

# Bella Coola eulachon study 2004 final report

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November, 2006

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## Executive summary

Eulachon (oolichan, ooligan) have been a fish of vital importance to First Nations along the Pacific Coast for millennia. While the products of their harvest may include fresh, dried, smoked, salted, and frozen whole fish, the product of greatest cultural, economic, nutritional, and social value is indisputably the 'grease' or oil rendered from the fish. Distributed widely in potlatches, traded with neighbouring Nations, and relied upon for its wealth of nutritional and medicinal uses, grease and grease-making has long been a tradition in almost all First Nations with spawning rivers in their territory.

The Bella Coola River, as recent as 1998, supported a spawning eulachon population that sustained a fishery by the Nuxalk Nation. In 1999 the run failed to return and for the past 6 years it has been insufficient to support a fishery. Studies were initiated on the Bella Coola River eulachon in 2001 and were repeated from 2002 to 2004. The objective was to collect basic information on the life history and habitat of eulachon in the Bella Coola River. This included describing the run timing, incubation period, spawning distribution, body size, fecundity, and to estimate the spawning escapement based on larval and egg abundance. This report details the results of the fourth year of studies on the Bella Coola River between March 01 and May 19, 2004.

Daily discharge data of the Bella Coola River was obtained by both mechanical and digital meters. Temperature was recorded daily using a hand-held thermometer as well as with temperature loggers that were anchored at the staff gauge site (Figure 2), March 01, 2004. The staff gauge was installed February 27, 2004 in the Bella Coola River mainstem, just below Tatsquan Creek at the east end of Bella Coola Indian Reserve number one.

Adult eulachon distribution and abundance was assessed by gillnet sampling and by visual observation- predator watches. Adult field sampling began on March 01, 2004 and continued until May 03, 2004. In total, 62 adult eulachon were captured during the 391 gillnet sets in the Bella Coola River and Paisla Creek. Samples of adult eulachon were collected, frozen and stored at Snootli Creek hatchery.

Eulachon eggs and larvae were sampled with plankton tows every second day between March 01 and May 19, 2004. A total of 229 eggs and zero larvae were captured. Eulachon egg density averaged  $0.00542\text{m}^{-3}/\text{day}$ , and was highest on April 09 ( $0.03714\text{m}^{-3}$ ). Although no eulachon larvae were captured in the main stem of Bella Coola River, larvae were captured in the Bella Coola estuary, providing evidence that eulachon larvae were produced in the Bella Coola River but just not captured in the plankton tows.

To calculate eulachon egg densities the individual catches were divided by the volume of water fished by the plankton net. The total number of eggs transported downstream was calculated by using the average numbers per cubic meter from all samples combined on a given day- and provides an abundance estimate only. The intent of the study was to reproduce the methods from year to year and provide relative population abundance trends rather than absolute spawner biomass. Approximately 2,755,000 eggs were produced. The total adult population was back calculated from eulachon egg abundance, assuming standard fecundity and sex ratio, at 0.0074 tonnes of eulachon.

In 2004, the Bella Coola River had the lowest productivity reported in the past four years of study. In 2001, the estimated run was 0.030 tonnes (Lewis and O'Conner 2001), 2002 an estimated run of 0.047-0.049 tonnes (Winbourne and Dow 2002) and in 2003 an estimated run of 0.016 tonnes (Moody 2005a). Adult catch, larval and egg density, estimated run size and fishing activity all support a conclusion of a small run in the Bella Coola River in 2004.

## Acknowledgements

This report represents the efforts of the Nuxalk Nation to determine the cause of the decline and the current status of the Bella Coola Eulachon stock. Among those whose involvement was essential, we would like to especially acknowledge the generous support of our funders, technical advisors, and the people of the Nuxalk Nation. The funding for the study was provided by Fisheries and Oceans Canada's Aboriginal Fisheries Strategy and the Mid Coast First Nations Training Society. Data analysis was provided by Megan Moody, Nuxalk Nation.

We are grateful for the continued support and cooperation of the Nuxalk Community.

Our local crew benefited from the input and support of many scientific advisors employees of Fisheries and Oceans Canada including: Russ Hilland, Doug Hay, John Willis, Dennis Tippie Jr., Lawrence Michalchuk, Carl Siwallace, Marshall Hans Jr., Blair Mack, and Tom Loosemore.

We would also like to thank Kristen Smith, Russ Hilland and Bruce McCarter for reading and editing the many drafts of this report, and the authors of the 2001 Bella Coola eulachon study final report (Adam Lewis and Paul O'Connor 2002) and the authors of the 2002 Central Coast eulachon project: final report of field surveys (Janet Winbourne and Shawn Dow 2002) for the structure and content of their reports which ultimately contributed to the 2004 report.

Finally, we would like to acknowledge the local team that ensured this year's project was a success: Troy Anderson, Nathan Clellamin, Edwin Edgar, Barry Mack, Edwin Mack, Lonnie Mack, Megan Moody, Bruce Siwallace, Ivan Siwallace, and Wally Webber.

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# 1 Introduction

The Nuxalk eulachon project is a multi-year, multi-phased study initiated through cooperation between concerned individuals within the Nuxalk Nation, concerned community members and fisheries biologists. This year's project involved field sampling, pertaining to eulachon (*Thaleichthys pacificus*), that consisted of field surveys and sampling for eulachon populations; collection of samples for DNA analysis; and local management, research and planning activities. The purpose of the field portion of the project was to conduct intensive sampling of one river—the Bella Coola—to determine eulachon presence, timing, relative abundance, and fecundity in the system. The field study results are presented in this report.

## 1.1 Objectives

In 2001, the Nuxalk Integrated Resource Department and the Eulachon Conservation Society initiated a field study of eulachon on the Bella Coola River that consisted of sampling eulachon adults, eggs, and larvae, and monitoring river conditions such as temperature and flow. The objective of the study was to collect information on eulachon life history and habitat use—including a description of run timing, incubation period, and spawning distribution; size, fecundity and age structure; annual adult eulachon spawning escapement, and a measure of relative abundance. The study, with few changes was continued from 2002 to 2004. Eulachon larval surveys can be a cost-effective means of determining eulachon presence and abundance. From 2001 to 2003 the Bella Coola River studies determined that the eulachon runs were extremely low. The returns were estimated at less than 50 kg of total adults or just over 1200 fish. A spawning biomass of 50 kg or less is a fraction of historic runs. Historical records indicate Nuxalk eulachon harvests averaged 15 tonnes per year on the Bella Coola River (DFO 1945-1989).

For the 2004 season, the Bella Coola River was again the main focus of the study. Intensive sampling occurred for the fourth straight year and for the second year an eulachon incubation experiment was also undertaken (Moody 2004 and 2005b). Between March 06 and April 29, 2004, a total of 62 adult eulachon were captured in the Bella Coola River and Paisla Creek from 391 gillnet checks. Extrapolation of these results estimated a spawning biomass of 0.0074 tonnes of eulachon, which for the fourth straight year, is extremely small. Consequently the Nuxalk community did not have an eulachon food fishery due to insufficient numbers of fish returning. Thus determining the current status of the Bella Coola eulachon run is extremely important to the Nuxalk Nation. It is hoped, that by conducting an annual assessment, the information gathered during each study will assist in determining and understanding the reason(s) for the decline of the Bella Coola eulachon.

## 1.2 Study area

The area referred to as the Central Coast of British Columbia essentially overlaps with the boundaries for the Mid-Coast Forest District, including the rivers and inlets, north of

Kingcome Inlet and south of the Kitlope River. Intensive sampling of eulachon adults, eggs and larvae occurred over a three-month period within the lower reaches of the Bella Coola River. The Bella Coola estuary encompasses the outflow from Paisla Creek and the Necleetsconnay River and was also sampled for eggs and larvae on two separate occasions. Figure 1 is a map of British Columbia, showing Nuxalk territory and the location of the Bella Coola and South Bentinck Rivers.

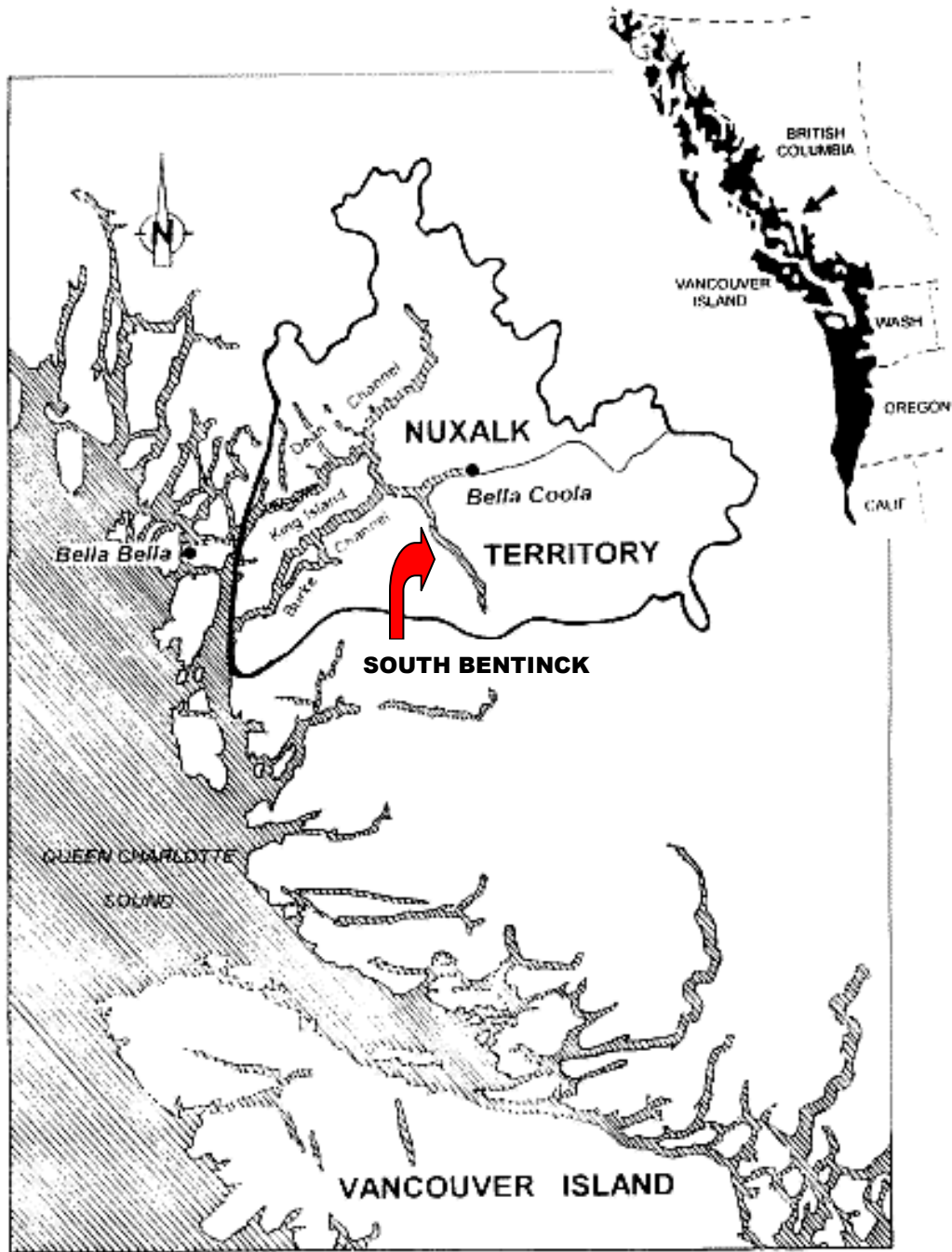


Figure 1. Map of Nuxalk territory showing the location of the Bella Coola River (adapted from website [www.nuxalk.org](http://www.nuxalk.org))

## 2 Methods

### 2.1 River flow and temperature

A staff gauge was reinstalled and calibrated above Site C (Figure 2), just below Tatsquan Creek, in accordance with Environment Canada, Water Management Branch Standards and procedures detailed in Lukyn (1982) and Harrelson *et al.* (1994). The staff gauge level was recorded daily (Appendix A) at the start of each plankton sample collection to estimate the total discharge from the Bella Coola River. This information was used for extrapolation of the plankton net results. Levels were recorded between March 01 and May 19, 2004. To obtain an average flow rate for the system, flow rates were recorded (using a Swoeffler digital flow meter) across the width of the Bella Coola River at intervals of approximately 5 meters. This was done on two occasions to calibrate the staff gauge.

