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March 19, 2010

Natalie Bandringa
Esquimalt Lagoon Stewardship Coordinator
Capital Regional District
625 Fisgard St, PO Box 1000
Victoria BC V8W 2S6

Dear Natalie,

Re: Data Report for the Forage Fish Survey and the Beach Profiling at Esquimalt Lagoon; P.O. #200068972 and P.O. #200073028

Below is a data report summarizing the objectives, methods and results for 1.0) the forage fish survey and 2.0) the beach profiling conducted at Esquimalt Lagoon between November 2009 and March 2010.

1.0 FORAGE FISH SURVEY

1.1 OBJECTIVES

- To assess the suitability for forage fish (Pacific sand lance (*Ammodytes hexapterus*) and Pacific surf smelt (*Hypomesus pretiosus*)) beach spawn habitat in the intertidal zone at Esquimalt Lagoon,
- To collect and examine sediment from the upper intertidal zone for presence of forage fish eggs at suitable beach spawn sites at Esquimalt Lagoon, and,
- To provide a data summary report that includes the methods and results of the forage fish survey at Esquimalt Lagoon.

1.2 METHODS

Following a desktop review of the intertidal habitats in Esquimalt Lagoon, twelve locations were selected as potential forage fish sample sites; three on the ocean side of Coburg Peninsula, three at the mouth of Esquimalt Lagoon, three along the lagoon side of Coburg Peninsula and three along the northwest shoreline of the lagoon in the vicinity of the rowing club. On November 26, 2009 a biologist from Archipelago conducted a field visit to Esquimalt Lagoon to confirm which sites were suitable for forage fish beach spawn sampling. Although the six locations within the lagoon were not suitable due to a higher content of fines in the upper intertidal zone, habitat suitable for sampling was confirmed at nine locations, five along the ocean side of Coburg Peninsula and four at the mouth of Esquimalt Lagoon (Figure 1.1).

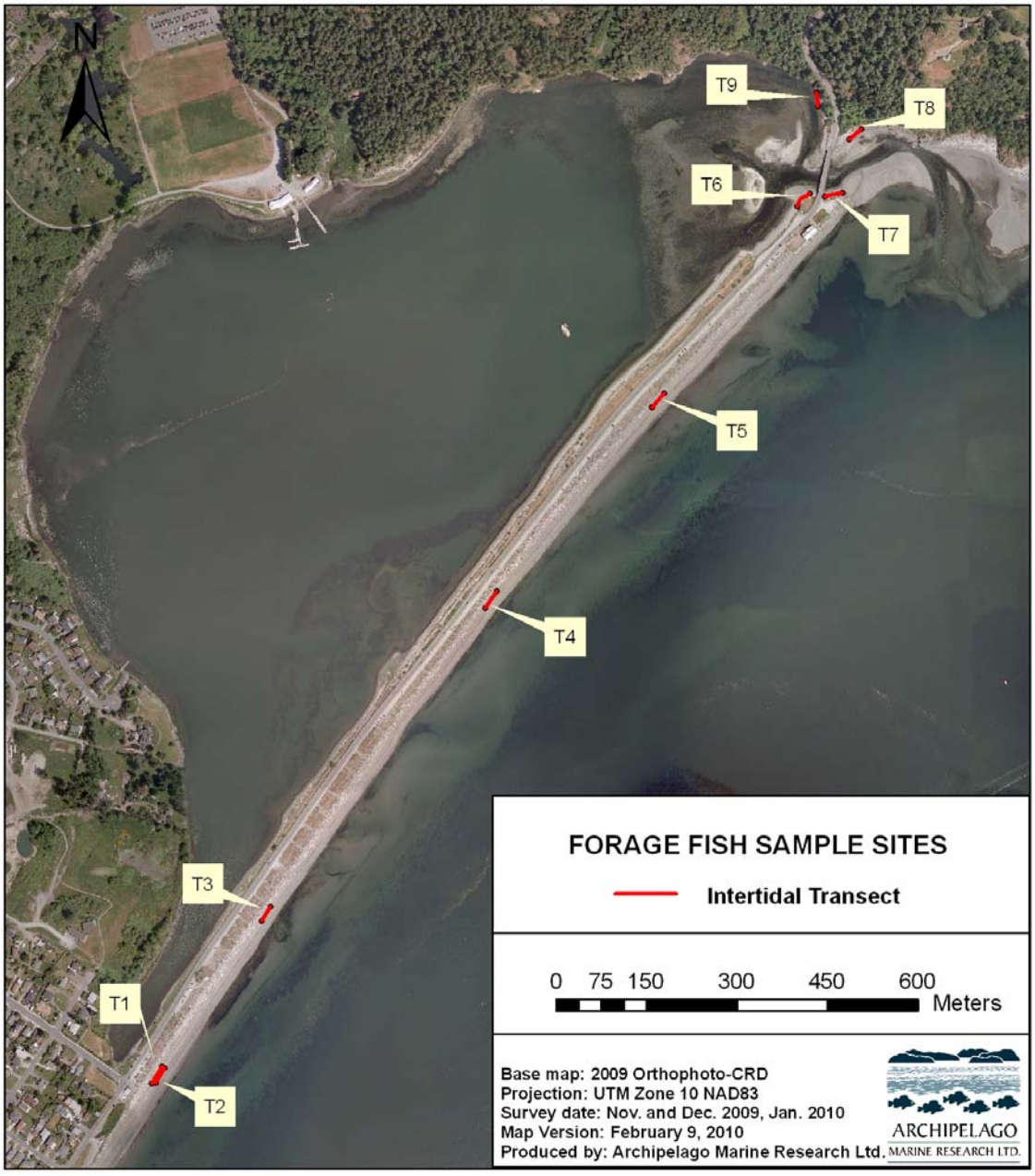


Figure 1.1. Forage fish beach spawn sample sites along Coburg Peninsula and at the mouth of Esquimalt Lagoon

