FRASER RIVER, PORT MANN BRIDGE-DOUGLAS ISLAND EULACHON STUDY, 2009

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July 13, 2009

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Executive Summary

Little is known about the specific eulachon migration and spawning corridors adjacent to the Port Mann Bridge and within Kwikwetlem territory. The 2009 Port Mann bridge eulachon study presents the following findings.

In general, eulachon spawn directly beneath the Port Mann bridge pillars and in the close upstream vicinity of the bridge and as expected eulachon use all channels under the bridge for migration to upstream areas.

In more detail, eulachon caught in this study spawned in areas with sandy and gravelly bottom, medium depth (<6m) and lower maximum current speeds (>0.6m/sec) on plateaus and edges. Areas with a mobile sand layer were not used for spawning. The fork length of eulachon in this study ranged from 14-22cm and their weight ranged from 20-100g. Age classes could not be positively indentified from weight or length frequency plots and otoliths have not yet been analyzed. The plots suggest potentially three age classes which have been described as two, three and four year old spawners in the Fraser before. The sex ratio of eulachon in the lower Fraser appeared unbiased early in the season and skewed towards female fish later in the season.

Far more work is needed to describe eulachon general behaviour and specifically spawning behaviour in vicinity of the Port Mann Bridge and the whole lower Fraser.

1. Introduction

The decline of the Fraser River eulachon population can be described by the change in effort required to catch a few hundred fish. In the 1950s Fraser eulachon were so plentiful during the peak of the run that it took a child less than an hour with a dip net to catch hundreds of fish from shore (Glen Joe, Kwikwetlem Fisheries Manager, pers. comm.). At the same time commercial harvesters set their 100m nets for less than 30min and commonly caught thousands of fish in a set. At the peak of the 2009 eulachon migration in this study, the same 100m commercial net caught a maximum of 140 fish in a one hour period and much fewer during all other sampling dates. Because of concerns over the decline in eulachon abundance, and in light of the imminent extension of the Port Mann Bridge to 10 lanes, the Kwikwetlem First Nation and Watershed Watch commissioned a study to assess the eulachon migration and spawning locations as well as eulachon densities adjacent to the proposed new Port Mann Bridge.

1.1. British Columbia Eulachon Populations and Life History

Within British Columbia, 33 rivers are documented to have spawning eulachon populations of which 15 are consistently used while others seem to be used for spawning only in years of large eulachon abundance. All rivers experience high glacial or snow pack run-off in spring following the eulachon larvae outmigration. The main British Columbia eulachon producers are Nass, Fraser, Skeena and Klinaklini rivers. While the large-scale traditional First Nations harvest of eulachon for oil or smoking has disappeared in many areas, it is still common practice in the lower Nass River, the Kemano River or the Kitlope River in BC.

Eulachon enter the lower reaches of their natal river from late February to April. A single female lays about 30,000 adhesive eggs in sand and pebble areas, and the small larvae hatch dependent on ambient water temperature (usually between 3 and 10 °C) in three to five weeks. Hatched larvae display a short freshwater residence time and are readily flushed out to estuarine or marine areas. Following a two to three-year stay in the ocean, eulachon return to their natal streams to spawn at lengths of 14-22 cm and weights of 20-100 grams. While the details of the eulachon's ocean migration route are largely unknown, they are regularly captured by groundfish and shrimp trawlers and in DFO shrimp surveys in offshore areas around Dixon Entrance, Hecate Strait, Queen Charlotte Sound, and the West Coast of Vancouver Island at depths of 80 to 200 m. Fraser River eulachon spawn mainly from March to May and have been captured on the southern West Coast of Vancouver Island mixing with Columbia River eulachon stocks (all eulachon life cycle information from: Hay & McCarter 2000; DFO 2008) .

1.2. Fraser River Eulachon Stock Status

The abundance of the Fraser River eulachon populations is currently being assessed by three methods (DFO 2007). These include; 1) the assessment of egg and larval density (

Figure 1), 2) catches from a test fishery that was discontinued in 2005 (Figure 2, left panel), and 3) the assessment of commercial catches in the Columbia and Fraser Rivers (Figure 2, right panel).

All three assessment methods show that the Fraser River eulachon population has declined severely since 2004 (

Figure 1 and Figure 2). A similar but less severe abundance decline was also observed in 1997, followed by a quick recovery until 2002. Long-term trends for the population are impossible to assess since even the farthest reaching data series starts only in 1973. Anecdotally, it is known that the Fraser River eulachon were harvested in large numbers by First Nations along the river and that typical eulachon predators such as glaucous and Bonaparte sea gulls, bald eagles and California sea lions used to migrate into the river in large numbers following the spawning migration. Recently, the increase in number of eulachon predators is hardly detectable when the fish are spawning (Glen Joe, Kwikwetlem Fisheries Manager, pers. comm.).

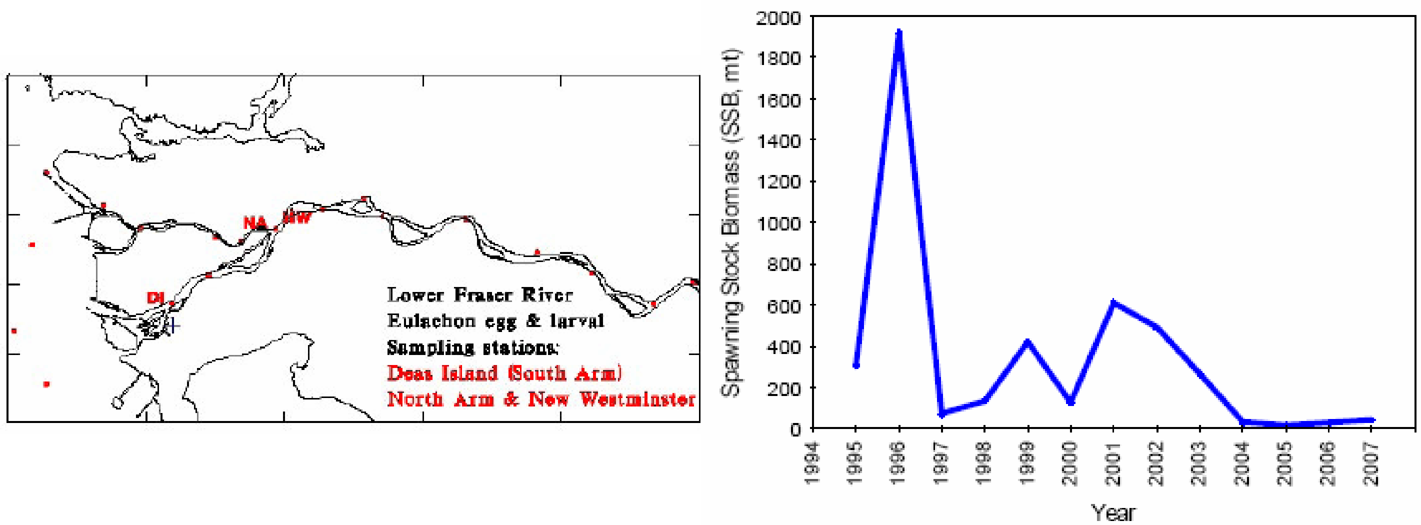

Figure 1: Fraser eulachon spawning stock biomass from 1995 to 2007 (right panel) estimated by egg and larval survey at Fraser sampling locations shown in left panel (from: DFO 2007)

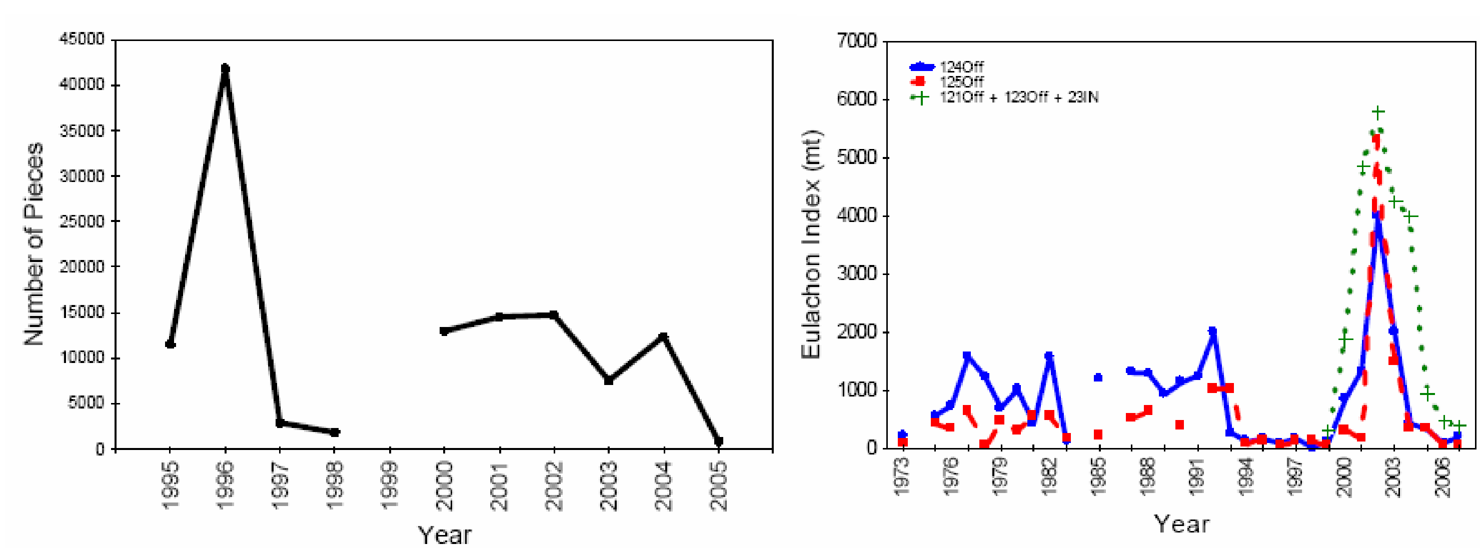

Figure 2: Left Panel: Catches from Fraser River eulachon test fishery (1995-2005); Right Panel: Commercial eulachon catches from the Columbia and Fraser rivers (1973-2007) (both from: DFO 2007)

1.3. Potential Areas of Concern for Fraser River Eulachon and their Habitat

In 2007, DFO conducted an eulachon workshop to bring together experts in the field and determine research priorities to address the sharp decline in Fraser River eulachon and other eulachon stocks (Pickard & Marmorek 2007). As a result of the workshop, the following potential main impacts and research priorities for Fraser River eulachon stocks were identified:

- Impact 1: Shoreline construction that reduces the quantity and quality of eulachon spawning habitat;

- Impact 2: Dredging activities that degrade eulachon spawning habitat and increase water velocity resulting in eulachon spawners not migrating upstream as far as they did historically (to the Mission area) and more rapid wash-out of larvae;

- Impact 3: Changes in ocean conditions that indirectly impact juvenile and adult eulachon survival through reduced food availability and increased predation;

Based on the same eulachon workshop the following research priorities were determined:

- Priority 1: Egg and larval surveys to monitor eulachon abundance over time;

- Priority 2: Monitor predator distribution and abundance, and temperature and food availability;

- Priority 3: Define, map and protect critical freshwater and estuarine eulachon habitat for spawning and rearing.