A ‘Vemco’ temperature recorder was installed at the staff gauge site and the information from the recorder was downloaded into an Excel spreadsheet at the end of the sampling period. The accuracy of the Vemco recorder was verified daily using calibrated hand held thermometers between March 01 and May 19, 2004 (Appendix B).

### 2.2 Distribution, relative abundance and timing

#### 2.2.1 Visual Observation

A two-person field crew conducted a ‘predator watch’, every second day, between March 01 and May 19, 2004. The intent of the predator watch was to correlate the location of predator activity with eulachon presence, and to indicate and further define eulachon migration routes, spawning areas, and timing. The crew made visual observations, recording any sightings of adult eulachon and their predators (seals, sea lions, gulls, and eagles) by date, time, and location of each sighting. Observations were conducted at five locations in the area known to be eulachon spawning habitat within the lower reaches of the Bella Coola River: the gillnet sites, plankton tows, and the staff gauge. These locations are shown in Figures 2 and 3.

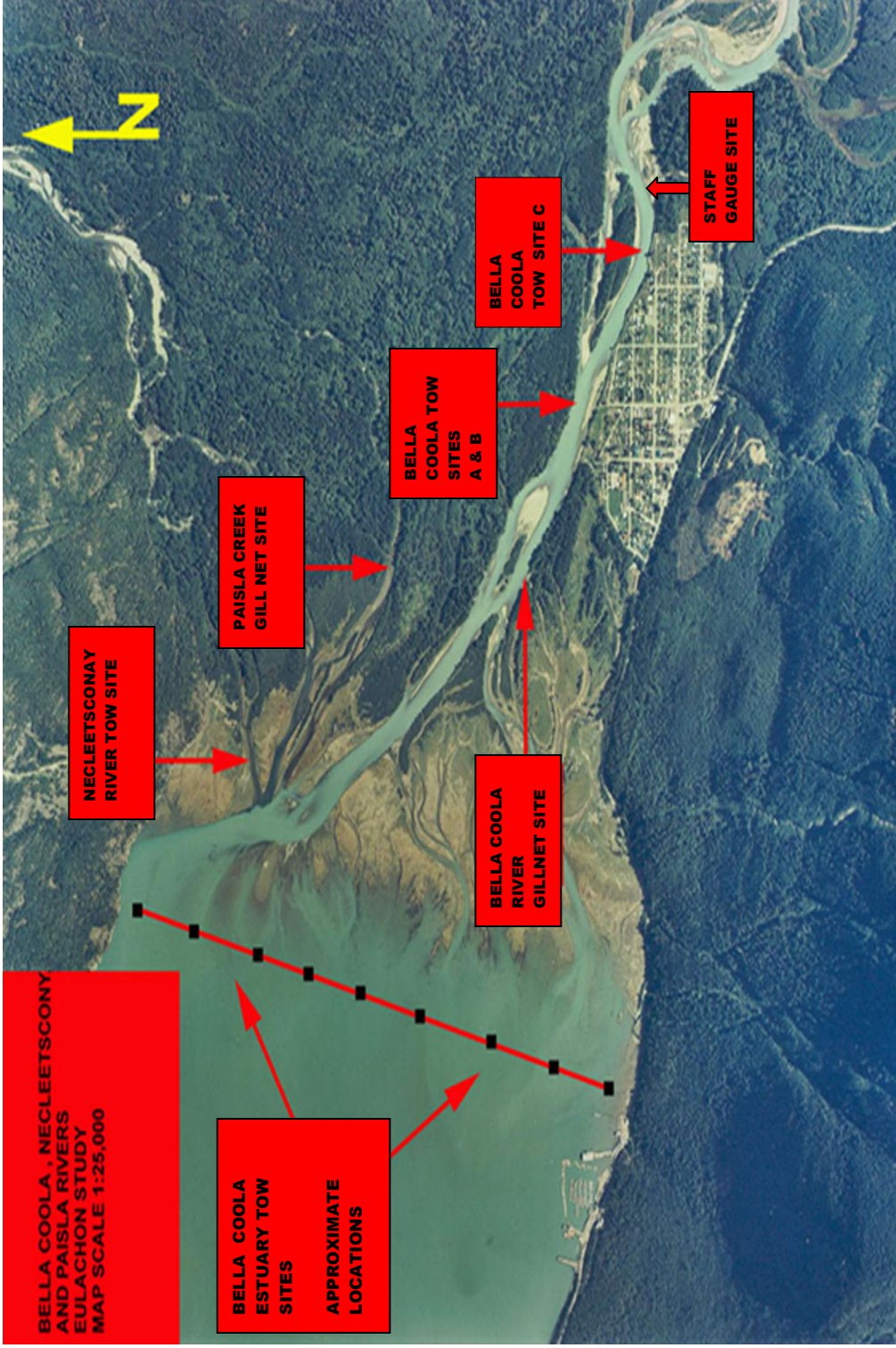


Figure 2. Locations of gill net and plankton tow sites in the Bella Coola River and sampling sites in the Bella Coola estuary



Figure 3. An air photo of the gillnet sampling site located at the 4-mile boat launch, Bella Coola River

### 2.2.2 Adult sampling

Adult eulachon were captured using smelt gillnets, set at three locations within known eulachon spawning areas in the lower reaches of the Bella Coola River and Paisla Creek. Each gillnet was approximately 8m long, 1.5 m deep, and made of 3.5cm monofilament mesh. The nets were tied to the bank side, set mid-river at a 45° downstream angle, and anchored to the channel bottom with lead weights. Nets were marked by a Scotchman float at the in stream end and a line of corks along the top edge. The nets were in place on the Bella Coola River between March 01 and April 27, 2004. They were removed on April 27 because of increased flow and associated debris, as well as the beginning of the Nuxalk salmon food fishery. The gillnet on Paisla Creek was in place from March 01 to May 03, 2004 when it was removed due to high algae content.

## 2.3 Eggs and larval sampling

To assess eulachon biomass and spawning distribution, egg/larval surveys were conducted with fixed depth plankton tows at an average depth of approximately 1.5 metres, at three locations in the Bella Coola River. The sample sites (see Figure 2) included both mid-channel and bankside locations. Three of this year's sample sites were established and sampled in 2002 (Sites A, B and C); Sites A and B are located closer to the mouth of the Bella Coola, whereas Site C is located farther up the river where there is less of a tidal influence. Site C sampling was discontinued March 07, 2004 due to swift water conditions and safety concerns.

The sampling of egg and larvae generally followed the methodology designed for the 2002 Nuxalk eulachon study. Initial sampling protocols were designed with the assistance of eulachon research scientist, Doug Hay, from the Pacific Biological Station in Nanaimo, BC. A 0.5 meter diameter, 1.5 meter long Puget Sound style plankton net panelled with 320-micron mesh was suspended in the river from a stable boat anchored to the substrate. A General Oceanics Ltd.® mechanical flow meter was attached at the centre of the net mouth, and the meter value recorded when the net was deployed and retrieved. Depending on debris load, plankton tows averaged 10, 5 or 3 minutes soak time. Plankton net data was collected between March 01 and May 19, 2004. Two crews conducted plankton tows every second day. On each sample day, four tows were done between 0400h and 2000h. Sampling occurred at roughly 4-hour intervals, taking place at dawn, mid-morning, late afternoon, and evening. In addition, approximately once every 5 sampling days, the crews conducted tows during a 'graveyard shift' between 1800h and 0600h, to determine the extent of nocturnal migration of eulachon larvae. Once again, four tows were done throughout each shift. Following collection, samples were transferred from the removable cod-end on the net to a 10-litre bucket, lidded, and transported to the laboratory. In the laboratory each sample was examined in its entirety. Approximately 500ml of each sample was placed in each of four, 2-litre clear pyrex dishes, and repeated until the entire was sorted through. Samples were identified with the use of a light table and a 15cm Matsushita illuminated magnifier.

Fisheries and Oceans Canada (DFO) personnel trained the crew and Nuxalk Fisheries program manager, Megan Moody, in egg and larvae identification during the 2002 eulachon surveys. Reference materials were also provided by DFO, including photographs, drawings, descriptive text, and samples of both eulachon eggs and larvae. All larval fish and eggs (including eulachon and sculpin eggs and larvae, as well as any unknowns) were removed from the sample and stored in 10ml plastic vials using a 50:50 ratio of formalin to water. Sample vials were labelled with the tow location, crew initials, date, time, and contents—including the number of opaque and/or translucent eggs—of the sample collection. Results were recorded on a pre-printed data sheet, with tow location, time, crew, flow meter readings, and the overall number of eggs and/or larvae. The eulachon larvae and eggs, sculpin larvae and eggs, and the unknowns were separated into different vials for each tow. Megan Moody confirmed identifications and enumerations within the vials by species using a dissecting microscope. Megan Moody and crew supervisor, Wally Webber, were also responsible for examining data sheets, any recorded information, and monitoring both field and laboratory activities during the study. These observations averaged approximately thirty hours per week.

### 2.3.1 Larvae presence: Bella Coola estuary

Following the peak of larval out-migration, the Bella Coola estuary was sampled on two occasions for eulachon larval presence. A three-person crew using an 18-foot jet-boat conducted a series of ten plankton tows on April 26, 2004 and seven plankton tows on May 7, 2004. The tows were conducted between 600 and 800 metres from the shore with an average depth between one and five metres. McCarter and Hay determined that most eulachon larvae were present in the surface waters at depths between zero and fifteen metres (1999). Each tow was approximately 100-200 metres in length and ran a straight line across the estuary from north to south (Figure 2). The crew used the 0.5 metre diameter Puget Sound style plankton net attached to a 30 metre rope for towing. The tow samples were stored in individual buckets for transport to the laboratory, where each sample was checked for eulachon presence, as carried out in the river sampling.

## 2.4 DNA and fecundity analyses

Moribund eulachon captured during the 2004 survey were retained and frozen for laboratory analysis to determine:

- Weight
- Nose to fork length
- Fecundity
- Sex ratio

Gender was determined by visual inspection. The weight was measured on a digital scale to the nearest hundredth of a gram and length to the nearest millimetre. Fecundity was estimated to the nearest egg by counting a small sample of eggs that was weighed on a digital scale to the nearest hundredth of a gram. All eulachon samples were counted and separated as to sex, to determine sex ratio. After sampling, the entire fish was frozen and stored at Snootli Creek hatchery.

### 2.4.1 Fish size

There were not enough adult eulachon captured to obtain a 'Bella Coola specific' average size of eulachon.

