 52) with a mean ± 1SE for all sites combined of 24.7 ± 0.2 ‰ (Figs. 12 and 15). Temperatures varied from 13.8 ° C (site 52) to 22.4 ° C (site 30) and the mean ± 1SE for this region was 18.2 ± 0.2 ° C (Figs. 19 and 22). Measurements of dissolved oxygen showed values between 7.2 (site 31) and 12.5 mgL^{-1} (site 52). The mean dissolved oxygen ± 1SE for this region was 9.6 ± 0.2 mgL^{-1} (Figs. 26 and 29).

Baynes Sound offshore

Sixty-six samples were recorded of the water properties at the eight sites in this region (27, 33, 47, 48, 49, 50, 51 and 53) (Table 3). Measurements of salinity varied from 22.5 ‰ to 27.6 ‰, both at site 47, with a mean ± 1SE for all sites combined of 26.1 ± 0.1 ‰ (Figs. 13 and 15). Temperatures ranged from 13.9 ° C (site 47) to 21.4 ° C (site 27) with a mean for the region ± 1SE of 17.0 ± 0.2 ° C (Figs. 20 and 22). Dissolved oxygen fluctuated from 8.3 mgL^{-1} (site 27) to 13.5 mgL^{-1} (site 48) and the mean ±1SE for the region was 10.2 +/- 0.2 mgL^{-1} (Figs. 27 and 29).

Nearshore and offshore regions in Baynes Sound

At all 19 sites in Baynes Sound the temperature varied from a low of 13.8 ° C at site 52 to a high of 22.4 ° C at site 30. The mean temperature ± 1SE for this region was 17.6 ± 0.2 ° C (Table 3). Salinity ranged from 18.3 ‰ at site 32 to 27.7 ‰ at site 52. The mean salinity ± 1SE for all sites combined was 25.4+/-0.1 ‰. Dissolved oxygen values fluctuated from 7.2 mgL^{-1} at sites 30 and 31 to 13.0 mgL^{-1} at site 49. The mean dissolved oxygen ± 1SE for the region was 9.9 ± 0.1 mgL^{-1}.

Outside

This region was represented by sites 36, 37 and 54 and water properties were recorded thirty-one times at these three sites (Table 3). The salinities in this region varied very little, with a low of 26.1 ‰ (site 54) and a high of 27.9 ‰ (site 36) (Fig. 14). The mean ± 1SE for all sites combined was 27.1 ± 0.1 ‰ (Fig. 15). Temperatures were somewhat more variable and ranged from 13.2 ° C (site 36) to 17.4 ° C (site 37), with a mean ± 1SE of 14.8 ± 0.2 ° C (Figs. 21 and 22). Dissolved

oxygen levels fluctuated from 8.6 to 12.1 mg/l, both at site 36 (Fig. 28). The mean ± 1SE for this region was 9.7 ± 0.1 mgL^{-1} (Fig. 29).

All regions combined

Salinities varied from 0 ‰ at all the upper river sites to 27.9 ‰ at both site 6 in the estuary and site 36 in the outside region. The mean salinity ± 1SE for all sites combined was 18.9 ± 0.7 ‰ (Table 3). Dissolved oxygen levels were quite variable throughout the 2000 sampling season. The minimum level was 3.4 mgL^{-1} at site 41 while the maximum dissolved oxygen level of 13.5 mgL^{-1} was recorded at site 48 in Baynes Sound. The mean ± 1SE for dissolved oxygen levels for all sites was 9.6 ± 0.1 mgL^{-1}.

Temperatures recorded at all sites during this study varied from 13.2 ° C (site 36, 5 m depth) to 28.3 ° C (site 23, surface). The mean temperature for the entire study area during the project was 18.1 ± 0.1 º C. Table 2 shows the results of the ANOVA analysis of all the temperatures recorded by site and region. There was no significant difference in temperatures between the upper and lower river ($p = 0.5$). There was also no significant difference between the estuary and the upper river ($p= 0.1$) or the Baynes nearshore zone and the estuary ($p=0.4$). All other ANOVAS yielded significant differences in temperatures.

SURVEYS OF JUVENILE SALMONIDS BY DATE

Sampling for juveniles

From July 11th to September 6th a total of only 350 juvenile salmonids were captured including 147 coho (42.0%), 98 chinook (28.0%), 43 cutthroat (12.3%), 39 steelhead (11.1%), 22 rainbow (6.3%) and 1 chum (0.3%) (Table 4) (Fig. 32). Sampling methods in the river and estuary included beach, pole and purse seines while purse and beach seines were used in Baynes Sound and purse seines only in the outside region. A more detailed sampling schedule may be found in Jenkins et al. (2001). In total there were 147 beach seines, 27 purse seines and seven pole seines completed during this project for a total of 181 sets for all gear combined. As no physical data was recorded for site 35, it was not included in the analysis leaving a total of 180 sets for the analysis (Tables 5 and 6).

Although juvenile salmonids were captured between July 11th and August 24th, the highest catches occurred on the July 25th trip when coho and steelhead dominated the population (Table 6) (Figs. 33 and 34). The next highest catches were on the July 11th and July 17th trips. Chinook were captured throughout this study and comprised 100% of the catch on six of the sampling dates (Fig. 35) (Table 6). No salmonids were captured on either the August 29th or September 6th trips. The highest CPUE was also recorded on the July 25th sampling trip (Fig. 34).

The CPUE ± 1SE by species of salmonid for all dates and regions combined ranged from a maximum of 0.8 ± 0.4 for coho to a minimum of 0.006 ± 0.006 for chum (Table 6) (Fig. 34). Standard errors are shown wherever enough samples were collected for this to be calculated. However, some values were too small to show on some of the graphs.

SURVEYS OF JUVENILE SALMONIDS BY REGION

Upper river

In this region 97 juvenile salmonids were caught, 27.7% of the total number of juvenile salmonids captured during the entire study (Tables 4 and 5) (Figs. 36 and 37). The upper river area appeared to be preferred by both steelhead (74.4% of total catch) and rainbow (81.8% of total catch) which were found only at site 24. Coho fry occurred in large numbers at site 1A (8.8% of total catch) which was located in a man-made groove off the Courtenay River in Millennium Park. Chinook were captured at all sites in this region but site 1A and made up 22.4% of the total catch for this species (Table 5) (Fig. 37). Cutthroat were found rearing only at sites 1 (9.3% of total catch) and 24 (11.6% of total catch). CPUE values ± 1SE for the individual sites ranged from 0.8 ± 0.5 for cutthroat at site 24 to 6.5 ± 2.5 for coho at site 1A. For all sites combined the highest CPUE ± 1SE was 1.5 ± 1.3 for steelhead followed by 1.1 ± 0.6 for chinook.

Lower river

A total of 207 juvenile salmonids or 59.1% of the 350 captured during the entire survey were found within this region (Tables 4 and 5) (Fig. 36). Coho dominated the catches (128) followed by cutthroat (34), chinook (31) and steelhead (10). The highest catches were at sites 11, 20, 21 and 39 (Fig. 38) (Table 5). Chinook were captured at eight of the 15 sites sampled in this area but steelhead and cutthroat appeared to prefer the habitat at sites 11 and 20. Coho were found at five of the sites with the highest numbers at sites 21 (99 fish) and 20 (21 fish). CPUE ± 1SE ranged from 0.1 ± 0.1 for coho at site 39 to 12.4 ± 7.6 for coho at site 21. Only four rainbow were captured, all at site 12. Coho dominated the catches for this region followed by cutthroat, chinook, steelhead, and rainbow (Table 5).

Estuary

Chinook were the only juvenile salmonids captured at the five sites sampled in the estuary, occurring at sites 6 (six fish) and 8 (one fish) (Table 4) (Figs. 36 and 39). This was 7.1% of the 98 juvenile chinook that were caught during the study. The CPUE ± 1SE for this species in this region was low at only 0.3 ± 0.2 (Table 5).

Baynes Sound nearshore

A total of 22 chinook were caught in this region, occurring in small numbers at eight of the 11 sites that were sampled (Figs. 36 and 40) (Table 5). This comprised 22.5% of the total 98 chinook captured during this study and 6.3% of the total salmonids. The highest CPUE ± 1SE in this region was 1.4 ± 1.4 at site 29.

Baynes Sound offshore

A total of nine juvenile chinook (9.2% of the 98 chinook captured in the study) and one chum (100% of the chum captured) were caught at four of the eight sites in this region (Tables 4 and 5) (Figs. 36 and 41). The highest CPUE ± 1SE in this region

was 1.5 ± 1.5 at site 48 where three chinook (3.1% of the total) were caught. The overall CPUE ± 1SE in this region was 0.4 ± 0.2 and the 10 salmon caught represented 2.9% of the total 350 salmonids captured during this study.

Outside

Seven juvenile chinook were caught at two of the three sites in this region (Tables 4 and 5). This was 7.1% of the 98 chinook captured during this study and 2.0% of the total 350 salmon caught at all sites (Figs. 36 and 42). The highest CPUE ± 1SE for this region was 2.0 ± 2.0 at site 37.

SURVEYS OF NON-SALMONIDS

Table 10 lists the non-salmonids captured during this study. Where possible, fish were identified to species. However, as all identifications were carried out in the field, many of the non-salmonids could not be identified beyond the level of family or order. The total catch by species or group and region, CPUE ± 1SE and percentage of the total population comprised by each species or group may be found in Table 11. Over 12,000 non-salmonids were caught during this study. Dominant groups included unidentified perch (4,102), unidentified sculpins (3,318) and unidentified gunnels (1,137). The highest CPUE ± 1SE recorded was 68.4 ± 44.3 for unidentified perch captured in the estuary followed by 36.6 +/- 11.4 for unidentified sculpins in the Baynes Sound nearshore region. The total catch by species and region are graphed in Figs. 43 to 49 and the CPUE ± 1SE for dominant groups and all species combined by region are illustrated in Figs. 50 and 51.

LENGTHS, WEIGHTS AND CONDITION FACTORS OF JUVENILE SALMONIDS

Mean lengths, weights and condition factors were determined for 155 salmonids from all sites combined (Table 7). This included 92 chinook, 62 coho and one chum. This single chum was excluded from further analysis (Tables 8 and 9) (Figs. 52 to 71). Where possible, the standard errors have been included on the figures. However, many values were too small to graph.

Chinook

For chinook the mean length ± 1SE increased from 81.0 ± 1.2 mm in the upper river region to 173.0 ± 19.8 mm in the outside region with a mean ± 1SE for all regions of 100.3 ± 3.4 mm (Table 8) (Figs. 52 to 58). One-way ANOVA analysis between the various regions showed that increases in chinook lengths were significantly different for most regions from the upper river region to outside. However, the lengths of chinook captured in the lower river were not significantly different from those captured in the upper river region (Table 9).

Mean weights ± 1SE ranged from 5.8 ± 0.2 grams in the upper river region to 72.4 ± 25.3 grams in the outside region with an overall mean weight of 15.5 ± 2.5 grams (Table 8) (Figs. 59 to 65). As with lengths, ANOVA analysis of chinook showed that weights were significantly different between all regions except the upper and lower river zones (Table 9).

The condition factors for chinook varied very little from region to region with a minimum ± 1SE of 1.05 ± 0.03 in the Baynes nearshore region and a maximum of 1.16 ± 0.05 in the outside region (Table 8) (Figs. 66 to 71). The mean ± 1SE for all sites combined was 1.1 ± 0.01 (Table 8). Condition factors for chinook were not significantly different from region to region (Table 9).

Coho

Coho were only captured in the upper and lower river regions during this project. The mean length ± 1SE for coho ranged from 61.1 ± 1.1 mm in the upper river region to 70.2 ± 1.6 mm in the lower river region with a mean of 67.8 ±1.3 mm for these two regions combined (Table 8) (Figs. 52 to 58). ANOVA analysis showed that lengths for coho were significantly different between these two regions (p=0.002) (Table 9).

The mean weight ± 1SE for coho varied from 2.6 ± 0.2 grams in the upper river region to 4.1 ± 0.3 grams in the lower river region. The mean ± 1SE was 3.7 ± 0.2 grams for these two regions combined (Table 8) (Figs. 59 to 65). As with length, ANOVA analysis showed that weights for coho were also significantly different between these two regions (p=0.005) (Table 9).

Mean condition factors ± 1SE for coho varied from 1.14 ± 0.03 in the upper river region to 1.10 ± 0.02 in the lower river with a mean ± 1SE of 1.10± 0.01 for both these regions together (Table 8) (Figs. 66 to 71). There was no significant difference in condition factor between these two regions (Table 9).

The largest coho captured was a marked hatchery fish 105 mm in length weighing 10.1 grams, caught on July 11th at site 20. Other coho captured at the same time ranged in length from 60 to 93 mm with weights between 2.6 and 9.0 grams (Jenkins et al. 2001). The smaller coho fry were found more frequently in the upper river area including the smallest coho captured (54 mm) which was caught at site 21 on July 11th.

Comparison of chinook and coho

ANOVA analysis of lengths, weights and condition factors was carried out between chinook and coho in all six regions (Table 9).

All comparisons for lengths for both species were statistically significantly different except for three tests which were not:

- chinook in the upper river region vs chinook in the lower river region
- chinook in the estuary vs chinook in the Baynes Sound nearshore region
- chinook in the Baynes offshore region vs chinook in the outside region.

Comparisons for weight between chinook and coho for all regions were also all statistically significantly different except for the three listed above (Table 9).

Condition factors ranged between 0.74 (chinook at site 30, 20th July) and 1.70 (chinook at site 11, 1st August) with 47.4% between 0.90 and 1.10. A total of 47.4% had condition factors above 1.10 and 3.9 % had condition factors below 0.90.

ANOVAs of the mean condition factors for chinook and coho for all six regions showed no significant difference between them (Table 9).

DISCUSSION

PROJECT HISTORY

In 1998 ECL Envirowest Limited was retained by the Department of Fisheries and Oceans (DFO) to develop an estuary management plan for the Courtenay River estuary (Adams and Asp 2000). The study carried out in 1998 by DFO staff on the distribution and abundance of juvenile salmonids within this estuary brought to light the elevated temperatures and the low number of juvenile salmonids in this area during the spring and summer (MacDougall et al. 1999; Bravender et al. 2002). As well, the study showed a lack of low tide refuges within the estuary. As a follow up, the present study was carried out to investigate whether juvenile salmon are able to successfully rear in the river and estuary and to also assess how important Baynes Sound is to their survival. Whether or not the hatchery and wild juveniles have sufficient suitable habitat in which to rear in the river, estuary and Baynes Sound was of primary concern.

DISTRIBUTION AND ABUNDANCE OF JUVENILE SALMONIDS

Virtually all of the 11.2 million juvenile salmon produced by the Puntledge River Hatchery had been released by approximately the middle of June 2000. Sampling for this study did not begin until early July. By this time, the majority of the hatchery and wild juveniles, especially the pink and chum, had either moved out of the area or died. Consequently only 350 juvenile salmonids were captured during the sampling period. Pink salmon are known to migrate immediately to seawater as fry after emerging from the gravel (Thorpe 1994). Healey (1980) noted that chum are abundant in estuaries for two months in early spring, coho smolts for 2 months in late spring and chinook smolts throughout the spring, summer and autumn. Cutthroat migrate into estuaries in the late winter to early spring and may stay there to rear throughout the summer.

The majority of those juveniles captured were in the upper or lower river regions and the catches were dominated by trout, coho fry and chinook which remained in the area until late summer. The small size of many of the coho captured in this study suggests that some were likely the offspring of wild spawners. This is particularly true for the coho fry captured at site 1A.

During this study, higher catches of fish were found at sites at the beginning of the field survey, from early July until early August while catches decreased from mid August to the beginning of September. Coho and chinook were caught more frequently at the beginning of the survey and chinook were present at a number of sites until August 24th. No pink salmon were captured during the 2000 survey. Numbers of cutthroat were relatively high compared to other salmonid species up until the beginning of August when they decreased. Only one chum was captured in this study in the offshore region in August (Figs. 33 and 36).

DISTRIBUTION OF JUVENILE SALMONIDS BY REGION

As salmon grow and smolt, their habitat requirements change. Based on salinities, the analysis of variance identified six distinctly different habitats in the area during this study and the species distribution, abundance and size of the juvenile salmonids captured in the six habitats reflected this. All regions appeared to provide some suitable habitat for rearing in that the majority of salmon had acceptable condition factors and there was no significant difference in the mean condition factors for any species from region to region.

During this study, field crews noticed a pattern developing in the distribution and abundance of each species of juvenile salmonid, especially in the upper and lower river regions. Of particular note is the consistent occurrence of cutthroat (5 fish), rainbow (18 fish) and steelhead (29 fish) at site 24 and cutthroat (31 fish) at site 11. Coho fry were mainly captured at site 1A (13 fish) and site 21 was also dominated by coho juveniles (99 fish). Sites along the river bank were characterized by swift currents and rainbow were the only species of salmonid found in these habitats. The lower river region appeared to be the region of choice for coho smolts (127), which occurred in the highest numbers at site 21, followed by cutthroat (31) which dominated the catches at site 11. Smaller salmonids such as coho fry were restricted to off-channel sloughs (sites 14, 1A) which were dependent on tidal height and were often shallow with elevated temperatures. Juvenile chinook were the only species caught in all six regions and they were the most numerous in both the upper and lower river where they were caught at 11 of the 14 sites.

WATER PROPERTIES AND JUVENILE SALMONID GROWTH

Temperatures between 16 º C and 21 º C are believed to be detrimental to salmonids (Walthers and Nener 1997). As mentioned earlier most temperatures recorded during the 2000 survey were in this range, and a few measurements were well above the 21 º C level. Mesa (1985) found that in the absence of low oxygen conditions, temperature has a large effect on salmonid distribution. Healey (1980) also found that chinook salmon in the Nanaimo River estuary may have discontinued the use of shallower areas to avoid high temperatures. As a result, juvenile salmonids may leave estuarine rearing habitat before they are strong enough, making them more susceptible to both disease and predation.

During the migration from fresh water to salt water, salmonids experience high levels of stress. Low dissolved oxygen (DO) levels, high temperatures and fluctuations in salinity due to riverine and tidal movements can affect their health and subsequent marine survival. Davis (1975) found that in the temperature range of 16 º C to 21 º C the optimum dissolved oxygen levels range from 7.0 mgL^{-1} to 8.0 mgL^{-1}. Throughout the 2000 survey, most DO levels were equal to or above these levels and therefore in a suitable range for healthy development. The only exceptions were at sites 39, 40, 41, 42 and 44 when DO levels below 7.0 mgL^{-1} were measured.

For juvenile chinook there was a gradual increase in length and weight as they moved from the upper to the lower river region (Table 8). However there was no statistically significant difference in either factor for this species between these two

regions (Table 9). In contrast, once they moved into the estuary the average lengths and weights showed a significant increase of 24.1% and 54.8% respectively ($p<0.001$). Similarly, lengths and weights for chinook in the Baynes Sound nearshore region were almost the same as in the estuary region ($p=0.9$) suggesting that the nearshore region of the Sound offers rearing habitat similar to that found in the estuary (Table 9). This is supported by the ANOVA analysis between the salinities in the two regions which showed that these two areas were barely significantly different ($p=0.05$) (Table 1). Once the chinook moved from the Baynes Sound nearshore to the Baynes Sound offshore region, their mean lengths and weights increased by a further 27.4% and 58.5% respectively (Table 8). ANOVA analysis between the nearshore and offshore regions of Baynes Sound showed a p factor of <0.001 for both length and weight for this species (Table 9).

Nine chinook were caught in the Baynes Sound offshore region and seven were caught in the outside region to the east of Denman Island (Figs. 2, 41 and 42). Increases were again seen in their mean lengths (18.3%) and weights (53.7%) as they moved out of Baynes Sound and into the offshore region (Table 9).