Sediment samples were collected from each of the sample sites on November 27 and 28, 2009, December 15 and 16, 2009 and January 25, 2010. A 30m transect was laid parallel to the shoreline within the upper intertidal zone (Photo A). A composite beach spawn sample of 2000mL of sediment from the top 2-3 cm of substrate within 2.5m on either side of the transect was collected. Each composite sample was then stored at a cool temperature and sieved (using fresh water) through graduated screens (4mm, 2mm, 0.5mm) (Photo B). The 0.5m fraction was retained for examination of eggs using a winnowing technique that involves swirling sediment with a cover of water to bring the lighter fraction to the surface. This fraction would have included any beach spawner eggs, which adhere to sand grains and fragments of shell.

All the samples collected in November 2009 and January 2010 were processed and examined for eggs within six days of the collection. Sediment samples collected in December 2009 were processed and preserved for egg examination in March 2010.


A


B

1.3 RESULTS

Table 1 provides the transect coordinates for the start and end of each 30m. Transect 1 and Transect 2 were located 6m from each other at the beach profile site 1 as shown in Appendix Figure 1. Table 2 summarizes the sample and processing activity from November 26, 2009 to March 19, 2010.

Table 1. Transect coordinates (start and end) for the forage fish sample sites.

Transect #	Start		End	
	Northing	Easting	Northing	Easting
T1	5362771.119	465086.849	5362799.292	465103.712
T2	5362772.293	465092.698	5362796.825	465107.951
T3	5363041.120	465268.825	5363064.541	465282.700
T4	5363559.994	465639.674	5363587.648	465657.973
T5	5363916.515	465935.870	5363892.749	465915.307
T6	5364247.011	466177.129	5364225.994	466156.350
T7	5364242.622	466202.166	5364249.128	466231.409
T8	5364337.493	466242.036	5364353.750	466262.700
T9	5364415.395	466188.669	5364392.371	466190.503

Table 2. Summary of the beach spawn sediment sample and processing activities between November 2009 and March 2010.

Date	Activity	Tide Height
November 26, 2009	Confirm suitable forage fish sample sites	Ebbing tide; 2.20 to 1.70mCD
November 27 and 28, 2009	Collect sediment samples	Ebbing tide; 2.20m to 1.30mCD
December 2 - 4, 2009	Process sediment samples and examine for egg presence	na
December 15 and 16, 2009	Collect sediment samples	Ebbing tide; 2.40 to 1.50mCD
December 17 and 18, 2009	Process and preserve sediment samples for egg examination in March 2010	na
January 25, 2010	Collect sediment samples	Ebbing tide; 2.10 to 0.60mCD
January 28 – February 1, 2010	Process sediment samples and examine for egg presence	na
March 15-19, 2010	Process preserved sediment samples from December and examine for egg presence	na

During the three month sample period, a total of 27 sediment samples at nine locations were collected within the upper intertidal zone. Representative photographs from each site are shown in Figure 1.2 below.

Figure 1.2. Photographs of beach spawn sample sites. **Left: T1** November 2009; Right: close view of substrate at T1.

Figure 1.2 continued. **Top left: T2** November 2009; Top right: close view of substrate at T2. **Middle left: T3** January 2010; Middle right: close view of substrate at T3. **Bottom left: T4** January 2010; Bottom right: close view of substrate at T4.

Figure 1.2 continued. **Top left: T5** December 2009; Top right: close view of substrate at T5. **Middle left: T6** January 2010; Middle right: close view of substrate at T6. **Bottom left: T7** January 2010; Bottom right: close view of substrate at T7.

Figure 1.2 continued. **Top left: T8** January 2010; Top right: close view of substrate at T8. **Bottom left: T9** January 2010; Bottom right: close view of substrate at T9.

No eggs were found in any of the samples. Suitable substrate for forage fish (*A. hexapterus* and *H. pretiosus*) beach spawn exists at all of the locations (sand lance spawn on pure sand and a mixture of sand and fine gravel with very few fines similar to surf smelt). The composite samples from T1 to T5 contained material of similar grain size comprised of predominantly medium to coarse sand with some small pebble. The substrate along T6 – T8 was comprised of fine to medium sand with higher pebble content. Shell hash was present at T6 along with some organics including small wood fibre. The substrate at T9 was a mixture of fine to coarse sand and shell hash, with a higher percentage of wood fibre and organics than at T6. The amount of fines at T6, T7 and T9 varied between November and January making these sites less suitable on a consistent basis.

Summary

- Although no forage fish eggs were found as a result of this survey, given suitable habitat exits along the ocean side of Coburg Peninsula, it is recommended a beach be sampled at least twice (between November – January for sand lance and winter surf smelt and between June – August for surf smelt) before determining whether it may be intertidal spawning habitat

- Sand lance and surf smelt beach spawn was documented in the vicinity of the sample sites at the end of December 2009 (B. Mitchell pers comm. 2010) and young of the year sand lance have been documented using the lower intertidal and shallow subtidal substrate in Esquimalt Harbour north of the Lighthouse in the late fall of 2009 (G. Lemieux pers. comm. 2009) indicating these species are present near and at Esquimalt Lagoon.