### 2.4.2 Fecundity

The sample of adult female eulachon obtained was too small to provide a valid estimate of average fecundity. Only nine female eulachon were sampled. Previously the number of eggs per female used for estimating the Bella Coola total spawning biomass was based on the mid-point of fecundities from other coastal systems ranging from 25,000 to 40,000 eggs per female (35,000) (Berry and Jacobs 1998). Observations made during the 2004 Nuxalk eulachon incubation study suggested that this fecundity may be too high for the Bella Coola

eulachon (Moody 2005b). Fecundities estimated ranged from 22,500-37,500 eggs per female. Therefore calculations for 2004 used an average fecundity of 30,000 eggs per female.

### 2.4.3 Sex ratio

Due to the very small run-size there were not enough fish caught to obtain an accurate sex ratio. However, of the fifty-five identifiable adult eulachon captured, twenty-eight were female and twenty-seven were male. Thus a 1:1 male/female sex ratio was assumed to calculate the total number of spawners.

## 2.5 Egg and larval distribution

Calculation of the total numbers of eggs plus larvae was based on the assumption that there is an even distribution of egg and larval drift across the whole river. However, this assumption may result in inflated total spawner biomass estimates. Distribution of egg and larval drift in the Kingcome River indicate that higher numbers of eggs and larvae were found in the main thalweg of the river and fewer along the margins (Berry and Jacobs 1998). The Kingcome studies also indicate a greater number of eggs and larvae in the mid-water column than at either the surface or near the bottom. The data summaries for the Bella Coola 2002 to 2004 studies assume even distribution.

## 2.6 Data analysis

A data summary was prepared by Megan Moody using the same methods as in 2002 and 2003, using the Bella Coola River sampling and river discharge data provided by the project crew. Calculations of egg and larval production and spawner biomass are similar to those used by Hay *et al.* (2002) to estimate Fraser River eulachon biomass.

### 2.6.1 Estimating river volume

Staff gauge readings were recorded before each set of tows and the daily river volume calculated from these readings. Each 10cm marking on the staff gauge was equivalent to 0.833m<sup>3</sup>/sec. As there were commonly 4 sets of tows conducted per day, 4 staff gauge readings were recorded and averaged to calculate the daily river volume.

### 2.6.2 Estimating daily egg and larval production

The daily river volume (V) was used to calculate the total eulachon egg and larvae production (P) for the day. The plankton net captures both eulachon eggs and larvae. For the purpose of calculating their total production, eggs and larvae were treated as numerical equivalents. Plankton samples were collected from the Bella Coola River on two-day

intervals. In mid-May, two extra sampling days per week were added to try and catch the peak of larval migration.

The number of eggs and larvae produced for each day was estimated using the formula developed by Hay *et al.* (2002) for the Fraser River eulachon. The cumulative number of eggs and larvae produced each day (t) was estimated as the product of the mean density of eggs plus larvae (D), the river discharge V (m<sup>3</sup>/sec) and the interval (I) or duration of the time period (t) in seconds.

$$P_t = D_t V_t I_t$$

Egg and larval densities or D (numbers/m<sup>3</sup>) were estimated for each tow by dividing the number of eggs and larvae in a sample by the volume of water fished by the plankton net. The water volume fished (m<sup>3</sup>) by the plankton net was estimated by multiplying the distance recorded on the mechanical flow meter by the area of the net mouth. All eulachon eggs plus larvae density estimates for the day (e.g. n = 12) were pooled and then averaged. The range of numbers of eggs and larvae caught in different samples on a given day was variable thus using the average numbers of eggs and larvae from all sample sites was deemed as the only way to arrive at an acceptable density estimate. For the days when no sampling occurred, the data was created using trend averaging between adjacent data points.

### 2.6.3 Calculating spawning biomass from estimates of egg and larval numbers

To estimate the spawning biomass of eulachon the following equation was used:

$$\text{Total spawners} = \frac{\text{calculated total eggs and larvae (P)}}{30,000 \cdot (\text{SR})}$$

Where 30,000 equals, the fecundity (eggs/spawning female) multiplied by the sex ratio (SR) equal to (0.5).

## 3 Results and discussion

### 3.1 River flow and temperature

Staff gauge data was recorded from March 01 to May 19; these results were then used in conjunction with the results from the Swoeffer flow meter calibration to calculate daily discharges for the Bella Coola River (Figure 4). Estimated discharge ranged from a minimum daily flow of 20.24m<sup>3</sup>/s on March 01 to a maximum daily flow of 174.28m<sup>3</sup>/s on May 19 (Table 1; Figure 4). Figure 4 also compares the river discharge recorded by Environment Canada at the Upper Bella Coola station (08FB007) (Environment Canada 2005). The Environment Canada river discharge pattern is very similar to the discharge

pattern estimated using the staff gauge measurements. Temperatures were recorded on a daily basis by thermographs anchored in the Bella Coola River from March 01 to May 31, 2004 and the results are summarized in Table 2 and graphed in Figure 5.

Table 1. Mean, max. and min. flows for the Bella Coola River recorded every second day between March 01 and May 19, 2004.

<b>Discharge (m<sup>3</sup>/s)</b>	<b>March</b>	<b>April</b>	<b>May</b>
Mean Daily	43.94	77.70	148.59
Maximum Daily	87.74	128.58	174.28
Minimum Daily	20.24	49.41	123.58
N	70	64	48

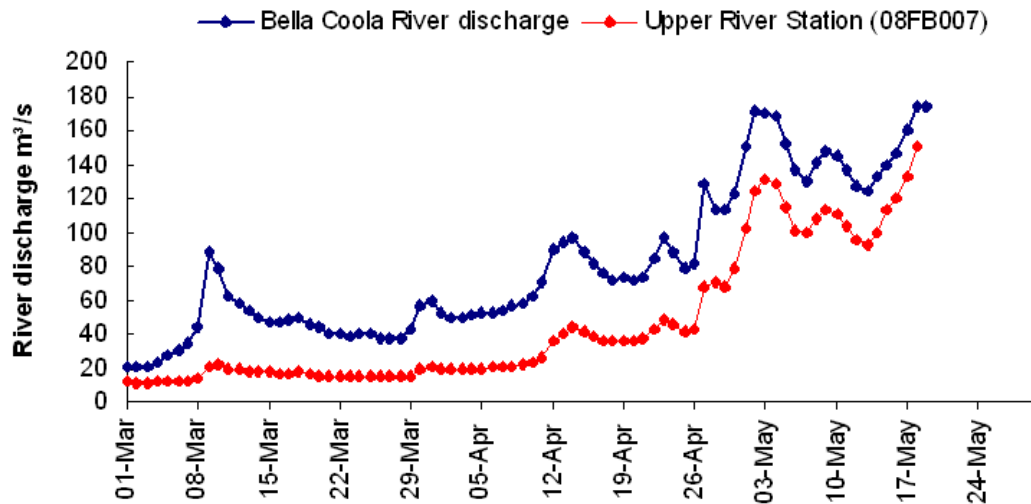


Figure 4. River discharge estimated during the study in the lower Bella Coola River and at the upper Bella Coola station (08FB007)

Table 2. Mean, max. and min. temperatures for the Bella Coola River, recorded daily between March 01 and May 31, 2004.

Temperature (°C)	March	April	May
Mean	4.60	7.18	8.54
Maximum	6.39	8.53	9.54
Minimum	3.03	5.28	6.83
N (# of hourly readings)	726	719	743

Temperatures ranged from 3.03°C to 9.54°C during the study period, correlating with an increase in flow over the same period. Figure 5 illustrates the increase in river temperature from the beginning of March to the end of May. Daily temperature and flow data are included in Appendix A and Appendix B.

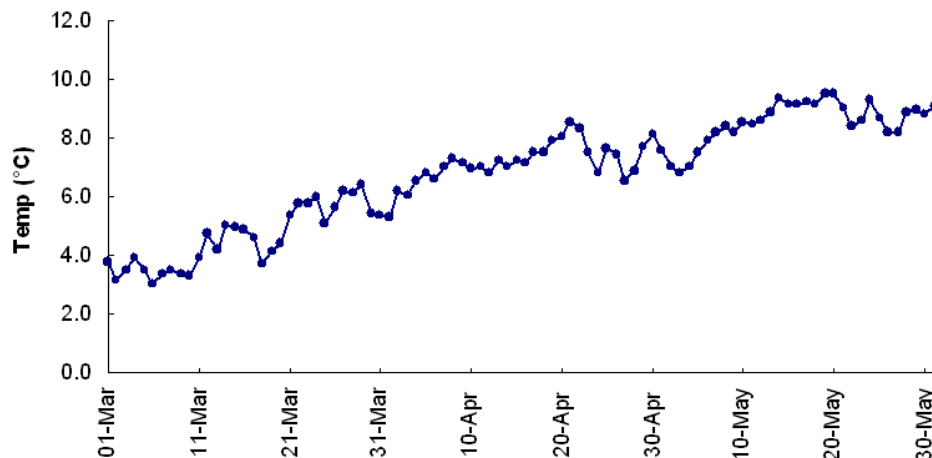


Figure 5. Bella Coola River temperatures (°C), March 01-May 31, 2004

## 3.2 Distribution, relative abundance and timing

### 3.2.1 Visual observation

Results from visual observations of eulachon predators in the lower reaches of the Bella Coola River remain inconclusive. There were very few predators or occurrences of predator activity observed during the study and could be attributed to the low abundance of prey (Appendix C).

### 3.2.2 Adult sampling

Gillnets were stationed in the Bella Coola River at two locations—the boat launch near the town of Bella Coola and the boat launch at the Four Mile Reserve (Figure 2 and 3). A third gillnet location, Site A, was added on April 20, 2004 and was located at the bank side of plankton sampling sites A and B and one net was also placed in the lower reach of Paisla Creek. Each of the nets on the Bella Coola River was checked between one and four times a day, between March 01 and April 27, for a total of 274 surveys. In Paisla Creek, the nets were checked between one and four times each day between March 01 and May 03, for a total of 117 surveys. In the Bella Coola River mainstem, a total of twenty-three adult eulachon were captured—seven males, nine females and seven unknowns (head only). The first eulachon was caught on March 12, and the last on April 22. In Paisla Creek, a total of thirty-nine adult eulachon were captured—twenty males and nineteen females. The first eulachon was caught on March 06 and the last on April 29. The results from the gillnet sampling are summarized in Table 3 and graphed in Figure 6. The gillnet data, incorporating sampling effort for the Bella Coola and Paisla Creek is included in Appendix D and Appendix E.

While there appears to be a peak at the end of March for the Bella Coola River the sample size was insufficient to draw firm conclusions regarding eulachon migration timing. Figure 6 shows the number of adult eulachon caught per day, by river location. It appears that the Paisla Creek eulachon run timing peaks in mid-March and at the beginning of April but because of the small sample size a strong conclusion can not be made.

Table 3. Adult eulachon captured during gillnet sampling on the Bella Coola River and Paisla Creek.

