Distribution and Abundance of Juvenile Salmonids and Other Fish Species in the Courtenay River Estuary and Baynes Sound, 2001

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DISTRIBUTION AND ABUNDANCE OF JUVENILE SALMONIDS AND OTHER FISH SPECIES IN THE COURTENAY RIVER ESTUARY AND BAYNES SOUND, 2001

by

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

Page

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

Page

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

Page

LIST OF TABLES

LIST OF TABLES (CONT'D)

Page

LIST OF FIGURES

LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

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LIST OF FIGURES (CONT'D)

Page

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LIST OF FIGURES (CONT'D)

LIST OF FIGURES (CONT'D)

Page

LIST OF FIGURES (CONT'D)

Page

LIST OF FIGURES (CONT'D)

Page

ABSTRACT

Hamilton, S. L., Bravender, B. A., Beggs, C., and Munro, B. 2008. Distribution and abundance of juvenile salmonids and other fish species in the Courtenay River estuary and Baynes Sound, 2001. Can. Tech. Rep. Fish. Aquat. Sci. 2806: xxvii + 213 p.

In 2001, juvenile salmonid populations and distributions were surveyed in the Courtenay River, its estuary, and Baynes Sound as far south as Denman Point. Between January 12th and August 15th, 76 sites were sampled using beach, purse, mini purse and pole seines, as well as Gee traps. A total of 7177 juvenile salmonids and 19741 non salmonids were captured. Lengths and weights were recorded for 1088 chinook, coho, chum, pink, rainbow, cutthroat and steelhead. Water temperature and salinity were recorded to a maximum five metres depth at all beach, purse and mini purse seine sites.

One way ANOVA analysis of the salinity measurements for all depths identified nine statistically significant ($p < 0.05$) different habitats in the river, estuary and Baynes Sound. One way ANOVA analysis of the temperature data showed a statistically significant ($p < 0.05$) difference in 53 of the 72 tests. Temperatures over 20 ºC were measured at many of the sites, well above the preferred range for salmonids.

The distribution of juvenile salmonids appeared to be influenced by the characteristics of each habitat type and were consistent with the distributions found in previous studies of this area in 1998 and 2000. Given that more fish on average were caught in the man made refuges, the amount of low tide refuges such as those found in the deeper portions of the Comox Marina appear to be inadequate for the number of juvenile salmonids which rear in the estuary.

Recommendations to improve the habitat in this area include: increasing river water flow during the spring and early summer while the juvenile salmonids are present in this area; reclaiming or constructing new salt marsh areas; exploring the opportunities to construct new off-channel habitats for fry rearing; and investigating copper levels in the estuary.

RÉSUMÉ

Hamilton, S. L., Bravender, B. A., Beggs, C., Munro, B. 2008. The distribution and abundance of juvenile salmonids and other fish species in the Courtenay River estuary and Baynes Sound, 2001. Can. Tech. Rep. Fish. Aquat. Sci. 2806 : xxvii + 213 p.

En 2001, des populations de salmonidés juvéniles et leur répartition ont été étudiées dans la rivière Courtenay, dans son estuaire et dans le chenal Baynes, et ce, jusqu’au cap Denman vers le sud. Entre le 12 janvier et le 15 août, 76 sites ont été échantillonnés à l’aide de sennes de plage, de petites et de grandes sennes coulissantes, de sennes à bâtons et de pièges à ménés. Au total, 7 177 salmonidés juvéniles et 19 741 non-salmonidés ont été recueillis. La taille et le poids de 1 088 poissons (saumons quinnats, saumons cohos, saumons kétas, saumons roses, saumons arc-en-ciel, truites fardées et truites arc-en ciel) ont été enregistrés. La température et la salinité de l’eau ont été mesurées jusqu’à une profondeur maximale de cinq mètres dans tous les sites où l’échantillonnage a été effectué à l’aide de sennes de plages et de petites et de grandes sennes coulissantes.

Une analyse de la variance unidirectionnelle (ANOVA) des mesures sur la salinité à toutes les profondeurs a permis de caractériser neuf types d’habitat significativement différents sur le plan statistique ($p < 0,05$) dans la rivière, l’estuaire et le chenal Baynes. L’ANOVA des données sur la température a indiqué une différence statistiquement significative ($p < 0,05$) pour 53 des 72 essais. Des températures de plus de 20 ºC (bien au-delà de la fourchette de température idéale pour les salmonidés) ont été mesurées dans de nombreux sites.

Les caractéristiques propres à chacun des habitats semblent influer sur la répartition des salmonidés juvéniles, laquelle correspondait à la répartition observée lors des études antérieures menées dans la même région, en 1998 et en 2000. En tenant compte du fait que, en moyenne, un plus grand nombre de poissons ont été pêchés dans les refuges dont la formation est d’origine humaine, le nombre de refuges à marée basse tels que ceux observés dans les zones plus profondes de la marina de Comox semble inadéquat pour le nombre de salmonidés juvéniles qui croissent dans l’estuaire.

Afin d’améliorer la qualité des habitats de cette région, des recommandations ont été formulées, notamment : augmenter le débit de la rivière au printemps et au début de l’été pendant la présence des salmonidés juvéniles dans cette région; mettre en valeur ou construire de nouvelles zones de marais salés; étudier les possibilités d’aménagement de nouveaux habitats hors du chenal pour l’alevinage; effectuer l’analyse des teneurs en cuivre dans l’estuaire.

1.0. INTRODUCTION

1.1. STUDY LOCATION

The Courtenay River estuary, also known as Comox Harbour, is located on the east coast of Vancouver Island, British Columbia, between the cites of Courtenay and Comox (49º 40' latitude, 124º 55' longitude) (Fig. 1). The Puntledge River merges with the Tsolum River to form the Courtenay River which then flows into the Courtenay River estuary. The mouth of the estuary opens into Baynes Sound, which is separated from the Strait of Georgia by Denman Island and the shallow Comox bar.

The Courtenay River estuary is highly stratified (Morris et al. 1979). This is particularly evident in summer when a saltwater wedge occurs beneath the freshwater surface layer supplied by the Courtenay River. Little wind mixing occurs as the estuary is protected by Goose Spit and surrounding islands. Baynes Sound is also protected by these islands, and is additionally protected from strong currents as indicated by the rich organic sand and mud substrate that dominates this area (Waldie 1951).

1.2. WATERSHED AND ENHANCEMENT

A number of rivers and creeks combine to provide the fresh water flows to the Courtenay River estuary (Fig. 2). Below are brief summaries of the larger streams and rivers.

1.2.1. Courtenay River

The Puntledge and Tsolum rivers conjoin to form the Courtenay River approximately three km from the head of the estuary (Fig. 2). The Puntledge River watershed includes the Tsolum, Browns and Cruikshank rivers as well as a number of creeks and lakes that together drain a combined area of 859 km^2 (Riddell and Bryden 1996) (Fig. 2). The habitat and water quality in the Courtenay River estuary is determined by the flows from the various creeks and rivers and the influx of salt water during the diurnal tidal cycle.

The Black Creek watershed lies to the north of the Puntledge River watershed and empties into the Strait of Georgia (Fig. 2). The Trent (Fig. 3) and Tsable river watersheds are located to the south and flow into the lower estuary and Baynes Sound.

In 1996 the B.C. Ministry of Environment, Lands and Parks developed a water allocation plan for the Courtenay River watershed which included an area of approximately 900 km^2 (Riddell and Bryden 1996). The mean monthly discharge for this river varies with a high of 76.4 $m^3 sec^{-1}$.

1.2.2. Puntledge River

The Puntledge River watershed covers an area of 582 km^2 (Fig. 2). This river originates in Puntledge Lake and flows 48 km to the confluence of the Tsolum River, passing through Comox Lake which is the largest lake in the watershed. The Cruikshank River as well as Boston and Perseverance creeks flow into this lake. Between 1983 and 1999, the mean monthly precipitation in this watershed ranged from approximately 300 millimetres in November to less than 50 millimetres in July. Mean temperatures range from approximately 4 ºC in December to almost 20 ºC in July and August (B.C. Hydro 2004a).

A hydroelectric dam was constructed on the Puntledge River in 1912 by Wellington Collieries (Dunsmuir) to provide electricity to coal mines on Vancouver Island. This facility was purchased by B.C. Hydro and Power Authority in 1953 (Morris et al. 1979) at which time two dams were either constructed or expanded for the generation of electricity. The Comox dam is located on the Puntledge River about 300 metres downstream of the east end of Comox Lake; it is estimated that the creation of this reservoir resulted in the loss of almost 2200 hectares of habitat (B.C. Hydro 1999). A second dam, the diversion dam, forms the headpond to divert water to the power house generators (B.C. Hydro 2004a, b). Between 2001 and 2003, a new water use plan was developed for this watershed based on the recommendations of the Puntledge River Water Use Plan Consultative Committee (B.C. Hydro 2004a). This plan calls for a minimum flow of 15.6 $m^3 sec^{-1}$ below the powerhouse at all times to protect the salmon stocks in the watershed.

1.2.3. Tsolum River

The Tsolum River originates in Blue Grouse Lake and flows 30 km to its junction with the Puntledge River (Fig. 2). This watershed covers an area of 258 km^2 and its flow is augmented by Murex, Headquarters, Dove, McKay, Pyrrhotite, Portugese creeks along with many other smaller creeks (Morris et al. 1979; B.C. Ministry of Environment, Lands and Parks and Environment Canada 2000a; Bainbridge and Chamberlain 1998). Flows in the Tsolum River can reach as high as 160 $m^3 sec^{-1}$ (Regnier 1999). Logging, road development, gravel removal, irrigation, agriculture and acid mine drainage from a former copper mine site have all affected this river. Large piles of ore and waste rock left at an abandoned copper mine in the upper watershed resulted in acid mine drainage and dissolved copper being released into Pyrrhotite, McKay and Murex Creeks which are all tributaries of the Tsolum River (National Orphaned/Abandoned Mines Initiative 2006; Erickson and Deniseger 2001). Other concerns include low summer flows, temperatures as high as 26.2 º C in tributaries, and 24.3 º C in the Tsolum itself, and elevated suspended solids during high flows (Campbell 1999; B.C. Ministry of Environment, Lands and Parks and Environment Canada 2000a). Remediation work on the copper mine was undertaken between 1987 and 1992 but unfortunately these efforts were not effective in stopping the acid mine drainage (Campbell 1999). A hydrological and hydrogeologic evaluation of the site was undertaken in 1999. This study confirmed that surface runoff and shallow groundwater flow were the main source of the contamination (Steffen Robertson and Kirsten (Canada) Inc. 2000). In January 2008 the Tsolum River Restoration Society announced that a design to cover the mine and finally stop the copper pollution had been finalized and that work would begin in 2008 (SRK Consulting 2007). The partners include the B.C. Ministry of Environment, the B.C. Ministry of Energy, Mines and Petroleum Resources, the Mining Association of B.C., the Pacific Salmon Foundation, Fisheries and Oceans Canada, Environment Canada, Natural Resources Canada, TimberWest and the Tsolum River Restoration Society (TRRS) (http://www.tsolumriver.org/news.php#5).

1.2.4. Browns River

This river has a watershed of 98 km^2 and flows into the Puntledge River (Fig. 2) (Riddell and Bryden 1996).

1.2.5. Headquarters Creek

This creek originates in Wolf Lake and flows downstream to join the Tsolum River (Fig. 2).

1.2.6. Millard and Piercy creeks

Both Millard Creek and its tributary, Piercy Creek discharge into the west side of the upper Courtenay River estuary (Fig. 1). These creeks drain a combined area of 13 km^2 and are fed by springs which produce consistent flows even throughout the summer months. In 1995 a new volunteer group, the Millard/Piercy Watershed Stewards, came together with the goal of carrying out streamkeepers' activities, habitat restoration and stream monitoring (http://www.millard-piercy-watershed-stewards.org). This group has provided input and assisted in protecting this watershed as much as possible from the effects of urban development in the watershed (Millard/Piercy Watershed Stewards 2005).

Like many other smaller creeks and streams, both these creeks have been impacted by development including channelization, removal of water for domestic purposes and riparian degradation. The habitat offered by these creeks includes areas of complex wetlands (Bainbridge et al. 1998). In 1998 a process was begun to create a watershed management plan with the long term goal of protecting the streams, salmon and wildlife in the area (Smailes 2001). As part of a larger survey by the B.C. Ministry of Environment, Lands and Parks, Piercy Creek was assessed for six factors (percent pools, large woody debris, percent wetted area, percent fines and percent instream cover) and was judged poor in respect to all but percent instream cover (Reid et al. 2000). Other concerns included the occurrence of temperatures as high as 21.5 ºC at several sites during late spring and early fall. Oxygen levels below those required for buried embryo and alevin stages occurred at one site in Piercy Creek. In addition, monitoring during 1998 recorded levels exceeding the maximum allowable criteria for dissolved aluminium, copper and zinc at two sites (Fleenor and Smailes 2000).

1.2.7. Morrison and Arden creeks

The estimated drainage area of Morrison Creek is 14.1 km^2 (Riddell and Bryden 1996). During 1998-1999 the Comox Valley Watershed Society completed a mapping and inventory project of the sensitive habitat in Morrison Creek and its tributary, Arden Creek, both of which flow into the Puntledge River (Comox Valley Project Watershed Society 2003; Bainbridge and Woodland 1999; Comox Valley Project Watershed Society 2001, 2004) (Fig. 2). Morrison Creek provides consistent flows year round, a result of the springs located at its source and the regulation of the water flow by numerous beaver dams.

1.2.8. Trent River

Trent River originates in the Beaufort Range of Vancouver Island and flows approximately 30 km into the lower western shore of the Courtenay River estuary (Fig. 3) (Morris et al. 1979). The watershed area is 82 km^2 and tributaries of this river include Bloedel and China creeks. A habitat survey was also undertaken in 2004-2005 of the upper reaches of this watershed (Comox Valley Project Watershed Society 2004).

1.2.9. Roy Creek

This creek is located to the south of Courtenay and flows east from the inland island highway to the estuary just north of Gartley Point (Fig. 1). It has a six month flow period from April to September and the estimated drainage area is 13.4 km^2 (Riddell and Bryden 1996) (Fig. 1).

1.2.10. Mallard Creek

Mallard Creek is located on the eastern side of Dyke Road and drains wetlands, woodlands and farm land before it passes under Dyke Road and joins the Courtenay River estuary in a large marsh near the head of the estuary (http://www.projectwatershed.bc.ca/pw_web_docs/mapsandbrochures/SHIMCD/SHIMCompilation1998-2000/Appendix12/Mallard_Creek_Map.pdf).

1.2.11. Brooklyn Creek

The head waters of this creek are located in the Crown Isle Golf Course. It flows 10.2 km through the City of Courtenay, the Regional Districts of Comox and Strathcona and the Town of Comox, emptying into the estuary just south of the Comox Marina (Fig. 1). In 1998 the Brooklyn Creek Streamkeepers community group was formed to address the loss of habitat in this watershed (http://www.projectwatershed.bc.ca/newsite/brooklynnpwsiteframe.html). The habitat for juvenile salmon and trout is limited in this creek due to urban development along its shores and ephemeral, low summer flows. The survey of this creek identified problems that are similar to those in other small creeks in this area including the loss of complexity due to urban development and the accompanying loss of streamside vegetation as well as erosion along the streambank. Many areas where improvements could be made to both spawning and rearing habitat were identified (Bainbridge and Kuta 2000).

1.2.12. Bonner Creek

This creek drains an estimated area of 9 km^2 and flows into the estuary directly below the mouth of the Courtenay River (Fig. 2) (Riddell and Bryden 1996).

1.2.13. Tsable River

The Tsable River has a drainage area of 113 km^2 and drains into Baynes Sound (Morris et al. 1979). The habitat for rearing salmonids has been impacted by loss of large woody debris and pools as well as logging, coal mining and urbanization (Lill, 2002).

1.2.14. Hart /Washer Creek

This creek is also known as “Washer Creek” and the entire stream complex includes “Stray Creek”, “Trout Tributary” and “Van West Tributary” (Fig. 3). In 1998 the Hart (Washer) Creek Watershed Committee was formed by local volunteers with the main activity directed toward habitat restoration (http://www-heb.pac.dfo-mpo.gc.ca/community/dir/davies_e.htm). In 1999 a Sensitive Habitat Inventory and Mapping (SHIM) survey was carried out on these creeks for the Comox Valley Watershed Society (Bainbridge et al. 1999; Comox Valley Project Watershed Society 2005). This creek flows for 5.2 km through the south Comox valley and discharges into Baynes Sound. The total watershed is approximately 11.7 km^2. In 2005 a submission was put forward to Fisheries & Oceans Canada by this group for an environmental assessment of a proposed project that would create a new channel and direct the creek away from a large pile of coal tailings. The creek was eroding the pile and subsequently carrying the tailings to the foreshore. (http://www.acee.gc.ca/050/Viewer_e.cfm?CEAR_ID=12579&ForceNOC=Y).

1.2.15. Dove Creek and Hydro Tributary

Dove Creek and the Dove Creek Hydro Tributary are both tributaries of the Tsolum River (Fig. 2). The main source of water for the Hydro Tributary is a wetland immediately west of the new inland highway (Ellefson and Taylor 2002).

1.2.16. Perseverance Creek

This creek flows for 6.9 km through Cumberland and drains into Comox Lake (Fig. 2) (Ellefson 2003b). It has a drainage area of 21 km^2 and is characterized by low summer flows and sudden high discharges during heavy rains. Its most well defined tributary is Cumberland Creek but it also receives flow from a low lying wetland as well as several other ephemeral tributaries. Several dams have been constructed which, along with Comox Lake, affect the flows in this creek.

1.2.17. Baynes Sound

Baynes Sound is a narrow offshoot of Georgia Strait lying between Vancouver Island and Denman Island, just south of the city of Courtenay (Fig. 3). It is approximately 25 kilometres long and between two and three and a half kilometres wide (Wikipedia 2008). This area is protected from strong currents by a shallow bar at the north end (approximately six feet deep); the substrate is predominately sand and black mud which is rich in organic detritus (Waldie 1951).

Surveys of this area in 1950 and 1951 found a surface flow of cold water from the Courtenay River which was evident for some distance along the Denman Island side of the Sound. This flow formed a cold isothermal layer approximately 3 metres deep in the Sound. Conversely, the water at all depths along the Vancouver Island side of the Sound was warmer. The water in Baynes Sound was found to be considerably less saline than the water in the Lazo Bight region with little horizontal variation in salinity. A brackish upper zone about 10 metres deep was evident in the north of the Sound, becoming more saline in the southern reaches. Measurements of the current using drags showed a predominately southward movement at approximately 0.4 knots in the Sound (Waldie 1951).

Several more oceanographic surveys of the estuary and Baynes Sound region were carried out during various times of the year in 1958, 1961 and 1962 (Waldichuk et al. 1968). Temperature, salinity, dissolved oxygen, alkalinity and currents were measured at sites from the lower estuary to the southern reaches of the Sound.

Selected areas of Baynes Sound have been designated as an Important Bird Area (IBA). The Important Bird Areas Program (IBA) is a global effort to identify and conserve areas that are vital to birds and other biodiversity. By working with Audubon chapters, landowners, public agencies, community groups, and other non-profits, Audubon endeavours to interest and activate a broad network of supporters to ensure that all Important Bird Areas are properly managed and conserved (http://www.audubon.org/bird/iba/). Within these IBAs in Baynes Sound, nine bird species have reached “globally significant levels” and overall are considered to be one of the most significant regions for wintering and migratory water birds in B.C. (Booth 2001).

Pollution has been a problem in the Sound, mostly from non point sources that deliver faecal coliform bacteria predominately in late spring and during the first fall rains (Joughin 2001). In 1994, Environment Canada discovered increased levels of faecal coliform bacterial pollution in this area and the Baynes Sound Stewardship Program was established by the Comox Valley Project Watershed Society to investigate the sources of pollution that were adversely affecting the water quality in the Sound (Joughin 2001). Between 1994 and 2000 volunteers took part in many initiatives to measure the pollution and plan remedial and monitoring actions. This long term monitoring program uses a geographic information system (GIS) to collect and analyze data for water quality and other indicators (Joughin 2001). Activities include storm drain monitoring, working with farmers to protect streamside access and vegetation, educating businesses about toxic chemical use and disposal, construction of a residential wetland and the education of boaters and construction of boat pump-out facilities (Baynes Sound stewardship initiative 2007).

Baynes Sound is the site of many tidal and subtidal shellfish farms. As of 2002, this area was producing approximately fifty percent of the cultured shellfish grown in B.C. with the harvests dominated by Pacific oysters (*Crassostrea gigas*) and Manila clams (*Tapes philippinarum*) (B.C. Ministry of Sustainable Resource Management, Coast and Marine Planning Branch 2002b). In 2001 the approximately fifty tenure holders produced about 3,360 tonnes of shellfish and generated over $8 million in wages. In 2002 the provincial government developed a plan for shellfish aquaculture in the Sound which designated six different types of management areas, including off bottom culture, special management (sub-tidal), special management (beach and sub-tidal), restricted expansion (off bottom and beach), future analysis, and no additional aquaculture (B.C. Ministry of Sustainable Resource Management, Coast and Marine Planning Branch 2002a). In 2005 the Sustainable Shellfish Aquaculture Initiative (SSAI) research project was set up by Simon Fraser University's Centre for Wildlife Ecology and the Canadian Wildlife Service to assess the effects of shellfish aquaculture. Baynes Sound was chosen as one of the sites to be studied (Simon Fraser University 2005).

B.C. fisheries habitat managers need quantitative information on the intertidal fish habitat of the region in order to properly manage our coast. In response to this requirement, staff from Fisheries & Oceans Canada developed the Baynes Sound Fish Habitat Atlas-Prototype (Tamasi et al. 1997). This document maps the location of herring spawning areas, intertidal eelgrass beds, sensitive ecosystems inventory, shellfish aquaculture leases and shellfish closures.

The potential environmental effects of shellfish aquaculture in Baynes Sound were investigated for the provincial Coast and Marine Planning Office (Emmett 2002). This investigation formed part of the implementation of the new Baynes Sound Shellfish Aquaculture Action Plan. This report noted that 15 salmon bearing streams drained into the Sound and that the estuaries of this region are considered to be significant rearing habitats for juvenile salmon. The potentially significant impacts of intertidal shellfish aquaculture identified included stream channelization, vehicle use on foreshore vegetation and the disruption of finfish beach spawning.

A survey of the Pacific sand lance (*Ammodytes hexapterus*) spawning habitat in the Sound and its relation to intertidal shellfish aquaculture was undertaken in 2003 by Archipelago Marine Research Ltd. for the B.C. Ministry of Sustainable Resource Management. This study looked at areas where aquaculture could be expanded without impacting these spawners as well as ensuring that any expansion is done in an environmentally sustainable fashion (Thuringer 2003).

The shores of Baynes Sound are also viewed as very important herring spawn areas (B.C. Ministry of Environment, Lands and Parks and Environment Canada 2000b; Fisheries & Oceans Canada 2007).

Spawning of plainfin midshipman (*Porichthys notatus*) along the western shores of the Sound was also documented in the 2001 study (Hamilton et al. 2002).

1.2.18. Estuary

For many years, the Comox Valley Naturalists Society has undertaken a series of wetland restoration projects which have included mapping the estuary plant communities, the removing of invasive species and planting of native species. They have also worked with the local sawmill to solve bark problems in the estuary (Sellentin 2003, 2004; Sellentin and Millham 2006).

Since 1998, an annual clean up of the estuary has been organized as part of the International Coastal Cleanup Program (Georgia Strait Alliance 2006). The collected waste is inventoried and the data is sent to the Vancouver Public Aquarium and the Ocean Conservancy in Washington D. C. where it is added to an international database.

1.3. SALMONID POPULATIONS

Salmonid populations rearing in the Courtenay River estuary include not only migrants from the Puntledge River and hatchery but also those juveniles which move to the estuary from the many creeks and rivers in the surrounding area to rear.

1.3.1. Puntledge River

Historically, the Puntledge River has been a major salmon producer (Hourston 1962). Coho (*Oncorhynchus kisutch*), chinook (*O. tshawytscha*) (summer and fall runs), pink (*O. gorbuscha*), chum (*O. keta*) and sockeye (*O. nerka*) salmon were all present in this watershed along with steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*). Dolly Varden (*Salvelinus malma malma*) are also found in Comox Lake and kokanee (*O. nerka*) are known to occur in Borbush, Willemar and Nimnim lakes in the upper watershed (Riddell and Bryden 1996).

Local communities and First Nations have relied on the production from the Puntledge River and Courtenay River estuary for countless decades. Fish were the main component of the Northern Coast Salish diet, and commercial businesses flourished from the large salmon runs that utilized the estuary and its tributaries. This abundance decreased due to problems that developed when the British Columbia Power Commission expanded the Puntledge River dam between 1954 and 1958 (Department of Fisheries 1958). The construction of an impoundment dam on Comox Lake and a diversion dam to direct water to the generating facility had many adverse impacts on the habitat including the destruction of historical spawning areas for both summer chinook and steelhead (Hirst 1991). Impacts included increased difficulty passing over Stotan and Nib falls due to low flow levels, migration delay and injury to adults from the powerhouse tailrace, as well as the diversion of juveniles through the powerhouse turbines. The former two problems were mitigated through the implementation of minimum flow requirements along with powerhouse closures during adult migration. An artificial spawning channel was also built to replace natural chinook spawning areas that had been lost and to provide a downstream route for emigrating fry (Lister 1968). Overall, the artificial spawning channel did little to enhance summer chinook. Fry survival rates were low due to siltation, and attempts to correct the problem did not succeed. Consequently, the spawning channel was converted to an adult holding channel instead (MacKinnon et al. 1979). The prospect of building a hatchery on this river to help offset the damage done to salmon stocks by the changes to the original dam and construction of new barriers was undertaken in 1974 (Marshall 1972, 1974). Construction of the Puntledge Hatchery began several years later.

Of the populations of salmon that were found in this river in the past, only the summer chinook, chum and coho remain as the original genetic stock. The pink and fall chinook runs have been rebuilt using stock from other watersheds. The summer chinook are genetically different from the fall run chinook and are spawned separately either by staff at the hatchery or naturally at their traditional spawning area above the diversion dam (Guimond and Withler 2007). The summer chinook stock is considered to be “a unique endangered stock and therefore a priority for recovery under the Wild Salmon Policy” (Guimond 2006c). Expansion of the hydroelectric facilities in 1955 and the subsequent adverse impacts on the spawning and rearing habitat of the summer chinook led to a decline in this stock from approximately 3000 to less than 600 spawners (Guimond 2006c). The impacts from this expansion included damage to spawning adults at the tail race of the dam, damage to fry from passage through the turbines and damage to the spawning grounds from siltation (Angus 1962; Hourston 1962). An assessment of the habitats in the streams tributary to Comox Lake was carried out by Griffith (1995), who found that “the stocking of hatchery coho fry in the Cruikshank drainage and the Puntledge River exceeded carrying capacity in 1994”. This report recommended that the fish production in these tributaries should be limited to that resulting from the returns of the wild stocks.

Efforts to rebuild the summer chinook stock include the rehabilitation of existing spawning areas at Bull Island (Wright and Guimond 2003; Guimond and Norgan 2003; Guimond 2006b) and the 2005 construction of a new spawning channel in the headpond located between the Comox Lake impoundment dam and the diversion dam 3.7 km downstream (Guimond 2006a; Guimond 2007c). In 2005 an assessment of improvements made to the impoundment dam and the passage of summer chinook past this and the diversion dam concluded that these fishways were operating as planned (Guimond 2006c) This study was repeated in 2006 (Guimond 2007a). The migration of the summer chinook up the river has been monitored as part of the Fishway Assessment Project which began in 2004. Cameras and digital recorders allow the hatchery staff and biologists to get an accurate count of these fish as they ascend the river (Comox Valley Echo 2007).

In 2006 the Forbidden Plateau side-channel was constructed in the diversion reach of the Puntledge River to create spawning and rearing habitat for coho and trout (Guimond 2007b). A captive brood program for the summer chinook was started in 1997 and as of 2002 had successfully spawned 115 females (Anonymous 1999). Escapement numbers for those summer chinook considered to be “wild” have varied from as low as 25 fish in the mid 1990s to as high as 2409 fish in 2005. Hatchery brood stock for this run has fluctuated from 117 fish in 1995 to 2200 spawners in 2001. The escapements of fall “wild” stock have mimicked to some extent the pattern seen for the runs of summer wild chinook, dropping to only 50 fish in the mid 1990s and then rising to slightly over 12,000 in 2006. Returns to the hatchery for the fall runs also show a steep drop in the mid 1990s to 75 fish, rising to over 2200 in the year 2000 (Pacific Region Salmon Escapement Data System).

Populations of trout are also in decline, especially the stocks of wild steelhead which are classified as an extreme conservation concern by the British Columbia Conservation Foundation (2002). This group has identified chronic problems with low summer flows, high water temperatures, predation by seals, loss of rearing habitat from logging and urban development, poaching and loss of mainstem rearing areas as issues adversely impacting the steelhead (Lill 2002; Silvestri 2006). Their goals include restoring the stock to 200-300 adult returns, modification of the river hydrograph to pre-regulation conditions and investigation of the release of cold water from Comox Lake. Some of the improvements being made to spawning areas for summer chinook will also benefit the steelhead populations (Silvestri 2006). In addition, a living gene bank and captive breeding program was established for both the summer and winter run steelhead stocks from 2001 to 2005 as part of the B.C. Hydro Bridge Coastal Fish and Wildlife Restoration Program (B.C. Hydro 2005a).

Historically the summer run steelhead had utilized habitat in the upper watershed above Stotan Falls, including the lower Cruickshank River. The decline of the summer run steelhead stock raised concerns and stimulated discussion on the possible ways of restoring this stock in 1994 (Rimmer et al. 1994). At this time returns were as low as 11 spawners and the possible causes for the loss of these fish included logging, mining, agriculture, urban development and the construction of the hydro electric dams. Spawning and rearing habitat was adversely impacted by the altered flow regime, migrations to the spawning grounds were blocked and juveniles were lost in the turbines. Some adults were also likely intercepted by the commercial gill net and seine net fisheries. Other adverse impacts include the recreational fishery, El Nino alterations of the ocean habitat, hatchery outplanting of coho fry which compete with the juvenile steelhead for food and fishway construction on Stotan and Nib Falls which allow other species access to the upper watershed for the first time.

In 2000, spawners returning to the Puntledge River included 3,050 coho, 10,000 pink and 40,500 chum. Returns for all three species have varied dramatically over the past ten years, from a low of 400 for coho in 1996 to a high of 24,487 in 2002; a low of 5,000 spawners to a high of 115,500 in 2001 for pink; and from a low of 34,813 in 1996 to a high of 170,951 in 2004 for chum (Pacific region salmon escapement data system).

In 2005 a water use plan was put in place for the Puntledge River (B.C. Hydro 2005b). Under the terms of reference for this plan and the provincial Water Act, B.C. Hydro is required to submit an annual report as well as individual monitoring program reports in July each year (http://www.bchydro.com/rx_files/environment47717.pdf). Monitoring reports have been submitted for 2006 and also for 2007. Work planned or undertaken in 2006 and 2007 includes the assessment of adult fish passage during pulse flow releases, egg incubation success in Reach C (Guimond and Burt 2007), steelhead production, effects of ramping rates on fish stranding, and gravel placement in the Puntledge River (B.C. Hydro 2006, 2007; Silvestri 2006).

Improvements in rearing habitat for coho and trout juveniles include rehabilitation of the Jack Hames Side-channel (originally constructed in 1984) with large woody debris and placement of spawning gravel (Guimond and K. Wong Environmental 2003). As well, spawning habitat for pink salmon was improved in the Powerline side channel (originally constructed in 1991), which will also provide rearing habitat for trout and coho juveniles (Guimond 2004). Stable summer and over wintering habitat for juvenile coho salmon and trout as well as limited spawning habitat for pink and coho salmon is provided in the Powerhouse side-channel which was constructed in 1990 and improved in 2004 (Guimond 2005). Spawning habitat was created below the Diversion Dam in Reach C of the Puntledge River in 2005 (Silvestri 2006).

In 2001 the juvenile salmon released by the Puntledge River hatchery included 2.6 million chinook (two million fall chinook and 580,000 summer chinook), 3.8 million chum, over 2 million coho, 2,413 cutthroat, 97,000 steelhead (45,000 summer run and 52,000 winter run) and a total of 2.9 million pinks from the hatchery and Puntledge River side channels combined (B. Munro Pers. Comm.). Therefore the total released into the Puntledge River and its watershed was 11.4 million juvenile salmon. Some would have remained in the upper watershed to rear for another year or two but the majority would have migrated down the system over the spring and summer toward the estuary.

1.3.2. Tsolum River

In 1998 and 1999 the Comox Valley Project Watershed Society surveyed the 15 different tributaries to this river (Bainbridge and Chamberlain 1998). This river has been subjected to contamination from a copper mine which was operated from 1964 to 1967 and subsequently abandoned (Erickson and Deniseger 2001; Deniseger and Kwong 1996). Whereas previous runs of up to 100,000 pink, 15,000 coho and 11,000 chum salmon as well as 3,500 steelhead and cutthroat trout (Deniseger and Pommen 1995) had been seen in this river, by 1985 a significant reduction in salmon populations had occurred (Sierra Club of Canada 2001). Subsequent investigations by the B.C. Ministry of Environment concluded that "sufficient copper was released from the abandoned mine in the form of acid mine drainage to endanger aquatic life in the Tsolum River" (Kangasniemi and Erickson 1986). Given this situation, the 15 tributaries are deemed to be particularly important for salmonid refuge during periodic "flushes" of copper into the system (Bainbridge and Chamberlain 1998). Much of the information collected during the survey of these tributaries will be useful in identifying any opportunities for restoration and protection in the future.

The high levels of copper in the Tsolum River were first noticed in the mid 1980s with the principle source identified as the north block of the mine site (Erickson and Deniseger 1987). Analysis of water samples revealed copper levels between 17 and 110 pbb. The maximum recommended level for copper is seven parts per billion (http://www.abandoned-mines.org/Nationalorphaned/abandonedminesinitiativeCICmw_e.htm). Samples of the benthic invertebrates in 1986 showed a complete absence of these organisms in Pyrrhotite Creek. Possible effects on juvenile salmonids at the levels of copper observed in the Tsolum River include adverse affects on the ability of pink salmon to acclimatize to salt water (Erickson and Deniseger 1987). A summary of the investigations of the copper levels is reported in Deniseger et al. (1994) and further discussion may be found in Agra Earth and Environmental Ltd. (1996).

A variety of efforts have been made to cap the abandoned copper mine to reduce the leaching of copper and subsequent acid mine drainage into the rivers and creeks in the area. A number of community groups have been active in pursuing this issue including the Tsolum River Restoration Society which was first formed in 1994. This group then set out to enhance the chum and pink stocks in this river (Fisheries & Oceans Canada, Habitat Enhancement Branch 2008). In 1997 the Tsolum River Task Force was formed, and immediately began a project to assess the salmonid habitat in the river in order to identify factors which were limiting production (Campbell 1999). Monitoring of trace elements began in 1985 and since 1995 this has largely focussed on copper levels. Ambient water quality objectives were put in place by the Environmental Protection Division of the B.C. Ministry of Environment (Denisiger and Pommen 1995). By 1998 the levels of copper had dropped by about 50% yet levels still peak in the spring and fall and tend to exceed these water quality objectives for much of the year. The high levels of copper have virtually eliminated fish populations. Establishment of new runs of salmon and trout would require a further drop in these levels by at least 95% (B.C. Ministry of Environment, Lands and Parks and Environment Canada 2000).

Efforts at reclaiming the mine site by capping the remaining ore and diverting water around the site was carried out between 1988 and 1994 by the Ministry of Energy, Mines and Petroleum Resources. The use of a wetland as a treatment option was proposed in 1997 (Golder Associates Ltd. 1997) and in 2003 the Spectacle Wetland Diversion was built to temporarily reduce copper levels in the lower watershed. Despite these efforts, the water drained from the mine site by Pyrrhotite Creek is highly acidic and the levels of cadmium, aluminium, manganese, zinc, chromium, iron, nickel and cobalt, as well as copper have, at times, exceeded the water quality criteria for aquatic life and drinking water (Environment Canada, B.C. Ministry of Environment and Yukon Department of Environment 2007). Recommendations based on these water quality criteria included the continued monitoring of copper levels downstream from Murex Creek during spring and fall and the use of triannual in-site steelhead egg bioassays as well as the sampling of benthic invertebrate abundance and diversity (Deniseger and Pommen 1995). Since 1998 water quality monitoring has shown sustained reductions of approximately 50% in the copper levels. In 2003, a new group, the Tsolum River Partnership, developed the Spectacle Lake Wetland Project which has achieved a further 40% reduction in the copper levels by filtering the contaminated run off from the mine site through a wetland. The group expanded its membership to include provincial and federal mining departments, which resulted in the development of a long term remediation plan for the site; final measures were to be undertaken at the mine site in mid 2008. This plan was funded in part by the B.C. Ministry of the Environment (B.C. Ministry of Environment 2006). The water quality objectives set out by the B.C. Ministry of Environment calls for a level of copper in the Tsolum River below Murex Creek to not exceed 0.011mg/L Cu and for the average thirty day concentration to not exceed 0.007 mg/L Cu (SRK Consulting 2007).

Inadequate flows in August and September have also impacted the salmon populations in this river by limiting adult migration. Over the years, many groups and government agencies have attempted to rebuild the various salmon stocks utilizing both egg plants and the release of fry but these all met with limited success (Campbell 1999).

1.3.3. Courtenay River

Salmonids which are found in this river include sockeye and kokanee, coho, chum, pink, and chinook salmon as well as rainbow and steelhead, cutthroat, and Dolly Varden trout (Riddell and Bryden 1996).

1.3.4. Browns River

Coho salmon, rainbow and steelhead trout are all found in this river (Riddell and Bryden 1996).

1.3.5. Headquarters Creek

Between 1953 and 1960 the returns of pink salmon to the Tsolum River had dropped from over 100,000 to less than 10,000 fish. Low flows in the summer were identified as the most limiting factor. Pink salmon were held back with a fence from 1958 to 1964 to restrict their migrations during the low flows in August. In 1964 a weir was built at Wolf Lake which provided increased flows to Headquarters Creek during the migration period. In 1968 the Fisheries Research Board constructed a fish fence and hatchery at the confluence of Headquarters Creek and the Tsolum River. Egg takes occurred for a number of years until the early 1980's when the effects of the copper leaching into the Tsolum River were first discovered. The current pink enhancement program began in 1995 when Project Watershed incubated 100,000 pink eggs (Tsolum River Restoration Society 2003). Today this hatchery incubates 1,000,000 pink eggs from the Quinsam or Puntledge River hatchery and releases the juveniles each spring. One of the primary goals of this group is to return the Tsolum River pink runs to their historic levels (http://tsolumriver.org/aboutus.php). In February of 2008 this group reported that cutthroat and chum were doing very well in this river and 3500 pinks returned to spawn the previous fall. In 2008 this group plans to undertake the augmentation of low summer flows and the enhancement of rainbow, steelhead, cutthroat and coho on a watershed scale (Town of Comox 2008).

1.3.6. Millard and Piercy creeks

Whereas many of the streams in the area suffer from low flow problems during the summer months, the consistent spring fed flows in these creeks provide habitat for chum, pink, and coho salmon as well as cutthroat and steelhead trout year round (Smailes 2001). As part of the stewardship of this area by the Millard/Piercy Watershed Stewards, juvenile coho have been planted in the upper watershed. Assessment of coho by the volunteer stewards in 2000 documented the downstream migration of almost 16,000 coho fry and 500 cutthroat juveniles (Fleenor and Smailes 2000). The watershed stewards have also undertaken an extensive survey of these habitats, found some real potential for further development and provided recommendations and guidelines for enhancement of potential salmonid rearing areas (Bainbridge et al. 1998). Wetlands and streams within the watershed are also under protection from urban development which would lead to habitat degradation and loss (Millard/Piercy Watershed Stewards interim report 2005). The areas of importance to spawning fish were also ascertained through surveys of adult fish and redds in these creeks (Fleenor and Smailes 2000).

1.3.7. Morrison and Arden creeks

Chum, coho and pink salmon, Dolly Varden, sea-run and resident cutthroat, and steelhead and rainbow trout utilize spawning and rearing habitat in Morrison Creek (Ellefson 2003a). The flows in Arden Creek are less reliable but anadromous fish continue to utilize its habitats. Both creeks have been subjected to the adverse impacts of urban development and numerous habitat restoration projects have been carried out including construction of weirs and the placement of root wads (Michalski and Reid 1999). The flows have been monitored at six gauged locations since 2002 and temperatures are recorded every four hours near the headwaters and the mouth of Morrison Creek at the bottom of the watershed (http://www.morrisoncreek.org/assessment.php). Between April and June 2002 migrating coho smolts and rainbow and cutthroat trout have been monitored at a smolt fence in Morrison Creek. Between 2003 and 2006, a total of 15,116 coho smolts and 814 trout, including rainbow and cutthroat, were counted. The number of coho smolts migrating past this fence has ranged from 9,996 in 2003 to 3,789 in 2006 (http://www.morrisoncreek.org/assessment.php).

1.3.8. Trent River

This system supports small populations of coho (Nass et al. 1993), cutthroat trout (Morris et al. 1979) and steelhead (http://www.bccf.com/steelhead/focus5.htm). The British Columbia Conservation Foundation has assessed the wild stocks of steelhead in this river as in decline and of extreme conservation concern. Recent assessment of the stocks in this river found 215 adults and 1650 smolts. Coho escapement during 1989 and 1990 and studies of the coho smolts leaving this system have been carried out by Fisheries and Oceans staff (Bocking et al. 1991, 1992; Nass et al. 1993). Logging, urbanization, and loss of large woody debris and pool habitat have been identified as contributing to the decline of these stocks (Lill, 2002). Since 1979 the Courtenay and District Fish and Game Protective Association has undertaken habitat restoration and has also constructed a spawning and rearing channel to enhance the coho populations in this river (Fisheries and Oceans Canada, Habitat and Enhancement Branch 2008). A survey of the plants, marine life and birds of the Trent River estuary was carried out in 1987 and 1988 by the Comox-Strathcona Natural History Society. This study noted that an estimated 600 coho and 125 chum salmon were spawning in this river (Brooks et al. 1994).

1.3.9. Roy Creek

Salmonids occurring in this creek include sea-run cutthroat trout and coho and chum salmon (Riddell and Bryden 1996). In 1981 a small hatchery was established by the Roy Creek Salmonid Enhancement group to produce coho for release into this watershed (http://www-heb.pac.cfo-mpo.gc.ca/community/dir/davies_e.htm) (Fisheries & Oceans Canada, Habitat Enhancement Branch 2008).

1.3.10. Brooklyn Creek

Coho juveniles are found within this creek and its watershed (Bainbridge and Kuta 2000). Low summer flows, poor rearing conditions including lack of large woody debris and little off-channel habitats as well as a lack of suitable spawning gravel were among the problems identified during the habitat mapping of this creek.

1.3.11. Bonner Creek

Coho salmon and sea-run and resident cutthroat trout are found in this creek (Riddell and Bryden 1996).

1.3.12. Tsable River

The Tsable River supports a variety of salmonid species including coho, pink, chum, sea-run cutthroat trout and steelhead (http://www.islandnet.com/~rajames/ite/Feb96_Bridges.html). The runs of chum are usually between five and ten thousand fish (Johnson et al. 1997). A recent survey of the steelhead stocks in this system by the British Columbia Conservation Foundation found 182 adults and 1400 smolts. The population is considered to be in decline and of extreme conservation concern.

1.3.13. Hart/Washer Creek

This creek suffers from low summer flows, lack of channel complexity, lack of large woody debris and barriers to juvenile fish. Opportunities exist to enhance this system by correcting these problems as well as enhancing any side channel habitat available. Coho juveniles were observed rearing in this stream complex during the mapping of this watershed by the Comox Valley Project Watershed Society (Bainbridge et al. 1999). Since 1998 the Hart (Washer) Creek Watershed committee has been active in the restoration of the habitat in this creek (Fisheries & Oceans Canada, Habitat Enhancement Branch 2008).

1.3.14. Dove Creek and Hydro Tributary

A survey carried out in 2002 noted that although the channel lacks complexity and offers limited spawning areas, it does offer abundant wetlands for the rearing of juvenile salmonids (Ellefson and Taylor 2002). However, the upper portion of the Dove Creek Hydro tributary has been recently rebuilt due to the construction of the new inland highway through its former location. Evidence of adults, possibly coho spawning was also seen.

1.3.15. Perseverance Creek

Coho salmon, cutthroat trout and Dolly Varden are all found in this creek (Ellefson 2003b).

1.3.16. Baynes Sound

Since 1995 the Fanny Bay Enhancement Society has undertaken the enhancement of the salmonid populations in the many creeks that drain into the Sound. As well as raising coho fry at the Rosewall Creek hatchery, this group carried out fry salvage, habitat restoration and stream stewardship (Fisheries & Oceans Canada, Habitat Enhancement Branch 2008). In previous years this group has released 100,000 coho smolts into Rosewall Creek every year. Unfortunately they reported poor returns of coho in 2006 and 2007 (Comox Valley Echo 2008).

1.4. PREVIOUS STUDIES COURTENAY RIVER ESTUARY

The information available for the Courtenay River estuary up to 1978 is summarized in a report published as one of a series on the estuaries of the British Columbia coast (Morris et al. 1979).

The results of previous investigations carried out on the Courtenay River estuary by Fisheries and Oceans staff are reported in MacDougall et al. (1999), Jenkins et al. (2001), Bravender et al. (2002), and Jenkins et al. (2006). In 1998, 767 juvenile salmonids were captured in 176 beach seine samples in the Courtenay River estuary. The mouth of the Courtenay River estuary south to Denman Point was sampled in addition to the Courtenay River estuary in 2000, by Jenkins et al. (2001, 2006). Three hundred and fifty juvenile salmonids were captured in 181 seines (pole, beach, and purse).

Other investigations on the estuary include those of Burns (1976). He discussed the adverse impact of the construction of the dam and hydro electric diversions and noted the decline that had taken place in the chinook and steelhead populations.

1.5. CURRENT PROJECT

The objective of the current study was to sample the same locations as had been sampled in 1998 and 2000, along with some additional locations throughout the Courtenay River estuary and Baynes Sound. Sampling was scheduled to begin as early as possible in spring and included some trapping during the winter months.

2.0. METHODS

2.1. FIELD PROGRAM

2.1.1. Site locations and descriptions

Site descriptions and GPS co-ordinates for the beach, purse, mini purse, pole seine and Gee trap surveys may be found in Hamilton et al. (2002). Site locations within the Courtenay River estuary, Courtenay River, and Puntledge River are shown in Figures 1 and 2. Figure 3 shows site locations within Baynes Sound and the surrounding area. A total of 343 beach seines, 55 purse seines, 18 mini purse seines, 30 Gee traps, and two pole seines were completed. In all 26,918 fish of all species were captured (Hamilton et al. 2002).