- Given the ocean side of Coburg Peninsula is a semi exposed shoreline, it is very likely that intertidal spawn would be dispersed rapidly (e.g., fresh spawn density may reach 200+ eggs/g of beach material, commonly reduced to <1 egg/gram during incubation for a more protected shoreline) following major storm events (e.g., January 18 and 24, 2010), and therefore it is more difficult to locate eggs in the upper intertidal zone following such events.

- Recommend that future sampling effort could be reduced to four or five sites including T1, T4, T5 and T8 with an additional sample added on the outside of the spit directly south of T7.

2.0 BEACH PROFILES

2.1 OBJECTIVES

- To collect physical beach profile information from 10 previously surveyed transects along Coburg Peninsula
- To locate and/or replace the permanent markers for the 10 transects, and,
- To provide a summary of transect information graphically (across shore beach profiles) and in tabular format (detailed transect information and transect locations).

2.2 METHODS

On February 22 and 23, 2010 a biologist from Archipelago Marine Research Ltd. and a volunteer collected physical information (distance from baseline, elevation and substrate) from ten across shore transects along the Coburg Peninsula (Figure 2.1; Table 1). Beach profile information was collected on the lagoon side and the ocean side of Coburg Peninsula. The transects were located using GPS co-ordinates from a previous survey (Bein 2005; Table 6, Section 2.3) that were entered into a hand-held Garmin Map 76 GPS and were verified using aerial photographs. Old tags marking the start of each transect were located when possible and replaced with new tags (Table 2, Photo 1).

Each transect was aligned perpendicular to the shoreline using a metered tape. Transects started at the edge of the road on the lagoon side of Coburg Peninsula and spanned the backshore and intertidal zone to the waterline of Esquimalt Lagoon (Table 2, Photo 2). Starting at the same point at the edge of the road on the lagoon side, the transect spanned across the road in a seaward direction, through the dune grass restoration area and across the beach to the waterline on the ocean side of Coburg Peninsula (Table 2, Photo 3, 4). The slope distance and vertical elevation were measured at every major change in vegetation and/or substrate type along each transect. Slope distance was measured using the metered transect tape and vertical elevations were measured using a hand held level and a surveyor's rod. The time at the waterline was recorded for each transect. The vertical elevations were then corrected relative to chart datum using tidal prediction software for Esquimalt (Tides and Currents Pro. Ver 3.0). General observations of substrate and biota were documented for each interval of the transect. Across shore profiles showing the vertical elevation and horizontal distance of each transect were produced.

Table 1: Beach Profile Survey Details

Survey Location	Survey Date	Transects
Coburg Peninsula	February 22, 2010	1-6
Coburg Peninsula	February 23, 2010	7-10

Figure 2.1. Across shore beach profile locations along the Coburg Peninsula at Esquimalt Lagoon.

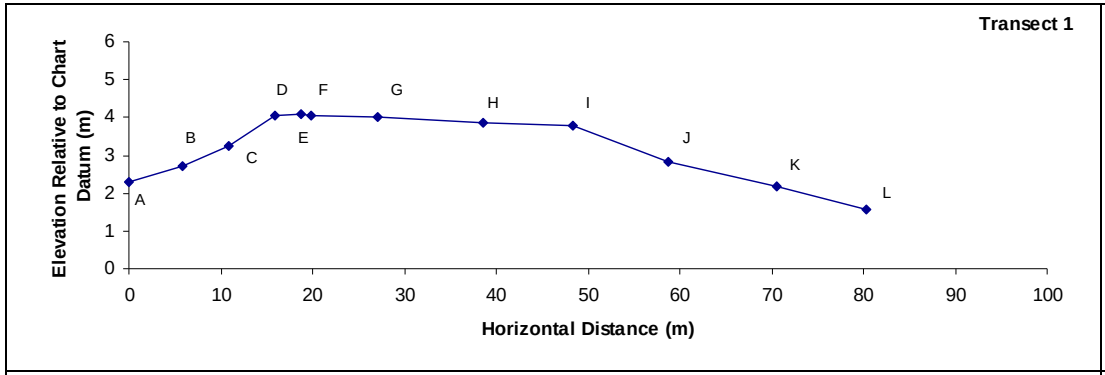
Table 2: Beach profile images.

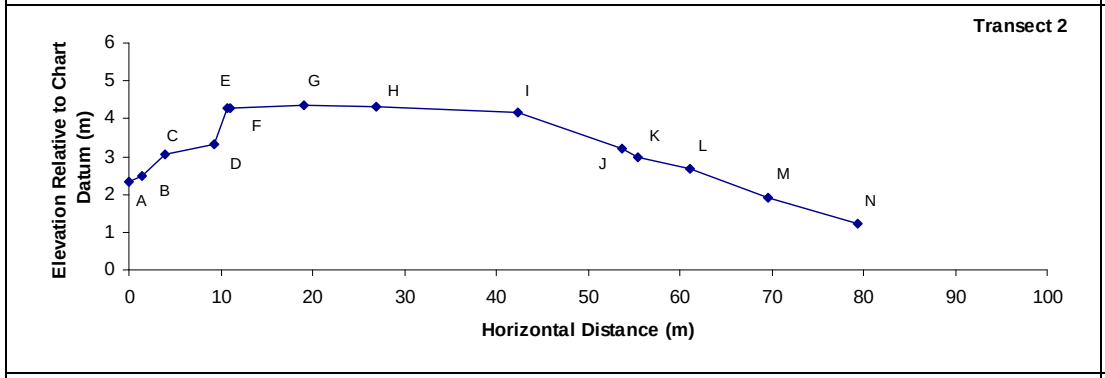
	
Photo 1: Example of new transect marker (nail and washer) placed in a log located along the shoreward side of the dune restoration area	Photo 2: Transect on the lagoon side of Coburg Peninsula taken from the waterline facing the road
	