<b>Date</b>	<b>Location</b>	<b># Males</b>	<b># Females</b>	<b>Unknown</b>
6-Mar-04	Paisla Creek	1	0	0
12-Mar-04	Bella Coola River Boat Launch	0	0	1
14-Mar-04	Paisla Creek	2	3	0
14-Mar-04	Bella Coola River Boat Launch	0	0	1
15-Mar-04	Bella Coola River Boat Launch	0	0	1
15-Mar-04	Paisla Creek	1	1	0
16-Mar-04	Paisla Creek	1	1	0
17-Mar-04	Bella Coola River Boat Launch	1	2	0
17-Mar-04	Paisla Creek	2	0	0
18-Mar-04	Paisla Creek	0	1	0
19-Mar-04	Bella Coola River Boat Launch	0	2	0
20-Mar-04	Bella Coola River Boat Launch	0	1	1
23-Mar-04	Bella Coola River Boat Launch	3	4	0
24-Mar-04	Bella Coola River Boat Launch	0	0	1
25-Mar-04	Paisla Creek	0	1	0
28-Mar-04	Paisla Creek	0	1	0
29-Mar-04	Bella Coola River Boat Launch	1	0	0
30-Mar-04	Four Mile Boat Launch	1	0	0
31-Mar-04	Paisla Creek	1	0	0
1-Apr-04	Paisla Creek	3	1	0
2-Apr-04	Paisla Creek	1	1	0
4-Apr-04	Paisla Creek	0	5	0
7-Apr-04	Bella Coola River Boat Launch	0	0	1
8-Apr-04	Paisla Creek	1	1	0
11-Apr-04	Paisla Creek	1	0	0
12-Apr-04	Bella Coola River Boat Launch	0	0	1
14-Apr-04	Paisla Creek	1	0	0
16-Apr-04	Paisla Creek	2	0	0
17-Apr-04	Paisla Creek	1	2	0
18-Apr-04	Paisla Creek	1	0	0
22-Apr-04	Site A	1	0	0
29-Apr-04	Paisla Creek	1	1	0
<b>Totals</b>		<b>27</b>	<b>28</b>	<b>7</b>

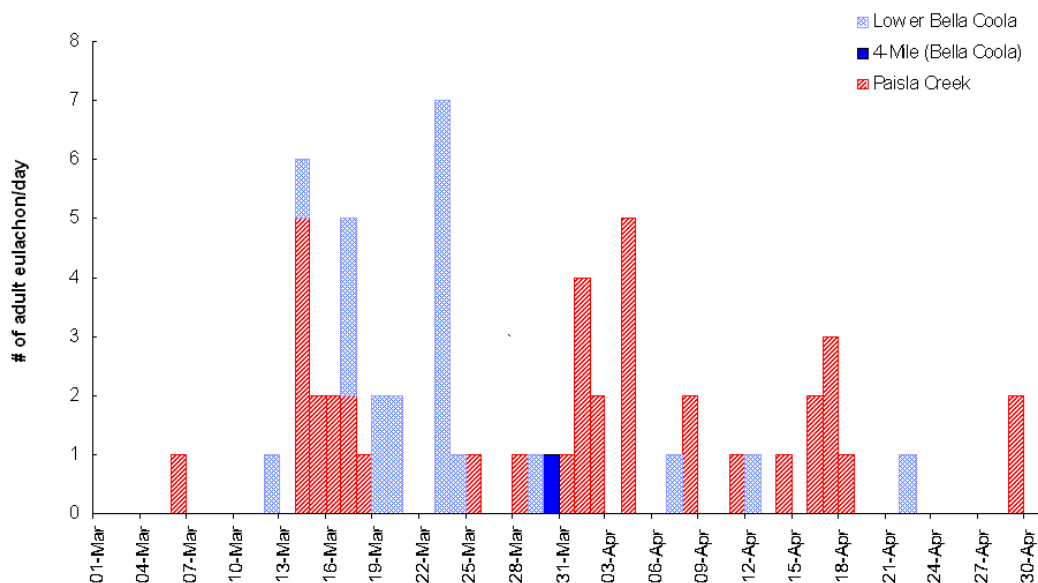


Figure 6. Adult eulachon captured during gillnet sampling on the Bella Coola River and Paisla Creek

### 3.2.3 Egg and larval abundance

A total of 501 plankton net tows were completed during the course of the study: 123 at Site A, 362 at Site B, and 16 at Site C (Figure 2). The average number of plankton tows completed per day was 11.9. Approximately 89% of the sampling was done between 0400h and 2000h; the usual pattern- 12 plankton tows over the 12-hour period with 11% of the sampling occurring at night between 2000h and 0400h.

A total of 229 eulachon eggs were collected during the plankton net tows in the Bella Coola River; the first was caught on March 19 and the last on May 06. The total eggs produced in the Bella Coola River for 2004 were estimated at 2,754,958 with the peak of spawning (egg drift) estimated between April 8 and April 23 (Figure 8). Average eulachon egg density was estimated at 0.00542 m<sup>-3</sup>/day with a high of 0.03714 m<sup>-3</sup>/day on April 9 (Figure 9; Table 4). There were not enough day/night data to determine diurnal variations in egg drift, although the average egg density on night shift sampling days (0.01223 m<sup>-3</sup>) was slightly higher than the average egg density during regular day shifts (0.00395 m<sup>-3</sup>) suggesting that eulachon spawn more at night.

The range of density of eggs caught in different samples on a given day was slightly variable. On some days the samples yielded similar numbers of eggs/m<sup>3</sup> regardless of site or time of day (e.g. April 05: 0.0-0.01550 eggs/m<sup>3</sup>, sample day 18) and on other days the range was greater (e.g. April 09: 0.0-0.20961 eggs/m<sup>3</sup>, sample day 20) (Figure 7).

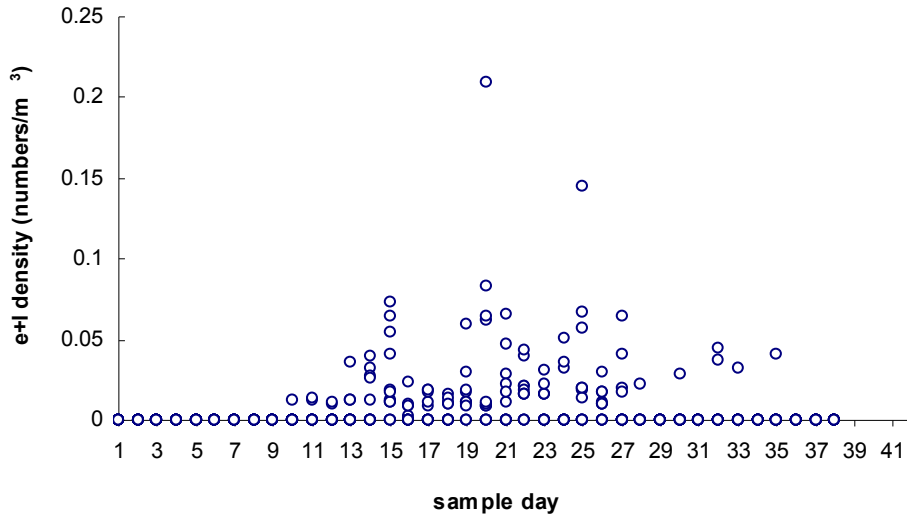


Figure 7. Distribution of eulachon egg plus larvae sample densities for each sample day

No eulachon larvae were collected during the plankton net tows in the Bella Coola River, compared to a total of 47 larvae caught in 2003 sampling. However, since larvae were caught during Bella Coola estuary tows, larvae must have been present in the Bella Coola River.

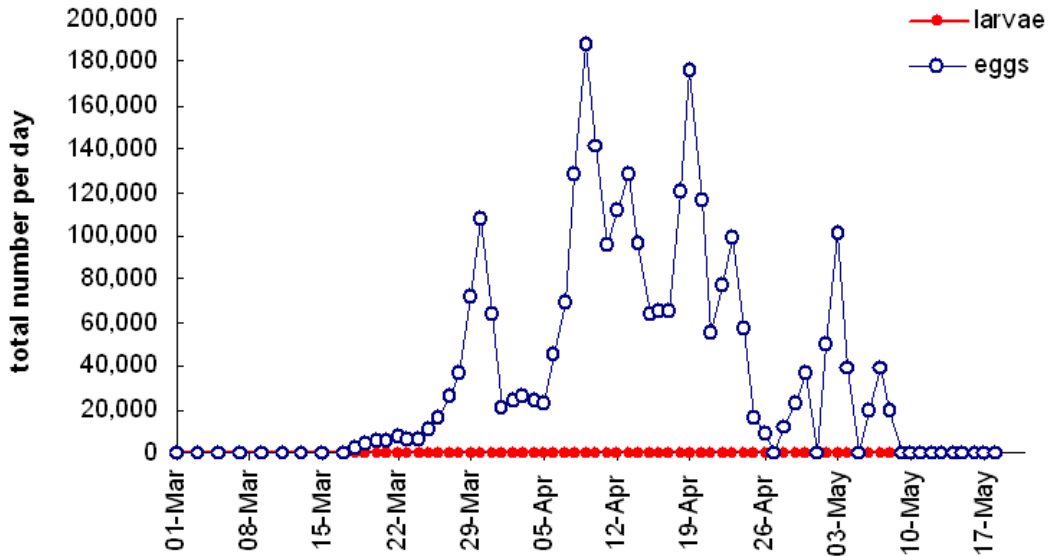


Figure 8. Total eulachon eggs and larvae per day, Bella Coola River, 2004

Table 4. Numbers and densities of eulachon egg and larvae captured by sample date and the corresponding river flow. Each density value is the daily average over a varying number of samples (ranging from a low of 9 to a high of 12 samples).

Date	Sample day	Flow (m <sup>3</sup> /s)	No. eggs caught	Egg density (m <sup>-3</sup> )	No. larvae caught	Larvae density (m <sup>-3</sup> )
01-Mar-04	1	20.2	0	-	0	-
03-Mar-04	2	21.1	0	-	0	-
05-Mar-04	3	26.9	0	-	0	-
07-Mar-04	4	34.4	0	-	0	-
09-Mar-04	5	87.7	0	-	0	-
11-Mar-04	6	61.9	0	-	0	-
13-Mar-04	7	53.6	0	-	0	-
15-Mar-04	8	46.9	0	-	0	-
17-Mar-04	9	48.6	0	-	0	-
19-Mar-04	10	45.2	1	0.00100	0	-
22-Mar-04	11	39.4	2	0.00213	0	-
24-Mar-04	12	40.2	2	0.00177	0	-
26-Mar-04	13	37.7	5	0.00502	0	-
28-Mar-04	14	36.9	11	0.01149	0	-
30-Mar-04	15	56.9	27	0.02191	0	-
01-Apr-04	16	52.7	6	0.00458	0	-
03-Apr-04	17	49.4	8	0.00615	0	-
05-Apr-04	18	51.9	5	0.00500	0	-
07-Apr-04	19	54.4	18	0.01475	0	-
09-Apr-04	20	58.6	49	0.03714	0	-
11-Apr-04	21	70.2	15	0.01567	0	-
13-Apr-04	22	93.6	10	0.01590	0	-
15-Apr-04	23	87.7	6	0.00849	0	-
17-Apr-04	24	76.1	7	0.00995	0	-
19-Apr-04	25	72.7	33	0.02807	0	-
21-Apr-04	26	72.7	10	0.00880	0	-
23-Apr-04	27	96.1	7	0.01188	0	-
25-Apr-04	28	78.6	1	0.00243	0	-
27-Apr-04	29	128.6	0	-	0	-
29-Apr-04	30	113.6	1	0.00238	0	-
01-May-04	31	150.2	0	-	0	-
03-May-04	32	170.2	2	0.00684	0	-
04-May-04	33	168.6	1	0.00267	0	-
05-May-04	34	151.1	0	-	0	-
07-May-04	35	129.4	2	0.00346	0	-
09-May-04	36	147.7	0	-	0	-
11-May-04	37	136.1	0	-	0	-
12-May-04	38	126.9	0	-	0	-
13-May-04	39	123.6	0	-	0	-
15-May-04	40	139.4	0	-	0	-
17-May-04	41	159.4	0	-	0	-
19-May-04	42	173.6	0	-	0	-
Average				0.00542		0.00000
Total			229		0	

