Community Beach Seining at Ship Harbor, Fidalgo Island, Washington, August 2012

By

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December 2012

NORTHWEST STRAITS
marine conservation initiative

SHANNON POINT MARINE CENTER
WESTERN WASHINGTON UNIVERSITY

Skagit MRC

Acknowledgments

The Skagit County Marine Resources Committee and Shannon Point Marine Center thanks the following for their valuable assistance with the Community Beach Seining Project:

Report Authors: Paul Dinnel and Jude Apple, Shannon Point Marine Center

Project Funding: Burning Foundation, Northwest Straits Foundation and Shannon Point Marine Center, Western Washington University

Project Management: Joan Drinkwin and Tracie Johannessen, Northwest Straits Foundation and Paul Dinnel, Skagit Marine Resources Committee

Vessel Operators: Nathan Schwarck and Jay Dimond, Shannon Point Marine Center

WSU Beach Watcher, Skagit MRC, Shannon Point Marine Center and Community Volunteers: Dan McCroskey, Erica Pickett, Pat Steffani, Austin Rose, Charles O'Hara, Kathleen McDanold, Bruce McDanold, Lin Folsom, Dixon Elder, Mike Mohundro, Patti Hutchins, Chris Brown, Kurt Buchanan, Nancy Olsen, Morty Cohen, Lennon Beckman, Thomson, Anne Benolkin, Pete Hasse, Christna Goethel, Sarah DeLand, Venna Dohman, Alannah Pratt, John Helmerl, Sylvia Yang, Klara Schwarz, Suann Yang, Carrie Schwarz, Christian Schwarz, Cory Tolman, Judy Boum, Bob Weathers, Lynn Coffelt, Elyse Etlicher, Maggie Irving, Mira Lutz, Tracy Alker, Daron Jones, Jacob Jones, Joel Jones, Clareesa Jones, Rachel Jones, Merci Jones, John Patton, Gabe Velazquel, Cadel Velazquel, Maya Velazquel, Andrea Doll, Lauren Falkenberg, Melanie Tate, Steve Hanson.

Partner Organizations: Skagit Marine Resources Committee, Shannon Point Marine Center, Skagit County WSU Beach Watchers, City of Anacortes, Port of Anacortes, Northwest Straits Foundation and the Burning Foundation.

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Introduction

One of the goals of the Northwest Straits Commission is to facilitate citizen science by training local citizens on how to collect scientific data and monitor the status of our marine resources and habitats. A second goal of the Commission is to provide education and outreach activities for local communities. The purpose of the Community Beach Seining project is to address both of these goals by using community volunteers to collect fish monitoring data and interact with interested community citizens by including them in the sampling efforts and data collection.

Beach seining at Ship Harbor is continuing, in part, the fish sampling initiated at this location in 2010 as part of Skagit County Marine Resources Committee's (Skagit MRC) Cannery Pond Evaluation Project, which was primarily conducted by a WWU graduate student (Dinnel and Seyl 2011). Continuation of fish sampling in 2011, 2012 and beyond will provide a longer term fish database for this North Fidalgo Island (west Guemes Channel) location, which is not being monitored for fish by any other organization. All data collected will be forwarded to Skagit River Systems Cooperative, which maintains an extensive database for seine sampling in Skagit County waters, especially in relation to juvenile salmonid species.

This report summarizes the Community Beach Seine sampling conducted at Ship Harbor on August 13, 2012. Data from this effort are presented in this report, and also includes comparisons to two previous sampling efforts at Ship Harbor (August 2011 and June 2012). Additional information and data from these two previous sampling efforts may be found in an earlier report (Dinnel and Apple 2012).

Methods

The location of the beach seining site is Ship Harbor, which is located on the northwest side of Fidalgo Island just east of the Washington State San Juan Island Ferry Terminal (Fig. 1). The tidelands are owned by the Port of Anacortes and the uplands are owned by the City of Anacortes, both which have given their permission for site access

All seining activities were conducted at high tides (+6.0 foot or higher). The site substrate is sand with a cobble fringe at the high tide level. The dominant vegetation is algae, with sea lettuce (*Ulva* spp.) being the dominant vegetation.

Two previous Community Beach Seine sampling and education events were held on 8 August 2011 and 14 June 2012. The sampling reported in this report occurred on 13 August 2012. Sampling was conducted with a large net beach seine measuring 120' (36.6 m) long by 12' (3.7 m) deep by 1/8" (0.3 cm) mesh knotless nylon net using sampling protocols established by the Skagit River System Cooperative Research Department (SRSC

2003) (Appendix 2). The beach seine was set using Shannon Point Marine Center's research vessel *Fauna* (Fig. 2). All volunteers were given an introduction and brief training session prior to sampling (Fig. 3). The net was set three successive times for four minutes each before being pulled to the beach by volunteers (Fig. 4). Once the net was retrieved, volunteers then captured all fish in the net and identified each fish to species or genus and measured each fish for total length (or counted excess fish when there were more than 25 of a given species -- Fig. 5), using the following fish guides: Hart 1973, Kramer et al. 1995, The Mountaineers 1984, Steele 2011, and a locally produced laminated fish guide based on illustrations posted on the Oregon Department of Fish and Wildlife's website (http://www.dfw.state.or.us/MRP/FishID/FishIDLists.asp). All fish were handled carefully, maintained in large buckets of seawater until measured and released alive at the sampling site.