Photo 3: Transect spanning through the dune grass restoration area on the ocean side of Coburg Peninsula	Photo 4: Transect through the bare beach on the ocean side of Coburg Peninsula.

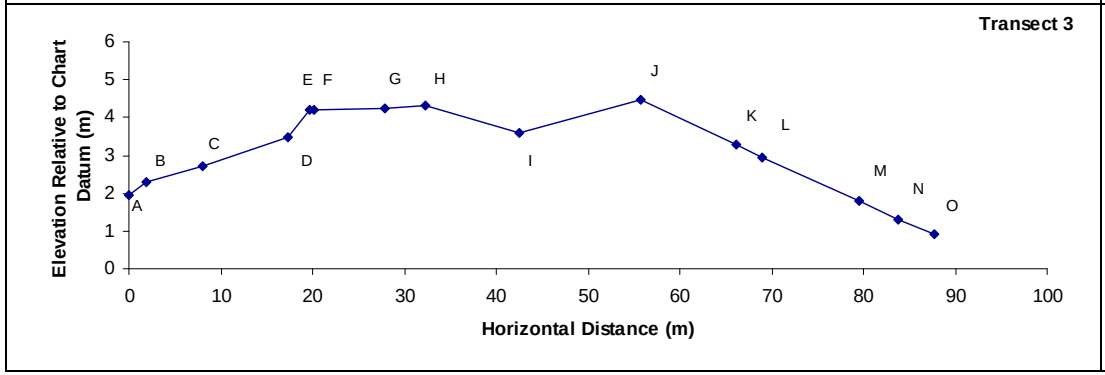
2.3 RESULTS

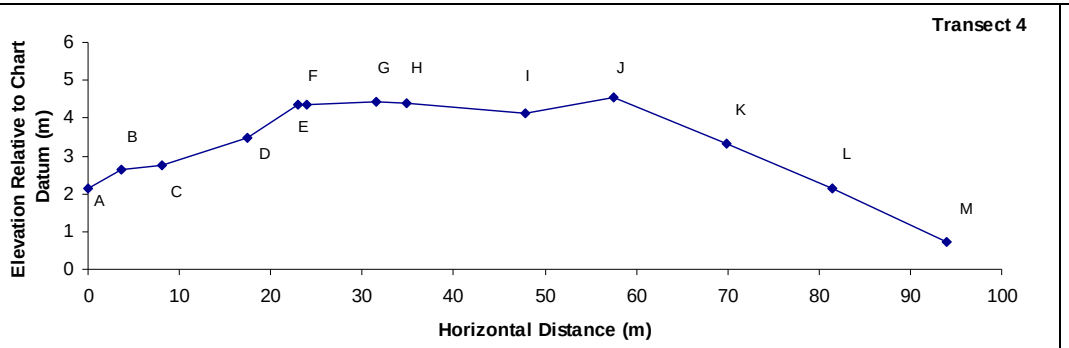
Table 3 shows an across shore profile and a representative photograph for each of the 10 transects. Each transect starts at the waterline on the lagoon side (A) of Coburg Peninsula and ends at the waterline on the ocean side of Coburg Peninsula. Table 4 provides a summary of the transect information with letters corresponding to the start of each interval. Table 5 outlines the sediment size catagories and sediment codes used in Table 4. Table 6 are the transect locations in UTMs.

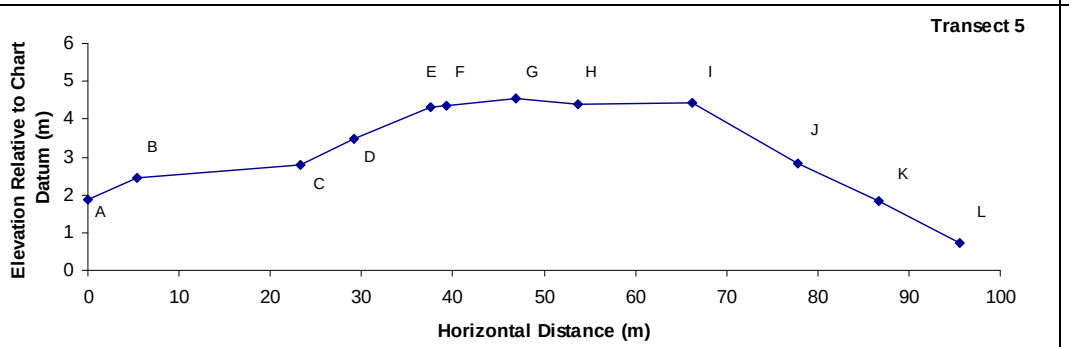
Table 3: Coburg Peninsula Beach Profiles