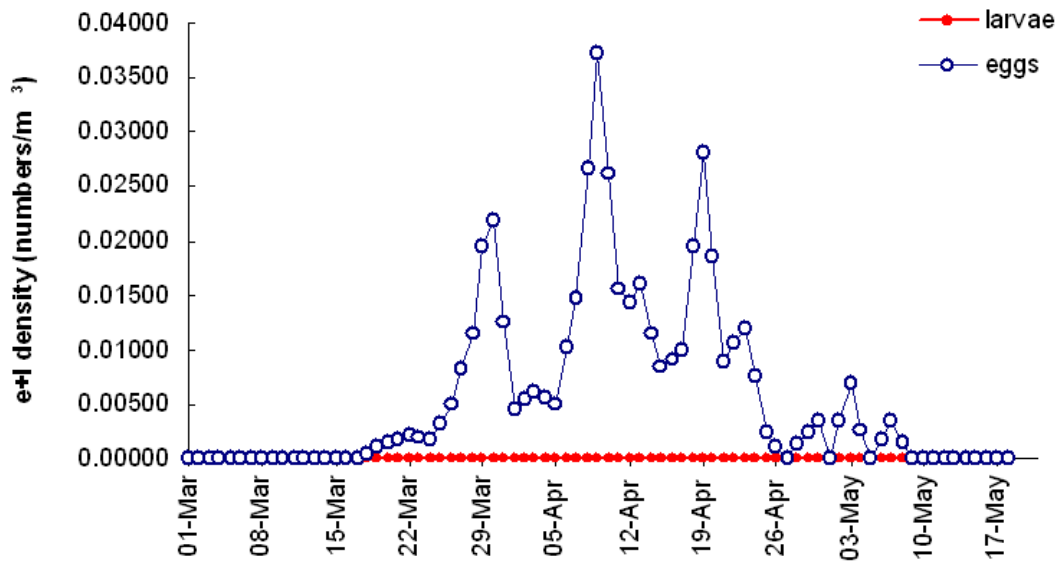


Figure 9. Total eulachon egg and larvae density per day, Bella Coola River, 2004

### 3.2.3 Relative spawner biomass

Traditional methods for population estimates were not feasible. It is impossible to visually ‘count’ spawning adults of such small size, mark/recapture techniques are not suitable for these fish, and abundance index fisheries are constrained by adverse river conditions and involve destruction of already depleted stocks. The results of the plankton tows were used to provide relative population abundance trends (rather than absolute spawner biomass). This was done by using back-calculation techniques (contributing spawners from estimates of total egg and larval drift) which is an accepted method for estimating eulachon spawner biomass (Hay *et al.* 2002). Resulting spawner biomass estimates are subject to a high degree of variability given the assumptions and trend averaging techniques described earlier.

Regardless of the lack of accurate spawner biomass counts, the 2004 return to the Bella Coola River was extremely low with the total run estimated at 7.4 kg of adults, or just over 180 fish. Results from the 2003 study calculated approximately double this amount; 18 kg of spawning adults (Moody 2004). By comparison the “low” 1997 return of eulachon to the Kingcome River was estimated at 14.35 tonnes of total adults (Berry and Jacob 1998) or approximately 358,750 fish. Furthermore, the Kingcome and Bella Coola Rivers have similar total daily discharge characteristics.

### 3.3 Egg and larvae presence: other watersheds

#### 3.3.1 Bella Coola/Necleetsconnay/Paisla estuary

Following larval out-migration, the Bella Coola estuary, which encompasses the estuaries of the Necleetsconnay and Paisla systems, was sampled on two occasions: April 26, 2004 (Survey 1) and May 07, 2004 (Survey 2). A three-person crew conducted a series of ten tows for Survey 1 and seven tows for Survey 2. Each plankton tow was five minutes and sampled a total distance of 2.7 km of the estuary for eulachon presence. Survey 1 took a total of 71 minutes to complete and captured 264 eulachon larvae. Survey 2 took a total of 42 minutes to complete and captured a total of 196 eulachon larvae. The plankton net data from these tows are included in Appendix F.

The majority of the larvae in Survey 1 (260) were found in the first four tows starting from the north side of the estuary (Figure 2). The last two tows revealed no eulachon larvae presence. The majority of the larvae in Survey 2 (187) were found in the first tow. Only nine were captured in the last six tows. By comparison, the 2003 estuary tows conducted on May 08, 2003 captured a total of 285 larvae. Methods were suggested as appropriate by DFO personnel, and the decision to increase the number of estuary surveys was made in order to determine the timing of larvae presence in the estuary.

The first adult eulachon was captured in Paisla Creek on March 06, 2004, fifty-one days before estuary Survey 1, suggesting that spawning occurred in late February. Therefore, it is recommended to sample the estuary earlier in 2005 so the timing of larval entry to the estuary can be determined.

#### 3.3.2 Other watersheds

Additional plankton sampling for eulachon presence/absence was conducted in the following South Bentinck Arm Rivers: the Aseek, the Taleomy, and the Noeick (Figure 10). The primary objective of this sampling was to corroborate the existence of spawning runs in these rivers as was confirmed in the Central Coast estuaries in 1994, 1996, and 1997 (McCarter and Hay 1999). The estuaries and near shore waters of these rivers were also sampled for eulachon larvae presence. The results from the sampling are presented in Table 5 and the raw data is included in Appendix G.

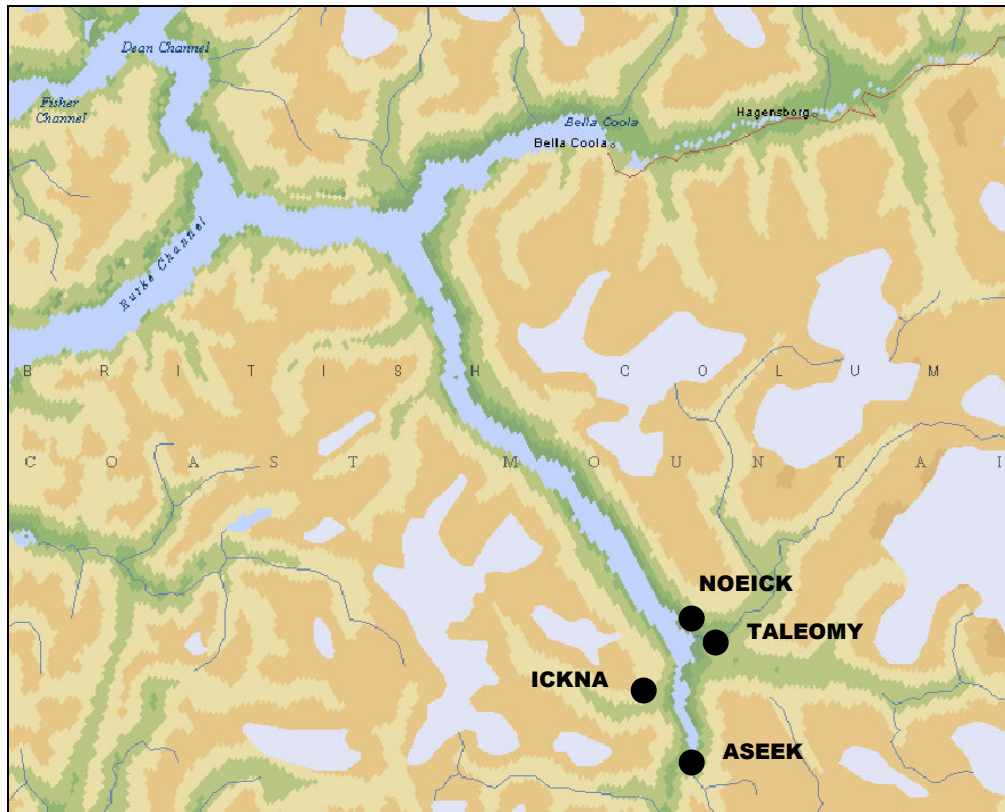


Figure 10. South Bentinck Arm approximate sampling river locations

The first trip's sampling period started March 27 and was completed on March 29, 2004. This trip consisted of in-river plankton tow sampling of three of the four rivers in South Bentinck using the same tow sampling methods used on the Bella Cooola River. In addition, one gillnet was set on the Aseek River in an attempt to capture spawning adults. On March 27<sup>th</sup>, two tows were conducted on the lower Aseek and Taleomy Rivers and a single plankton tow was conducted on the Noeick River. The tows on the Aseek River captured a total of 183 eulachon eggs with three eggs showing eye development. The Noeick River tows captured twenty-four eggs, ten of which showed eye development. The tows on the lower Taleomy River recovered seven eulachon eggs, none of which showed eye development. On March 28<sup>th</sup> two more tows were conducted on the Aseek River recovering four more eulachon eggs. The eggs captured, which did not show eye development, were either dead (white), or alive and in the early developmental stages (i.e. translucent with visible membranes). The tow on the Taleomy River recovered nothing but the two tows on the Noeick River recovered twenty eggs, four of which had eye development and one eulachon larva. This was the first larvae found in any of the rivers suggesting adult eulachon presence in late February. Incubation time for eulachon eggs on the Cowlitz River in Oregon ranges from 30-40 days in temperatures between 4 -7°C (Smith and Saalfeld 1955). Hay and McCarter (2000) also suggest that the duration of eulachon incubation in northern BC Rivers with ambient temperatures of 4 to 5 °C is 4 weeks. The temperature for the two sampling days on the Noeick River was recorded between 6 and 7°C. Thus spawning may have occurred between February 17 and 28, 2004. On March 29, one additional tow was

conducted on each the Aseek and Noeick Rivers, recovering no eulachon eggs or larvae. The Aseek gillnet captured one adult eulachon and the last tow on the Taleomy River recovered three eulachon eggs.

Table 5. South Bentinck Arm sampling results from in-river and estuary tows.

Date	River/estuary	# tows	Alive eggs	Alive eggs w eyes	Dead eggs	Total eggs	Larvae	Adults
27-Mar-04	Aseek R.	2	5	3	175	183	0	0
	Taleomy R.	2	0	0	7	7	0	0
	Noeick R.	1	0	10	14	24	0	0
28-Mar-04	Aseek R.	2	0	0	4	4	0	0
	Taleomy R.	1	0	0	0	0	0	0
	Noeick R.	2	0	4	16	20	1	0
29-Mar-04	Aseek R.	1	0	0	0	0	0	1
	Taleomy R.	1	0	0	3	3	0	0
	Noeick R.	1	0	0	0	0	0	0
07-Apr-04	Aseek R.	1	50	14	4	68	50	0
	Tal-Noeick E.	7	0	0	0	0	38	0
08-Apr-04	Aseek R.	1	77	3	0	80	9	0
	Aseek E.	3	0	0	1	1	44	0

The second trip's sampling period started on April 07, 2004 and was completed on April 08, 2004. The sampling on this trip consisted of plankton tows of the Aseek estuary and the offshore waters located between the Taleomy and Noeick Rivers (Figure 9). These tows were conducted as per the same methodology as the estuary tows of the Bella Coola estuary. Seven, ten-minute tows were completed between the offshore waters of the Taleomy and Noeick Rivers on April 07, 2004. These tows recovered 38 eulachon larvae with the majority of the larvae captured closest to the Noeick River. On April 08, 2004, three, five-minute tows were conducted in the Aseek estuary. These tows recovered a total of forty-four eulachon larvae and one eulachon egg.