Juvenile coho were only captured in the upper and lower river regions and showed a significant difference for both length ($p=0.002$) and weight ($p=0.005$) between these two regions (Table 9). The average length increased by 13.0% ($p=0.002$) from the upper sites to those in the lower river region and the average weight increased by 36.6% (Table 8).

ANOVA analysis of the condition factors for most species and regions showed no significant difference (Table 9). However, the condition factors for coho in both the upper river ($p=0.05$) and lower river regions ($p=0.04$) were significantly different from the condition factors for chinook captured in the Baynes nearshore zone.

SUMMARY

Data from 2000 has shown that the high temperatures recorded in the 1998 field survey of the Courtenay River and estuary were not an anomaly and may well be characteristic of this area in most years.

Although habitat may be limited, the fact that over 96% of the fish captured had acceptable condition factors suggests that there are some suitable rearing areas within this region.

At the beginning of this survey, it was hypothesized that, in response to the high temperatures and lack of suitable refuges in the estuary, the majority of the juvenile salmonids were migrating through the estuary to rear in Baynes Sound. This study does not support this hypothesis as only a few chinook were captured in the Sound. This may have been partially due to the late start date for the field sampling and further sampling earlier in the year would provide a valuable comparison.

This study has identified a nearshore zone in Baynes Sound that offers habitat that is similar to portions of the Courtenay River estuary in terms of salinity. This is likely the result of the freshwater flows from the many creeks and rivers in this area as well as groundwater percolation. In addition, the ANOVA analysis of

temperatures between the six regions has shown a significant difference for both the upper and lower river regions when compared to the Baynes nearshore region, Baynes offshore region and the outside region. The temperatures in the estuary were also shown to be significantly different from the Baynes offshore region and the outside region (Table 2).

Patterns of distribution for the various juvenile salmonids were apparent during the study, especially in the upper and lower river regions.

RECOMMENDATIONS

Based on the results of the 2000 field survey of the Courtenay River, estuary and Baynes Sound area any enhancement of habitat should be carried out primarily in the upper and lower river regions. Expansion and dredging of off channel pockets is recommended to improve the quality and extent of such habitat in both these areas. As well, the marshy area by the viewing stand (sites 11, 20) should be protected and if possible extended by providing access for juveniles through the tide gates to the sloughs located on the west side of Comox road. Swift currents along the river banks appear to inhibit all but the larger trout and it appears unlikely that this habitat can be improved. However, before any work is undertaken, it must be decided which species and life stage is in need of additional habitat and any rearing areas created must reflect the habitat characteristics of the sites where these fish were predominately found.

Further investigation of the role played by Baynes Sound in the life cycle of the Courtenay River stocks is also recommended. This is especially important for the nearshore area which appears to offer an estuary type habitat which may augment the limited rearing area available in the Courtenay River estuary. Conflicting pressures on this area include the shore based shellfish aquaculture sites which alter the sediments and habitat type where they occur (Simenstad et al. 1995; Spencer et al. 1998). At this time, the impact of this activity on rearing juvenile salmonids is not known and further investigation is needed.

Any further sampling in this area should begin as early as possible in the year in order to collect information on the distribution and abundance of juvenile salmonids during early and mid spring.

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Table 1. Results of ANOVA analysis of salinities for all sites and regions.

Zone	Sites	Upper River		Lower River		Estuary		Baynes Nearshore		Baynes Offshore		Outside	
		F	p	F	p	F	p	F	p	F	p	F	p
Upper River	1, 1A, 17, 24	-	-	2001.9	<0.001	1459.7	<0.001	5786.2	<0.001	15764.0	<0.001	59619.6	<0.001
Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	2001.9	<0.001	-	-	51.9	<0.001	209.8	<0.001	466.1	<0.001	362.3	<0.001
Estuary	4, 6, 8, 40, 46	1459.7	<0.001	51.9	<0.001	-	-	3.3	0.0513	32.4	<0.001	38.7	<0.001
Baynes NS	15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55	5786.2	<0.001	209.8	<0.001	3.3	0.0513	-	-	42.1	<0.001	78.6	<0.001
Baynes OS	27, 33, 47, 48, 49, 50, 51, 53	15764.0	<0.001	466.1	<0.001	32.4	<0.001	42.1	<0.001	-	-	31.6	<0.001
Outside	36, 37, 54	59619.6	<0.001	362.3	<0.001	38.7	<0.001	78.6	<0.001	31.6	<0.001	-	-

Table 2. Results of ANOVA analysis of temperatures for all sites and regions.

Zone	Sites	Upper River		Lower River		Estuary		Baynes Nearshore		Baynes Offshore		Outside	
		F	p	F	p	F	p	F	p	F	p	F	p
Upper River	1, 1A, 17, 24	-	-	0.4	0.5444	2.6	0.1133	11.4	0.001	52.3	<0.001	186.0	<0.001
Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	0.4	0.5444	-	-	6.7	0.0112	25.5	<0.001	88.3	<0.001	175.5	<0.001
Estuary	4, 6, 8, 40, 46	2.6	0.1133	6.7	0.0112	-	-	0.9	0.3516	16.4	<0.001	59.6	<0.001
Baynes NS	15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55	11.4	0.001	25.5	<0.001	0.9	0.3516	-	-	19.9	<0.001	102.9	<0.001
Baynes OS	27, 33, 47, 48, 49, 50, 51, 53	52.3	<0.001	88.3	<0.001	16.4	<0.001	19.9	<0.001	-	-	56.4	<0.001
Outside	36, 37, 54	186.0	<0.001	175.5	<0.001	59.6	<0.001	102.9	<0.001	56.4	<0.001	-	-

Table 3. Salinity, temperature and dissolved oxygen ranges and mean values ± 1SE in the six salinity regions of the estuary, Baynes Sound and surrounding area (n/s = not sampled).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mgL^{-1})
Upper River	1	Jul 11-Aug 15	7	0900-1230	Surface to 2	16.8-20.4	0	9.3-10.9
	Mean ± 1SE					18.7+/-0.6	0	10.1+/-0.6
Upper River	1A	Jul 17	2	1845	Surface to 1	21.3	0	7.6-7.9
	Mean ± 1SE					21.3	0	7.8
Upper River	17	Jul 11-Aug 15	6	0825-1240	Surface to 2	16.8-20.6	0	8.9-10.1
	Mean ± 1SE					19.2+/-0.7	0	9.4+/-0.2
Upper River	24	Jul 17-Aug 9	6	1145-1740	Surface to 1	20.5-21.2	0	8.4-10.3
	Mean ± 1SE					20.9+/-0.1	0	9.4+/-0.3
All upper River	Mean ± 1SE	Jul 11-Aug 15	21		Surface to 2	19.7+/-0.3	0	9.4+/-0.2
Lower River	11	Jul 11-Aug 9	6	1010-1400	Surface to 1	18.7-20.0	0.2-2.7	9.3-10.4
	Mean ± 1SE					19.5+/-0.3	0.8+/-0.4	9.7+/-0.2
Lower River	12	Aug 1-15	6	0910-1615	Surface to 1	18.4-21.8	0.1-1.1	9.9-10.9
	Mean ± 1SE					19.7+/-0.7	0.57+/-0.2	10.3+/-0.2

Table 3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mgL^{-1})
Lower River	14	Jul 17-25	4	1045-1715	Surface to 1	20.9-21.2	0.4-7.3	9.2-10.7
	Mean ± 1SE					21.1+/-0.1	2.5+/-1.6	9.8+/-0.3
Lower River	18	July 11	1	1005	Surface	17.2	0.2	n/s
Lower River	19	Jul 11	1	1237	Surface	21.8	5.6	n/s
Lower River	20	Jul 11-Aug 9	7	1310-1640	Surface to 2	18.7-22.5	0.3-9.0	10.0-10.5
	Mean ± 1SE					20.8+/-0.6	2.8+/-1.3	10.3+/-0.1
Lower River	21	Jul 11-Aug 9	9	1255-1820	Surface to 2	18.1-21.1	0.1-0.4	8.4-9.4
	Mean ± 1SE					20.0+/-0.4	0.2+/-0.0	8.8+/-0.1
Lower River	22	Jul 17-Aug 15	6	1030-1320	Surface to 1	18.6-20.5	0.7-17.8	6.8-10.5
	Mean ± 1SE					19.8+/-0.4	3.9+/-2.8	9.0+/-0.6
Lower River	23	Jul 17	3	1415-1920	Surface to 1	23.1-28.3	8.8-11.3	7.4-9.5
	Mean ± 1SE					25.2+/-1.6	10.3+/-0.8	8.3+/-0.6
Lower River	39	Jul 17-Aug 15	5	0945-1440	Surface to 1	19.3-21.5	0.6-20.0	5.2-10.7
	Mean ± 1SE					20.2+/-0.5	10.4+/-4.2	8.8+/-1.0

Table 3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mgL^{-1})
Lower River	41	Jul 27	1	0900	Surface	16.4	1.6	3.4
Lower River	42	Jul 27	2	0925	Surface to 1	17.5-17.6	0	6.6-9.1
Lower River	43	Jul 27	1	1020	Surface	16.6	3.3	9.5
Lower River	44	Jul 27	1	1010	Surface	17.2	7.5	6.3
Lower River	45	Jul 27	1	0945	Surface	16.7	2.6	8.4
All Lower River	Mean ± 1SE	Jul 11-Aug 15	54		Surface to 2	20.0+/-0.3	3.1+/-0.7	9.1+/-0.2
Upper and lower river	Mean ± 1SE	Jul 11-Aug 15	75		Surface to 2	19.9+/-0.2	2.2+/-0.5	9.2+/-0.2
Estuary	4	Aug 1	2	1715	Surface to 1	18.2-19.1	22.7-24.3	9.0-9.7
	Mean ± 1SE					18.7	23.5	9.4
Estuary	6	Jul 11-Aug 9	10	0835-1510	Surface to 1	14.1-20.1	18.1-27.9	7.8-9.6
	Mean ± 1SE					18.5+/-0.6	24.1+/-0.8	9.1+/-0.2
Estuary	8	Jul 11-Aug 1	11	0920-1605	Surface to 2	16.5-21.7	20.6-27.0	7.1-10.3
	Mean ± 1SE					18.8+/-0.4	24.3+/-0.6	8.2+/-0.4

Table 3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mgL^{-1})
Estuary	40	Aug 1	2	1750	Surface to 1	25.8-26.1	21.5-21.9	6.0-7.7
	Mean ± 1SE					26.0	21.7	6.9
Estuary	46	Aug 29	5	1140	Surface to 4	15.4-16.6	13.4-26.8	8.1-10.3
	Mean ± 1SE					15.8+/-0.2	23.7+/-2.6	8.7+/-0.4
All Estuary	Mean ± 1SE		30		Surface to 2	18.7+/-0.5	23.9+/-0.5	8.6+/-0.2
Baynes Nearshore	15	Jul 13-Aug 3	7	0820-1350	Surface to 2	17.5-19.4	20.9-25.7	7.8-10.0
	Mean ± 1SE					18.3+/-0.3	24.0+/-0.6	9.2+/-0.3
Baynes Nearshore	25	Jul 20-Aug 3	5	1000	Surface to 2	18.1-20.2	24.7-25.5	9.8-10.9
	Mean ± 1SE					19.0+/-0.4	25.1+/-0.2	10.5+/-0.2
Baynes Nearshore	26	Jul 13-Aug 3	6	0900-1040	Surface to 2	18.1-20.0	24.7-25.4	7.6-12.1
	Mean ± 1SE					19.0+/-0.2	25.2+/-0.1	9.9+/-0.7
Baynes Nearshore	28	Jul 13	2	1035	Surface to 1	18.7-18.8	25.6	7.7-7.8
	Mean ± 1SE					18.8	25.6	7.8

Table3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mgL^{-1})
Baynes Nearshore	29	Jul 13-Aug 3	5	1130-1230	Surface to 2	19.0-21.1	24.2-25.6	8.4-10.8
	Mean ± 1SE					19.7+/-0.3	24.9+/-0.2	9.6+/-0.3
Baynes Nearshore	30	Jul 13-20	4	1235-1300	Surface to 1	19.3-22.4	24.5-25.3	7.2-11.4
	Mean ± 1SE					20.3+/-0.7	24.9+/-0.2	8.8+/-1.0
Baynes Nearshore	31	Jul 13-Aug 3	4	1255-1310	Surface to 2	18.7-21.3	23.9-24.5	7.2-9.8
	Mean ± 1SE					19.7+/-0.6	24.1+/-0.2	8.7+/-0.6
Baynes Nearshore	32	Jul 13-Aug 3	7	0805-0855	Surface to 2	16.9-18.9	18.3-25.9	7.9-10.5
	Mean ± 1SE					17.8+/-0.3	23.6+/-1.0	9.2+/-0.2
Baynes Nearshore	34	Aug 3	2	1335	Surface to 1	19.8-21.5	23.9-24.0	11.1-12.2
	Mean ± 1SE					20.6	24.0	11.7
Baynes Nearshore	52	Sept 6	6	1210	Surface to 5	13.8-15.9	22.6-27.7	11.0-12.5
	Mean ± 1SE					15.0+/-0.4	25.9+/-0.9	11.6+/-0.2
Baynes Nearshore	55	Aug 17-29	14	0940-1140	Surface to 5	15.7-19.1	21.9-26.7	7.5-10.9
	Mean ± 1SE					17.2+/-0.3	24.7+/-0.4	9.3+/-0.3

Table 3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mgL^{-1})
All Baynes Nearshore	Mean ± 1SE	Jul 13-Sept 6	62		Surface to 5	18.2+/-0.2	24.7 +/-0.2	9.6+/-0.2
Baynes Offshore	27	Jul 13-Aug 3	7	0959-1155	Surface to 2	17.7-21.4	24.7-25.9	8.3-11.1
	Mean ± 1SE					19.1+/-0.4	25.4+ /-0.2	9.8+/-0.4
Baynes Offshore	33	Jul 20-Aug 3	5	0915-0925	Surface to 2	16.8-17.8	24.7-26.6	9.2-10.5
	Mean ± 1SE					17.2+/-0.2	25.8+ /-0.5	9.7+/-0.2
Baynes Offshore	47	Aug 11-29	12	0945-1230	Surface to 4	13.9-19.2	22.5-27.6	8.4-10.1
	Mean ± 1SE					16.4+/-0.5	26.2+ /-0.4	9.2+/-0.2
Baynes Offshore	48	Aug 17-24	7	0830-0935	Surface to 3	16.4-18.0	24.6-27.1	9.5-13.5
	Mean ± 1SE					17.4+/-0.2	26.1+ /-0.3	11.3+/-0.5
Baynes Offshore	49	Aug 17-Sept 6	14	0900 - 1130	Surface to 5	14.8-18.4	25.0-27.1	9.3-13.0
	Mean ± 1SE					16.3+/-0.4	26.6+/ -0.2	11.7+/-0.3
Baynes Offshore	50	Aug 24	5	0940	Surface to 4	16.8-18.3	24.8-26.9	9.5-11.8
	Mean ± 1SE					17.6+/-0.2	25.8+/ -0.4	10.2+/-0.4

Table 3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mg/L)
Baynes Offshore	51	Aug 17-24	8	1010-1035	Surface to 4	16.6-18.7	24.2-26.7	9.1-10.6
	Mean ± 1SE					17.5+/-0.3	25.9+/-0.3	9.7+/-0.2
Baynes Offshore	53	Aug 11-29	8	0900-1145	Surface to 4	15.3-17.8	26.0-26.8	9.0-10.0
	Mean ± 1SE					16.2+/-0.4	26.5 +/-0.1	9.5+/-0.1
All Baynes Offshore	Mean ± 1SE	Jul 13-Sept 6	66		Surface to 5	17.0+/-0.2	26.1 +/-0.1	10.2+/-0.2
Baynes Nearshore and Offshore	Mean ± 1SE	Jul 13-Sept 6	128		Surface to 5	17.6 +/-0.2	25.4 +/-0.1	9.9 +/-0.1
Outside	36	Aug 22-Sept 6	10	0915-1030	Surface to 5	13.2-15.5	26.7-27.9	8.6-12.1
	Mean ± 1SE					14.4+/-0.3	27.4 +/-0.1	9.9+/-0.4
Outside	37	Aug 17-22	6	0900-1000	Surface to 3	13.7-17.4	26.2-27.7	9.3-11.2
	Mean ± 1SE					15.3+/-0.7	27.1 +/-0.3	10.0+/-0.3
Outside	54	Aug 22-Sept 6	15	0830-1030	Surface to 5	14.0-16.0	26.1-27.6	9.0-10.1
	Mean ± 1SE					15.0+/-0.2	27.0 +/-0.1	9.5+/-0.1
All Outside	Mean ± 1SE	Aug 22-Sept 6	31		Surface to 5	14.8+/-0.2	27.1 +/-0.1	9.7+/-0.1

Table 3 (cont'd).

Region	Site No.	Dates	Total No. of Samples	Time (PST)	Depth (m)	Temp (^{0}C)	Sal (‰)	Oxygen (mg/L)
All Study Areas	46	Jul 11-Sept 6	264		Surface to 5	13.2-28.3	0-27.9	3.4-13.0
	Mean ± 1SE					18.1 +/- 0.1	18.9 +/- 0.7	9.6 +/- 0.1

Table 4. Total catch of salmonid species by salinity region for the 2000 survey.

Region	Chinook	Chum	Coho	Cutthroat	Rainbow	Steelhead	Totals
Upper River	22	0	19	9	18	29	97
Lower River	31	0	128	34	4	10	207
Estuary	7	0	0	0	0	0	7
Baynes Nearshore	22	0	0	0	0	0	22
Baynes Offshore	9	1	0	0	0	0	10
Outside	7	0	0	0	0	0	7
Total	98	1	147	43	22	39	350

Table 5. Total catch, CPUE ± 1SE and percent of total population for each species of salmonid by site and mean values for each salinity region.

Region/		Chinook			Chum			Coho			Cutthroat			Rainbow			Steelhead		
Site No.	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Upper River																			
1	6	3	0.5± 0.3	3.1	0	0	0	3	0.5± 0.3	2.0	4	0.7± 0.4	9.3	0	0	0	0	0	0
1A	2	0	0	0	0	0	0	13	6.5	8.8	0	0	0	0	0	0	0	0	0
17	6	13	2.2± 1.6	13.3	0	0	0	3	0.5± 0.3	2.0	0	0	0	0	0	0	0	0	0
24	6	6	1.0± 0.8	6.1	0	0	0	0	0	0	5	0.8± 0.5	11.6	18	3.0± 1.6	8.2	29	4.8± 4.1	74.4
All	20	22	0.5± 0.3	22.4	0	0	0	19	1.0± 0.5	12.9	9	0.5± 0.2	20.9	18	0.9± 0.5	81.8	29	1.5± 1.3	74.4
Lower River																			
11	8	6	0.8± 0.6	6.1	0	0	0	3	0.4± 0.3	2.0	31	3.9± 2.3	72.1	0	0	0	5	0.6± 0.6	12.8
12	6	0	0	0	0	0	0	0	0	0	0	0	0	4	0.7± 0.4	18.2	0	0	0
14	4	2	0.5± 0.5	2.0	0	0	0	4	1.0± 1.0	2.7	0	0	0	0	0	0	0	0	0
18	2	1	0.5	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	2	2	1.0	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	6	6	1.0± 0.6	6.1	0	0	0	21	3.5± 2.5	14.3	2	0.3± 0.2	4.7	0	0	0	5	0.8± 0.8	12.8
21	8	3	0.4± 0.3	3.1	0	0	0	99	12.4± 7.6	67.3	0	0	0	0	0	0	0	0	0
22	6	0	0	0	0	0	0	0	0	0	1	0.2± 0.2	1.0	0	0	0	0	0	0
23	3	1	0.3± 0.3	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	8	10	2.8± 1.0	10.2	0	0	0	1	0.1± 0.1	0.7	0	0	0	0	0	0	0	0	0
41	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	60	31	0.5± 0.2	31.6	0	0	0	128	2.1± 1.1	87.1	34	0.6± 0.3	79.1	4	0.07± 0.05	18.2	10	0.2± 0.1	25.6

Table 5 (cont'd).

