

Juvenile Salmon and Other Species Inhabiting the Mouth of Dry Slough in
Conway, WA in Conjunction with a Tide Gate

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Introduction

Skagit Conservation District (SCD) and the Skagit Fisheries Enhancement Group (SFEG) enter into an agreement conduct work associated with monitoring the presence of juvenile salmonid species in Dry Slough near Conway, Washington. The work is contracted under the Pacific Salmon Fund (PSF) Grant No. SF-2008-H-4 "Dry Slough Estuary Function Restoration Design."

Between March and June of 2008 Skagit Fisheries Enhancement Group (SFEG) and the Skagit Conservation District sampled for fish at the mouth of Dry Slough. A biologist from the Upper Skagit Indian Tribe participated in all the sampling events under sub-contract with SFEG. Contributors from SFEG include Andrew Beckman, Joe George, Jim Johnson, Sacha Johnson, Kyle Koch, Mike McCain, Kevik Rensink, and Perry Welch. Doug Couvelier from Upper Skagit Indian Tribe participated in all events as did Tom Slocum from the Skagit Conservation District.

The site is located in the Skagit River Delta on Fir Island near Conway, Washington, at the mouth of Dry Slough in Dike District 22 where there is a tide gate that regulates flow at the mouth of Dry Slough. The site is accessed through private property off of Mann Road in Section 22, Township 33 and Range 3E (48 19.661; 122.24.197). (See Attachment A Vicinity Map).

On six dates between March 5th and June 5th of 2008 Skagit Fisheries Enhancement Group sampled Dry Slough for juvenile salmon, other species of fish and macroinvertebrates. Sampling methods included beach seining with nets of varying sizes, as well as dip net sampling. The objective of the sampling is to determine species presence of juvenile salmon inhabiting the vicinity of the Dry Slough tide gate during the season of the year when they typically utilize blind slough habitat in the Skagit Delta. Project objectives were to sample downstream and upstream of the tide gate to determine species presence. Sample site locations are shown in Attachment B. Photos are provided in Attachment C. Sampling variables include differing tide conditions such as incoming and outgoing tide and water quality, including dissolved oxygen, temperature, conductivity and salinity.

Fish sampling methods included using beach seine nets. All species collected were tallied and identified by species and all juvenile salmon were measured length-wise and released alive immediately at the site.

Methods

Six sample dates occurred including March 5th, April 3rd, April 24th, May 1st, May 15th and June 5th during the presumed peak migration of juvenile salmon. Estuarine fish sampling methods as detailed by Skagit River System Cooperative (March 2003) were followed. At each date at two sample locations (one above and one below the tide gate), three sets were made. Set methodology is detailed for below and above to gate.

Methodology upstream of the gate had to be adapted in order to get an effective sample given heavy muck conditions. The Sample Site Location Map (Attachment B) shows that the location of the Above Gate sample location changed in order to sample closer to the gate. Downstream of the tide gates was always seined with the large net three times

about 200 feet downstream of the tide gate. One end of the seine was kept stationary at the shoreline and pulled upstream at the other end by rowboat about halfway the length of the net into the channel. It was then pulled upstream and finally back to the stationary end creating a ‘purse’ that encircles the fish. Both ends of the seine were pulled in to retrieve the species caught. The large seine used by SFEG was an 80’ (24.4m) by 6’ (1.8m) by 1/8” (0.3cm) nylon mesh net. The seine location was the same for each sampling event with variation according to flow conditions.

Initially the upstream site was to be seined using the same method with the same net, except it was pulled by hand, rather than by boat. Unfortunately the mud proved to be too deep in order to sample safely and effectively. Therefore other methods were tried such as using a smaller block net seine that is a 21.3’ (6.5m) by 3.6’ (1.1m) by 1/8” (0.3cm) nylon mesh net, which was used in the same fashion as the large seine. The smaller seine was also tried by swiping the surface of the water in the channel and near the shoreline. On the last two sampling dates, May 15 and June 5, the smaller seine was used just upstream to the mouth of the gates.