Eulachon eggs and larvae were present in all three of the South Bentinck Rivers sampled. It is estimated that the timing of the adult spawning occurred between mid and late February. The raw data from these trips can be found in Appendix G.

## 4 Conclusions and recommendations for further study

For the past four years, the Nuxalk Fisheries Department has estimated the Bella Coola eulachon population at less than 50 kg of spawners. This study has improved the Nuxalk Fisheries Department's knowledge of the Bella Coola eulachon run timing and eulachon spawning locations. Results of a fourth year of sampling, indicates that the Bella Coola eulachon population has reached a historic low. For this reason, the annual study must be continued and any commercial or environmental activity that may impact the Central Coast eulachon runs must not resume. Nuxalk Fisheries has also proven that there is eulachon presence in three of the four South Bentinck Rivers. Although their run size can not be estimated there was no evidence of any large numbers of spawning eulachon.

Three recommendations for changes to the sampling program for next year are:

- 1) Recommence presence/absence studies on rivers in South Bentinck and the upper Dean Channel.
- 2) Conduct sampling of the Bella Coola estuary on more than two occasions in order to determine the initial timing and length of estuary occupancy of eulachon larvae.
- 3) Consider a regular sampling regime for Paisla Creek.

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## Appendix A. 2004 Bella Coola River staff gauge readings

Date	Time	Reading (m)	Avg. Daily	# of readings per day
01-Mar-04	8:00 AM	0.19		
	1:08 PM	0.18		
	3:35 PM	0.18		
	6:54 PM	0.18	<b>0.18</b>	<b>4</b>
02-Mar-04	8:30 AM	0.19		
	4:30 PM	0.19	<b>0.19</b>	<b>2</b>
03-Mar-04	7:16 AM	0.19		
	11:49 AM	0.19		
	2:19 PM	0.19		
	6:43 PM	0.20	<b>0.19</b>	<b>4</b>
05-Mar-04	7:09 AM	0.23		
	11:15 AM	0.27		
	2:11 PM	0.26		
	6:41 PM	0.27	<b>0.26</b>	<b>4</b>
07-Mar-04	7:04 AM	0.32		
	11:13 AM	0.34		
	1:57 PM	0.38		
	7:02 PM	0.36	<b>0.35</b>	<b>4</b>
09-Mar-04	7:01 PM	1.00		
	10:30 PM	0.97	<b>0.99</b>	<b>2</b>
10-Mar-04	2:10 AM	0.90		
	7:16 AM	0.85	<b>0.88</b>	<b>2</b>
11-Mar-04	6:40 AM	0.70		
	11:15 AM	0.68		
	2:18 PM	0.67		
	6:41 PM	0.67	<b>0.68</b>	<b>4</b>
13-Mar-04	7:00 AM	0.59		
	11:25 AM	0.58		
	2:52 PM	0.57		
	6:44 PM	0.58	<b>0.58</b>	<b>4</b>
15-Mar-04	7:17 AM	0.51		
	11:50 AM	0.50		
	1:58 PM	0.50		
	6:45 PM	0.50	<b>0.50</b>	<b>4</b>
17-Mar-04	7:33 AM	0.54		
	12:04 PM	0.51		
	2:17 PM	0.51		
	6:07 PM	0.51	<b>0.52</b>	<b>4</b>
18-Mar-04	8:30 AM	0.54		
	4:30 PM	0.53	<b>0.54</b>	<b>2</b>
19-Mar-04	7:04 PM	0.48	<b>0.48</b>	<b>1</b>
20-Mar-04	12:21 AM	0.48		
	2:14 AM	0.46		
	5:08 AM	0.48	<b>0.47</b>	<b>3</b>

Date	Time	Reading (m)	Avg. Daily	# of readings per day
21-Mar	8:30 AM	0.41		
	4:30 PM	0.40	<b>0.41</b>	<b>2</b>
22-Mar	6:50 AM	0.42		
	11:39 AM	0.40		
	2:16 PM	0.42		
	6:19 PM	0.40	<b>0.41</b>	<b>4</b>
23-Mar	8:30 AM	0.40		
	4:30 PM	0.40	<b>0.40</b>	<b>2</b>
24-Mar	6:51 AM	0.40		
	11:27 AM	0.43		
	2:59 PM	0.43		
	6:13 PM	0.43	<b>0.42</b>	<b>4</b>
25-Mar	8:30 AM	0.42	<b>0.42</b>	<b>1</b>
26-Mar	6:57 AM	0.40		
	11:56 AM	0.39		
	2:43 PM	0.39		
	6:34 PM	0.38	<b>0.39</b>	<b>4</b>
27-Mar	8:30 AM	0.38	<b>0.38</b>	<b>1</b>
28-Mar	7:33 AM	0.38		
	11:36 AM	0.38		
	1:51 PM	0.38		
	6:42 PM	0.38	<b>0.38</b>	<b>4</b>
29-Mar	7:11 PM	0.42		
	10:38 PM	0.48	<b>0.45</b>	<b>2</b>
30-Mar	2:27 AM	0.57		
	6:36 AM	0.66	<b>0.62</b>	<b>2</b>
01-Apr	6:56 AM	0.59		
	11:40 AM	0.58		
	2:21 PM	0.57		
	6:34 PM	0.55	<b>0.57</b>	<b>4</b>
03-Apr	7:00 AM	0.53		
	12:01 PM	0.53		
	1:45 PM	0.53		
	6:38 PM	0.53	<b>0.53</b>	<b>4</b>
04-Apr	8:30 AM	0.55	<b>0.55</b>	<b>1</b>
05-Apr	7:00 AM	0.56		
	11:42 AM	0.56		
	2:18 PM	0.57		
	6:50 PM	0.56	<b>0.56</b>	<b>4</b>
06-Apr	8:30 AM	0.57	<b>0.57</b>	<b>1</b>
07-Apr	7:15 AM	0.58		
	12:39 PM	0.59		
	2:12 PM	0.58		
	6:44 PM	0.59	<b>0.59</b>	<b>4</b>
08-Apr	7:54 PM	0.60		
	11:11 PM	0.62	<b>0.61</b>	<b>2</b>
09-Apr	1:52 AM	0.63		

Date	Time	Reading (m)	Avg. Daily	# of readings per day
09-Apr	6:32 AM	0.64	<b>0.64</b>	<b>2</b>
11-Apr	6:51 AM	0.76		
	11:48 AM	0.78		
	2:31 PM	0.78		
	7:16 PM	0.80	<b>0.78</b>	<b>4</b>
13-Apr	6:37 AM	1.06		
	11:44 AM	1.06		
	2:06 PM	1.06		
	7:07 PM	1.04	<b>1.06</b>	<b>4</b>
15-Apr	6:41 AM	1.02		
	11:13 AM	1.01		
	1:52 PM	0.98		
	7:12 PM	0.96	<b>0.99</b>	<b>4</b>
16-Apr	8:30 AM	0.92	<b>0.92</b>	<b>1</b>
17-Apr	4:47 AM	0.87		
	9:21 AM	0.86		
	3:23 PM	0.84		
	7:46 PM	0.83	<b>0.85</b>	<b>4</b>
18-Apr	7:00 PM	0.80		
	11:51 AM	0.80	<b>0.80</b>	<b>2</b>
19-Apr	2:05 AM	0.83		
	5:32 AM	0.79	<b>0.81</b>	<b>2</b>
20-Apr	8:30 AM	0.80		
	4:30 AM	0.79	<b>0.80</b>	<b>2</b>
21-Apr	4:57 AM	0.80		
	10:17 AM	0.81		
	3:32 PM	0.80		
	6:49 PM	0.82	<b>0.81</b>	<b>4</b>
23-Apr	4:54 AM	1.08		
	10:24 AM	1.11		
	3:03 PM	1.10		
	7:25 PM	1.08	<b>1.09</b>	<b>4</b>
25-Apr	8:33 AM	0.90		
	2:48 PM	0.88		
	7:49 PM	0.86	<b>0.88</b>	<b>3</b>
27-Apr	5:09 AM	1.24		
	9:39 AM	1.60		
	2:50 PM	1.56		
	6:50 PM	1.52	<b>1.48</b>	<b>4</b>
28-Apr	8:18 PM	1.30		
	11:42 PM	1.30	<b>1.30</b>	<b>2</b>
29-Apr	1:43 AM	1.30		
	6:12 AM	1.30	<b>1.30</b>	<b>2</b>
01-May	5:38 AM	1.70		
	10:28 AM	1.72		
	2:31 PM	1.76		
	6:44 PM	1.78	<b>1.74</b>	<b>4</b>
03-May	5:24 AM	2.00		

Date	Time	Reading (m)	Avg. Daily	# of readings per day
03-May	9:00 AM	2.00		
	2:28 PM	1.96		
	6:50 AM	1.96	<b>1.98</b>	<b>4</b>
04-May	5:05 AM	1.98		
	9:20 AM	1.98		
	2:29 AM	1.96		
	6:49 PM	1.90	<b>1.96</b>	<b>4</b>
05-May	5:07 AM	1.80		
	9:01 AM	1.74		
	2:21 PM	1.74		
	6:56 PM	1.70	<b>1.75</b>	<b>4</b>
06-May	7:24 PM	1.66		
	10:23 PM	1.50	<b>1.58</b>	<b>2</b>
07-May	1:50 AM	1.50		
	6:25 AM	1.48	<b>1.49</b>	<b>2</b>
09-May	5:10 AM	1.72		
	9:07 AM	1.74		
	3:16 PM	1.76		
	7:07 PM	1.62	<b>1.71</b>	<b>4</b>
11-May	5:18 AM	1.68		
	9:06 AM	1.61		
	3:09 PM	1.50		
	7:12 PM	1.48	<b>1.57</b>	<b>4</b>
12-May	5:22 AM	1.50		
	9:03 AM	1.49		
	2:46 PM	1.44		
	6:38 PM	1.40	<b>1.46</b>	<b>4</b>
13-May	5:10 AM	1.46		
	9:20 AM	1.47		
	2:50 PM	1.38		
	6:25 PM	1.36	<b>1.42</b>	<b>4</b>
14-May	6:34 PM	1.48		
	11:31 PM	1.56	<b>1.52</b>	<b>2</b>
15-May	2:26 AM	1.58		
	5:15 AM	1.64	<b>1.61</b>	<b>2</b>
17-May	5:01 AM	1.88		
	9:16 AM	1.94		
	3:10 PM	1.78		
	6:55 PM	1.78	<b>1.85</b>	<b>4</b>
19-May	5:29 AM	2.08		
	9:30 AM	2.08		
	3:13 PM	1.96		
	6:34 PM	1.96	<b>2.02</b>	<b>4</b>

Appendix B. 2004 Bella Coola River average daily temps.