Region/		Chinook			Chum			Coho			Cutthroat			Rainbow			Steelhead		
Site No.	No. Sets	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Estuary																			
4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	10	6	0.6± 0.4	6.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	10	1	0.1± 0.1	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	25	7	0.3± 0.2	7.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baynes NS																			
15	6	1	0.2± 0.2	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	4	4	1.0± 0.7	4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	3	0.5± 0.3	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	6	7	1.4± 1.4	7.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	4	3	0.8± 0.5	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	4	2	0.5± 0.3	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	6	1	0.2± 0.2	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	3	1	0.3± 0.3	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	44	22	0.5± 0.2	22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5 (cont'd).

Region/ Site No.	No. Sets	Chinook			Chum			Coho			Cutthroat			Rainbow			Steelhead		
		Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Baynes OS																			
27	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	3	2	0.7± 0.7	2.0	1	0.3±0.3	100	0	0	0	0	0	0	0	0	0	0	0	0
48	2	3	1.5	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	3	2	0.7± 0.7	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	2	2	1.0	2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	23	9	0.4± 0.2	9.2	1	0.04± .04	100	0	0	0	0	0	0	0	0	0	0	0	0
Outside																			
36	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	2	4	2.0	4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	4	3	0.8± 0.5	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	8	7	0.9± 0.5	7.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6. Total catch, CPUE ± 1SE and percent of total population for all species of salmonid by date for all sampling gear.

Date		Chinook			Chum			Coho			Cutthroat			Rainbow			Steelhead		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
11 Jul	18	26	1.3± 0.6	45.6	0	0	0	21	1.2±0. 6	36.8	10	0.6±0. 3	17.5	0	0	0	0	0	0
13 Jul	16	14	0.9± 0.4	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Jul	19	19	1.0± 0.5	33.9	0	0	0	18	0.9±0. 5	32.1	4	0.2±0. 2	7.1	15	0.8±0. 6	26.8	0	0	0
20 Jul	16	4	0.3± 0.2	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25 Jul	16	6	0.4± 0.2	4.8	0	0	0	86	5.4±4. 0	69.4	2	0.1±0. 1	1.6	1	0.1±0. 1	0.8	29	1.8±1. 6	23.4
27 Jul	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 Aug	16	9	0.6± 0.4	25.7	0	0	0	3	0.2±0. 1	8.6	23	1.4±1. 2	65.7	0	0	0	0	0	0
3 Aug	18	3	0.2± 0.1	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Aug	18	0	0	0	0	0	0	15	0.8±0. 8	48.4	2	0.1±0. 1	6.5	4	0.2±0. 1	12.9	10	0.6±0. 4	32.3
11 Aug	3	3	1.0± 0.6	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Aug	10	0	0	0	0	0	0	4	0.4±0. 2	50.0	2	0.2±0. 2	25.0	2	0.2±0. 2	25.0	0	0	0
17 Aug	5	9	1.8± 0.8	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 Aug	4	4	0.8± 0.5	80.0	1	0.2±0.2	20.0	0	0	0	0	0	0	0	0	0	0	0	0
24 Aug	5	1	0.2± 0.2	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 Aug	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6 (cont'd).

Date		Chinook			Chum			Coho			Cutthroat			Rainbow			Steelhead		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
6 Sep	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	180	98	0.5± 0.1	28.0	1	0.006 ± 0.006	0.3	147	0.8 ± 0.4	42.0	43	0.2 ± 0.1	12.3	22	0.1 ± 0.1	6.3	39	0.2 ± 0.1	11.1

Table 7. Mean lengths, weights and condition factors for juvenile salmonids by site, species and salinity region.

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
Upper River					
1	Chinook	3	79.0 ± 1.5	5.4 ± 0.4	1.1 ± 0.06
1	Coho	3	63.7 ± 3.8	2.9 ± 0.6	1.1 ± 0.06
1	All	6	71.3 ± 3.9	4.1 ± 0.6	1.1 ± 0.04
1A	Coho fry	10	60.3 ± 0.9	2.6 ± 0.1	1.2 ± 0.03
17	Chinook	10	80.2 ± 1.8	5.6 ± 0.3	1.1 ± 0.02
17	Coho	3	61.3 ± 4.3	2.6 ± 0.6	1.1 ± 0.07
17	All	13	75.8 ± 2.8	4.9 ± 0.4	1.09 ± 0.02
24	Chinook	5	83.8 ± 2.2	6.3 ± 0.5	1.1 ± 0.02
All	Chinook	18	81.0 ± 1.2	5.8 ± 0.2	1.1 ± 0.02
"	Coho	16	61.1 ± 1.1	2.6 ± 0.2	1.1 ± 0.03
"	All	34	71.6± 1.9	4.3 ± 0.3	1.1 ± 0.02
Lower River					
11	Chinook	6	86.0 ± 1.8	7.4 ± 0.4	1.2 ± 0.1
11	Coho	3	74.3 ± 0.7	4.6 ± 0.09	1.1 ± 0.05
11	All	9	82.1 ±2.3	6.5 ± 0.5	1.2 ± 0.07
14	Chinook	2	87.5	6.8	1.1
14	Coho	4	65.0 ± 2.0	3.1 ± 0.3	1.1 ± 0.03
14	All	6	72.5 ± 5.2	4.3 ± 0.9	1.1 ± 0.04
18	Chinook	1	82.0	6.2	1.1

Table 7 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
19	Chinook	2	83	5.6	1.1
20	Chinook	5	82.6 ± 3.0	5.8 ± 0.7	1.1 ± 0.07
20	Coho	17	79.7 ± 2.6	5.9 ± 0.5	1.1 ± 0.03
20	All	22	79.6 ± 1.8	5.6 ± 0.4	1.1 ± 0.04
21	Chinook	3	80.7 ± 4.1	5.5 ± 1.0	1.0 ± 0.05
21	Coho	21	62.9 ± 1.1	2.8 ± 0.2	1.1 ± 0.03
21	All	24	65.1 ± 1.6	3.1 ± 0.3	1.1 ± 0.03
23	Chinook	1	88.0	7.3	1.07
39	Chinook	10	79.7 ± 2.2	5.6 ± 0.5	1.1 ± 0.01
39	Coho	1	70.0	3.7	1.08
39	All	11	78.8 ± 2.2	5.4 ± 0.5	1.08 ± 0.01
All	Chinook	30	82.6 ± 1.1	6.1 ± 0.3	1.1 ± 0.03
All	Coho	46	70.2 ± 1.6	4.1 ± 0.3	1.1 ± 0.02
All	All	76	75.1 ± 1.3	4.9 ± 0.2	1.1 ± 0.01
Estuary					
6	Chinook	6	104.8 ± 7.7	14.5 ± 3.5	1.1 ± 0.1
8	Chinook	1	88.0	7.3	1.1
All	Chinook	7	102.5 ± 7.0	13.5 ± 3.1	1.1 ± 0.1

Table 7 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
Baynes Nearshore					
15	Chinook	1	90.0	6.9	1.0
25	Chinook	4	138.3 ± 8.1	32.5 ± 5.8	1.2 ± 0.03
26	Chinook	3	123.3 ± 6.1	19.8 ± 3.8	1.0 ± 0.06
29	Chinook	7	84.4 ± 4.7	6.7 ± 1.0	1.1 ± 0.05
30	Chinook	3	82.0 ± 5.3	5.4 ± 1.7	0.9 ± 0.11
31	Chinook	2	94.0	8.9	1.2
32	Chinook	1	90.0	7.6	1.0
55	Chinook	1	130.0	20.7	1.0
All	Chinook	22	102.6 ± 5.4	13.9 ± 2.5	1.1 ± 0.03
Baynes Offshore					
47	Chinook	2	146.0	33.8	1.1
47	Chum	1	150.0	31.9	1.0
47	All	3	147.3 ± 4.8	33.8 ± 4.0	1.0 ± 0.05

Table 7 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
48	Chinook	3	138.7 ± 8.7	31.0 ± 6.0	1.1 ± 0.02
49	Chinook	2	137.5	29.3	1.1
53	Chinook	2	145.0	41.3	1.2
All	Chinook	9	141.4 ± 5.9	33.5 ± 4.7	1.1 ± 0.02
All	Chum	1	150.0	31.9	1.0
All	All	10	142.3 ± 5.4	33.4 ± 4.2	1.1 ± 0.02
Outside					
37	Chinook	4	142.5 ± 3.2	33.4 ± 3.6	1.2 ± 0.07
54	Chinook	2	234.0	150.5	1.2
All	Chinook	6	173.0 ± 19.8	72.4 ± 19.8	1.2 ± 0.05
All regions combined					
All	Chinook	92	100.3 ± 3.4	15.5 ± 2.5	1.1 ± 0.01
All	Coho	62	67.8 ± 1.3	3.7 ± 0.2	1.1 ± 0.01
All	Chum	1	150.0	31.9	1.0
All	All	155	87.6 ± 2.5	10.9 ± 1.5	1.1 ± 0.01

Table 8. Summary of mean lengths, weights and condition factors by region for all species of salmonid.

Region		Upper River		Lower River		Estuary		Baynes Nearshore		Baynes Offshore		Outside		All	
		N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE
Species	**Factor**														
Chinook	Length	18	81.0 ± 1.2	30	82.6 ± 1.1	7	102.5 ± 7.0	22	102.6 ± 5.4	9	141.4 ± 5.9	6	173.0 ± 19.8	92	100.3± 3.4
	Weight	18	5.8 ± 0.2	30	6.1 ± 0.3	7	13.5 ± 3.1	22	13.9 ± 2.5	9	33.5 ± 4.7	6	72.4 ± 25.3	92	15.5 ± 2.5
	Condition factor	18	1.1 ± 0.02	30	1.09 ± 0.03	7	1.10 ± 0.05	22	1.05 ± 0.03	9	1.13 ± 0.02	6	1.16 ± 0.05	92	1.1 ± 0.01
Coho	Length	16	61.1 ± 1.1	46	70.2 ± 1.6		-		-		-		-	62	67.8 ± 1.3
	Weight	16	2.6 ± 0.2	46	4.1 ± 0.3		-		-		-		-	62	3.7 ± 0.2
	Condition factor	16	1.14 ± 0.03	46	1.1 ± 0.02		-		-		-		-	62	1.1 ± 0.01
Chum	Length	-	-		-		-		-	1	150		-	1	150
	Weight	-	-		-		-		-	1	31.9		-	1	31.9
	Condition factor	-	-		-		-		-	1	0.95		-	1	0.95
All	Length	34	71.6 ± 1.9	76	75.1± 1.3	7	102.5 ± 7.0	22	102.6 ± 5.4	10	142.3 ± 5.4	6	173.0 ± 19.8	155	87.6 ± 2.5
	Weight	34	4.3 ± 0.3	76	4.9 ± 0.2	7	13.5 ± 3.1	22	13.9 ± 2.5	10	33.4 ± 4.2	6	72.4 ± 25.3	155	10.9 ± 1.5
	Condition factor	34	1.1 ± 0.02	76	1.1 ± 0.01	7	1.10 ± 0.05	22	1.05 ± 0.03	10	1.11 ± 0.02	6	1.16 ± 0.05	155	1.1 ± 0.01

Table 9. Results of one-way ANOVA analysis of salmonid lengths, weights and condition factors by species and region.

Zone and Species	Site No.	Chinook Upper River		Coho Upper River		Chinook Lower River		Coho Lower River		Chinook Estuary		Chinook Baynes Nearshore		Chinook Baynes Offshore		Chinook Outside	
		F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Factor - Length																	
Chinook Upper River	1, 1A, 17, 24	-	-	142.4	<0.001	0.859	0.359	16.4	<0.001	21.4	<0.001	12.7	0.001	185.0	<0.001	68.4	<0.001
Coho Upper River	1, 1A, 17, 24	142.4	<0.001	-	-	145.6	<0.001	10.5	0.002	74.7	<0.001	41.8	<0.001	303.7	<0.001	90.3	<0.001
Chinook Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	0.859	0.359	145.6	<0.001	-	-	32.4	<0.001	24.4	<0.001	17.4	<0.001	241.5	<0.001	107.1	<0.001
Coho Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	16.4	<0.001	10.5	0.002	32.4	<0.001	-	-	44.1	<0.001	55.3	<0.001	260.2	<0.001	164.3	<0.001
Chinook Estuary	4, 6, 8, 40, 46	21.4	<0.001	74.7	<0.001	24.4	<0.001	44.1	<0.001	-	-	0.0004	0.984	18.5	<0.001	12.8	0.004

Table 9 (cont'd).

Zone and Species	Sites	Chinook Upper River		Coho Upper River		Chinook Lower River		Coho Lower River		Chinook Estuary		Chinook Baynes Nearshore		Chinook Baynes Offshore		Chinook Outside	
		F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Factor-Length (cont'd)																	
Chinook Baynes NS	15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55	12.7	0.001	41.8	<0.001	17.4	<0.001	55.3	<0.001	0.0004	0.984	-	-	17.5	<0.001	24.0	<0.001
Chinook Baynes Offshore	27, 33, 47, 48, 49, 50, 51, 53	185.0	<0.001	303.7	<0.001	241.5	<0.001	260.2	<0.001	18.5	<0.001	17.5	<0.001	-	-	3.3	0.094
Chinook Outside	36, 37, 54	68.4	<0.001	90.3	<0.001	107.1	<0.001	164.3	<0.001	12.8	0.004	24.0	<0.001	3.3	0.094	-	-

Table 9 (cont'd).

Zone and Species	Sites	Chinook Upper River		Coho Upper River		Chinook Lower River		Coho Lower River		Chinook Estuary		Chinook Baynes Nearshore		Chinook Baynes Offshore		Chinook Outside	
		F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Factor - Weight																	
Chinook Upper River	1, 1A, 17, 24	-	-	116.3	<0.001	0.834	0.366	11.6	0.001	16.1	<0.001	8.7	<0.001	70.5	<0.001	22.9	<0.001
Coho Upper River	1, 1A, 17, 24	116.3	<0.001	-	-	80.2	<0.001	8.6	0.005	28.8	<0.001	14.9	<0.001	77.7	<0.001	22.1	<0.001
Chinook Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	0.834	0.366	80.2	<0.001	-	-	23.0	<0.001	22.6	<0.001	13.2	<0.001	114.0	<0.001	38.7	<0.001
Coho Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	11.6	0.001	8.6	0.005	23.0	<0.001	-	-	46.4	<0.001	31.3	<0.001	192.1	<0.001	63.8	<0.001

Table 9 (cont'd).

Zone and Species	Sites	Chinook Upper River		Coho Upper River		Chinook Lower River		Coho Lower River		Chinook Estuary		Chinook Baynes Nearshore		Chinook Baynes Offshore		Chinook Outside	
		F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Factor – Weight (cont'd)																	
Chinook Estuary	4, 6, 8, 40, 46	16.1	<0.001	28.8	<0.001	22.6	<0.001	46.4	<0.001	-	-	0.006	0.937	10.9	0.005	6.3	0.029
Chinook Baynes NS	15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55	8.7	<0.001	14.9	<0.001	13.2	0.0007	31.3	<0.001	0.006	0.937	-	-	16.1	<0.001	19.1	<0.001
Chinook Baynes Offshore	27, 33, 47, 48, 49, 50, 51, 53	70.5	<0.001	77.7	<0.001	114.0	<0.001	192.1	<0.001	10.9	0.005	16.1	<0.001	-	-	3.4	0.088
Chinook Outside	36, 37, 54	22.9	<0.001	22.1	<0.001	38.7	<0.001	63.8	<0.001	6.3	0.029	19.1	<0.001	3.4	0.088	-	-

Table 9 (cont'd).

Zone and Species	Sites	Chinook Upper River		Coho Upper River		Chinook Lower River		Coho Lower River		Chinook Estuary		Chinook Baynes Nearshore		Chinook Baynes Offshore		Chinook Outside	
		F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Condition factor																	
Chinook Upper River	1, 1A, 17, 24	-	-	1.6	0.208	0.062	0.805	0.656	0.421	1.02	0.324	1.54	0.223	1.66	0.209	2.208	0.152
Coho Upper River	1, 1A, 17, 24	1.6	0.208	-	-	1.39	0.246	0.222	0.639	<0.001	0.999	4.17	0.049	0.036	0.852	0.142	0.710
Chinook Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	0.062	0.805	1.39	0.246	-	-	1.2	0.278	0.668	0.419	0.767	0.385	0.785	0.381	1.165	0.288
Coho Lower River	11, 12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45	0.656	0.421	0.222	0.639	1.2	0.278	-	-	0.109	0.743	4.5	0.037	0.054	0.817	0.490	0.487

Table 9 (cont'd).

Zone and Species	Sites	Chinook Upper River		Coho Upper River		Chinook Lower River		Coho Lower River		Chinook Estuary		Chinook Baynes Nearshore		Chinook Baynes Offshore		Chinook Outside	
		F	p	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Factor Condition KC (cont'd)																	
Chinook Estuary	4, 6, 8, 40, 46	1.02	0.324	<0.001	0.999	0.668	0.419	0.109	0.743	-	-	2.087	0.160	0.026	0.875	0.084	0.777
Chinook Baynes NS	15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55	1.54	0.223	4.17	0.049	0.767	0.385	4.5	0.037	2.087	0.160	-	-	2.963	0.095	2.852	0.103
Chinook Baynes Offshore	27, 33, 47, 48, 49, 50, 51, 53	1.66	0.209	0.036	0.852	0.785	0.381	0.054	0.817	0.026	0.875	2.963	0.095	-	-	0.396	0.539
Chinook Outside	36, 37, 54	2.208	0.152	0.142	0.710	1.165	0.288	0.490	0.487	0.084	0.777	2.852	0.103	0.396	0.539	-	-

Table 10. Common and scientific names and abbreviations for all non-salmonid fish species captured in all regions.

Fish Species	Common name	Abbreviation
Ammodytes hexapterus	Pacific sandlance	PASA
Apodichthys flavidus	Penpoint gunnel	PEGU
Brachyistius frenatus	Kelp surfperch	KLSP
Cymatogaster aggregata	Shiner surfperch	SHSP
Damalichthys vacca	Pile surfperch	PLSP
Embiotoca jacksoni	Black surfperch	BLSP
Family Bathymasteridae	Unidentified ronquil	UNRQ
Family Blenniidae	Unidentified blenny	UNBL
Family Bothidae	Unidentified sanddab	UNSD
Family Cottidae	Unidentified sculpin	UNSC
Family Embiotocidae	Unidentified perch	UNPE
Family Hexagrammidae	Unidentified greenling	UNGL
Family Pholididae	Unidentified gunnel	UNGU
Family Scorpaenidae	Unidentified rockfish	UNRO
Gasterosteus aculeatus	Threespine stickleback	THST
Hippoglossus stenolepis	Pacific Halibut	PAHL
Lumpenus saggita	Snake prickleback	SNPR
Order Pleuronectiformes	Unidentified Flatfish	UNFL
Pholis laeta	Crescent gunnel	CRGU
Pholis ornata	Saddleback gunnel	SBGU
Platichthys stellatus	Starry flounder	STFL
Syngnathus leptorhynchus	Bay pipefish	BAPI

Table 11. Total catch, CPUE ± 1SE, percent of total population for each species of non-salmonid by site and total values for each salinity region.