All species caught were identified, tallied, and immediately released to the water near the sampling location. All salmon species were measured by their total length, in millimeters and promptly released to the water. After all samples were totaled the results were calculated by ‘catch per unit.’ The unit used is time, so each set has been measured by how many species were caught per minute (Table 1).

Results

A total of 9,298 organisms were caught with 172 (1.8%) of those being salmon. The data is included in Attachment D. Of the 9,298 organisms caught, 9,086 (97.7%) of those were found downstream of the tide gate and 212 were caught upstream, or 2.3%. Thirty-nine of the 172 salmon were Chinook (22.7%). Also, of the 39 salmon caught only one was found upstream of the tide gate, and this was a juvenile chinook salmon on June 5th. Total quantity by all organisms is shown on Table 2.

Table 1. Species Caught Per Minute.

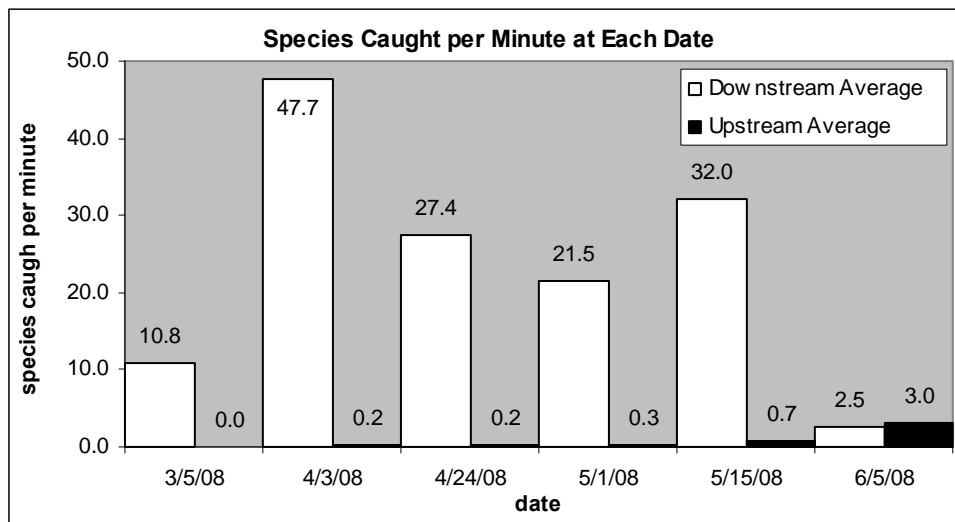


Table 2. Breakdown of Organisms Caught Below and Above the Gate

Organism	Below Gate	Above Gate	Total
Chinook	38	1	39
Chum	118	0	118
Coho	5	0	5
Pink	10	0	10
Shrimp	5392	2	5394
Stickleback	3135	158	3293
sculpin	312	0	312
Isopod	67	1	68
damsfly larvae	1	35	36
dragonfly larvae	0	4	4
Starry flounder	6	0	6
mosquito larvae	0	4	4
snail	0	4	4
diving water beetle	0	1	1
sand lance	1	0	1
shiner	1	0	1
red worm	0	1	1
water boatman	0	1	1
Totals	9086	212	9298

Table 3 provides water quality readings for each sampling event.

Table 3. YSI Readings for Temperature, DO, Conductivity, Salinity

3/5/08

<i>YSI Readings:</i>							
Site	Temperature °C	DO %	DO mg/L	Conductivity µS	Specific Conductivity µS	Salinity ppt	
DS of culvert @ surface	9.4	108.4	12.09	5.33	7.6	4.2	
DS of culvert @ bottom	9.0	115.0	12.89	5.96	8.6	4.8	
US of culvert @ surface	9.0	77.5	8.88	1705.00	2454.0	1.3	
US of culvert @ bottom	8.3	44.8	5.19	3122.00	4590.0	2.5	