2.1.2. Habitat types

Habitat types that were sampled within the Courtenay River estuary varied from a sandy substrate with marsh grass and a moderate slope (i.e. site 17), to rip-rap breakwaters with rocky/gravel substrates and large eelgrass beds nearby (i.e. site 4), to pebble and sand substrates with large rocks, little vegetation, and a steep slope (i.e. site 8) (Hamilton et al. 2002). Within Baynes Sound, habitat types varied from coal substrates with mud/gravel mixed into the shallow slope (i.e. site 31), to boulders with sand substrate and eelgrass and kelp beds nearby with a moderate slope (i.e. site 34), to sand substrates with gravel and boulders covered in barnacles and *Ulva* sp. on a moderate slope (i.e. site 29). Vegetation at the sites included marsh grass, trees, shrubs, eelgrass, and algae. *Fucus* sp. and *Ulva* sp. were often seen, with marsh grass and shrubs in the high intertidal or backshore areas.

Sites 1, 1A, 4, 8, 9, 14, 21, 22, 38, 39, 42B, and 67 were located in areas which had been impacted by development, including dredged basins and construction of rip rap breakwaters and pilings. Sites 1, 12, 17, 24, and 63 were characterised by swift currents within the Courtenay River. Within the estuary, swift currents were found at sites 6 and 60 (Fig. 1). Site descriptions may be found in Hamilton et al. (2002).

2.1.3. Gear and sampling schedule

Between January 12th and August 15th, 2001 a total of 48 trips were carried out, sampling the populations of juvenile salmonids at 77 sites (Hamilton et al. 2002). Five sampling methods were used to follow these fish as they moved down the Puntledge River into the Courtenay River estuary, and then into Baynes Sound and the surrounding area. Locations and sampling method chosen depended on the numbers of juvenile salmonids captured during previous trips.

During 26 of the trips, a beach seine was used to sample 43 sites within the Courtenay River, its estuary and Baynes Sound south of the river mouth to Denman Point (Fig. 1, 3). The beach seine was 13.5 m long and 2.9 m deep with 4.5 m wings of 1 cm stretched mesh, and a 4.6 m bunt of 0.6 cm stretched mesh. A 15 m long rope was attached to rope bridles at each end of the seine. In the lower river and estuary, one of the ropes was held from shore, while the other was held in a 5.6 m aluminium boat with a 150 hp jet engine. The net was pulled offshore to the full length of the ropes where possible, set in a U-shape back to shore, and retrieved by hand. Duplicate sets were completed at each site. The seine was set using the same methods in Baynes Sound, where a 6.1 m Marinex aluminium boat with a 100 hp outboard motor was used. Beach seining in the estuary and Courtenay River began on March 6 and ended on August 13, 2001. Beach seining was carried out in Baynes Sound between May 29 and July 9, 2001 (Hamilton et al. 2002).

A purse seine was used to capture the juvenile salmonids during 11 sampling trips at five sites in the deeper regions of the lower estuary and 11 sites offshore in Baynes Sound and the surrounding area (Fig 1, 3). The purse seine was 61.5 m long and 6.2 m deep, consisting of a 24.6 m section of 1.8 cm stretched mesh, a 24.6 m section of 1.25 cm stretched mesh and a 12.3 m bunt section of 0.6 cm stretched mesh. A lead line of 2 $lb \cdot fathom^{-1}$ and a sea anchor were attached to the seine to allow the entire length of the net to be pursed. The net was pulled in a circle by the Marinex aluminium boat, the purse line was tightened using a hydraulically powered winch, and the net was pulled into the boat until the catch was confined in a small enclosure in the water. Single sets were done at each site. Baynes Sound and the estuary were sampled with the purse seine from June 19 to August 15, 2001 (Hamilton et al. 2002).

As the season progressed the salmon moved away from the shore and could be seen in the surface waters beyond the reach of the beach seine. In an attempt to capture these fish, the beach seine was modified to produce a mini purse seine by attaching rings and a rope to the bottom. This net was then used during three sampling trips at six sites in the lower estuary and one in Baynes Sound (Fig. 1, 3). It was set and retrieved by hand in the same manner as the regular purse seine and duplicate or triplicate sets were completed at each site. This was the first year that the mini purse seine method was used. Baynes Sound was mini pursed on June 25, and the estuary was mini pursed on June 27 and July 3, 2001 (Hamilton et al. 2002).

Between January 12th and May 24th sampling to indicate presence or absence of juvenile salmonids was carried out using Gee traps during nine trips at eight sites in both the Puntledge and Courtenay rivers (Fig. 1, 2). The traps were set singly or in pairs and left for between two and five hours (Hamilton et al. 2002).

A single site located in a tributary of the Courtenay River was sampled with a pole seine (Fig. 1). The pole seine was 5.2 m long and 2.1 m deep, with 0.95 cm mesh and 4.3 m poles. The net was opened as far as possible and pulled the length of the site. A duplicate set was completed (Hamilton et al. 2002).

2.1.4 Fish catches

All captured fish were counted and identified to species where possible. Large catches were randomly sub-sampled to estimate total catch. Salmonids were further identified as hatchery marked (coded wire tag) with a clipped adipose fin, or unmarked. All or a sub-sample of salmonids were then anaesthetised with Alka Seltzer™ on shore at the site. Fork length was measured and recorded to the nearest millimetre. Fish were damp dried and weighed to the nearest 0.1 g using an Ohaus Model No. C305 portable balance. They were then released at the site once they had recovered.

The field program ended on August 15th as by this time most of the juvenile salmonids had left the area.

Condition factor (K) for all salmonids was 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). Catch per unit effort (CPUE) was calculated as the mean catch for all sets at each site.

2.1.5. Physical data

Physical data were recorded at most sites except the Gee traps and pole seine locations using a YSI 85 oxygen, conductivity, salinity, and temperature meter. Salinity and temperature were recorded at the surface, and then at 1 m intervals to either the bottom or to 5 m depth, depending on site depth. Dissolved oxygen levels were measured in $mg \cdot L^{-1} \pm 2\%$. Depth ranges were recorded using a Humminbird 100SX portable sounder. A differential Eagle Explorer was used to determine Global Positioning System (GPS) co-ordinates (Hamilton et al. 2002).

2.2. DATA ANALYSIS

Microsoft Excel was used to carry out analysis of variance tests (ANOVA) of the salinities recorded at all depths at all sites except the Gee trap and pole seine locations. The graphs in this report were produced using Lotus Freelance graphics.

3.0. RESULTS

3.1. WATER PROPERTIES

3.1.1. ANOVAs of salinities

The ANOVAs carried out on salinities recorded during this study identified nine different zones within the river, estuary and Baynes Sound. All zones were statistically significantly different from each other with p values ranging from <0.001 to 0.016. Based on this analysis, the sixty-eight sites sampled in these regions were assigned to one of the nine salinity zones. The least number of sites were found in the mid river beach seine zone (2) and the most sites fell within the estuary mini/purse seines and Baynes Sound inner purse seines zone (15) (Table 1).

3.1.2. Salinities by zone

Salinities were sampled between March 6th and August 15th at all sites except the pole seine and Gee trap locations. The lowest salinities were found in the upper river region (0‰) and the highest occurred in Baynes Sound and the surrounding area (29.6 ‰) (Table 3) (Fig. 4 to 9).

Between March 6th and July 30th a total of 71 measurements of salinity were made at the four sites in Zone #1 in the upper river (UR) region. The lowest salinity values of 0 ‰ were recorded at all these sites, varying from 0 to 2.5 ‰ with an overall average ± 1SE of 0.1 ± 0.0 ‰ (Fig. 4).

Salinities ranged slightly higher at the two sites in Zone #2, the mid river beach (MR) seine region, varying from 0 to 6.2 ‰ but still with an average of only 0 ‰ (Fig. 5). However, the nine sites in Zone #3 in the lower river (LR) beach seine region varied in salinity over a much wider range, from 0.1 to 28.8 ‰ with the mean ± 1SE increasing slightly to 4.4 ± 1.1 ‰ (Fig. 6).

In the estuary beach seine zone (ES) (Zone #4), the three sites varied in salinity slightly less, from 0.1 to 26.2 ‰, but with a higher average ± 1SE of 9.2 ± 1.7 ‰ (Fig. 7). Within the estuary west (EW) (Zone #5) region, the range was similar at 1.3 to 29.2 ‰ but the mean ± 1SE increased dramatically to 21.1 ± 1.0 ‰ (Fig. 8). The minimum salinity recorded in the estuary east/Baynes east beach seine region (EE) (Zone #6) increased significantly to 11.8 ‰ and the overall mean ± 1SE for this zone was 25.2 ± 0.5 ‰ (Fig. 9).

In the estuary mini and purse and Baynes inner purse seine zone (EP) (Zone #8) the range of salinity recorded was 16.0 ‰ to 28.9 ‰, and the mean ± 1SE for all sites was 26.0 ± 0.1 ‰ (Fig. 10). The salinities recorded in the Baynes west region (BW) (Zone #7) had less variation, from 24.7 to 29.6 ‰ with the mean ± 1SE for all sites at 26.8 ± 0.2 (Fig. 11). The smallest variation in salinities and the highest mean value were found in the Baynes outer purse and mini seines region (BO) (Zone #9).

Here salinities varied from 25.6 to 29.0 ‰ with a mean ± 1SE of 27.5 ± 0.1 ‰ (Fig. 12).

At all sites combined between the surface and 5 metres depth 730 salinity measurements were taken (Table 3). This was during the period between March 6th and August 15th. The minimum salinity recorded was 0 ‰ and the maximum was 29.6 ‰. The mean salinities ± 1SE increased from the upper river (Zone #1) to the Baynes outer purse and mini seines region (Zone #9), with an overall mean ± 1SE for all zones of 19.4 ± 0.4 ‰ (Fig. 13).

3.1.3. ANOVAs of temperatures

Analysis of variance tests of the temperatures recorded during the survey between March 6th and August 15th at all sites except the Gee trap and pole seine locations found values that were statistically significantly different between the nine zones in 73.6% of the tests (53/72)(Table 2). The temperatures for the four sites in the upper river beach seine region (Zone #1) were significantly different from all of the other zones. The Baynes Sound west beach seine region (Zone 7) and the Baynes Sound outer purse and mini seines region (Zone #9) each had p values that were significantly different from all but one of the eight other zones. The nine sites in the lower river (Zone #3) were significantly different from all but the estuary beach seine (Zone #4) (3 sites) and estuary west beach seine (Zone #5) regions (9 sites). The least difference was found between the estuary beach seine samples (Zone 4), estuary west beach seine samples (Zone #5), and estuary east and Baynes east beach seine region (Zone #6).

3.1.4. Temperatures by salinity region

Temperatures in the upper river (UR) (Zone #1) varied from 4.5 to 19.2 ° C, with an average ± 1SE over the project for all sites in this region of 10.2 ± 0.6 °C (Table 3). By site, the lowest mean temperatures ± 1SE occurred at site 1A (7.8 ± 1.2) and the highest mean temperatures ± 1SE were found at site 24 (11.1 ± 1.3) (Fig. 14). By date, the lowest temperature recorded in this zone was 4.5 °C on March 6th at site 17 and the highest was 19.2 °C at site 24 on July 30th. A steady warming trend of almost 15 °C for the mean temperatures recorded between March and August is evident for all sites (Fig. 24).

Temperatures in the mid river region (MR) (Zone #2) were higher than the mean temperatures recorded in the upper river region (Zone #1) (Fig. 15) and averaged 14.8 ± 0.8 °C overall (Table 3). The lowest mean temperatures were found at site 21 on March 6th (5.7°C ± 0.6 °C) and the highest mean temperature of 22.4 °C was recorded at site 42B on August 13th. However, by date the same trend is visible from March to August as appears in the upper river temperature patterns (Fig. 25).

In the lower river region (LR) (Zone #3) temperatures varied from 5.4 to 21.7 °C with an overall mean ± 1SE of 11.7 ± 0.6 °C (Table 3). Site 61 had the lowest temperature (5.5°C, March 29th) while site 66 was the warmest (14.3 °C, May 23rd) (Fig. 16). The highest mean temperature ± 1SE was 21.1 ± 0.4 °C at site 14 on August 13th. There was slightly more variation in the mean temperatures by date for this zone but the same warming trend is evident (Fig. 26).

The temperatures recorded at the three sites in the estuary region (ER) (Zone #4) varied between 5.9 and 22.8 °C with an overall mean ± 1SE of 13.6 ± 1.3 °C (Table 3). The temperatures were lowest at site 20 (5.9 °C) on March 6th and highest at site 40 (22.8 °C, June 18th) (Fig. 17, 27). The warming trend from March to July is again evident.

The range of temperatures in the estuary west zone (EW) (Zone #5) was 6.7 to 21.7 °C and the overall mean ± 1SE was 13.1 ± 0.6 °C (Table 3, Fig. 18). The lowest temperatures were recorded at sites 2 (6.8 °C Mar 20th) and 3 (7 °C, Mar 20th). The warmest areas in this region were at site 4 on July 11th with a mean of 21.4 °C. In this region the temperatures increased fairly rapidly from March to July followed by a slight cooling and then a further increase (Fig. 28).

The estuary east and Baynes east (EE) (Zone #6) region included sites in both the estuary and Baynes Sound which resulted in a range of temperatures from 6.8 (site 6, March 20th) to 23.7 °C (site 31, July 9th)(Table 3). The overall mean temperature ± 1SE for this area was 13.1 ± 0.4 °C (Fig. 19). Although the same warning trend as seen in other regions is also present in this zone, the temperatures show several cooling trends followed by further increases (Fig. 29).

The Baynes west zone (BW) (Zone #7) was only sampled between May 29th and July 31st (Table 3). As a result the range of temperatures between 11.5 to 22.0 °C was smaller than seen in other zones and the mean ± 1SE was higher than in other regions at 17.0 ± 0.4 (Fig. 30). Both the lowest temperature of 11.5 °C on June 7th and the highest temperature of 21.6 °C on July 9th were recorded at site 32. The lowest mean temperature ± 1SE was 11.7 °C at site 32 on June 7th and the highest mean temperature ± 1SE was 21.4 °C at site 67 on July 9th (Fig. 21).

Sampling in the estuary purse and mini and Baynes inner purse seines zone (EP) (Zone #8) didn’t start until June 19th and ended on August 15th. During this period, temperatures ranged between 12.3 and 21.9 °C with a mean ± 1SE for the region of 17.3 ± 0.1°C (Table 3). Most temperatures were between 15 and 20 °C (Figs. 20, 31).

The Baynes outer purse and mini seines region (BO) (Zone #9) was sampled between June 19th and August 14th (Table 3). Temperatures varied from 11.4 (site 35, July 16th) to 18.1 °C (site 48 July 16th) with an overall mean ± 1SE of 15.4 ± 0.2 °C. The mean temperatures for all six sites varied very little (Fig 22, 32).

A total of 730 measurements of temperature were taken at all sites between March 6th and August 15th (Table 3). The overall range was 4.5 to 23.7 °C with a mean ± 1SE of 14.8 ± 0.2 °C (Fig. 23).

3.1.5. Dissolved oxygen levels by salinity region

Dissolved oxygen levels were measured at all sites except the eight Gee trap and one pole seine locations. Sampling of the upper river region (UR) (Zone #1) was carried out between March 6th and July 30th for a total of 71 samples (Table 3). The lowest level of 8.2 mgL^{-1} was recorded at site 24 on June 18th and the highest level of 15.1 mgL^{-1} was recorded at this site as well on March 22nd. The mean dissolved levels varied very little between the four sites in this zone and the overall mean ± 1SE was 12.2 ± 0.2 mgL^{-1} (Fig. 33).

In the mid river region (MR) (Zone #2), between March 6th and August 13th, the overall mean ± 1SE for the 40 measurements was 10.2 ± 0.7 mgL^{-1} (Table 3) (Fig. 34). The lowest level of 6.1 mgL^{-1} occurred at site 42B on August 13th and the highest level of 14.0 mgL^{-1} was recorded at site 21 on March 6th. The highest mean oxygen was 10.6 ± 0.3 mgL^{-1} at site 21.

The 61 samples of dissolved oxygen recorded at the nine sites in the lower river region (LR) (Zone #3) between March 8th and August 13th showed a range of 5.2 to 15.0 mgL^{-1} with an overall mean ± 1SE for this region of 11.2 ± 0.3 mgL^{-1} (Table 3) (Fig. 35). The lowest level of 5.2 mgL^{-1} occurred at the one metre depth at site 22 on June 18th. The highest concentration of oxygen was found at site 11 on March 22nd. The mean dissolved oxygen was lowest at sites 11, 14 and 22.

Twenty-five measurements of water quality were done at the three sites in the estuary zone (ES) (Zone #4) between March 6th and July 30th (Table 3). The highest oxygen level of 13.7 mgL^{-1} was found at site 16 on March 22nd (Fig. 36). The lowest level recorded was 7.4 mgL^{-1} at site 20 at the one metre depth on July 23rd. For all three sites combined in this region the mean oxygen level ± 1SE was 11.0 ± 0.4 mgL^{-1}.

There were nine beach seine sites grouped into the estuary west region (EW) (Zone #5). A total of 57 samples were taken of the water quality in this area between March 8th and August 13th. This showed an overall mean level of oxygen ± 1SE for this zone of 9.8 ± 0.2 mgL^{-1} (Table 3) (Fig. 37). The lowest level of 6.1 mgL^{-1} occurred at the one metre depth at site 2 on March 8th. The highest level of 13.4 mgL^{-1} was also recorded at the surface at this site on March 20th and at the one metre depth on June 11th. The highest mean ± 1SE for this zone was 12.0 mgL^{-1} at site 39. The lowest mean levels ± 1SE were calculated for sites 4 (9.4 ± 0.3 mgL^{-1}), 19 (9.0 ± 0.5 mgL^{-1}), 69 (9.7 mgL^{-1}) and 75 (9.2 ± 0.3).

Thirteen sites comprised the estuary east and Baynes east region (EE) (Zone #6). In this zone, the dissolved oxygen levels were measured between March 16th and August 13th for a total of 118 samples. The levels fluctuated between 5.1 and 12.9 mgL^{-1} and the overall mean ± 1SE was 9.8 ± 0.2 mg L^{-1} (Table 3) (Fig. 38). The lowest level of 5.1 mg L^{-1} was measured at site 38 at the 5 metre depth on July 17th and the highest level of 12.9 mg L^{-1} occurred at the surface at site 9 on March 13th. Low levels were also recorded at sites 30 and 31.

In the Baynes west region (BW) (Zone #7) a total of 46 measurements of the dissolved oxygen were made between May 29th and July 31st. The levels recorded ranged from 9.2 to 13.1 mgL^{-1} with an overall mean ± 1SE of 10.9 ± 0.1 mg L^{-1} (Table 3) (Fig. 40). The lowest level of 9.2 mgL^{-1} was recorded at site 32 at the one metre depth on June 7th. The highest level was recorded at the one metre depth at site 67 on the same day.

A total of 237 measurements of the dissolved oxygen levels were made in the estuary purse and mini and Baynes inner purse seines region (EP) (Zone #8) between June 19th and August 15th. In this region, the dissolved oxygen levels fluctuated between 7.5 and 14.4 mgL^{-1} (Table 3) (Fig. 39). The mean level for this zone ± 1SE was 10.5 ± 0.1 mg L^{-1} and the lowest value of 7.5 mg L^{-1} was recorded at the one metre depth at site 56 on August 15th. The highest level of 14.4 mg L^{-1} was found at site 51 at a depth of 5 metres on August 14th.

The Baynes outer purse and mini seines region (BO) (Zone #9) was sampled between June 19th and August 14th (Table 3) (Fig. 41) with a total of 74 samples. The levels of dissolved oxygen fluctuated from 7.1 to 13.0 mg L^{-1} with an overall mean ± 1SE of 10.4 ± 0.2 mg L^{-1} for the zone. Site 35 had the lowest value of 7.1 mg L^{-1} recorded on July 16th at the 5 metre depth. The highest value of 13.8 mg L^{-1} for this zone was found at site 48 at the 4 metre depth on July 4th.

A total of 730 samples of dissolved oxygen levels were taken in the nine zones combined between March 6th and August 15th (Table 3). The overall range was 5.1 to 15.1 mg L^{-1} with a mean value ± 1SE of 10.6 ± 0.1 (Fig. 42).

3.2. JUVENILE SALMONID CATCHES BY GEAR TYPE

3.2.1. Beach seines, purse seines, mini purse seines, Gee traps and pole seines combined

For all gear types combined (416 sets) 2831 pink, 1743 coho, 1590 chinook, 1004 chum, 85 cutthroat, 21 steelhead, three rainbow, two unidentified salmonids, and one sockeye were captured, for a total catch of 7280 juvenile salmonids (Table 4, 9) (Fig. 52).

3.2.2. Beach seines

Forty-three sites were sampled with the beach seine in the estuary and Baynes Sound (Fig. 1, 3). The majority of salmon of all species were caught at site 8 (Fig. 58, n=2799) in the estuary east and Baynes east (EE) region. The next highest combined catch was at site 11 (n=873), (Fig. 55) in the lower river (LR) region. Most pink salmon were caught at site 8 (n=2646), chinook at site 11 (n=753), coho at sites FS2 (n=304) and 1A (n=270), and chum at site 3 (n=261). One sockeye was captured at site 22. No salmon were caught at sites 25, 26, 28, 30, 32, 52, 63, 69, 71, 72, 74, 78, FS7 or FS8 (Tables 5, 9).

3.2.3. Purse seines

Juvenile salmon were sampled using the purse seine on eleven trips between June 19th and August 15th (Table 7). Fifty-five sets were completed at 16 sites. Of the 7280 salmonids captured during the project, only 207 were caught using this method. Chinook and chum were the most abundant during the first two trips in June while coho occurred in the highest numbers on the first trip in July (Fig. 106,107,108). For all salmon species combined, the highest catch was on June 26th (Fig. 109).

3.2.4. Mini purse seines

Mini purse sampling was carried out at five sites in the estuary and one site in Baynes Sound (Fig. 1, 3). No fish were captured using this method.

3.2.5. Gee traps

Gee traps were set out at eight sites on nine days between January 12th and May 24th (Fig. 1, 2) (Table 8). Juveniles of chinook (1, 0.2%), coho (457, 98.9%), rainbow (3, 0.7%) and cutthroat (1, 0.2%) were captured for a total of 462 fish in 36 samples. The single chinook was captured on January 12th and the three rainbow were caught on January 12th and January 18th. The dominant species at the Gee trap sites was coho and they were the most numerous between January 12th and March 16th after which catches declined quickly to zero (Fig. 118). The highest catch of 110 coho was on March 14th. Of these coho, 304 (66.5%) were caught at site FS2 in the man made pond in Millenium Park (Fig. 1). All three rainbow were caught at site FS6 above the Condensory Bridge (Table 9) (Fig. 119, 120).

3.2.6. Pole seines

Two pole seine samples were done at site 45 on May 24th (Fig. 1). No fish were caught at this site (Hamilton et al. 2002).

3.3. JUVENILE SALMONID CATCHES, CATCH PER UNIT EFFORT (CPUE) ± 1SE AND PERCENT OF TOTAL CATCH BY SALINITY ZONE AND SITE

The total catch of juvenile salmonids by species and salinity region, CPUE ± 1SE and percent of total catch by species may be found in Tables 4 and 5. At all zones combined (Gee traps excluded) 2831 pink ,1589 chinook, 1286 coho,1004 chum, 84 cutthroat, 21 steelhead, 2 unidentified salmonids and 1 sockeye were caught for a total of 6818 fish.

In the upper river (UR) region (Zone #1) 65 beach seines were completed at the four sites (1, 1A, 17, 24) (Fig. 1). The catches were dominated by chum (186) followed by chinook (166), coho (120), pink (26), and steelhead (1) for a total of 499 fish which made up 7.3% of the total salmonids captured during this project (Table 5) (Fig. 43). One hundred and sixty-eight (33.7%) of the 499 fish caught in this zone were captured at site 1 (Fig. 53) and 104 (61.9%) of the 168 chinook caught in this zone were also captured at this site (Fig. 62, 80). The highest CPUE ± 1SE recorded in this zone was 23.3 ± 22.3 for the 70 coho caught at site 1A followed by a CPUE of 22.7 ± 11.3 for the 68 chum captured at the same site (Table 5) (Fig. 71). The overall CPUE ± 1SE for all species captured in this zone was 7.7 ± 1.6. Chum made up 37.3% of the salmonids captured in this region followed by chinook (33.3%) and coho (24.1%) (Table 5) (Fig. 80). Chinook dominated the catches at site 1 (61.9%). At site 1A coho comprised 48.3% of the total catch followed by chum (46.9%) (Fig. 80). Site 17 was dominated by chum (47.2%) followed by chinook (30.7%). Chum were also dominant at site 24 (54.2%).

Only sites 21 and 42B were in the mid river (MR) region (Zone #2). Nevertheless, 509 juvenile salmonids were captured here, making up 7.5% of the total salmonids captured during this study (Fig. 44). Three hundred and sixteen coho fry were captured at site 42B which consisted of a man made pond in the middle of Millennium Park (Fig. 54). This pond was connected by a culvert to a groove excavated off the river (Fig. 1). These fish comprised 62.1% of the total catch for this zone and 74.2% of the coho captured at these two sites (Fig. 81). The 110 coho at site 21 made up 76.4% of the total catch at this site (Fig. 63). This site consisted of a bay created at the end of the slough off the river when Millennium Park was built (Fig. 1). The highest CPUE ± 1SE of 52.7 ± 15.9 was recorded for the coho caught at site 42 B (Table 5, Fig. 72).

One thousand two hundred and ninety-two juvenile salmonids were captured including chinook (1033), chum (35), coho (144), pink (6), cutthroat (54), steelhead (19) and sockeye (1) at eight of the nine sites in the lower river (LR) (Zone #3) (sites 11, 12, 14, 18, 22, 61, 63, 65, 66). This was 19.0% of the total salmonids captured in the nine salinity regions combined (Table 5). No salmon were found at site 63 (Fig. 1, 64). Chinook dominated the catches at sites 11 (753 fish, 86.3% of catch) and 22 (256 fish, 77.3% of catch (Table 5) (Fig. 82). Coho were the most numerous at site 11 (61 fish, 7.0%), site 12 (35 fish, 59.3%) and site 22 (28 fish, 8.5%). Cutthroat were only captured at sites 11 (24 fish) and 22 (30 fish). All the steelhead (19 fish) captured in this zone were also caught at site 22 (Fig. 55, 64). The overall CPUE ± 1SE for this zone was 23.9 ± 13.8 (Fig. 73).

Zone #4 in the estuary (ES) included sites 16, 20, 40. A total of 101 juvenile salmonids were captured in this region, comprising 1.5% of the total catch for the nine salinity regions combined (Fig. 1) (Table 5). This zone was dominated by chum (50 fish, 49.5%) followed by pink (18 fish, 17.8%), cutthroat (17 fish, 16.8%) and coho (13 fish, 12.9%) (Fig. 46). Of the total captured, 67 (66.3% of the total catch for this zone) were caught at site 20 (3 chinook, 18 chum, 13 coho, 16 pink, and 17 cutthroat) (Fig. 56, 65). The highest CPUE ± 1SE for this zone was 15.5 for the capture of 31 chum at site 16 (Fig. 74). These fish made up 93.9% of the catch for this site (Fig. 83). Only one chum was caught at site 40.

Zone #5 in the estuary west region (EW) included nine sites (2, 3, 4, 19, 39, 60, 62, 69, and 75) (Table 5, Fig. 1). A total of 422 juvenile salmonids were captured in this zone, or 6.2% of the total salmonids caught in the nine zones combined (Fig. 47). This zone was dominated by chum and 261 (91.3%) of the 286 captured in this zone were caught at site 3 (Fig. 57, 66). Chinook (62 fish), coho (36 fish) and pink (36 fish) were also captured at these sites. The highest CPUE ± 1SE of 32.6 ± 24.1 was recorded at site 3 for the capture of the 261 chum (Fig. 75). The majority of the salmonids captured in this zone were caught at sites 3 and 4 which together made up 83.7% of the fish in this region (Fig. 84).

Of the 6818 salmonids captured in all nine salinity zones combined, 3767 (55.3% of the total catch) were caught at eleven of the thirteen sites in the estuary east/Baynes east (EE) region (Zone #6). This region included sites 6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70 (Table 5, Fig. 58). Of this, 74.3% of the total catch was at site 8. This site was located in the Comox marina in an area which is dredged on a regular basis (Fig. 1). Pink dominated the catches in the region (Fig. 48) and 2646 were captured at this site (Fig. 67). Lower numbers of chum (71 fish) and coho (64 fish) were also caught here. The highest CPUE ± 1SE was 120.3 ± 66.9 for the 2646 pink caught at site 8 (Fig. 76). Chinook comprised 100% of the catch at sites 68 and 70 (Fig. 85).

There were seven sites in Zone # 7 in the Baynes west (BW) region (25, 26, 28, 32, 33, 49, and 67) (Fig. 1). Only 27 salmonids were captured in this zone (Table 5) including 26 chinook and one chum (Fig. 50, 69). Seventeen of the chinook were caught at site 67 which had the highest CPUE ± 1SE of 2.8 ± 1.9 (Fig. 59, 78). These fish comprised 94.4% of the catch at this site. Chinook juveniles made up 96.3% of the total catch in this zone (Fig. 86).

A total of 141 juvenile salmonids were caught at the 15 sites (46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, and 75) in the estuary purse/mini and Baynes inner purse (EP) region (Zone #8) (Table 5) (Fig. 1, 2). This included chum (64 fish, 45.4% of total catch), chinook (42 fish, 29.8% of total catch), coho (34 fish, 24.1% of total catch), and one unidentified salmon (Fig. 49, 87). Sixty-three of these fish were caught at site 47 making up 44.7% of the fish caught in this zone (Fig. 60, 77). Chum dominated site 73B making up 90.9% of the catch at this site (Fig. 68). Chinook and coho were the most numerous at site 47 (Fig. 68). The highest CPUE ± 1SE was 5.0 ± 3.3 for the 30 coho caught at site 47 (Fig. 77).

In the Baynes outer (BO) area (Zone #9) a total of 60 juvenile salmonids were captured at the six sites (35, 48, 53, 59, 76, and 77B) including chinook (36), chum (16), coho (7) and one unidentified salmon (Table 5) (Fig. 1, 2) (Fig. 51). Twelve of the sixteen chum (75%) were caught at site 35 (Fig. 61). Chinook were captured at sites 53 (11), 59 (9) and 35 (8) (Fig. 70). The highest CPUE ± 1SE for this zone was 8 for the 8 chinook caught at site 77B (Fig. 79). Chinook made up 75% of the catch at site 59 (Fig. 88).

3.4. JUVENILE SALMONID CATCHES, CPUE ± 1SE AND PERCENT OF TOTAL CATCH BY DATE AND GEAR TYPE

The total catch, CPUE ± 1SE and percent of total catch by date, species and gear type may be found in Tables 6 and 7 and Figures 89 to 117.

3.4.1. Beach seines

The total catch of all species of salmonids by date is graphed in Fig. 94 (Table 6). The highest combined catch was 1991 fish on March 13th. This was a mean CPUE ± 1SE of 132.7 ± 88.8 (Fig. 99) or 30.1% (Fig. 105) of the total salmonids captured in all the beach seine samples (Table 6).

The highest catch for chinook using the beach seine was on June 11th (Table 6, Fig. 89). On this date a total of 962 chinook were captured in 14 sets, giving the highest CPUE ± 1SE recorded for this species of 68.7 ± 46.9 (Fig. 95). Chinook also dominated the catches on June 12th (95.5% of total catch) and June 11th (89.2% of total catch) (Fig. 100).

Eight hundred and seventy-three (93.6%) of the 933 chum caught were captured between March 13th and May 29th (Table 6, Fig. 90). The highest CPUE ± 1SE recorded for chum was 20.0 ± 14.0 on March 29th (Table 6, Fig. 96). Chum comprised between zero and 95.9% of the total catch for each sampling day (Fig. 101).

Eighty-six percent (1074) of the coho were caught between May 14th and June 11th (Table 6, Fig. 91, 102). Coho were caught on twenty-three of the twenty-eight sampling days, comprising between zero (March 6, 8, 13; June 25th; July 9th) and 90.9 % (July 11th) of the total catch for each date (Fig. 102). The highest CPUE ± 1SE for this species was 25.4 ± 12.3 fish on May 14th when 254 coho were caught in 41 beach seines (Fig. 97).

Virtually all of the 2835 pink juveniles were caught between March 6th and March 29th (Table 6, Fig. 92). The largest catch was 1897 pink (95.3%) (Fig. 103) on

March 13th (mean CPUE ± 1SE of 126.5 ± 86.7) (Fig. 98). Catches dropped abruptly after this date.

A total of 84 cutthroat were captured during the beach seining between May 14th and August 13th (Table 6, Fig. 93). The highest CPUE ± 1SE recorded for this species was 2.6 ± 1.4 on June 18th when 36 were caught (18.2% of the total catch for this species) (Fig. 93, 104).

<u>3.4.2. Purse seines</u>

Between June 19th and August 15th, 55 purse seine sets were completed during eleven sampling trips and 207 juvenile salmonids were captured (Fig. 109). The catches were made up of chinook (86), chum (80) and coho (41) (Table 7, Fig. 106, 107, 108). The highest total catch of 76 salmonids (36.7% of the total purse seine catch) was on June 26th (CPUE ± 1SE = 19.0 ± 7.7) (Fig. 113, 117).

The highest catch for chinook was on June 19th when 24 fish were caught in 4 purse seine sets (Fig. 106). This was 92.3% of the total salmonids caught on this date and the CPUE ± 1SE for this date was the highest for the chinook at 6.0 ± 2.1 (Fig. 110, 114).

The highest catch for chum was on June 26 when 44 were caught in 4 sets (Fig. 107). The CPUE ± 1SE was 11.0 ± 5.6 (Fig. 111). The catch for chum as a percent of the total for each date is graphed in Figure 115.

Only 41 coho were caught in the purse seines. Nineteen of these fish were caught in 4 sets on July 4th, giving a mean CPUE ± 1SE of 4.8 ± 4.8 (Fig. 112) and comprising 82.6% of the total catch for this date (Fig. 116).

3.5. LENGTHS, WEIGHTS AND CONDITION FACTORS FOR SALMONIDS FOR ALL AREAS COMBINED

Lengths and weights were recorded, and condition factors were calculated for 1121 juvenile salmonids captured in all the salinity zones and Gee traps combined (Table 10). Eighty (7.1%) of these were marked hatchery fish. Of the 481 coho measured, 38 (7.9%) were marked. Twenty-two (5.5%) of the 401 measured chinook were marked, and 19 (47.5%) of the 40 measured cutthroat were marked. Only one (0.5%) of the 189 measured chum was marked. The minimum K-factor (0.34) was calculated for a coho captured on May 14 at site 21. The maximum K-factor (1.69) was also calculated for a coho on May 14, this time at site 1A.

3.6. LENGTHS, WEIGHTS AND CONDITION FACTORS FOR SALMONIDS BY SALINITY REGION

Means ± 1SE by salinity region for the lengths, weights and condition factors for chinook, coho, chum, steelhead, cutthroat, pink, sockeye and all species combined may be found in Table 10. The data for lengths (mm) is illustrated in Figures 123 to 128, weights (g) in Figures 129 to 134 and condition factors in Figures 135 to 140. Steady growth of the chinook, coho and chum was seen as they moved from the upper river region (UR) (Zone #1) to the outer Baynes region (OB) (Zone #9)(Fig. 123 to 125). Steelhead were the smallest in the upper river region (UR) (Zone #1)and increased in length and weight dramatically in the lower river (LR) (Zone #3) and Baynes west regions (BW) (Zone #5) (Fig. 126). The largest cutthroat were caught in the mid river region (MR) (Zone #2) while much smaller ones were captured in the lower river (LR) (Zone #3), estuary (ES) (zone #4), estuary west (EW) (Zone #5) and estuary east/Baynes east regions (EE) (Zone #6) (Fig. 127). The mean length ± 1SE was the highest for all species combined in the estuary region (Zone #4) followed by the Baynes outer region (Zone #9) (Fig. 128).

In Zone #1 in the upper river (UR) region 149 juvenile chinook, coho, chum and steelhead were weighed and measured (Table 10). The mean length ± 1SE for chinook varied from 60.0 ± 1.8 mm at site 1 to 72.9 mm ± 4.4 mm at site 24 with an overall mean length for this region of 63.4 ± 1.7 mm (Fig. 123). The mean weights of these species ranged from 2.3 ± 0.3 to 5.2 ± 0.6 g (Fig. 129). The lengths for coho in this region varied from 38.6 ± 0.3 mm at site 1A to 57.3 ± 21.8 mm at site 24. The mean for all sites for coho was 51.9 ± 2.5 mm (Fig. 124). Weights were recorded from 0.5 ± 0.1 g at site 1A to 2.5 ± 0.5 g at site 1 with an overall mean for this zone for coho of 1.9 ± 0.4 g (Fig. 130). Chum were the smallest species varying from 41.0 mm at site 17 to 42.4 ± 0.7 mm at site 1 with an overall mean for the region of 41.8 ± 0.4 mm (Table 10) (Fig. 125). Weights for these fish ranged from 0.4 to 0.5 ± 0.04 g with an overall mean for the region of 0.5 ± 0.02 g (Fig. 131). The one steelhead captured at site 1 was the smallest at 33 mm (Fig. 126, 132). The overall mean length for all species of salmonid in this region was 55.2 ± 1.4 mm (Fig. 128) and the mean weight was 2.1 ± 0.2 g (Fig. 134). The condition factors recorded for the 149 fish that were measured varied from a mean ± 1SE of 0.63 ± 0.02 for the chum caught at site 24 to 1.03 ± 0.03 for the 14 chinook also from site 24 (Table 10). The mean condition factors ± 1SE by species for this zone may be found in Fig. 135 to 138 and the overall mean of 0.88 ± 0.02 for all species combined is graphed in Fig. 140. Condition factors were the lowest for the chum in seven of the nine regions (Fig. 137).

In Zone #2 in the mid river (MR) region, a total of 181 chinook, coho, chum and cutthroat were measured at both sites in this region (Table 10). The chinook captured were the largest at site 21 with a mean length of 78.5 ± 2.9 mm (N=24) and a mean weight of 5.4 ± 0.6 g. Much smaller chinook were caught at site 42B with a mean length ± 1SE of 57.9 ± 1.7 mm and a mean weight of 1.9 ± 0.2 g. The overall mean length for chinook in the region was 72.0 ± 2.6 mm (Table 10) (Fig 123) and the overall mean weight ± 1SE was 4.3 ± 0.5 g (Fig. 129) . The mean lengths and weights ± 1SE for coho varied slightly between sites 21 (63.4 ± 2.4 mm, 3.2 ± 0.4 g) and 42B (61.5 ± 1.5 mm, 3.1 ± 0.2 g) with an overall mean for the coho in this region of 62.5 ± 1.4 mm and 3.2 ± 0.2 g (Fig. 124, 130). The chum averaged 41.0 ± 1.4 mm and 0.5 ± 0.1 g at site 21 and were only slightly larger at site 42B with a mean ± 1SE of 43.1 ± 0.7 mm and 0.6 ± 0.04 g. The mean length for chum for the region was 42.6 ± 0.6 mm and they weighed an average of 0.5 ± 0.03 g (Fig. 125, 131). Four large cutthroat were caught at site 21 with a mean length of 527.5 ± 123.5 mm and a mean weight of 39.5 ± 2.9 g while only one small cutthroat (161 mm, 33.9 g) was caught at site 42B. The five cutthroat caught in this region averaged 454.2 ± 120.5 mm and 38.1 ± 2.5 g (Fig. 127, 133). Condition factors were calculated for 89 fish in this region and ranged from 0.6 ± 0.06 for four chum caught at site 21 to 1.2 ± 0.01 for 64 coho at site 42B (Table 10). The mean condition factor ± 1SE for all species in this zone was 1.03 ± 0.01 (Fig. 140).

Five species of salmonids were weighed and measured from eight of the nine sites in Zone #3 in the lower river (LR) region (Table 10). The largest fish were six cutthroat caught at site 11 which averaged 184.8 ± 12.8 mm and 65.2 ± 15.2 g. The coho caught at this site were also the largest in the region (108.2 ± 3.4 mm, 13.2 ± 1.3 g). The smallest fish caught was a 66 mm long sockeye at site 22. The mean lengths and weights ± 1SE by species and for all species combined are shown in Figs. 123 to 134. The condition factors for the 174 fish caught varied from a mean of 0.70 for the single sockeye caught at site 22 to 1.10 ± 0.01 for twelve coho at site 14. The mean condition factors by species and for the zone overall are graphed in Figures 135 to 140.

Although juvenile salmonids were captured at all three sites in Zone #4 in the estuary region (ES), chinook, coho and cutthroat were weighed and measured only at site 20. The largest fish were 14 cutthroat which averaged 196.4 ± 9.0 mm in length and 79.3 ± 11.9 g in weight (Figs. 123, 124, 129, 130). For all species combined, the mean length and weight were 133.2 ± 11.8 mm and 39.8 ± 8.8 g (Fig. 128, 134). The mean condition factor ± 1SE for these three species are graphed in Figures 135, 136 and 139. The mean condition factor for the 30 salmonids captured in this zone was 1.02 ± 0.02 (Fig. 140).

Chinook, coho, chum, cutthroat and steelhead were weighed and measured at four of the nine sites in Zone #5 in the estuary west (EW) region. The largest fish captured were 16 coho at site 4 with a mean length of 126.5 ± 18.7 mm and a mean weight of 10.6 ± 1.5 g. The mean length and weight for all coho captured at this site was 113.9 ± 8.0 mm and 8.9 ± 1.3 g (Fig. 124, 130). Chum were the smallest at this site averaging 54.8 ± 4.0 mm in length and weighing an average of 1.5 ± 0.4 g (Fig. 125,131). Mean condition factors varied from 0.74 for two coho at site 2 to 1.04 ± 0.04 for the 19 chinook captured at site 4 (Table 10). The mean condition factors ± 1SE for each species may be found in Figures 135 to139. The mean value for the zone is graphed in Figure 140.

In Zone #6 in the estuary east/Baynes east (EE) region juvenile salmonids were captured at 11 of the 13 sites and were weighed and measured at ten sites. The largest fish caught in this zone were cutthroat, one at site 6 (137 mm) and one at site 64 (158 mm) (Fig. 127). The coho ranged from a mean of 85.7 ± 10.3 mm at site 9 to 137 mm at site 29 with an overall mean for the zone of 110.0 ± 1.6 mm (Fig. 124). Chinook lengths varied from a mean ± 1SE of 65.7 ± 2.8 mm at site 8 to 120.6 ± 7.1 mm at site 38. The mean for this region was 91.9 ± 1.8 mm (Fig. 123). Condition factors were calculated for 249 chinook, coho, chum, cutthroat and pink salmon captured in this zone. The overall mean ± 1SE was 0.99 ± 0.01 (Table 10) (Fig. 140). The lowest condition factors were found for the 5 chum from site 6 (mean ± 1SE = 0.70 ± 0.07) while the highest were for the eight chinook from site 38 (mean ± 1SE =1.22 ± 0.04). The means for each species are graphed in Figures 135, 136, 137 and 139.

Twenty-two chinook and one chum were measured at the three sites in Zone #7 in the Baynes west (BW) region (Table 10). The single chum was 73 mm in length and weighed 3.1 g (Table 10) (Fig. 125, 131) while the mean length for the chinook was 95.2 ± 2.0 mm (Fig. 123) and the mean weight was 4.0 ± 0.9 g (Fig. 129). Mean condition factors ranged from 0.80 for a chum at site 67 (Fig. 137) to 0.97 ± 0.04 for a chinook at site 33. The mean condition factor for all the chinook is graphed in Figure 135 and the overall mean for the zone may be found in Figure 140.

There were fifteen sites in Zone #8 in the estuary purse and mini and Baynes inner purse seine (EP) zone (Fig. 1, 3). Chinook, coho and chum were weighed and measured at nine of these sites (Table 10). The coho captured at site 56 were the largest with a mean length of 169.3 ± 16.4 mm and a mean weight of 57.5 ± 12.1 g. The mean length for chinook ranged from 91.8 ± 3.5 mm at site 46 to 168.5 mm at site 57. The mean weight for chinook varied from 7.6 ± 0.8 g at site 46 to 60.5 g at site 57. The mean length and weight for the zone were highest for the 24 coho measured with a mean length of 152.0 ± 3.3 mm and a mean weight of 42.4 ± 2.9 g (Fig. 124, 130). Forty chum were also analyzed and had an overall mean for the zone of 109.9 ± 1.9 mm and 13.5 ± 0.7 g (Fig. 125, 131). The overall means for all species in this zone were 122.2 ± 2.5 mm and 23.0 ± 1.6 g (Table 10) (Fig 128, 134). Mean condition factors ± 1SE were calculated for 105 juvenile salmonids (Fig. 140) including 41 chinook (Fig. 135); 24 coho (Fig. 136); and 40 chum (Fig. 137). The lowest mean condition factor of 0.97 ± 0.01 was calculated for five chinook at site 46 while the highest value of 1.18 ± 0.02 was for the twenty coho at site 47. The mean condition factor for all species combined is graphed in Figure 140.

Zone #9 in the Baynes outer purse and mini seines (BO) region included six sites (Fig. 1, 3). A total of 59 chinook, coho and chum were weighed and measured at five of these sites (Table 10). The largest fish were the coho captured at site 35 with a mean length ± 1SE of 182.0 ± 5.4 mm and a mean weight ± 1SE of 73.7 ± 7.2 g. The means for all species caught in this region were 130.3 ± 4.6 mm and 31.3 ± 1.9 g (Fig. 128, 134). Mean condition factors ± 1SE were calculated for chinook (36 fish) (Fig. 135), coho (7 fish) (Fig. 136) and chum (16 fish) (Fig. 137) captured in this region. Mean values ranged from 0.79 for a chum at site 59 to 1.21 ± 0.03 for four coho captured at site 35 (Table 10). The overall means for all species combined was 1.10 ± 0.01 (Fig. 140).