In this study, primarily research priority 3 was addressed by defining and mapping critical eulachon freshwater habitat for spawning and rearing in the vicinity of the Port Mann Bridge, Tree Island, Douglas Island and the mouth of the Coquitlam River.

1.4. Study Design to Monitor Potential Impacts in the Pre, During, and Post-Construction periods of the Proposed 10-Lane Port Mann Bridge

The construction of a new 10-lane Port Mann Bridge represents a major addition to shoreline and in-river construction on the lower Fraser River and has the potential to significantly impact the quantity and quality of eulachon spawning habitat within the vicinity of the new bridge footprint (as pointed out in the eulachon workshop, Pickard & Mamorek 2007). Important eulachon spawning habitat has been identified by members of the Kwikwetlem First Nations on the west end of the Port Mann Bridge near Douglas Island (Figure 3) and the shores of Tree Island directly adjacent to the north pillar of the bridge in the Fraser main channel (Figure 3). In line with the most important eulachon research priorities described in the 2007 eulachon workshop

(Pickard & Mamorek 2007), and specific to the Port Mann Bridge construction site and claimed Kwikwetlem territories, the following was completed:

1. A desk top background study on eulachon in BC and specifically in the Fraser watershed;
2. A sub-bottom profiling and sonar survey of the river bottom with ground truthing using sampling equipment to identify water depth, river substrate morphology and type (Shipek Grab Sampler), substrate stability (seismic profiling boomer) as well as water depth and current speed in the Douglas and Tree Islands vicinity;
3. Eight days of eulachon field sampling during the spring of 2009 spawning season;
4. A thorough analysis of the eulachon catch data with regards to;
    - Catch locations and catch per unit effort (CPUE) of immature or migrating versus mature and spawning eulachon;
    - weight, length and state of maturity of all fish caught;
    - length and weight frequencies by sex; and
    - the biological and physical characteristics of eulachon spawning and migration corridors in the vicinity of the Port Mann Bridge.

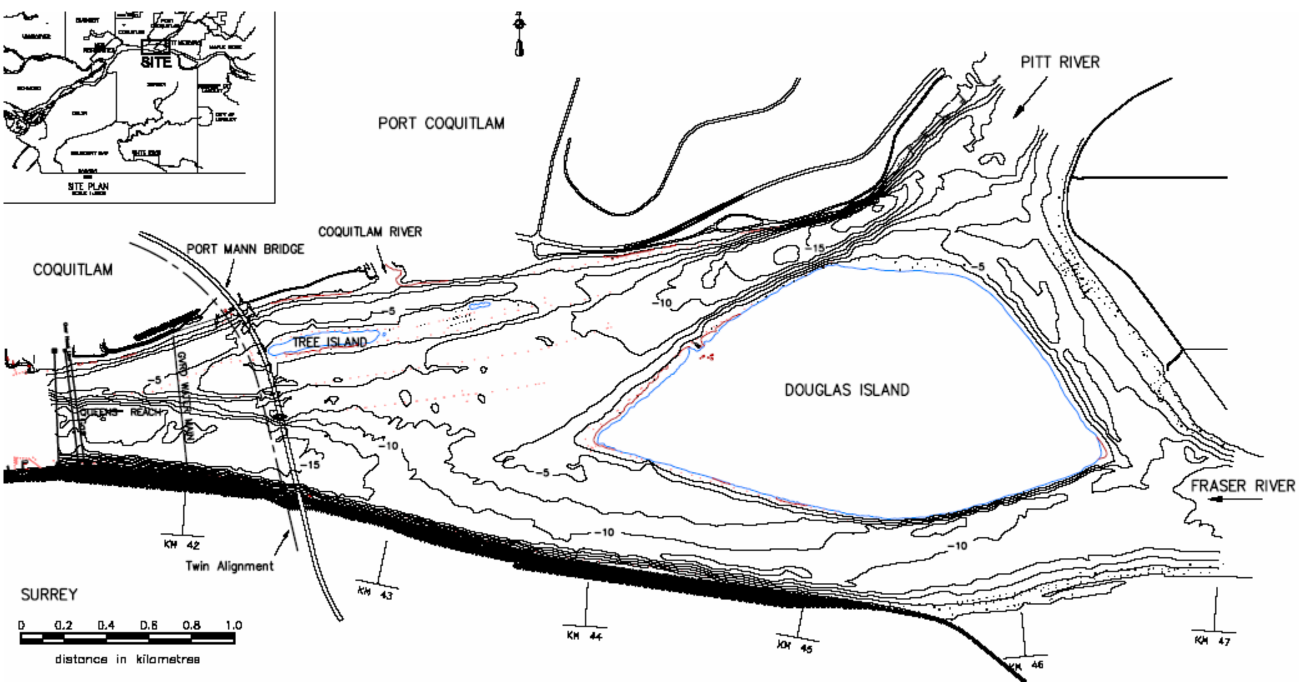

Figure 3: Map of Port Mann Bridge construction site in relation to Douglas Island and the Fraser River (from: Northwest Hydraulic Consultants 2004)

2. Methods

2.1. Seismic Profiling and Bathymetric Data Collection

All sub-bottom profiling using a seismic profiling boomer was carried out by Terra Remote Sensing Incorporated between October 14th and October 17th, 2008. Generally, the field work was carried out from a 26 foot research vessel (Figure 4) and data were recorded in hard copy on a paper role (Figure 5) and in digital format. Seismic profiling transects were chosen to represent all river morphology types found in the area. Additional transects were chosen in areas of former eulachon spawning around Tree Island and the western end of Douglas Island (Figure 8).

Figure 4: Terra Remote Sensing Inc. research vessel that is used as the operating platform for seismic profiling (left photo) and operating of the boomer system (right photo).

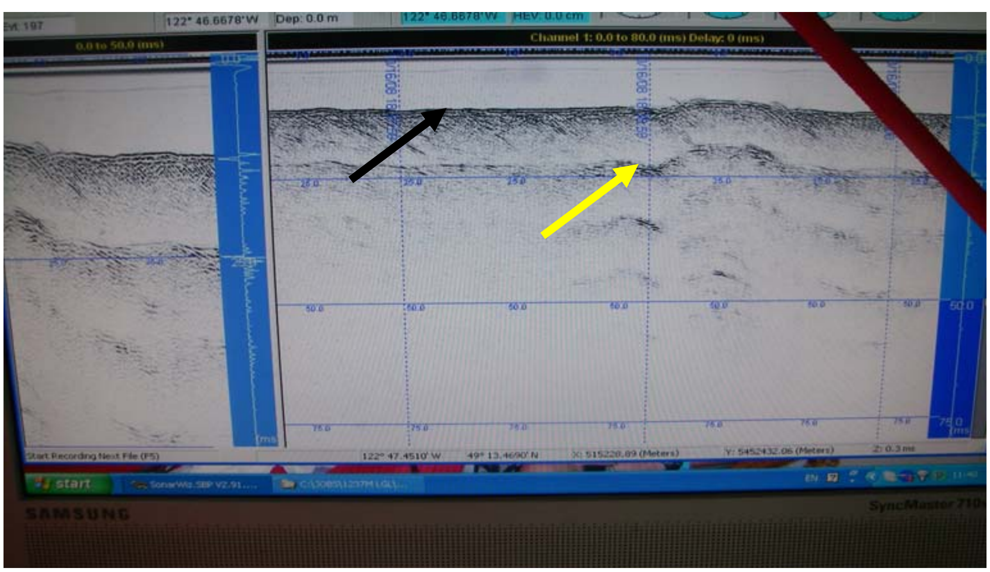

Figure 5: Typical printout and hardcopy back–up from seismic sub-bottom profiling showing river bottom (black arrow) and the first layer of substrate with different physical features (yellow arrow). The soft layer between the black and yellow arrow is likely unstable and will change in thickness with different scouring and deposition rates as flows change.

2.2. Substrate Sampling

To verify the interpreted seismic profiling of substrate condition, substrate was sampled with a Shipek Grab Sampler (Figure 6), which was lowered to the river bottom and triggered to close on impact.

Figure 6: Shipek Grab sampler

2.3. Eulachon Capture and Sampling

Eulachon were captured and sampled over a period of eight field days from: 6-8 April; 18-20 April; 4-5 May.

Two types of nets were used, either as a set net or drift net:

1. Net Size: 15.3m wide x 4.9m deep (total area $75m^2$); mesh size: 2.54cm
2. Net Size: 91.5m wide x 10.7m deep ($979m^2$); mesh size: 2.79cm

As a set net, both ends of the float line were attached to large floats connected by a rope to rock-filled burlap sacks used as anchors. Depending on the net used, depths fished were from the surface to 4.9m, or from the surface to 10.7m.

Both nets were mainly used as drift nets, with the larger net used in the wider and deeper channels, and the shorter and shallower net in more confined areas and shallower water. The drift direction of the smaller net was easily manipulated during a drift, whereas control of the drift direction of the larger net was minimal. Both nets were set from an 18-foot aluminum boat with a 50 hp outboard motor.