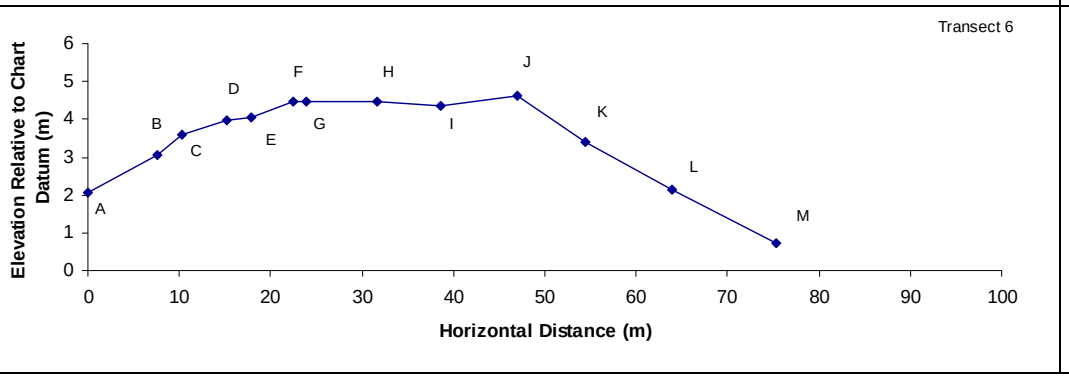


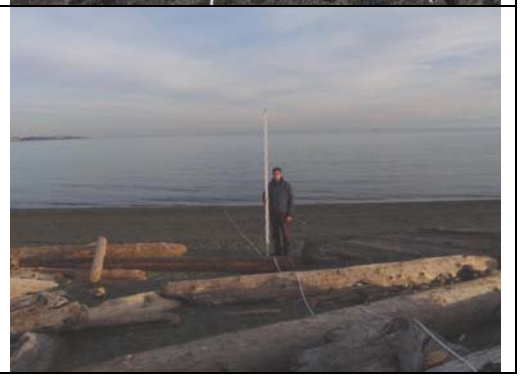


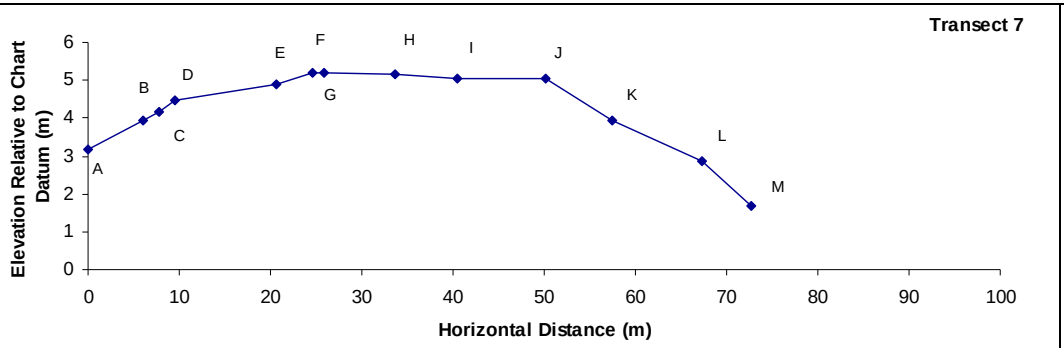


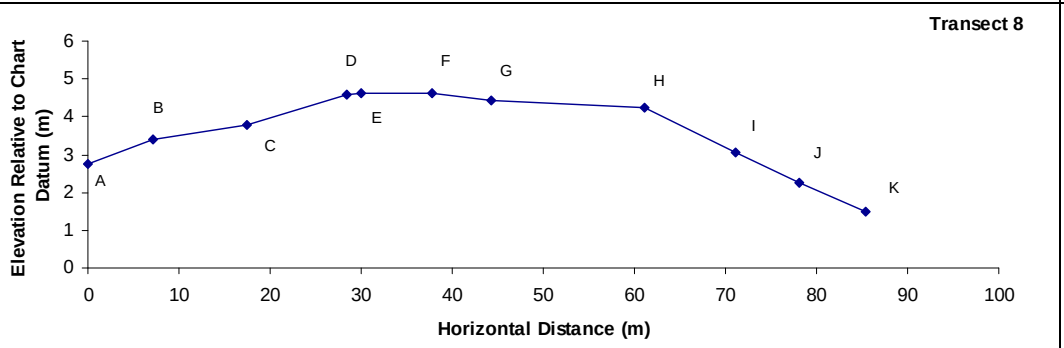

Transect 4
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
F
G
H
I
J
K
L
M

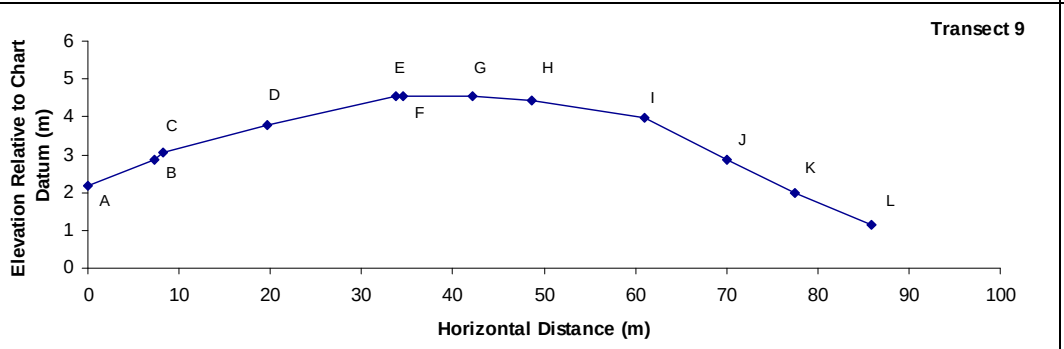

Transect 5
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
F
G
H
I
J
K
L


Transect 6
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
F
G
H
I
J
K
L
M




Transect 7
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
F
G
H
I
J
K
L
M


Transect 8
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
F
G
H
I
J
K


Transect 9
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
F
G
H
I
J
K
L

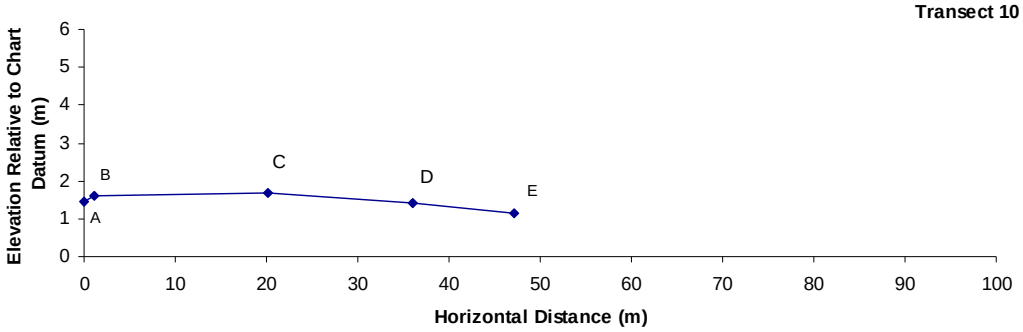

Transect 10
Elevation Relative to Chart Datum (m)
Horizontal Distance (m)
A
B
C
D
E
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
80
90
100

Table 4: Beach profile data by transect (horizontal distance is cumulative; WL = waterline).

Point	Horizontal Distance (m)	Vertical Elevation Relative to Chart Datum (m)	Interval	Substrate	Notes
Transect 1					
A	0.0	2.30	-	-	-
B	5.9	2.71	**AB**	m	Bare beach with logs
C	10.9	3.24	**BC**	soil, s	Mixed grasses: Dune grass, gum weed
D	16.0	4.07	**CD**	soil, s	Mixed grasses: Dune grass, gum weed
E	18.8	4.08	**DE**	s,soil	Low turf grass
F	19.9	4.07	**EF**	s,p	Road shoulder
G	27.1	4.02	**FG**	pavement	Road
H	38.7	3.87	**GH**	g,p,s	Road shoulder