4/3/08

<i>YSI Readings:</i>							
Site	Temperature °C	DO %	DO mg/L	Conductivity µS	Specific Conductivity µS	Salinity ppt	
DS of culvert @ surface	12.0	30.3	3.23	2661	3539	1.9	
DS of culvert @ bottom	10.8	33.9	3.71	2590	3552	1.9	
US of culvert @ surface	11.3	32.6	3.52	3229	4374	2.3	
US of culvert @ bottom	10.7	17.3	1.89	3376	4644	2.5	

4/24/08

YSI Readings:						
Site	Temperature °C	DO %	DO mg/L	Conductivity µS	Specific Conductivity µS	Salinity ppt
DS of culvert @ surface	10.7	83.4	9.01	5.70	7.9	4.4
DS of culvert @ bottom	10.7	81.3	8.76	5.82	8.0	4.5
US of culvert @ surface	11.3	95.9	10.40	2374	3219	1.7
US of culvert @ bottom	11.8	9.7	1.02	7.27	9.74	5.5

5/1/08

YSI Readings						
Site	Temperature °C	DO %	DO mg/L	Conductivity µS	Specific Conductivity µS	Salinity ppt
DS of culvert @ surface	12.4	84.3	8.90	2621	3449	1.8
DS of culvert @ bottom	12.1	52.4	5.57	2676	3550	1.9
US of culvert @ surface	14.2	73.8	7.44	3751	4720	2.5
US of culvert @ bottom	12.7	83.3	8.67	4270	5.58	3.0

5/15/08

YSI Readings:						
Site	Temperature °C	DO %	DO mg/L	Conductivity µS	Specific Conductivity µS	Salinity ppt
DS of culvert @ surface	12.8	45.8	4.79	2656	3461	1.8
DS of culvert @ bottom	11.8	48.4	5.16	3344	4469	2.4
US of culvert @ surface	13.4	36.5	3.79	1640	2106	1.1
US of culvert @ bottom	13.4	32.9	3.42	1725	2218	1.1

6/5/08

Site	Temperature °C	DO %	DO mg/L	Conductivity µS	Conductivity µS	Salinity ppt
DS of culvert @ surface	11.5	73.4	7.97	1209	1631	0.8
DS of culvert @ bottom	11.8	62.4	6.64	3836	5.12	2.8
US of culvert @ surface	12.4	56.7	6.03	557	733	0.4
US of culvert @ bottom	12.7	43.1	4.56	1086	1419	0.7
RB peizometer	11.2	1.5	0.16	4017	5.46	3.0
LB peizometer	12.4	3.0	0.31	3949	5.20	2.8

Table 4 shows the date and time of the sampling according to the tidal conditions.

Table 4. Estimated Tide Conditions from LaConner WA

Date	Time Monitored	Tide Stage	Tide Height
3/5/08	1:53pm - 3:10pm	Flood to high tide slack	8 to 8.89 ft - High tide
4/3/08	1:52pm - 3:12pm	Flood	6.5 to 8 ft
4/24/08	9:30am - 11:00am	Ebb	7 to 5 ft
5/1/08	12:35pm - 2:25pm	Flood	5.5 to 7.5 ft
5/15/08	6:45am - 8:47am	Ebb	5.5 to 2 ft
6/5/08	8:15am - 9:55am	Ebb	7 to 3 ft

Discussion

After calculating the catch per unit effort it was found that there was 23.7 species caught per minute downstream and 0.7 species caught per minute upstream. Further analysis showed that there also a significant difference between the species caught 200' upstream of the gate and right at the gate. Upstream at the gate there was a catch per unit effort of 2.1 species per minute. The site 200' upstream from the gate had 0.1 fish caught per minute. All of the organisms caught at the downstream site were with the large seine. Of all of the methods used at the upstream only the small seine caught anything.