REGION	UPPER RIVER			LOWER RIVER			ESTUARY			BAYNES SOUND NEARSHORE			BAYNES SOUND OFFSHORE			OUTSIDE		
Sites	1, 1A, 17, 24			11,12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45			4, 6, 8, 40, 46			15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55			27, 33, 47, 48, 49, 50, 51, 53			36, 37, 54		
Catch	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop
Species																		
Pacific Sandlance	0	0	0	0	0	0	36	1.44+/-1.00	1.1	60	1.36+/-0.86	1.1	12	0.52+/-0.48	0.8	0	0	0
Penpoint Gunnel	0	0	0	0	0	0	0	0	0	1	0.02+/-0.02	<0.1	0	0	0	0	0	0
Kelp Surfperch	0	0	0	0	0	0	0	0	0	46	1.05+/-0.52	0.9	32	1.39+/-1.39	2.0	0	0	0
Shiner Surfperch	0	0	0	165	2.80+/-2.20	8.4	66	2.64+/-1.88	2.1	685	14.89+/-7.04	12.8	74	3.22+/-2.27	4.7	0	0	0
Pile Surfperch	0	0	0	0	0	0	0	0	0	0	0	0	33	1.43+/-1.43	2.1	0	0	0
Black Surfperch	0	0	0	0	0	0	1	0.04+/ 0.04	<0.1	0	0	0	0	0	0	0	0	0
Unident Ronquil	0	0	0	0	0	0	0	0	0	1	0.02 +/- 0.02	<0.1	0	0	0	0	0	0
Unident Sanddab	0	0	0	1	0.02 +/- 0.02	<0.1	537	21.48+/- 9.05	16.9	8	0.18 +/- 0.13	0.1	0	0	0	0	0	0
Unident Sculpin	9	0.45 +/- 0.21	20.9	565	9.58 +/- 1.48	28.7	585	23.40 +/- 6.00	18.4	1611	36.61 +/- 11.35	30.0	548	23.83 +/- 12.41	34.8	0	0	0
Unident Perch	0	0	0	724	12.27+/- 3.69	36.8	1710	68.40 +/- 44.29	53.9	1312	29.82 +/- 6.83	24.5	356	15.48 +/- 8.03	22.6	0	0	0
Unident Greenling	0	0	0	2	0.03 +/- 0.02	0.1	1	0.04 +/- 0.04	<0.1	7	0.16 +/- 0.06	0.1	0	0	0	0	0	0
Unident Gunnel	0	0	0	50	0.85 +/- 0.36	2.5	94	3.76 +/- 1.86	3.0	832	18.91+/- 4.66	15.5	161	7.00 +/- 3.26	10.2	0	0	0

Table 11 (cont'd).

REGION	UPPER RIVER			LOWER RIVER			ESTUARY			BAYNES SOUND NEARSHORE			BAYNES SOUND OFFSHORE			OUTSIDE		
Sites	1, 1A, 17, 24			11,12, 14, 18, 19, 20, 21, 22, 23, 39, 41, 42, 43, 44, 45			4, 6, 8, 40, 46			15, 25, 26, 28, 29, 30, 31, 32, 34, 52, 55			27, 33, 47, 48, 49, 50, 51, 53			36, 37, 54		
Catch	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop	Tot No.	CPUE ± 1SE	% of pop
Species																		
Unident Rockfish	0	0	0	0	0	0	0	0	0	1	0.02 +/- 0.02	<0.1	0	0	0	0	0	0
Unident Blenny	0	0	0	0	0	0	0	0	0	3	0.07 +/- 0.05	<0.1	0	0	0	0	0	0
Three Spine Stickle back	27	1.35 +/- 0.52	62.8	367	6.22 +/- 1.58	18.7	69	2.76 +/- 1.49	2.2	85	1.93 +/- 0.72	1.6	26	1.13 +/- 0.77	1.7	1	0.13 +/- 0.13	100
Snake Prickle back	0	0	0	0	0	0	37	1.48 +/- 0.84	1.2	1	0.02 +/- 0.02	<0.1	1	0.04 +/- 0.04	<0.1	0	0	0
Crescent Gunnel	0	0	0	1	0.02 +/- 0.02	<0.1	2	0.08 +/- 0.08	<0.1	0	0	0	0	0	0	0	0	0
Saddle back Gunnel	0	0	0	8	0.14 +/- 0.10	0.4	2	0.08 +/- 0.06	<0.1	0	0	0	0	0	0	0	0	0
Starry Flounder	7	0.35 +/- 0.24	16.3	54	0.92 +/- 0.23	2.7	6	0.24 +/- 0.12	0.2	8	0.18 +/- 0.07	0.1	3	0.13 +/- 0.10	0.2	0	0	0
Bay Pipefish	0	0	0	0	0	0	6	0.24 ± 0.10	0.2	553	12.57+/- 3.47	10.3	158	6.87 +/- 3.18	10.0	0	0	0
Pacific Halibut	0	0	0	0	0	0	0	0	0	2	0.05 +/- 0.03	<0.1	1	0.04 +/- 0.04	<0.1	0	0	0
Unident Flatfish	0	0	0	30	0.51 +/- 0.27	1.5	19	0.76 +/- 0.32	0.6	146	3.32 +/- 0.79	2.7	169	7.35 +/- 4.31	10.7	0	0	0
TOTAL	43	2.15 +/- 0.78	100	1967	33.3 +/- 4.9	100	3171	126.8+/- 45.9	100	5362	121.86 +/- 18.58	100	1574	68.43 +/- 26.04	100	1	0.13 +/- 0.13	100

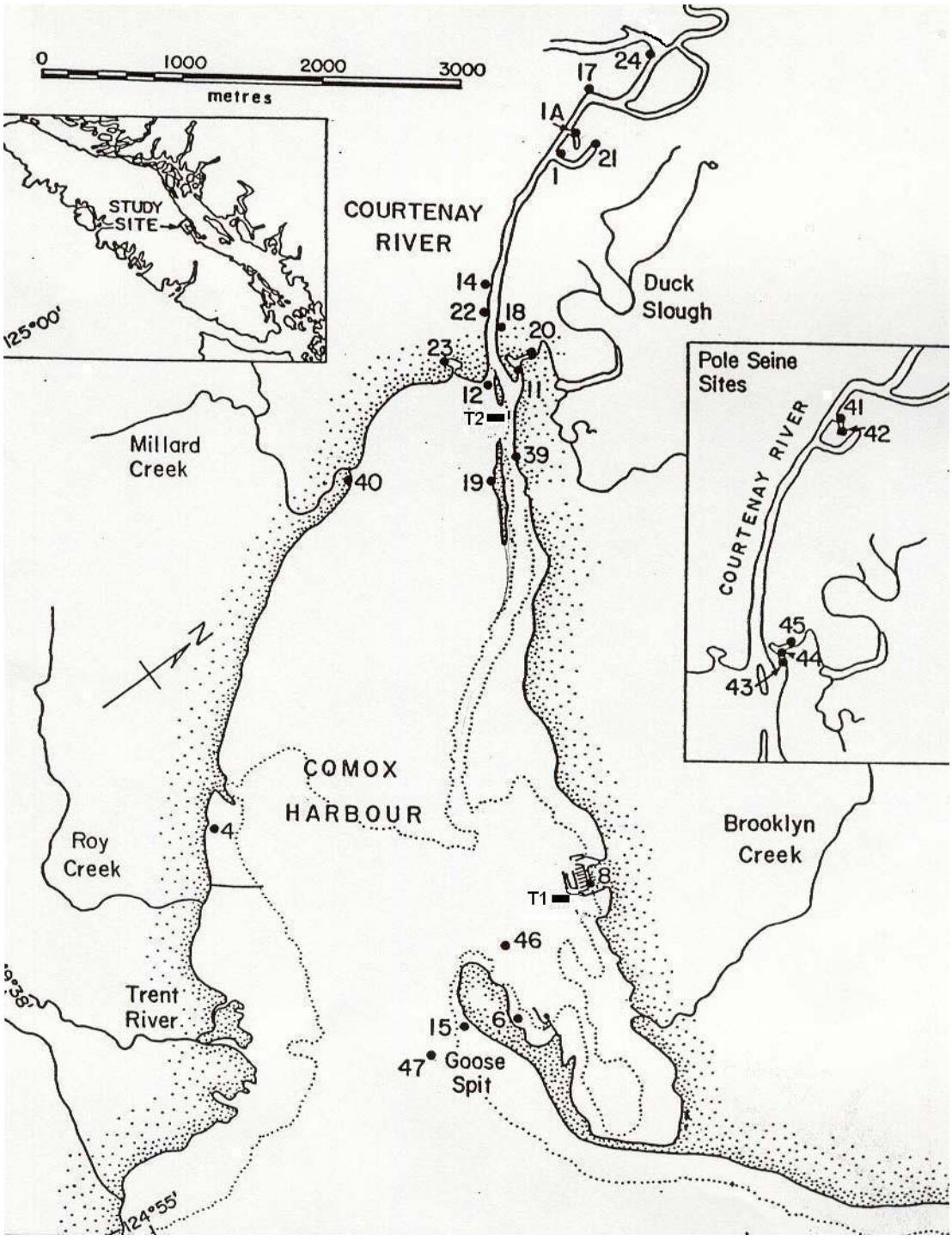

Fig. 1. Map of the Courtenay River and estuary showing the sites sampled in 2000. T1 shows the location of the temperature data loggers at the sea pens and T2 shows the location of the temperature data loggers at the cement silo.

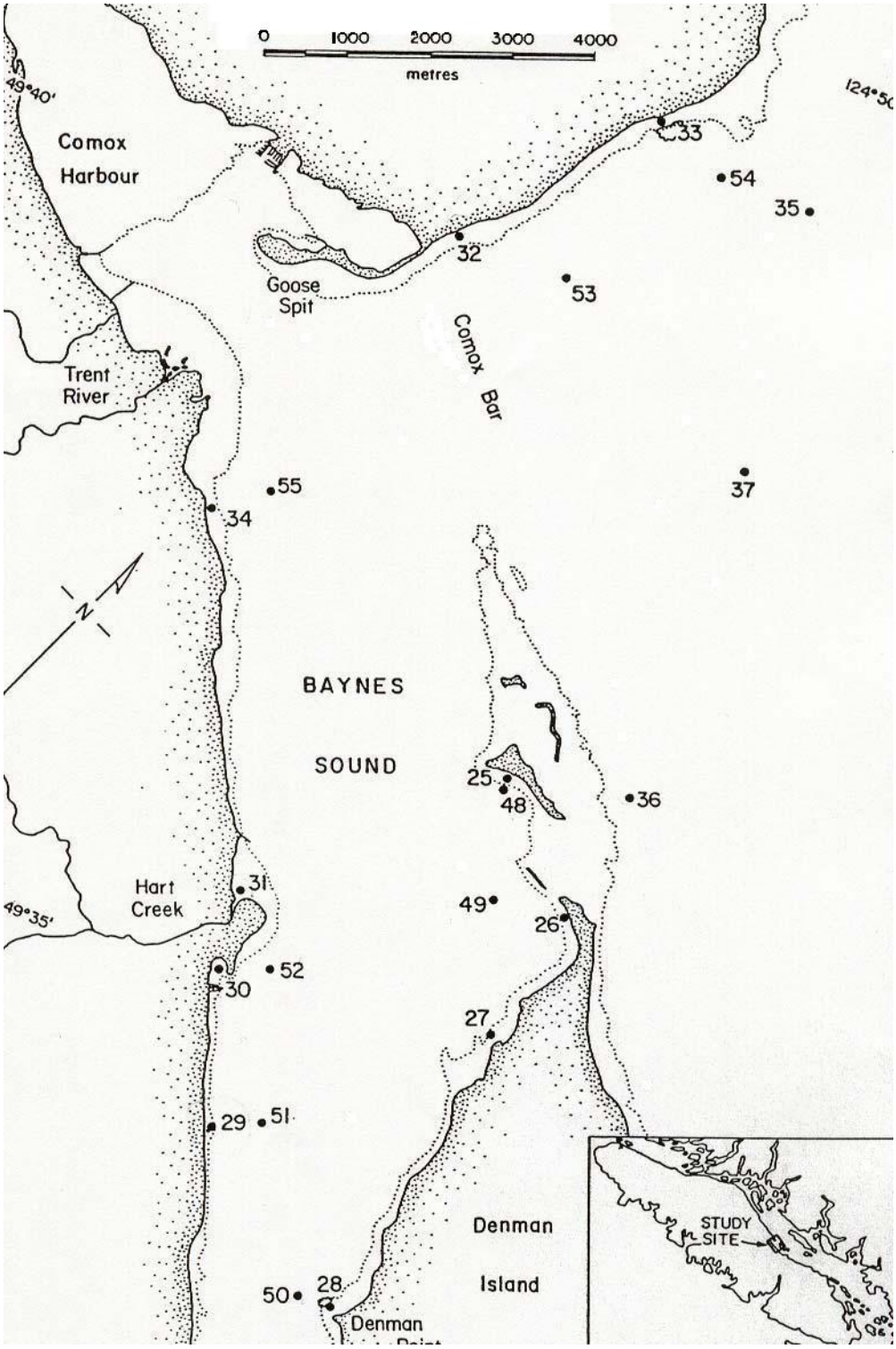

Fig. 2. Map of Baynes Sound and the outside area showing the sites sampled in 2000.

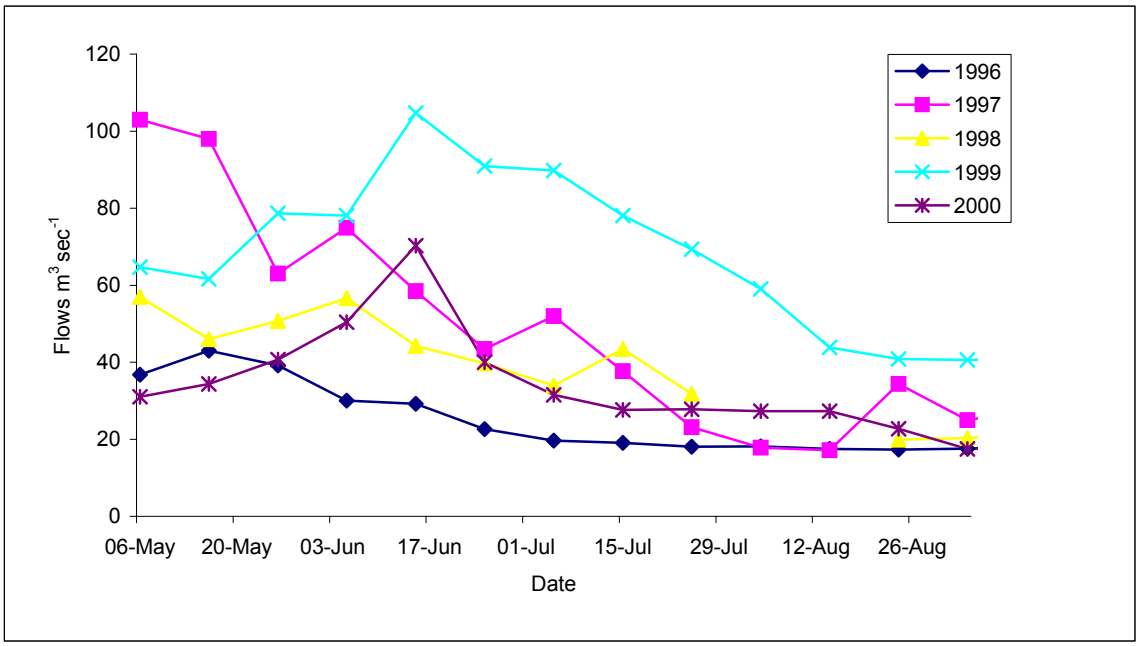

Fig. 3. Flows in the Puntledge River (m^3 sec^{-1}) 1996 to 2000 by five day averages.

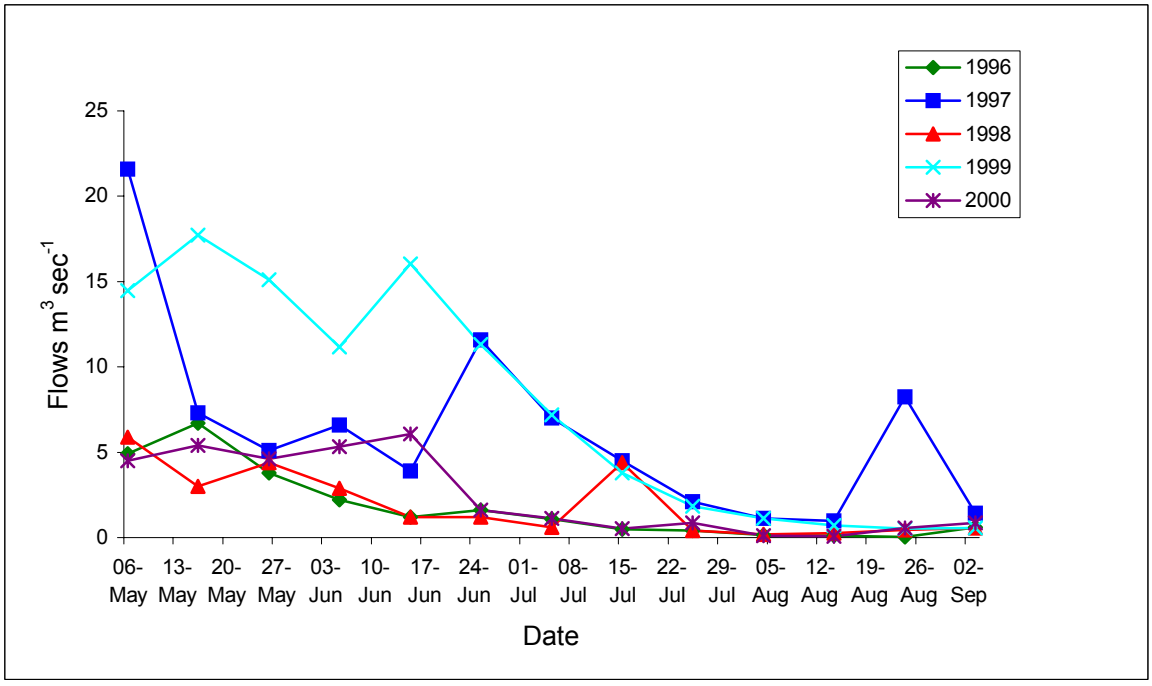

Fig. 4. Flows in the Tsolum River (m^3 sec^{-1}) 1996 to 2000 by five day averages.