I	48.4	3.77	**HI**	s,p	Dune grass restoration area
J	58.8	2.82	**IJ**	s,c	Log line
K	70.5	2.16	**JK**	s,p,c	Bare sand beach
L	80.4	1.57	**KL**	c,p,s,g	Bare cobble beach, WL @ 12:21
Transect 2					
A	0.0	2.34	-	-	-
B	1.5	2.50	**AB**	p,g,s,sh	Bare beach
C	3.9	3.05	**BC**	p,g,s,sh	*Salicornia*
D	9.2	3.34	**CD**	soil,s	Dune grass, gum weed
E	10.6	4.28	**DE**	soil,s	Dune grass, gum weed
F	11.1	4.28	**EF**	g,s	Road shoulder
G	19.1	4.37	**FG**	pavement	Road
H	27.0	4.31	**GH**	g,p,s	Road shoulder
I	42.3	4.16	**HI**	s,g	Dune grass restoration area
J	53.7	3.20	**IJ**	s	Log line
K	55.5	2.99	**JK**	s	Bare sand beach
L	61.2	2.66	**KL**	p,c,g,s	Bare granule, pebble beach
M	69.6	1.92	**LM**	s,g,c,p	Bare sand beach
N	79.4	1.22	**MN**	c,p,s,g	Bare cobble beach, WL @ 13:44
Transect 3					
A	0.0	1.95	-	-	-
B	2.0	2.31	**AB**	c,p/c,s	Bare beach
C	8.1	2.72	**BC**	soil,s	*Salicornia*
D	17.4	3.46	**CD**	soil,s	Mixed grasses: Dune grass, gum weed
E	19.6	4.19	**DE**	soil,g,s	Low turf grass
F	20.1	4.19	**EF**	g,s	Road shoulder
G	27.9	4.26	**FG**	pavement	Road
H	32.2	4.31	**GH**	p,g,s	Road shoulder
I	42.6	3.58	**HI**	s,g	Dune grass restoration area
J	55.8	4.46	**IJ**	s,g	Dune grass restoration area
K	66.1	3.27	**JK**	s	Log line
L	69.0	2.96	**KL**	s,p	Bare sand beach
M	79.5	1.80	**LM**	c,p,s	Bare cobble beach
N	83.8	1.31	**MN**	p,s,c	Bare granule, pebble beach
O	87.8	0.92	**NO**	c,p,g,s	Bare cobble beach, WL @ 14:35