3.7. LENGTHS, WEIGHTS AND CONDITION FACTORS FOR SALMONIDS CAPTURED IN THE GEE TRAPS

In the Gee trap samples, lengths were recorded for 59 coho, three rainbow and one cutthroat and weights were recorded for 30 coho (Table 10). The lengths for coho captured at site FS1 (in the new pond area at the head of the Courtenay River slough (Fig. 1)) varied from 65 mm to 97 mm with a mean length ± 1SE of 83.0 ± 1.7 mm (Fig. 121). The weights varied from 2.9 g to 8.9 g with a mean weight ± 1SE of 5.4 ± 0.5 g (Table 10) (Fig. 122). At site FS2, 19 coho were measured. The lengths varied from 54 mm to 78 mm with a mean ± 1SE of 66.8 ± 1.5 mm. Weights were recorded for seven coho from this site and these varied from 1.9 g to 3.9 g with a mean ± 1SE of 3.0 ± 0.3 g (Table 10) (Fig. 121, 122). At site FS3 lengths and weights were recorded for 10 coho juveniles. The smallest fish was 56 mm in length and the largest was 85 mm long with a mean ± 1SE of 77.5 ± 3.0 mm (Table 10, Fig. 121, 122). One cutthroat 265 mm long was also captured at this site. At site FS4 lengths were recorded for 10 coho juveniles between 59 mm and 90 mm with an overall mean ± 1SE of 75.4 +/- 3.3 mm (Table 10, Fig. 121, 122). Only three coho were measured and weighed at site FS6. The smallest fish was 80 mm and the largest was 98 mm with a mean ± 1SE of 86.7 +/- 5.7 mm. Weights varied between 4.5 and 13.8 g. The mean weight ± 1SE was 7.8 +/- 3.0 g (Table 10, Fig. 121, 122). The three rainbow captured at this site were between 100 and 200 mm in length with an overall mean ± 1SE of 143.7 ± 29.6 mm. The mean length ± 1SE for all 59 coho was 76.3 ± 1.4 mm and the mean weight was 4.8 ± 0.4 g (Table 10, Fig. 121, 122).

3.8. ANOVA ANALYSIS OF LENGTHS, WEIGHTS AND CONDITION FACTORS BY SPECIES AND SALINITY REGION

Table 13 lists the results of the 276 one-way ANOVAs for the lengths, weights and condition factors of chinook, coho and chum.

3.9. LENGTHS OF CHINOOK, COHO AND CHUM IN THE NINE SALINITY ZONES

Thirty-six ANOVAs on the lengths of chinook captured in each zone as compared to chinook in the other eight salinity regions showed significantly different results at the p=0.05 level for all but seven of these tests (Table 13). This showed that chinook in the estuary (Zone #4) were not significantly different in length from chinook in the mid river (Zone #2), lower river (Zone #3), estuary west (Zone #5) and estuary east/Baynes east zones (Zone #6). There was also no significant difference in the lengths of chinook in the estuary west zone (Zone #5) when compared to those caught in Zone #6 in the estuary east/Baynes east samples. The lengths of chinook captured in the Baynes west region (Zone #5) and estuary east/Baynes east zone

(Zone #6) were also not significantly different. This was also the case for the chinook caught in Zone #9 in the Baynes outer purse/mini seines zone when compared to those captured in Zone #8 in the estuary purse and mini/Baynes inner purse zone.

Twenty-eight ANOVAs were completed comparing the lengths of coho in the nine salinity zones (Table 13). All but three of these tests were significantly different. The lengths of coho in the estuary west region (Zone #5) were not significantly different from the coho in the lower river (Zone #3), estuary (Zone #4), and estuary east/Baynes east (Zone #6) regions.

Twenty-one ANOVAs were completed for the chum lengths. All but four were significantly different (Table 13). This analysis showed that the lengths of the chum in the mid river zone (Zone #2) were not significantly different from the chum captured in the upper river zone (Zone #1). As well, there was no significant difference between the chum juveniles in the lower river region (Zone #3) and those found in the estuary west (Zone #5)and estuary east/Baynes east (Zone #6) zones. Furthermore the chum in the estuary east/Baynes east zone (Zone #6) were not significantly different in length from those caught in the estuary west seines (Zone #5).

3.10. WEIGHTS OF CHINOOK, COHO AND CHUM IN THE NINE SALINITY ZONES

The results of the thirty-six ANOVAs on the weights of the juvenile chinook in the nine salinity regions showed that all but eleven of these were significantly different (p=0.05) (Table 13). There were fewer differences between regions for the chinook weights (25 significantly different) than the chinook lengths (29 significantly different). The greatest similarity was in the chinook caught in the estuary zone (Zone #4). The weights of these fish were significantly different (p=0.05) only from the chinook in the upper river region (Zone #1) (Fig. 129). The chinook caught in the estuary (Zone #4) were of similar weight to those captured in the Baynes west (Zone #7), estuary purse/mini and Baynes inner purse seine region (Zone #8) and Baynes outer purse/mini seine area (Zone #9) (Fig. 129). Similarly, the chinook found in the estuary west region (Zone #5) were not significantly different in weight from the chinook in the Baynes west region (Zone #7).

Twenty-seven ANOVAs were carried out on the weights of the coho recorded in the nine salinity regions (Table 13). All but one of these tests were significantly different (p=0.05). The coho captured in the lower river region (Zone #3) were similar to the coho found in the estuary west region (Zone #5) (Fig. 130).

Twenty-one ANOVAs were completed on the weights of the chum captured in the nine salinity zones and this showed that all but three were significantly different (p=0.05) (Table 13). The weights for chum captured in the lower river (Zone #3) were similar to those caught in the estuary west (Zone #5) and estuary east /Baynes east (Zone #6) regions (Fig. 131).

3.11. CONDITION FACTORS OF CHINOOK, COHO AND CHUM IN THE NINE SALINITY ZONES

Chinook condition factors were the least significantly different (p=0.05) between regions compared to the other factors tested. Of the 36 ANOVAs completed, only 12 were significantly different (p=0.05) (Table 13; Fig. 135). The condition factors for the chinook caught in the Baynes outer purse/mini seine region (Zone #9) showed the most difference, being similar only to the estuary (Zone #4) and estuary purse mini/Baynes inner purse (Zone #8) regions.

Twenty-eight ANOVAs were completed on the condition factors for coho in the nine zones and of these only five were not significant (Table 13; Fig. 136). The coho captured in the upper river region (Zone #1) and the lower river (Zone #3) were both similar to those found in the estuary west region (Zone #5). Coho in the mid river (Zone #2) were similar to the coho in the estuary region (Zone #4) and coho in the estuary east/Baynes east (Zone #6) were also similar to those in the estuary. Lastly, the coho juveniles in the estuary and mini purse and Baynes inner purse seine region (Zone #8) were not significantly different from those in Zone #9 in the Baynes outer purse and mini seines region.

Twenty-one ANOVAs were done on the condition factors for chum in the nine regions. Of these, only four were not significantly different (p=0.05) (Table 13) (Fig. 137). Chum caught in the upper river Zone #1 had similar condition factors to the chum caught in the mid river Zone #2. There was also no significant difference between the chum caught in the lower river when tested against those caught in Zone #6 in the estuary east/Baynes east region. Likewise, the chum caught in Zone #5 in the estuary west were similar to those caught in Zone #6 (estuary east/Baynes east region). Finally, the condition factors for the chum captured in Zone #8 in the estuary purse and mini and Baynes inner purse seine region were similar to those caught in the Baynes outer purse and mini seines area (Zone #9).

3.12. ANOVA ANALYSIS OF LENGTHS AND WEIGHTS FOR COHO CAPTURED IN THE GEE TRAPS

The summary of the mean lengths and weights for all the salmonids captured in the Gee trap survey may be found in Table 12. The largest coho were captured at site FS6 at the Condensory Bridge (mean 86.7 ± 5.7 mm, 7.8 ± 3.0 g). The smallest coho were caught at site FS2 in the pond in Millennium Park (mean 66.8 ± 1.5 mm, 3.0 ± 0.3 g). One-way ANOVAs of the lengths and weights of the coho captured at five sites showed that the lengths were significantly different in ten of the twenty tests and the weights were also significantly different in six of twelve tests (Table 14). This analysis showed that the coho captured in Millennium Pond were significantly different from the other four sites for both lengths and weights. The coho caught in the Courtenay River slough at site FS1 were also significantly different in length from both the Millennium Pond fish and those caught in the Millennium Groove (site FS4).

3.13. CATCHES OF NON SALMONIDS

A total of 19303 non-salmonid fish were also caught during the project in the nine salinity regions. Table 15 lists the common and scientific names and abbreviations for all non salmonid fish species captured in the nine regions. Total catch, CPUE ± 1SE and percent of the total population for each species in each zone may be found in Table 16. Figures 141 to 149 show the total catch for the dominant non salmonid species and for all zones combined.

Overall, the three most common groups included unidentified sculpins (5431 fish), Pacific sand lance *(Ammodytes hexapterus)* (4129 fish), and shiner surfperch (*Cymatogaster aggregate*) (3115 fish). Large numbers of threespine stickleback (*Gasterosteus aculeatus*) (2337 fish) and bay pipefish (*Syngnathus leptorhynchus*) (586 fish) were also captured (Fig. 149).

All three river regions (Zone #1, #2, #3) were dominated by threespine sticklebacks and unidentified sculpins (Figs. 141, 142, 143). These two groups also dominated the estuary region (Zone #4) along with shiner surfperch (Fig. 144) (Table 14). The estuary west region (Zone #5) had higher numbers of shiner surfperch along with unidentified sculpins and bay pipefish (Fig. 145).

In the estuary east/Baynes east region (Zone #6) unidentified sculpins and shiner surfperch were still dominant but unidentified sanddabs and Pacific sandlance were much more abundant than in the four previous zones (Fig. 146). The highest total catch of non salmonids of 9135 fish occurred in this region. Non salmonids were the second most abundant in the estuary mini and purse/Baynes inner purse region (Zone #8) with a total of 4304 fish (Fig. 148). Pacific sandlance and Pacific herring made up 94% of the catch in this zone. Unidentified sculpins and shiner surfperch were still numerous in Zone #7 in the Baynes west region (Fig. 147) but the total for this zone was much lower at 2399 fish. A total of only 7 non salmonids were caught in Zone #9 in the Baynes outer purse/mini seines region (Table 14).

The highest CPUE ± 1SE that was recorded by species was 62.3 ± 57.3 for Pacific sandlance caught in the estuary purse and mini and Baynes inner purse seine region (Zone #8) (Table 16). Overall the highest CPUE ± 1SE by zone for all species combined was 93.2 ± 29.5 in Zone #6 in the estuary east/Baynes east region. By region and species, the highest percentage of the total population was 93.5% for threespine stickleback in the mid river region (Zone #2).

4.0. SUMMARY

4.1. WATER PROPERTIES

- Nine statistically significant habitat zones were identified based on the ANOVA analysis of the salinity data from all depths collected from 68 sites during the project;

- ANOVA analysis of the temperatures recorded determined that:
  - these values were statistically significantly different between the nine zones in 73.6% of the tests;
  - the upper river beach seine (Zone #1) was significantly different from the other eight zones;
  - the estuary mini and purse seines and Baynes Sound inner purse seines region (Zone #8) was significantly different from all but the Baynes west beach seine region (Zone #5);
  - the Baynes Sound outer purse and mini seines region (Zone #9) was significantly different from all other zones except Zone #2 in the mid river;
  - the least difference in temperatures was found between the estuary beach seine region (Zone #4), estuary west beach seine region (Zone #5), and estuary east and Baynes east beach seine region (Zone #6).

- Most oxygen levels recorded were acceptable with:
  - the lowest level of 5.1 mg l^{-1} being recorded at site 38 in the estuary east/Baynes east beach seine region (Zone #6);
  - the highest level of 15.1 mg l^{-1} being recorded at site 24 in Zone #1 in the upper river beach seine region;
  - an overall mean for all oxygen levels in all zones of 10.6 ± 0.1 mg l^{-1}.

4.2. SALMONID CATCHES BY SALINITY ZONE

- In Zone #1 in the upper river (UR) zone, chinook preferred site 1 while chum and coho were captured at all four sites (1, 1A, 17, 24);

- In the mid river (MR) (Zone #2), coho fry preferred site 42B (the man made pond in Millennium Park), although some were also captured at site 21;

- In the lower river (LR) (Zone #3), sites 11 and 22 were preferred by chinook, coho, cutthroat and steelhead;
- In the estuary (ES) (Zone #4), site 20 was preferred by chinook, chum, coho, pink and cutthroat;

- The estuary west region (EW) (Zone #5) was dominated by chum which were captured at site 3;

- Pink juveniles dominated the catch in the estuary east/Baynes east (EE) (Zone #6) and the majority of the salmonids (74.3%) were caught at site 8;

- Low numbers of salmonids were captured in Zone #7 in the Baynes West (BW) region which was dominated by chinook at site 67;

- The estuary purse/mini and Baynes inner purse (EP) (Zone #8) was dominated by chum that made up 45.4% of the total catch. Chinook and coho were the next most abundant.

- Chinook were found throughout the Baynes outer purse seine region (Zone #9) in small numbers and dominated the catches.

4.3. SALMONID CATCHES BY GEAR TYPE AND DATE – BEACH SEINES

- Pink were caught only between March 6th and March 29th, moving through the area very quickly;

- Chum occurred in the area from March 13th to May 29th but 770 of the 933 chum caught (82.5%) were captured in the two month period from March 13th to May 14th;

- Chinook were in the area from May 14th to the end of the project on August 13th but the highest numbers were captured in mid June;

- Coho showed a bimodal distribution over time with peaks from May 14th to June 7th and June 27th to August 13th when sampling was ended;

- Cutthroat were caught in the highest numbers in mid June;

- No rainbow trout were caught in the beach seine samples;

- Nineteen of the 21 steelhead collected were caught on June 11th.

4.4. SALMONID CATCHES BY GEAR TYPE AND DATE –PURSE SEINES

- Chinook and chum were caught in almost equal numbers during this survey;

- Chinook were captured from June 19th to August 14th but the highest numbers were found in mid June;

- Chum were caught from June 19th to July 31st with the highest numbers in late June;

- Coho were only half as abundant as chinook or chum;

- Coho were caught between June 19th and July 31st but were the most abundant in late June and early July;

- The total catches were highest in mid to late June and declined in early August;

- A total of 207 juvenile salmon were captured in the 55 purse seine sets.

4.5. SALMONID CATCHES BY GEAR TYPE AND DATE –GEE TRAPS

- Coho fry dominated the Gee trap samples and were captured from January 12th to March 23rd with the highest numbers occurring on January 27th and March 14th;

- One chinook fry, one cutthroat and three rainbow were also captured using this method.

- The man made pond in Millennium Park served as a nursery for coho fry on a year round basis and the highest concentrations of these fry were found at this site.

4.6. LENGTHS OF CHINOOK, COHO AND CHUM IN THE NINE SALINITY REGIONS

- Chinook showed a significant difference in length between the various salinity zones in 80.1% (29/36) of the ANOVAs completed.

- Coho showed a significant difference in length between the various salinity zones in 69.4% (25/36) of the ANOVAs completed.

- Twenty-one ANOVAs were completed for the chum lengths in the nine salinity zones. Eighty-one percent (17/21) were significantly different.

4.7. WEIGHTS OF CHINOOK, COHO AND CHUM IN THE NINE SALINITY REGIONS

- Chinook showed a significant difference in weight between the various salinity zones in 80.1% (25/36) of the ANOVAs completed.
- Twenty-seven ANOVAs were carried out on the weights of the coho in the various zones and the results of all but one of these tests (96.5%, 26/27) were significantly different.
- Chum showed a significant difference in weight in 85.7% (18/21) of the ANOVAs completed.

4.8. CONDITION FACTORS OF CHINOOK, COHO AND CHUM IN THE NINE SALINITY REGIONS

- Twelve of the 36 ANOVAs (33.3%) for chinook condition factors were significantly different.
- Twenty-three of the 28 (82.1%) of the ANOVAs completed for the condition factors for coho were significantly different.
- Seventeen of the 21 (81.0%) ANOVAs for condition factors for chum were significantly different.

4.9. LENGTHS, WEIGHTS AND CONDITION FACTORS FOR COHO CAPTURED IN THE GEE TRAPS

- Lengths and weights of coho were both significantly different in half of the ANOVAs completed.
- This analysis showed that the coho captured in Millennium Pond were significantly different from the other four sites for both lengths and weights.

4.10. NON SALMONID CATCHES

- The three most common groups of non salmonids caught during this survey included unidentified sculpins, Pacific sandlance (*Ammodytes hexapterus*), and shiner surfperch (*Cymatogaster aggregate*);
- The highest total catch of non salmonids (9135 fish) was in the estuary east/Baynes east region (Zone #6). The highest CPUE ± 1SE recorded was 93.2 ± 29.5 in Zone #6 in the estuary east/Baynes east region. By region and species, the highest percentage of the total population was 93.5% for threespine stickleback in the mid river region (Zone #2).

5.0. DISCUSSION

5.1. PROJECT HISTORY

Prior to this investigation two projects to assess the distribution and abundance of juvenile salmonids in this area had already been completed during 1998 ((MacDougall et al. 1999; Bravender et al. 2002) and 2000 (Jenkins et al. 2001, 2006). The 1998 study found very few juvenile salmonids rearing in the Courtenay River and its estuary and this was reflected in the fact that only 734 salmonids were captured at all the sites combined during the survey. This was despite the release of over 8.3 million juveniles into this system by the Puntledge River Hatchery either prior to or during the investigation (Bravender et al. 2002). Two different habitats were identified based on ANOVAs of the salinity recorded, the results showing that the lower river and upper estuary were statistically significantly different ($p=0.05$) from the lower estuary.

High temperatures of concern were recorded in some areas of the lower estuary. During the 1998 project, over half the temperatures recorded were between 16 º C and 20 ºC and temperatures of 20 ºC or higher made up 34.7% of all the temperatures recorded. A steady increase in temperature was documented in this region from May to August, with an overlap between the two areas in May and July. Despite this the lower estuary was significantly warmer during the remaining four sampling trips (Bravender et al. 2002).

Given the low number of salmonids captured in the 1998 project, it was hypothesized that these fish were moving quickly down the river and through the estuary and were rearing in the intertidal habitats in Baynes Sound. The 2000 survey was designed to investigate this hypothesis by including sites not only in the Courtenay River and its estuary but also Baynes Sound south from the river mouth to Denman Point. Due to budgetary constraints the field work was not started until July. By that time most of the young fish had already left the area and only 350 salmonid juveniles were captured including nine chinook in Baynes Sound and seven in the region outside of Denman Island (Jenkins et al. 2001). This was surprising given that the Puntledge River Hatchery had released 11.2 million salmonids by June 2000. Although the study did not support the hypothesis, based on the salinities recorded, six discrete habitat areas in this region were identified including a nearshore zone in Baynes Sound that offered habitat that was similar to portions of the Courtenay River estuary in terms of salinity (Jenkins et al. 2006).

The current study in 2001 was the first to successfully sample the river and estuary early in the year. Gee trap surveys were started on January 12th at eight new sites followed by beach seining in the estuary beginning on March 6th (Hamilton et al. 2002). More sites were also sampled during this survey than during the 2000 investigation including 15 new beach seine sites, three new purse seine sites, six new mini purse seine sites and eight Gee trap sites (Fig. 1, 2, and 3).

5.2. CONTAMINATION IN THE ESTUARY

5.2.1. Faecal coliforms

In the past faecal coliform pollution from municipal wastes were regarded as the principal source of pollution in the estuary. Prior to 1962, raw sewage from houses and septic tanks was dumped into outfalls located on the Trent and Courtenay rivers and runoff from leaking septic fields flowed into the estuary at various sites (Morris et al. 1979). Subsequently a deep water outfall to handle the sewage from Comox was constructed and a sewage lagoon was constructed at the head of the estuary to handle the sewage from Courtenay. However, tests showed that the effluent from the lagoon still contained high levels of coliforms (Morris et al. 1979; Waldichuk 1974). In 1983 a deepwater outfall into Baynes Sound was constructed by the City of Courtenay and the sewage lagoon was abandoned. Today, under the Canadian Shellfish Sanitation Program, faecal coliform levels in the estuary are monitored annually by Environment Canada and as of 2000 the levels had improved markedly but were still a problem (Asp and Adams 2000). In the 1990's the lagoon was redeveloped as a park comprised of a tidal wetland and upland recreation area. The construction of this wetland was undertaken by the Small Craft Harbours Branch of Fisheries and Oceans Canada as partial compensation for the impact to fish and wildlife habitat from the expansion of the federal marina at Comox. This is a tidal wetland consisting of mudflats, brackish marsh and subtidal pools. A breach in the dyke around the eastern shore of the lagoon allows the influx of salt water at high tide (Asp and Adams 2000).

Traditionally the Comox Indian Band had harvested shellfish in the estuary at the site where the Comox Marina is now located but lost access to this area in 1963 (Clayton 2006). In 1940 B.C. Packers held tenures in this area for the culture of Pacific Oysters which were active until approximately the 1980s when the water quality deteriorated. In 1992 Transport Canada took over; these tenures were then designated as "Prohibited" due to the poor water quality and in 2002 they reverted back to the Crown. In 2004, the Comox Indian Band received funding to proceed with a Microbial Source Tracking (MST) project in order to ascertain if shellfish harvesting could once again be carried out (Pentlatch Seafoods Ltd. 2004). Samples were collected from fifteen sites in the estuary and analyzed for faecal coliform bacterial levels (Pentlatch Seafoods Ltd. 2005). A wide range of source contamination was identified from the 201 marine samples collected including 64% from birds, 9% from dogs and 8% from humans. As a result of this project, the Band has secured nearly 80 hectares of tidal and sub-tidal beach sites for the purpose of shellfish aquaculture.

5.2.2. Log handling

Historically pollution from log handling and storage has affected the estuary and lower river. Bark, cables and other debris littered the shores and bottom and presented a hazard to migrating fish. While the sawmill was operating, it was necessary to dredge the river channel periodically to allow the transport of log booms to the mill. This type of activity could potentially have resulted in the release of hydrogen sulphide from the sediments (Asp and Adams 2000). The recent closure of this mill offers an opportunity to redevelop the site in a manner that will not have the same adverse impact on the river and estuary.

5.2.3. Copper

The acid mine drainage from the abandoned copper mine in the Tsolum River watershed was found to have transported copper up to 18 km downstream from the pit (Deniseger and Kwong 1996) but tests with amphipods confirmed that the copper in the lower watershed was bound to the sediments and appeared to be highly stable. Dilution of the copper drainage and attenuation in wetlands has also contributed to the reduced copper levels in the lower watershed. However, little work has been done to determine the copper levels in the sediments in the estuary, being largely confined to an investigation by Environment Canada during 1999. This study looked at the metals present in the surface sediments only and concluded that the copper levels were not of concern (B. Kooi, Area Coordinator, Environment Canada, Marine Water Quality Monitoring Unit-Pacific, 2645 Dollarton Highway, North Vancouver, B.C., Canada, V7H 1B1 pers. comm). The copper levels in the sediments at depth have not been investigated in the estuary and the levels of copper within the surface sediments have not been tested since 1999. Although copper may be bound to sediments and be considered to be reasonably stable, it can still be released under conditions of low salinity (Windom et al. 1983). In similar habitats in Howe Sound significant adverse impacts of copper on estuarine food webs were documented (Levings et al. 2004) and levels of copper were found to be fatal to juvenile salmonids (Barry et al. 2000). Experiments elsewhere have shown the adverse affect of copper on the maturation and growth rates of sediment amphipods (Marsden 2002) and the adverse affect of acidified metals on amphipod behaviour (Taylor et al. 1994). In addition, recent research has shown that copper is present in urban run off at a level that may have negative effects on salmon such as the impairment of their olfactory and lateral line neurosensors (Estuary Newsletter 2007). Other known effects of elevated copper on chinook salmon smolts include the inhibition of gill activity (Beckman and Zaugg 1988). Sediments can provide a clear record of the rate of removal of copper and the effectiveness of remediation attempts (Macdonald 1999). Given this evidence it would appear that an investigation of the copper levels in the estuary water and sediments could yield valuable information on the likely past and possible present effects on the populations of juvenile salmonids rearing in the estuary.

5.3. CHANGES IN THE ESTUARY AND SURROUNDING LAND USE

Many of the estuaries on the Strait of Georgia are under pressure as a result of increasing population and urbanization, including the Courtenay River estuary. In order to protect this estuary, a management plan was put in place in 2000 which classified the various habitats as to their potential for future development or alternatively recommended them for preservation (Asp and Adams 2000). However, urban sprawl and a sky rocketing population are still putting increased stress on the estuary ecosystem.

In 1999 the Comox Valley Land Trust was created by local volunteers dedicated to protecting the heritage of land and resources in the area. A report published by this group (2008) states that 60% (approximately 4,700 hectares) of sensitive ecosystem lands in the Comox Valley have been lost, fragmented or reduced through development (Comox Valley Land Trust 2007).

Settlers arrived in this area in the mid 1850’s and many began farming on the floodplain and marsh areas. Repeated flooding of their lands prompted the construction of numerous dykes in the upper marshes, effectively isolating these areas from tidal inundation (Isenor et al. 1987). This is common for this coast, with the Fraser River estuary having lost 70% of the intertidal marshes for farmland (Romaine et al. 1976). Indeed, this dyking of marshes is cited as the “most serious habitat loss” in the estuaries on the east coast of Vancouver Island with a combined decrease in marsh habitat for this area of 32% (Prentice and Boyd 1988). Once the Dyke Road to Comox was constructed, what had once been salt marsh offering many hectares of rearing habitat for juvenile salmonids was permanently lost when it was cut off from the estuary. Today the estuary is encircled by 250 hectares of dyked farmland (Trumpetings Online 1998). A further three hectares of marsh were destroyed when the sewage lagoon was built at the head of the estuary (Prentice and Boyd 1988). More losses of marsh were incurred with the construction of marinas and the destruction of intertidal habitat due to log storage and handling. Burns (1976) commented on “the most serious intrusion” in the estuary being the loss of approximately 660 acres of “surgeplain” (saltmarsh) to agricultural uses with only 89 acres still remaining. He points out the value of the surgeplain as a source of detritus for the estuary food chain. This report also contains a list of the other developments that have reduced the productivity of the estuary including sawmills, barge docks, residential developments and marinas and recommends that where possible developments be reversed or removed and the estuary be zoned as a conservation area.

In 1998, to help support the Comox Valley Waterfowl Management Project, the Pacific Estuary Conservation Program purchased 78 hectares, much of it former marsh, to be managed as a farm and made available as wintering habitat to the large flocks of trumpeter swans that return to this valley each year (Environment Canada 2004). Nearby a small fresh water slough known as Duck Slough or Rosenlof Waterfowl Sanctuary was purchased by the Nature Trust of B.C. in 1975 as a reserve (Asp and Adams 2000). It connects to the estuary through a culvert under the Dyke Road with a flap valve which closes at high tide preventing salt water and juvenile salmonids from entering the slough and opens at low tide discharging fresh water into the marsh in the estuary.

5.4. FACTORS LEADING TO HIGH TEMPERATURES AND THE ADVERSE IMPACT ON SALMON

Although the mechanism is poorly understood, research has shown that salinity, temperature and physiological development influence the habitat choice made by juvenile salmonids (Webster and Dill 2006). Outside of the preferred habitats, the cost to the fish in terms of energy can be greater than in the preferred areas thus increasing the likelihood that where possible, the most cost efficient habitats will be chosen. A study in the Columbia River found that for juvenile salmonids there are velocity thresholds for rearing with most being captured in water velocities less than 26 cm sec^{-1} (Tiffan et al. 2006). Velocity and the lateral slope of the bank affected temperature as well, along with substrate and vegetation. In California, research on coho salmon found that temperatures above 18.0 ºC determined the presence or absence of these fish and that "management strategies to restore or conserve coho salmon in the Mattole River drainage should focus on the water temperature regime" (Welsh et al. 2001).

It is well documented that high temperatures are detrimental to all life stages of salmon including spawning, embryo development, growth, maturation, and resistance to disease (Jensen et al. 2004; Cairns et al. 2005). Elevations in temperature can also affect swimming performance (Farrell 2002) and increase susceptibility to predation for juveniles (Petersen and Kitchell 2001).

Measurements of the water temperature in the Nicola River B.C. during 1994 and 1995 set the LT_{50} (range of temperatures at which 50% of the salmonids die) between 21 ºC and 25 ºC for spawning adults returning to the system. The preferred temperature for spawners is 16 ºC (Walthers and Nener 1997) and spawners become much more susceptible to disease above this temperature (Snyder and Blahm 1968). As well, extreme changes in temperature or exposure to sub-lethal temperatures for long periods can result in stress to the fish followed by increased susceptibility to infection and disease and even death (Dean 1973; Fagerlund et al. 1995).

Elevated temperatures in the Puntledge and Courtenay rivers have been of concern since the Puntledge River Hatchery was built in the late 1970s. The construction of the dam at the mouth of Comox Lake to divert water for the generation of hydro electric energy has resulted in the regulation of the flows within this river and has led to adverse impacts that are common in systems that are dammed. In the Snake River it has been demonstrated that the reservoirs can affect water temperature "by greatly extending water residence times and changing the heat exchange characteristics of affected river reaches" (U. S. Army Corps of Engineers 2000). Water that is released into the Puntledge River from the lake consists of surface waters that have been warmed by the sun. A study by Jensen et al. (2004) documented temperatures in the Puntledge River at the lower site hatchery between 1998 and 2002 showing maximums approaching 24 ºC in early August when summer chinook and pink adults were returning to the river to spawn. This study found that "typical water temperatures occurring during late August and early September in the Puntledge River adversely affect the final stages of pink salmon maturation" leading to "increased adult mortality, delayed maturation rate and reduced gamete viability".

This effect also extends to the estuary, where the temperature is increased not only by the warmer lake water in the river but also by the reduction of the flows in both the Puntledge and Tsolum rivers through domestic and agricultural water licences. Add to this the loss of the riparian zones on many of the creeks and rivers due to clearcut logging and the water temperatures can become even higher (Shrimpton et al. 2000). The water in the estuary is also warmed by the salt water in the flooding tide as it flows over mudflats which have been heated by the summer sun. The highest temperature of 22.8 ºC recorded in the estuary during 2001 was at site 40 in the upper north west corner, but temperatures above 20 ºC were recorded at many of the other sites during this study. The concept of constructing a cold water release from the Comox Lake Dam to help cool the river and estuary is not new and has been considered for many years. However, despite the efforts of many of the local naturalist groups, this has not progressed beyond speculation.

Although it has been documented that juvenile chinook can survive in water temperatures up to 24 ºC, it is known that they experience significantly decreased growth rates, exhibit difficulty smolting and become increasingly susceptible to predation (Marine and Cech, Jr. 2004). Some investigators point out that although chinook salmon have evolved to migrate during the summer months, their phylogenetically determined responses to thermal stress may not allow them to adapt to greatly increased summer water temperatures (Sauter et al. 2001). Experiments on the upper thermal tolerance limits for juvenile fall run chinook salmon in California found that mortality increased at temperatures between 21ºC and 27 ºC and that "smaller fish may have greater tolerance to elevated water temperature than do larger juvenile Chinook salmon" (Hanson 1997). In the Columbia/Snake river system it was found that chinook survival depended on migration distance, temperature and the flows from the dams (Anderson 2003). The survival of salmon juveniles may well depend on steps being taken to increase flows and decrease temperatures within those rivers and streams that have been thermally impacted.

Investigations in other river systems have suggested that the migration and survival of juvenile salmonids is affected by river temperature (Beer and Anderson 2004; Anderson 2003; Smith et al. 2003). Investigations by Connor et al. (2003) predicted higher survival for those chinook juveniles who were exposed to augmented flows resulting in decreased temperatures during their migration. Similarly Smith et al. (2003) found decreased survival as flow was reduced and temperature increased. During this study, the mean temperatures by site exceeded 20 º C in seven of the nine salinity zones, with the upper river zone and Baynes outer purse and mini seine zone being only slightly cooler.

5.5. COMMENTS ON DISTRIBUTION OF JUVENILE SALMONIDS

In this study, the distribution of the salmonids by species and life stage was consistent. For example, the Gee trap surveys showed that the off channel sites were preferred as rearing sites by coho juveniles, especially fry, from January to late March at which time they moved lower in the watershed and were then found at the two sites in the mid river zone (the new pond in Millennium Park (site 42B) and the expanded lagoon at the end of the slough next to the park (site 21)). The pond is connected to a groove off the river by a culvert which regulates the influx of water. A total of 426 fry (CPUE 52.7± 15.9, 86.6% of the population for this zone) were captured here between May 14th and August 13th. It was noted that water from the river could only enter the pond through this culvert at the higher tides. The water in the pond reached a maximum depth of approximately 1.5 metres, was predominately fresh and reached temperatures as high as 22.6 ºC. Nevertheless, the coho fry captured in the pond increased from a mean length ± 1SE of 45.1 ± 1.1 mm on May 14th to 76.0 ± 2.0 mm on August 13th, giving a growth rate of 40.7% during the sampling period. The coho fry were seen to move into this pond and the newly dredged slough as soon as they were constructed and this would seem to indicate that this type of habitat is in short supply.

Rainbow and cutthroat trout were captured consistently in the lower river zone at site 11, at the mouth of a small marsh and at site 20, beside the flap gate on the Dyke Road. They were observed following the tide in as it flooded and holding at the mouth of the marsh apparently preying on juvenile chum and chinook that were feeding in this area.

The larger coho juveniles released by the hatchery seemed to move quickly to the mouth of the estuary with large schools being observed both inside and outside Goose Spit.

Juvenile chinook were captured consistently, mostly in small numbers, in all zones, with the lowest numbers occurring in Zone #2 in the mid river region and Zone #4 in the estuary. Chum juveniles were captured in all nine zones as well, with the lowest numbers in Zone #7 in the Baynes West region. Coho were captured in all zones except Zone #7.

In the estuary, there were only a few low tide refuges available to the juvenile salmon and these were located in areas that had been dredged. Site 8 in the Comox Marina and site 22 in the marina on the lower river were utilized predominately by chinook and cutthroat juveniles.

Below Lewis Park, the main river channel provided little habitat that was suitable for the salmonids to feed and rest due to the high currents and lack of off-channel refuges. The groove off the river into Millennium Park (site 1A) offered some habitat but seemed to function mainly as a conduit for coho and chum fry to enter the pond in this park (site 42B).

The distribution of juvenile salmon seen during this project was similar to that observed in the two studies carried out in 1998 and 2000. When designing and constructing any new habitat for juvenile salmonids, the species and life stage must be identified and taken into consideration as their rearing requirements change as they grow and move toward the offshore zone.

As described in the introduction, the many naturalist and streamkeeper groups have done an enormous amount of work documenting the habitats in the watershed, making improvements and enhancing the juvenile salmonid populations. Many of these fish migrate to the estuary to rear before moving into the offshore waters and, added to the millions of juveniles released by the Puntledge River Hatchery each year, this increases the pressure on the limited rearing areas available in the estuary and Baynes Sound.

6.0. RECOMMENDATIONS

Most of the issues identified in the studies on the Courtenay River estuary and Baynes Sound are the result of the man made impacts on the river and its delta over the past 160 years. This includes dyking of the flood plain by the first settlers resulting in the loss of large areas of marsh, construction of dams on the river, logging, mining, aquaculture and urban development. Global warming may also be playing a role. Unfortunately changes to the ecosystem are cumulative and are often not apparent for many years. Although it will never be possible to return this area to its previous level of productivity the following are recommended:

- Investigate the extent of the salt marsh historically present in the upper estuary and the possibility of returning a portion of the former flood plains to marsh.

- Increase off-channel rearing areas, especially in the upper, mid and lower river zones (below the confluence of the Puntledge and Tsolum rivers to the cement silo in the estuary). The construction of ponds and sloughs with low but continuous flows and riparian shelter would be beneficial for the juvenile coho and chinook in the system as this type of habitat is apparently inadequate.

- Explore the opportunities to create more low tide refuges, especially in the lower river and estuary east zones.

- Investigate the possibility of creating new marsh habitat and dredged pools in the former sewage lagoon at the head of the estuary.

- Collaborate with B.C. Hydro to maximize flows as much as possible during the warmer summer months and to investigate the potential benefits of constructing a system to allow the release of cold water from the depths of the lake.

- Assess the levels of copper in the water and sediments in the estuary to ascertain historic and present levels.

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Table 1. Results of ANOVA analysis of salinities for all sites and regions (BS = beach seine, PS = purse seine).

Zone	Sites	Upper River Beach Seines Zone #1	Mid River Beach Seines Zone #2	Lower River Beach Seines Zone #3	Estuary Beach Seines Zone #4	Estuary West Beach Seines Zone #5	Estuary East and Baynes Sound East Beach Seines Zone #6	Baynes Sound West Beach Seines Zone #7	Estuary Mini and Purse Seines and Baynes Sound Inner Purse Seines Zone #8	Baynes Sound Outer Purse and Mini Seines Zone #9
		P	P	P	P	P	P	P	P	P
Upper River BS Zone #1	1, 1A, 17, 24	-	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mid River BS Zone #2	21, 42B	0.002	-	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lower River BS Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	0.006	-	0.016	<0.001	<0.001	<0.001	<0.001	<0.001
Estuary BS Zone #4	16, 20, 40	<0.001	<0.001	0.016	-	<0.001	<0.001	<0.001	<0.001	<0.001
Estuary West BS Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Estuary East /Baynes East BS Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	<0.001	<0.001	-	0.008	0.012	<0.001
Baynes West BS Zone #7	25, 26, 28, 32, 33, 49, 67	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	-	0.005	<0.001
Estuary Mini/PS, Baynes Inner PS Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	0.012	0.005	-	<0.001
Baynes Outer PS Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table 2. Results of ANOVA analysis of temperatures for all sites and regions (BS = beach seine, PS = purse seine, NS = not significantly different).

Zone	Sites	Upper River Beach Seines Zone #1	Mid River Beach Seines Zone #2	Lower River Beach Seines Zone #3	Estuary Beach Seines Zone #4	Estuary West Beach Seines Zone #5	Estuary East and Baynes Sound East Beach Seines Zone #6	Baynes Sound West Beach Seines Zone #7	Estuary Mini and Purse Seines and Baynes Sound Inner Purse Seines Zone #8	Baynes Sound Outer Purse and Mini Seines Zone #9
		P	P	P	P	P	P	P	P	P
Upper River BS Zone #1	1, 1A, 17, 24	-	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Mid River BS Zone #2	21, 42B	<0.001	-	0.004	NS	NS	NS	0.011	<0.001	NS
Lower River BS Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	0.004	-	NS	NS	0.004	<0.001	<0.001	<0.001
Estuary BS Zone #4	16, 20, 40	0.001	NS	NS	-	NS	NS	0.002	<0.001	0.031
Estuary West BS Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.001	NS	NS	NS	-	NS	<0.001	<0.001	<0.001
Estuary East /Baynes East BS Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	NS	0.004	NS	NS	-	<0.001	<0.001	0.003
Baynes West BS Zone #7	25, 26, 28, 32, 33, 49, 67	<0.001	0.011	<0.001	0.002	<0.001	<0.001	-	NS	<0.001
Estuary Mini/PS, Baynes Inner PS Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NS	-	<0.001
Baynes Outer PS Zone #9	35, 48, 53, 59, 76, 77B	<0.001	NS	<0.001	0.031	<0.001	0.003	<0.001	<0.001	-

Table 3. Salinity, temperature and dissolved oxygen ranges and mean values ±1SE in the nine salinity regions of the estuary, Baynes Sound and surrounding area (BS = beach seine, PS = purse seine).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Upper River BS Zone #1	1	6 Mar – 30 Jul	24	0805-1650	Surface to 2	4.8 – 19.0	0 – 2.5	8.6 – 15.0
	Mean ± 1SE					10.9 ± 1.0	0.2 ± 0.1	11.8 ± 0.4
Upper River BS Zone #1	1A	15 Mar – 14 May	4	0855-1040	Surface to 1	5.8 – 9.9	0	11.4-13.1
	Mean ± 1SE					7.8 ± 1.2	0	12.1 ± 0.4
Upper River BS Zone #1	17	6 Mar – 11 Jul	26	0835-1355	Surface to 3	4.5 – 17.4	0	9.3 – 14.9
	Mean ± 1SE					9.4 ± 0.9	0	12.6 ± 0.4
Upper River BS Zone #1	24	6 Mar – 30 Jul	17	0825-1240	Surface to 1	4.7 – 19.2	0	8.2 – 15.1
	Mean ± 1SE					11.1 ± 1.3	0	12.2 ± 0.5
All Upper River BS Zone #1		6 Mar – 30 Jul	71	0805-1650	Surface to 3	4.5 – 19.2	0 – 2.5	8.2 – 15.1
	Mean ± 1SE					10.2 ± 0.6	0.1 ± 0	12.2 ± 0.2

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Mid River BS Zone #2	21	6 Mar - 13 Aug	28	0905-1710	Surface to 2	5.1 – 21.4	0 - 6.2	8.1 - 14.0
	Mean ± 1SE					14.0 ± 1.1	0.9 ± 0.3	10.6 ± 0.3
Mid River BS Zone #2	42B	14 May – 13 Aug	12	0930-1735	Surface to 1.5	10.7 – 22.6	0 – 0.1	6.1 – 11.3
	Mean ± 1SE					16.8 ± 1.3	0 ± 0	9.4 ± 0.5
All Mid River BS Zone #2		6 Mar-13 Aug	40	0905-1735	Surface to 2	5.1 – 22.6	0 – 6.2	6.1 – 14.0
	Mean ± 1SE					14.8 ± 0.8	0.7± 0.2	10.2 ± 0.3
Lower River BS Zone #3	11	8 Mar – 13 Aug	20	0921-1330	Surface to 1	6.0 – 21.7	0.1 – 26.4	6.7 – 15.0
	Mean ± 1SE					13.3 ± 1.2	4.7 ± 1.5	10.2 ± 0.7
Lower River BS Zone #3	12	13 Mar – 30 May	6	0815- 1335	Surface to 0.75	6.6 – 11.3	0.1 – 0.7	12.0 – 13.4
	Mean ± 1SE					9.3 ± 0.9	0.4 ± 0.8	12.7 ± 0.2

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Lower River BS Zone #3	14	8 Mar – 13 Aug	9	0933-1408	Surface to 1.5	5.8 – 21.7	0.1 – 2.9	8.2 – 14.2
	Mean ± 1SE					13.4 ± 2.3	1.0 ± 0.3	11.1 ± 0.8
Lower River BS Zone #3	18	16 May	2	1315	Surface to 1	9.5 – 9.6	0.1	12.5 – 13.9
	Mean ± 1SE					9.5	0.1	13.2
Lower River BS Zone #3	22	8 Mar – 27 Jun	17	1120-1430	Surface to 3	5.4 – 16.5	0.2 – 27.3	5.2 – 14.5
	Mean ± 1SE					11.4 ± 1.0	6.7 ± 2.8	10.5 ± 0.6
Lower River BS Zone #3	61	8 Mar – 29 Mar	5	1255-1420	Surface to 2	5.5 – 8.1	0.2 – 28.8	8.1 – 14.3
	Mean ± 1SE					6.7± 0.5	8.9 ± 5.6	12.0 ± 1.2
Lower River BS Zone #3	65	23 May	1	1230	Surface	12.2	0.3	13.0
	Mean ± 1SE					12.2	0.3	13.0

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Lower River BS Zone #3	66	23 May	1	1300	Surface	14.3	1.8	13.1
	Mean ± 1SE					14.3	1.8	13.1
All Lower River BS Zone #3		8 Mar – 13 Aug	61	0815-1430	Surface to 3	5.4 – 21.7	0.1 – 28.8	5.2 – 15.0
	Mean ± 1SE					11.7 ± 0.6	4.4 ± 1.1	11.2 ± 0.3
Estuary BS Zone #4	16	22 Mar	2	1305	Surface to 0.5	6.0 – 6.2	0.7 – 1.3	13.3-14.1
	Mean ± 1SE					6.1	1.0	13.7
Estuary BS Zone #4	20	6 Mar – 30 Jul	17	0943-1710	Surface to 2	5.9 – 20.8	0.6 – 26.2	7.4 – 14.1
	Mean ± 1SE					15.0 ± 1.4	8.6 ± 2.0	10.7 ± 0.4
Estuary BS Zone #4	40	13 Mar – 18 Jun	6	0855-1640	Surface to 0.75	6.2 – 22.8	0.1 – 22.6	9.5 – 13.0
	Mean ± 1SE					12.4 ± 3.3	13.8 ± 3.6	11.1 ± 0.5

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
All Estuary BS Zone #4		6 Mar – 30 Jul	25	0855-1710	Surface to 2	5.9 – 22.8	0.1 -26.2	7.4 – 14.1
	Mean ± 1SE					13.6 ± 1.3	9.2 ± 1.7	11.0 ± 0.4
Estuary West BS Zone #5	2	8 Mar – 11 Jun	11	0940-1150	Surface to 1	6.8 – 13.8	1.3 – 28.8	6.1 – 13.4
	Mean ± 1SE					10.2 ± 0.8	21.6 ± 2.9	10.4 ± 0.8
Estuary West BS Zone #5	3	8 Mar – 17 Jul	8	0920-1135	Surface to 1	6.7 – 17.5	6.2 – 28.7	7.4 – 13.2
	Mean ± 1SE					10.0± 1.6	20.8 ± 2.5	10.0 ± 0.6
Estuary West BS Zone #5	4	16 May – 13 Aug	20	0825-1605	Surface to 2	11.1 – 21.7	10.1 - 28.7	7.1 – 12.1
	Mean ± 1SE					16.6 ± 0.8	21.3 ± 1.2	9.4 ± 0.3
Estuary West BS Zone #5	19	8 Mar – 11 Jun	4	1020-1110	Surface to 0.5	8.2 – 14.1	8.7 – 28.8	8.0 – 10.5
	Mean ± 1SE					11.0 ± 1.6	23.5± 4.9	9.0 ± 0.5

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary West BS Zone #5	39	22 May	1	0900	Surface	11.2	2.2	12.0
Estuary West BS Zone #5	60	8 Mar – 20 Mar	5	1140 – 1350	Surface to 2	7.4 – 7.9	5.6 – 29.2	7.4 – 12.7
	Mean ± 1SE					7.7 ± 0.1	19.7 ± 5.1	10.1 ± 0.9
Estuary West BS Zone #5	62	13 Mar	2	0935	Surface to 0.5	7.9 – 8.3	18.3 - 24.2	10.6 – 11.0
	Mean ± 1SE					8.1	21.3	10.8
Estuary West BS Zone #5	69	25 Jun	2	1006	Surface to 1	16.2 – 16.3	26.9 – 27.3	9.6 – 9.8
	Mean ± 1SE					16.2	27.1	9.7
Estuary West BS Zone #5	75	3 Jul	4	1709	Surface to 3	19.0– 21.0	9.9-26.6	8.9-10.2
	Mean ± 1SE					19.7± 0.5	21.5 ± 3.9	9.2 ± 0.3
All Estuary West BS Zone #5		8 Mar-13 Aug	57	0825-1605	Surface to 3	6.7 – 21.7	1.3 – 29.2	6.1 – 13.4
	Mean ± 1SE					13.1 ± 0.6	21.2 ± 1.0	9.8 ± 0.2

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary East/ Baynes East BS Zone #6	6	6 Mar – 17 Jul	23	0955-1325	Surface to 3	6.8 – 20.5	16.2 - 29.5	6.9 – 12.3
	Mean ± 1SE					11.7 ± 1.6	26.2 ± 1.6	10.1 ± 0.7
Estuary East/ Baynes East BS Zone #6	7	29 Mar – 5 Jun	4	1025-1415	Surface to 0.75	6.9 – 14.4	19.3- 28.5	9.9 – 12.4
	Mean ± 1SE					10.6 ± 1.8	23.4 ± 2.4	11.0 ± 0.6
Estuary East/ Baynes East BS Zone #6	8	6 Mar – 13 Aug	27	1030-1445	Surface to 2	6.9 – 20.0	14.2 - 29.2	7.2 – 11.8
	Mean ± 1SE					12.1± 1.4	24.5 ± 1.7	9.4 ± 0.5
Estuary East/ Baynes East BS Zone #6	9	13 Mar – 23 Jul	9	1120-1524	Surface to 1	7.8 – 18.5	11.8 - 28.5	9.5 – 12.9
	Mean ± 1SE					13.0 ± 1.6	23.1± 1.9	10.6 ± 0.4

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary East/ Baynes East BS Zone #6	15	6 Mar – 7 Jun	13	0835 - 1305	Surface to 2	8.3 – 16.8	15.7 – 29.4	8.6 – 12.2
	Mean ± 1SE					11.7 ± 0.8	25.8 ± 1.4	10.4 ± 0.3
Estuary East/ Baynes East BS Zone #6	29	20 Jun – 9 Jul	5	1145 - 1523	Surface to 2	17.4 – 21.4	25.8 – 26.4	8.7 – 10.8
	Mean ± 1SE					19.6 ± 0.9	26.1 ± 0.1	9.8 ± 0.4
Estuary East/ Baynes East BS Zone #6	30	9 Jul	2	1427	Surface to 1	20.2 – 21.5	25.5 – 25.8	7.8 – 8.2
	Mean ± 1SE					20.9	25.7	8.0
Estuary East/ Baynes East BS Zone #6	31	9 Jul	2	1330	Surface to 1	20.8 – 23.7	26.0	8.1 – 9.1
	Mean ± 1SE					22.3	26.0	8.6

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary East/ Baynes East BS Zone #6	34	7 Jun – 9 Jul	6	1000 - 1248	Surface to 1	13.6 – 21.6	16.3 – 27.3	9.9 – 12.7
	Mean ± 1SE					16.7 ± 1.3	23.0 ± 1.8	10.7 ± 0.4
Estuary East/ Baynes East BS Zone #6	38	17 Jul – 23 Jul	9	0833-1009	Surface to 5	13.3 - 17.2	23.6 - 28.5	5.1 – 9.9
	Mean ± 1SE					15.7 ± 0.5	26.9 ± 0.6	7.9 ± 0.5
Estuary East/ Baynes East BS Zone #6	64	23 May	3	1130	Surface to 2	13.4 - 14.8	13.0 - 27.8	11.6 – 12.6
	Mean ± 1SE					14.2 ± 0.4	21.6 ± 4.4	12.0 ± 0.3
Estuary East/ Baynes East BS Zone #6	68	17 Jul – 13 Aug	7	0830-0915	Surface to 4	15.0 - 20.6	21.8- 27.5	7.6 – 10.9
	Mean ± 1SE					17.5 ± 0.7	25.1 ± 0.8	9.3 ± 0.5

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary East/ Baynes East BS Zone #6	70	27 Jun – 3 Jul	8	0853 - 1513	Surface to 3	15.0 – 19.7	24.4 – 27.7	11.3 – 12.0
		Mean ± 1SE				16.8 ± 0.7	26.8 ± 0.4	11.6 ± 0.1
All Estuary East/ Baynes East BS Zone #6		16 Mar- 13 Aug	118	0830 - 1524	Surface to 5	6.8 – 23.7	11.8 – 29.5	5.1 – 12.9
	Mean ± 1SE					13.1 ± 0.4	25.2 ± 0.5	9.8 ± 0.2
Baynes West BS Zone #7	25	20 Jun – 9 Jul	5	1110 – 1630	Surface to 2	16.8 – 18.7	26.4 – 26.8	9.6 – 12.4
	Mean ± 1SE					17.4 ± 0.4	26.5 ± 0.1	10.7 ± 0.5
Baynes West BS Zone #7	26	20 Jun	3	1013	Surface to 2	16.7 – 17.0	26.3 – 26.5	9.8 – 10.3
	Mean ± 1SE					16.8 ± 0.1	26.4 ± 0.1	10.1 ± 0.1
Baynes West BS Zone #7	28	9 Jul	2	1546	Surface to 1	19.7 – 21.3	26.2	9.4 – 10.2
	Mean ± 1SE					20.5	26.2	9.8

Table 3 (cont'd).