For drift fishing, drift corridors were chosen that had a variety of current speeds and bottom substrate compositions. All proposed drift corridors were scanned beforehand with a side-scanning sonar for snags. Since the current in the Port Mann Bridge area was influenced by river level and tide, a variety of currents was experienced while drift and set fishing.

2.4. Maturity Measures

State of maturity was determined by:

1. General appearance of the fish:
   darker colour for both sexes and tubercles and rough skin along the lateral line of males were typical for mature or spawning fish (Figure 7, Panel 2); immatures were of silvery colouration and showed no tubercles (Figure 7, Panel 1); and

2. An eulachon's response to light pressure to the abdominal area:
   resulting in the release of sperm or eggs (Figure 7, Panel 3) in mature fish and no release of gonadal products in immature fish.

Figure 7: Morphological features of immature (Panel 1) and mature (Panel 2) eulachon and release of sperm upon light pressure to the abdominal area (Panel 3).

3. Results

3.1. Seismic Profiling and Bathymetric Data Collection Results

All of the suitable eulachon habitat determined by sub-bottom profiling and the detection of substrate surface features was found to overlap with traditionally known areas of eulachon spawning (Glen Joe, Kwikwetlem Fisheries Manager, pers. comm.). The areas south and south-east of Tree Island, north and north-east of Douglas Island, the initial 300m of Pitt River, and the Fraser River shore along the Kwikwetlem lands north of Douglas Island feature medium and coarse sands and occasional pebbles and slow currents speeds. A part of the traditionally known eulachon spawning areas in the shallow water directly around Tree and Douglas Islands is now covered by log booms and could therefore not be investigated. Most bottom samples taken from locations close to log booms featured organic-rich gas-charged silts and mud. In the future, it should be investigated if the organic debris and gas-producing process from log booming affect eulachon spawning habitat.

3.2. Substrate Sampling

The river bottom north of Tree Island extending into the mouth of the Coquitlam River was covered with a relatively stable layer of substrate composed of coarse sand and small rounded pebbles, which appeared to be good eulachon spawning substrate (Figure 9 and Figure 10). In contrast, the river bottom in the area between the log booms east of Tree Island was covered with fine sand interlaced with mud clasts and releases of organic-rich gases. This kind of substrate is unlikely to support eulachon spawning and may be anoxic (Figure 9 and Figure 11).

Potential eulachon spawning areas were also found south of Tree Island (Figure 9 and Figure 12) and north of Douglas Island and at the mouth of the Pitt River (Figure 9 and Figure 13).

Table 1 shows the detailed bottom sampling results from all sampling locations in the vicinity of the Port Mann bridge and Douglas Island.

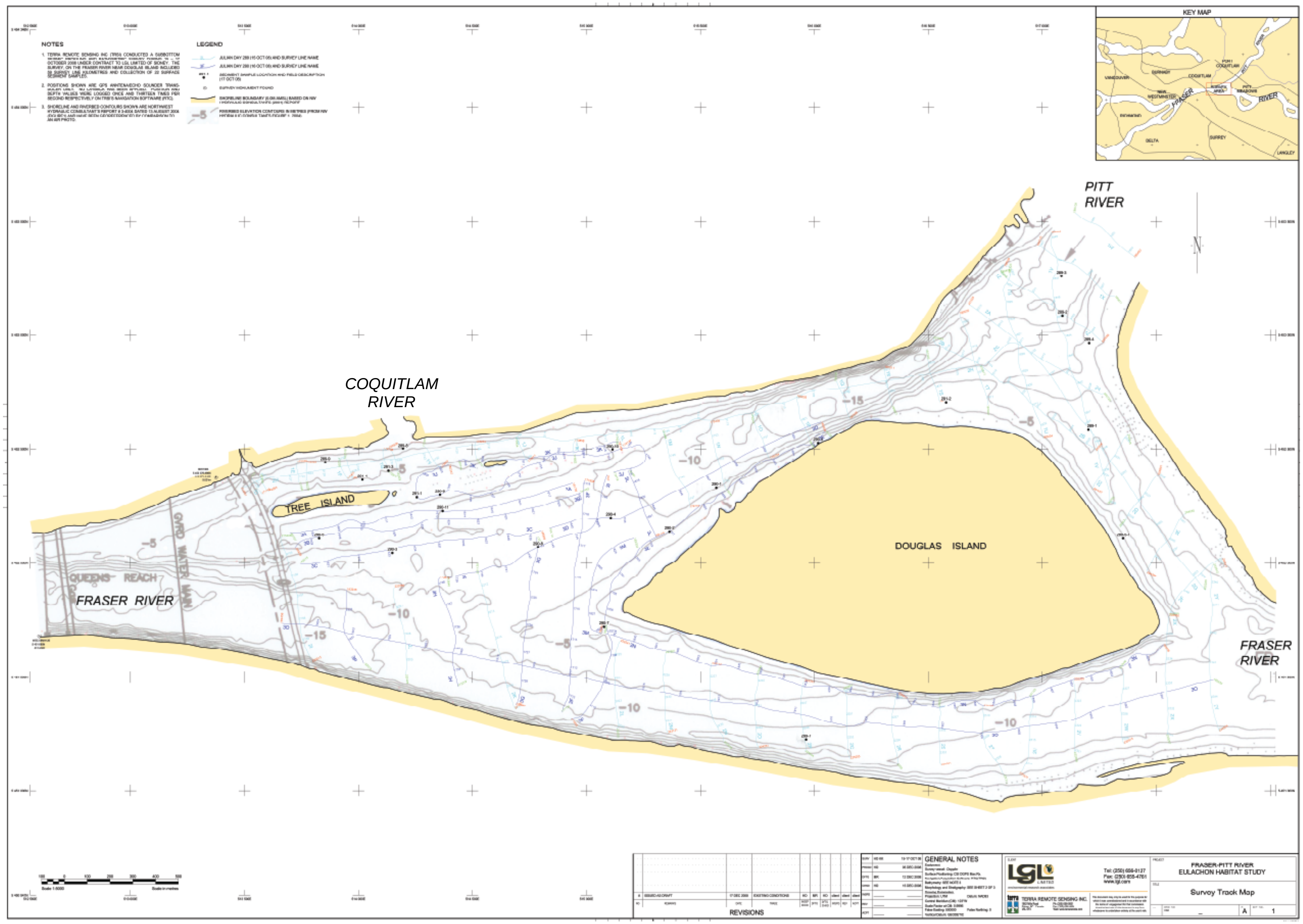

Figure 8: Map showing tracks of all seismic profiling transects carried out between 14 and 17 October, 2008

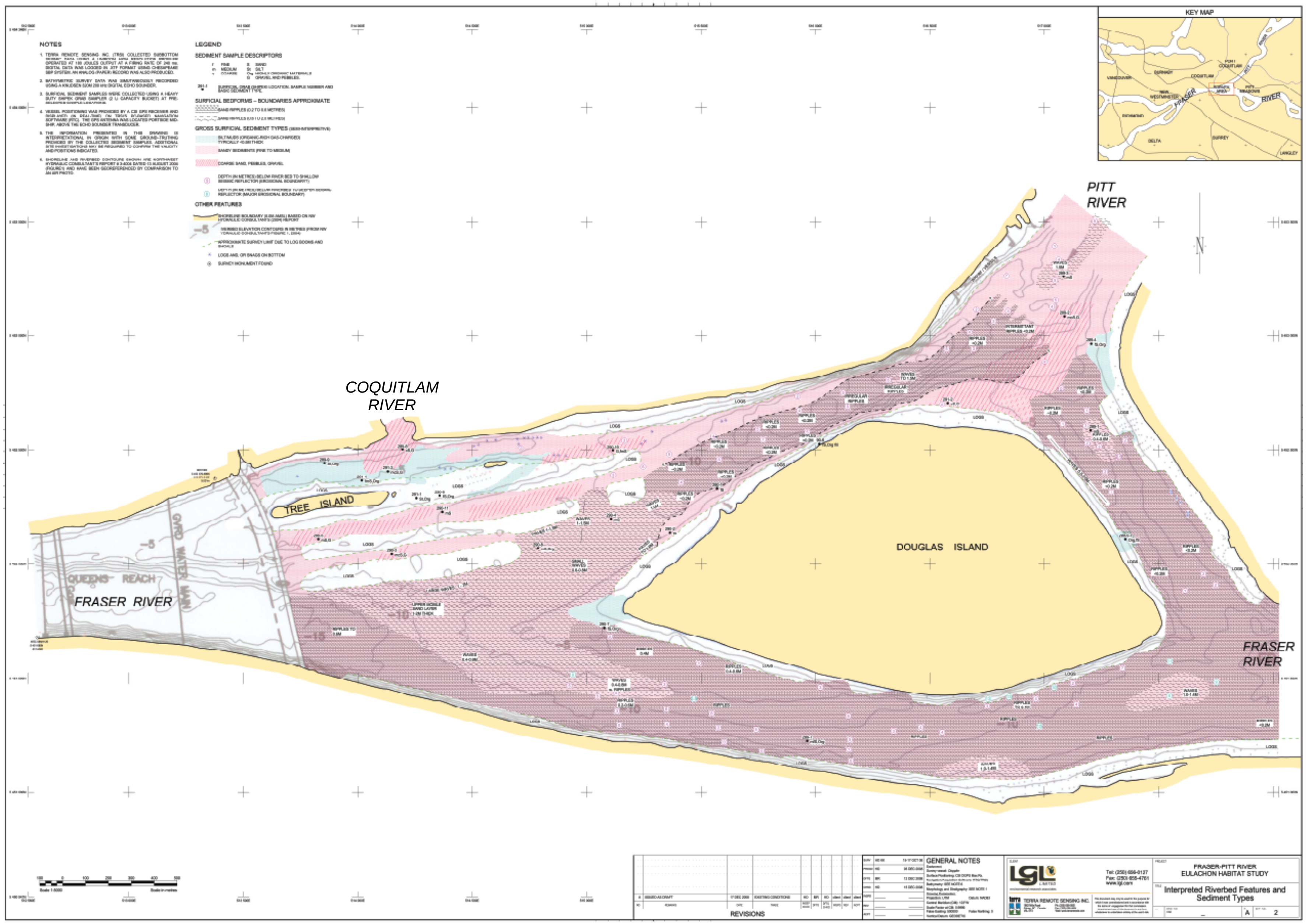

Figure 9: Map of interpreted morphological and sub-bottom river bed features and sediments. Coarse sand and pebbles and sandy sediments, are the most likely eulachon spawning substrates in combination with low current speeds (no sand ripples); such conditions were mainly found on the south and the east side of Tree Island, the north and the north-east side of Douglas Island, the initial 300m of Pitt River and on the Kwikwetlem Shore of the Fraser River north of Douglas Island .