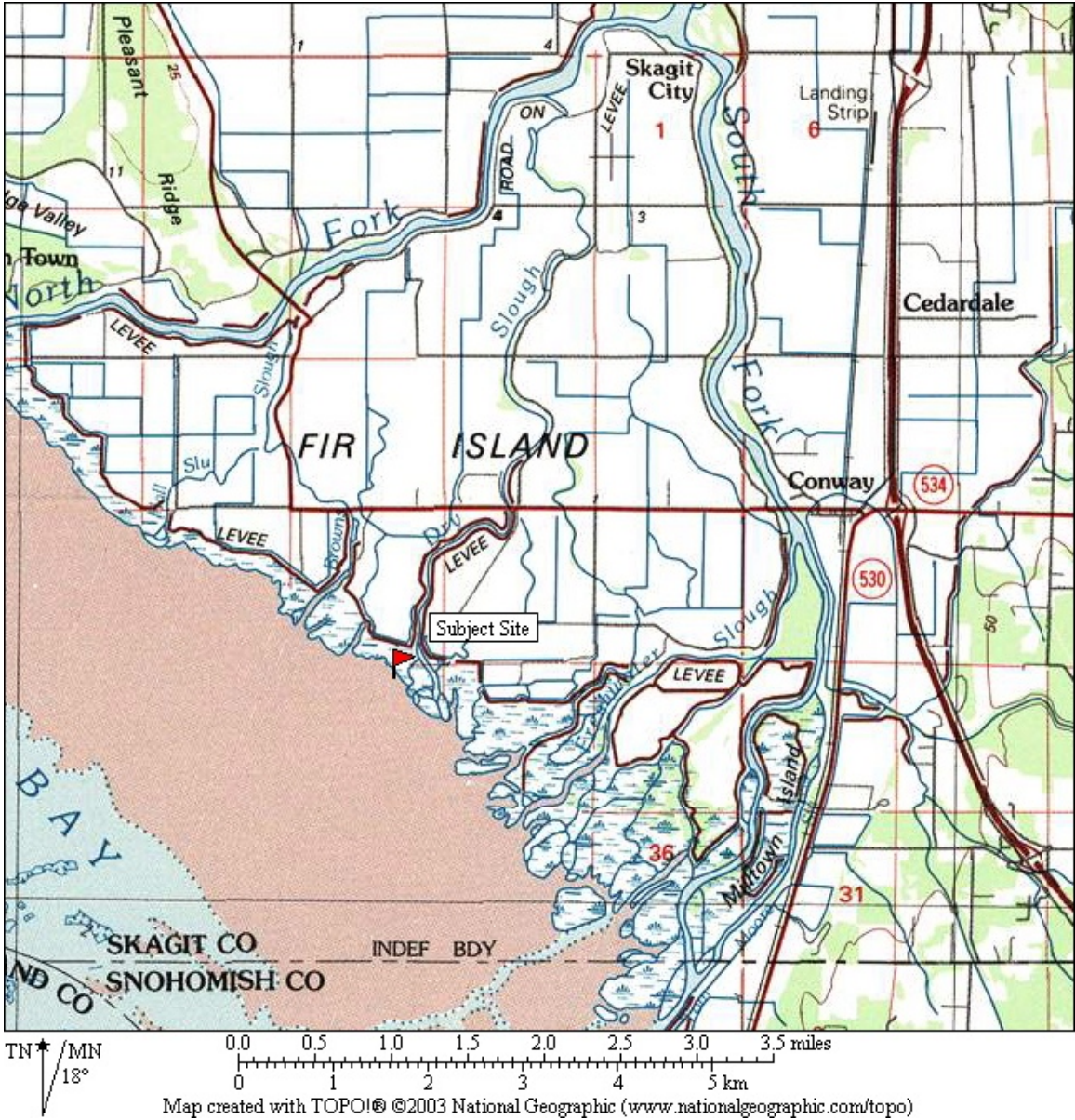
Out of the six sample dates, three where taken during a flood tide and three where taken during an ebb tide. On a flood tide, the tide height increases in feet as it nears the shore. On an ebb tide, the amount of feet decreases as the tide moves away from the shore. The first sample day started out during a flood tide and came to an end right as high tide occurred. Although tide conditions were a variable in the sampling method, the current data does not show any strong correlations between the amount of juvenile salmon or other species and the conditions of the tide.