Region	**Site No.**	**Dates**	**Total # Samples**	**Time (PST)**	**Depth Range (m)**	**Temperature Range (°C)**	**Salinity Range (‰)**	**Oxygen Range (mgL^{-1})**
Baynes West BS Zone #7	32	29 May – 9 Jul	7	0930 - 1738	Surface to 1	11.5 – 21.6	24.7 – 29.6	9.2 – 11.8
	Mean ± 1SE					15.1 ± 1.7	27.7 ± 0.7	10.5 ± 0.3
Baynes West BS Zone #7	33	7 Jun – 9 Jul	5	0845-1708	Surface to 1	11.7-20.8	26.3 – 29.0	10.3 – 11.3
	Mean ± 1SE					16.4 ± 1.5	27.3 ± 0.5	10.7 ± 0.2
Baynes West BS Zone #7	49	19 Jun – 31 Jul	18	0952 - 1210	Surface to 5	15.7 – 19.2	25.6 – 28.8	9.9 – 12.9
	Mean ± 1SE					17.3 ± 0.3	26.8 ± 0.2	11.2 ± 0.2
Baynes West BS Zone #7	67	7 Jun – 9 Jul	6	0843 - 1345	Surface to 1	13.7 – 22.0	25.6 – 28.0	10.3 – 13.1
	Mean ± 1SE					17.6 ± 1.3	26.4 ± 0.4	11.6 ± 0.4
All Baynes West BS Zone #7		29 May – 31 Jul	46	0843 - 1738	Surface to 5	11.5 – 22.0	24.7 – 29.6	9.2 – 13.1
	Mean ± 1SE					17.0 ± 0.4	26.8 ± 0.2	10.9 ± 0.1

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary Mini/PS Baynes Inner PS Zone #8	46	19 Jun – 15 Aug	24	0845-1552	Surface to 5	13.9 – 19.2	16.0 - 28.2	8.6 - 10.8
	Mean ± 1SE					16.3 ± 0.3	25.9 ± 0.5	9.4 ± 0.1
Estuary Mini/PS Baynes Inner PS Zone #8	47	26 Jun – 15 Aug	30	1245 – 1625	Surface to 5	12.3 – 20.9	17.3 – 28.9	8.3 – 13.3
	Mean ± 1SE					16.7 ± 0.4	26.1 ± 0.5	10.5 ± 0.2
Estuary Mini/PS Baynes Inner PS Zone #8	50	4 Jul – 7 Aug	18	0940 - 1210	Surface to 5	13.6 – 18.9	16.8 – 28.5	9.2 – 13.8
	Mean ± 1SE					16.6 ± 0.5	26.7 ± 0.6	11.6 ± 0.4
Estuary Mini/PS Baynes Inner PS Zone #8	51	19 Jun – 14 Aug	18	1014-1245	Surface to 5	15.4 – 20.5	23.9 – 27.0	9.6 – 14.4
	Mean ± 1SE					18.5 ± 0.4	25.6 ± 0.3	10.8 ± 0.3

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth Range (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary Mini/PS Baynes Inner PS Zone #8	52	4 Jul – 14 Aug	12	1020 - 1110	Surface to 5	16.4 – 20.4	22.0 – 26.7	10.1 – 13.4
	Mean ± 1SE					18.9 ± 0.3	25.1 ± 4.1	10.9 ± 0.3
Estuary Mini/PS Baynes Inner PS Zone #8	55	26 Jun – 14 Aug	18	1154 - 1555	Surface to 5	14.4 – 21.9	22.4 – 28.4	9.5 – 13.2
	Mean ± 1SE					18.5 ± 0.5	25.6 ± 0.5	11.6 ± 0.3
Estuary Mini/PS Baynes Inner PS Zone #8	56	10 Jul-15 Aug	30	0847-1339	Surface to 5	13.3-20.0	19.7-28.6	7.5-14.4
	Mean ± 1SE					16.9 ± 0.3	25.8 ± 0.4	10.9 ± 0.3
Estuary Mini/PS Baynes Inner PS Zone #8	57	18 Jul – 7Aug	18	1100-1420	Surface to 5	13.2-17.6	23.9-28.5	8.6-12.3
	Mean ± 1SE					16.0 ± 0.4	26.5± 0.4	9.8 ± 0.3

Table 3 (cont'd).

Region	**Site No.**	**Dates**	**Total # Samples**	**Time (PST)**	**Depth (m)**	**Temperature Range (°C)**	**Salinity Range (‰)**	**Oxygen Range (mgL^{-1})**
Estuary Mini/PS Baynes Inner PS Zone #8	58	16 Jul – 14 Aug	18	1235 - 1255	Surface to 5	16.0 – 20.6	21.2 – 27.5	9.1 – 12.2
	Mean ± 1SE					18.3 ± 0.3	25.4 ± 0.4	10.4 ± 0.2
Estuary Mini/PS Baynes Inner PS Zone #8	71	3 Jul	4	1529	Surface to 3	18.3-18.5	26.3-26.4	9.1-10.9
	Mean ± 1SE					18.4± 0.1	26.4 ± 0	10.2 ± 0.4
Estuary Mini/PS Baynes Inner PS Zone #8	72	3 Jul	4	1600	Surface to 3	16.5-19.3	25.5-27.4	10.4-11.7
	Mean ± 1SE					17.7 ± 0.7	26.6 ± 0.4	11.1 ± 0.3
Estuary Mini/PS Baynes Inner PS Zone #8	73	3 Jul	4	1630	Surface to 3	17.0-18.9	25.8-27.2	10.5-11.3
	Mean ± 1SE					18.2 ± 0.4	26.5 ± 0.3	10.8 ± 0.2

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Estuary Mini/PS Baynes Inner PS Zone #8	73B	26 Jun-15 Aug	30	1204-1715	Surface to 5	14.6-21.7	23.4-27.9	7.6-11.6
	Mean ± 1SE					17.0 ± 0.3	26.3 ± 0.2	9.9 ± 0.2
Estuary Mini/PS Baynes Inner PS Zone #8	74	3 Jul	4	1645	Surface to 3	18.4-19.9	24.3-26.5	9.3-10.5
	Mean ± 1SE					19.0 ± 0.3	25.8 ± 0.5	10.1± 0.3
Estuary Mini/PS Baynes Inner PS Zone #8	78	14 Aug	6	0914	Surface to 5	16.7 – 18.1	25.4 – 26.7	10.4 – 11.4
	Mean ± 1SE					17.5 ± 0.2	26.1 ± 0.2	11.0 ± 0.2
All Estuary Mini/PS Baynes Inner PS Zone #8		19 Jun-15 Aug	237	0845 - 1645	Surface to 5	12.3 – 21.9	16.0 – 28.9	7.5 – 14.4
	Mean ± 1SE					17.3 ± 0.1	26.0 ± 0.1	10.5 ± 0.1

Table 3 (cont'd).

Region	Site No.	Dates	Total # Samples	Time (PST)	Depth (m)	Temperature Range (°C)	Salinity Range (‰)	Oxygen Range (mgL^{-1})
Baynes Outer PS Zone #9	35	16 Jul – 31 Jul	12	0852 - 0920	Surface to 5	11.4 – 17.0	27.1 – 29.0	7.1 – 10.7
	Mean ± 1SE					14.8 ± 0.5	27.7 ± 0.2	9.5 ± 0.4
Baynes Outer PS Zone #9	48	4 Jul – 7 Aug	18	0900 - 1040	Surface to 5	12.7 – 18.1	26.8 – 28.7	8.3 – 13.8
	Mean ± 1SE					15.9 ± 0.5	27.7 ± 0.2	10.9 ± 0.4
Baynes Outer PS Zone #9	53	19 Jun - 14 Aug	24	0840 - 1000	Surface to 5	12.9 – 17.4	25.6 – 28.4	9.0 – 12.8
	Mean ± 1SE					15.6 ± 0.3	27.3 ± 0.2	10.3 ± 0.2
Baynes Outer PS Zone #9	59	31 Jul – 7Aug	12	0845 - 1011	Surface to 5	13.7 - 17.7	25.7 – 27.9	9.0 – 10.7
	Mean ± 1SE					15.2 ± 0.5	27.3 ± 0.2	9.8 ± 0.2
Baynes Outer PS Zone #9	76	25 Jun	2	1035	Surface to 1	16.2 – 16.3	27.2 – 27.3	9.5 – 9.7
	Mean ± 1SE					16.3	27.3	9.6
Baynes Outer PS Zone #9	77B	26 Jun	6	1630	Surface to 5	12.5-17.5	26.9 - 28.9	9.4-12.5
	Mean ± 1SE					14.8 ± 0.9	28.0 ± 0.4	11.1 ± 0.4

Table 3 (cont'd).

Region	**Site No.**	**Dates**	**Total # Samples**	**Time (PST)**	**Depth (m)**	**Temperature Range (°C)**	**Salinity Range (‰)**	**Oxygen Range (mgL^{-1})**
All Baynes Outer PS Zone #9		19 Jun – 14 Aug	74	0840 - 1630	Surface to 5	11.4 – 18.1	25.6 – 29.0	7.1 – 13.8
	Mean ± 1SE					15.4 ± 0.2	27.5 ± 0.1	10.4 ± 0.2
All sites		6 Mar – 15 Aug	730	0805 - 1738	Surface to 5	4.5 – 23.7	0 – 29.6	5.1 – 15.1
	Mean ± 1SE					14.8 ± 0.2	19.4 ± 0.4	10.6 ± 0.1

Table 4. Total catch of salmonid species by salinity region for the 2001 survey.

Region	Sites	Chinook	Chum	Coho	Pink	Cutthroat	Rainbow	Sockeye	Steelhead	Unident Salmon	All Salmonids
Upper River BS Zone #1	1, 1A, 17, 24	166	186	120	26	0	0	0	1	0	499
Mid River BS Zone #2	21, 42B	41	37	426	0	5	0	0	0	0	509
Lower River BS Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	1033	35	144	6	54	0	1	19	0	1292
Estuary BS Zone #4	16, 20, 40	3	50	13	18	17	0	0	0	0	101
Estuary West BS Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	62	286	36	36	1	0	0	1	0	422
Estuary East/ Baynes East BS Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	180	329	506	2745	7	0	0	0	0	3,767

Table 4 (cont;d).

Region	Sites	Chinook	Chum	Coho	Pink	Cutthroat	Rainbow	Sockeye	Steelhead	Unident Salmon	All Salmonids
Baynes West BS Zone #7	25, 26, 28, 32, 33, 49, 67	26	1	0	0	0	0	0	0	0	27
Estuary Mini/PS, Baynes Inner PS Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	42	64	34	0	0	0	0	0	1	141
Baynes Outer PS Zone #9	35, 48, 53, 59, 76, 77B	36	16	7	0	0	0	0	0	1	60
All Regions		1589	1004	1286	2831	84	0	1	21	2	6818

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/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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 BS Zone #1																			
1	22	104	4.7 ± 2.0	61.9	26	1.2 ± 0.7	15.5	36	1.6 ± 0.8	21.4	1	0.05 ± 0.05	0.6	0	0	0	0	0	0
1A	3	0	0	0	68	22.7 ± 11.3	46.9	70	23.3 ± 22.3	48.3	7	2.3 ± 1.9	4.8	0	0	0	0	0	0
17	22	39	1.8 ± 1.0	30.7	60	2.7 ± 0.9	47.2	11	0.5 ± 0.2	8.7	17	0.8 ± 0.4	13.4	0	0	0	0	0	0
24	18	23	1.3 ± 0.6	39.0	32	1.8 ± 0.9	54.2	3	0.2 ± 0.1	5.1	1	0.06 ± 0.06	1.7	0	0	0	0	0	0
All	65	166	2.6 ± 0.8	33.3	186	2.9 ± 0.8	37.3	120	2.4 ± 1.2	24.1	26	0.4 ± 0.2	5.2	0	0	0	0	0	0
Mid River BS Zone #2																			
21	24	25	1.0 ± 0.4	17.4	5	0.2 ± 0.1	3.5	110	4.6 ± 1.9	76.4	0	0	0	4	0.2 ± 0.1	2.8	0	0	0
42B	6	16	2.7 ± 2.5	4.4	32	5.3 ± 4.8	8.8	316	52.7 ± 15.9	86.6	0	0	0	1	0.2 ± 0.2	0.3	0	0	0
All	30	41	1.4 ± 0.6	8.1	37	1.2 ± 1.0	7.3	426	14.2 ± 4.9	83.7	0	0	0	5	0.2 ± 0.1	1.0	0	0	0

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Upper River BS Zone #1													
1	22	0	0	0	1	0.05 ± 0.05	0.6	0	0	0	168	7.6 ± 2.7	33.7
1A	3	0	0	0	0	0	0	0	0	0	145	48.3± 12.4	29.1
17	22	0	0	0	0	0	0	0	0	0	127	5.3 ± 1.3	25.5
24	18	0	0	0	0	0	0	0	0	0	59	3.3 ± 1.0	11.8
All	65	0	0	0	1	0.02 ± 0.02	0.2	0	0	0	499	7.7 ± 1.6	100
Mid River BS Zone #2													
21	24	0	0	0	0	0	0	0	0	0	144	6.0 ± 2.3	28.3
42B	6	0	0	0	0	0	0	0	0	0	365	60.8 ± 22.2	71.7
All	30	0	0	0	0	0	0	0	0	0	509	17.0 ± 6.1	100

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Lower River BS Zone #3																			
11	**20**	**753**	**37.7 ± 33.2**	**86.3**	**16**	**0.8 ± 0.4**	**1.8**	**61**	**3.1 ± 1.8**	**7.0**	**0**	**0**	**0**	**24**	**1.2 ± 0.9**	**2.8**	**0**	**0**	**0**
12	**6**	**23**	**3.8 ± 3.6**	**39.0**	**1**	**0.2 ± 0.2**	**1.7**	**35**	**5.8 ± 5.1**	**59.3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
14	**5**	**1**	**0.2 ± 0.2**	**7.1**	**1**	**0.2 ± 0.2**	**7.1**	**12**	**2.4 ± 1.7**	**85.7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
18	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.5**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
22	**12**	**256**	**21.3 ± 10.4**	**77.3**	**12**	**1.0 ± 0.5**	**3.6**	**28**	**2.3 ± 1.4**	**8.5**	**5**	**0.4 ± 0.4**	**1.5**	**30**	**2.5 ± 1.2**	**9.1**	**0**	**0**	**0**
61	**4**	**0**	**0**	**0**	**5**	**1.3 ± 0.9**	**62.5**	**2**	**0.5 ± 0.3**	**25.0**	**1**	**0.3 ± 0.3**	**12.5**	**0**	**0**	**0**	**0**	**0**	**0**
63	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
65	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1.5**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
66	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1.0**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
All	**54**	**1033**	**19.1 ± 12.5**	**80.0**	**35**	**0.6 ± 0.2**	**2.7**	**144**	**2.7 ± 0.9**	**11.2**	**6**	**0.1 ± 0.1**	**0.5**	**54**	**1.0 ± 0.4**	**4.2**	**0**	**0**	**0**
Est BS Zone #4																			
16	**2**	**0**	**0**	**0**	**31**	**15.5**	**93.9**	**0**	**0**	**0**	**2**	**1.0**	**6.1**	**0**	**0**	**0**	**0**	**0**	**0**
20	**12**	**3**	**0.3 ± 0.2**	**4.5**	**18**	**1.5 ± 1.5**	**26.9**	**13**	**1.1 ± 0.8**	**19.4**	**16**	**1.3 ± 1.3**	**23.9**	**17**	**1.4 ± 1.2**	**25.4**	**0**	**0**	**0**
40	**6**	**0**	**0**	**0**	**1**	**0.2 ± 0.2**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Est BS Zone #4																			
All	20	3	0.2 ± 0.1	3.0	50	2.5 ± 1.7	49.5	13	0.6 ± 0.5	12.9	18	0.9 ± 0.8	17.8	17	0.9 ± 0.7	16.8	0	0	0

Table 5 (cont'd).

Region/ Site No.	No. Sets	Sockeye Tot	Sockeye CPUE ± 1SE	Sockeye % Pop	Steelhead Tot	Steelhead CPUE ± 1SE	Steelhead % Pop	Unidentified Salmon Tot	Unidentified Salmon CPUE ± 1SE	Unidentified Salmon % Pop	All Salmonids Tot	All Salmonids CPUE ± 1SE	All Salmonids % Pop
Lower River BS Zone #3													
11	**20**	**0**	**0**	**0**	**19**	**1.0 ± 0.9**	**2.2**	**0**	**0**	**0**	**873**	**43.6 ± 36.7**	**67.6**
12	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**59**	**9.8 ± 5.7**	**4.5**
14	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**2.8 ± 1.6**	**1.1**
18	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.5**	**0.1**
22	**12**	**1**	**0.1 ± 0.1**	**0**		**0**	**0**	**0**	**0**	**0**	**332**	**27.6 ± 11.3**	**25.6**
61	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**2.0 ± 1.1**	**0.6**
63	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
65	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1.5**	**0.2**
66	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1.0**	**0.2**
All	**54**	**1**	**0.02 ± 0.02**	**0.1**	**19**	**0.4 ± 0.3**	**1.5**	**0**	**0**	**0**	**129 2**	**23.9 ± 13.8**	**100**
Est BS Zone #4													
16	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**33**	**16.5**	**32.7**
20	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**5.6 ± 2.9**	**66.3**
40	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.2 ± 0.2**	**1.0**

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Est BS Zone #4													
All	20	0	0	0	0	0	0	0	0	0	101	5.1 ± 2.3	100

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Est West BS Zone #5																			
2	12	1	0.1 ± 0.1	7.1	12	1.0 ± 0.5	85.7	1	0.1 ± 0.1	7.1	0	0	0	0	0	0	0	0	0
3	8	2	0.3 ± 0.2	0.7	261	32.6 ± 24.1	88.5	0	0	0	32	4.0 ± 2.6	10.9	0	0	0	0	0	0
4	18	24	1.3 ± 0.6	41.4	1	0.06 ± 0.06	1.7	31	1.7 ± 1.4	53.5	0	0	0	1	0.06 ± 0.06	1.7	0	0	0
19	4	34	8.5 ± 5.7	97.1	0	0	0	1	0.3 ± 0.3	2.9	0	0	0	0	0	0	0	0	0
39	2	0	0	0	9	4.5	75.0	3	1.5	25.0	0	0	0	0	0	0	0	0	0
60	4	1	0.3 ± 0.3	20.0	2	0.5± 0.3	40.0	0	0	0	2	0.5 ± 0.5	40.0	0	0	0	0	0	0
62	2	0	0	0	1	0.5	33.3	0	0	0	2	1.0	66.6	0	0	0	0	0	0
69	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All	54	62	1.1 ± 0.5	14.7	286	5.3 ± 3.7	67.8	36	0.7 ± 0.5	8.5	36	0.7 ± 0.4	8.5	1	0.02 ± 0.02	0.2	0	0	0

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Est West BS Zone #5													
2	12	0	0	0	0	0	0	0	0	0	14	1.2 ± 0.5	3.3
3	8	0	0	0	0	0	0	0	0	0	295	36.9 ± 26.8	69.9
4	18	0	0	0	1	0.1 ± 0.1	1.7	0	0	0	58	3.2 ± 1.5	13.7
19	4	0	0	0	0	0	0	0	0	0	35	8.5 ± 5.7	8.3
39	2	0	0	0	0	0	0	0	0	0	12	6.0	2.8
60	4	0	0	0	0	0	0	0	0	0	5	1.3 ± 0.6	1.2
62	2	0	0	0	0	0	0	0	0	0	3	1.5	0.7
69	2	0	0	0	0	0	0	0	0	0	0	0	0
75	2	0	0	0	0	0	0	0	0	0	0	0	0
All	54	0	0	0	1	0.02 ± 0.02	0.2	0	0	0	422	7.8 ± 4.2	100

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Est East/ Baynes East BS Zone #6																			
6	20	41	2.1 ± 1.3	11.4	57	2.9 ± 1.9	15.9	235	11.8± 10.8	65.5	20	1.0 ± 0.7	5.6	6	0.3 ± 0.3	1.7	0	0	0
7	6	1	0.2 ± 0.2	6.7	13	2.2± 1.5	86.7	0	0	0	1	0.2 ± 0.2	6.7	0	0	0	0	0	0
8	22	18	0.8 ± 0.7	0.6	71	3.2 ± 1.6	2.5	64	2.9 ± 2.0	2.3	264 6	120.3 ± 66.9	94.5	0	0	0	0	0	0
9	10	33	3.3 ± 2.9	62.3	3	0.3 ± 0.3	5.7	3	0.3 ± 0.3	5.7	14	1.4 ± 0.8	26.4	0	0	0	0	0	0
15	14	46	3.3 ± 2.6	11.6	168	12.0 ± 8.1	42.3	119	8.5 ± 5.3	30.0	64	4.6 ± 4.1	16.1	0	0	0	0	0	0
29	4	19	4.8 ± 2.8	67.9	8	2.0 ± 2.0	28.6	1	0.3 ± 0.3	3.6	0	0	0	0	0	0	0	0	0
30	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	6	9	1.5 ± 1.5	14.1	0	0	0	55	9.2 ± 9.2	85.9	0	0	0	0	0	0	0	0	0
38	4	8	2.0 ± 0.7	80.0	0	0	0	2	0.5 ± 0.5	20.0	0	0	0	0	0	0	0	0	0
64	2	0	0	0	9	4.5	24.3	27	13.5	73.0	0	0	0	1	0.5	2.7	0	0	0
68	4	3	0.8 ± 0.8	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	4	2	0.5 ± 0.3	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Est East/ Baynes East BS Zone #6																			
All	**98**	**180**	**1.8 ± 0.6**	**4.8**	**329**	**3.4 ± 1.3**	**8.7**	**506**	**5.2 ± 2.4**	**13.4**	**274 5**	**28.0 ± 15.6**	**72.9**	**7**	**0.07 ± 0.06**	**0.2**	**0**	**0**	**0**

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Est East/ Baynes East BS Zone #6													
6	20	0	0	0	0	0	0	0	0	0	359	18.0 ± 11.4	9.5
7	6	0	0	0	0	0	0	0	0	0	15	2.5 ± 1.5	0.4
8	22	0	0	0	0	0	0	0	0	0	279 9	127.8 ± 68.2	74.3
9	10	0	0	0	0	0	0	0	0	0	53	5.3 ± 2.9	1.4
15	14	0	0	0	0	0	0	0	0	0	397	28.3 ± 13.4	10.5
29	4	0	0	0	0	0	0	0	0	0	28	7.0 ± 4.1	0.7
30	2	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0
34	6	0	0	0	0	0	0	0	0	0	64	10.7 ± 10.7	1.7
38	4	0	0	0	0	0	0	0	0	0	10	2.5 ± 0.6	0.3
64	2	0	0	0	0	0	0	0	0	0	37	18.5	1.0
68	4	0	0	0	0	0	0	0	0	0	3	0.8± 0.8	0.08
70	4	0	0	0	0	0	0	0	0	0	2	0.5 ± 0.3	0.05

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Est East/ Baynes East BS Zone #6													
All	**98**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3767**	**38.4 ± 16.0**	**100**

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Baynes West BS Zone #7																			
25	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	2	0	0	0	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
32	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	6	1	0.2 ± 0.2	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	3	8	2.7 ± 2.2	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	6	17	2.8 ± 1.9	94.4	1	0.2 ± 0.2	5.6	0	0	0	0	0	0	0	0	0	0	0	0
All	31	26	0.8 ± 0.4	96.3	1	0.03 ± 0.03	3.7	0	0	0	0	0	0	0	0	0	0	0	0

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Baynes West BS Zone #7													
25	4	0	0	0	0	0	0	0	0	0	0	0	0
26	2	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
32	8	0	0	0	0	0	0	0	0	0	0	0	0
33	6	0	0	0	0	0	0	0	0	0	1	0.2 ± 0.2	3.7
49	3	0	0	0	0	0	0	0	0	0	8	2.7 ± 2.2	29.6
67	6	0	0	0	0	0	0	0	0	0	18	3.0 ± 2.0	66.7
All	31	0	0	0	0	0	0	0	0	0	27	0.9 ± 0.5	100

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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 Mini/PS, Baynes Inner PS Zone #8																			
46	4	5	1.3 ± 1.3	83.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	6	18	3.8 ± 1.4	28.6	15	2.5 ± 2.5	23.8	30	5.0 ± 3.3	47.2	0	0	0	0	0	0	0	0	0
50	3	1	0.3 ± 0.3	50.0	1	0.3 ± 0.3	50.0	0	0	0	0	0	0	0	0	0	0	0	0
51	3	1	0.3 ± 0.3	33.3	1	0.3 ± 0.3	33.3	1	0.3 ± 0.3	33.3	0	0	0	0	0	0	0	0	0
52	2	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	33.3	2	0.7 ± 0.3	66.7	0	0	0	0	0	0	0	0	0	0	0	0
56	7	9	1.3 ± 0.6	33.3	15	2.1 ± 1.7	55.6	3	0.4 ± 0.3	11.1	0	0	0	0	0	0	0	0	0
57	3	2	0.7 ± 0.7	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	2	2	0.7 ± 0.7	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73B	5	3	0.6 ± 0.4	9.1	30	6.0 ± 4.8	90.9	0	0	0	0	0	0	0	0	0	0	0	0
74	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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 Mini/PS, Baynes Inner PS Zone #8																			
All	**49**	**42**	**0.8 ± 0.3**	**29.8**	**64**	**1.3 ± 0.6**	**45.4**	**34**	**0.2 ± 0.1**	**24.1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Estuary Mini/PS, Baynes Inner PS Zone #8													
46	4	0	0	0	0	0	0	1	0.3 ± 0.3	16.7	6	1.5 ± 1.2	4.3
47	6	0	0	0	0	0	0	0	0	0	63	10.5 ± 6.3	44.7
50	3	0	0	0	0	0	0	0	0	0	2	0.7 ± 0.3	1.4
51	3	0	0	0	0	0	0	0	0	0	3	1.0 ± 1.0	2.1
52	2	0	0	0	0	0	0	0	0	0	0	0	0
55	3	0	0	0	0	0	0	0	0	0	3	1.0 ± 0.6	2.1
56	7	0	0	0	0	0	0	0	0	0	27	3.9 ± 2.1	19.2
57	3	0	0	0	0	0	0	0	0	0	2	0.7 ± 0.7	1.4
58	3	0	0	0	0	0	0	0	0	0	2	0.7 ± 0.7	1.4
71	3	0	0	0	0	0	0	0	0	0	0	0	0
72	3	0	0	0	0	0	0	0	0	0	0	0	0
73	2	0	0	0	0	0	0	0	0	0	0	0	0
73B	5	0	0	0	0	0	0	0	0	0	33	6.6 ± 5.1	23.4
74	2	0	0	0	0	0	0	0	0	0	0	0	0
78	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 5 (cont'd).

Region/ Site No.		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Estuary Mini/PS, Baynes Inner PS Zone #8													
All	**49**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.02 ± 0.02**	**0.7**	**141**	**2.7 ± 1.0**	**100**

Table 5 (cont'd).

Region/ Site No.		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Baynes Outer PS Zone #9																			
35	2	8	4.0	33.3	12	6.0	50.0	4	2.0	16.7	0	0	0	0	0	0	0	0	0
48	3	0	0	0	0	0	0	1	0.3 ± 0.3	50.0	0	0	0	0	0	0	0	0	0
53	4	11	2.8 ± 2.8	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	2	9	4.5	75.0	1	0.5	8.3	2	1.0	16.7	0	0	0	0	0	0	0	0	0
76	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77B	1	8	8.0	72.7	3	3.0	27.3	0	0	0	0	0	0	0	0	0	0	0	0
All	14	36	2.6 ± 1.1	60.0	16	1.1 ± 0.9	26.7	7	0.4 ± 0.3	11.7	0	0	0	0	0	0	0	0	0
All sites	416	1589	3.8 ± 1.7	23.3	1004	2.4 ± 0.6	14.7	1286	3.0 ± 0.7	18.9	2831	6.8 ± 3.7	41.5	84	0.2 ± 0.07	1.2	0	0	0

Table 5 (cont'd).

Region/ Site No.	No. Sets	Sockeye Tot	Sockeye CPUE ± 1SE	Sockeye % Pop	Steelhead Tot	Steelhead CPUE ± 1SE	Steelhead % Pop	Unidentified Salmon Tot	Unidentified Salmon CPUE ± 1SE	Unidentified Salmon % Pop	All Salmonids Tot	All Salmonids CPUE ± 1SE	All Salmonids % Pop
Baynes Outer PS Zone #9													
35	2	0	0	0	0	0	0	0	0	0	24	12.0	40.0
48	3	0	0	0	0	0	0	1	0.3 ± 0.3	50.0	2	0.7 ± 0.3	3.3
53	4	0	0	0	0	0	0	0	0	0	11	2.8 ± 2.8	18.3
59	2	0	0	0	0	0	0	0	0	0	12	6.0	20.0
76	2	0	0	0	0	0	0	0	0	0	0	0	0
77B	1	0	0	0	0	0	0	0	0	0	11	11.0	18.3
All	14	0	0	0	0	0	0	1	0.07 ± 0.07	1.7	60	4.2 ± 2.0	100.0
All sites	416	1	<0.01	<0.1	21	0.05± 0.04	0.3	2	<0.01	<0.1	6818		100.0

Table 6. Total catch, CPUE ± 1SE and percent of total population for each species of salmonid by date for beach seines.

Date		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Mar 6	16	0	0	0	24	1.5 ± 0.7	3.0	0	0	0	788	49.3 ± 46.7	97.0	0	0	0	0	0	0
Mar 8	15	0	0	0	6	0.4± 0.2	37.5	0	0	0	10	0.7 ± 0.4	62.5	0	0	0	0	0	0
Mar 13	15	0	0	0	94	6.3 ± 3.1	4.7	0	0	0	189 7	126.5± 86.7	95.3	0	0	0	0	0	0
Mar 15	15	0	0	0	121	8.1 ± 3.0	75.2	3	0.2 ± 0.1	1.9	37	2.5 ± 1.2	23.0	0	0	0	0	0	0
Mar 20	14	1	0.1 ± 0.1	0.5	128	9.1 ± 7.6	65.0	2	0.1 ± 0.1	1.0	66	4.7 ± 4.1	33.5	0	0	0	0	0	0
Mar 22	14	0	0	0	70	5.0 ± 2.1	95.9	1	7.1 ± 7.1	1.4	2	14.3 ± 14.3	2.7	0	0	0	0	0	0
Mar 29	14	2	0.1 ± 0.1	<0.1	280	20.0 ± 14.0	88.9	2	0.1 ± 0.1	0.6	31	2.2 ± 1.5	9.8	0	0	0	0	0	0
May 14	10	41	4.1± 1.7	10.9	77	7.7± 3.1	20.5	254	25.4 ± 12.3	67.7	0	0	0	3	0.3 ± 0.2	0.8	0	0	0
May 16	14	0	0	0	16	1.1 ± 0.9	18.0	72	5.1 ± 2.3	80.9	0	0	0	0	0	0	0	0	0
May 22	12	1	0.1 ± 0.1	0.7	17	1.4 ± 0.8	11.9	125	10.4 ± 4.5	87.4	0	0	0	0	0	0	0	0	0
May 23	11	2	0.2 ± 0.2	1.5	12	1.1 ± 0.6	8.8	122	11.1 ± 7.6	89.1	0	0	0	1	0.1 ± 0.1	0.7	0	0	0
May 28	12	85	7.1 ± 2.8	58.2	13	1.1 ± 0.5	8.9	44	3.7 ± 1.1	30.1	0	0	0	4	0.3 ± 0.3	2.7	0	0	0

Table 6 (cont'd).

Date		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
May 29	4	0	0	0	45	11.3 ± 11.3	39.1	70	17.5 ± 16.5	60.9	0	0	0	0	0	0	0	0	0
May 30	14	27	1.9 ± 1.6	10.3	8	0.6 ± 0.4	3.0	220	15.7± 15.4	83.7	0	0	0	8	0.6 ± 0.4	3.0	0	0	0
Jun 5	13	3	0.2 ± 0.1	6.4	9	0.7 ± 0.6	19.2	35	2.7 ± 2.2	74.5	0	0	0	0	0	0	0	0	0
Jun 7	10	62	6.2 ± 3.7	50.0	1	0.1 ± 0.1	0.8	61	6.1 ± 5.5	49.2	0	0	0	0	0	0	0	0	0
Jun 11	14	962	68.7 ± 46.9	89.2	2	0.1 ± 0.1	0.2	71	5.1 ± 2.6	6.6	0	0	0	25	1.8 ± 1.3	2.4	0	0	0
Jun 12	8	85	10.6 ± 3.9	95.5	2	0.1 ± 0.1	2.3	2	0.3 ± 0.2	2.3	0	0	0	0	0	0	0	0	0
Jun 18	14	143	10.2 ± 3.1	72.2	0	0	0	18	1.3 ± 0.7	9.1	0	0	0	36	2.6± 1.4	18.2	0	0	0
Jun 20	10	20	2.0 ± 1.3	69.0	8	0.8 ± 0.8	27.6	1	0.1 ± 0.1	3.5	0	0	0	0	0	0	0	0	0
Jun 25	6	3	0.5 ± 0.3	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun 27	12	18	1.5 ± 0.6	38.3	0	0	0	29	2.4 ± 2.1	61.7	0	0	0	0	0	0	0	0	0
Jul 9	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul 11	11	3	0.3 ± 0.3	6.8	0	0	0	40	3.6 ± 3.5	90.9	0	0	0	1	0.1 ± 0.1	2.3	0	0	0
Jul 17	14	22	1.6 ± 0.6	78.6	0	0	0	3	0.2 ± 0.2	10.7	0	0	0	3	0.2 ± 0.2	10.7	0	0	0
Jul 23	10	8	0.8± 0.3	40.0	0	0	0	12	1.2 ± 1.0	60.0	0	0	0	0	0	0	0	0	0

Table 6 (cont'd).

Date		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Jul 30	13	3	0.2 ± 0.2	13.0	0	0	0	19	1.5± 1.3	82.6	0	0	0	1	0.1 ± 0.1	4.4	0	0	0
Aug 13	12	3	0.3 ± 0.2	6.5	0	0	0	40	3.3 ± 2.5	87.0	0	0	0	2	0.2 ± 0.2	4.4	0	0	0
Total	343	149 4	4.4 ± 2.0	22.6	933	2.7± 0.7	14.1	124 6	3.6 ± 0.9	18.8	2835	8.3 ± 4.5	42.9	84	0.2 ± 0.1	1.3	0	0	0

Table 6 (cont'd).

Date		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Mar 6	16	0	0	0	0	0	0	0	0	0	812	50.8 ± 46.7	12.3
Mar 8	15	0	0	0	0	0	0	0	0	0	16	1.1 ± 0.4	0.2
Mar 13	15	0	0	0	0	0	0	0	0	0	1991	132.7 ± 88.8	30.1
Mar 15	15	0	0	0	0	0	0	0	0	0	161	10.7 ± 3.9	2.4
Mar 20	14	0	0	0	0	0	0	0	0	0	197	14.1 ± 11.8	3.0
Mar 22	14	0	0	0	0	0	0	0	0	0	73	5.2 ± 2.2	1.1
Mar 29	14	0	0	0	0	0	0	0	0	0	315	22.5 ± 15.6	4.8
May 14	10	0	0	0	0	0	0	0	0	0	375	37.5 ± 15.4	5.7
May 16	14	0	0	0	1	0.1 ± 0.1	1.1	0	0	0	89	6.4 ± 2.3	1.4
May 22	12	0	0	0	0	0	0	0	0	0	143	11.9 ± 4.9	2.2
May 23	11	0	0	0	0	0	0	0	0	0	137	12.5± 7.9	2.1
May 28	12	0	0	0	0	0	0	0	0	0	146	12.2 ± 4.0	2.2

Table 6 (cont'd).

Date		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
May 29	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**115**	**28.8 ± 27.8**	**1.7**
May 30	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**263**	**18.8 ± 16.2**	**4.0**
Jun 5	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**47**	**3.6 ± 2.3**	**0.7**
Jun 7	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**124**	**12.4 ± 7.1**	**1.9**
Jun 11	**14**	**0**	**0**	**0**	**19**	**1.4 ± 1.3**	**1.8**	**0**	**0**	**0**	**1079**	**77.1 ± 51.8**	**16.3**
Jun 12	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**89**	**12.7 ± 3.9**	**1.4**
Jun 18	**14**	**1**	**0.1 ± 0.1**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**198**	**14.1 ± 3.5**	**3.0**
Jun 20	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**29**	**2.9 ± 1.9**	**0.4**
Jun 25	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0.5 ± 0.3**	**0.1**
Jun 27	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**47**	**3.9 ± 2.6**	**0.7**
Jul 9	**16**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Jul 11	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**44**	**4.0 ± 3.6**	**0.7**
Jul 17	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**28**	**2.0 ± 0.7**	**0.4**
Jul 23	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**20**	**2.0 ± 1.0**	**0.3**

Table 6 (cont'd).

Date		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE± 1SE	% Pop
Jul 30	13	0	0	0	0	0	0	0	0	0	23	1.8 ± 1.3	0.4
Aug 13	12	0	0	0	1	0.1 ± 0	2.2	0	0	0	46	3.8 ± 2.5	0.7
Total	343	1	<0.1	0.02	21	0.1 ± 0.1	0.3	0	0	0	6610	19.3 ± 5.2	100

Table 7. Total catch, CPUE ± 1SE and percent of total population for each species of salmonid by date for purse seines.

Date		Chinook			Chum			Coho			Pink			Cutthroat			Rainbow		
	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
Jun 19	4	24	6.0 ± 2.1	92.3	1	0.3 ± 0.3	3.9	1	0.3 ± 0.3	3.9	0	0	0	0	0	0	0	0	0
Jun 26	4	21	5.3 ± 2.2	27.6	44	11.0 ± 5.6	57.9	11	2.8 ± 2.8	14.5	0	0	0	0	0	0	0	0	0
Jul 4	4	4	1.0 ± 1.0	17.4	0	0	0	19	4.8 ± 4.8	82.6	0	0	0	0	0	0	0	0	0
Jul 10	6	5	0.8 ± 0.5	62.5	1	0.2 ± 0.2	12.5	2	0.2 ± 0.2	25.0	0	0	0	0	0	0	0	0	0
Jul 16	5	8	1.6 ± 1.6	30.7	13	2.6± 2.4	50.0	5	1.0± 0.8	19.2	0	0	0	0	0	0	0	0	0
Jul 18	7	7	1.0 ± 0.5	26.9	18	2.6 ± 1.7	69.2	1	0.1 ± 0.1	3.9	0	0	0	0	0	0	0	0	0
Jul 25	4	0	0	0	2	0.5 ± 0.3	100	0	0	0	0	0	0	0	0	0	0	0	0
Jul 31	5	11	2.2 ± 1.7	78.6	1	0.2 ± 0.2	7.1	2	0.4 ± 0.4	14.3	0	0	0	0	0	0	0	0	0
Aug 7	5	3	0.6 ± 0.5	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug 14	7	3	0.4 ± 0.4	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug 15	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	55	86		41.6	80		38.7	41		19.8	0	0	0	0	0	0	0	0	0

Table 7 (cont'd).

Date		Sockeye			Steelhead			Unidentified Salmon			All Salmonids		
	No. Sets	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop	Tot	CPUE ± 1SE	% Pop
Jun 19	4	0	0	0	0	0	0	0	0	0	26	6.5 ± 1.7	12.6
Jun 26	4	0	0	0	0	0	0	0	0	0	76	19.0 ± 7.7	36.7
Jul 4	4	0	0	0	0	0	0	0	0	0	23	5.8± 5.8	11.1
Jul 10	6	0	0	0	0	0	0	0	0	0	8	1.3 ± 0.8	3.9
Jul 16	5	0	0	0	0	0	0	0	0	0	26	5.2 ± 4.7	12.6
Jul 18	7	0	0	0	0	0	0	0	0	0	26	3.7 ± 2.1	12.6
Jul 25	4	0	0	0	0	0	0	0	0	0	2	0.5 ± 0.3	1.0
Jul 31	5	0	0	0	0	0	0	0	0	0	14	2.8 ± 2.3	6.8
Aug 7	5	0	0	0	0	0	0	0	0	0	3	0.6 ± 0.5	1.5
Aug 14	7	0	0	0	0	0	0	0	0	0	3	0.4 ± 0.4	1.5
Aug 15	4	0	0	0	0	0	0	0	0	0	0	0	0
Total	55	0	0	0	0	0	0	0	0	0	207	18.8± 6.6	100

Table 8. Total catch and percent of total population for each species of salmonid by date for Gee traps.

Date		Chinook		Chum		Coho		Pink		Cutthroat		Rainbow		Sockeye		Steelhead		Unid		All Salmonids	
	No. Sets	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop
Jan 12	6	0	0	0	0	69	97.2	0	0	0	0	2	2.8	0	0	0	0	0	0	71	100
Jan 18	6	1	1.6	0	0	61	96.8	0	0	0	0	1	1.6	0	0	0	0	0	0	63	100
Jan 27	6	0	0	0	0	102	99.0	0	0	1	1.0	0	0	0	0	0	0	0	0	103	100
Mar 7	2	0	0	0	0	58	100	0	0	0	0	0	0	0	0	0	0	0	0	58	100
Mar 12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar 14	5	0	0	0	0	110	100	0	0	0	0	0	0	0	0	0	0	0	0	110	100
Mar 16	5	0	0	0	0	49	100	0	0	0	0	0	0	0	0	0	0	0	0	49	100
Mar 23	4	0	0	0	0	8	100	0	0	0	0	0	0	0	0	0	0	0	0	8	100
May 24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	36	1	0.2	0	0	457	98.9	0	0	1	0.2	3	0.7	0	0	0	0	0	0	462	100

Table 9. Total catch and percent of total population for each species of salmonid by site for Gee traps.