Point	Horizontal Distance (m)	Vertical Elevation Relative to Chart Datum (m)	Interval	Substrate	Notes
Transect 4					
A	0.0	2.13	-	-	-
B	3.6	2.62	**AB**	p,c,g,s	Bare pebble beach
C	8.1	2.77	**BC**	soil,s	*Salicornia*
D	17.4	3.46	**CD**	soil,s	Mixed grasses
E	23.0	4.35	**DE**	soil,s	Low turf grasses and shrubs
F	24.0	4.35	**EF**	g,s	Road shoulder
G	31.6	4.42	**FG**	pavement	Road
H	34.8	4.41	**GH**	g,s	Road shoulder
I	47.9	4.13	**HI**	s,soil	Dune grass restoration area
J	57.6	4.56	**IJ**	s,g,soil	Dune grass restoration area
K	69.8	3.32	**JK**	s,g,soil	Log line
L	81.5	2.13	**KL**	s,g	Bare sand beach
M	93.9	0.74	**LM**	s,g,p	Bare sand beach, WL @ 15:19
Transect 5					
A	0.0	1.87	-	-	-
B	5.4	2.46	**AB**	c,p,g,s	Bare beach
C	23.4	2.80	**BC**	soil,c,p,s	*Salicornia*
D	29.2	3.47	**CD**	c,p,s	Mixed grass and logs
E	37.6	4.31	**DE**	c,p,s	Low turf grass
F	39.3	4.34	**EF**	g,p,s	Road shoulder
G	46.9	4.53	**FG**	pavement	Road
H	53.8	4.39	**GH**	g,p,s	Road shoulder
I	66.3	4.44	**HI**	s,g,p	Dune grass restoration area
J	77.9	2.82	**IJ**	s,g	Log line
K	86.6	1.82	**JK**	s,g,p	Bare sand beach
L	95.5	0.71	**KL**	g,s,p	Bare sand beach, WL @ 14:07
Transect 6					
A	0.0	2.06	-	-	-
B	7.5	3.07	**AB**	p,c	Bare beach
C	10.3	3.60	**BC**	soil,p	Grass, logs and low shrubs
D	15.2	3.98	**CD**	soil,p	Grass, shrubs
E	17.9	4.07	**DE**	c,p,soil	Bare
F	22.4	4.48	**EF**	soil,p	Grass and shrubs
G	23.8	4.49	**FG**	g,s,p	Road shoulder
H	31.6	4.46	**GH**	pavement	Road
I	38.5	4.37	**HI**	g,p,s	Road shoulder
J	47.0	4.61	**IJ**	s,g	Dune grass restoration area
K	54.4	3.42	**JK**	s,g	Log line
L	64.0	2.13	**KL**	s,g,p	Bare sand beach
M	75.3	0.71	**LM**	g,s,p	Bare sand beach, WL @ 14:42

Point	Horizontal Distance (m)	Vertical Elevation Relative to Chart Datum (m)	Interval	Substrate	Notes
Transect 7					
A	0.0	3.19	-	-	-
B	6.0	3.93	**AB**	c,p,s	Bare cobble beach
C	7.7	4.16	**BC**	soil,c,p	*Salicornia*
D	9.5	4.47	**CD**	c,p,soil	Grass/gumweed
E	20.7	4.91	**DE**	c,p	Cobble/grass/low shrubs
F	24.6	5.20	**EF**	g,p,s	Low turf grass
G	25.9	5.20	**FG**	g,p,s	Road shoulder
H	33.7	5.15	**GH**	pavement	Road
I	40.5	5.06	**HI**	g,p,s	Road shoulder
J	50.1	5.04	**IJ**	s,g,small wood	Dune grass restoration area
K	57.5	3.93	**JK**	s,g	Log line
L	67.3	2.88	**KL**	s,g,p	Bare sand beach
M	72.7	1.68	**LM**	s,g,p	Bare sand beach, WL @ 13:07
Transect 8					
A	0.0	2.75	-	-	-
B	7.1	3.40	**AB**	p,g,soil	Bare pebble beach
C	17.4	3.77	**BC**	p,g,soil	*Salicornia*
D	28.3	4.60	**CD**	g,p,soil	Low turf grass and shrubs
E	29.9	4.63	**DE**	g,s,p	Road shoulder
F	37.7	4.61	**EF**	pavement	Road
G	44.3	4.44	**FG**	g,p,soil	Road shoulder
H	61.1	4.25	**GH**	soil,s,c,p	Dune grass restoration area
I	71.1	3.07	**HI**	s,g	Log line
J	78.2	2.24	**IJ**	s,g,p	Bare sand beach
K	85.4	1.50	**JK**	s,g,p	Bare sand beach, WL @ 13:43
Transect 9					
A	0.0	2.16	-	-	-
B	7.3	2.87	**AB**	p,sh,c	Bare beach
C	8.2	3.07	**BC**	p,g	*Salicornia*
D	19.7	3.80	**CD**	p,c,g,soil	Shrubs and pebble
E	33.8	4.55	**DE**	soil,g,p,sh	Low turf grass and shrubs
F	34.6	4.55	**EF**	g,s,p	Road shoulder
G	42.1	4.56	**FG**	pavement	Road
H	48.6	4.44	**GH**	g,p,s	Road shoulder
I	61.1	3.98	**HI**	s,g	Dune grass restoration area
J	70.0	2.87	**IJ**	s,p	Log line
K	77.5	2.00	**JK**	s,g,p	Bare sand/granule beach
L	85.9	1.13	**KL**	s,g,p	Bare sand/granule beach, WL @ 14:22
Transect 10					
A	0.0	1.47	-	-	-
B	1.1	1.61	**AB**	p,s,g	Bare pebble/cobble beach
C	20.1	1.70	**BC**	p,c,s,g	Bare pebble/cobble beach
D	36.1	1.40	**CD**	p,c,s,g	Bare pebble/cobble beach
E	47.1	1.13	**DE**	c,p,s,g	Bare pebble/cobble beach, WL@ 14:40

Table 5. Sediment size categories (Modified Wentworth 1922) and substrate codes ().