References

Beamer and Robert LaRock. 1998. Fish Use and Water Quality Associated with a Levee Crossing the Tidally Influenced Portion of Browns Slough, Skagit River Estuary, Washington. Skagit River System Cooperative

2003. Estuarine fish sampling methods. Skagit System Cooperative Research Department, P.O. Box 368, 11426 Moorage Way La Conner, WA 98257-0368
March 2003

Attachment A
Vicinity Map



Attachment B

Sample Site Locations Map



Attachment C
Photos

Photo 1. Looking downstream from levee at Estuarine Sample Location.



Photo 2. Looking upstream of Tide Gate



Attachment D
Data

3/5/2008							
tide stage:	Incoming						
Below the Gate							
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 3</i>	<u>number</u>		
Chum	1	Chinook	1	shrimp	61		
stickleback	2	shrimp	207	stickleback	27		
sculpin	6	stickleback	13				
shrimp	314	sculpin	1				
		isopod	2				
<i>Totals</i>	323		224		88	TOTAL	635
time (min.)	25		16		16		
total # / time (min.)	12.920		14.000		5.500		
Above the Gate							
<i>Set 1</i>	<u>number</u>	<i>Dipnet</i>	<u>number</u>				
<i>Totals</i>	0		0			TOTAL	0
time (min.)	10		10				
total # / time (min.)	0.000		0.000				
4/3/2008							
Tide Stage:	incoming						
Below the Gate							
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 3</i>	<u>number</u>		
shrimp	180	shrimp	721	shrimp	853		
sculpin	3	sculpin	4	stickleback	2		
<i>Totals</i>	183		725		855	TOTAL	1763
time	16		11		13		
total # / time (min.)	11.438		65.909		65.769		
Above the Gate							
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 3</i>	<u>number</u>		
	0		0	mosquito larvae	4		
				red worm	1		
<i>totals</i>	0		0		5	TOTAL	5
time	11		9		10		
total # / time (min.)	0.000		0.000		0.500		

4/24/2008								
tide stage:	outgoing							
Below the Gate								
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 3</i>	<u>number</u>			
Chum	6	Pink	1	Chum	18			
shrimp	9	Chum	30	Coho	4			
sculpin	10	shrimp	1	shrimp	1564			
sand lance	1	sculpin	4	sculpin	64			
stickleback	1	stickleback	4	stickleback	12			
				damsselfy larvae	1			
<i>totals</i>	27		40		1663		TOTAL	1730
<i>time</i>	11		25		21			
<i>total # / time (min.)</i>	2.455		1.600		79.190			
Above the Gate								
<i>Set 1 (bank)</i>	<u>number</u>	<i>Set 2 (bank)</i>	<u>number</u>	<i>Set 3 (main channel)</i>	<u>number</u>	<i>Set 4 (main channel)</i>	<u>number</u>	
dragonfly larvae	1	damsselfy larvae	1		0		0	TOTAL
<i>totals</i>	1		1		0		0	2
<i>time</i>	4		5		5		5	
<i>total # / time (min.)</i>	0.250		0.200		0.000		0.000	
	<i>Dipnets</i>	<u>number</u>						
		0						
<i>totals</i>		0						
<i>time</i>		5						
<i>total # / time (min.)</i>		0.000						
5/1/2008								
tide stage:	incoming							
Below the Gate								
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 3</i>	<u>number</u>			
Coho	1	Chum	4	Chinook	2			
Chum	22	Chinook	4	Chum	9			
Chinook	11	sculpin	6	Pink	4			
sculpin	32	stickleback	290	sculpin	11			
starry flounder	1	shrimp	477	stickleback	14			
shrimp	339			isopod	2			
stickleback	123			shrimp	241			
<i>totals</i>	529		781		283		TOTAL	1593
<i>time</i>	30		23		22			
<i>total # / time (min.)</i>	17.633		33.957		12.864			
Above the Gate								
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>			
stickleback	2	stickleback	6	stickleback	1			
<i>totals</i>	2		6		1		TOTAL	9
<i>time</i>	5		10		10			
<i>total # / time (min.)</i>	0.400		0.600		0.100			