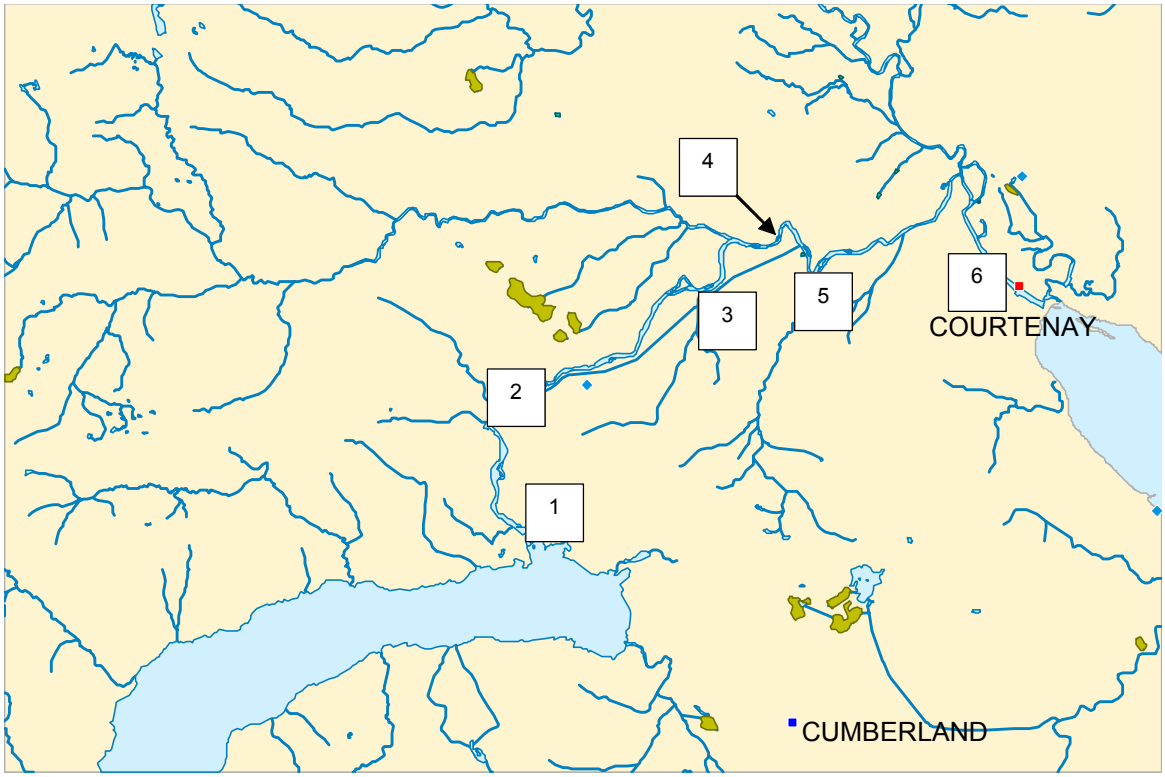

Fig. 5. Map of the Puntledge River watershed showing the locations of the six temperature data loggers at the Comox Lake outlet (1), Puntledge Hatchery upper site (2), pink side channel (3), Puntledge power house pool (4), Puntledge Hatchery lower site main fence (5) and 5th Street bridge (6).

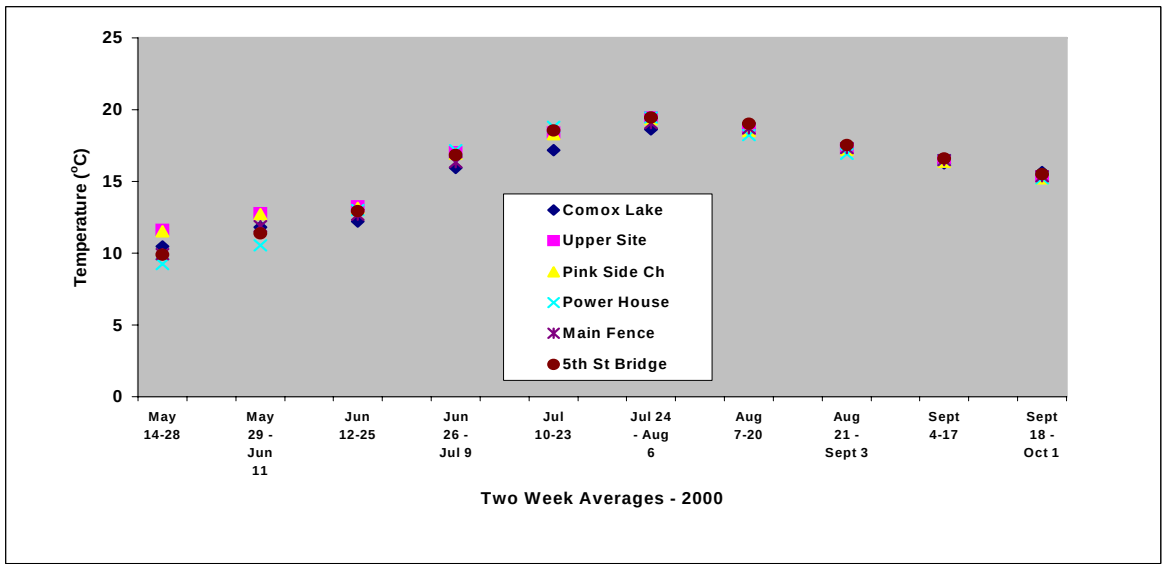

Fig. 6. Temperatures (° C) recorded by six data loggers located in the Puntledge River watershed (see Fig. 5 for logger sites).

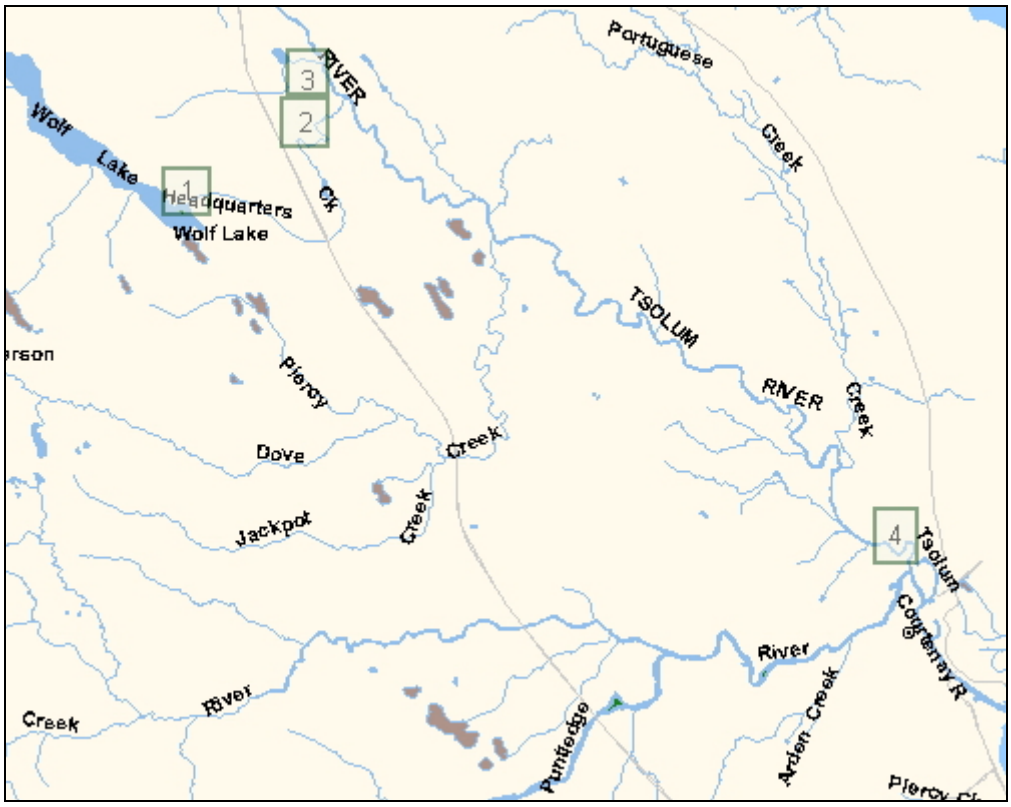

Fig. 7. Map of the Tsolum River watershed showing the locations of the four temperature data loggers at the Wolf Lake outlet (1), Headquarters Creek (2), Yew Tree (3) and lower Tsolum (4).

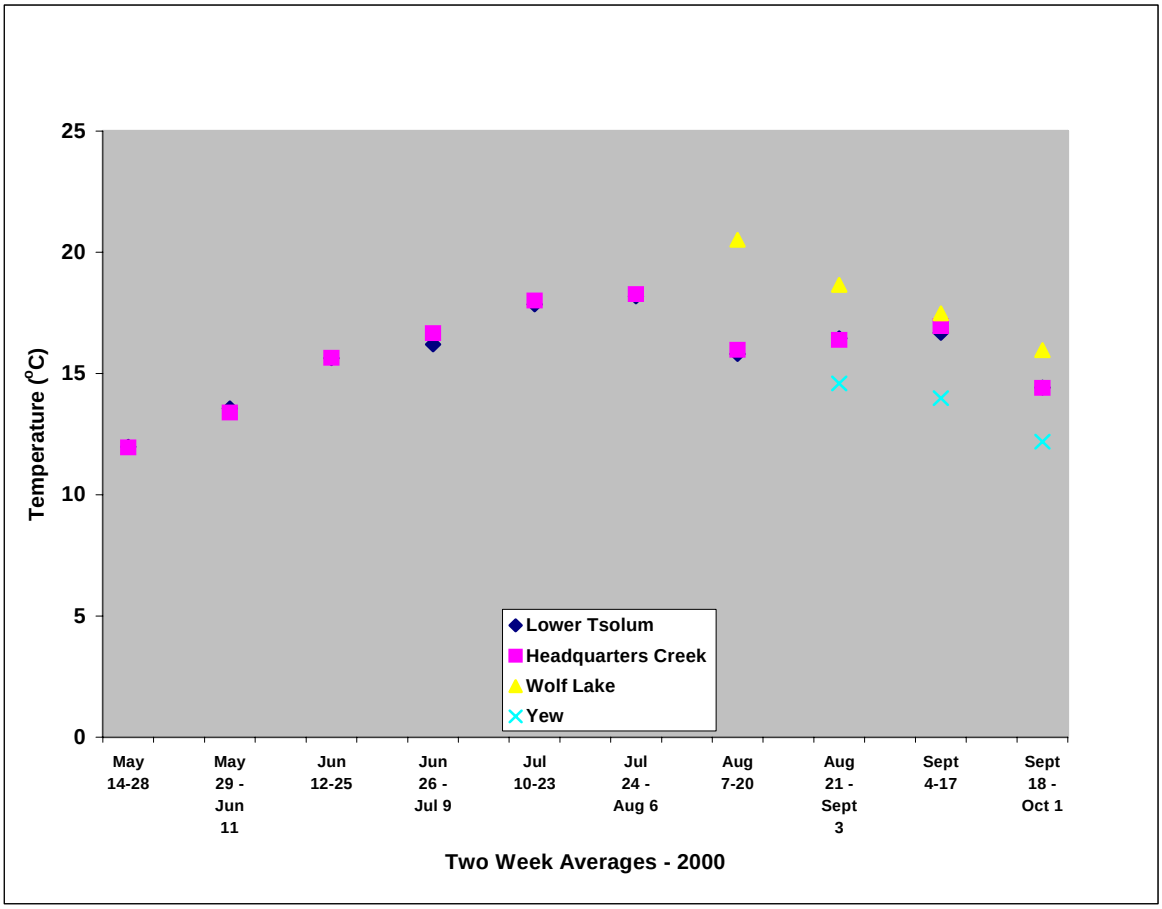

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Fig. 8. Temperatures (ºC) recorded by four data loggers located in the Tsolum River watershed (see Fig. 7 for logger sites).

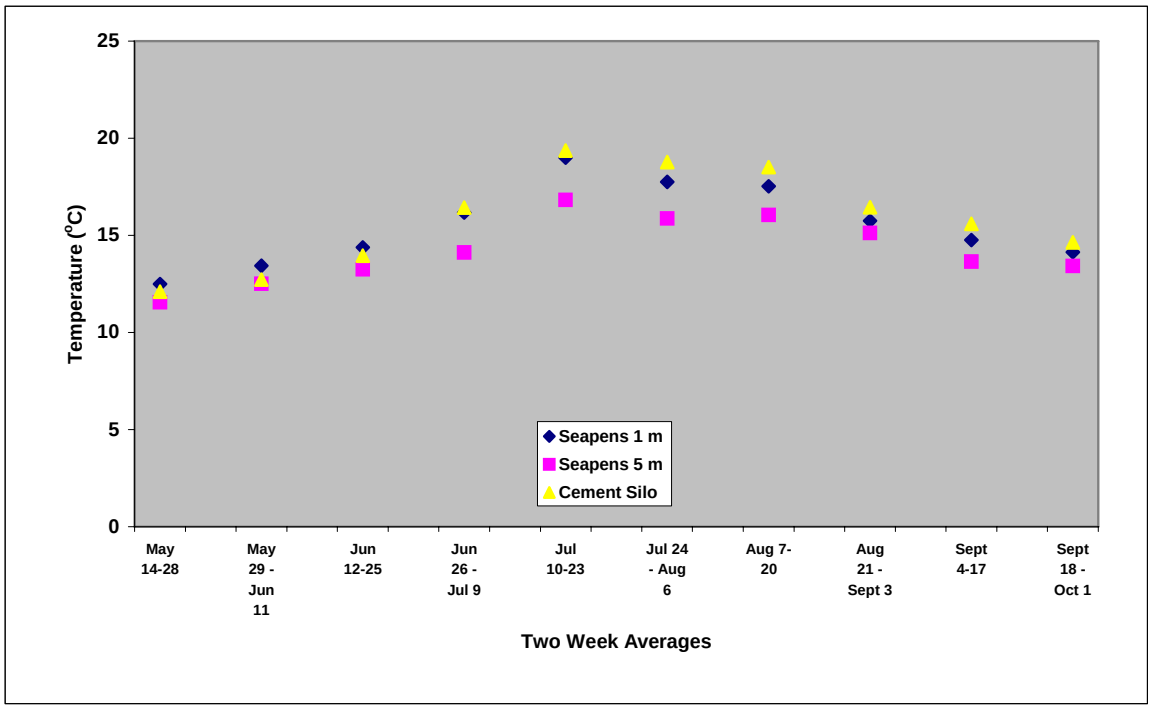

Fig. 9. Temperatures (° C) recorded by three data loggers located in the Courtenay River estuary (see Fig. 1 for logger sites).

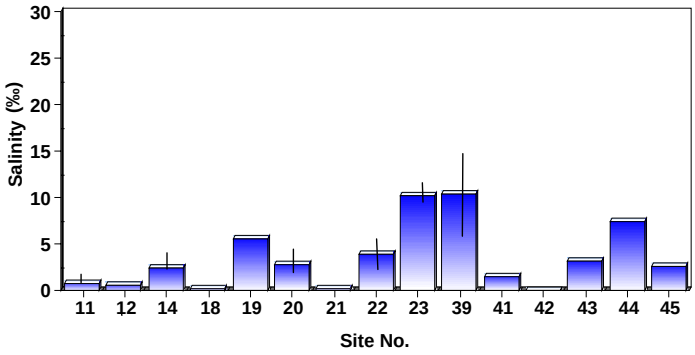

Fig 10. Mean salinity (‰) +/- 1SE for each site in the lower river region.

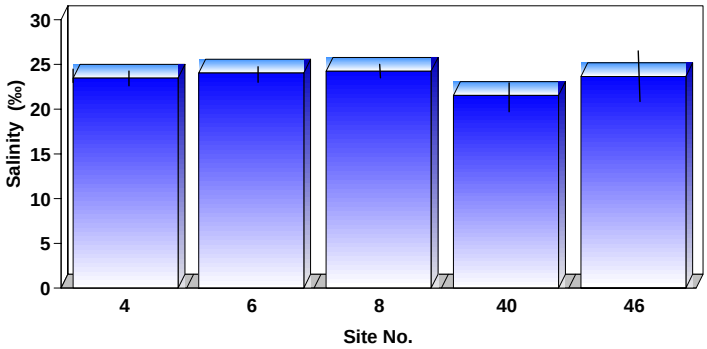

Fig. 11. Mean salinity (‰) +/- 1SE for each site in the estuary region.

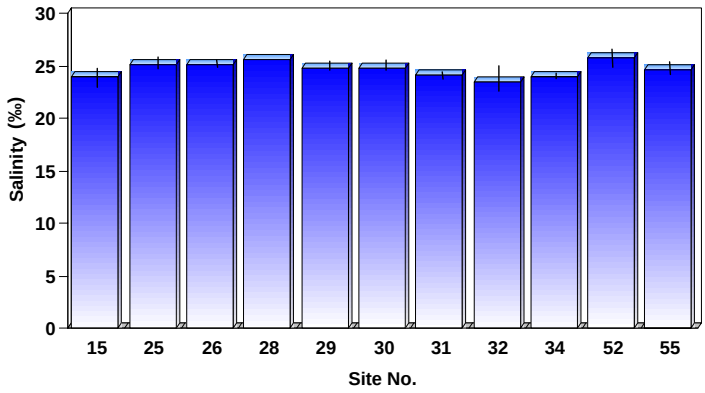

Fig 12. Mean salinity (‰) +/- 1SE for each site in the Baynes Sound nearshore region.

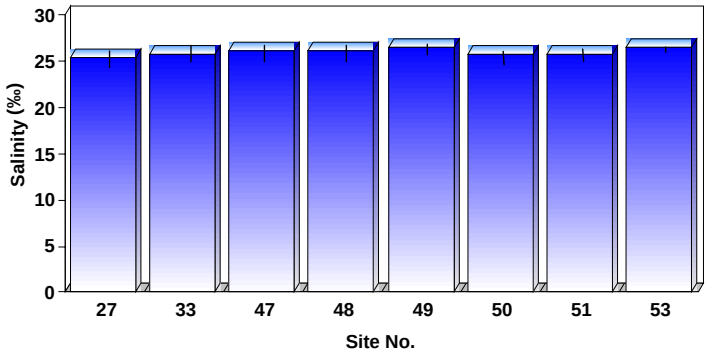

Fig 13. Mean salinity (‰) +/- 1SE for each site in the Baynes Sound offshore region.

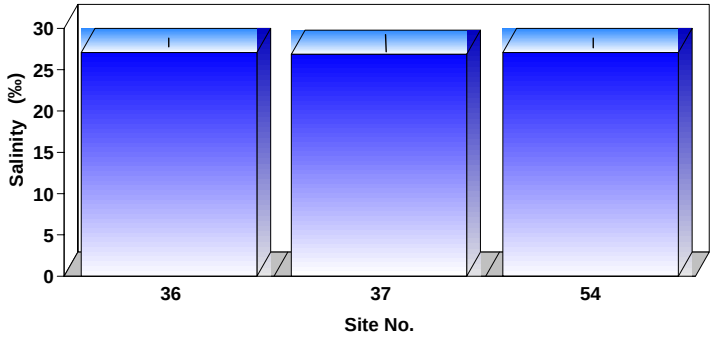

Fig. 14. Mean salinity (‰) +/- 1SE for each site in the outside region.

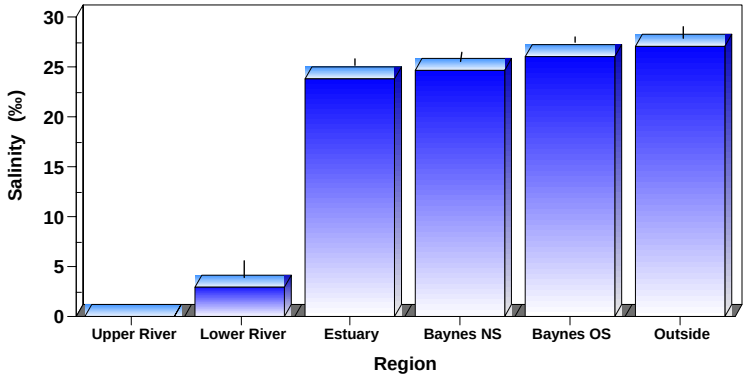

Fig. 15. Mean salinity (‰) +/- 1SE for each of the six regions.

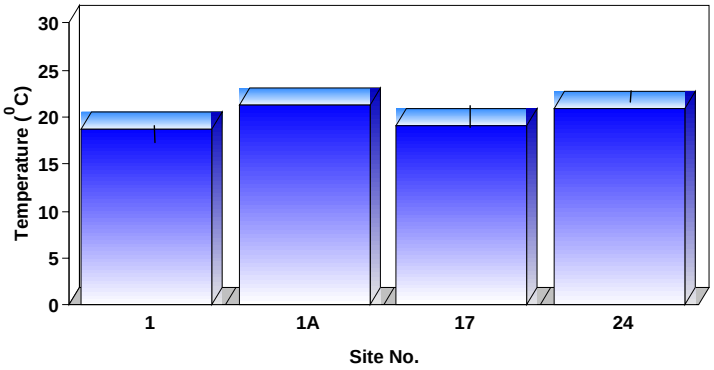

Fig 16. Mean temperature (° C) +/- 1SE for each site in the upper river region.