Figure 10: Coarse sand and pebble sediments sampled from the area north of Tree Island and mouth of the Coquitlam River. These sediments are considered suitable for eulachon spawning.

Figure 11: Fine sand with mud clasts and evidence of gas bubbles sampled from the area east of Tree Island between log booms. This sediment type is considered too fine for eulachon spawning and was probably anoxic

Figure 12: Medium and coarse sand interlaced with small 0.5cm to 1cm rounded gravel sampled in the area south of Tree Island. These sediments are considered suitable for eulachon spawning.

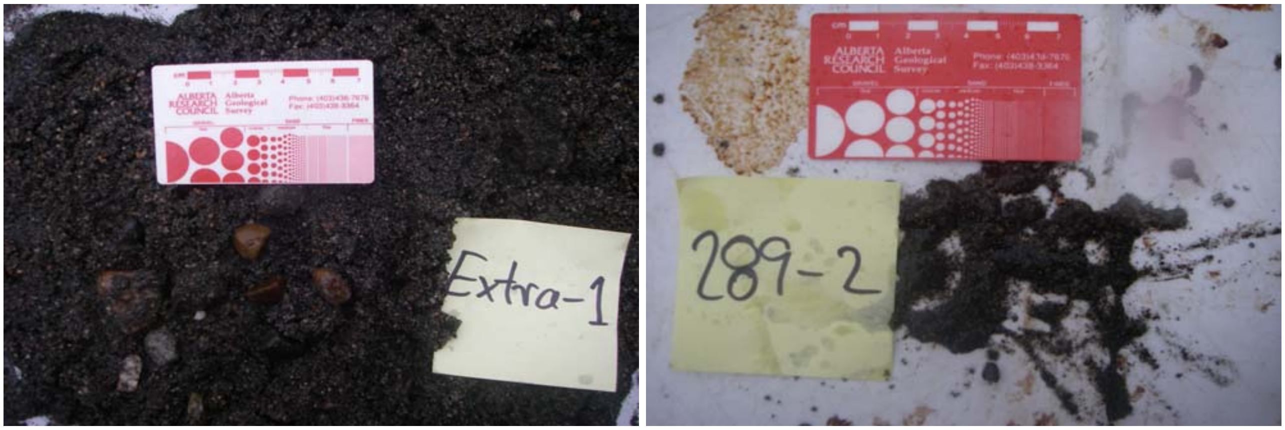

Figure 13: Coarse sand with rounded pebbles and 100% medium to coarse sand sampled from the area north of Douglas Island and in the mouth of the Pitt River. These sediments are considered suitable for eulachon spawning.

Table 1: Bottom sampling data sheet for the Fraser River in the vicinity of Douglas Island and directly adjacent to the Port Mann Bridge

SAMPLE #	TIME	NORTHING	EASTING	DEPTH (M)	CURRENT (m/s)	PICTURE	SUBSTRATE COMPOSITION & OTHER COMMENTS
289-9-1	161650	5452441	513862	3	0.513	no	Silt & mud
289-9-2	162204	5452460	513845	1.8	0.513	yes	Silt & mud and organics, trace clay (bubbles on impact). Second attempt.
291-4	194157	5452364	513947	6.3	0.1539	no	Mainly fine-medium sand with trace organics
290-5	172537	5452140	513813	5.9	0.2565	yes	70% medium sand, 30% gravel (1-2cm rounded)
290-3	174807	5452056	514146	5	0.2565	yes	90% medium-coarse sand, 10% gravel (0.5cm rounded)
290-11	171030	5452224	514347	7.5	0.2565	yes	100% medium sand
290-9	173251	5452293	514289	2	0.2565	yes	100% fine sand with mud clasts (bubbles on impact, organics) ,east end of Tree Is.
291-1	173957	5452294	514232	1.2	0	no	Organic sludge, no silt, second attempt, East end of Tree Is.
290-8	175406	5452059	514793	5.9	0.2565	yes	Mainly medium sand with trace organics
291-3	193753	5452397	514159	6.2	0.1539	yes	Mainly medium-coarse sand with a few pebbles (0.2-0.5cm rounded), trace of organics
289-8	162926	5452512	514182	2.9	0.1539	yes	Mouth of Coquitlam River, 80% coarse sand, 10% pebbles (1-3cm rounded), 10% organics, 1 lamprey ammocoetes larvae (11cm)
290-10	163827	5452522	515075	6.4	0.2565	yes	Also close to mouth of Coquitlam River, 40% gravel, (1-4cm rounded), 60% fine sand, gravel overlaying sand
290-4	170104	5452180	515078	7.3	0.7695	yes	100% medium sand
290-2	165455	5452181	515343	8	1.026	yes	100% fine compact sand
290-1	192131	5452309	515580	6	0.2565	yes	100% fine sand
290-6	191357	5452525	515987	3	0.2565	yes	100% muddy silk with mud clasts, 1 ammocoetes lamprey (7cm)
291-2	190350	5452693	516633	4.8	0.4104	yes	90% coarse sand, 10% pebbles (0.5-3cm rounded)
289-3	185434	5453256	517058	12.1	0.2565	yes	100% medium sand
289-2	184923	5452997	517104	7.8	0.7695	yes	Mainly medium-coarse sand with a few pebbles (0.5cm rounded)
289-4	184210	5452939	517257	3.4	0.513	yes	Mainly fine sand with trace organics
289-1	183523	5452538	517232	9.1	0.7695	no	100% medium sand
289-5-1	182541	5452108	517324	2.3	0	yes	50% mud and 50% organics (closer to shoreline). Second attempt.
289-7	180918	5451265	515962	11.5	0.2565	no	Mainly medium-fine sand with trace organics
290-7	175955	5451739	515097	3.8	0.2565	yes	Mainly fine sand with trace organics

3.3. Eulachon Capture and Sampling

Over the first three days of fishing (6-8 April), no eulachon were caught (Figure 14). Total catch was 78, 129 and 28 fish on 18, 19 and 20 April respectively, and 18 and 34 fish on 4 and 5 May (Figure 14).

The catch per unit effort or CPUE (number of fish/h/m^2 of net fished) by date is shown in Figure 15. CPUE was zero for 6-8 April. CPUE during the 3-day period (18-20 April) increased from 1.3 on the first day to 2.6 and to 11.5 on the last day. During 4 and 5 May, CPUE dropped to 1.7 and 2.8, respectively.

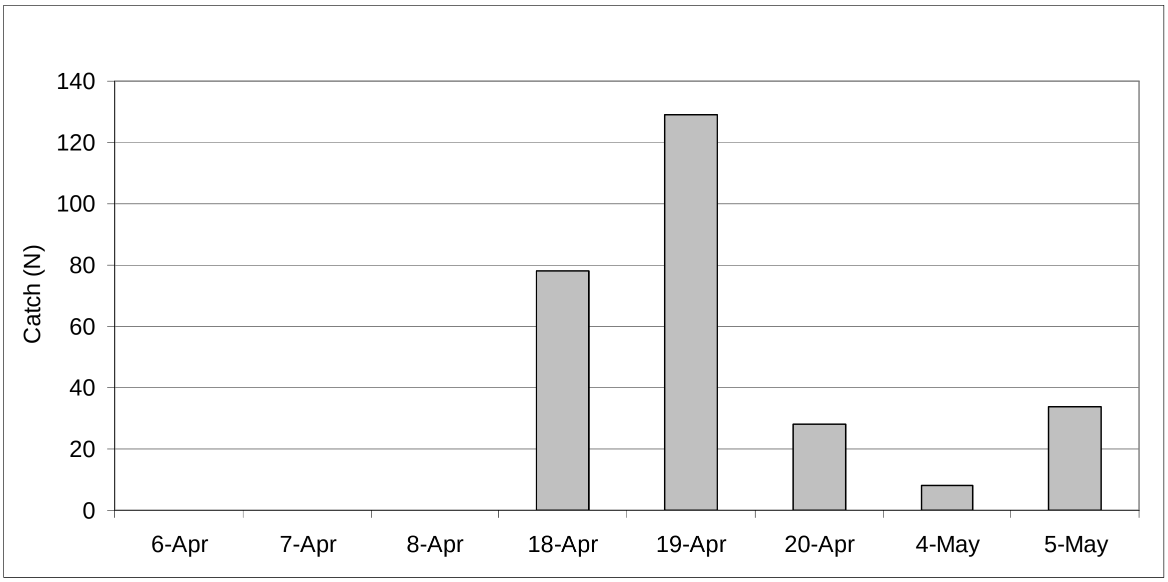

Figure 14: Total eulachon catch in spring 2009.