5/15/2008								
tide stage	outgoing							
Below the Gate								
<i>Set 1</i>	<u>number</u>	<i>Set 2</i>	<u>number</u>	<i>Set 3</i>	<u>number</u>			
Chum	2	Chum	5	Pink	1			
shrimp	172	Pink	2	Chum	9			
sculpin	47	shrimp	134	shrimp	119			
isopods	42	sculpin	59	sculpin	20			
stickleback	6	stickleback	2463	stickleback	119			
		isopods	5	flounder	1			
		flounder	1	isopods	16			
<i>totals</i>	269		2669		285		TOTAL	3223
<i>time</i>	20		40		18			
<i>total # / time (min.)</i>	13.450		66.725		15.833			
Above the Gate								
<i>Set 1 u.s. of culvert</i>	<u>number</u>	<i>Set 2 next to culvert</i>	<u>number</u>	<i>Set 3 in culvert</i>	<u>number</u>	<i>Set 4 in culvert</i>	<u>number</u>	
stickleback	1	stickleback	9	stickleback	1	stickleback	5	
		dragonfly larvae	1	shrimp	1	shrimp	1	
		water boatman	1					
		damselfly larvae	1					
<i>totals</i>	1		12		2		6	TOTAL 21
<i>time</i>	9		8		7		8	
<i>total # / time (min.)</i>	0.111		1.500		0.286		0.750	

6/5/2008							
tide stage:	outgoing						
Below the Gate							
<i>Set 1 (next to LB)</i>	<u>number</u>	<i>Set 2 (next to LB)</i>	<u>number</u>	<i>Set 3 (channel)</i>	<u>number</u>		
Chinook	3	sculpin	10	stickleback	50		
Pink	2			Chinook	17		
Chum	1			Chum	11		
stickleback	9			sculpin	29		
sculpin	6			flounder	3		
				shiner species	1		
<i>totals</i>	21		10		111	TOTAL	142
<i>time</i>	15		15		20		
<i>total # / time (min.)</i>	1.400		0.667		5.550		
Above the Gate							
<i>Set 1 (left culvert)</i>	<u>number</u>	<i>Set 2 (left culvert)</i>	<u>number</u>	<i>Set 3 (right culvert)</i>	<u>number</u>	<i>Set 4 (right culvert)</i>	<u>number</u>
Chinook	1	stickleback	8	stickleback	1	stickleback	2
stickleback	122	damsel fly larvae	5	damsel fly larvae	1	damsel fly	2
damsel fly larvae	25			snail	1	snail	1
snail	2			isopod	1		
dragonfly larvae	2						
diving water beetle	1						TOTAL
<i>totals</i>	153		13		4		5 175
<i>time</i>	20		5		5		5
<i>total # / time (min.)</i>	7.650		2.600		0.800		1.000
						GRAND TOTAL	9298
						Above Gate	212
						Below Gate	9086
						chinook*	39
						chum	118
						coho	5
						pink	10
						<i>subtotal salmon</i>	172
						shrimp	5394
						stickleback	3293
						sculpin	312
						isopod	68
						damsel fly larvae	36
						dragonfly larvae	4
						flounder	6
						mosquito larvae	4
						snail	4
						diving water beetle	1
						sand lance	1

						shiner	1
						red worm	1
						water boatman	1
Contributors:							
Andrew Beckman, Doug Couvelier, Joe George, Jim Johnson, Sacha Johnson, Kyle Koch						<i>subtotal other</i>	<u>9126</u>
Mike McCain, Kevik Rensink, Tom Slocum and Perry Welch						<i>TOTAL</i>	<u>9298</u>