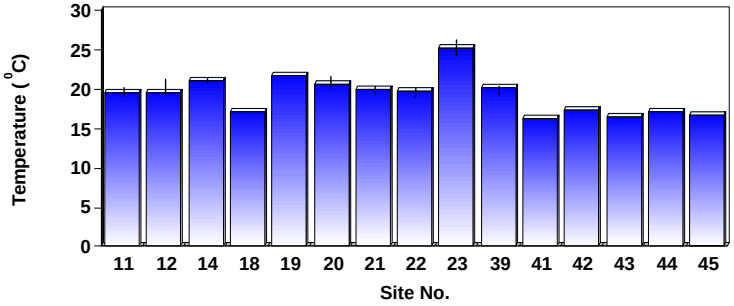

Fig. 17. Mean temperature (° C) +/- 1SE for each site in the lower river region.

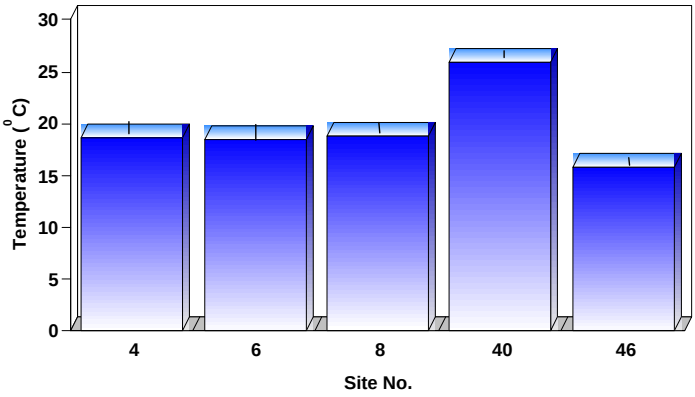

Fig. 18. Mean temperature (° C) +/- 1SE for each site in the estuary region.

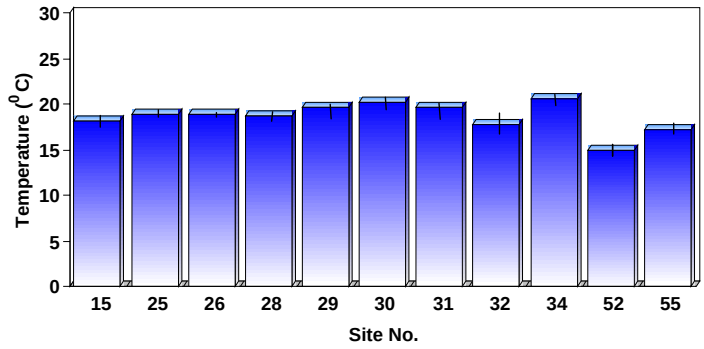

Fig. 19. Mean temperature (° C) +/- 1SE for each site in the Baynes Sound nearshore region.

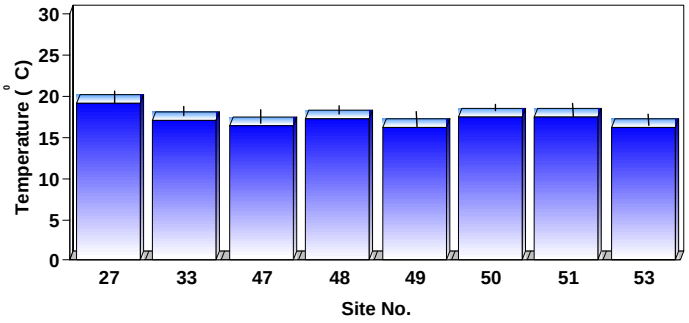

Fig. 20. Mean temperature (° C) +/- 1SE for each site in the Baynes Sound offshore region.

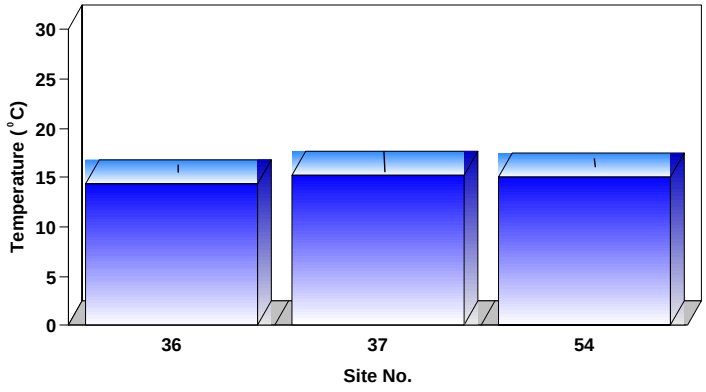

Fig. 21. Mean temperature (° C) +/- 1SE for each site in the outside region.

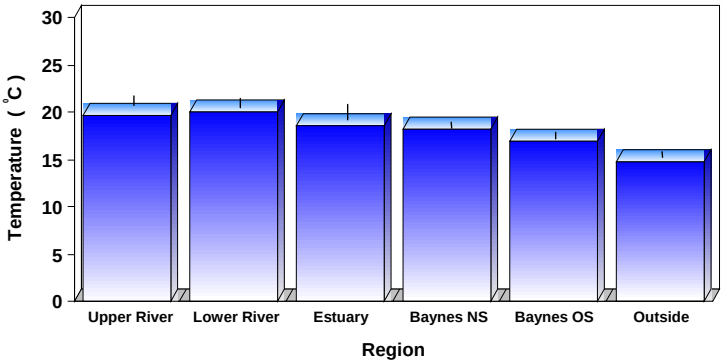

Fig. 22. Mean temperature (° C) +/- 1SE for each of the six regions.

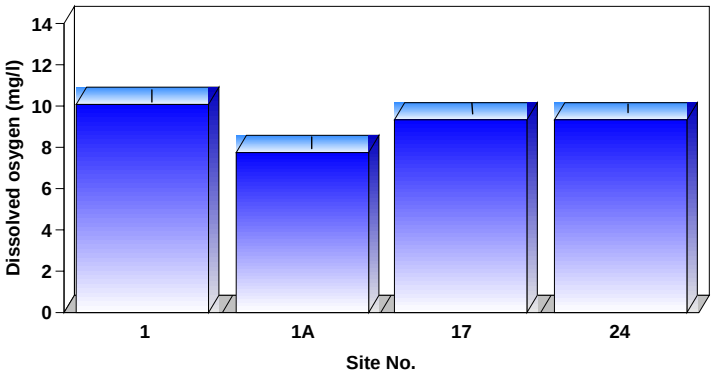

Fig. 23 . Mean dissolved oxygen (mg/l) +/- 1SE for each site in the upper river region.

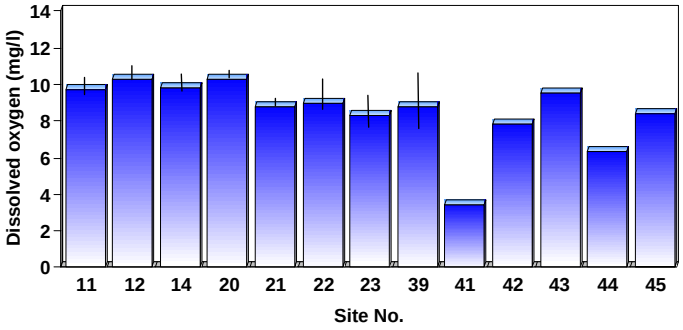

Fig. 24 . Mean dissolved oxygen (mg/l) +/- 1SE for each site in the lower river region.

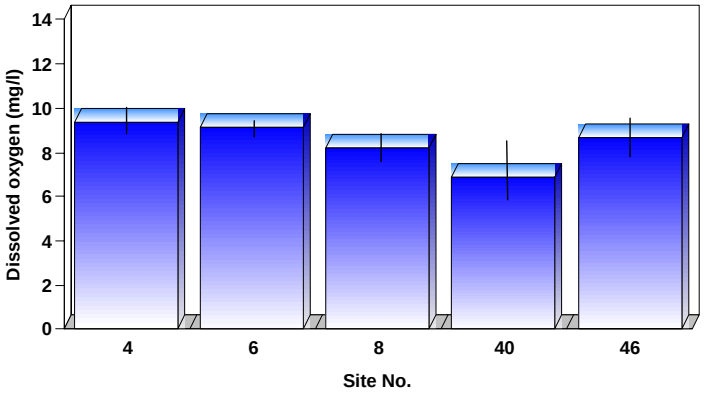

Fig. 25. Mean dissolved oxygen (mg/l) +/- 1SE for each site in the estuary region.

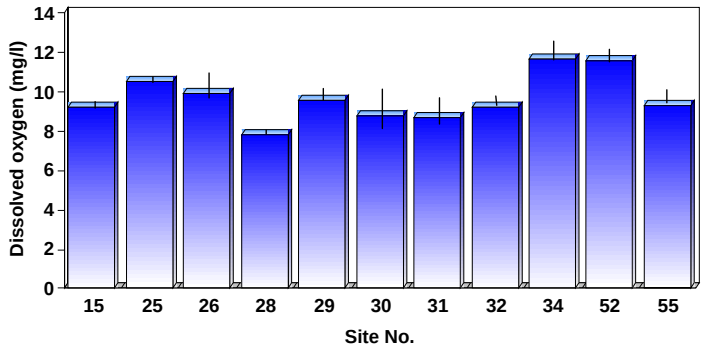

Fig. 26. Mean dissolved oxygen (mg/l) +/- 1SE for each site in the Baynes Sound nearshore region.

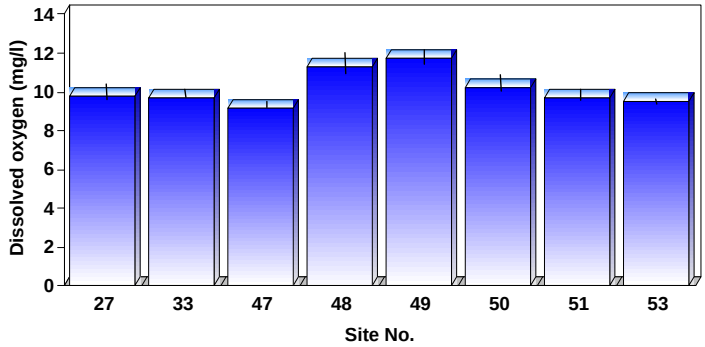

Fig. 27. Mean dissolved oxygen (mg/l) +/- 1SE for each site in the Baynes Sound offshore region.

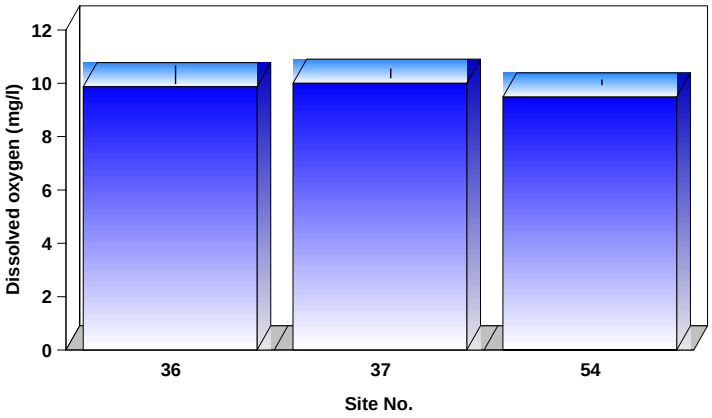

Fig. 28. Mean dissolved oxygen (mg/l) +/- 1SE for each site in the outside region.

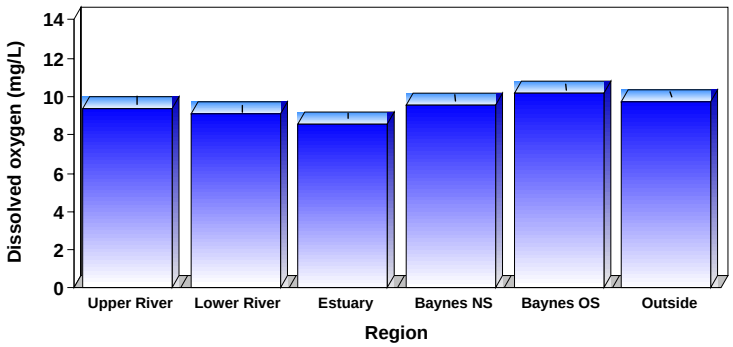

Fig. 29. Mean dissolved oxygen (mg/l) +/- 1SE for each of the six regions.

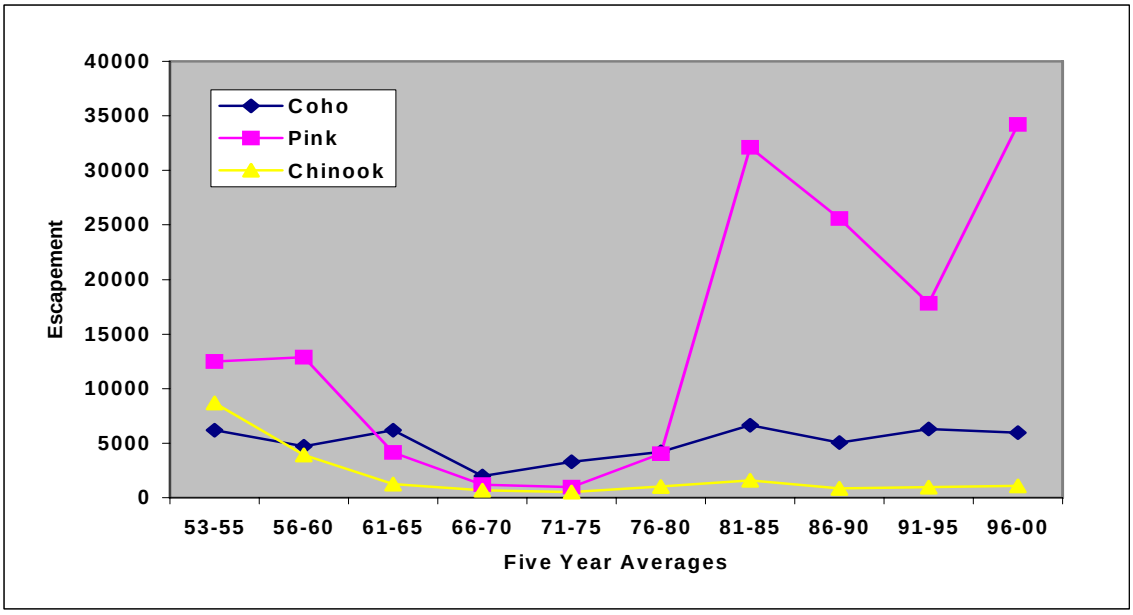

Fig. 30. Escapement of coho, pink and chinook to the Puntledge River 1953 – 2000.

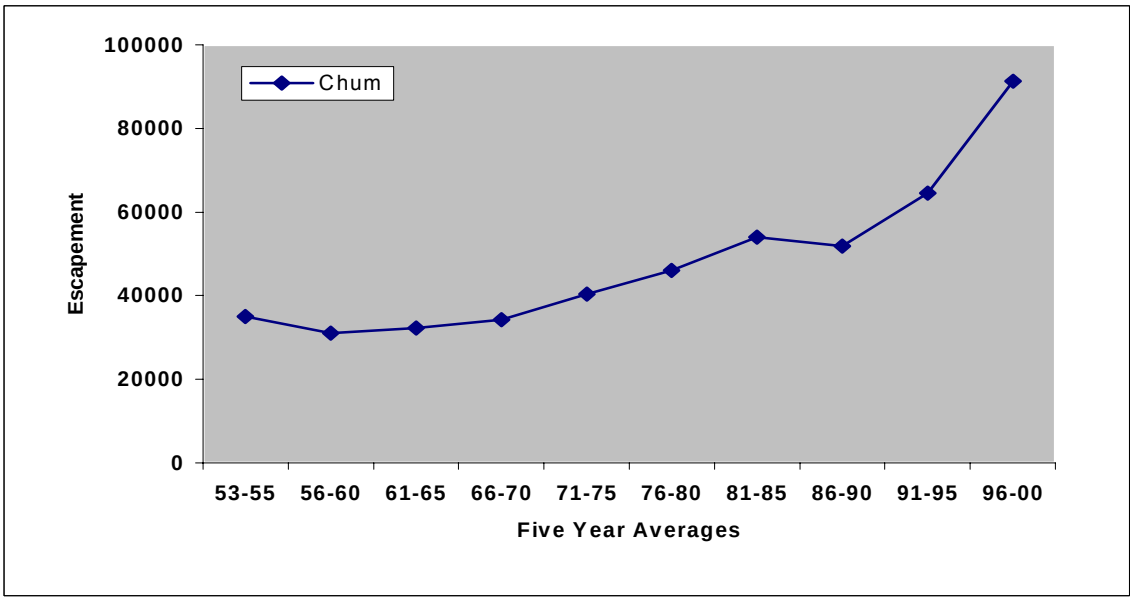

Fig. 31. Escapement of chum to the Puntledge River 1953-2000.

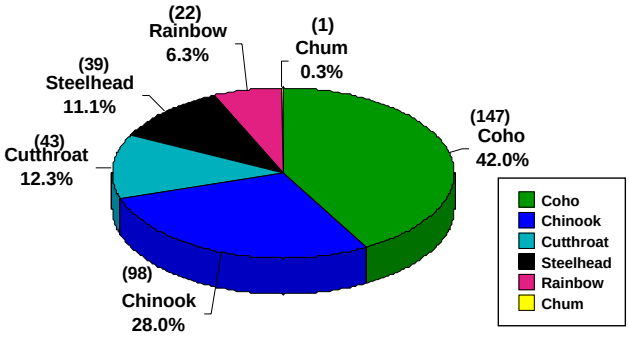

Fig. 32. Catch of each species of salmonid as percent of total catch.

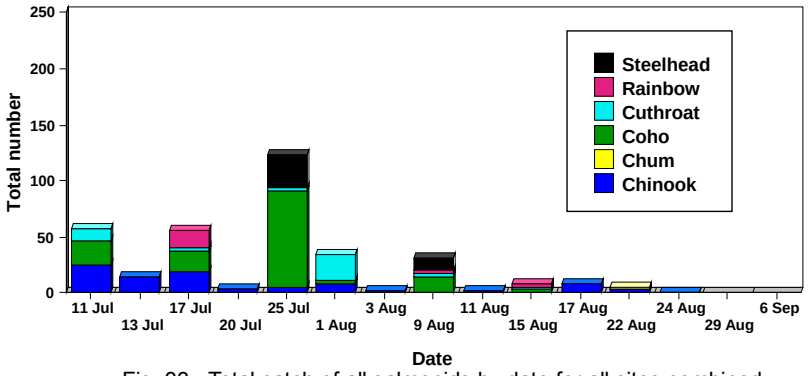

Fig. 33. Total catch of all salmonids by date for all sites combined.

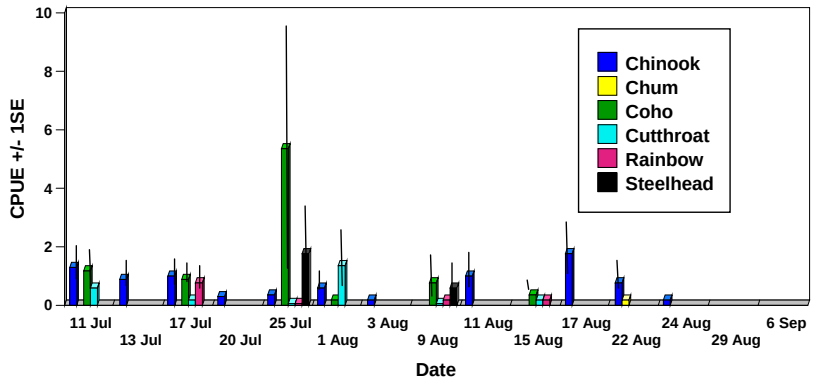

Fig. 34. CPUE +/- 1SE by date for all salmonid species captured.