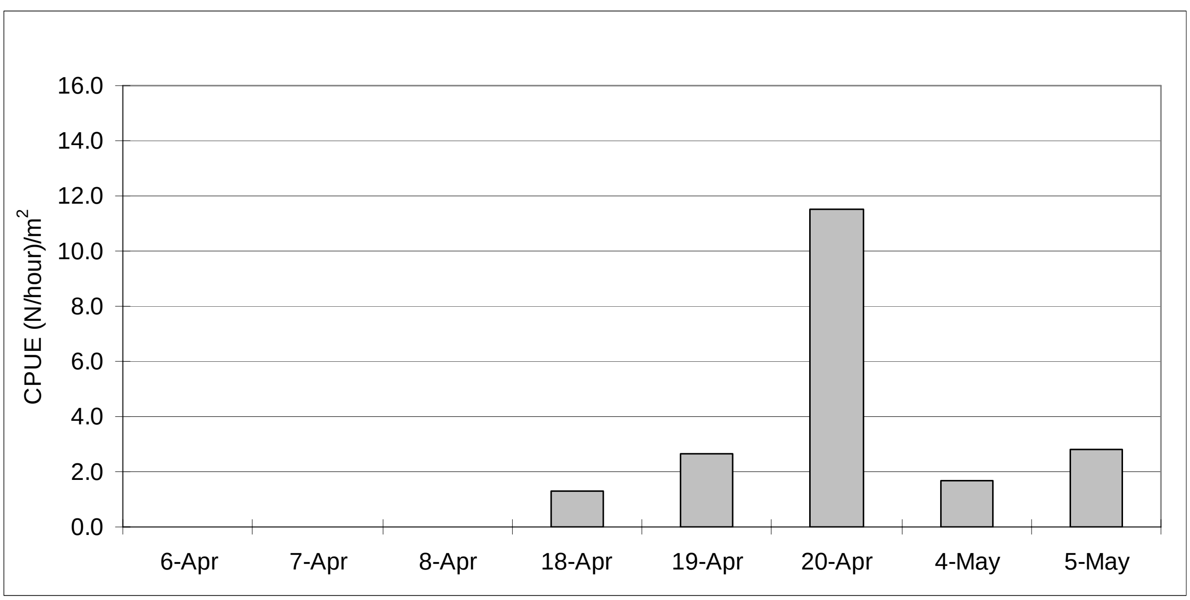

Figure 15: Average CPUE in spring 2009.

3.4. Eulachon Sex Ratios

The eulachon catch by sex showed a trend of increasing numbers of female fish as the spawning season advanced (Figure 16). The percentage of female eulachon in the catch was close to the expected 50% on April 18 (53%) and 19 (53%), and rose thereafter (April 20, 79%; May 4, 100%; May 5, 88%).

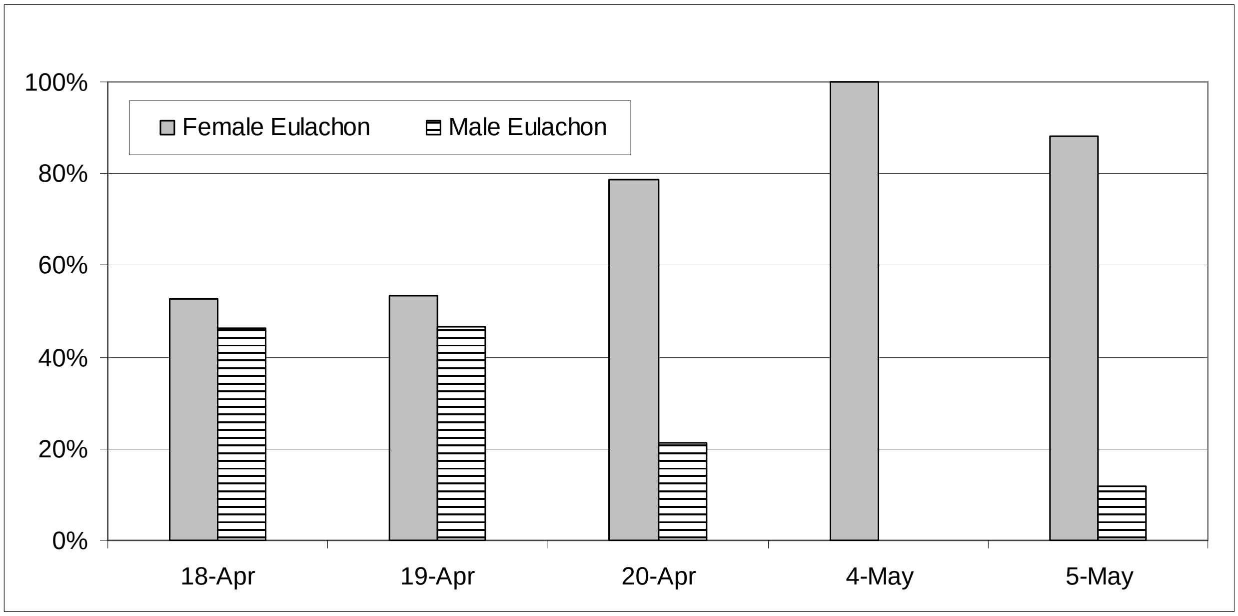

Figure 16: Percentage of female and male eulachon caught in spring 2009.

3.5. Catch Per Effort

A CPUE of 14.9 (number of fish/h/m^2) was obtained in the side channel south of Tree Island and directly upstream of the Port Mann Bridge (Figure 17). Other relatively high CPUEs came from locations close to the north shore of Douglas Island (CPUE 9) upstream of the Port Mann Bridge and in the central channel of the Fraser River close to the north pillar of the Port Mann Bridge (CPUE 6.5). Medium CPUE values came from the Fraser side channel that the Coquitlam River drains into (CPUE 3.3) just upstream of the Port Mann Bridge and in the downstream extension of that channel beneath the Port Mann Bridge and to the Maquabeak Park boat ramp (CPUE 3.2).

Lower CPUEs were obtained in the north lane of the Fraser Central Channel beneath the Port Mann Bridge (CPUE 0.9) and the south lane of the Fraser Central Channel beneath the Port Mann Bridge (CPUE 0.5).

Length and weight frequency distribution plots of female (average weight=51g, average length=180mm) versus male (average weight=59g, average length=192mm) eulachon show a similar pattern (Figure 20, Figure 21). Three weight and three length frequency peaks are suggested for female (weight peaks at 35g, 55g and 65g; length frequency peaks at 165mm, 180mm and 200mm) and for male fish (weight peaks at 40g, 55g and 70g; length peaks at 165mm, 180mm and 200mm) (Figure 20, Figure 21).

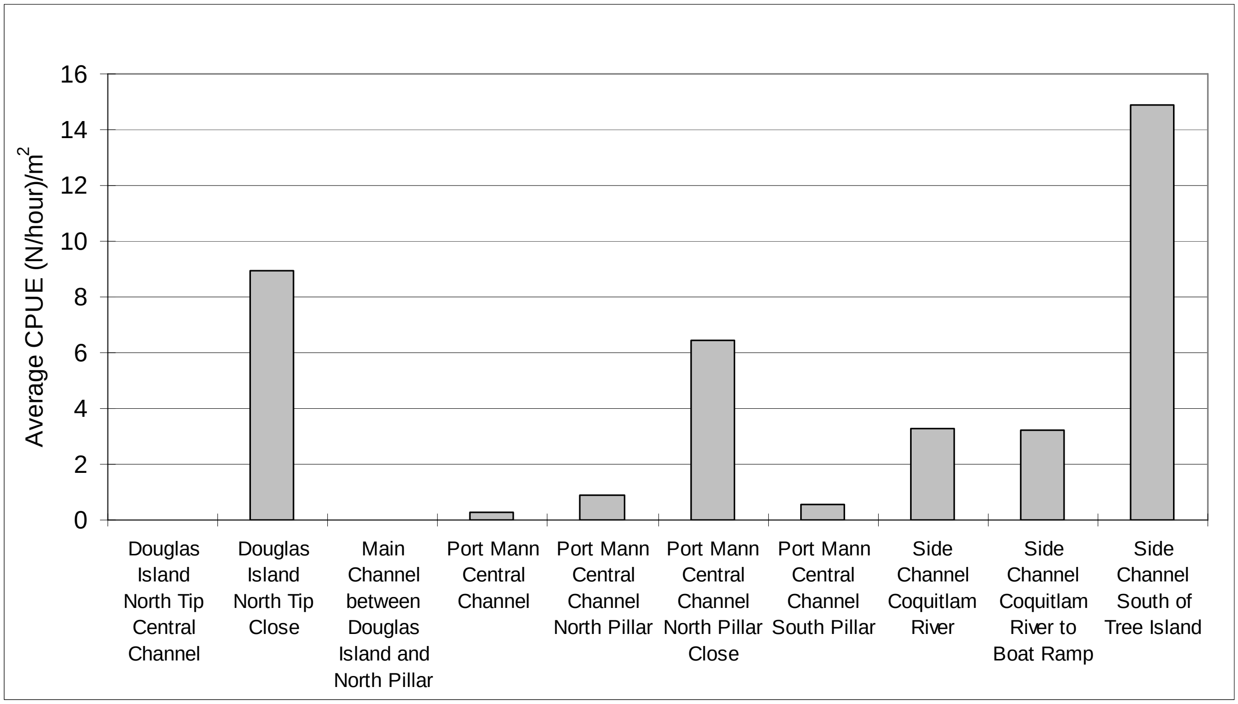

Figure 17: CPUE by location in the lower Fraser River area, spring 2009.

3.6. Eulachon Sizes

The average weight and length of eulachon caught was 54.2 g and 185 mm, respectively. Neither weight (Figure 18) nor length frequency plots (Figure 19) clearly revealed age classes. There is the suggestion of peaks around the 165 mm, 180-185 mm and 200 mm mark, which may mean that three age classes were present. Future otolith analysis may clarify this possibility.