Site		Chinook		Chum		Coho		Pink		Cutthroat		Rainbow		Sockeye		Steelhead		Unid		All Salmonids	
	No. Sets	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	T ot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop	Tot	% Pop
FS1	6	0	0	0	0	103	100	0	0	0	0	0	0	0	0	0	0	0	0	103	22.3
FS2	7	0	0	0	0	304	100	0	0	0	0	0	0	0	0	0	0	0	0	304	65.8
FS3	6	0	0	0	0	28	100	0	0	1	0	0	0	0	0	0	0	0	0	29	6.3
FS4	6	0	0	0	0	17	100	0	0	0	0	0	0	0	0	0	0	0	0	17	3.7
FS5	3	1	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.3
FS6	6	0	0	0	0	5	62.5	0	0	0	0	3	37.5	0	0	0	0	0	0	8	2.2
FS7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FS8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	36	1	0.3	0	0	457	98.9	0	0	1	0	3	0.8	0	0	0	0	0	0	462	100

Table 10. Mean lengths, weights and condition factors for juvenile salmonids by site, species and salinity region (BS = beach seine, PS = purse seine).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
Upper River BS Zone #1					
1	Chinook	36	60.0 ± 1.8	2.3 ± 0.3	0.97 ± 0.02
"	Coho	31	57.0 ± 3.5	2.5 ± 0.5	0.90 ± 0.03
"	Chum	12	42.4 ± 0.7	0.5 ± 0.04	0.67 ± 0.04
"	Steelhead	1	33	0.4	1.11
"	All	80	55.9 ± 1.7	2.1 ± 0.2	0.90 ± 0.02
1A	Chum	2	41.5	0.4	0.49
"	Coho	10	38.6 ± 0.3	0.5 ± 0.1	0.90 ± 0.09
"	All	12	39.1 ± 0.4	0.5 ± 0.1	0.83 ± 0.09
17	Chinook	17	62.7 ± 3.3	2.7 ± 0.4	0.90 ± 0.05
"	Coho	10	49.2 ± 4.6	1.4 ± 0.5	0.85 ± 0.05
"	Chum	2	41.0	0.4	0.59
"	All	29	56.6 ± 2.8	2.1 ± 0.3	0.86 ± 0.04
24	Chinook	14	72.9 ± 4.4	5.2 ± 0.6	1.03 ± 0.03
"	Coho	3	57.3 ± 21.8	-	-
"	Chum	11	41.3 ± 0.5	0.4 ± 0.02	0.63 ± 0.02
"	All	28	58.8 ± 4.1	3.1 ± 0.6	0.85 ± 0.05
Total for region	Chinook	67	63.4 ± 1.7	2.9 ± 0.3	0.96 ± 0.02
"	Coho	54	51.9 ± 2.5	1.9 ± 0.4	0.89 ± 0.03
"	Chum	27	41.8 ± 0.4	0.5 ± 0.02	0.64 ± 0.02
"	Steelhead	1	33	0.4	1.11
"	All species	149	55.2 ± 1.4	2.1 ± 0.2	0.88 ± 0.02

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
Mid River BS Zone #2					
21	Chinook	24	78.5 ± 2.9	5.4 ± 0.6	1.0 ± 0.01
"	Coho	60	63.4 ± 2.4	3.2 ± 0.4	1.0 ± 0.02
"	Chum	4	41.0 ± 1.4	0.5 ± 0.1	0.6 ± 0.06
"	Cutthroat	2	401.5	40.4	n/a
	All species	90	86.6 ± 11.1	4.9 ± 0.7	1.03 ± 0.01
42B	Chinook	11	57.9 ± 1.7	1.9 ± 0.2	1.0 ± 0.02
"	Coho	64	61.5 ± 1.5	3.1 ± 0.2	1.2 ± 0.01
"	Chum	13	43.1 ± 0.7	0.6 ± 0.04	0.7 ± 0.03
"	Cutthroat	1	161	33.9	0.81
	All species	89	59.6 ± 1.8	2.9 ± 0.4	1.07 ± 0.02
Total for region	Chinook	35	72.0 ± 2.6	4.3 ± 0.5	1.0 ± 0.01
"	Coho	124	62.5 ± 1.4	3.2 ± 0.2	1.09 ± 0.01
"	Chum	17	42.6 ± 0.6	0.5 ± 0.03	0.67 ± 0.02
"	Cutthroat	5	454.2 ± 120.5	38.1 ± 2.5	0.81
"	All species	181	73.3 ± 5.8	3.9 ± 0.4	1.03 ± 0.01

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
Lower River BS Zone #3					
11	Chinook	26	83.5 ± 2.4	6.2 ± 0.5	1.00 ± 0.01
"	Coho	25	108.2 ± 3.4	13.2 ± 1.3	0.98 ± 0.01
"	Chum	4	52.8 ± 2.0	1.2 ± 0.1	0.81 ± 0.01
"	Cutthroat	6	184.8 ± 12.8	65.2 ± 15.2	0.96 ± 0.03
"	Steelhead	2	244.5	23.7	0.88
"	All	63	106.1 ± 6.0	14.7 ± 2.6	0.97 ± 0.01
12	Chinook	10	76.0 ± 0.5	n/a	n/a
"	Coho	11	90.8 ± 2.4	7.1 ± 0.7	0.93 ± 0.02
"	Chum	1	55	n/a	n/a
"	All	22	82.5 ± 2.4	7.1 ± 0.7	0.93 ± 0.02
14	Chinook	1	61	2.0	0.88
"	Coho	12	73.3 ± 2.5	4.6 ± 0.4	1.10 ± 0.01
"	All	13	72.3 ± 2.5	4.4 ± 0.4	1.10 ± 0.02
18	Coho	1	89	7.0	0.99
"	All	1	89	7.0	0.99
22	Chinook	34	81.8 ± 2.0	5.8 ± 0.4	1.02 ± 0.01
"	Coho	19	103.3 ± 4.2	11.7 ± 1.5	0.97 ± 0.02
"	Chum	5	60.2 ± 1.5	1.9 ± 0.3	0.85 ± 0.02

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
22	Cutthroat	11	183.6 ± 8.3	57.1 ± 7.4	0.95 ± 0.04
"	Sockeye	1	66	2.0	0.70
"	All	70	101.9 ± 4.9	14.6 ± 2.4	0.98 ± 0.01
65	Coho	3	93.0 ± 4.0	4.7 ± 3.7	1.06 ± 0.07
65	All	3	93.0 ± 4.0	4.7 ± 3.7	1.06 ± 0.07
66	Coho	2	93.5	8.7	1.06
"	All	2	93.5	8.7	1.06
Total for region	Chinook	71	81.3 ± 1.4	6.0 ± 0.3	1.00 ± 0.01
"	Coho	73	96.9 ± 2.2	10.9 ± 1.1	1.00 ± 0.01
"	Chum	10	56.7 ± 2.0	1.6 ± 0.2	0.83 ± 0.01
"	Cutthroat	17	184.1 ± 6.8	60.1 ± 7.1	0.95 ± 0.03
"	Steelhead	2	244.5	23.7	0.88
"	Sockeye	1	66	2.0	0.70
"	All species	174	98.4 ± 3.0	13.1 ± 1.5	0.98 ± 0.01
Estuary BS Zone #4					
20	Chinook	3	82.7 ± 112.9	6.0 ± 0.9	1.04 ± 0.02
"	Coho	13	76.8 ± 1.7	5.0 ± 0.3	1.09 ± 0.03
"	Cutthroat	14	196.4 ± 9.0	79.3 ± 11.9	0.95 ± 0.02

Table 10 (cont'd).

Site No.	Fish	No.	Mean	Mean	Mean

	Species	of Fish	Length (mm) ± 1SE	Weight (g) ± 1SE	Condition Factor ± 1SE
20	All species	30	133.2 ± 11.8	39.8 ± 8.8	1.02 ± 0.02
Estuary West BS Zone #5					
2	Chinook	1	72	3.3	0.88
"	Coho	2	93.5	7.5	0.87
"	Chum	2	70.0	3.2	0.74
"	All species	5	79.8	4.3 ± 1.4	0.81 ± 0.04
4	Chinook	19	90.8 ± 2.3	8.4 ± 0.8	1.04 ± 0.04
"	Coho	16	126.5 ± 18.7	10.6 ± 1.5	0.98 ± 0.02
"	Chum	2	51	1.1	0.8
"	Cutthroat	1	190	n/a	n/a
"	Steelhead	1	197	68.2	0.89
"	All species	39	108.7 ± 8.9	10.6 ± 2.0	1.00 ± 0.02
19	Chinook	10	87.9 ± 2.1	6.8 ± 0.6	0.98 ± 0.01
"	Coho	1	105	9.7	0.84
"	All species	11	89.5 ± 2.5	7.1 ± 0.6	0.97 ± 0.02
39	Coho	3	63.3 ± 5.2	2.7 ± 0.6	1.02 ± 0.03
"	Chum	9	52.2 ± 3.8	1.2 ± 0.3	0.76 ± 0.01
"	All species	12	55.0 ± 3.3	1.6 ± 0.3	0.82 ± 0.04

Table 10 (cont'd).

Site No.	**Fish Species**	**No. of Fish**	**Mean Length (mm) ± 1SE**	**Mean Weight (g) ± 1SE**	**Mean Condition Factor ± 1SE**
Total for region	Chinook	30	89.2 ± 1.7	7.6 ± 0.6	1.01 ± 0.02
"	Coho	22	113.9 ± 8.0	8.9 ± 1.3	0.97 ± 0.02
"	Chum	13	54.8 ± 4.0	1.5 ± 0.4	0.77 ± 0.02
"	Cutthroat	1	190	n/a	n/a
"	Steelhead	1	197	68.2	0.89
"	All	67	93.7 ± 5.8	7.7 ± 1.2	0.94 ± 0.02
Estuary East/Baynes East BS Zone #6					
6	Chinook	19	96.8 ± 3.7	11.1 ± 1.7	1.09 ± 0.03
"	Coho	29	115.4 ± 2.1	15.7 ± 1.2	1.05 ± 0.03
"	Chum	5	46.6 ± 5.1	0.5 ± 0.1	0.70 ± 0.07
"	Cutthroat	1	137	n/a	n/a
"	Pink	1	32	n/a	n/a
"	All	55	101.6 ± 3.5	12.5 ± 1.2	1.04 ± 0.02
8	Chinook	14	65.7 ± 2.8	3.0 ± 0.4	0.96 ± 0.03
"	Coho	21	97.9 ± 3.0	10.1 ± 1.0	1.02 ± 0.01
"	Chum	19	53.6 ± 1.5	1.4 ± 0.1	0.8 ± 0.02
"	Pink	1	35	n/a	n/a
"	All	55	73.2 ± 3.1	5.4 ± 0.7	0.94 ± 0.02
9	Chinook	14	86.9 ± 1.3	6.8 ± 0.4	1.03 ± 0.03
"	Coho	3	85.7 ± 10.3	7.6 ± 3.1	1.06 ± 0.05
"	Chum	1	62	n/a	n/a

Table 10 (cont'd).

Site No.	**Fish Species**	**No. of Fish**	**Mean Length (mm) ± 1SE**	**Mean Weight (g) ± 1SE**	**Mean Condition Factor ± 1SE**
9	All	18	85.3 ± 2.2	6.9 ± 0.6	1.03 ± 0.02
15	Chinook	17	89.4 ± 1.3	7.4 ± 0.4	1.02 ± 0.03
"	Coho	27	113.7 ± 3.3	16.4 ± 1.6	1.04 ± 0.02
"	Chum	23	62.7 ± 2.5	2.3 ± 0.3	0.82 ± 0.01
"	All	67	90.0 ± 3.1	9.3 ± 1.0	0.96 ± 0.02
29	Chinook	11	104.3 ± 4.2	12.6 ± 2.0	1.03 ± 0.03
"	Coho	1	137	25.7	1.00
"	Chum	8	82.1 ± 3.3	5.6 ± 0.7	0.97 ± 0.02
"	All	20	97.1 ± 4.1	10.4 ± 1.6	1.00 ± 0.02
34	Chinook	9	94.8 ± 1.8	8.8 ± 0.5	1.02 ± 0.03
"	Coho	11	123.2 ± 0.8	18.5 ± 0.4	0.99 ± 0.02
"	All	20	110.4 ± 3.4	14.2 ± 1.2	1.01 ± 0.02
38	Chinook	8	120.6 ± 7.1	23.7 ± 4.4	1.22 ± 0.04
"	Coho	2	123	23.5	1.26
"	All	10	121.1 ± 5.7	23.6 ± 3.5	1.23 ± 0.04
64	Coho	10	97.9 ± 2.8	10.1 ± 0.9	1.06 ± 0.03
"	Chum	9	60.7 ± 2.7	1.7 ± 0.3	0.72 ± 0.05
"	Cutthroat	1	158	35.2	0.89

Table 10 (cont'd).

Site No.	**Fish Species**	**No. of Fish**	**Mean Length (mm) ± 1SE**	**Mean Weight (g) ± 1SE**	**Mean Condition Factor ± 1SE**
64	All	20	84.2 ± 6.0	7.6 ± 1.8	0.90 ± 0.05
68	Chinook	3	83.7 ± 4.4	6.0 ± 0.9	1.01 ± 0.01
"	All	3	83.7 ± 4.4	6.0 ± 0.9	1.01 ± 0.01
70	Chinook	1	106	n/a	n/a
"	All	1	106	n/a	n/a
Total for region	Chinook	96	91.9 ± 1.8	9.5 ± 0.8	1.04 ± 0.01
"	Coho	104	110.0 ± 1.6	14.4 ± 0.7	1.04 ± 0.01
"	Chum	65	60.9 ± 1.6	2.3 ± 0.2	0.82 ± 0.02
"	Cutthroat	2	147.5	35.2	0.89
"	Pink	2	33.5	n/a	n/a
"	All	269	91.2 ± 1.6	9.7 ± 0.5	0.99 ± 0.01
Baynes West BS Zone #7					
33	Chinook	1	93	7.6	0.94
"	All	1	93	7.6	0.94
49	Chinook	8	94.3 ± 3.8	8.4 ± 1.0	0.97 ± 0.04
"	All	8	94.3 ± 3.8	8.4 ± 1.0	0.97 ± 0.04

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
67	Chinook	13	96.0 ± 2.5	9.8 ± 0.8	1.07 ± 0.02
"	Chum	1	73	3.1	0.80
"	All	14	94.4 ± 2.8	9.3 ± 0.9	1.05 ± 0.02
Total for region	Chinook	22	95.2 ± 2.0	4.0 ± 0.9	1.03 ± 0.02
"	Chum	1	73	3.1	0.80
"	All	23	94.3 ± 2.1	8.9 ± 0.6	1.02 ± 0.02
Estuary Purse and Mini/Baynes Inner Purse Zone #8					
46	Chinook	5	91.8 ± 3.5	7.6 ± 0.8	0.97 ± 0.01
"	All	5	91.8 ± 3.5	7.6 ± 0.8	0.97 ± 0.01
47	Chinook	17	109.9 ± 3.7	15.5 ± 1.9	1.09 ± 0.03
"	Coho	20	150.2 ± 2.9	41.1 ± 2.7	1.18 ± 0.02
"	Chum	6	99.2 ± 1.1	9.1 ± 0.5	0.93 ± 0.02
"	All	43	127.1 ± 3.9	26.5 ± 2.6	1.11 ± 0.02
50	Chinook	1	144	31.3	1.05
"	Chum	1	111	13.8	1.01
"	All	2	127.5	22.6	1.03

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
51	Chinook	1	96	8.8	1.03
'	Coho	1	137	25.1	0.98
'	Chum	1	90	7.1	0.97
'	All	3	107.7 ± 14.8	13.7 ± 5.7	0.99 ± 0.02
55	Chinook	1	103	10.5	0.96
"	Chum	2	97.0	9.1	0.96
"	All	3	99.0 ± 4.5	9.6 ± 1.7	0.96 ± 0.06
56	Chinook	9	129.7 ± 9.2	29.1 ± 5.5	1.17 ± 0.03
"	Coho	3	169.3 ± 16.4	57.5 ± 12.1	1.17 ± 0.09
"	Chum	15	119.0 ± 2.1	16.6 ± 1.1	0.97 ± 0.04
"	All	27	128.1 ± 4.6	25.3 ± 3.3	1.06 ± 0.03
57	Chinook	2	168.5	60.5	1.24
"	All	2	168.5	60.5	1.24
58	Chinook	2	154.5	39.8	1.08
"	All		154.5	39.8	1.08
73B	Chinook	3	102.7 ± 59.3	13.6 ± 4.9	1.14 ± 0.05
"	Chum	15	108.1 ± 2.8	13.0 ± 1.1	1.00 ± 0.01

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
73B	All	18	107.2 ± 2.9	13.1 ± 1.1	1.02 ± 0.02
Total for region	Chinook	41	116.8 ± 4.1	20.9 ± 2.5	1.09 ± 0.02
"	Coho	24	152.0 ± 3.3	42.4 ± 2.9	1.17 ± 0.02
"	Chum	40	109.9 ± 1.9	13.5 ± 0.7	0.98 ± 0.02
"	All	105	122.2 ± 2.5	23.0 ± 1.6	1.07 ± 0.01
Baynes Outer Purse and Mini Seines Zone #9					
35	Chinook	8	124.0 ± 2.3	22.0 ± 1.3	1.1 ± 0.01
"	Coho	4	182.0 ± 5.4	73.7 ± 7.2	1.21 ± 0.03
"	Chum	12	129.8 ± 2.0	23.1 ± 1.3	1.04 ± 0.02
"	All	24	136.6 ± 4.5	31.2 ± 4.2	1.11 ± 0.02
48	Coho	1	140	31.4	1.14
"	All	1	140	31.4	1.14
53	Chinook	11	94.4 ± 2.8	8.9 ± 0.8	1.02 ± 0.01
"	All	11	94.4 ± 2.8	8.9 ± 0.8	1.02 ± 0.01

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
59	Chinook	9	174.4 ± 8.2	66.8 ± 10.1	1.19 ± 0.02
"	Coho	2	206.5	110.0	1.23
"	Chum	1	144	23.5	0.79
"	All	12	177.3 ± 7.9	70.4 ± 10.3	1.16 ± 0.04
77B	Chinook	8	103.6 ± 4.0	12.8 ± 1.8	1.10 ± 0.02
"	Chum	3	92.7 ± 3.7	8.1 ± 1.2	1.00 ± 0.03
"	All	11	100.6 ± 3.4	11.5 ± 1.5	1.07 ± 0.02
Total for region	Chinook	36	123.9 ± 5.9	27.2 ± 4.7	1.11 ± 0.01
"	Coho	7	183.0 ± 9.5	78.0 ± 12.0	1.21 ± 0.02
"	Chum	16	123.8 ± 4.3	20.3 ± 1.8	1.02 ± 0.02
"	All	59	130.3 ± 4.6	31.3 ± 3.9	1.10 ± 0.01
Gee Traps					
1	Coho	20	85.2 ± 1.9	5.4 ± 0.5	na
"	All	20	85.2 ± 1.9	5.4 ± 0.5	na
2	Coho	17	66.8 ± 1.5	3.0 ± 0.3	na
"	All	17	66.8 ± 1.5	3.0 ± 0.3	na

Table 10 (cont'd).

Site No.	**Fish Species**	**No. of Fish**	**Mean Length (mm) ± 1SE**	**Mean Weight (g) ± 1SE**	**Mean Condition Factor ± 1SE**
3	Coho	10	77.5 ± 3.0	4.6 ± 0.4	na
"	Cutthroat	1	265	na	na
"	All	11	94.5 ± 17.3	4.6 ± 0.4	na
4	Coho	10	75.4 ± 3.3	na	na
"	All	10	75.4 ± 3.3	na	na
6	Coho	3	86.7 ± 5.7	7.8 ± 3.0	na
	Rainbow	3	143.7 ± 29.6	na	na
"	All	6	75.7 ± 33.2	7.8 ± 3.0	na
Total for Gee traps	Coho	60	76.5 ± 1.4	4.8 ± 0.4	na
	Cutthroat	1	265	na	na
	Rainbow	3	143.7 ± 29.6	na	na
	All	64	82.6 ± 3.8	4.8 ± 0.4	na
All salinityregions	Chinook	401	88.7 ± 1.3	10.1 ± 0.7	1.03 ± 0.01
"	Coho	481	89.2 ± 1.8	10.8 ± 0.7	1.04 ± 0.01
"	Chum	189	71.6 ± 2.2	5.8 ± 0.6	0.83 ± 0.01
"	Cutthroat	40	221.4 ± 20.7	64.6 ± 6.2	0.94 ± 0.02
"	Pink	2	33.5	n/a	n/a
"	Steelhead	4	179.8	30.8 ± 17.2	0.96 ± 0.08

Table 10 (cont'd).

Site No.	Fish Species	No. of Fish	Mean Length (mm) ± 1SE	Mean Weight (g) ± 1SE	Mean Condition Factor ± 1SE
All salinity regions	Sockeye	1	66	2.0	0.70
"	Rainbow	3	143.7 ± 29.6	-	-
"	All salmonids	1121	91.2 ± 1.5	11.6 ± 0.6	1.34 ± 0.27

Table 11. Summary of mean lengths, weights and condition factors by region for all species of salmonid.

Region		Upper River Beach Seines Zone #1		Mid River Beach Seines Zone #2		Lower River Beach Seines Zone #3		Estuary Beach Seines Zone #4		Estuary West Beach Seines Zone #5	
		N	**Mean ± 1SE**	**N**	**Mean ± 1SE**	**N**	**Mean ± 1SE**	**N**	**Mean ± 1SE**	**N**	**Mean ± 1SE**
Species	**Factor**										
Chinook	Length (mm)	67	63.4 ± 1.7	35	72.0 ± 2.6	71	81.3 ± 1.4	3	82.7 ± 112.9	30	89.2 ± 1.7
"	Weight (g)	65	2.9 ± 0.3	34	4.3 ± 0.5	61	6.0 ± 0.3	3	6.0 ± 0.9	28	7.6 ± 0.6
"	Condition factor	65	0.96 ± 0.02	34	1.0 ± 0.01	61	1.01 ± 0.01	3	1.04 ± 0.02	28	1.01 ± 0.02
Coho	Length (mm)	54	51.9 ± 2.5	124	62.5 ± 1.4	73	97.2 ± 2.2	13	76.8 ± 1.7	22	113.9 ± 8.0
"	Weight (g)	51	1.9 ± 0.4	124	3.2 ± 0.2	72	10.9 ± 1.1	13	5.0 ± 0.3	17	8.9 ± 1.3
"	Condition factor	51	0.89 ± 0.03	124	1.09 ± 0.01	72	1.00 ± 0.01	13	1.09 ± 0.03	17	0.97 ± 0.02
Chum	Length (mm)	27	41.8 ± 0.4	17	42.6 ± 0.6	10	56.7 ± 2.0	0	-	13	54.8 ± 4.0
"	Weight (g)	25	0.5 ± 0.02	17	0.5 ± 0.03	9	1.6 ± 0.2	0	-	13	1.5 ± 0.4
"	Condition factor	25	0.64 ± 0.02	17	0.67 ± 0.02	9	0.83 ± 0.01	0	-	13	0.77 ± 0.02
Steelhead	Length (mm)	1	33	0	-	2	244.5	0	-	1	197
"	Weight (g)	1	0.4	0	-	1	23.7	0	-	1	68.2
"	Condition factor	1	1.11	0	-	1	0.88	0	-	1	0.89

Table 11 (cont'd).

Region		Upper River Beach Seines Zone #1		Mid River Beach Seines Zone #2		Lower River Beach Seines Zone #3		Estuary Beach Seines Zone #4		Estuary West Beach Seines Zone #5	
		N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE
Species	**Factor**										
Cutthroat	Length (mm)	0	-	5	454.2 ± 120.5	17	184.1 ± 6.8	14	196.4 ± 9.0	1	190
"	Weight (g)	0	-	4	38.1 ± 2.5	16	60.1 ± 7.1	14	79.3 ± 11.9	0	-
"	Condition factor	0	-	1	0.81	16	0.95 ± 0.03	14	0.95 ± 0.02	0	-
Sockeye	Length (mm)	0	-	0	-	1	66	0	-	0	-
"	Weight (g)	0	-	0	-	1	2.0	0	-	0	-
"	Condition factor	0	-	0	-	1	0.70	0	-	0	-
Pink	Length (mm)	0	-	0	-	0	-	0	-	0	-
"	Weight (g)	0	-	0	-	0	-	0	-	0	-
"	Condition factor	0	-	0	-	0	-	0	-	0	-
All species	Length (mm)	149	55.2 ± 1.4	181	73.3 ± 5.8	174	98.4 ± 3.0	30	133.2 ± 11.8	67	93.7 ± 5.8
"	Weight (g)	142	2.1 ± 0.2	179	3.9 ± 0.4	160	13.1 ± 1.5	30	39.8 ± 8.8	59	7.7 ± 1.2
"	Condition factor	142	0.88 ± 0.02	176	1.03 ± 0.01	160	0.98 ± 0.01	30	1.02 ± 0.02	59	0.94 ± 0.02

Table 11 (cont'd).

Region		Estuary East/Baynes East Beach Seines Zone #6		Baynes West Beach Seines Zone #7		Estuary Purse and Mini/Baynes Inner Purse Seines Zone #8		Baynes Outer Purse and Mini Seines Zone #9		All Regions Combined	
		N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE
Species	**Factor**										
Chinook	Length (mm)	96	91.9 ± 1.8	22	95.2 ± 2.0	41	116.8 ± 4.1	36	123.9 ± 5.9	401	88.7 ± 1.3
"	Weight (g)	94	9.5 ± 0.8	22	4.0 ± 0.9	41	20.9 ± 2.5	36	27.2 ± 4.7	384	10.1 ± 0.7
"	Condition factor	94	1.04 ± 0.01	22	1.02 ± 0.02	41	1.09 ± 0.02	36	1.11 ± 0.01	384	1.03 ± 0.01
Coho	Length (mm)	104	110.0 ± 1.6	0	-	24	152.0 ± 3.3	7	183.0 ± 9.5	421	89.2 ± 1.8
"	Weight (g)	94	14.4 ± 0.7	0	-	24	42.4 ± 2.9	7	78.0 ± 12.0	402	10.8 ± 0.7
"	Condition factor	94	1.04 ± 0.01	0	-	24	1.17 ± 0.02	7	1.21 ± 0.02	402	1.04 ± 0.01
Chum	Length (mm)	65	60.9 ± 1.6	1	73	40	109.9 ± 1.9	16	123.8 ± 4.3	189	71.6 ± 2.2
"	Weight (g)	60	2.3 ± 0.2	1	3.1	40	13.5 ± 0.7	16	20.3 ± 1.8	181	5.8 ± 0.6
"	Condition factor	60	0.82 ± 0.02	1	0.80	40	0.98 ± 0.02	16	1.02 ± 0.02	181	0.83 ± 0.01
Steelhead	Length (mm)	0	-	0	-	0	-	0	-	4	179.8 ± 66.1
"	Weight (g)	0	-	0	-	0	-	0	-	3	30.8 ± 20.0
"	Condition factor	0	-	0	-	0	-	0	-	3	0.96 ± 0.08

Table 11 (cont'd).

Region		Estuary East/Baynes East Beach Seines Zone #6		Baynes West Beach Seines Zone #7		Estuary Purse and Mini/Baynes Inner Purse Seines Zone #8		Baynes Outer Purse and Mini Seines Zone #9		All Regions Combined	
		N	**Mean ± 1SE**	**N**	**Mean ± 1SE**	**N**	**Mean ± 1SE**	**N**	**Mean ± 1SE**	**N**	**Mean ± 1SE**
Species	**Factor**										
Cutthroat	Length (mm)	2	147.5	0	-	0	-	0	-	39	221.4 ± 20.7
“	Weight (g)	1	35.2	0	-	0	-	0	-	35	64.6 ± 6.2
“	Condition factor	1	0.89	0	-	0	-	0	-	32	0.94 ± 0.02
Sockeye	Length (mm)	0	-	0	-	0	-	0	-	1	66
“	Weight (g)	0	-	0	-	0	-	0	-	1	2.0
“	Condition factor	0	-	0	-	0	-	0	-	1	0.70
Pink	Length (mm)	2	33.5	0	-	0	-	0	-	2	33.5
“	Weight (g)	0	n/a	0	-	0	-	0	-	0	-
“	Condition factor	0	n/a	0	-	0	-	0	-	0	-
All species	Length (mm)	269	91.2 ± 1.6	23	94.3 ± 2.1	105	122.2 ± 2.5	59	130.3 ± 4.6	1057	91.2 ± 1.5
“	Weight (g)	249	9.7 ± 0.5	23	8.9 ± 0.6	105	23.0 ± 1.6	59	31.3 ± 3.9	1006	11.6 ± 0.6
“	Condition factor	249	0.99 ± 0.01	23	1.02 ± 0.02	105	1.07 ± 0.01	59	1.10 ± 0.01	1003	1.34 ± 0.27

Table 12. Summary of mean lengths and weights for all salmonids captured in the Gee trap survey.

		Site FS1 Courtenay River Slough		Site FS2 Millennium Pond		Site FS3 Lookout Millennium Park		Site FS4 Groove Millennium Park		Site FS5 Old Tsolum Confluence		Site FS6 Condensory Bridge		FS7 Beaver Pond		FS8 Mouth of Duck Slough	
		N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE	N	Mean ± 1SE
Species	**Factor**																
Coho	Length (mm)	20	83.0 +/- 1.7	17	66.8 +/- 1.5	10	77.5 +/- 3.0	10	75.4 +/- 3.3	-	-	3	86.7 +/- 5.7	-	-	-	-
	Weight (g)	10	5.4 +/- 0.5	7	3.0 +/- 0.3	10	4.6 +/- 0.4	-	-	-	-	3	7.8 +/- 3.0	-	-	-	-
Cutthroat	Length (mm)	-	-	-	-	1	265	-	-	-	-	-	-	-	-	-	-
	Weight (g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow	Length (mm)	-	-	-	-	-	-	-	-	-	-	3	143.7 +/- 29.6	-	-	-	-
	Weight (g)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 13. 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 Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	P	p	p	p	p	p
Factor – Length										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	-	<0.001	<0.001	0.005	0.701	<0.001	<0.001	<0.001	0.138
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	0.006	<0.001	<0.001	0.043	<0.001	<0.001	0.46
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	0.006	-	<0.001	<0.001	0.254	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	0.005	<0.001	<0.001	-	0.002	<0.001	<0.001	<0.001	0.004
Coho Mid River Beach Seines Zone #2	21, 42B	0.701	<0.001	<0.001	0.002	-	<0.001	<0.001	<0.001	0.253
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	0.043	0.254	<0.001	<0.001	-	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.138	0.46	<0.001	0.004	0.253	<0.001	<0.001	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		P	p	p	p	p	p	p	p	p
Factor – Length										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.019	<0.001	-	<0.001	<0.001	0.044	<0.001	<0.001	0.292
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.008	<0.001	-	<0.001	<0.001	0.645	<0.001	<0.001	0.004
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	0.252	0.287	-	<0.001	0.001	0.001	<0.001	<0.001	<0.001
Coho Mid River Beach Seines Zone #2	21, 42B	0.030	0.002	-	<0.001	<0.001	0.093	<0.001	<0.001	0.498
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	<0.001	-	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.841	0.174	-	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.190	<0.001	-	0.029	0.061	<0.001	0.062	<0.001	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	-	<0.001	0.013	0.695	<0.001	<0.001	0.339

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	**p**	**p**	**p**	**p**	**p**	**p**	**p**	**p**
Factor – Length										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.631	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Length										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	0.019	0.008	<0.001	0.252	0.030	<0.001	0.,841	0.190	<0.001
Coho Estuary Beach Seines Zone #4	16, 20, 40	<0.001	<0.001	<0.001	0.287	0.002	<0.001	0.174	<0.001	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.029	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.061	0.013
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.044	0.645	<0.001	<0.001	0.093	0.002	<0.001	<0.001	0.695
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.062	<0.001
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.292	0.004	<0.001	<0.001	0.498	<0.001	<0.001	<0.001	0.339

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		p	p	p	p	p	p	p	p	p
Factor – Length										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	-	0.175	-	0.249	0.439	0.006	0.385	0.004	0.007
Coho Estuary Beach Seines Zone #4	16, 20, 40	0.175	-	-	<0.001	0.058	<0.001	0.004	<0.001	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.249	<0.001	-	-	0.052	<0.001	0.443	<0.001	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.439	0.058	-	0.052	-	0.004	0.006	0.602	<0.001
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.006	<0.001	-	<0.001	0.004	-	<0.001	<0.001	0.144
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.385	0.004	-	0.443	0.006	<0.001	-	<0.001	<0.001
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.004	<0.001	-	<0.001	0.602	<0.001	<0.001	-	<0.001
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.007	<0.001	-	<0.001	<0.001	0.144	<0.001	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone#7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	**p**	**p**	**p**	**p**	**p**	**p**	**p**	**p**
Factor – Length										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	0.035	-	-	0.022	<0.001	<0.001	0.056	<0.001	<0.001
Coho Estuary Beach Seines Zone #4	16, 20, 40	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.025	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.205	-	-	0.807	0.010	0.716	0.501	0.014	0.573
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.399	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	-	-	<0.001	<0.001	0.965	0.003	<0.001	0.002
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Length										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.631	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		p	p	p	p	p	p	p	p	p
Factor – Length										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	0.035	<0.001	-	0.025	0.205	<0.001	0.399	<0.001	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.022	<0.001	-	<0.001	0.807	<0.001	<0.001	<0.001	<0.001
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	-	<0.001	0.010	<0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	-	<0.001	0.716	<0.001	0.965	<0.001	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.056	<0.001	-	<0.001	0.501	<0.001	<0.001	0.003	<0.001
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	-	<0.001	0.014	<0.001	<0.001	<0.001	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	-	<0.001	0.573	<0.001	<0.001	0.002	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	**p**	**p**	**p**	**p**	**p**	**p**	**p**	**p**
Factor – Length										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	-	-	-	<0.001	0.132	0.378	<0.001	0.334
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	-	-	<0.001	-	0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	-	-	0.132	<0.001	-	0.028	<0.001	0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	0.378	<0.001	0.028	-	<0.001	0.938
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	<0.001	<0.001	0.001	<0.001	-	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	0.334	<0.001	0.001	0.938	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Weight										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	-	0.012	<0.001	0.007	0.524	<0.001	<0.001	<0.001	0.051
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.012	-	0.006	<0.001	0.001	0.101	<0.001	<0.001	0.739
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	0.006	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	0.007	<0.001	<0.001	-	0.019	<0.001	0.003	<0.001	0.006
Coho Mid River Beach Seines Zone #2	21, 42B	0.524	0.001	<0.001	0.019	-	<0.001	<0.001	<0.001	0.045
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	0.030	0.101	<0.001	<0.001	-	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	-	<0.001	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.051	0.739	<0.001	0.006	0.045	<0.001	<0.001	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		P	**p**	**p**	**p**	**p**	**p**	**p**	**p**	**p**
Factor – Weight										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.013	<0.001	-	<0.001	<0.001	0.015	<0.001	<0.001	0.055
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.008	<0.001	-	<0.001	<0.001	0.599	<0.001	<0.001	0.330
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
						<0.001				
Chinook Mid River Beach Seines Zone #2	21, 42B	0.305	0.389	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Mid River Beach Seines Zone #2	21, 42B	0.040	0.007	-	<0.001	<0.001	0.012	<0.001	<0.001	0.010
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	<0.001	-	<0.001	<0.001	0.007	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.991	0.167	-	0.007	0.001	<0.001	<0.001	<0.001	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.249	0.003	-	0.046	0.475	<0.001	0.602	<0.001	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	-	<0.001	<0.001	0.839	0.002	<0.001	0.271

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	p	p	p	p	p	p	p	p
Factor – Weight										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
										<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
										<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.498	-	-	<0.001	<0.001	0.003	<0.001	<0.001	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	-	-	<0.001	<0.001	<0.001	0.009	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Weight										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	0.013	0.008	<0.001	0.305	0.040	<0.001	0.991	0.249	<0.001
Coho Estuary Beach Seines Zone #4	16, 20, 40	<0.001	<0.001	<0.001	0.389	0.007	<0.001	0.167	0.003	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	0.046	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.475	<0.001
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.015	0.599	<0.001	<0.001	0.012	0.007	<0.001	<0.001	0.839
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.602	0.002
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.055	0.330	<0.001	<0.001	0.010	<0.001	<0.001	<0.001	0.271

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		p	p	p	p	p	p	p	p	p
Factor – Weight										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	-	0.012	-	0.359	0.352	<0.001	0.414	0.033	0.001
Coho Estuary Beach Seines Zone #4	16, 20, 40	0.352	-	-	0.004	0.012		0.031	<0.001	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.359	<0.001	-	-	0.299	<0.001	0.197	<0.001	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.352	<0.001	-	0.299	-	<0.001	0.096	0.002	<0.001
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	-	<0.001	<0.001	-	<0.001	<0.001	0.149
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.414	0.031	-	0.197	0.757	<0.001	-	<0.001	<0.001
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.033	<0.001	-	<0.001	0.002	<0.001	<0.001	-	<0.001
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.001	<0.001	-	<0.001	<0.001	0.149	<0.001	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	p	p	p	p	p	p	p	p
Factor –Weight										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	0.073	-	-	0.119	<0.001	0.009	0.202	0.005	0.004
Coho Estuary Beach Seines Zone #4	16, 20, 40	<0.001	-	-	<0.001	<0.001	<0.001	0.007	<0.001	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.076	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.858	-	-	0.004	<0.001	0.002	0.011	<0.001	<0.001
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	-	-	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.829	-	-	<0.001	<0.001	0.003	<0.001	<0.001	<0.001
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	-	-	<0.001	<0.001	0.427	<0.001	<0.001	0.002
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Weight										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.498	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.009
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		p	p	p	p	p	p	p	p	p
Factor – Weight										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	0.073	<0.001	-	0.076	0.858	<0.001	0.829	<0.001	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.119	<0.001	-	<0.001	0.004	<0.001	<0.001	<0.001	<0.001
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.009	<0.001	-	<0.001	0.002	<0.001	0.003	0.427	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.202	0.007	-	<0.001	0.011	0.002	<0.001	<0.001	<0.001
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.005	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.004	<0.001	-	<0.001	<0.001	<0.001	<0.001	0.002	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	**p**	**p**	**p**	**p**	**p**	**p**	**p**	**p**
Factor – Weight										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	0.001	<0.001	<0.001	0.004	<0.001	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.001	-	-	-	<0.001	0.006	0.224	<0.001	0.892
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	-	-	<0.001	-	<0.001	0.017	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	-	-	0.006	<0.001	-	0.003	<0.001	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.004	-	-	0.224	0.017	0.003	-	<0.001	0.341
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	-	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	0.892	<0.001	<0.001	0.341	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	**p**	**p**	**p**	**p**	**p**	**p**	**p**	**p**
Factor – Condition Factor										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	-	0.027	<0.001	0.146	<0.001	<0.001	0.043	0.087	0.013
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.027	-	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.364
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	<0.001	-	<0.001	<0.001	0.288	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	0.146	0.002	<0.001	-	<0.001	<0.001	0.813	0.829	<0.001
Coho Mid River Beach Seines Zone #2	21, 42B	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	<0.001	0.288	<0.001	<0.001	-	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.043	<0.001	<0.001	0.813	<0.001	<0.001	-	0.608	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.087	<0.001	<0.001	0.829	<0.001	<0.001	0.608	-	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.013	0.364	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		P	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.379	0.005	-	0.115	0.832	<0.001	<0.001	<0.001	<0.001
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.187	<0.001	-	0.003	0.101	0.022	<0.001	<0.001	0.018
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	0.348	<0.001	-	0.635	0.118	<0.001	0.056	0.044	<0.001
Coho Mid River Beach Seines Zone #2	21, 42B	0.547	0.990	-	0.011	<0.001	<0.001	0.014	0.002	<0.001
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	<0.001	-	<0.001	<0.001	0.007	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.416	<0.001	-	0.684	0.072	<0.001	0.026	0.025	<0.001
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.428	<0.001	-	0.484	0.228	<0.001	0.008	0.007	<0.001
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	<0.001	-	<0.001	<0.001	0.019	<0.001	<0.001	0.758

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.060	-	-	0.003	<0.001	0.581	<0.001	<0.001	0.142
Coho Upper River Beach Seines Zone #1	1, 1A, 17, 24	0.002	-	-	<0.001	<0.001	0.012	<0.001	<0.001	0.011
Chum Upper River Beach Seines Zone #1	1, 1A, 17, 24	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Mid River Beach Seines Zone #2	21, 42B	0.240	-	-	0.087	<0.001	0.226	<0.001	<0.001	0.417
Coho Mid River Beach Seines Zone #2	21, 42B	0.049	-	-	0.385	0.010	<0.001	0.443	0.034	0.060
Chum Mid River Beach Seines Zone #2	21, 42B	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.264	-	-	0.037	<0.001	0.101	<0.001	<0.001	0.484
Coho Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	0.191	-	-	0.017	<0.001	0.256	<0.001	<0.001	0.372
Chum Lower River Beach Seines Zone #3	11, 12, 14, 18, 22, 61, 63, 65, 66	<0.001	-	-	0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	0.379	0.187	<0.001	0.348	0.547	<0.001	0.416	0.428	<0.001
Coho Estuary Beach Seines Zone #4	16, 20, 40	0.005	<0.001	<0.001	<0.001	0.990	<0.001	<0.001	0.001	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.115	0.003	<0.001	0.635	0.011	<0.001	0.684	0.484	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.832	0.101	<0.001	0.118	<0.001	<0.001	0.072	0.228	<0.001
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	0.022	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	0.019
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	0.056	0.014	<0.001	0.026	0.008	<0.001
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	<0.001	<0.001	0.044	0.002	<0.001	0.025	0.007	<0.001
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	<0.001	0.018	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.758

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	-	0.385	-	0.744	0.101	<0.001	0.947	0.965	0.002
Coho Estuary Beach Seines Zone #4	16, 20, 40	0.385	-	-	0.072	<0.001	<0.001	0.206	0.063	<0.001
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.744	0.072	-	-	0.205	<0.001	0.261	0.300	<0.001
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.101	<0.001	-	0.205	-	<0.001	0.016	0.005	<0.001
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	<0.001	-	<0.001	<0.001	-	<0.001	<0.001	0.101
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.947	0.206	-	0.261	0.016	<0.001	-	0.657	0.101
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.965	0.063	-	0.300	0.005	<0.001	0.657	-	<0.001
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.002	<0.001	-	<0.001	<0.001	0.101	0.101	<0.001	-

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Estuary Beach Seines Zone #4	16, 20, 40	0.812	-	-	0.833	0.067	0.300	0.169	<0.001	0.711
Coho Estuary Beach Seines Zone #4	16, 20, 40	0.058	-	-	0.675	0.036	<0.001	0.482	0.006	0.048
Chum Estuary Beach Seines Zone #4	16, 20, 40	-	-	-	-	-	-	-	-	-
Chinook Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.700	-	-	0.248	<0.001	0.192	<0.001	<0.001	0.871
Coho Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	0.036	-	-	0.064	<0.001	0.798	<0.001	<0.001	0.072
Chum Estuary West Beach Seines Zone #5	2, 3, 4, 19, 39, 60, 62, 69, 75	<0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chinook Estuary East/Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.528	-	-	0.472	<0.001	0.003	0.004	<0.001	0.449
Coho Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.635	-	-	0.282	<0.001	0.001	<0.001	<0.001	0.495
Chum Estuary East/ Baynes East Beach Seines Zone #6	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Upper River Beach Seines Zone #1	Coho Upper River Beach Seines Zone #1	Chum Upper River Beach Seines Zone #1	Chinook Mid River Beach Seines Zone #2	Coho Mid River Beach Seines Zone #2	Chum Mid River Beach Seines Zone #2	Chinook Lower River Beach Seines Zone #3	Coho Lower River Beach Seines Zone #3	Chum Lower River Beach Seines Zone #3
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	0.060	0.002	<0.001	0.240	0.049	<0.001	0.264	0.191	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.003	<0.001	<0.001	0.087	0.385	<0.001	0.037	0.017	
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	<0.001	<0.001	<0.001	0.010	<0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.581	0.012	<0.001	0.226	<0.001	<0.001	0.101	0.256	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	0.443	<0.001	<0.001	<0.001	<0.001
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	<0.001	<0.001	<0.001	0.034	<0.001	<0.001	<0.001	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.142	0.011	<0.001	0.417	0.060	<0.001	0.484	0.372	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Estuary Beach Seines Zone #4	Coho Estuary Beach Seines Zone #4	Chum Estuary Beach Seines Zone #4	Chinook Estuary West Beach Seines Zone #5	Coho Estuary West Beach Seines Zone #5	Chum Estuary West Beach Seines Zone #5	Chinook Estuary East/Baynes East Beach Seines Zone #6	Coho Estuary East/ Baynes East Beach Seines Zone #6	Chum Estuary East/ Baynes East Beach Seines Zone #6
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	0.812	0.058	-	0.700	0.036	<0.001	0.528	0.635	<0.001
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.833	0.675	-	0.248	0.064	<0.001	0.472	0.282	<0.001
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.067	0.036	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.300	<0.001	-	0.192	0.798	0.001	0.003	0.001	<0.001
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.169	0.482	-	<0.001	<0.001	<0.001	0.004	<0.001	<0.001
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	0.006	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.711	0.048	-	0.871	0.072	<0.001	0.449	0.495	<0.001

Table 13 (cont'd).

Zone and Species	Site No.	Chinook Baynes West Beach Seines Zone #7	Coho Baynes West Beach Seines Zone #7	Chum Baynes West Beach Seines Zone #7	Chinook Estuary Purse Mini/Baynes Inner Purse Zone #8	Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	Chinook Baynes Outer Purse/Mini Seines Zone #9	Coho Baynes Outer Purse/Mini Seines Zone #9	Chum Baynes Outer Purse/Mini Seines Zone #9
		p	p	p	p	p	p	p	p	p
Factor – Condition Factor										
Chinook Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	0.408	<0.001	0.059	<0.001	<0.001	0.820
Coho Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chum Baynes West Beach Seines Zone #7	25, 26, 28, 32, 33, 49, 67	-	-	-	-	-	-	-	-	-
Chinook Estuary Purse/Mini Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.408	-	-	-	0.022	0.016	0.224	0.073	0.400
Coho Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	<0.001	-	-	0.022	-	<0.001	0.020	0.442	<0.001
Chum Estuary Purse Mini/Baynes Inner Purse Zone #8	46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78	0.059	-	-	0.016	<0.001	-	<0.001	<0.001	0.140
Chinook Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	0.224	0.020	<0.001	-	0.005	<0.001
Coho Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	<0.001	-	-	0.073	0.442	<0.001	0.005	-	<0.001
Chum Baynes Outer Purse/Mini Seines Zone #9	35, 48, 53, 59, 76, 77B	0.820	-	-	0.400	<0.001	0.140	<0.001	<0.001	-

Table 14. Results of one-way ANOVA analysis of coho lengths and weights by Gee trap site.

Site No.	Courtenay Slough FS1	Millennium Pond FS2	Millennium Lookout FS3	Millennium Groove FS4	Condensory Bridge FS6
	p	p	p	p	p
Factor - Length					
Courtenay Slough FS1	-	<0.001	0.094	0.031	0.449
Millennium Pond FS2	<0.001	-	0.002	0.013	<0.001
Millennium Lookout FS3	0.094	0.002	-	0.644	0.172
Millennium Groove FS4	0.031	0.013	0.644	-	0.128
Condensory Bridge FS6	0.449	<0.001	0.172	0.128	-

Table 14 (cont'd).