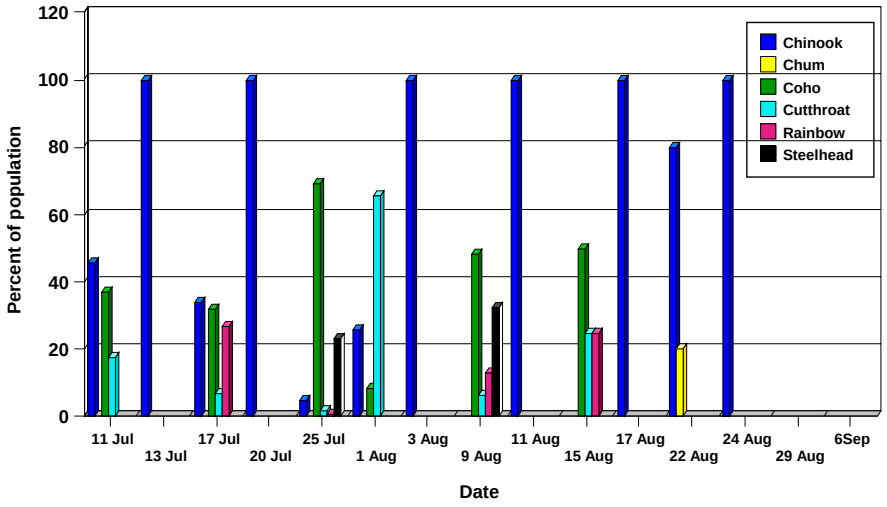

Fig. 35. Percent of total salmonid population for each species by date.

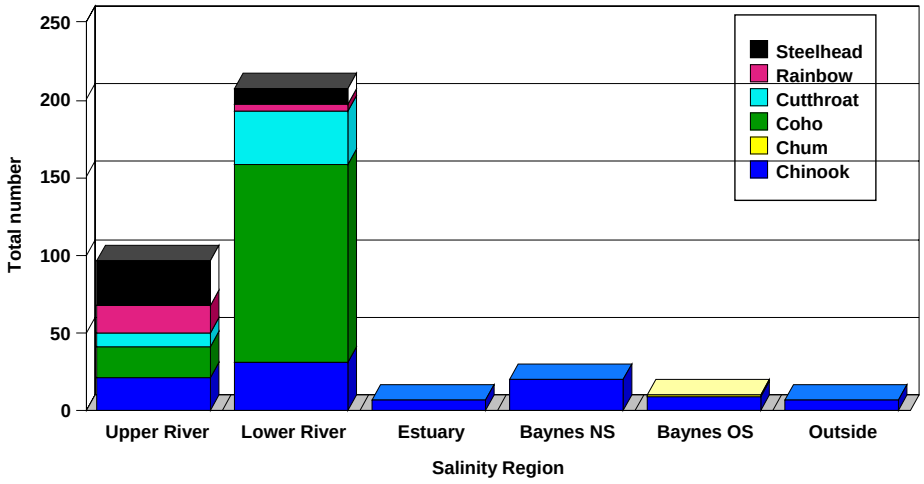

Fig. 36. Total catch of all salmonids by salinity region for all sites combined.

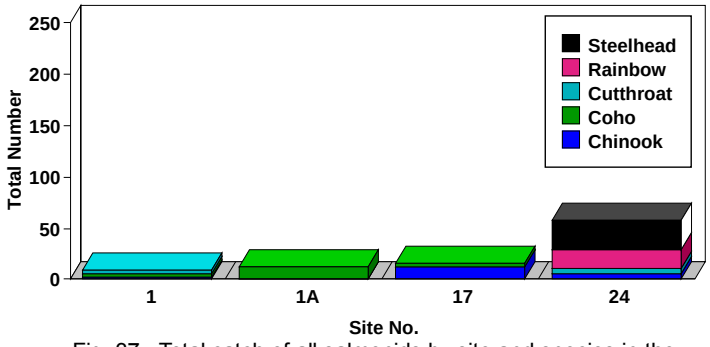

Fig. 37. Total catch of all salmonids by site and species in the upper river region.

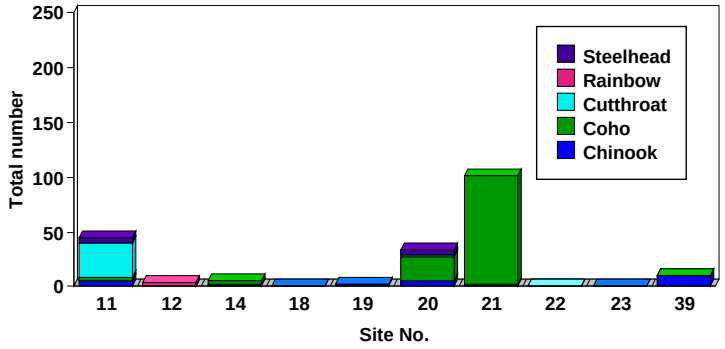

Fig 38. Total catch of all salmonids by site and species in the lower river region.

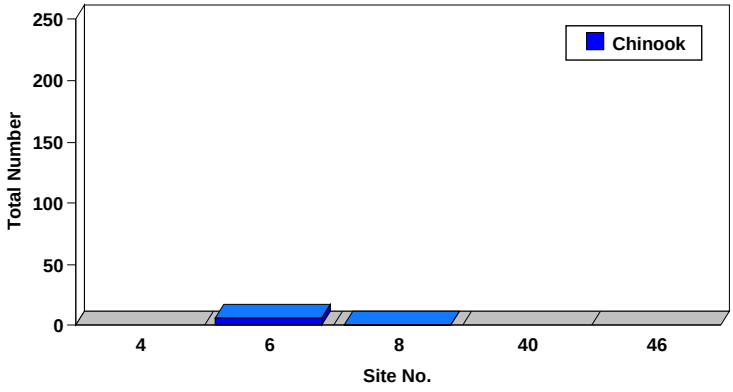

Fig. 39. Total catch of all salmonids by site and species in the estuary region.

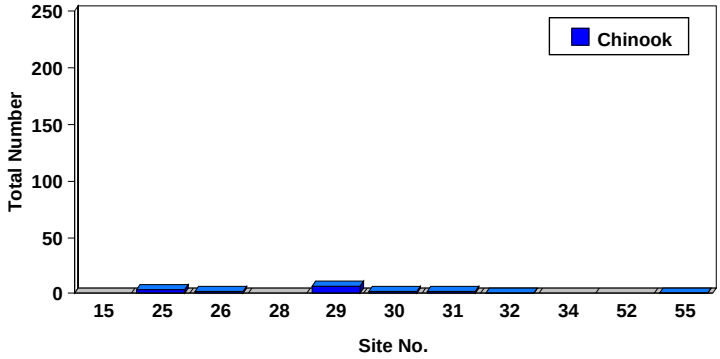

Fig. 40. Total catch of all salmonids by site and species in the Baynes Sound nearshore region.

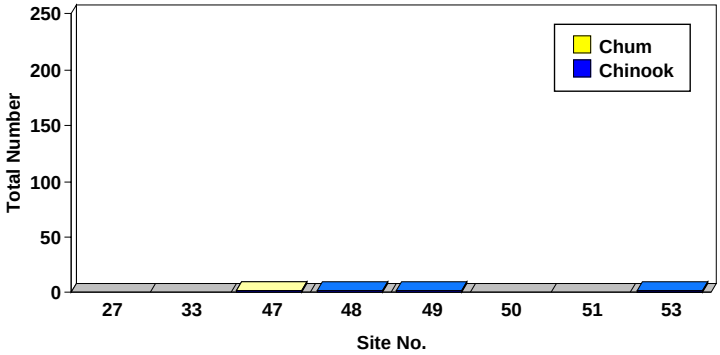

Fig. 41. Total catch of all salmonids by site and species in the Baynes Sound offshore region.

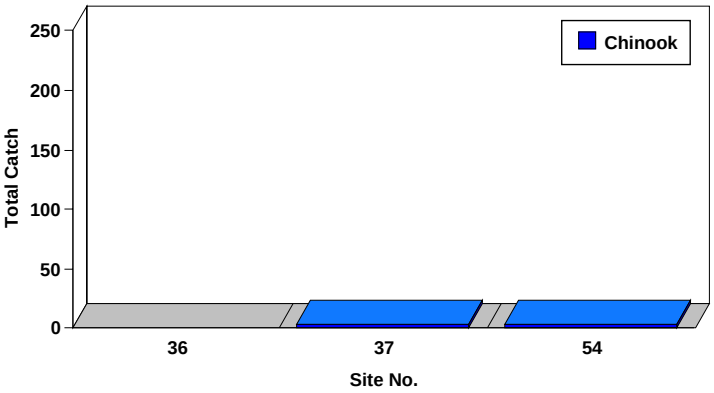

Fig. 42. Total catch of all salmonids by site and species in the outside region.

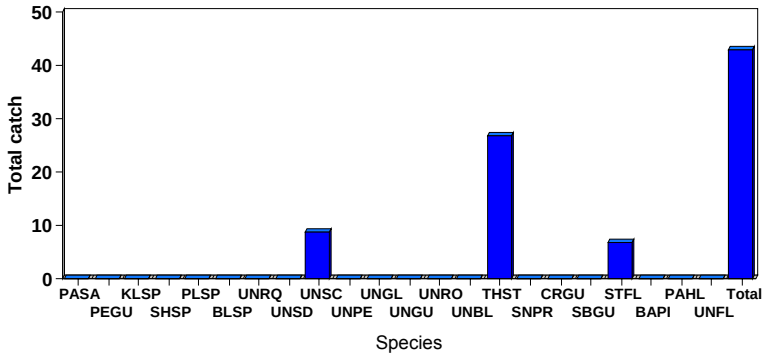

Fig. 43. Total catch of all non-salmonids by species in the upper river region (see Table 10 for abbreviations).

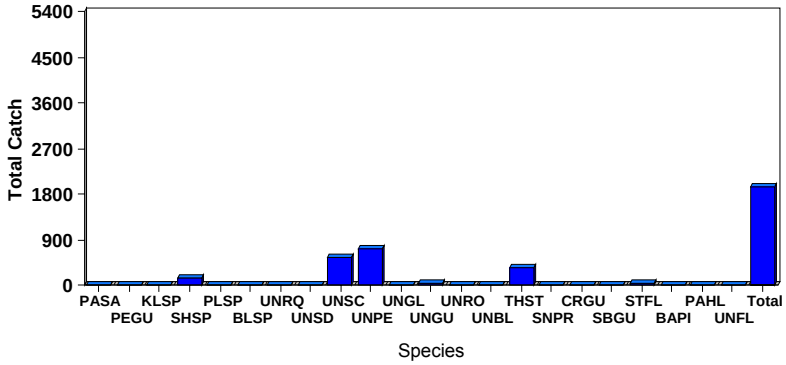

Fig. 44. Total catch of all non-salmonids by species in the lower river region (see Table 10 for abbreviations).

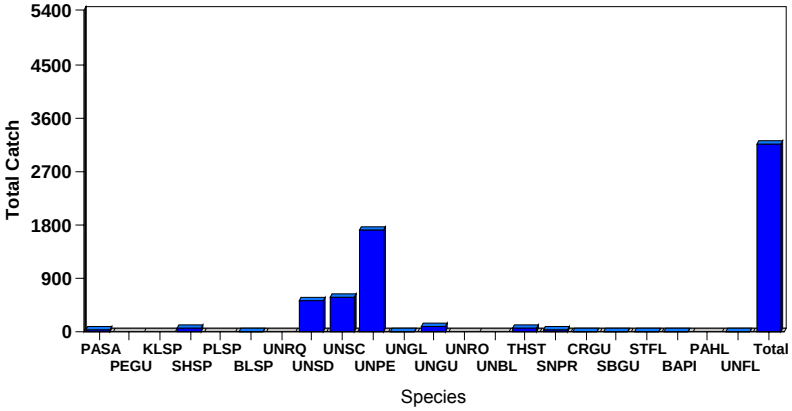

Fig. 45. Total catch of all non-salmonids by species in the estuary region (see Table 10 for abbreviations).

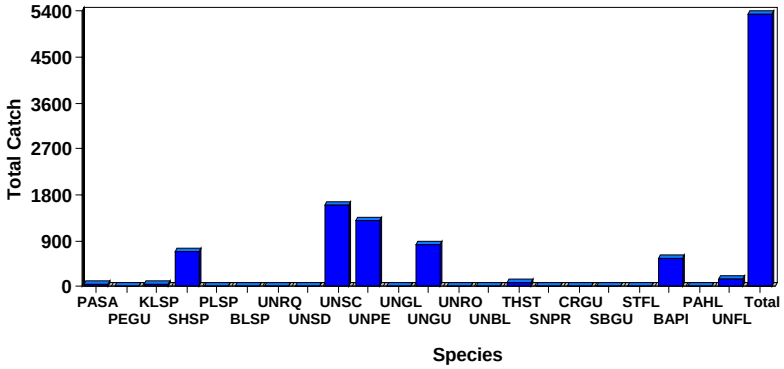

Fig. 46. Total catch of all non-salmonids by species in the Baynes Sound nearshore region (see Table 10 for abbreviations).

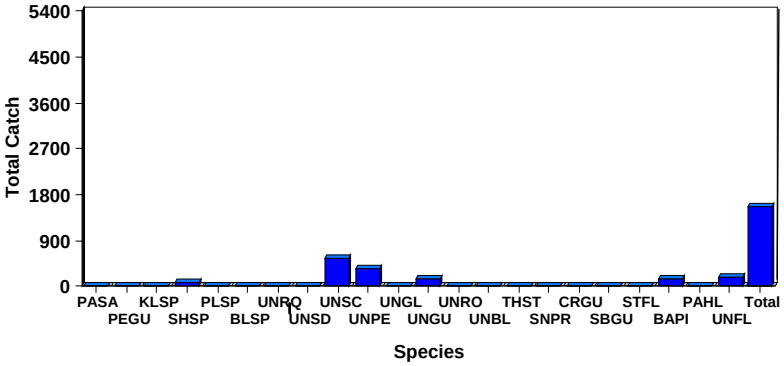

Fig .47. Total catch of all non-salmonids by species in the Baynes Sound offshore region (see Table 10 for abbreviations).

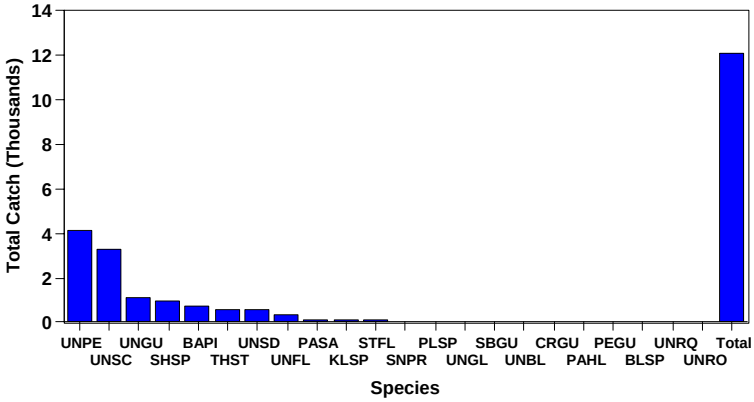

Fig. 48. Total catch of all non-salmonids by species in all regions combined (see Table 10 for abbreviations).

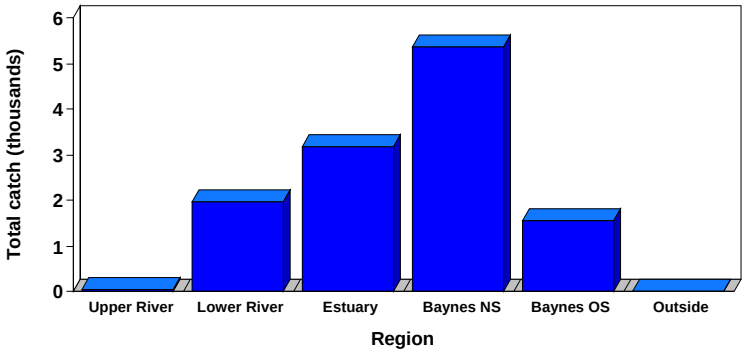

Fig. 49. Total catch of all species of non-salmonids combined by region.

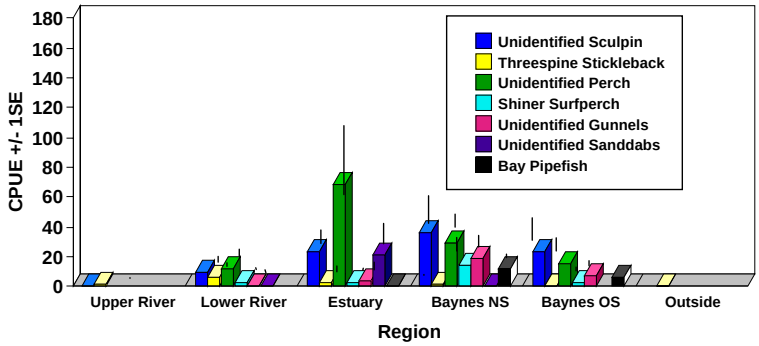

Fig. 50. CPUE +/- 1SE for dominant non-salmonid groups and species by region.

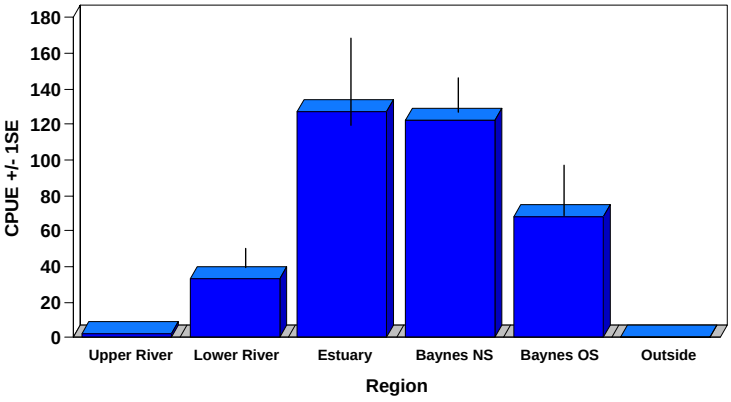

Fig. 51. CPUE +/- 1SE for all species of non-salmonids combined by region.

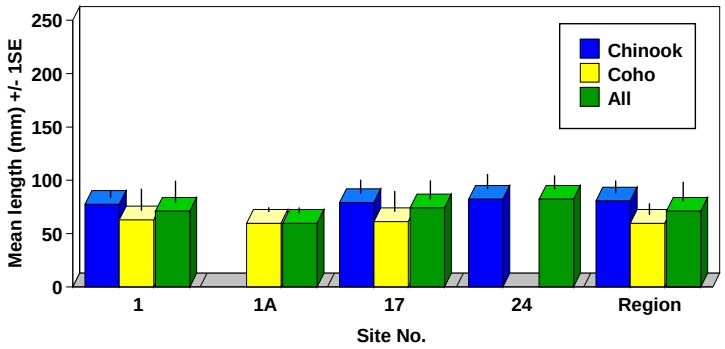

Fig. 52. Mean length (mm) +/- 1SE for all salmonids captured by site and for all sites combined in the upper river region.

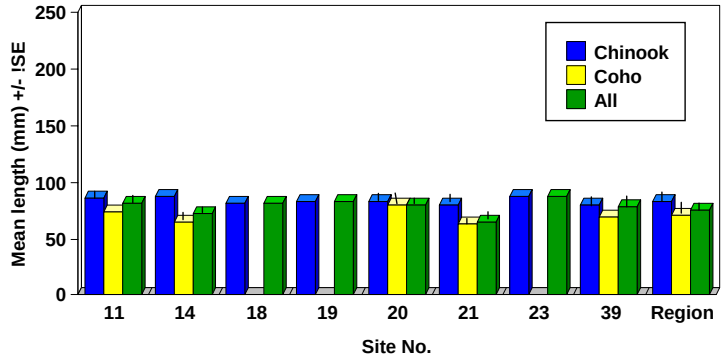

Fig. 53. Mean length (mm) +/- 1SE for all salmonids captured by site and for all sites combined in the lower river region.