Sediment Category	Size (intermediate axis)	General Category
(b)oulder	>25.6cm	GRAVEL
(c) obble	6.4 to 25.6cm	
(p)ebble	4mm to 6.4cm	
(g)ranules	2-4mm	
(s)and	0.062 to 2mm	SAND
(m)ud	<0.062mm	MUD
(sh)ell (coarse)	>2mm	ORGANICS

Table 6. Transect coordinates (in UTMs) taken at the markers along the shoreward side of the dune restoration area (see Table 2, Photo 1).

Transect #	Northing	Easting
1	5362783.222	465067.881
2	5362906.809	465147.108
3	5363078.372	465252.651
4	5363208.812	465344.105
5	5363432.703	465516.943
6	5363595.733	465645.274
7	5363764.507	465778.669
8	5363930.219	465917.845
9	5364093.933	466077.203
10	5364260.490	466281.224

If you have any questions, please give us a call.

Sincerely,

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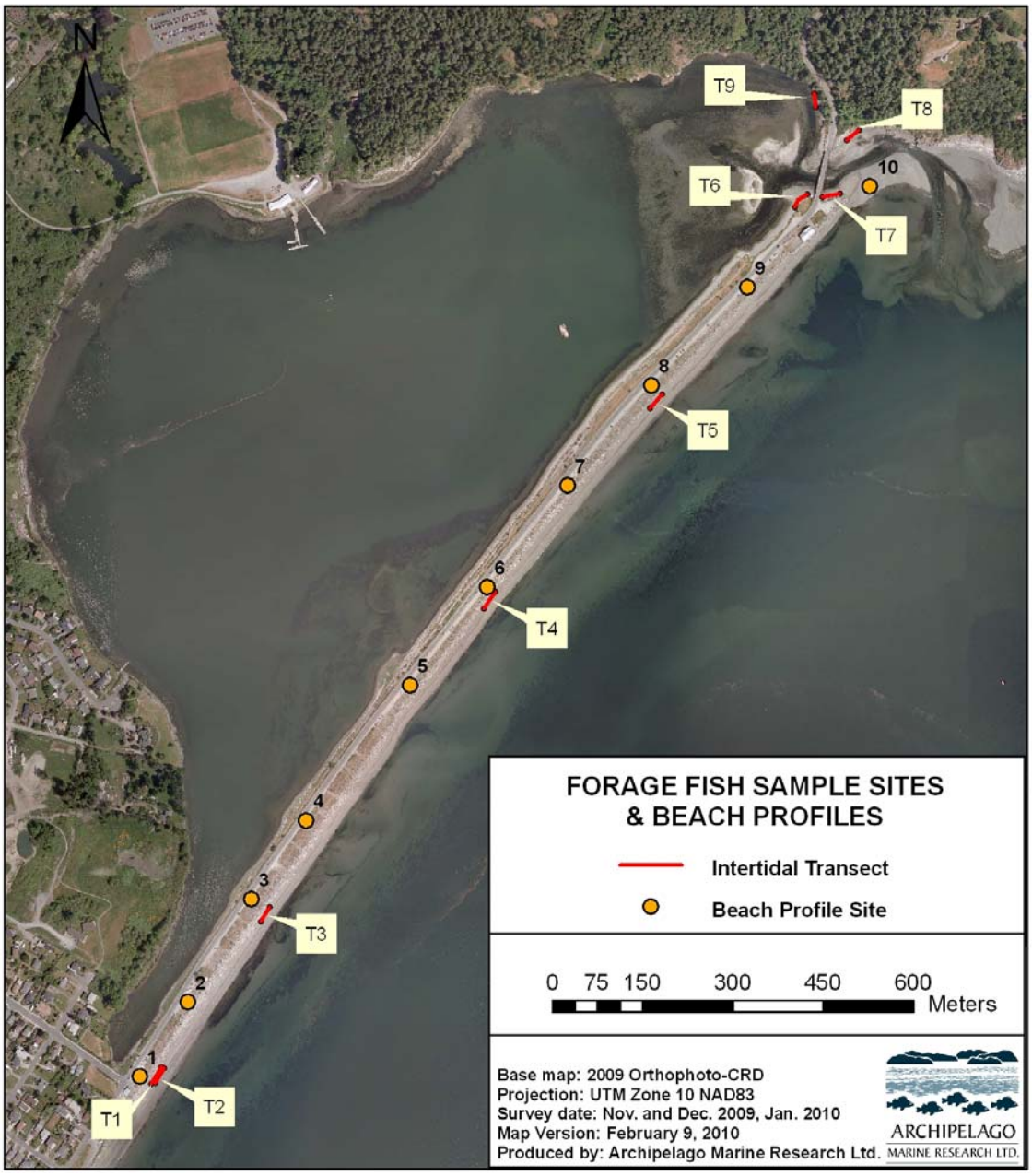

Appendix Figure 1. Location of forage fish sample sites in relation to the beach profiles at Esquimalt Lagoon.