Site No.	Courtenay Slough FS1	Millennium Pond FS2	Millennium Lookout FS3	Millennium Groove FS4	Condensory Bridge FS6
	p	p	p	p	p
Factor-Weight					
Courtenay Slough FS1	-	0.002	0.255	-	0.197
Millennium Pond FS2	0.002	-	0.015	-	0.034
Millennium Lookout FS3	0.255	0.015	-	-	0.089
Millennium Groove FS4	-	-	-	-	-
Condensory Bridge FS6	0.197	0.034	0.089	-	-

Table 15. Common and scientific names for all non-salmonid fish species captured in all the regions.

Fish Species	Common Name
Ammodytes hexapterus	Pacific sandlance
Brachyistius frenatus	Kelp surfperch
Clupea harengus pallasi	Pacific herring
Cymatogaster aggregata	Shiner surfperch
Engraulis mordax	Northern anchovy
Enophrys bison	Buffalo sculpin
Family Bothidae	Unidentified sanddab
Family Cottidae	Unidentified sculpin
Family Embiotocidae	Unidentified perch
Family Hexagrammidae	Unidentified greenling
Family Petromyzonidae	Unidentified lamprey
Family Pholididae	Unidentified gunnel
Family Salmonidae	Unidentified salmonid
Family Scorpaenidae	Unidentified rockfish
Gasterosteus aculeatus	Threespine stickleback
Hypomesus pretiosus pretiosus	Surf smelt
Lumpenus sagitta	Pacific snake prickleback
Microgadus proximus	Pacific tomcod
Oligocottus snyderi	Fluffy sculpin
Ophiodon elongatus	Juvenile lingcod
Order Pleuronectiformes	Unidentified flatfish
Platichthys stellatus	Starry flounder
Porichthys notatus	Plainfin midshipman
Syngnathus leptorhynchus	Bay pipefish
Trichodon tricodon	Pacific sandfish

Table 16. 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 Zone #1			Mid River Zone #2			Lower River Zone #3			Estuary Zone #4			Estuary West Zone #5		
Sites	1, 1A, 17, 24 65 Sets			21, 42B 30 Sets			11, 12, 14, 18, 22, 61, 63, 65, 66 54 Sets			16, 20, 40 20 Sets			2, 3, 4, 19, 39, 60, 62, 69, 75 54 Sets		
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
Species															
Pacific Sandlance	0	0	0	0	0	0	0	0	0	0	0	0	11	0.2 ± 0.2	0.7
Kelp Surfperch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific Herring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shiner Surfperch	0	0	0	24	0.8 ± 0.6	2.5	61	1.1 ± 0.7	11.9	62	3.1 ± 1.3	19.3	724	13.4 ± 6.8	48.0
Northern Anchovy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buffalo Sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Sanddab	0	0	0	0	0	0	1	0.02 ± 0.02	0.2	0	0	0	0	0	0
Unidentified Sculpin	36	0.6 ± 0.1	23.5	37	1.2 ± 0.5	3.9	361	6.7 ± 1.5	70.4	74	3.7 ± 1.1	23.0	626	11.6 ± 6.4	41.5
Unidentified Perch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Greenling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Lamprey	1	0.02 ± 0.02	0.7	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Gunnel	0	0	0	0	0	0	11	0.2 ± 0.1	2.1	0	0	0	25	0.5 ± 0.2	1.7
Unidentified Salmonid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Rockfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Threespine Stickleback	87	1.3 ± 0.3	56.9	899	30.0 ± 8.2	93.5	62	1.1 ± 0.3	12.1	175	8.8 ± 5.2	54.4	11	0.2 ± 0.1	0.7
Surf Smelt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluffy Sculpin	0	0	0	0	0	0	0	0	0	1	0.1 ± 0.1	0.3	1	0.02 ± 0.02	0.1

Table 16 (cont'd).

REGION	Estuary East/Baynes East Zone #6			Baynes West Zone #7			Estuary Purse/Mini/Baynes Inner Purse Zone #8			Baynes Outer Purse/Mini Seine Zone #9			All Regions		
Sites	6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70 98 Sets			25, 26, 28, 32, 33, 49, 67 31 Sets			46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78 49 Sets			35, 48, 53, 59, 76, 77B 14 Sets			All Sites 415 Sets		
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			
Species															
Pacific Sandlance	1000	10.2 ± 8.7	11.0	63	2.0 ± 1.5	2.6	3054	62.3 ± 57.3	71.0	1	0.1 ± 0.1	14.3	4129	9.9 ± 7.1	21.4
Kelp Surfperch	4	0.04 ± 0.03	0.04	21	0.7 ± 0.5	0.9	0	0	0	0	0	0	25	0.06 ± 0.04	0.1
Pacific Herring	0	0	0	0	0	0	1002	20.4 ± 20.4	23.3	1	0.1 ± 0.1	14.3	1003	2.4 ± 2.4	5.2
Shiner Surfperch	1502	15.3 ± 4.2	16.4	741	23.9 ± 7.7	30.9	1	0.02 ± 0.02	0.02	0	0	0	3115	7.7 ± 1.5	16.1
Northern Anchovy	1	0.01 ± 0.01	0.01	0	0	0	25	0.5 ± 0.5	0.6	0	0	0	26	0.06 ± 0.06	0.1
Buffalo Sculpin	1	0.01 ± 0.01	0.01	6	0.2 ± 0.1	0.3	0	0	0	0	0	0	7	0.02 ± 0.01	0.04
Unidentified Sanddab	1359	13.9 ± 13.6	14.9	3	0.1 ± 0.1	0.1	0	0	0	0	0	0	1363	3.3 ± 3.2	7.1
Unidentified Sculpin	3517	35.9 ± 9.4	38.5	779	25.1 ±	32.5	1	0.02 ± 0.02	0.02	0	0	0	5431	13.1 ± 0.01	28.1
Unidentified Perch	13	0.1 ± 0.1	0.1	0	0	0	0	0	0	0	0	0	13	0.03 ± 0.03	0.07
Unidentified Greenling	18	0.2 ± 0.1	0.2	2	0.1 ± 0.1	0.1	0	0	0	0	0	0	20	0.8 ± 0.7	0.1
Unidentified Lamprey	0	0	0	0	0	0	0	0	0	0	0	0	1	<0.01 ± <0.01	0.01
Unidentified Gunnel	230	2.3 ± 0.5	2.5	217	7.0 ± 3.3	9.1	0	0	0	0	0	0	483	1.2 ± 0.3	2.5
Unidentified Salmonid	0	0	0	0	0	0	1	0.02 ± 0.02	0.02	1	0.1 ± 0.1	14.3	2	<0.01 ± <0.01	0.01
Unidentified Rockfish	0	0	0	0	0	0	5	0.1 ± 0.1	0.1	0	0	0	5	0.01 ± 0.01	0.03
Threespine Stickleback	919	9.4 ± 6.5	10.1	3	0.1 ± 0.1	0.1	180	3.7 ± 1.3	4.2	1	0.1 ± 0.1	14.3	2337	5.6 ± 1.7	12.1
Surf Smelt	3	0.03 ± 0.03	0.03	0	0	0	0	0	0	0	0	0	3	0.01 ± 0.01	0.02
Fluffy Sculpin	3	0.03 ± 0.03	0.03	0	0	0	0	0	0	0	0	0	5	0.01 ± 0.01	0.03

Table 16 (cont'd).

REGION	Upper River Zone #1			Mid River Zone #2			Lower River Zone #3			Estuary Zone #4			Estuary West Zone #5		
Sites	1, 1A, 17, 24 65 Sets			21, 42B 30 Sets			11, 12, 14, 18, 22, 61, 63, 65, 66 54 Sets			16, 20, 40 20 Sets			2, 3, 4, 19, 39, 60, 62, 69, 75 54 Sets		
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
Species															
Pacific Snake Prickleback	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific Tomcod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Juvenile Lingcod	0	0	0	0	0	0	4	0.1 ± 0.04	0.8	9	0.5 ± 0.3	2.8	3	0.06 ± 0.04	0.2
Unidentified Flatfish	6	0.1 ± 0.4	3.9	2	0.1 ± 0.1	0.2	1	0.02 ± 0.02	0.2	1	0.1 ± 0.1	0.3	13	0.2 ± 0.2	0.1
Starry Flounder	23	??	15.0	0	0	0	9	0.2 ± 0.1	1.8	0	0	0	2	0.04 ± 0.03	0.1
Plainfin Midshipman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bay Pipefish	0	0	0	0	0	0	3	0.06 ± 0.04	0.6	0	0	0	92	1.7 ± 0.7	6.1
Pacific Sandfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	153	2.4 ± 0.4	100	962	32.1 ± 8.1	100	513	9.5 ± 1.7	100	322	16.1 ± 6.7	100	1508	27.9 ± 9.6	100

Table 16 (cont'd).

REGION	Estuary East/Baynes East Zone #6			Baynes West Zone #7			Estuary Purse/Mini/Baynes Inner Purse Zone #8			Baynes Outer Purse/Mini Seine Zone #9			All Regions		
Sites	**6, 7, 8, 9, 15, 29, 30, 31, 34, 38, 64, 68, 70 98 Sets**			**25, 26, 28, 32, 33, 49, 67 31 Sets**			**46, 47, 50, 51, 52, 55, 56, 57, 58, 71, 72, 73, 73B, 74, 78 49 Sets**			**35, 48, 53, 59, 76, 77B 14 Sets**			**All Sites 415 Sets**		
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**
Species															
Pacific Snake Prickleback	218	2.2 ± 1.8	2.4	22	0.7 ± 0.5	0.9	0	0	0	0	0	0	240	0.6 ± 0.4	1.2
Pacific Tomcod	1	0.01 ± 0.01	0.01	0	0	0	0	0	0	0	0	0	1	<0.01 ± <0.01	0.01
Juvenile Lingcod	3	0.03 ± 0.03	0.03	14	0.5 ± 0.2	0.6	0	0	0	0	0	0	33	0.1 ± 0.02	0.2
Unidentified Flatfish	148	1.5 ± 0.7	1.6	192	6.2 ± 4.6	8.0	1	0.02 ± 0.02	0.2	0	0	0	364	0.9 ± 0.4	1.9
Starry Flounder	4	0.04 ± 0.02	0.04	1	0.03 ± 0.03	0.04	0	0	0	0	0	0	39	0.7 ± 0.6	0.2
Plainfin Midshipman	29	0.3 ± 0.1	0.3	38	1.2 ± 0.7	1.6	0	0	0	0	0	0	67	0.2 ± 0.1	0.4
Bay Pipefish	161	1.6 ± 0.5	1.8	294	9.5 ± 4.2	12.3	33	0.7 ± 0.1	0.8	3	0.2 ± 0.2	42.9	586	1.4 ± 0.4	3.0
Pacific Sandfish	1	0.01 ± 0.01	0.01	3	0.1 ± 0.1	0.1	1	0.02 ± 0.02	0.2	0	0	0	5	0.01 ± 0.01	0.03
Total	9135	93.2 ± 29.5	100	2399	77.4 ± 15.0	100	4304	87.8 ± 62.0	100	7	0.5 ± 0.2	100	19303	46.5 ± 10.4	100

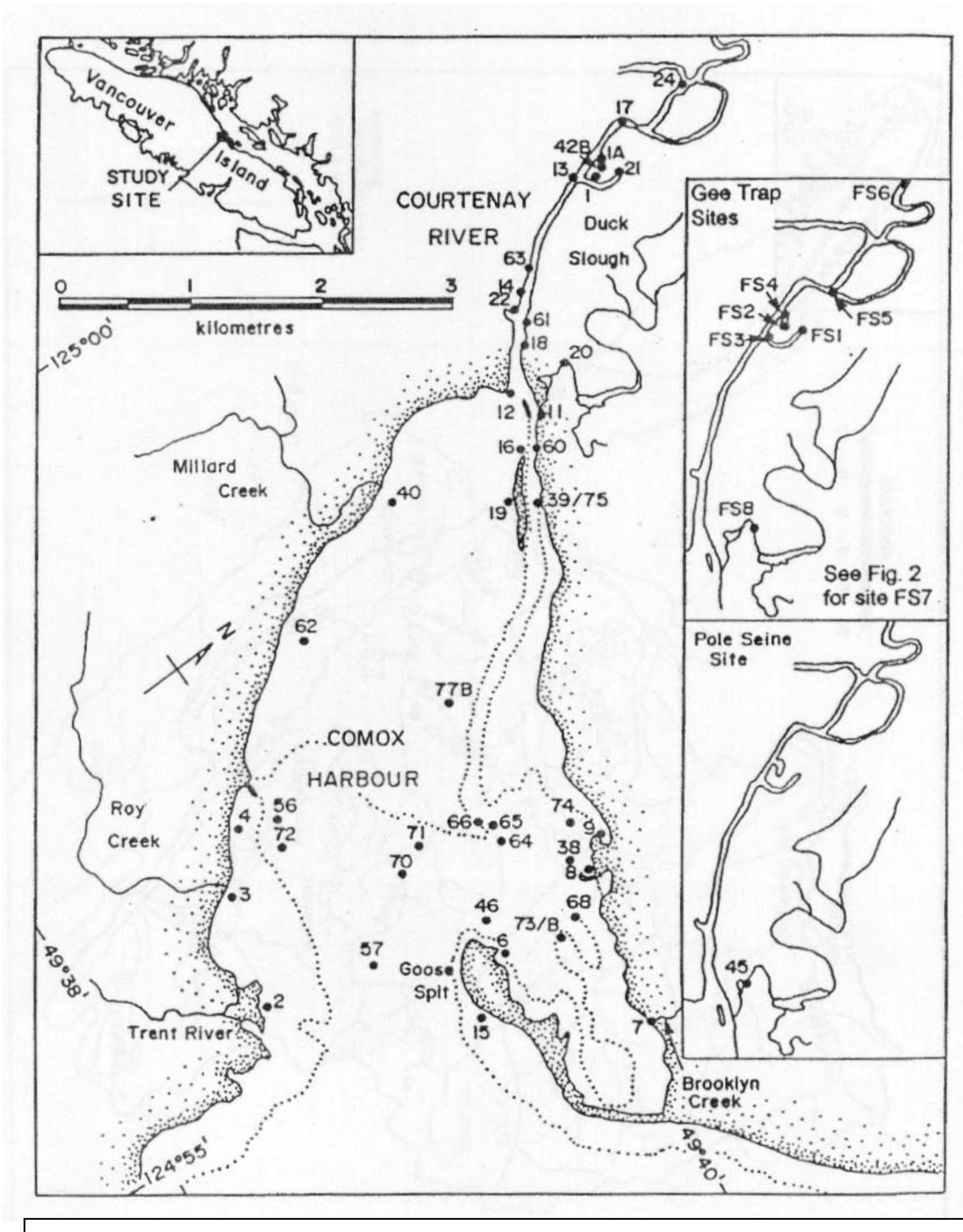

Fig. 1. Map of the Courtenay River and estuary showing the fifty-two sites sampled in the 2001 survey.

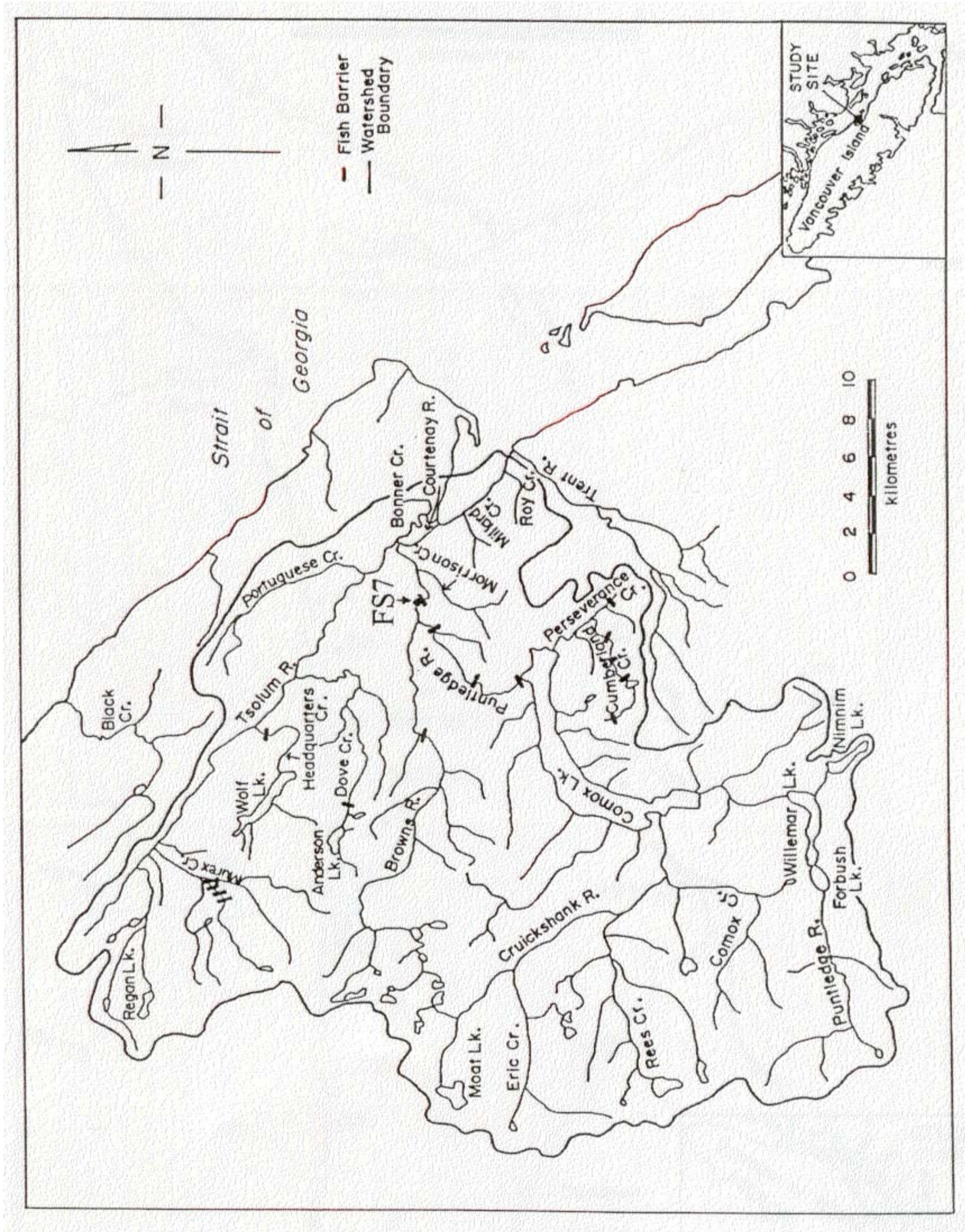

Fig. 2. Location of Gee trap site FS7 in the Puntledge River (modified from Riddell and Bryden 1996).

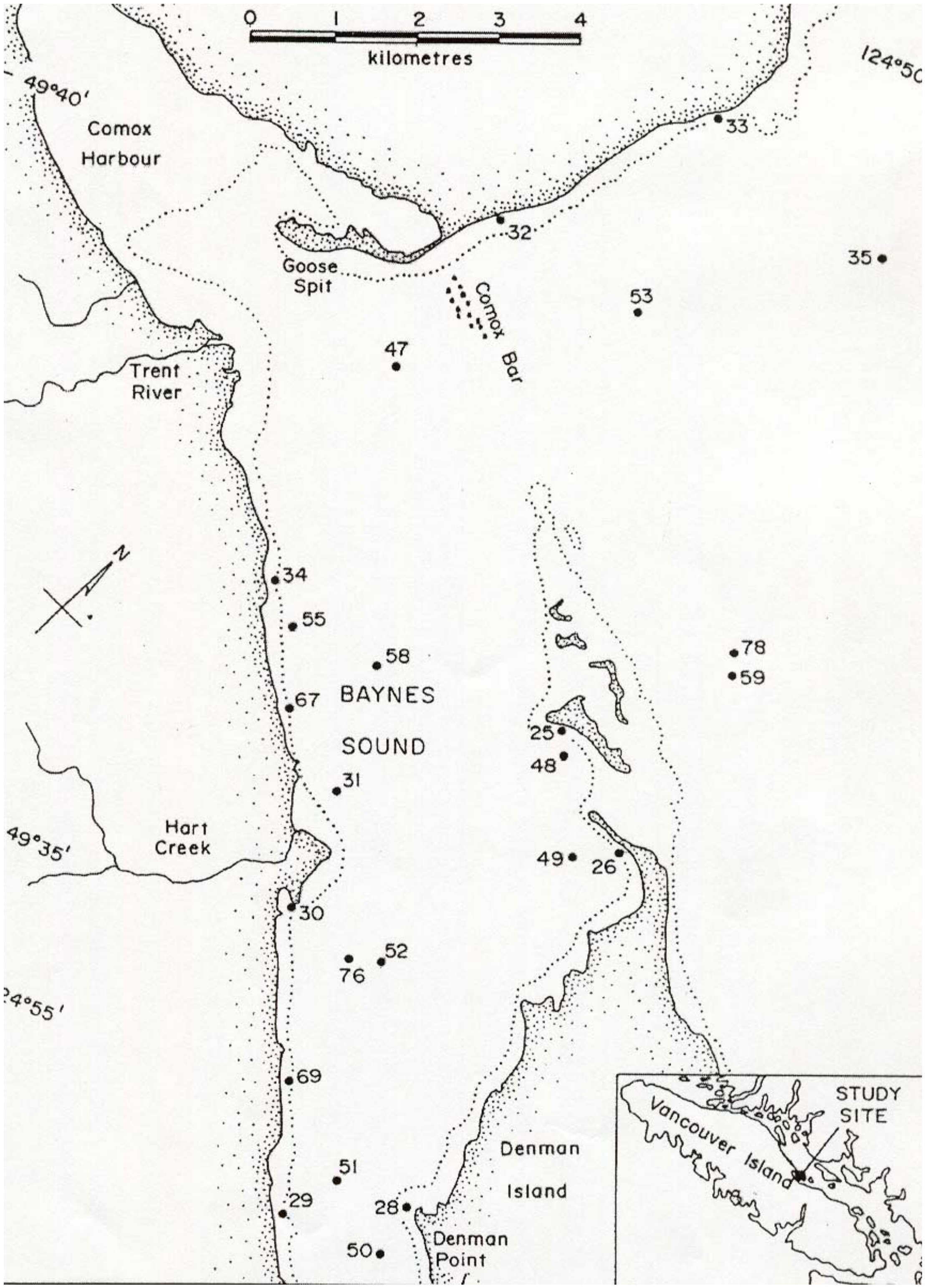

Fig. 3. Map of Baynes Sound and the outside area showing the twenty-four sites sampled in the 2001 survey.

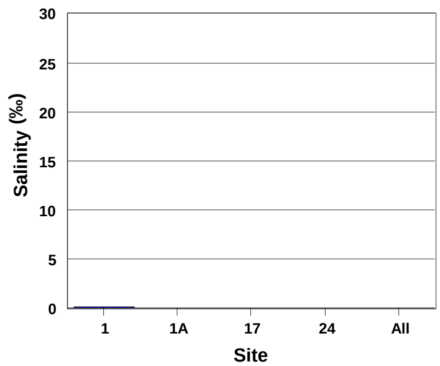

Fig. 4. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #1 in the upper river region.

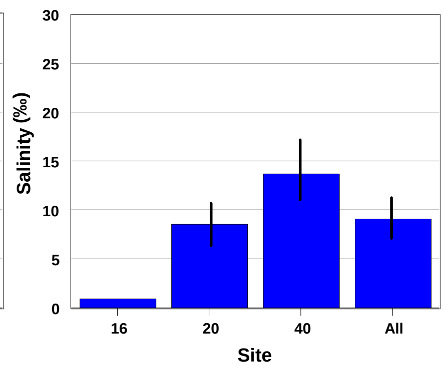

Fig. 7. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #4 in the estuary region.

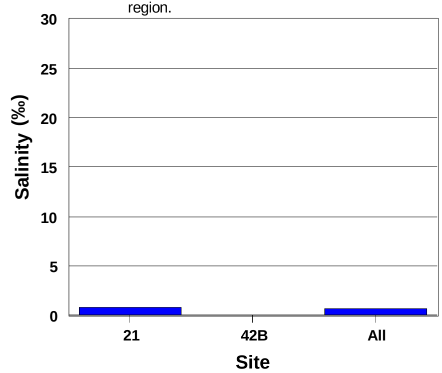

Fig. 5. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #2 in the mid river region.

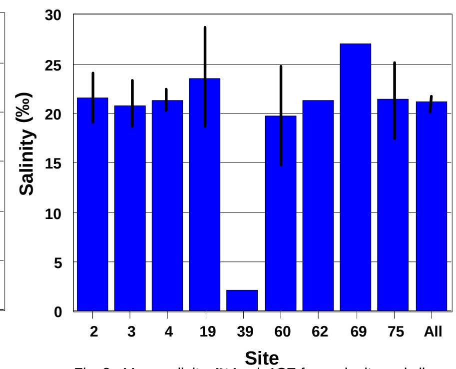

Fig. 8. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #5 in the estuary west region.

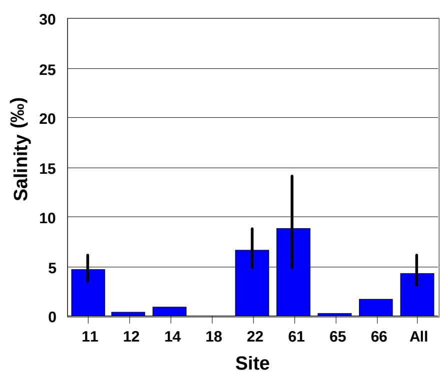

Fig. 6. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #3 in the lower river region.

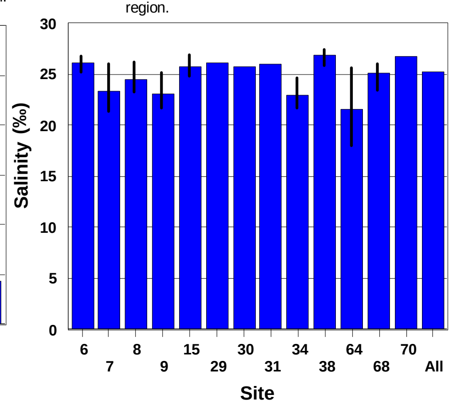

Fig. 9. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #6 in the estuary east and Baynes east region.

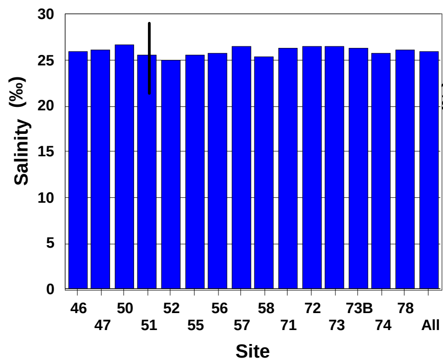

Fig. 10. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region.

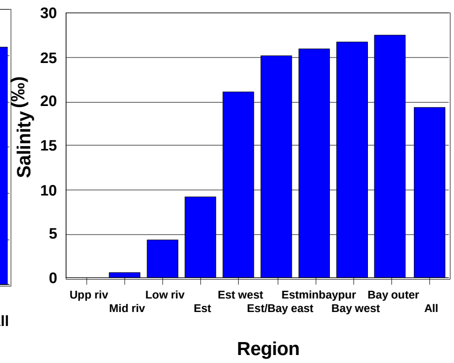

Fig. 13. Mean salinity (‰) +/- 1SE for each of the nine salinity regions and all regions combined.

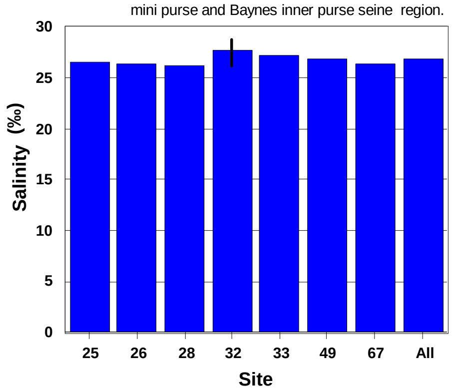

Fig. 11. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #7 in the Baynes west region.

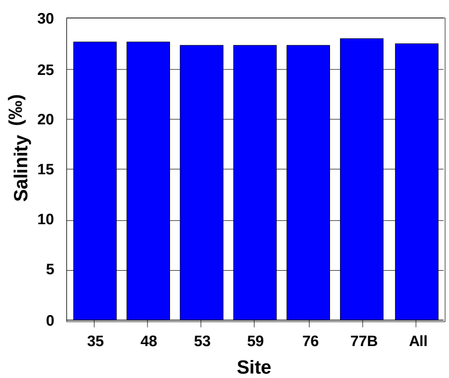

Fig. 12. Mean salinity (‰) +/- 1SE for each site and all sites combined in Zone #9 in the Baynes outer purse and mini seine region.

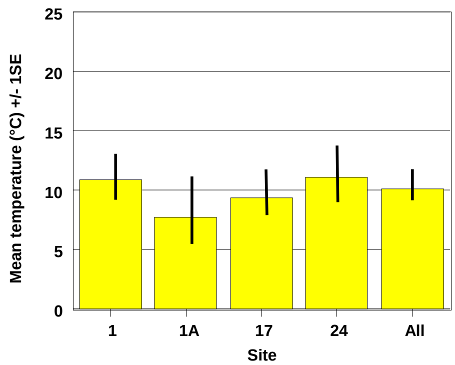

Fig. 14. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #1 in the upper river region .

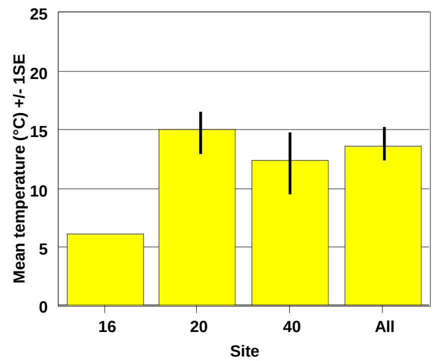

Fig. 17. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #4 in the estuary region.

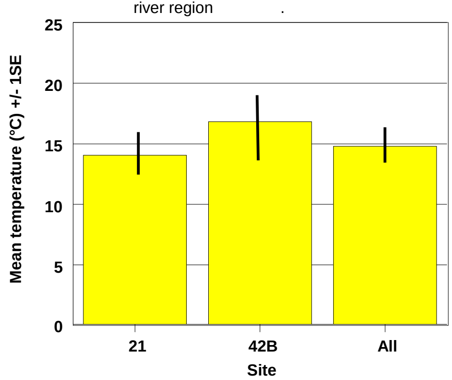

Fig. 15. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #2 in the mid river region.

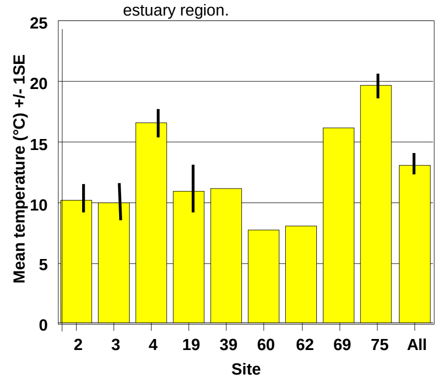

Fig. 18. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #5 in the estuary west region.

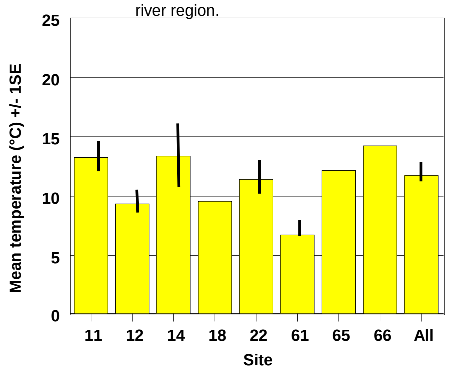

Fig. 16. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #3 in the lower river region.

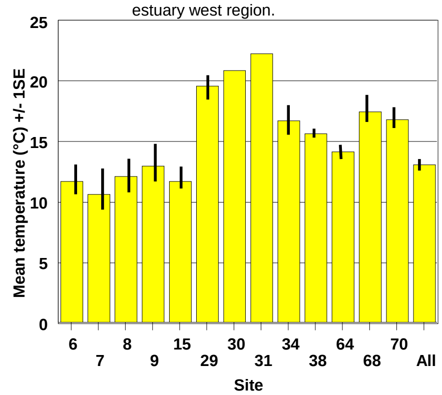

Fig. 19. Mean temperatures (°C)+/- 1SE for each site and all sites combined in Zone #6 in the estuary east and Baynes east region.

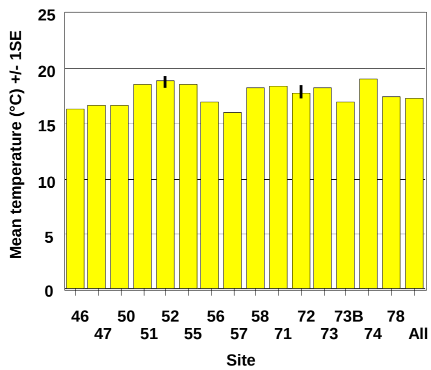

Fig. 20. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region.

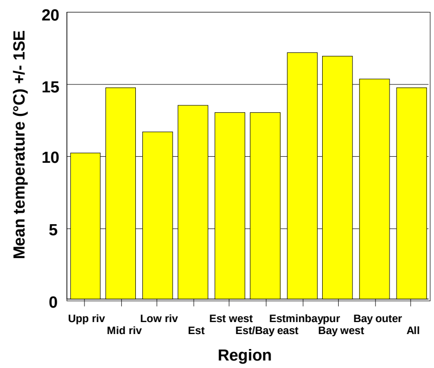

Fig. 23. Mean temperature (°C) +/- 1SE for each of the nine salinity regions and all regions combined.

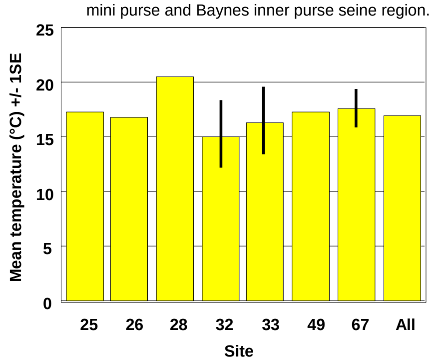

Fig. 21. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #7 in the Baynes west region.

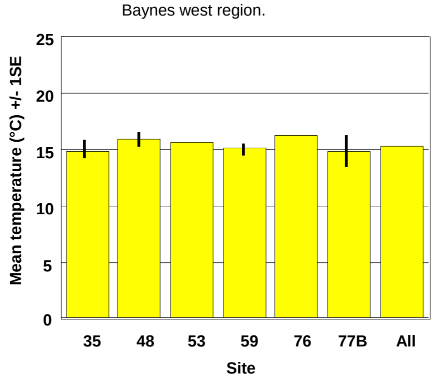

Fig. 22. Mean temperatures (°C) +/- 1SE for each site and all sites combined in Zone #9 in the Baynes outer purse and mini seine region.

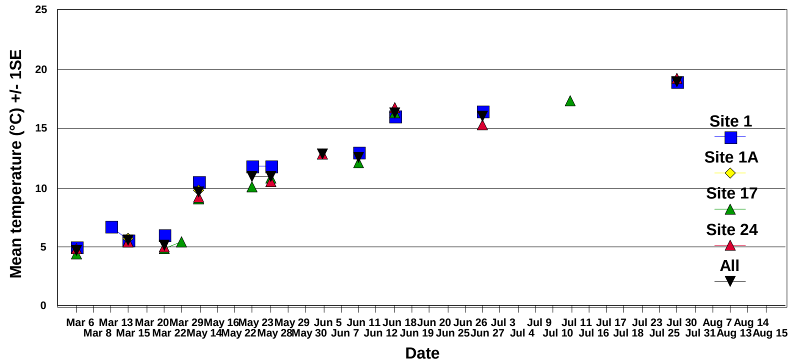

Fig. 24. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #1 in the upper river region.

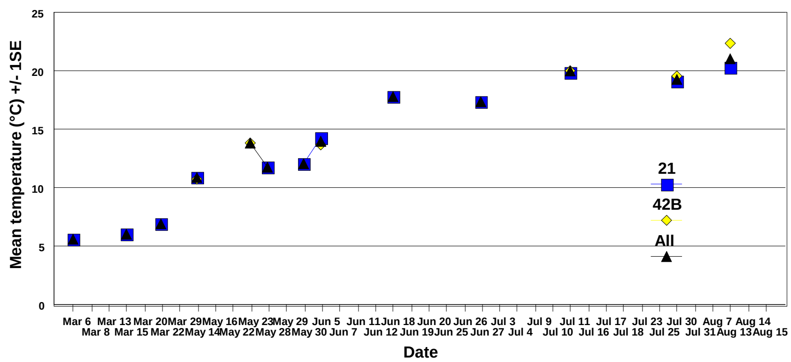

Fig. 25. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #2 in the mid river region.

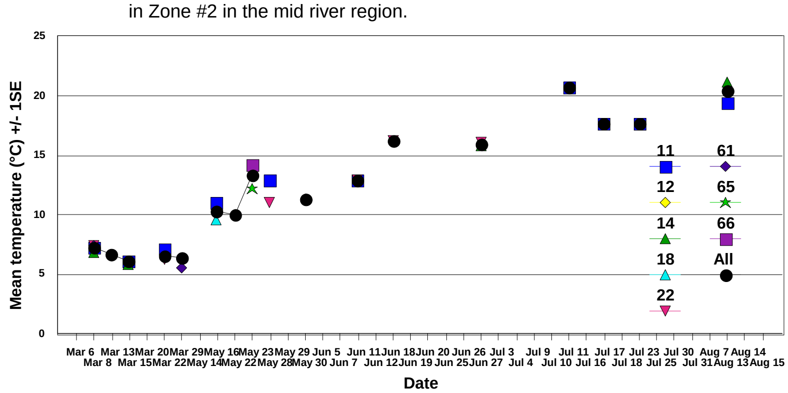

Fig.26. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #3 in the lower river region.

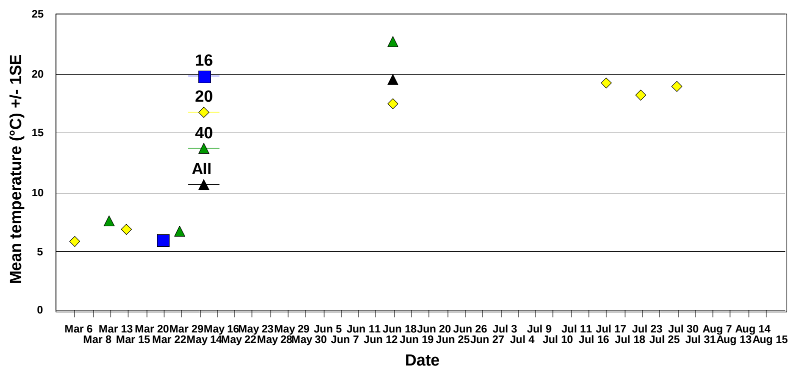

Fig. 27. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #4 in the estuary region.

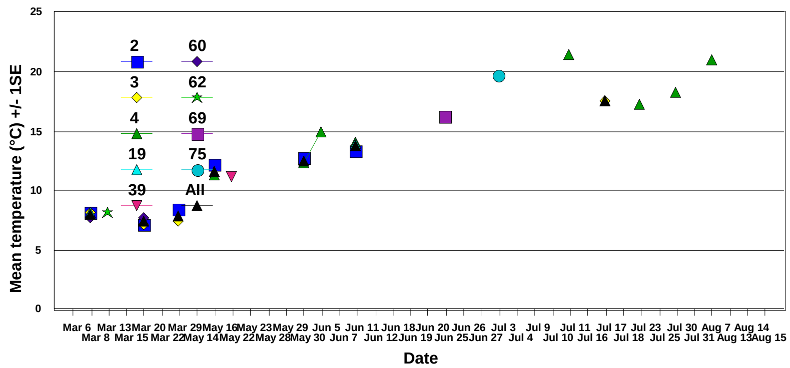

Fig. 28. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #5 in the estuary west region.

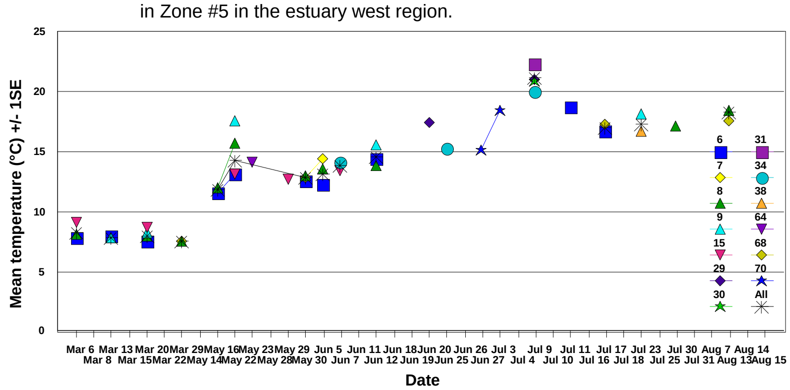

Fig. 29. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #6 in the estuary east and Baynes east region.

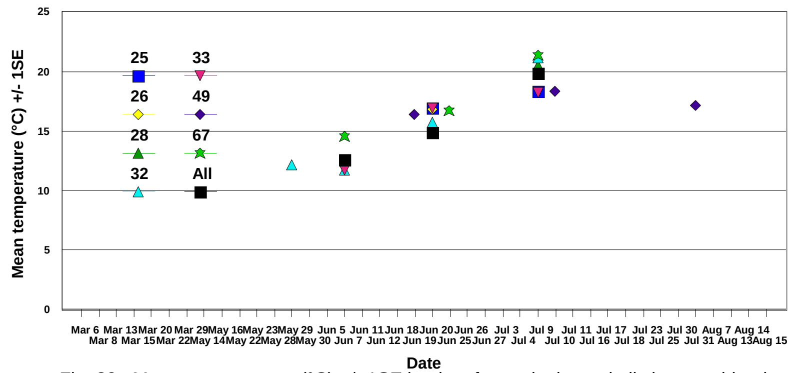

Fig. 30. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #7 in the Baynes west region.

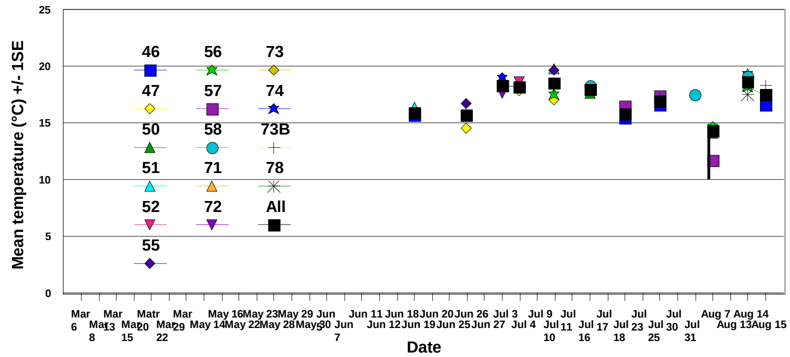

Fig. 31. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region.

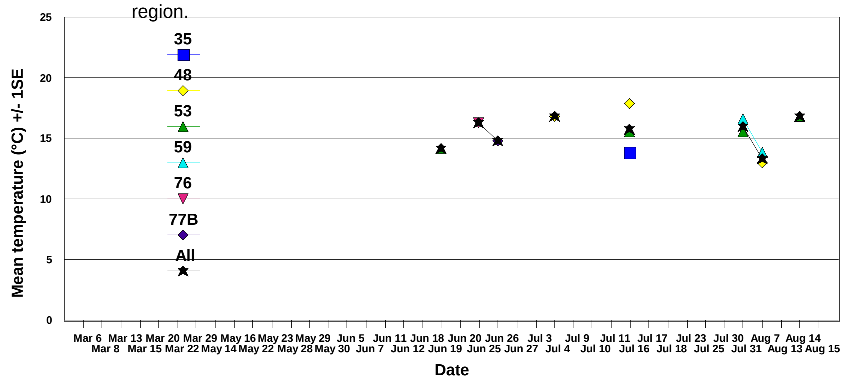

Fig. 32. Mean temperatures (°C) +/- 1SE by date for each site and all sites combined in Zone #9 in the Baynes outer purse and mini seine region.

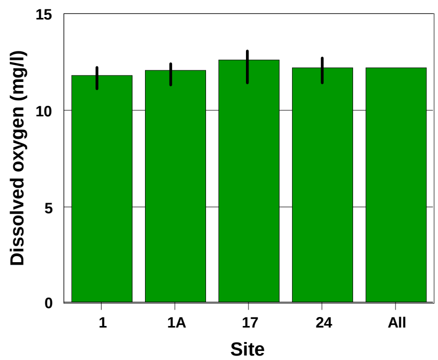

Fig. 33. Mean dissoved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #1 in the upper river region.

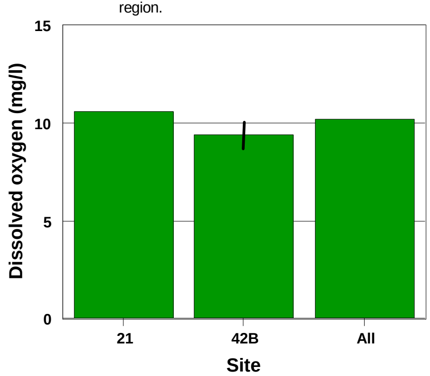

Fig. 34. Mean dissolved oxygen (mg/l) +/-1SE for each site and all sites combined in Zone #2 in the mid river region.

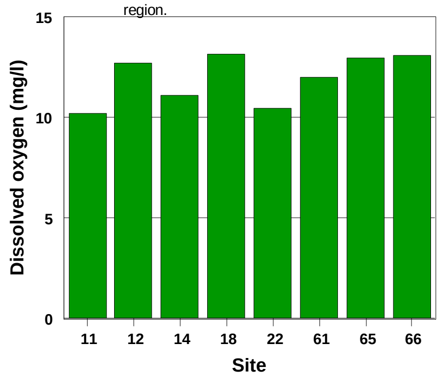

Fig. 35. Mean dissolved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #3 in the lower river region.

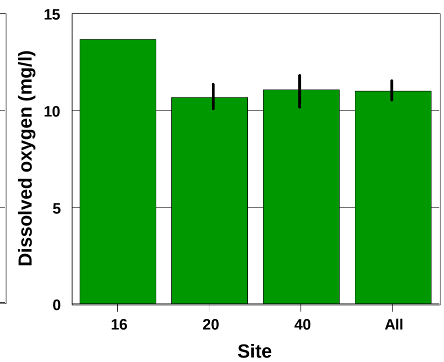

Fig. 36. Mean dissolved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #4 in the estuary region.