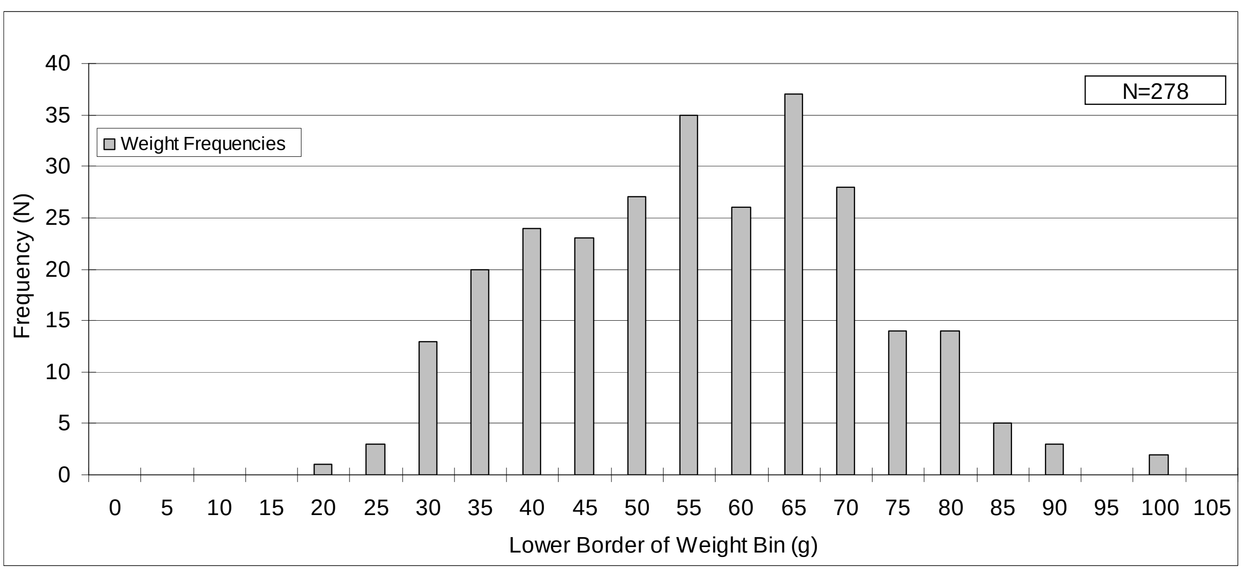

Figure 18: Weight frequency distribution for a total of 278 eulachon caught in spring 2009. The average weight is 54.2 g.

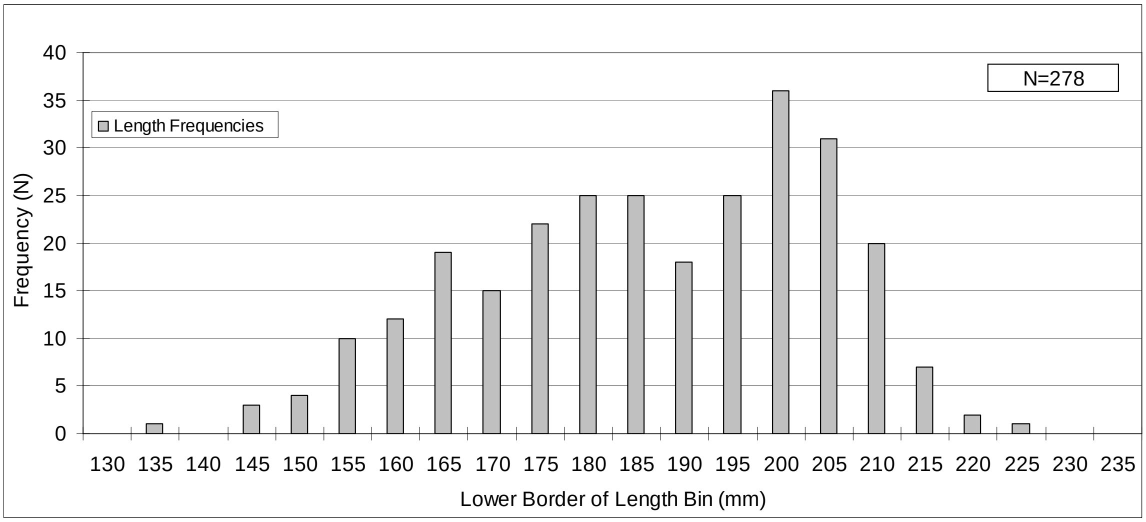

Figure 19: Length frequency distribution for a total of 278 eulachon caught in spring 2009. The average length is 185 mm.

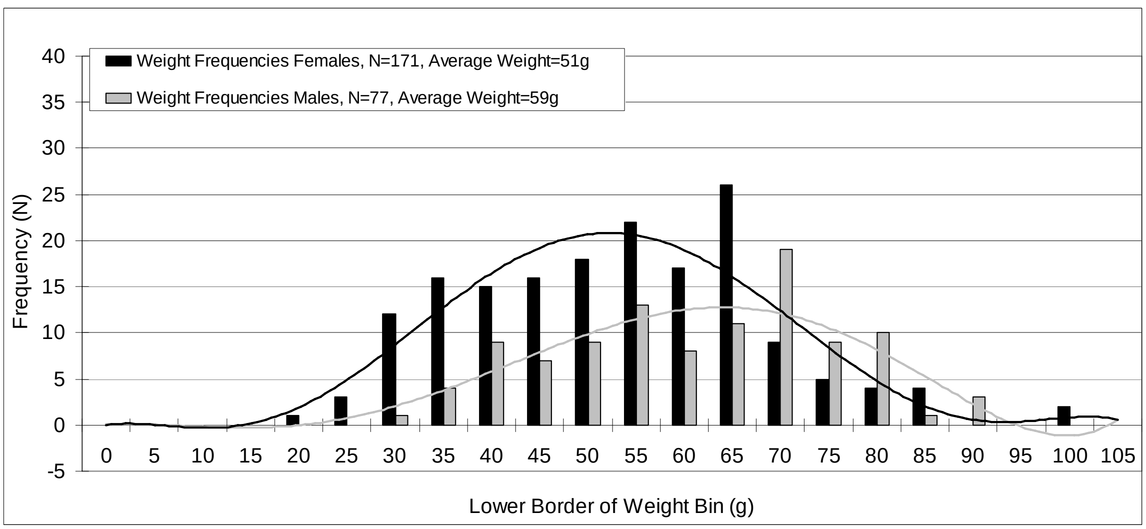

Figure 20: Weight frequency distribution for female versus male eulachon caught in spring 2009. Average weight for females is 51g, for males 59g.

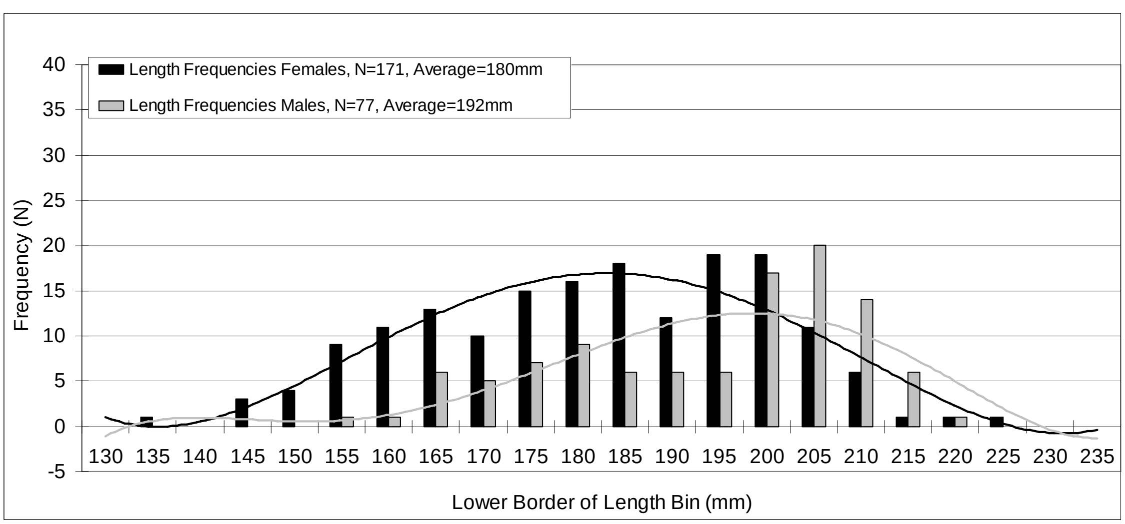

Figure 21: Length frequency distribution for female versus male eulachon caught in spring 2009. Average length for females is 180mm, for males 192mm.

3.7. Maturity

State of maturity, “running” sex products for mature fish versus “firm” for immature fish was determined for all fishing locations (Figure 22).

The highest percentages of mature fish were found at the north tip of Douglas Island close to shore on May 5, the central channel of the Fraser under the Port Mann Bridge on April 18-20 and May 5 and adjacent to the north pillar of the Port Mann Bridge in the main channel of the Fraser River on April 18-20 and May 5. Mature fish were also caught in the side channels south of Tree Island (April 18-20) and in the side channel on the north shore of the Fraser River where the Coquitlam River enters (April 18-20 and May 5). All of these locations represent eulachon spawning sites or locations that are likely very close to where spawning occurs.

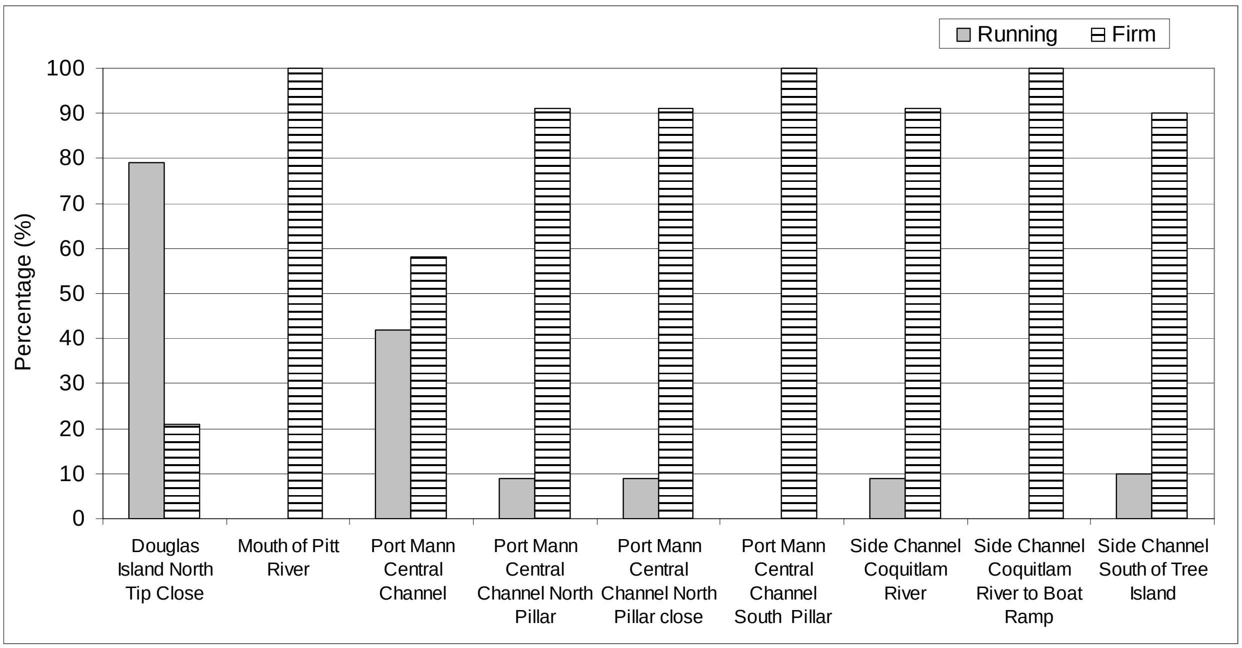

Figure 22: Percentages of “running” (mature) eulachon, and “firm” (immature) eulachon sampled in the Fraser River, April 18-20 and May 4-5, 2009 at different locations adjacent to the Port Mann Bridge.