<b>Date</b>	<b>Average daily temperature</b>
01-Mar	3.80
02-Mar	3.17
03-Mar	3.50
04-Mar	3.94
05-Mar	3.50
06-Mar	3.03
07-Mar	3.38
08-Mar	3.53
09-Mar	3.37
10-Mar	3.30
11-Mar	3.95
12-Mar	4.74
13-Mar	4.23
14-Mar	5.02
15-Mar	5.00
16-Mar	4.91
17-Mar	4.65
18-Mar	3.75
19-Mar	4.10
20-Mar	4.43
21-Mar	5.40
22-Mar	5.78
23-Mar	5.78
24-Mar	5.97
25-Mar	5.12
26-Mar	5.65
27-Mar	6.22
28-Mar	6.10
29-Mar	6.39
30-Mar	5.48
31-Mar	5.37
01-Apr	5.28
02-Apr	6.21
03-Apr	6.08
04-Apr	6.58
05-Apr	6.84
06-Apr	6.64
07-Apr	7.03
08-Apr	7.30
09-Apr	7.17
10-Apr	7.00
11-Apr	7.05
12-Apr	6.81
13-Apr	7.26
14-Apr	7.02

<b>Date</b>	<b>Average Daily Temperature</b>
15-Apr	7.27
16-Apr	7.16
17-Apr	7.51
18-Apr	7.49
19-Apr	7.95
20-Apr	8.08
21-Apr	8.53
22-Apr	8.32
23-Apr	7.49
24-Apr	6.83
25-Apr	7.66
26-Apr	7.42
27-Apr	6.58
28-Apr	6.90
29-Apr	7.74
30-Apr	8.13
01-May	7.58
02-May	7.07
03-May	6.83
04-May	7.00
05-May	7.53
06-May	7.93
07-May	8.21
08-May	8.40
09-May	8.22
10-May	8.57
11-May	8.48
12-May	8.60
13-May	8.87
14-May	9.38
15-May	9.18
16-May	9.19
17-May	9.22
18-May	9.15
19-May	9.50
20-May	9.54
21-May	9.03
22-May	8.40
23-May	8.62
24-May	9.33
25-May	8.70
26-May	8.20
27-May	8.21
28-May	8.92
29-May	8.94
30-May	8.80
31-May	9.09

## Appendix C. 2004 Bella Coola River predator summary

Date	Crows	Ducks	Eagles	Hérons	Otters	Sea gulls	Seals	Sea Lions	Swans	geese
01-Mar	4	37	0	0	1	0	0	0	0	0
02-Mar	4	3	2	0	0	68	0	0	60	0
03-Mar										
04-Mar										
05-Mar	18	16	1	1	0	16	0	0	0	0
06-Mar										
07-Mar	0	7	0	0	0	4	0	0	0	5
08-Mar										
09-Mar	7	0	0	0	0	0	0	0	19	0
10-Mar	0	10	2	0	0	0	0	0	60	0
11-Mar	0	7	0	0	1	11	0	0	0	0
12-Mar										
13-Mar	12	2	0	3	0	2	0	0	0	0
14-Mar	51	21	8	0	0	7	2	1	0	0
15-Mar										
16-Mar	0	23	2	0	0	0	0	0	0	0
17-Mar	12	5	4	0	0	0	0	0	0	0
18-Mar	0	17	0	0	0	2	0	0	0	0
19-Mar	0	7	1	1	0	0	0	0	0	0
20-Mar	0	4	2	0	0	0	0	0	0	0
21-Mar	0	0	0	0	0	0	0	0	0	0
22-Mar	13	41	6	0	0	0	0	0	0	0
23-Mar	0	50	1	0	0	0	0	0	0	0
24-Mar	7	14	4	0	4	1	1	0	0	0
25-Mar										
26-Mar										
27-Mar										
28-Mar	4	21	2	0	0	1	0	0	0	0
29-Mar										
30-Mar	12	2	3	0	0	0	0	0	0	0
31-Mar	0	7	0	0	0	0	0	0	0	0
01-Apr	0	0	0	0	0	0	0	2	0	0
02-Apr	4	2	0	0	0	0	0	0	0	0
03-Apr	5	28	5	0	0	24	1	1	0	0
04-Apr										
05-Apr	4	4	0	0	0	0	0	0	0	0
06-Apr										
07-Apr	17	9	2	0	0	0	0	0	0	0
08-Apr										
09-Apr										
10-Apr										
11-Apr										
12-Apr										
13-Apr	4	0	0	0	0	0	0	2	0	0

<b>Date</b>	<b>Crows</b>	<b>Ducks</b>	<b>Eagles</b>	<b>Hérons</b>	<b>Otters</b>	<b>Sea gulls</b>	<b>Seals</b>	<b>Sea Lions</b>	<b>Swans</b>	<b>geese</b>
14-Apr										
15-Apr	44	21	3	0	1	14	4	0	0	0
16-Apr										
17-Apr										
18-Apr	5	0	2	0	0	1	0	0	0	0
19-Apr										
20-Apr	2	0	0	0	0	0	0	0	0	0
21-Apr	13	4	0	0	0	0	0	0	0	0
22-Apr										
23-Apr	0	0	1	0	0	0	1	0	0	0
24-Apr										
25-Apr										
26-Apr										
27-Apr	3	4	0	0	0	0	2	0	0	0
28-Apr										
29-Apr	0	0	0	0	0	0	0	0	0	0

## Appendix D. 2004 Bella Coola gillnet data (boat launch)

# of checks	Date	Time	Temp	Cond.	# Males	# Females	# M Heads	# F. Heads	
1	01-Mar	7:43 AM			0	0	0	0	
2		11:36 AM	3.8	72.80	0	0	0	0	
3		2:42 PM	5.1	103.10	0	0	0	0	
4		6:35 PM	4.9	103.10	0	0	0	0	
5	02-Mar	4:25 PM	4.9	105.50	0	0	0	0	
6	03-Mar	6:46 AM	4.4	103.10	0	0	0	0	
7		1:35 PM	4.6	102.20	0	0	0	0	
8		6:18 PM	4.7	103.70	0	0	0	0	
9	04-Mar	4:03 PM	5.8	104.40	0	0	0	0	
10	05-Mar	6:29 AM		tide too high to check net					
11		1:55 PM	3.7	85.30	0	0	0	0	
12		6:18 AM	3.4	85.90	0	0	0	0	
13	06-Mar	8:27 AM	2.8	85.70	0	0	0	0	
14	07-Mar	6:40 AM	3.3	84.90	0	0	0	0	
15		11:00 AM	3.7	80.40	0	0	0	0	
16		1:38 PM		tide too high to check net					
17		6:36 PM	4.5	80.10	0	0	0	0	
18	08-Mar	9:01 AM	4.3	79.20	0	0	0	0	
19	09-Mar	9:40 AM	3.8	39.40	0	0	0	0	
20	10-Mar	1:52 AM		tide too high to check net					
21		6:25 AM	3.1	61.30	0	0	0	0	
22		2:25 PM	4.0	62.70	0	0	0	0	
23	11-Mar	9:31 AM	3.7	68.70	0	0	0	0	
24		12:10 PM	4.3	70.20	0	0	0	0	
25		6:20 PM	5.0	44.90	0	0	0	0	
26	12-Mar	11:36 AM	4.8	72.20	0	0	0	1	
27		6:48 AM	4.1	42.00	0	0	0	0	
28	13-Mar	1:26 PM	4.7	73.90	0	0	0	0	
29		6:26 PM	4.9	73.80	0	0	0	0	
30	14-Mar	9:37 AM	4.7	73.80	0	0	0	1	
31	15-Mar	6:30 AM	4.9	73.40	0	0	0	0	
32		11:19 AM	5.2	75.80	0	0	0	1	
33		1:40 PM	5.6	75.00	0	0	0	0	
34		6:14 AM	5.8	74.40	0	0	0	0	
35	16-Mar	9:05 AM	4.8	73.00	0	0	0	0	
36	17-Mar	6:37 AM	4.6	75.60	1	2	0	0	
37		11:19 AM	4.9	71.80	0	0	0	0	
38		1:36 PM	5.3	73.80	0	0	0	0	
39		6:50 PM	5.3	46.50	0	0	0	0	
40	18-Mar	7:33 AM	4.1	44.90	0	0	0	0	
41		2:48 PM	4.2	50.50	0	0	0	0	
42	19-Mar	9:12 AM	4.0		0	1	0	0	
43		3:20 PM	5.4	49.60	0	0	0	0	
44		6:45 PM	5.4	50.80	0	0	0	0	

# of checks	Date	Time	Temp	Cond.	# Males	# Females	# M Heads	# F. Heads
45		11:29 PM	4.7	45.50	0	1	0	0
46	20-Mar	7:23 AM	3.7	46.90	0	1	0	1
47		5:05 PM	6.0		0	0	0	0
48	21-Mar	10:30 AM	5.2	81.20	0	0	0	0
49		6:36 PM	6.7	54.50	0	0	0	0
50	22-Mar	6:30 AM	5.7	82.60	0	0	0	0
51		11:21 AM	5.9	66.80	0	0	0	0
52		1:33 PM				tide too high to check net		
53		5:32 PM	6.8	81.60	0	0	0	0
54	23-Mar	7:36 AM	5.2	123.30	3	4	0	0
55		4:08 PM	7.2	69.90	0	0	0	0
56	24-Mar	6:31 AM	6.1	174.90	0	0	0	1
57		11:05 AM	6.0	96.50	0	0	0	0
58		1:48 PM	6.8	86.80	0	0	0	0
59		5:17 PM	7.3	53.20	0	0	0	0
60	25-Mar	7:38 AM	5.1		0	0	0	0
61	26-Mar	6:37 AM	5.0	52.50	0	0	0	0
62		11:36 AM	5.7	50.50	0	0	0	0
63		1:48 PM	6.6	54.50	0	0	0	0
64		5:48 PM	7.2	80.10	0	0	0	0
65	27-Mar	9:59 AM	8.3	80.00	0	0	0	0
66	28-Mar	6:35 AM	6.1	49.60	0	0	0	0
67		11:14 AM	6.3	81.40	0	0	0	0
68		1:34 PM	6.5	50.40	0	0	0	0
69		6:30 PM	7.1	78.40	0	0	0	0
70	29-Mar	7:58 PM	8.6	75.80	0	0	0	0
71		1:45 AM	7.6	67.90	1	0	0	0
72	30-Mar	6:18 PM	6.8	65.20	0	0	0	0
73		3:50 PM	6.8	41.10	0	0	0	0
74	31-Mar	7:37 AM	5.0	42.60	0	0	0	0
75		7:30 PM	7.0	67.90	0	0	0	0
76	01-Apr	6:31 AM	4.4	70.70	0	0	0	0
77		11:10 AM	5.3	69.30	0	0	0	0