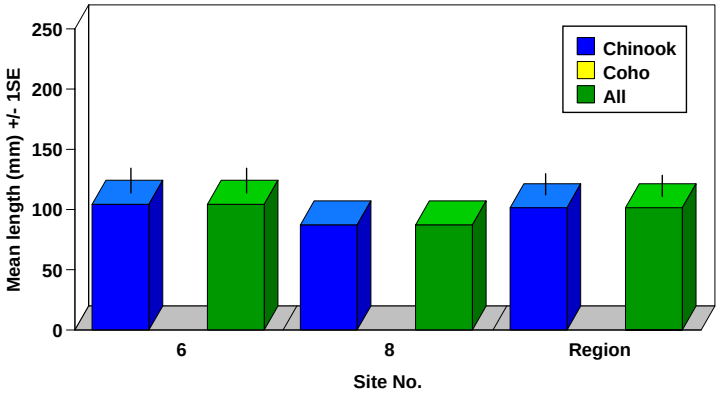

Fig. 54. Mean length (mm) +/- 1SE for all salmonids captured by site and for all sites combined in the estuary region.

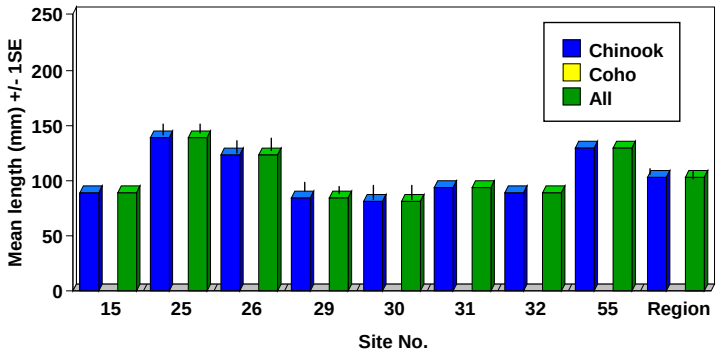

Fig. 55. Mean length (mm) +/- 1SE for all salmon captured by site and for all sites combined in the Baynes Sound nearshore region.

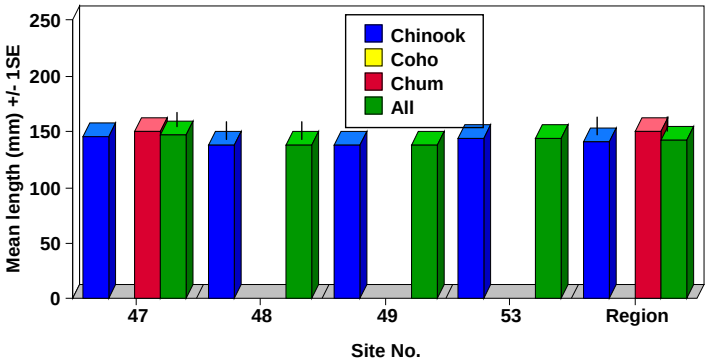

Fig. 56. Mean length (mm) +/- 1SE for all salmon captured by site and for all sites combined in the Baynes Sound offshore region.

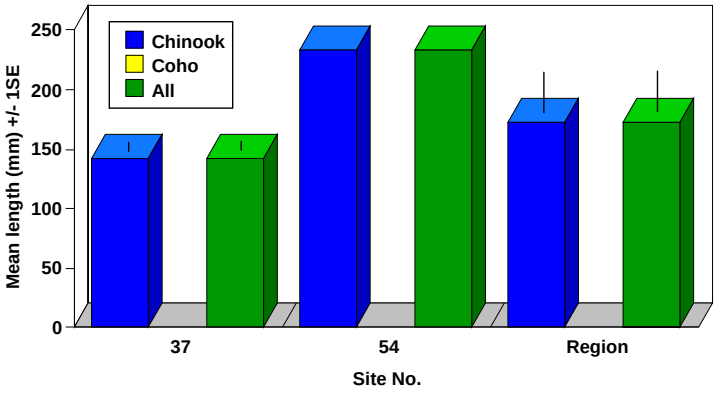

Fig. 57. Mean length (mm) +/- 1SE for all salmon captured by site and for all sites combined in the outside region.

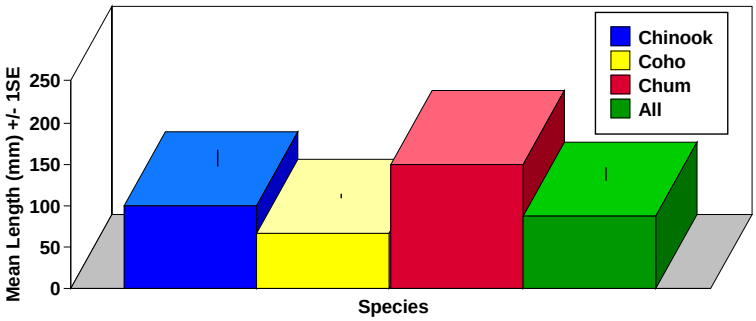

Fig. 58. Mean length (mm) +/- 1SE for all salmonids captured by species.

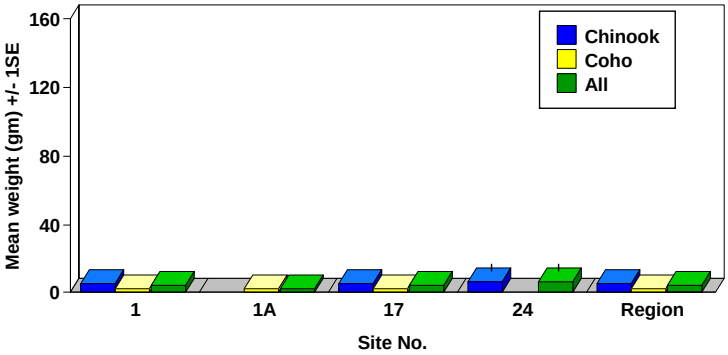

Fig. 59. Mean weight (gm) +/- 1SE for all salmonids captured by site and for all sites combined in the upper river region.

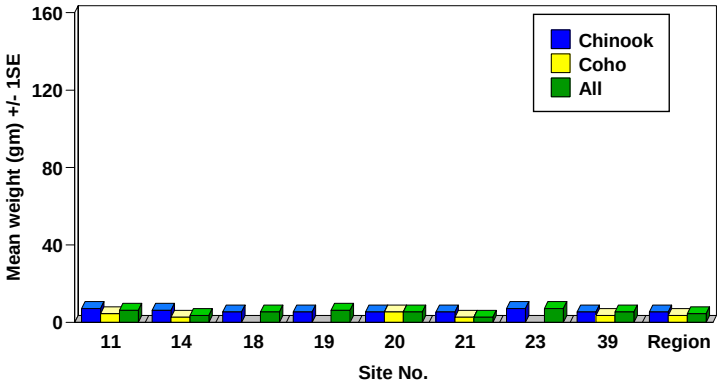

Fig. 60. Mean weight (gm) +/- 1SE for all salmonids captured by site and for all sites combined in the lower river region.

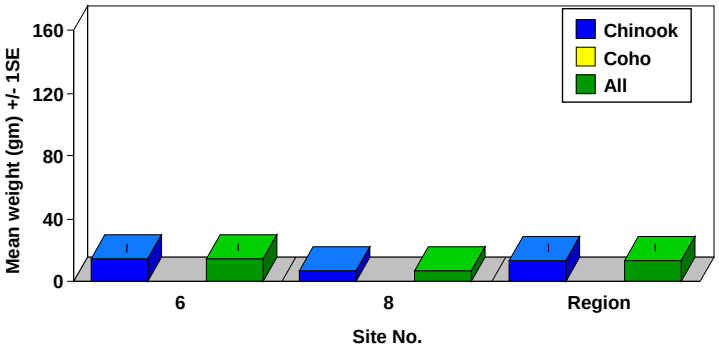

Fig. 61. Mean weight (gm) +/- 1SE for all salmonids captured by site and for all sites combined in the estuary region.

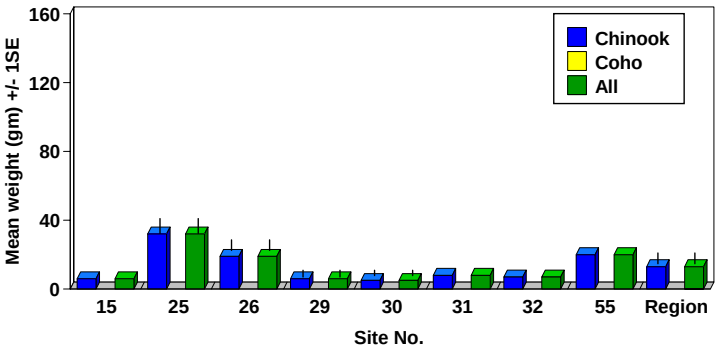

Fig. 62. Mean weight (gm) +/- 1SE for all salmonids captured by site and for all sites combined in the Baynes Sound nearshore region.

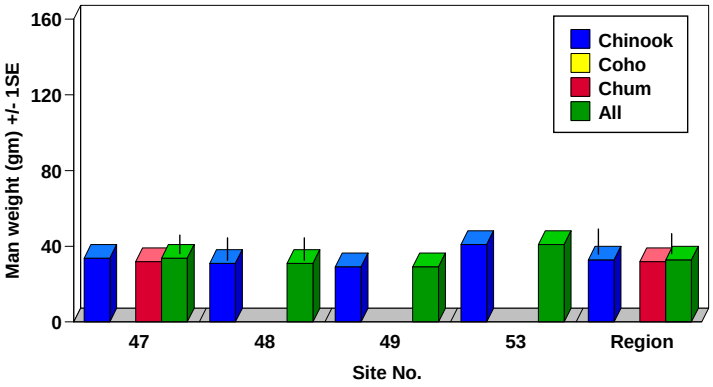

Fig. 63. Mean weight (gm) +/- 1SE for all salmonids captured by site and for all sites combined in the Baynes Sound offshore region.

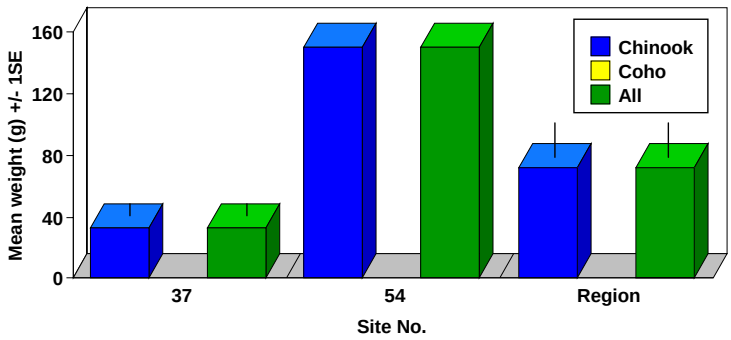

Fig. 64. Mean weight (gm) +/- 1SE for all salmonids captured by site and for all sites combined in the outside region.

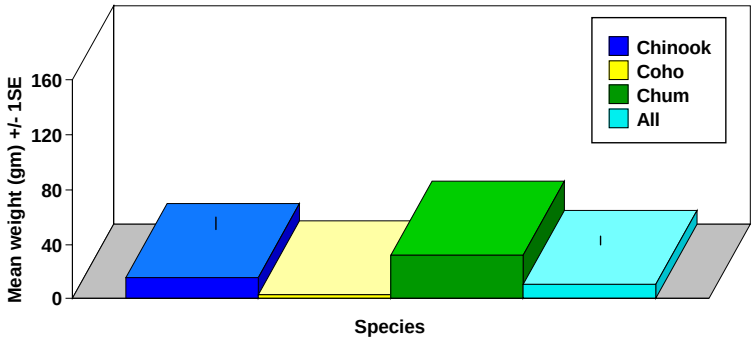

Fig. 65. Mean weight (gm) +/- 1SE for all salmonids captured by species.

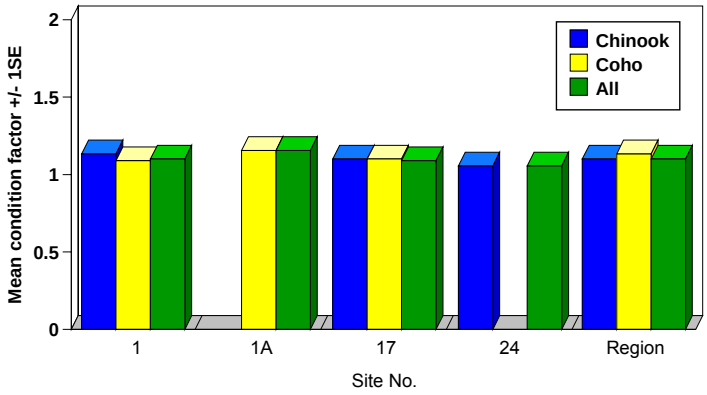

Fig. 66. Mean condition factor +/- 1SE for all salmonids captured by site and for all sites combined in the upper river region.

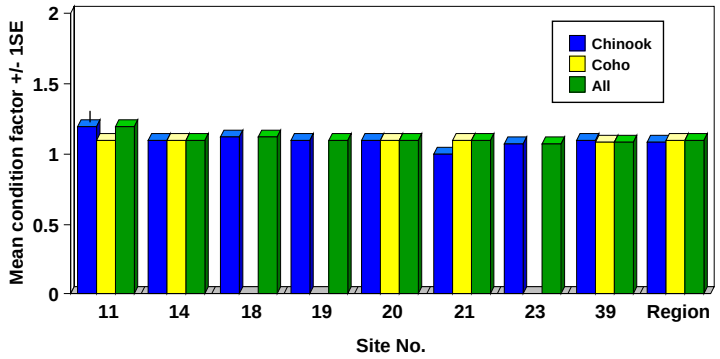

Fig. 67. Mean condition factor +/- 1SE for all salmonids captured by site and for all sites combined in the lower river region.

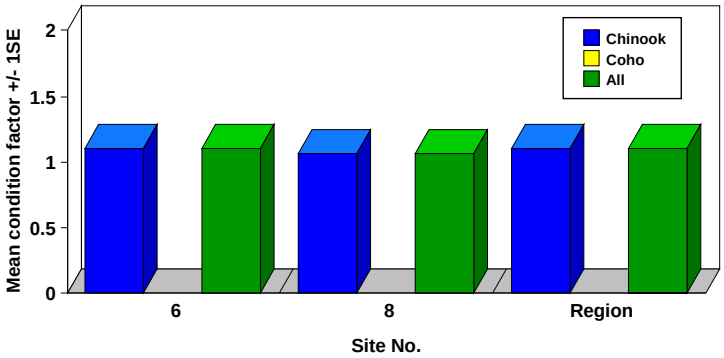

Fig. 68. Mean condtion factor +/- 1SE for all salmonids captured by site and for all sites combined in the estuary region.

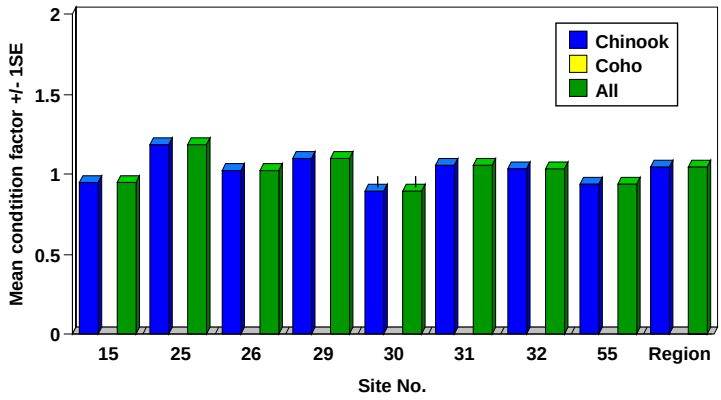

Fig. 69. Mean condtion factor +/- 1SE for all salmonids captured by site and for all sites combined in the Baynes Sound nearshore region.

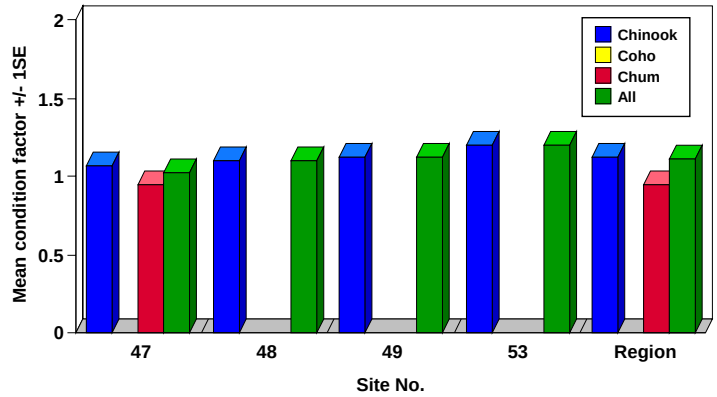

Fig. 70. Mean condtion factor +/- 1SE for all salmonids captured by site and for all sites combined in the Baynes Sound offshore region.

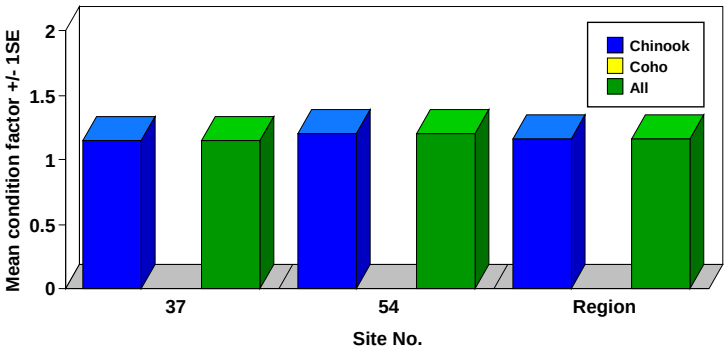

Fig. 71. Mean condition factor +/- 1SE for all salmonids captured by site and for all sites combined in the outside region.

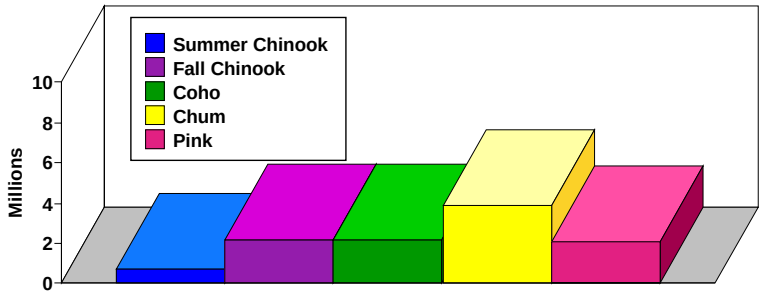

Fig. 72. Releases of juvenile salmonids from the Puntledge River Hatchery during 2000.

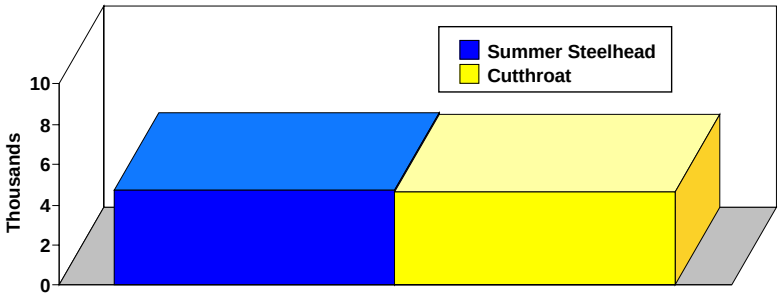

Fig. 73. Releases of juvenile trout from the Puntledge River Hatchery during 2000.