3.8. Catch Summary on Depth Contour and Bottom Substrate Map

In Figure 23, the bottom substrate base map was used to add eulachon migration (blue) and spawning (green) corridors. Table 2 lists the physical features for each numbered migration and spawning corridor.

Eulachon migration corridors (blue lines in Figure 23) showed a variety of bottom substrate compositions (silt, fine-medium-coarse sand), bottom morphology (flat, rippled or with waves), depth (5-20m) and maximum current speeds (0.6-1.2m/s) and had few common features.

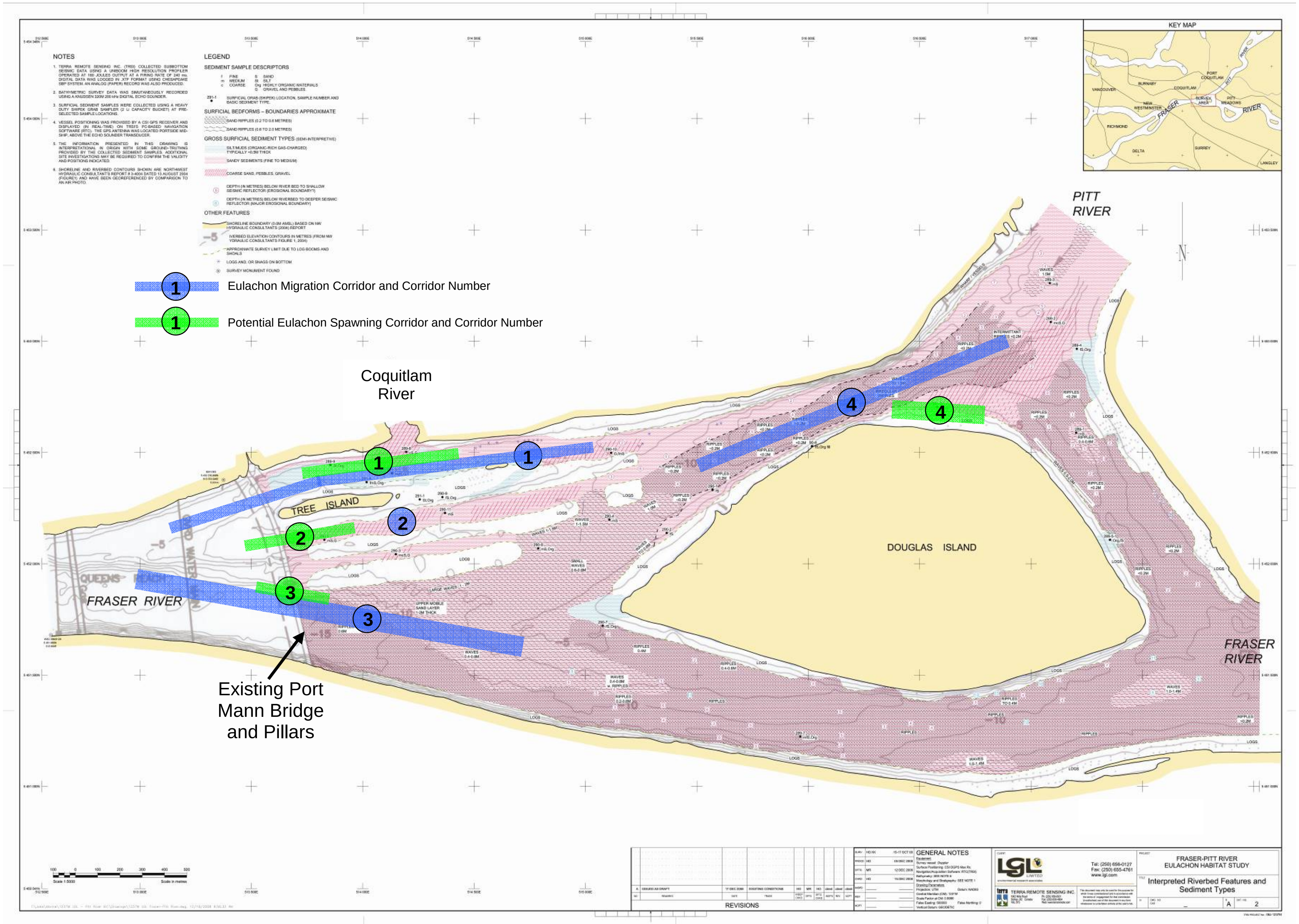

Figure 23: Map of eulachon migration corridors in blue and eulachon spawning corridors in green in the Fraser River adjacent to the Port Mann Bridge.

Table 2: Summary table for the substrate composition, bottom morphology, depth and current speed for eulachon migration and spawning corridors shown in Figure 23

Location Type & Number	Site Name & Description	Substrate Composition	Bottom Morphology	Depth	Current Speed
Eulachon Migration Corridor 1	Side Channel Coquitlam River to Boat Ramp	Silt in main channel, fine-medium sand close to shore & coarse sand & pebbles in the Coquitlam R. mouth	Flat bottom main channel gradually sloping towards shore, no sand ripples or waves	5-6m in main channel	Tide dependent between 0.6- 0 m/s in main channel
Eulachon Migration Corridor 2	Side Channel South of Tree Island	Fine, medium & coarse sand with small patches of pebbles	Flat bottom main channel gradually sloping towards shore, no sand ripples or waves	5-7m in main channel	Tide dependent between 0.7 - 0 m/s in main channel
Eulachon Migration Corridor 3	Port Mann Central Channel North Pillar	Fine-medium sand in an upper mobile sand layer	Sand layer in ripples (<0.6m) & waves (<2m)	10-20m in main channel	Tide dependent between 1.2 - 0 m/s in main channel
Eulachon Migration Corridor 4	Side Channel to Mouth of Pitt River	Fine-medium sand in an upper mobile layer	Sand layer in ripples (<0.6m) on east end & waves (<2m) on west end	10-15m in main channel	Tide dependent between 0.7 - 0 m/s in main channel
Eulachon Spawning Corridor 1	Side Channel Coquitlam River	Fine-medium sand and pebbles in the Coquitlam R, mouth	Flat bottom main channel gradually sloping towards shore, no sand ripples or waves	5-6m in main channel	Tide dependent between 0.6 - 0 m/s in main channel
Eulachon Spawning Corridor 2	Side Channel South of Tree Island	Fine, medium & coarse sand with small patches of pebbles	Flat bottom main channel gradually sloping towards shore, no sand ripples or waves	5-7m in main channel	Tide dependent between 0.7 - 0 m/s in main channel
Eulachon Spawning Corridor 3	Port Mann Central Channel North Pillar Close	Fine-medium sand	Bottom steeply sloping to a plateau around the pillar	10m in channel-5m on plateau	Tide dependent between 0.7 - 0 m/s turbulent around pillar
Eulachon Spawning Corridor 4	Douglas Island North Tip Close	Medium-coarse sand & pebbles	Plateau gently rising towards Douglas Island shore	5-7m on plateau	Tide dependent between 0.3 - 0 m/s on plateau

In contrast, the eulachon spawning corridors (green lines in Figure 23) had common features. All spawning corridors displayed fine-medium and coarse sands interlaced with pebbles, depth between 5-10m and lower maximum current speeds between 0.3-0.7m/s. Upper mobile sand layers that form ripples or waves of >2m height and bottom substrate composed of silt, mud and organics do not appear to be used for spawning.

4. Discussion

4.1. Seismic Profiling and Substrate Sampling

In the main current channels of the Fraser in the vicinity of the Port Mann Bridge a mobile sand layer has built regular ripples of 0.3-0.6m height and waves of up to 2m in height (Figure 23). This type of bottom morphology is typical for high current areas with a mobile sand layer. Fish migrate along the bottom in these areas from one vertical back eddy to the next but the mobile sand layer disqualifies this type of substrate for spawning of fish that attach their eggs to the bottom, such as eulachon. Nevertheless, the slower parts of the main current channels are used by eulachon for migration. Adjacent to the Port Mann Bridge, eulachon were found to preferably migrate along the northern pillar on the main channel.

The seismic profiling and substrate sampling also pointed to potential eulachon spawning areas by identifying areas of medium to slow maximum current speeds without a mobile sand layer and instead covered by fine-medium and coarse sands interlaced with pebbles and gravel. Examples of such areas are the shores of the side channel north of Tree Island and south of the Coquitlam River mouth, the channel directly south of Tree Island, the area at the northern shore of Douglas Island and the area leading towards the northern pillar of the Port Mann Bridge in the Fraser main channel. The detailed bottom morphology and substrate composition of the aforementioned areas can be found in Table 1 and Table 2 and in Figure 23.

4.2. Eulachon Catch by Date

From 1995 to 2005 the DFO carried out an eulachon test fishery in the lower Fraser at New Westminster. Thus it is known that the Fraser eulachon run starts at the end of March, peaks around the third week of April, remains at a higher level until the second week of May and ends in the third week of May (Figure 24).