## Appendix E. 2004 Paisla Creek gillnet data

# of checks	Date	Time	Temp	Cond.	# Males	# Females	# M Heads	# F. Heads
1	01-Mar	12:29 PM	6.0	53.90	0	0	0	0
2	02-Mar	3:16 PM		57.70	0	0	0	0
3		5:26 PM	6.3	32.60	0	0	0	0
4	03-Mar	9:00 AM			net not checked-high tide			
5		2:04 AM	6.0	48.30	0	0	0	0
6	04-Mar	4:45 PM	6.8	77.00	0	0	0	0
7	05-Mar	9:15 AM			net not checked-high tide			
8	06-Mar	9:20 AM	4.0	190.40	1	0	0	0
9	07-Mar	8:50 AM	4.4	139.90	0	0	0	0
10		4:20 PM	5.3	112.50	0	0	0	0
11	08-Mar	9:41 AM	4.8	109.80	0	0	0	0
12	09-Mar	10:50 AM	3.0	48.40	0	0	0	0
13		8:00 PM	4.0	64.50	0	0	0	0
14	10-Mar	7:00 AM	3.4	47.20	0	0	0	0
15	11-Mar	8:08 AM	4.3	78.40	0	0	0	0
16		2:05 PM	5.6	75.20	0	0	0	0
17	12-Mar	12:20 PM	5.5	78.20	0	0	0	0
18	13-Mar	7:49 AM	4.3	93.30	0	0	0	0
19		1:54 PM	5.5	91.50	0	0	0	0
20	14-Mar	10:02 AM	5.5	147.50	2	3	0	0
21	15-Mar	6:53 AM	5.3	89.10	0	1	0	0
22		8:58 AM			0	0	0	0
23		2:56 PM	6.4	155.90	1	0	0	0
24		5:42 PM	6.1	150.30	0	0	0	0
25	16-Mar	9:39 AM	5.3	111.30	1	1	0	0
26		2:23 PM	6.0	135.50	0	0	0	0
27	17-Mar	7:15 AM	4.8	103.10	2	0	0	0
28		11:51 AM	5.5	58.70	0	0	0	0
29		2:55 PM	5.9	81.90	0	0	0	0
30		5:41 PM	5.6	83.40	0	0	0	0
31	18-Mar	8:09 AM	4.4	64.10	0	1	0	0
32		3:15 PM	4.9	61.50	0	0	0	0
33	19-Mar	9:50 AM	4.7	87.70	0	0	0	0
34		4:00 PM	5.9	150.00	0	0	0	0
35	20-Mar	6:54 AM	4.1	115.00	0	0	0	0
36	21-Mar	7:08 PM	6.4	151.40	0	0	0	0
37	22-Mar	7:43 AM	6.0	418.40	0	0	0	0
38		12:45 PM	6.5	102.90	0	0	0	0
39		3:05 PM	7.1	213.90	0	0	0	0
40		6:01 PM	7.1	71.90	0	0	0	0
41	23-Mar	8:19 AM	5.5	67.70	0	0	0	0
42		4:35 PM	7.6	100.20	0	0	0	0
43	24-Mar	7:41 AM	6.0	112.90	0	0	0	0
44		12:16 PM	6.8	412.80	0	0	0	0

# of checks	Date	Time	Temp	Cond.	# Males	# Females	# M Heads	# F. Heads
45	24-Mar	2:23 PM	6.8	80.00	0	0	0	0
46		5:55 PM		213.60	0	0	0	0
47	25-Mar	8:15 AM	6.0		0	1	0	0
48	26-Mar	7:47 AM	5.5	99.20	0	0	0	0
49		12:42 PM	7.1	271.30	0	0	0	0
50		2:27 PM	7.6	189.50	0	0	0	0
51			7.5	190.60	0	0	0	0
52	27-Mar	10:26 AM	7.0	297.20	0	0	0	0
53	28-Mar	7:04 AM	6.0	64.40	0	1	0	0
54		12:24 PM	7.1	133.60	0	0	0	0
55		2:37 PM	7.5	243.70	0	0	0	0
56		7:26 PM	5.2	118.70	0	0	0	0
57	29-Mar	6:53 PM	8.7	104.10	0	0	0	0
58	30-Mar	7:11 AM	6.3	41.20	0	0	0	0
59	31-Mar	8:07 AM	4.7	26.40	1	0	0	0
60		7:11 PM	6.5	71.50	0	0	0	0
61	01-Apr	7:53 AM	4.3	113.00	3	1	0	0
62		12:38 PM	6.3	180.10	0	0	0	0
63		7:16 PM	6.6	97.50	0	0	0	0
64	02-Apr	7:53 AM	5.5	101.20	1	1	0	0
65	03-Apr	7:59 AM	5.2	101.00	0	0	0	0
66		11:41 AM	5.8	65.40	0	0	0	0
67		7:25 PM	7.1	136.50	0	0	0	0
68	04-Apr	8:30 AM	6.3	113.50	0	5	0	0
69	05-Apr	8:10 AM	6.1	131.80	0	0	0	0
70		7:35 PM	8.0	253.90	0	0	0	0
71	06-Apr	7:54 AM	5.8	368.40	0	0	0	0
72	07-Apr	8:06 AM	6.9	182.20	0	0	0	0
73		7:26 PM	8.2	208.30	0	0	0	0
74	08-Apr	7:54 AM	6.3	408.90	1	1	0	0
75		7:19 PM	8.3	169.30	0	0	0	0
76		10:56 AM	7.2	163.00	0	0	0	0
77	09-Apr	7:15 AM	5.8	110.60	0	0	0	0
78	10-Apr	9:15 AM	5.4	184.40	0	0	0	0
79		9:20 AM			0	0	0	0
80	11-Apr	7:36 AM	6.2	107.70	1	0	0	0
81		3:13 PM	8.9	85.50	0	0	0	0
82		6:50 PM	4.8	54.90	0	0	0	0
83	12-Apr	11:50 AM	6.7	56.40	0	0	0	0
84	13-Apr	12:10 PM	7.0	66.90	0	0	0	0
85		6:45 PM	8.1	56.30	0	0	0	0
86	14-Apr	5:25 PM	8.5	65.50	1	0	0	0
87	15-Apr	11:46 AM	6.3	43.30	0	0	0	0
88		2:33 PM	8.3	100.50	0	0	0	0
89		7:55 PM	8.3	88.50	0	0	0	0
90	16-Apr	12:28 PM	6.4	72.40	2	0	0	0
91	17-Apr	5:21 AM	6.9	110.90	1	2	0	0

# of checks	Date	Time	Temp	Cond.	# Males	# Females	# M Heads	# F. Heads
92	17-Apr	9:52 AM	7.1	108.10	0	0	0	0
93		3:00 PM	7.9	45.20	0	0	0	0
94		7:15 PM	8.1	78.40	0	0	0	0
95	18-Apr	9:43 AM	6.8	70.00	1	0	0	0
96		7:44 PM	7.9	81.30	0	0	0	0
97	19-Apr	6:25 AM	6.7	77.60	0	0	0	0
98	20-Apr	8:33 AM	6.9	141.40	0	0	0	0
99	21-Apr	10:50 AM	6.9	71.60	0	0	0	0
100		2:48 PM	8.6	221.80		tide too high to check net		
101		7:32 PM	9.1	129.10	0	0	0	0
102	22-Apr	8:15 AM	6.6	77.60	0	0	0	0
103	23-Apr	10:51 AM	6.7	64.20	0	0	0	0
104		3:55 PM	7.8	46.60		tide too high to check net		
105	24-Apr	8:02 PM	7.3	51.30	0	0	0	0
106		12:42 PM	7.1	90.50	0	0	0	0
107	25-Apr	8:16 AM	6.3	108.00	0	0	0	0
108		3:17 PM	9.1	80.60	0	0	0	0
109	26-Apr	11:33 AM			0	0	0	0
110	27-Apr	5:39 AM	6.3	17.10		tide too high to check net		
111		10:27 AM	6.0	18.70	0	0	0	0
112	28-Apr	7:52 PM	8.5	38.90	0	0	0	0
113	29-Apr	6:38 AM	5.8	35.00	1	1	0	0
114	30-Apr	3:51 PM	9.3	38.00	0	0	0	0
115	01-May	5:01 AM	6.8	24.10	0	0	0	0
116		10:13 AM	6.6	18.20	0	0	0	0
117	03-May	5:00 AM	6.5	24.80	0	0	0	0
				TOTAL	20	19	0	0

## Appendix F. 2004 Bella Coola estuary tows

Date	Tow	Start	End	Total Elarvae	Total Sculpin	Temp:	7.8C
26-Apr-04	1	10:40 AM	10:45 AM	117	0		
	2	10:46 AM	10:51 AM	12	6		
	3	10:52 AM	10:57 AM	80	9		
	4	10:58 AM	11:03 AM	40	4		
	5	11:04 AM	11:09 AM	11	1		
	6	11:21 AM	11:26 AM	0	0		
	7	11:27 AM	11:32 AM	1	0		
	8	11:33 AM	11:38 AM	3	0		
	9	11:40 AM	11:45 AM	0	0		
	10	11:46 AM	11:51 AM	0	0		
<b>TOTAL</b>				264	20		

Date	Tow	Start	End	Total Elarvae	Total Sculpin	Temp:	10.2
						Cond:	344us
7-May-04	1	3:15 PM	3:20 PM	187	50		
	2	3:24 PM	3:29 PM	3	1		
	3	3:29 PM	3:34 PM	4	3		
	4	3:34 PM	3:39 PM	1	0		
	5	3:40 PM	3:45 PM	0	0		
	6	3:46 PM	3:51 PM	1	0		
	7	3:52 PM	3:57 PM	0	0		
<b>TOTAL</b>				196	54		

### Necleetsconay River (50m up from mouth)

Tow for 5 minutes            3:18 PM  
 Temp: 7.8 C  
 Cond: 40.2 us                NOTHING found

### Paisla Creek (50m up from mouth)

Tow for 9 minutes            2:29 PM  
 Temp: 8.5C  
 Cond: 40.4us                NOTHING found

### Bella Coola River (50m up from mouth)

Tow for 9 minutes            2:55 PM  
 Temp: 9.1C  
 Cond: 41.2                 NOTHING found

# Appendix G. 2004 other watershed sampling

Location:  
South Bentinck Arm

Date	River	Tow	Time start	Time end	Temp	Total eggs	Dead eggs	Dead w eyes	live eggs	L w eyes	Larvae	Adults
<b>1<sup>st</sup> trip</b>												
27-Mar	Asseek	1	7:05 AM	7:20 AM		6	174	168	1	5	0	0
27-Mar	Asseek	2	3:55 PM	4:05 PM		6	9	7	2	0	0	0
28-Mar	Asseek	3	9:50 AM	10:00 AM		6	0	0	0	0	0	0
28-Mar	Asseek	4	5:07 PM	5:12 PM		7	4	4	0	0	0	0
29-Mar	Asseek	5	7:45 AM	7:50 AM		6						1
27-Mar	Talheomy	1	8:53 AM	9:12 AM		6	7	7	0	0	0	0
27-Mar	Talheomy	2	4:53 PM	4:58 PM		8	0	0	0	0	0	0
28-Mar	Talheomy	3	10:36 AM	10:51 AM		7	0	0	0	0	0	0
29-Mar	Talheomy	4	8:35 AM	8:45 AM		5.5	3	3	0	0	0	0
27-Mar	Noeick	1	9:37 AM	9:52 AM		6	24	14	10	0	0	0
28-Mar	Noeick	2	11:15 AM	11:25 AM		7	20	16	4	0	0	0
28-Mar	Noeick	3	3:54 PM	4:04 PM		7	0	0	0	0	1	0
29-Mar	Noeick	4	9:06 AM	9:11 AM		6	0	0	0	0	0	0

<b>2<sup>nd</sup> trip</b>												
07-Apr	Asseek	1	6:08 PM	6:13 AM		8	68	4	0	50	14	78
08-Apr	Asseek	2	10:52 AM	10:57 AM		6	80	0	2	77	1	24

**Estuary tows**

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Talheomy Narrows to the Noeick

07-Apr

					Total Larvae	Total eggs	Comments
1	11:24 AM	11:34 AM			0		Lots of ducks in the area
2	11:37 AM	11:47 AM			1		
3	11:49 AM	11:59 AM			2		
4	12:01 PM	12:11 PM			1		
5	12:13 PM	12:23 PM			0		
6	12:24 PM	12:34 PM			28		
7	12:36 PM	12:46 PM			7		
<b>TOTAL</b>					39	0	

Asseek Estuary

08-Apr

1	10:11 AM	10:16 AM			24	
2	10:18 AM	10:23 AM			10	1
3	10:25 AM	10:30 AM			10	
<b>TOTAL</b>					44	1