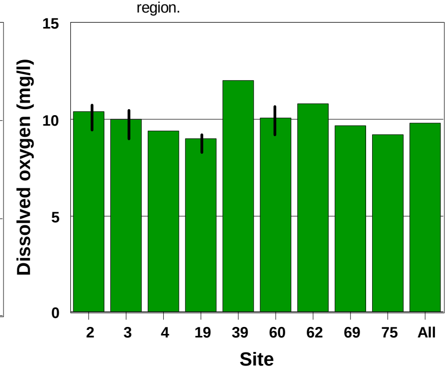

Fig. 37. Mean dissolved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #5 in in the estuary west region.

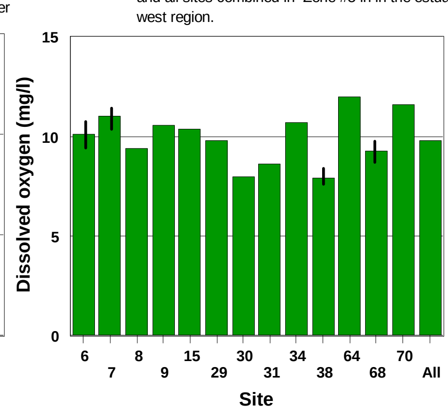

Fig. 38. Mean dissolved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #6 in the estuary east and Baynes east region.

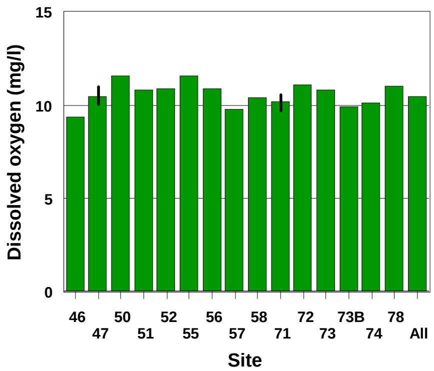

Fig. 39. Mean dissolved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region.

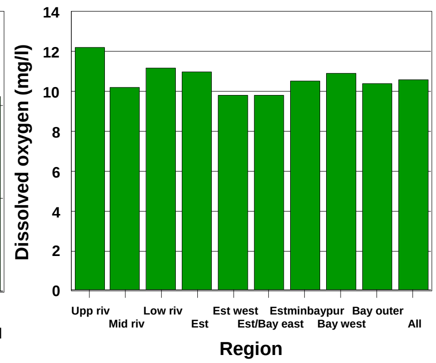

Fig. 42. Mean dissolved oxygen (mg/l) +/- 1SE for each of the nine salinity regions and all regions combined.

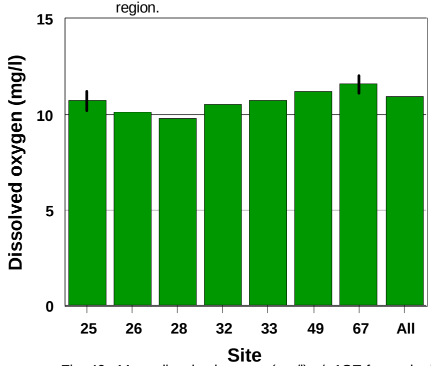

Fig. 40. Mean dissolved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #7 in the Baynes west region.

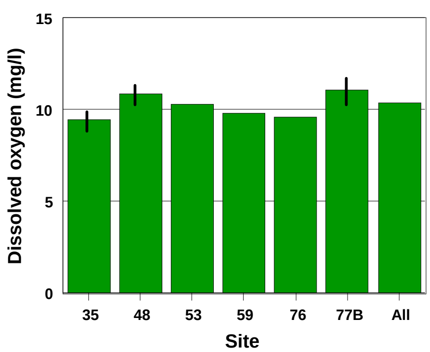

Fig. 41. Mean dissoved oxygen (mg/l) +/- 1SE for each site and all sites combined in Zone #9 in the Baynes outer purse and mini seine region.

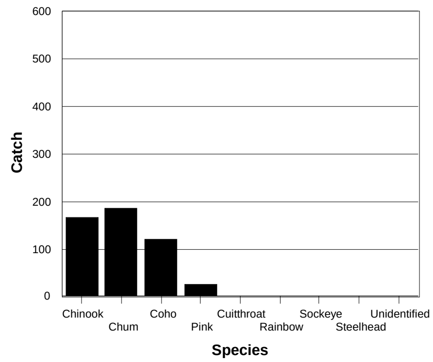

Fig. 43. Catch of juvenile salmon by species at the four sites in Zone #1 in the upper river region (65 sets).

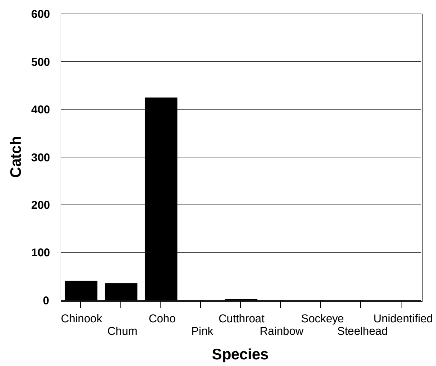

Fig. 44. Catch of juvenile salmon by species at the two sites in Zone #2 in the mid river region (30 sets).

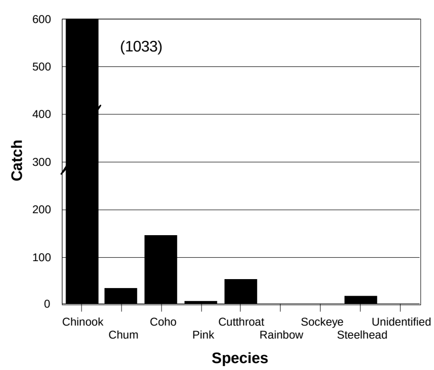

Fig. 45. Catch of juvenile salmon by species at the nine sites in Zone #3 in the lower river region (54 sets).

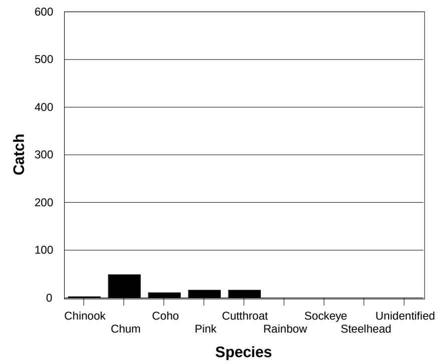

Fig. 46. Catch of juvenile salmon by species at the three sites in Zone #4 in the estuary region (20 sets).

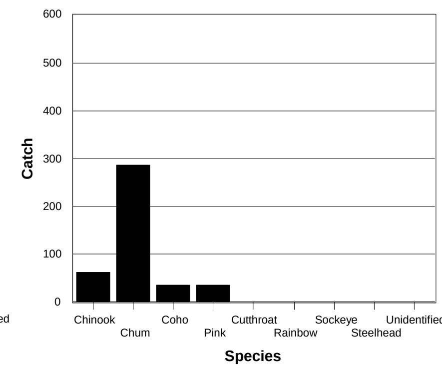

Fig. 47. Catch of juvenile salmon by species at the nine sites in Zone #5 in the estuary west region (54 sets).

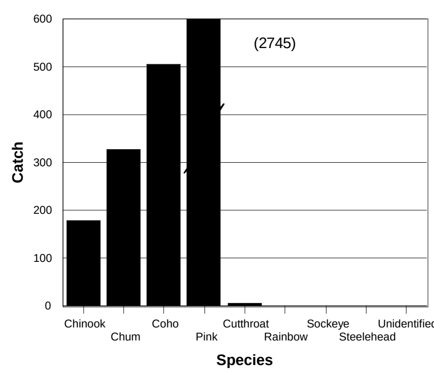

Fig. 48. Catch of juvenile salmon by species at the thirteen sites in Zone #6 in the estuary east and Baynes east region (98 sets).

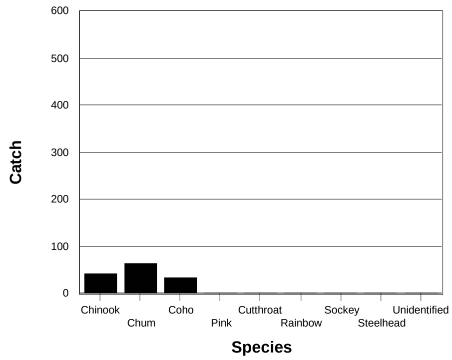

Fig. 49. Catch of juvenile salmon by species at the fifteen sites in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region (49 sets).

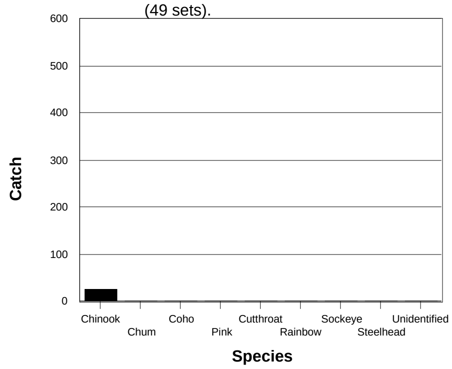

Fig. 50. Catch of juvenile salmon by species at the seven sites in Zone #7 in the Baynes west region (31 sets).

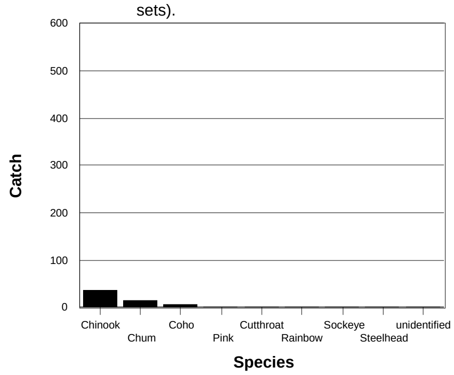

Fig. 51. Catch of juvenile salmon by species at the six sites in Zone #9 in the Baynes outer purse and mini seine region (14 sets).

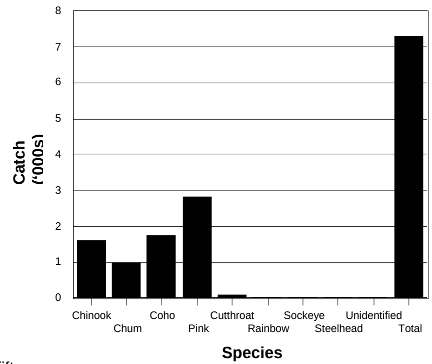

Fig. 52. Total catch of juvenile salmon by species for all sixty-eight beach, purse, mini purse and pole seines and Gee trap sites (416 sets).

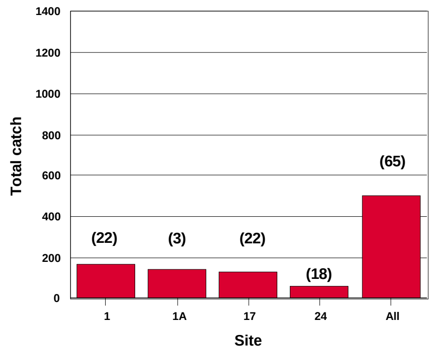

Fig. 53. Total catch of all species of salmon at each of the four sites and all sites combined in Zone #1in the upper river region (number of sets in brackets).

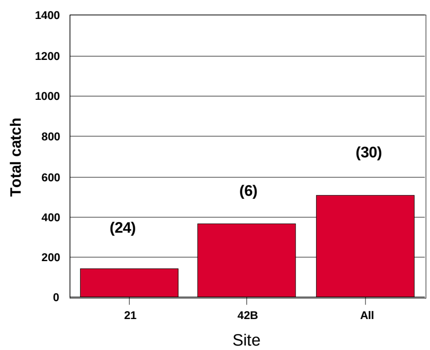

Fig. 54. Total catch of all species of salmon at each of the two sites and both sites combined in Zone #2 in the mid river region (number of sets in brackets).

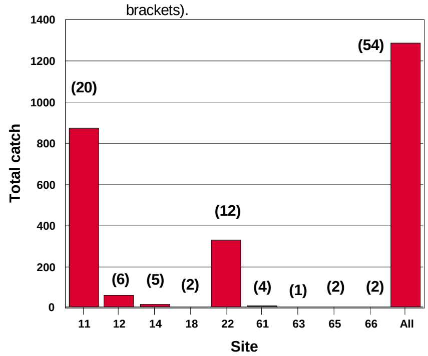

Fig. 55. Total catch of all species of salmon at each of the nine sites and all sites combined in Zone #3 in the lower river region (number of sets in brackets).

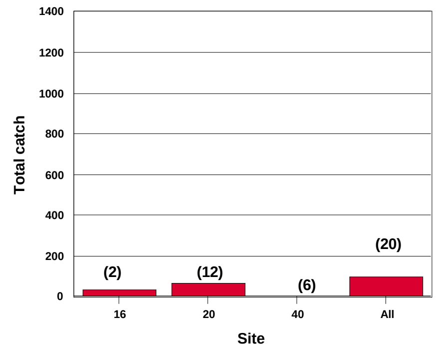

Fig. 56. Total catch of all species of salmon at each of the three sites and all sites combined in Zone #4 in the estuary region (number of sets in brackets).

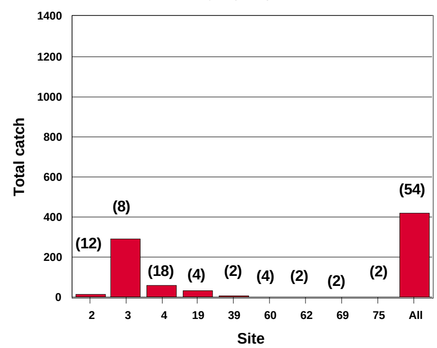

Fig. 57. Total catch of all species of salmon at each of the nine sites and all sites combined in Zone #5 in the estuary west region (number of sets in brackets).

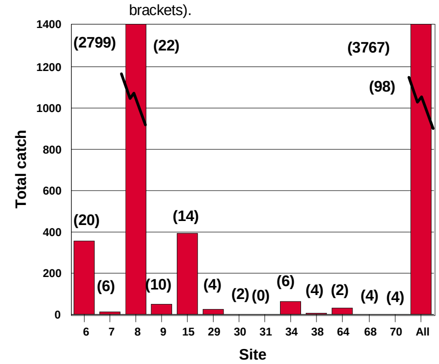

Fig. 58. Total catch of all species of salmon at each of the thirteen sites and all sites combined in Zone #6 in the estuary east and Baynes east region (number of sets in brackets).

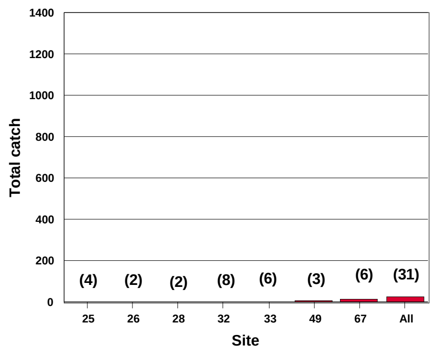

Fig. 59. Total catch of all species of salmon at each of the seven sites and all sites combined in Zone #7 in the Baynes west region (number of sets in brackets).

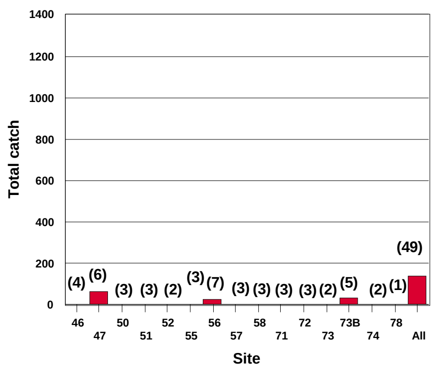

Fig. 60. Total catch of all species of salmon at each of the fifteen sites and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region (number of sets in brackets).

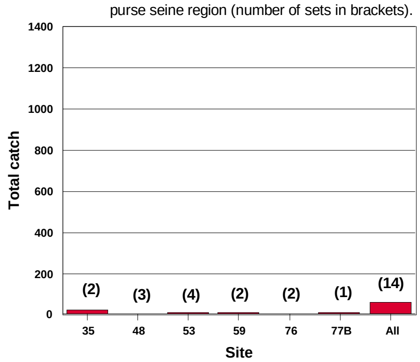

Fig. 61. Total catch of all species of salmon at each of the six sites and all sites combined in Zone #9 in the Baynes outer purse and mini seine region (number of sets in brackets).

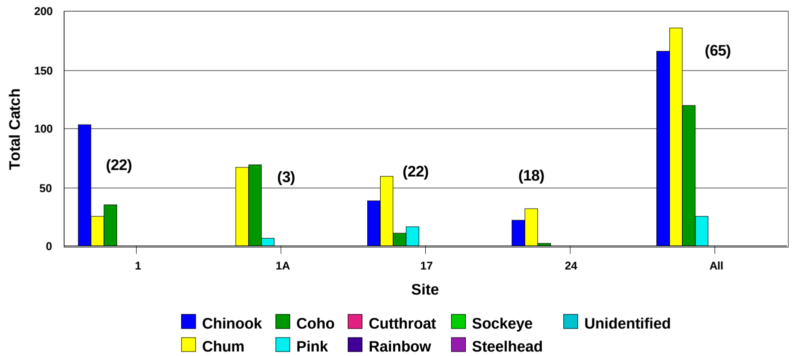

Fig. 62. Total catch of juvenile salmon by species at each of the four sites and all sites combined in Zone #1 in the upper river region (number of sets in brackets)..

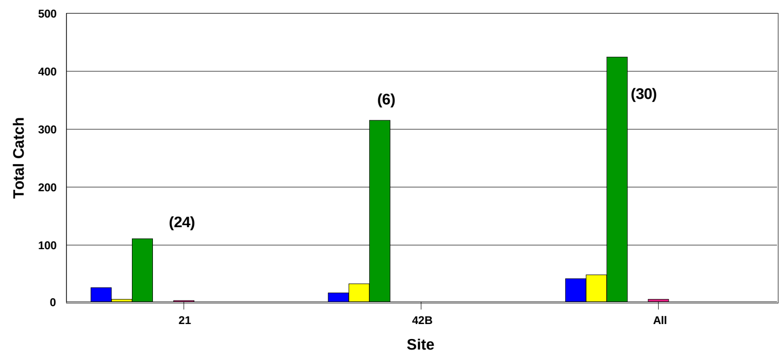

Fig. 63. Total catch of juvenile salmon by species at each of the two sites and both sites combined in Zone #2 in the mid river region (number of sets in brackets).

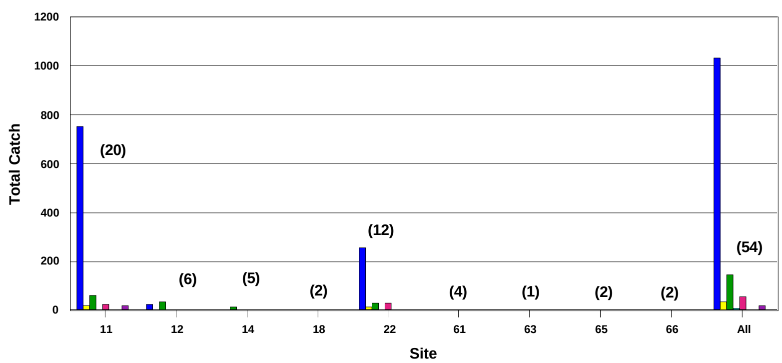

Fig. 64. Total catch of juvenile salmon by species at each of the nine sites and all sites combined in Zone #3 in the lower river region (number of sets in brackets).

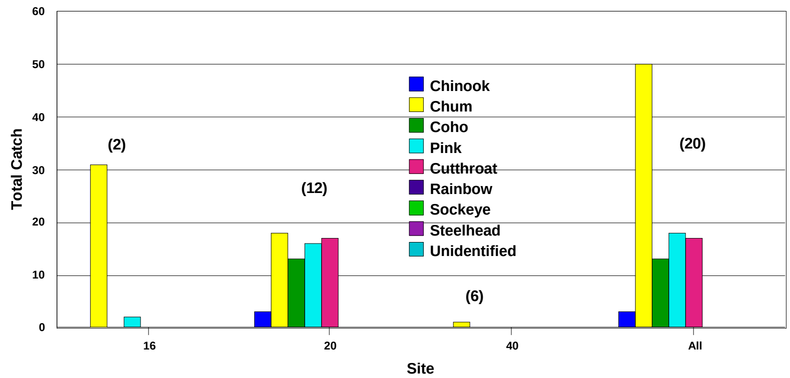

Fig. 65. Total catch of juvenile salmon by species at each of the three sites and all sites combined in Zone #4 in the estuary region (number of sets in brackets).

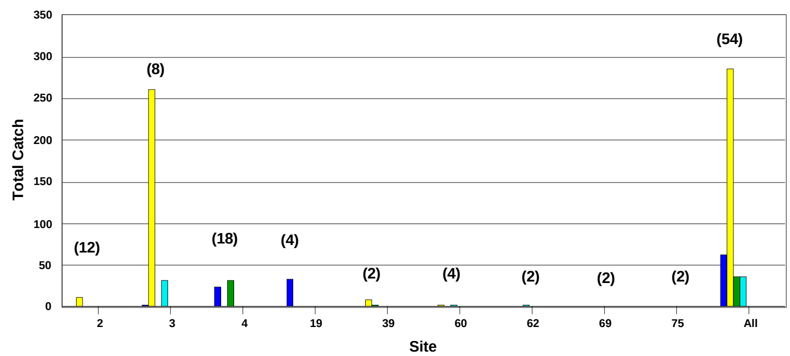

Fig. 66. Total catch of juvenile salmon by species at each of the nine sites and all sites combined in Zone #5 in the estuary west region (number of sets in brackets).

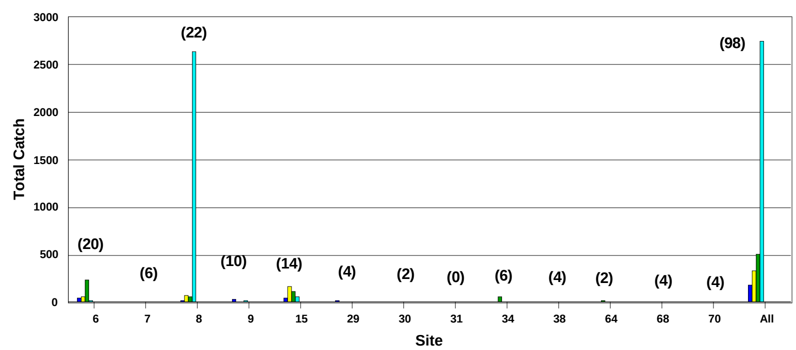

Fig. 67. Total catch of juvenile salmon by species at each of the thirteen sites and all sites combined in Zone #6 in the estuary east and Baynes east region (number of sets in brackets).

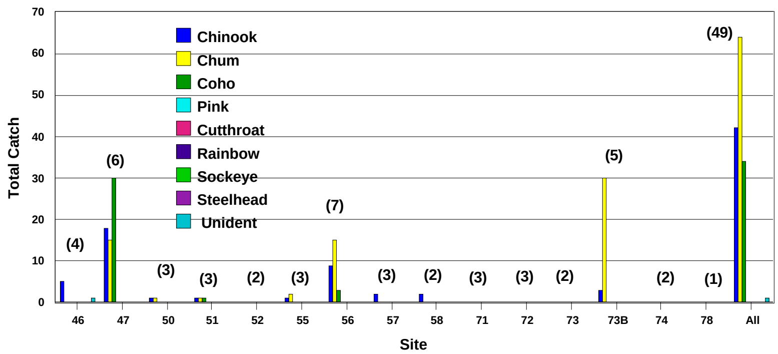

Fig. 68. Total catch of juvenile salmon by species at each of the fifteen sites and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region (number of sets in brackets).

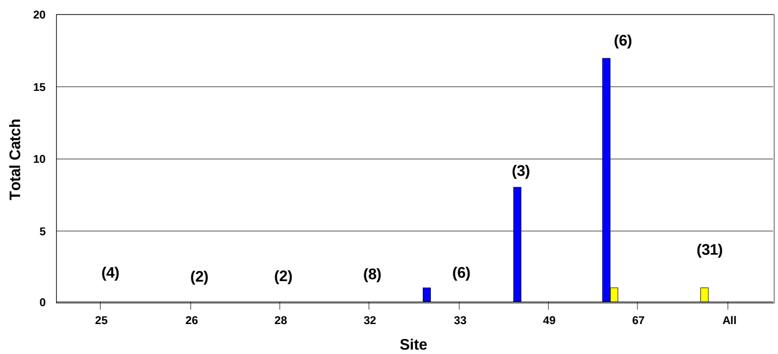

Fig. 69. Total catch of juvenile salmon by species at each of the seven sites and all sites combined in Zone #7 in the Baynes west region (number of sets in brackets).

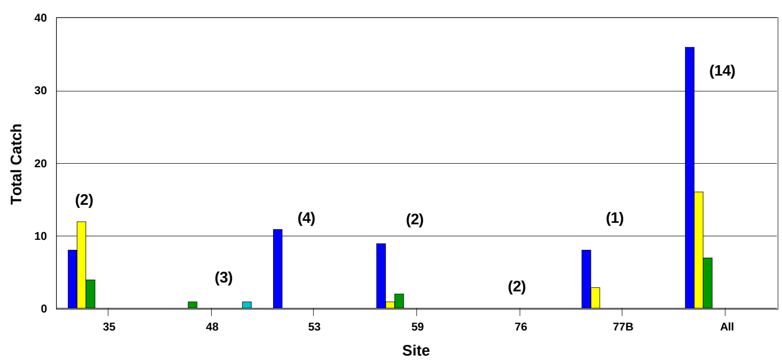

Fig. 70. Total catch of juvenile salmon by species at each of the six sites and all sites combined in Zone #9 in the Baynes outer purse and mini seine region (number of sets in brackets).

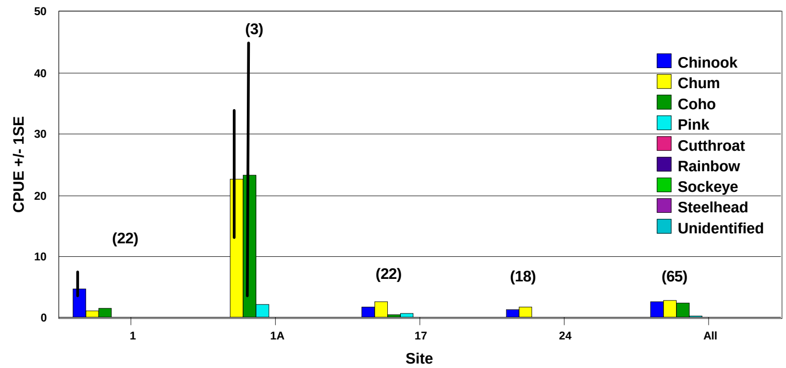

Fig. 71. CPUE +/- 1SE by site and species for all salmon captured at the four sites and all sites combined in Zone #1 in the upper river region (number of sets in brackets).

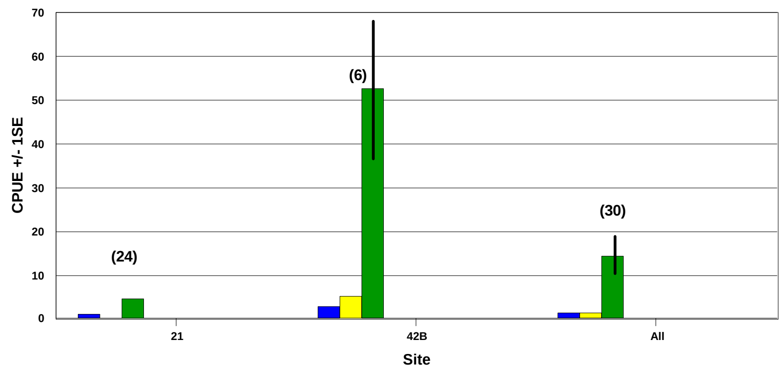

Fig. 72. CPUE +/- 1SE by site and species for all salmon captured at the two sites and both sites combined in Zone #2 in the mid river region (number of sets in brackets).

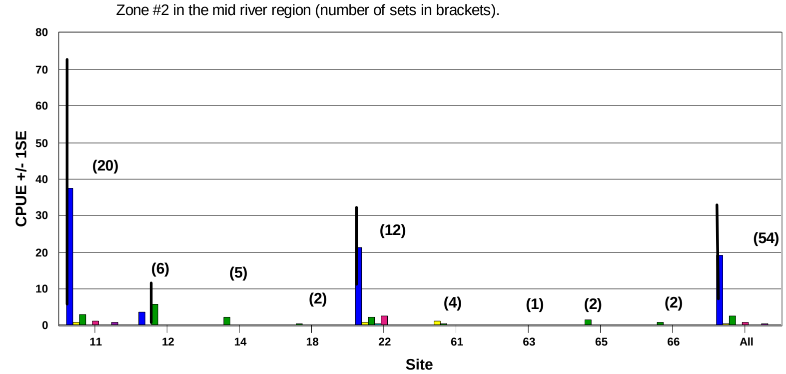

Fig. 73. CPUE +/- 1SE by site and species for all salmon captured at the nine sites and all sites combined in Zone #3 in the lower river region (number of sets in brackets).

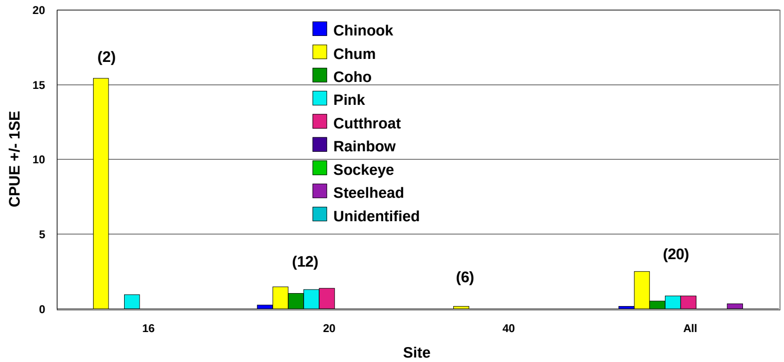

Fig. 74. CPUE +/- 1SE by site and species for all salmon captured at the three sites and all sites combined in Zone #4 in the estuary region (number of sets in brackets).

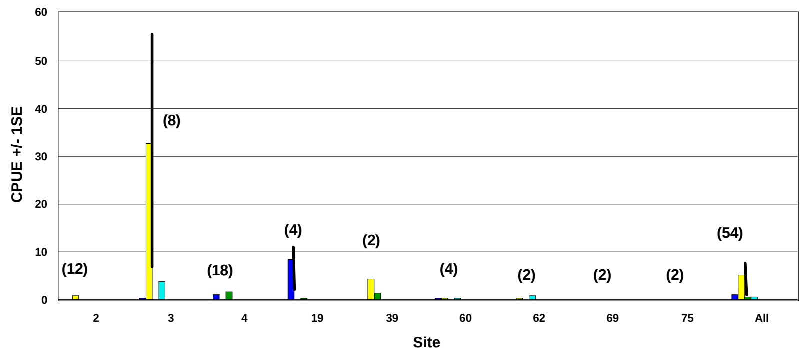

Fig. 75. CPUE +/- 1SE by site and species for all salmon captured at the nine sites and all sites combined in Zone #5 in the estuary west region (number of sets in brackets).

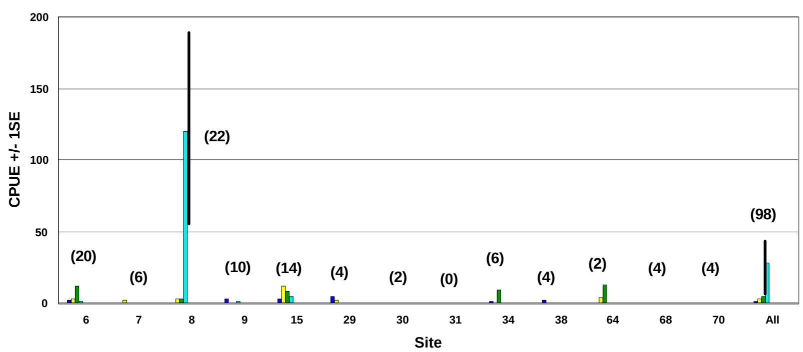

Fig. 76. CPUE +/- 1SE by site and species for all salmon captured at the thirteen sites and all sites combined in Zone #6 in the estuary east and Baynes east region (number of sets in brackets).

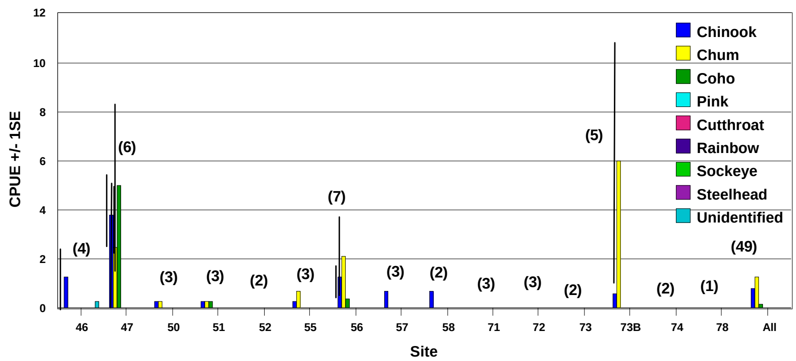

Fig. 77. CPUE +/- 1SE by site and species for all salmon captured at the fifteen sites and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region (number of sets in brackets).

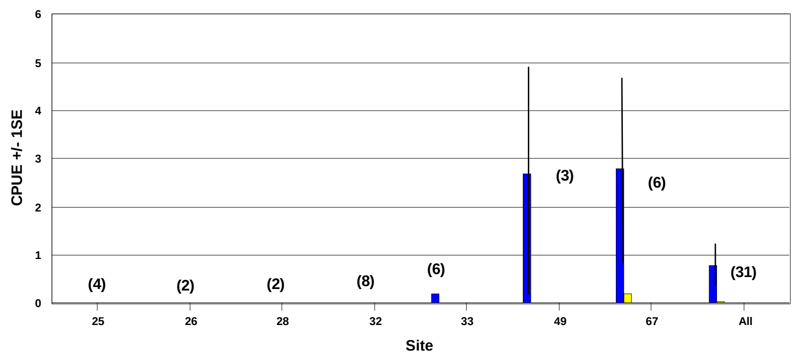

Fig. 78. CPUE +/- 1SE by site and species for all salmon captured at the seven sites and all sites combined in Zone #7 in the Baynes west region (number of sets in brackets).

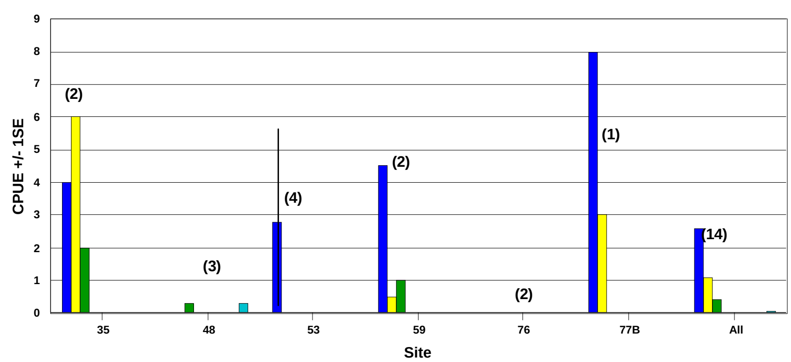

Fig. 79. CPUE +/- 1SE by site and species for all salmon captured at the six sites and all sites combined in Zone #9 in the Baynes outer purse and mini seine region (number of sets in brackets).

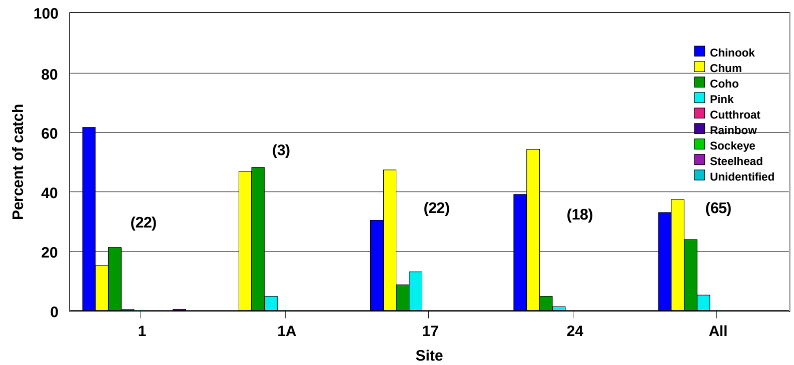

Fig. 80. Catch of juvenile salmon by species as a percent of total catch at each of the four sites and all sites combined in Zone #1 in the upper river region (number of sets in brackets).

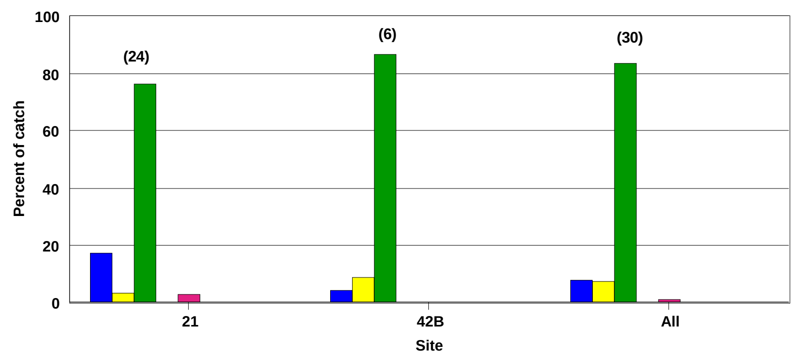

Fig. 81. Catch of juvenile salmon by species as a percent of total catch at each of the two sites and all sites combined in Zone #2 in the mid river region (number of sets in brackets).

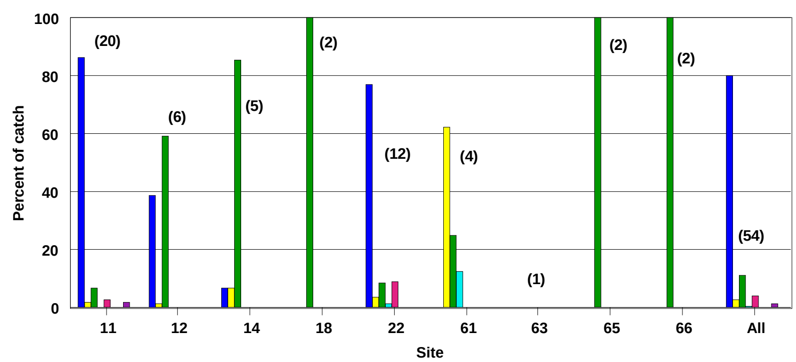

Fig. 82. Catch of juvenile salmon by species as a percent of total catch at each of the nine sites and all sites combined in Zone #3 in the lower river region (number of sets in brackets).

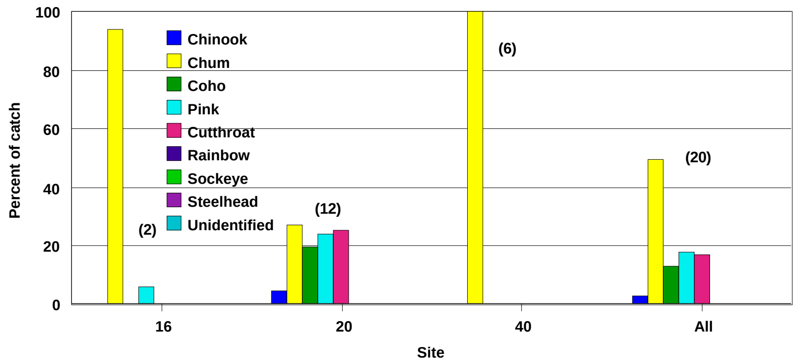

Fig. 83. Catch of juvenile salmon by species as a percent of total catch at each of the three sites and all sites combined in Zone #4 in the estuary region (number of sets in brackets).

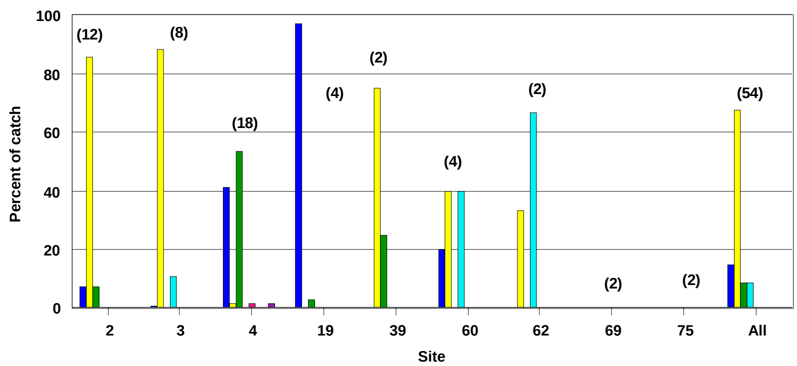

Fig. 84. Catch of juvenile salmon by species as a percent of total catch at each of the nine sites and all sites combined in Zone #5 in the estuary west region (number of sets in brackets).

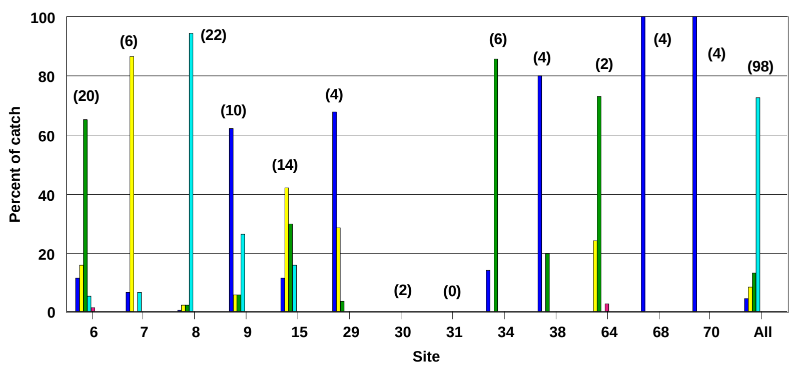

Fig. 85. Catch of juvenile salmon by species as a percent of total catch at each of the thirteen sites and all sites combined in Zone #6 in the estuary east and Baynes east region (number of sets in brackets).

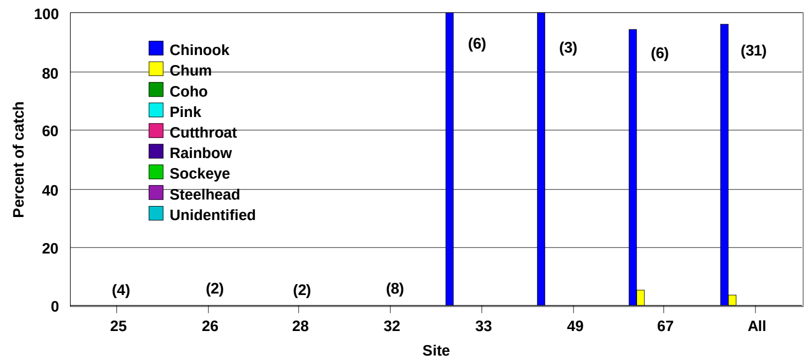

Fig. 86. Catch of juvenile salmon by species as a percent of total catch at each of the seven sites and all sites combined in Zone #7 in the Baynes west region (number of sets in brackets).

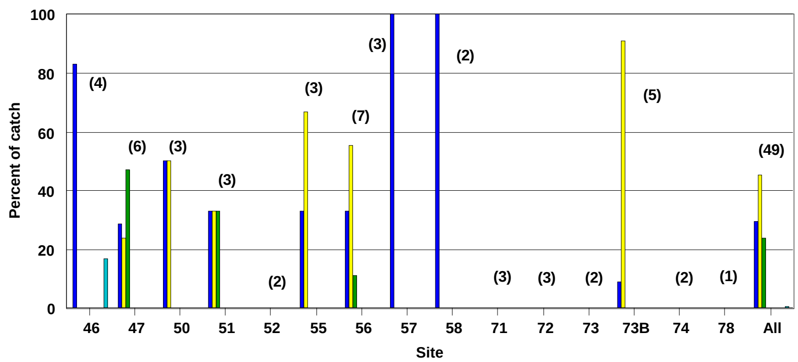

Fig. 87. Catch of juvenile salmon by species as a percent of total catch at each of the fifteen sites and all sites combined in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region (number of sets in brackets).

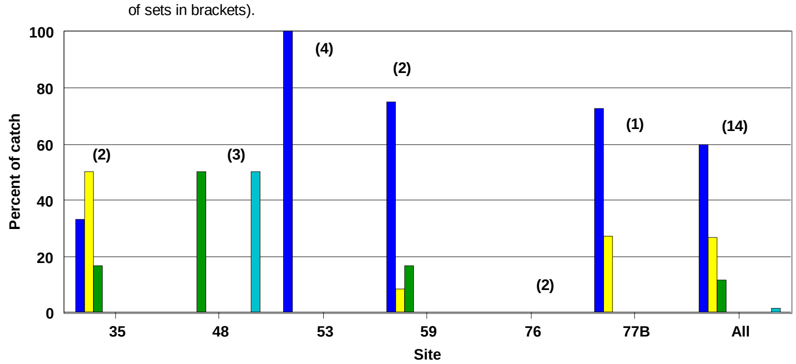

Fig. 88. Catch of juvenile salmon by species as a percent of total catch at each of the six sites and all sites combined in Zone #9 in the Baynes outer purse and mini seine region (number of sets in brackets).

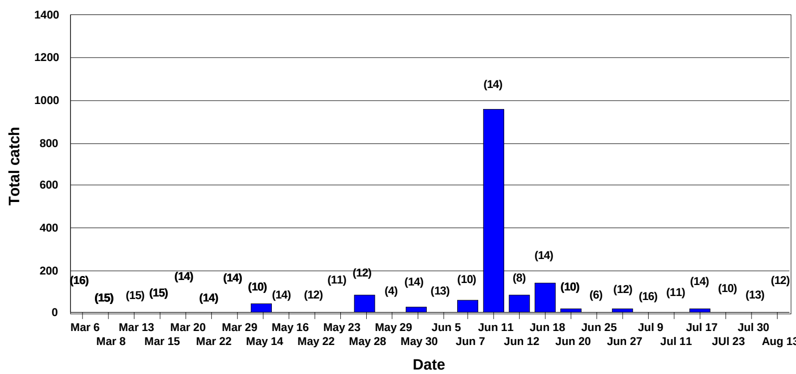

Fig. 89. Total catch of chinook by date for all beach seine sites (number of sets in brackets).

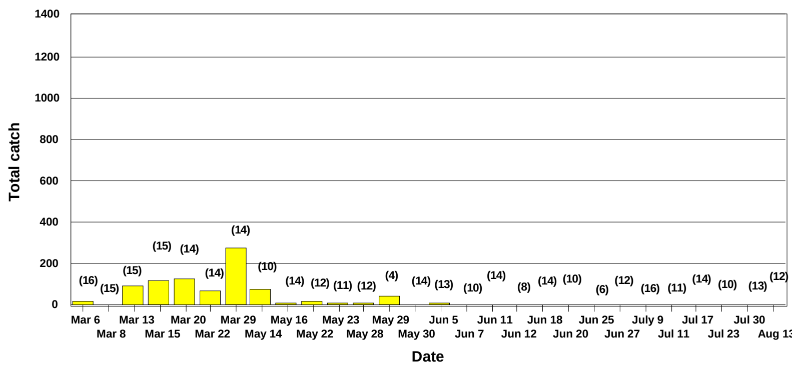

Fig. 90. Total catch of chum by date for all beach seine sites (number of sets in brackets).