No eulachon were caught in a variety of locations on April 6-8, 2009 although the historical data shows that smaller numbers of eulachon will have entered the river at this date in a normal year. Three reasons could explain this lack of fishing success, either the 2009 Fraser eulachon run was fairly small, it was late, or the wrong equipment was used in the wrong locations. Since eulachon were caught in the same locations and with the same nets later in the season as part of this study, its is assumed that the 2009 run was either late or small. By June 24, at the time when this report was written, DFO (Bruce McCarter personal comm.) had analyzed part of their annual Spawning Stock Biomass sampling and it appears that the 2009 eulachon run was indeed small (although slightly larger than the very low return in 2008). The question of the 2009 eulachon run timing can not be answered yet and warrants the temporal analysis of the Spawning Stock Biomass results.

On April 18-20, 2009 our total catch and our catch per unit effort (CPUE) peaked as it did in the 1995-2005 test fishery (Figure 14, Figure 15 and Figure 24). The total catch and the CPUE remained stable but on a lower level for the May 4 and May 5, 2009 dates (Figure 14, Figure 15).

As an additional observation, it was noticed that eulachon appeared to be caught in the lower part of the net and deeper part of the river early in the season and in shallower parts and higher in the net later in the season.

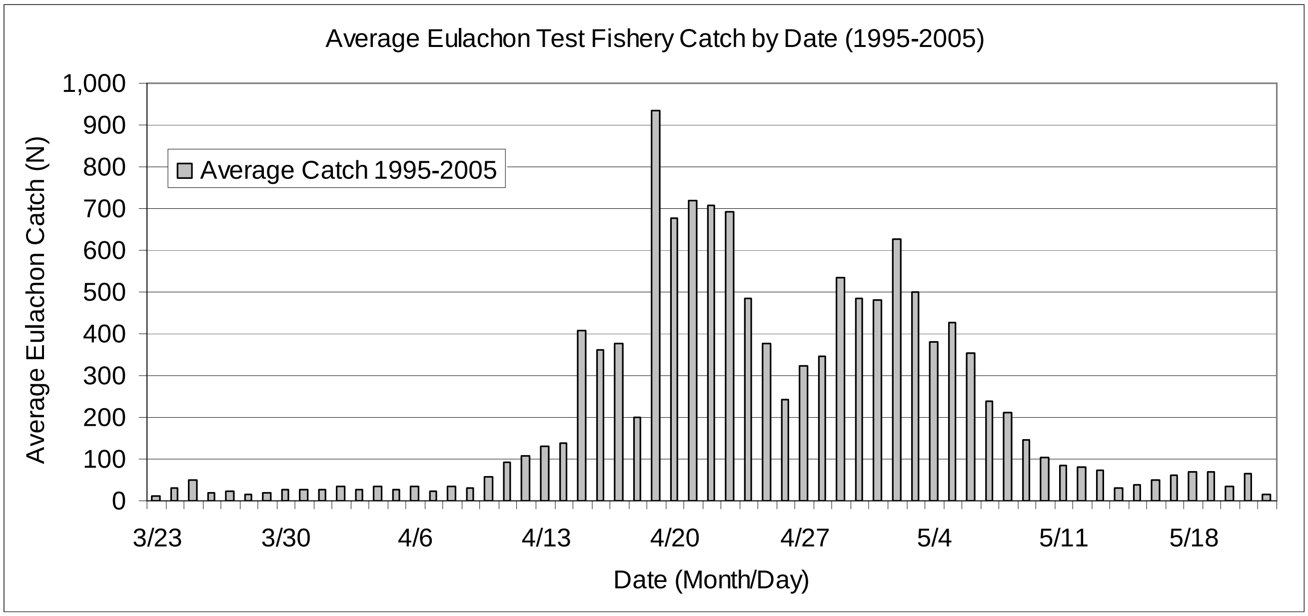

Figure 24: 1995-2005 average eulachon test fishery catch by date (data from: http://www.pac.dfo-mpo.gc.ca/fraserriver/eulachon/eulachonreport.pdf)

4.3. Eulachon Catch by Sex and Date

Throughout our fishing dates the percentage of female fish in the catch increased. While the percentage of female eulachon was close to the expected 50% on the first two successful sampling dates on April 18 and 19, the catch on all later dates was strongly biased towards female fish (Figure 16). It can therefore be suggested, that female eulachon in the Fraser River arrive following the male fish and that the peak of the male migration was missed before April 18th. Alternatively, the Fraser eulachon stocks are biased towards female fish, which could be explained by a selective harvest of male fish somewhere else or our sample size was simply too small to show an unbiased sex ratio.

4.4. Eulachon Catch by Location

Not all chosen locations produced the same catch of eulachon. In the central channel of the Fraser under the Port Mann Bridge, catches of eulachon were higher on its slightly slower and shallower north bank than on its slightly faster and deeper south bank (Figure 23). In particular, the location very close to the north pillar of the main channel produced a high number of immature, likely migrating, as well as mature, likely spawning fish. Other good producers were the side channels north and south of Tree Island and the North tip of Douglas Island on May 5. No fish were caught in the center of the channel north of Douglas Island that leads to the Pitt River.

Eulachon appear to be avoiding areas of high current (>0.7m/s maximum current speed) and depth (<12m) and areas that display a rippled or wavy bottom morphology built by a mobile sand layer. Eulachon can be mainly found to migrate and spawn in areas along edges of between 12-5m depth, current velocities <0.7m/s and a bottom morphology that is not overlain by a mobile sand layer.

4.5. Eulachon Length and Weight Frequencies

Neither the weight nor the length frequency distribution of eulachon in our catch sample (n = 278) showed clear age classed but this could be expained by the relatively low sample size. A larger sample size would be needed to show strong age class peaks. Nevertheless, three weak peaks can be seen within the weight as well as the length distribution for combined sexes and for the distributions of female and male fish separated. Three age classes of spawners have been observed in the Fraser and elsewhere (Hay et al. 2003) based on length frequency distribution of spawning and ocean rearing fish. The three age classes may represent two, three and four year old fish. These spawner age classes have been observed to spawn in the Fraser and other rivers before (Hay and Carter 2000 and Hay et al. 2003). The differences in average weight and length between male and female fish observed in this study is not significant and in general sex specific differences in length or weight have not been observed in past studies in the Fraser or in other river systems (Hay and McCarter 2000).

4.6. State of Maturity by Location

Based on the presence of immature or "firm" eulachon on the April 18-20 but less so on the May 4-5 sampling dates, it can be assumed that the area adjacent to the Port Mann Bridge is used for eulachon migration of fish that are spawning above the bridge. The presence of mature or "running" fish, in close proximity to the bridge pillar indicate that eulachon are spawning directly under the bridge and adjacent to the pillar. Other likely spawning locations are the north shore of Douglas Island, the northern part of the main channel of the Fraser River under the Port Mann Bridge and the Fraser side channels south and north (Coquitlam River mouth) of Tree Island directly upstream of the bridge. The spawning act of eulachon has been described to be lasting for a few hours (Hay and McCarter 2000). Thus, the capture sites of eulachon that are releasing eggs or sperm when they are caught must be close to spawning sites. This is especially true for locations where spawning fish are consistently caught for several hours in a row such as close to the north pillar of the Port Mann Bridge in the Fraser main channel on April 19 and the north shore of Douglas Island on May 5, 2009.

4.7. Eulachon Spawning Habitat Locations

The features of locations where spawning eulachon were caught show similarities in substrate composition, bottom morphology and maximum current speed. In general, current speed in the lower Fraser is highly dependent on the size of the tides and flow. Large tides can occasionally cause the river to flow "upstream" at the Port Mann Bridge and current speed is constantly increasing on the outgoing tide and decreasing on the incoming tide. Therefore the maximum current speed that was observed in the eight day period of this study is probably quite different during other times of the year when flows are different and during different tidal cycles. Regardless, eulachon seem to prefer areas of relatively slow current (<0.6m/s maximum current speed), on quite plateaus or along edges that are composed of stable fine-medium and coarse sand and pebbles and gravel in depths of less then 7m.

4.8. Eulachon Spawning and Migration Corridors

Based on our eulachon catch data, it can be concluded that most of the Fraser River underneath the Port Mann Bridge is used for eulachon migration and it is unknown what effect pile driving and other construction activities for the Port Mann Bridge extension would have on eulachon migration. Therefore, the construction activity within the water should be avoided from April 1st to May 15th. Areas of special concern that are within the footprint of the expanded Port Mann Bridge are the potential eulachon spawning corridors along the north pillar of the Fraser main channel and the side channels north and south of Tree Island that are both ending under the Port Mann Bridge. These areas may also be made either permanently or temporarily unsuitable for eulachon spawning and mitigative measures should be considered as part of the Port Mann Bridge Environmental Assessment Certificate process.

5. Recommendations

Fraser River eulachon are close to all time low numbers and likely at a level that is several orders of magnitude below the former eulachon carrying capacity for the system. Details of the Fraser eulachon run are nevertheless largely unknown. Stock assessment information on eulachon in-river behaviour and preferred spawning and migration corridors are significant data gaps. The following recommendations are suggested to improve understanding of Fraser River eulachon:

1. The continuation of the DFO managed “Spawning Stock Biomass” sampling of eulachon larvae and eggs;
2. The re-start of the DFO managed New Westminster eulachon test fishery terminated in 2005;
3. An expanded lower Fraser River study to find and describe the main eulachon migration and spawning corridors;
4. The confirmation of spawning locations by sampling eggs at potential spawning locations with an epibenthic sled as shown in Figure 25;

Figure 25: Epibenthic sled that can be used to slide along the bottom and sample the upper layer of sediment and all zoo fauna.

5. An assessment of the effect of log booming on eulachon migration and especially spawning corridors; and
6. The development of a habitat based carrying capacity model for Fraser River eulachon.

Ultimately, the preservation of Fraser River eulachon will depend on the identification and establishment of eulachon migration and spawning corridor protected areas.

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