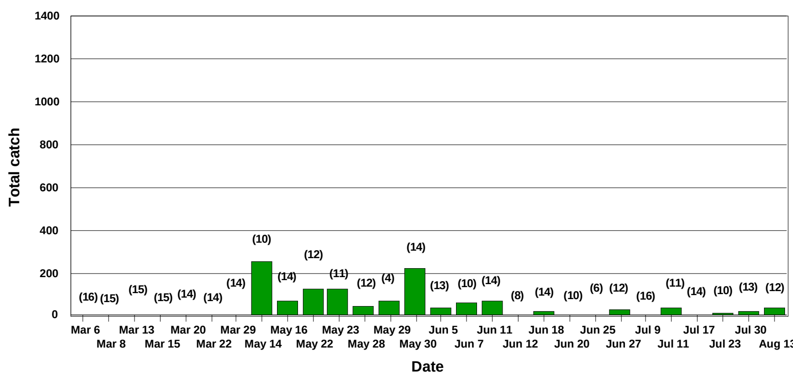

Fig. 91. Total catch of coho by date for all beach seine sites (number of sets in brackets).

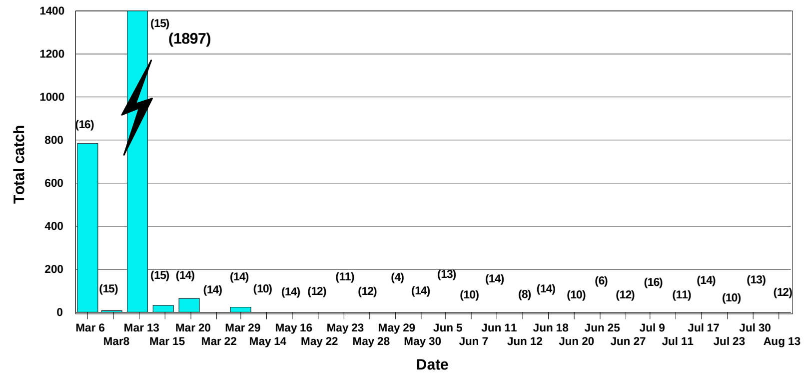

Fig. 92. Total catch of pink by date for all beach seine sites (number of sets in brackets).

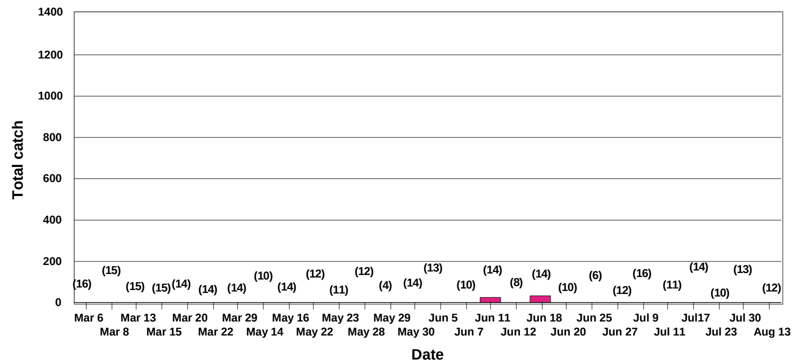

Fig. 93. Total catch of cutthroat by date for all beach seine sites (number of sets in brackets).

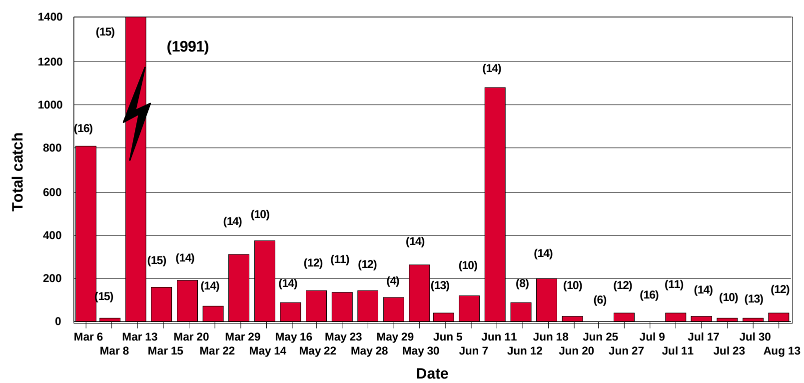

Fig. 94. Total catch of all salmonids by date for all beach seine sites (number of sets in brackets).

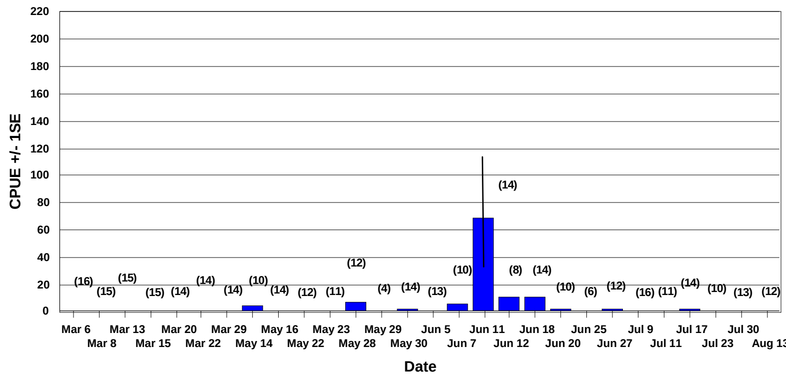

Fig. 95. CPUE +/- 1SE for chinook by date for all beach seine sites (number of sets in brackets).

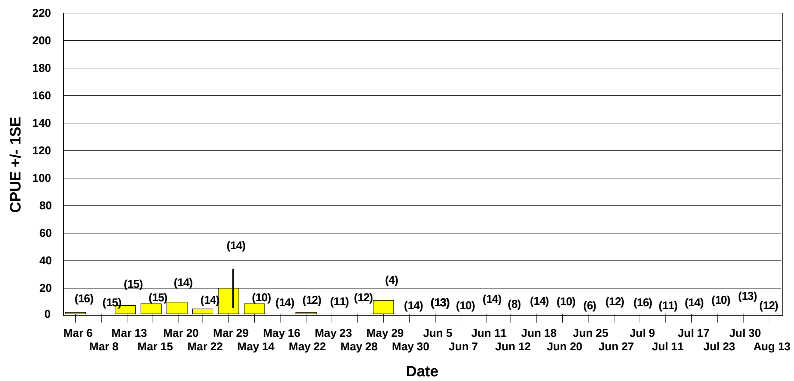

Fig. 96. CPUE +/- 1SE for chum by date for all beach seine sites (number of sets in brackets).

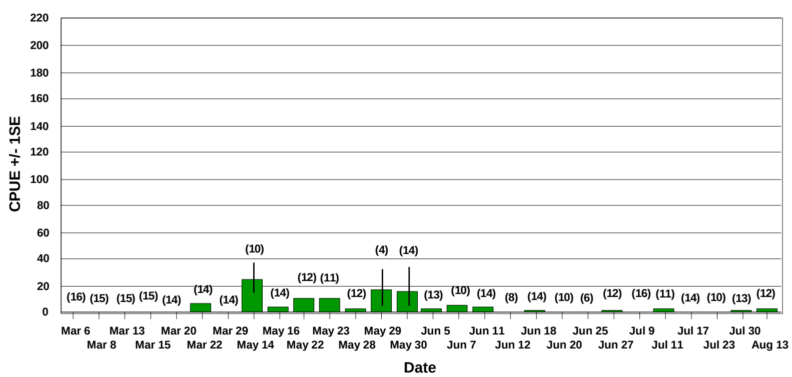

Fig. 97. CPUE +/- 1SE for coho by date for all beach seine sites (number of sets in brackets).

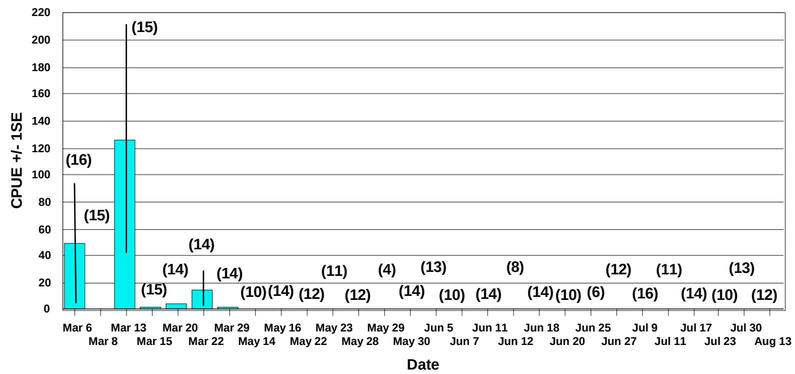

Fig. 98. CPUE +/- 1SE for pink by date for all beach seine sites (number of sets in brackets).

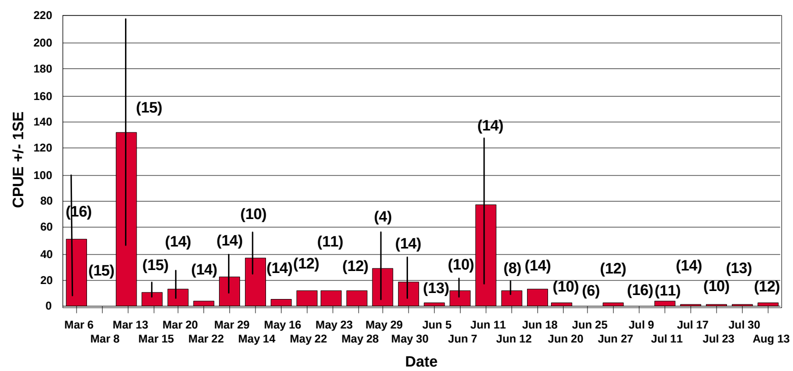

Fig .99. CPUE +/- 1SE for all salmonids by date for all beach seines sites (number of sets in brackets).

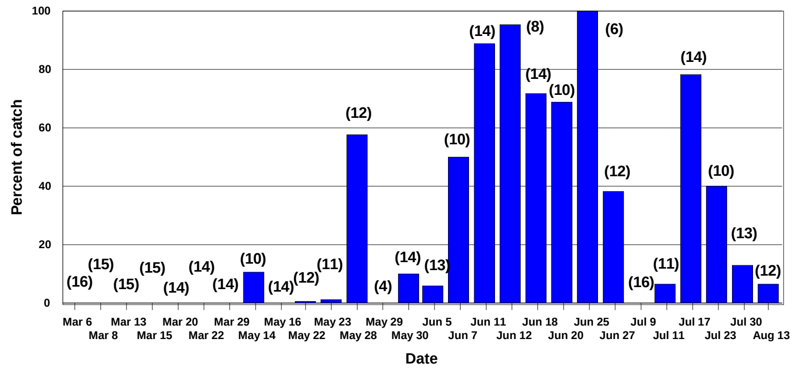

Fig. 100. Catch of chinook as a percent of total catch by date for all beach seine sites (number of sets in brackets).

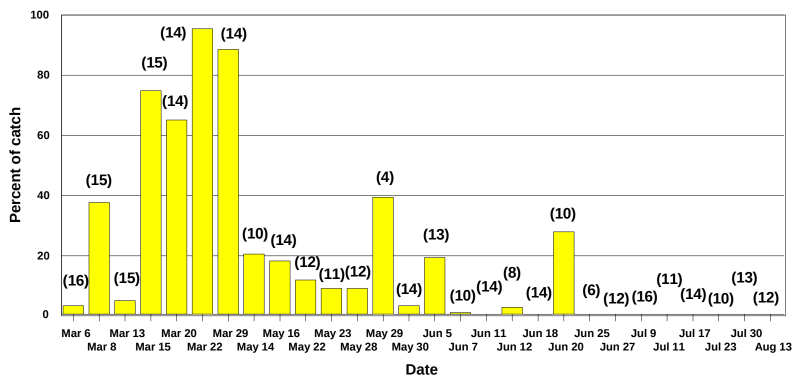

Fig. 101. Catch of chum as a percent of total catch by date for all beach seine sites (number of sets in brackets).

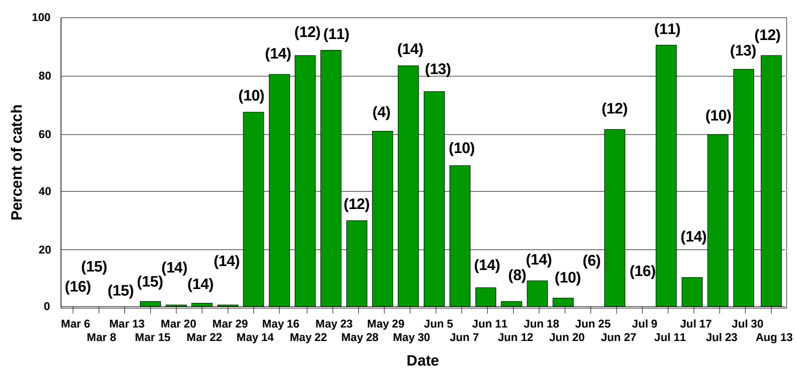

Fig. 102. Catch of coho as a percent of total catch by date for all beach seine sites (number of sets in brackets).

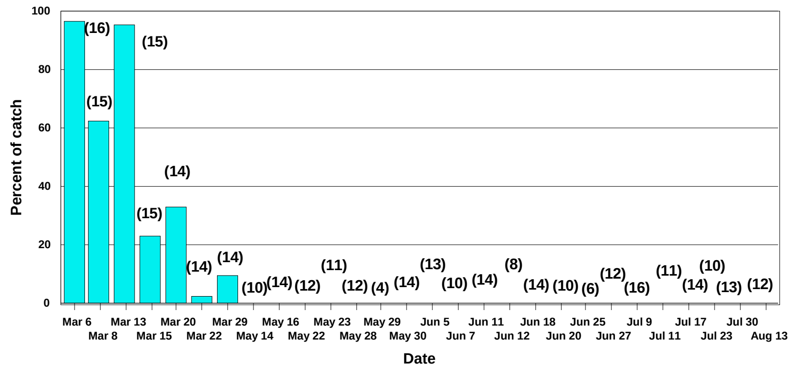

Fig. 103. Catch of pink as a percent of total catch by date for all beach seine sites (number of sets in brackets).

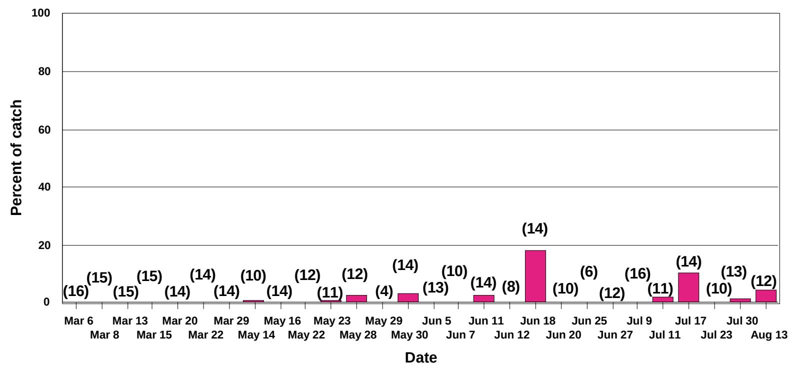

Fig. 104. Catch of cutthroat as a percent of total catch by date for all beach seine sites (number of sets in brackets).

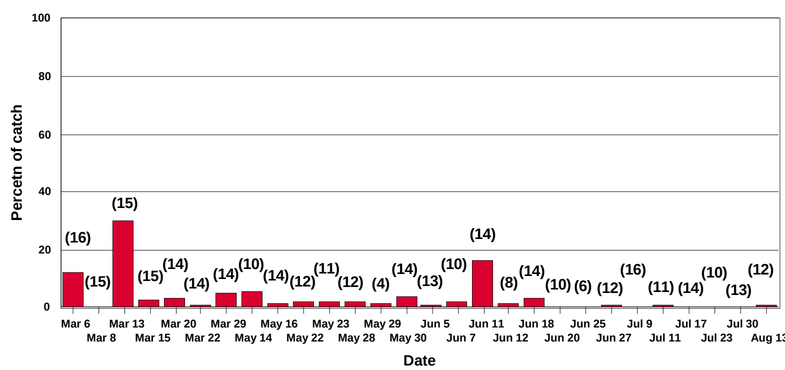

Fig. 105. Catch of all salmonids as a percent of total catch by date for all beach seine sites (number of sets in brackets).

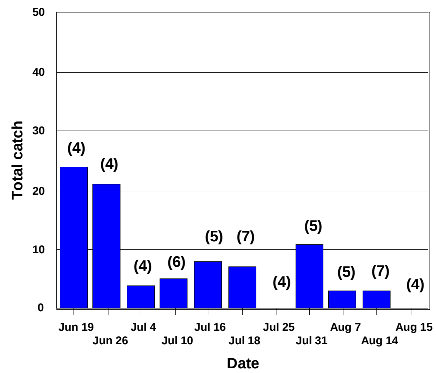

Fig. 106. Total catch of chinook by date for all purse seine sites (number of sets in brackets)..

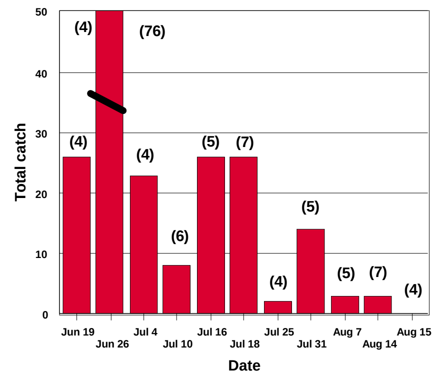

Fig. 109. Total catch of all salmonids by date for all purse seine sites (number of sets in brackets).

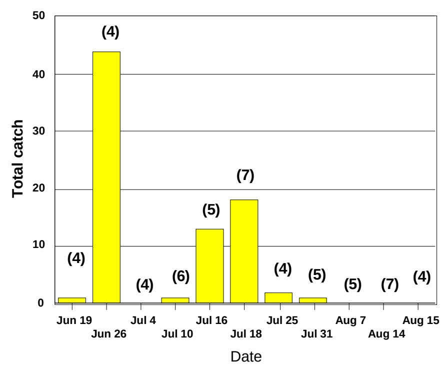

Fig. 107. Total catch of chum by date for all purse seine sites (number of sets in brackets).

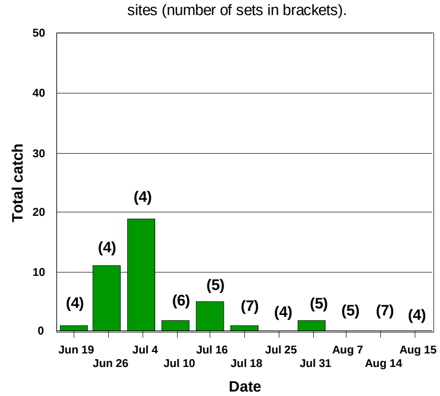

Fig. 108. Total catch of coho by date for all purse seine sites (number of sets in brackets).

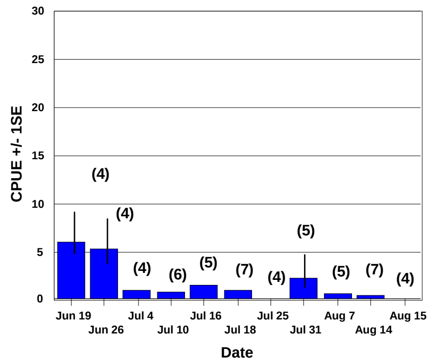

Fig. 110. CPUE +/- 1SE for chinook by date for all purse seine sites (number of sets in brackets).

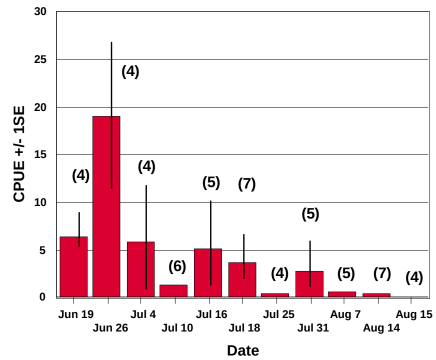

Fig. 113. CPUE +/- 1SE for all salmonids by date for all purse seine sites (number of sets in brackets).

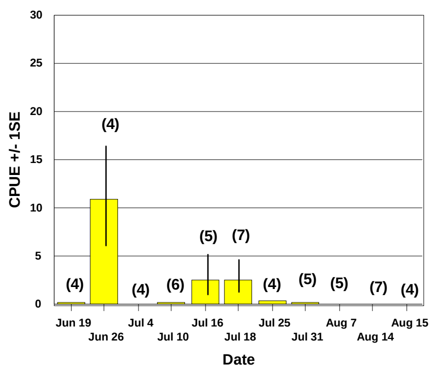

Fig. 111. CPUE +/- 1SE for chum by date for all purse seine sites (number of sets in brackets).

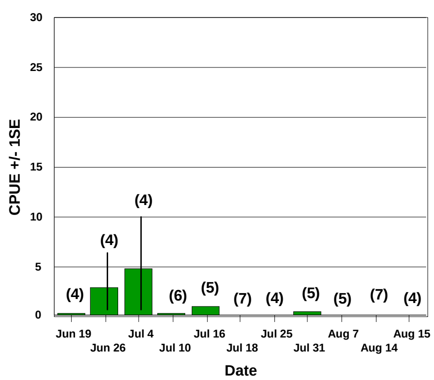

Fig. 112. CPUE +/- 1SE for coho by date for all purse seine sites (number of sets in brackets).

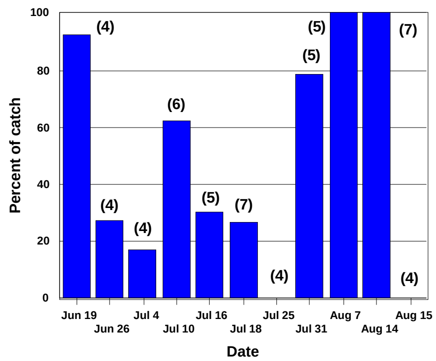

Fig. 114. Catch of chinook as a percent of total catch by date for all purse seine sites (number of sets in brackets).

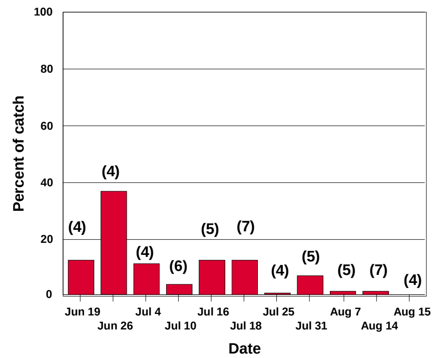

Fig. 117. Catch of all salmonids as a percent of total catch by date for all purse seine sites (number of sets in brackets).

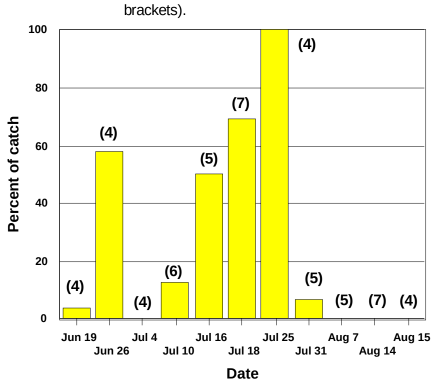

Fig. 115. Catch of chum as a percent of total catch by date for all purse seine sites (number of sets in brackets).

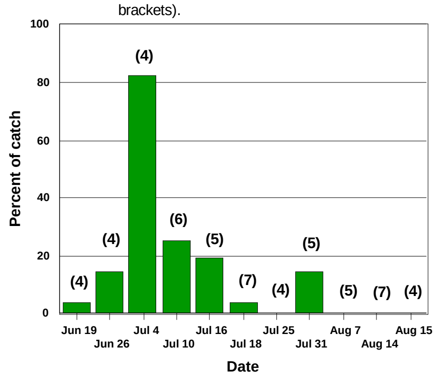

Fig. 116. Catch of coho as a percent of total catch by date for all purse seine sites (number of sets in brackets).

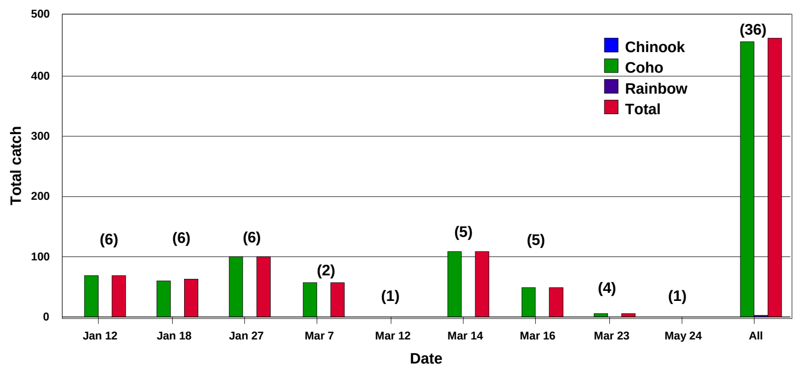

Fig. 118. Total catch of chinook, coho and rainbow by date for all Gee trap sites and all dates combined (number of sets in brackets)..

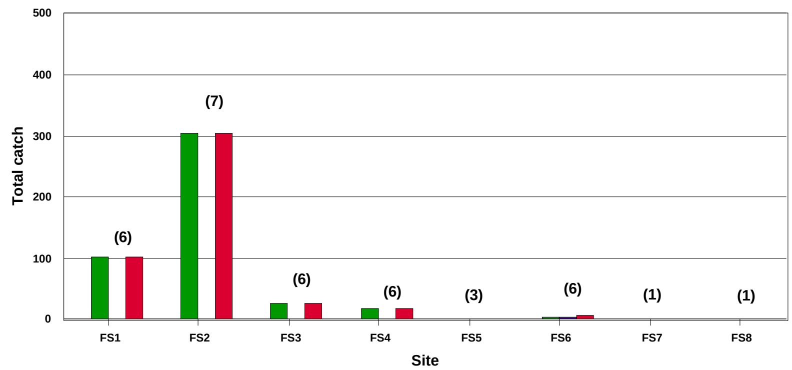

Fig. 119. Total catch of juvenile salmon by species at each of the eight Gee trap sites (number of sets in brackets).

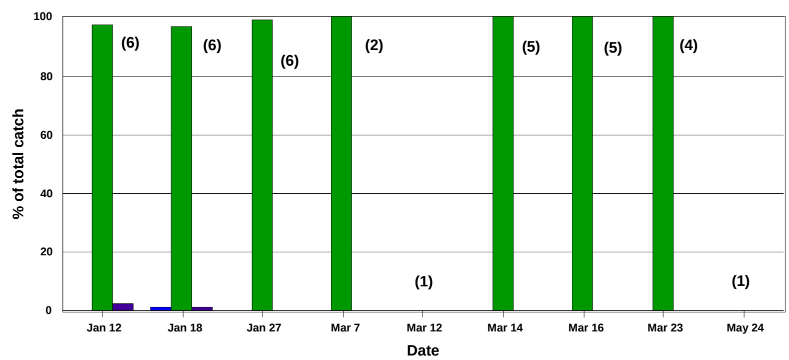

Fig. 120. Catch of juvenile salmon by species and date as a percent of total catch for all Gee trap sites combined (number of sets in brackets).

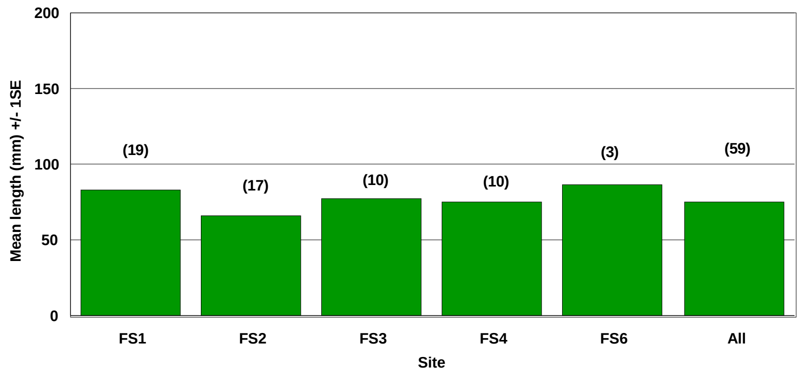

Fig. 121. Mean length (mm) +/- 1SE for coho captured at the Gee trap sites (number sampled in brackets).

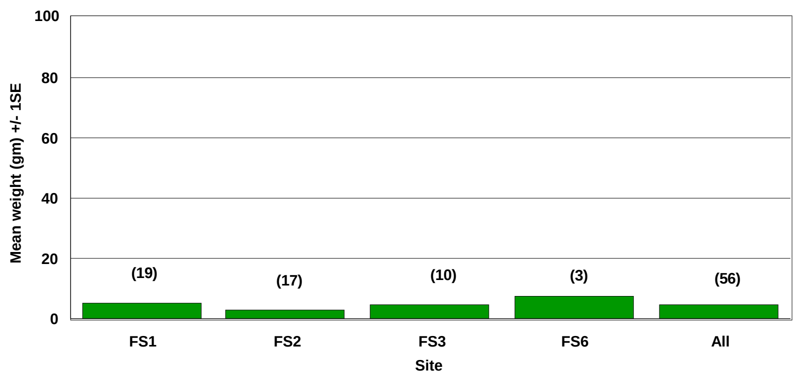

Fig. 122. Mean weight (gm) +/- 1SE for coho captured at the Gee trap sites (number sampled in brackets)

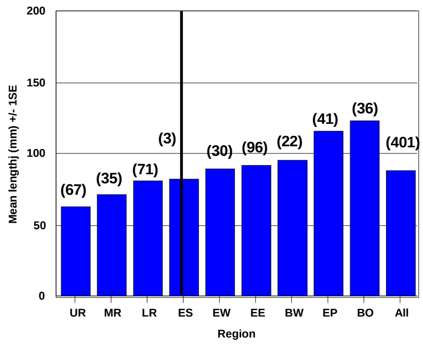

Fig. 123. Mean length (mm) +/- 1SE for chinook captured in each of the nine regions and all regions combined (number sampled in brackets).

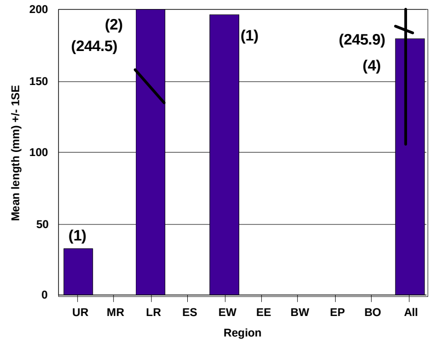

Fig. 126. Mean length (mm) +/- 1SE for steelhead captured in each of the nine regions and all regions combined (number sampled in brackets).

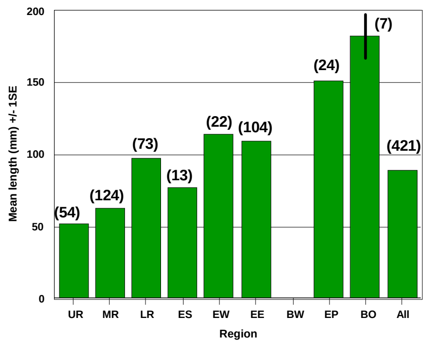

Fig. 124. Mean length (mm) +/- 1SE for coho captured in each of the nine regions and all regions combined (number sampled in brackets).

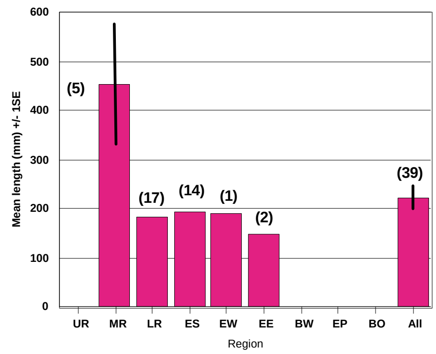

Fig. 127. Mean length (mm) +/- 1SE for cutthroat captured in each of the nine regions and all regions combined (number sampled in brackets).

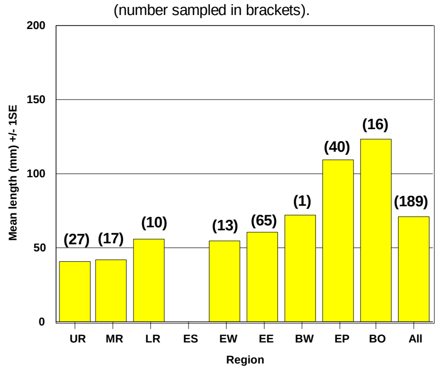

Fig. 125. Mean length (mm) +/- 1SE for chum captured in each of the nine regions and all regions combined (number sampled in brackets).

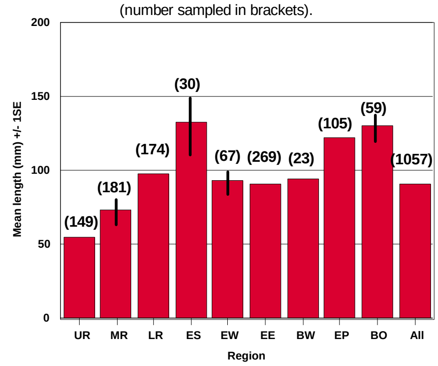

Fig. 128. Mean length (mm) +/- 1SE for all salmonids captured in each of the nine regions and all regions combined (number sampled in brackets).

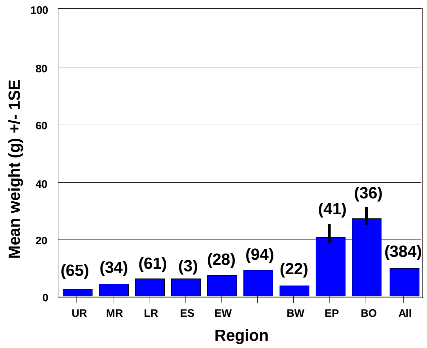

Fig. 129. Mean weight (g) +/- 1SE for chinook captured in each of the nine regions and all regions combined (number sampled in brackets).

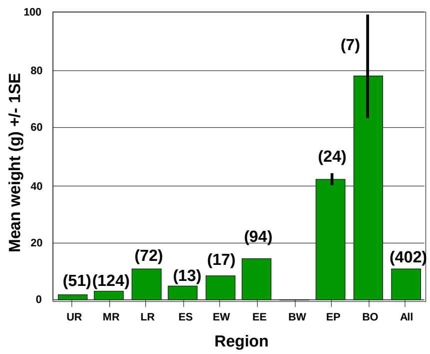

Fig. 130. Mean weight (g) +/- 1SE for coho captured in each of the nine regions and all regions combined (number sampled in brackets).

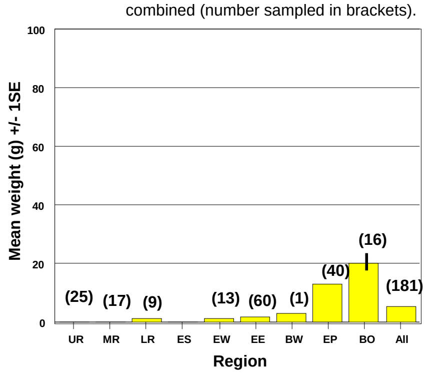

Fig. 131. Mean weight (g) +/- 1SE for chum captured in each of the nine regions and all regions combined (number sampled in brackets).

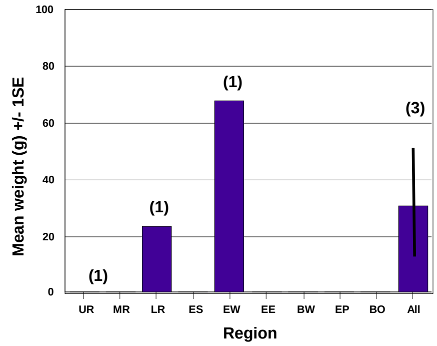

Fig. 132. Mean weight (g) +/- 1SE for steelhead captured in each of the nine regions and all regions combined (number sampled in brackets).

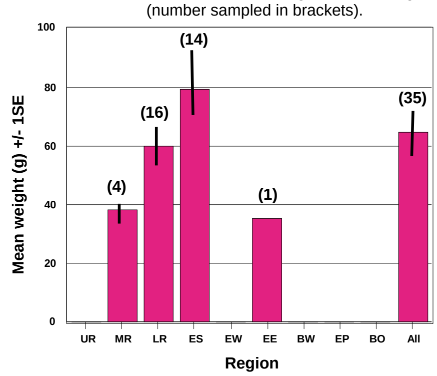

Fig. 133. Mean weight (g) +/- 1SE for cutthroat captured in each of the nine regions and all regions combined (number sampled in brackets).

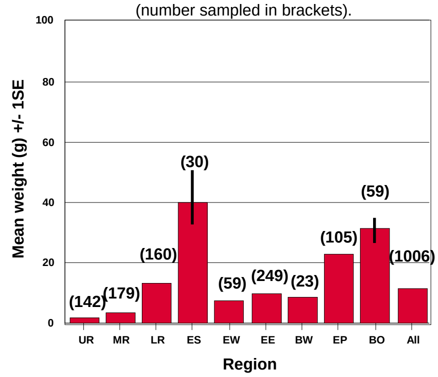

Fig. 134. Mean weight (g) +/- 1SE for all salmonids captured in each of the nine regions and all regions combined (number sampled in brackets).

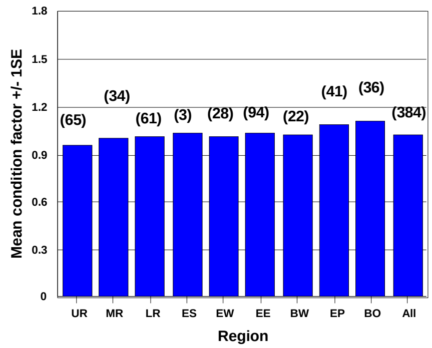

Fig. 135. Mean condition factor +/- 1SE for chinook captured in each of the nine regions and all regions combined (number sampled in brackets).

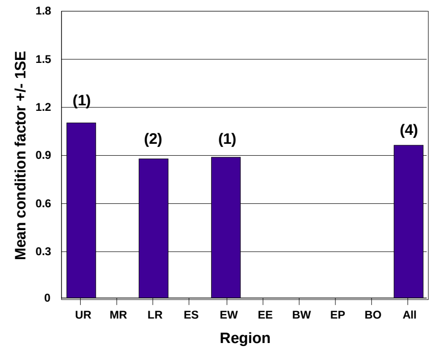

Fig. 138. Mean condition factor +/- 1SE for steelhead captured in each of the nine regions and all regions combined (number sampled in brackets).

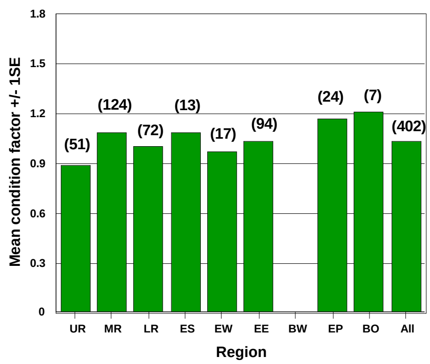

Fig. 136. Mean condition factor +/- 1SE for coho captured in each of the nine regions and all regions combined (number sampled in brackets).

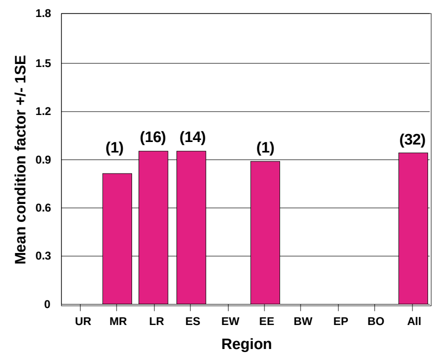

Fig. 139. Mean condition factor +/- 1SE for cutthroat captured in each of the nine regions and all regions combined (number sampled in brackets).

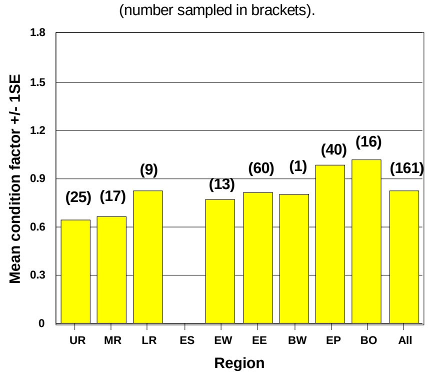

Fig. 137. Mean conditon factor +/- 1SE for chum captured in each of the nine regions and all regions combined (number sampled in brackets).

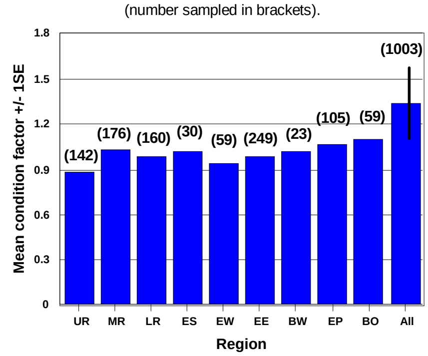

Fig. 140. Mean conditon factor +/- 1SE for all salmonids captured in each of the nine regions and all regions combined (number sampled in brackets).

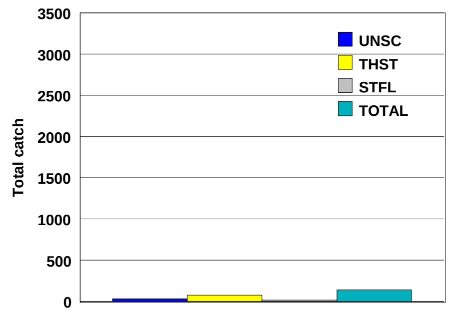

Fig. 141. Total catch of dominant non salmonid species in Zone #1 in the upper river region (see Table 13 for abbreviations).

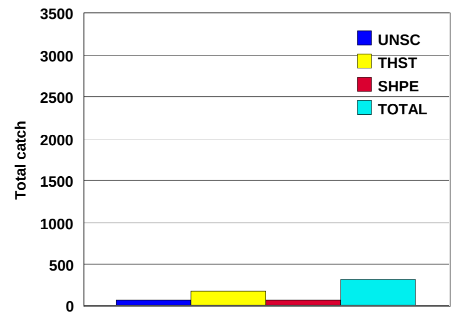

Fig. 144. Total catch of dominant non salmonid species in Zone #4 in the estuary region (see Table 13 for abbreviations).

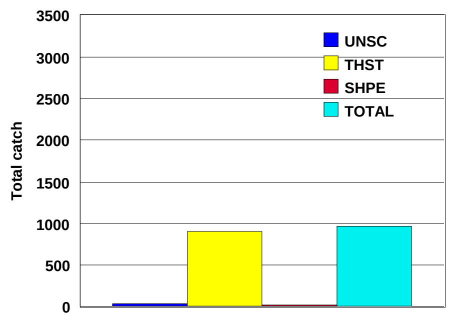

Fig. 142. Total catch of dominant non salmonid species in Zone #2 in the mid river region (see Table 13 for abbreviations).

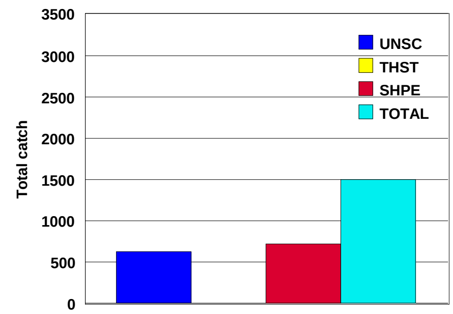

Fig. 145. Total catch of dominant non salmonid species in Zone #5 in the estuary west region (see Table 13 for abbreviations).

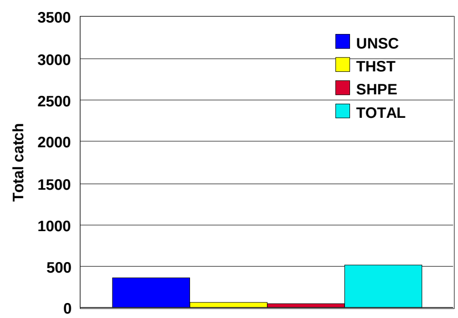

Fig. 143. Total catch of dominant non salimonid species in Zone #3 in the lower river region (see Table 13 for abbreviations).

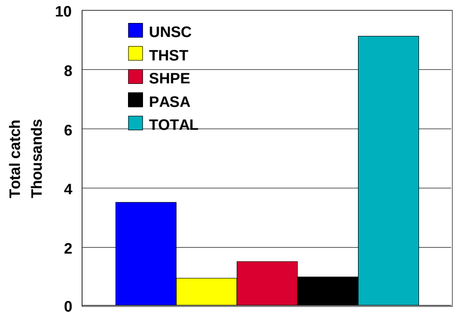

Fig. 146. Total catch of dominant non salmonid species in Zone #6 in the estuary east and Baynes east region (see Table 13 for abbreviations).

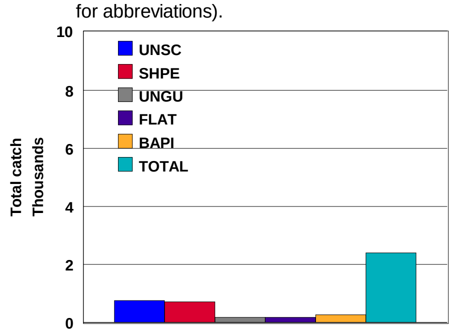

Fig. 147. Total catch of dominant non salmonid species in Zone #7 in the Baynes west region (see Table 13 for abbreviations).

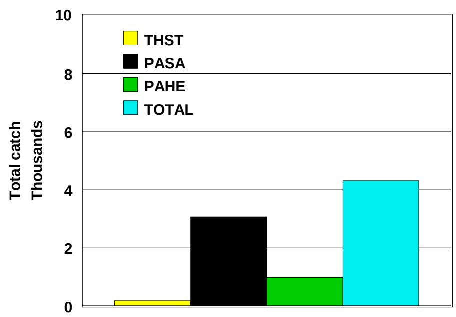

Fig. 148. Total catch of dominant non salmonid species in Zone #8 in the estuary purse and mini purse and Baynes inner purse seine region (see Table 13 for abbreviations).

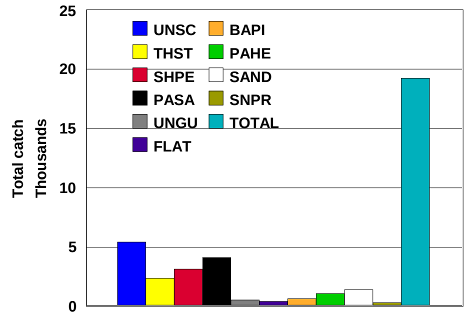

Fig. 149. Total catch of dominant non salmonid species for each of the nine regions and all regions combined (see Table 13 for abbreviations).