Results

Fish Catches

The three August 2012 beach seine samples contained 530, 1,763 and 1,121 fish for a total of 3,414 fish for all three samples (Table 1). Thirteen species (or groups of species) were represented in the samples including:

Juvenile Chinook salmon, *Oncorhynchus tshawytscha*
Starry flounder, *Platichtys stellatus*
English sole, *Parophrys vetulus*
Speckled sanddab, *Citharichthys stigmaeus*
Pacific shiner perch, *Cymatogaster aggregata*
Staghorn sculpin, *Leptocottus armatus*
Surf smelt, *Hypomesus pretiosis*
Pacific sand lance, *Ammodytes hexapterus*
Greenling sp. (*Hexagrammos* sp.)
Pacific tomcod, *Microgadus proximus*
Snake prickleback, *Lumpenus sagitta*
Threespine stickleback, *Gasterosteus aculeatus*
Gunnel sp., Family Pholidae

All of these species are common to Puget Sound. Of particular note were the high catches of surf smelt, juvenile English sole, Pacific shiner perch and snake prickleback (Table 1).

Size frequency histograms were prepared for some of the most commonly caught species (Figs. 6-13) and include comparisons of fish size distributions for this sampling and the two previous sample efforts in August 2011 and June 2012. These histograms show that all of the Chinook and pink salmon were caught in 2012 and were juveniles in transit from their natal rivers to the ocean (Figs. 6 and 7). Surf smelt, only caught in 2012, were mostly juveniles (40-100 mm) (Fig 8). English sole and starry flounder were caught in both years and were mostly juveniles, the sizes indicating that these fish likely represented several year classes (Figs. 9 and 10). Pacific shiner perch were caught in both years and were mostly adults, with a few juveniles, especially in August 2012 (Fig. 11). This species produces live during the summer, which measure approximately 20-60 mm in length. Snake prickleback were caught in both years and were mostly adults measuring between 80-220

mm (Fig. 12). Staghorn sculpin were very common in the catches of both years and included a wide range of sizes from juveniles to adults (Fig. 13). Summaries of the individual fish sizes (or subset of fish when many of a given species were caught) appear in Appendix Table 1.

Community Beach Seine Partners and Participants

This project was coordinated by Skagit MRC (project coordination/administration, data management, report preparation and the beach seine) in cooperation with Shannon Point Marine Center (boat and skipper, three Marine Scientists and students), the City and Port of Anacortes (site access) and WSU Beach Watchers (assist with setting the seine, measuring and identifying the fish, recording the data and interacting with the public invited to the events). Volunteers for these two seining events included:

- Nine Shannon Point Marine Center participants, including three Marine Scientists (Drs. Paul Dinnel, Jude Apple and Sylvia Yang), SPMC staff (Nate Schwarck and Jay Dimond) and four graduate and undergraduate students

- Four members of the Skagit Marine Resources Committee

- At least 17 trained Washington State University Beach Watchers

- In addition, approximately 30-40 interested citizens and kids from the community (including persons walking the beach while waiting in the ferry line) participated in the event.

Volunteer Hours

Total volunteer time expended for the two Community Beach Seining events, including the sampling efforts, project coordination/administration and final report preparation was approximately 160 hours. This does not include the efforts by the 30-40 citizens from the community who assisted with (or observed) the sampling.

Cost Matching

Most of the cost for this project was for the research vessel used to set the beach seine and the skipper's time. The hourly cost for the vessel and skipper was $110/hour. Four hours of vessel/skipper time were used for the August 2012 Community Beach Seine event. The Northwest Straits Foundation and Burning Foundation provided half of the funding ($550) for this sampling event. Dr. Steve Sulkin, Director of the Shannon Point Marine Center, contributed the other half of the vessel charter fees as a co-partner for this effort.

Event Advertising

Advertising for this event appeared in several editions of the local *Anacortes American* weekly newspaper in the Community Events section and one edition of the *Skagit Valley Herald.* Following is an example press release prepared for the event and sent to the local newspapers for publication:

Press Release
Invitation to Community Beach Seine Sampling

Skagit County Marine Resources Committee (Skagit MRC) and Shannon Point Marine Center are co-sponsoring a Community Beach Seine sampling event at Ship Harbor, next to the San Juan Ferry Terminal in Anacortes on Monday, August 13th. Students, community members and any interested persons are invited to assist and learn about local marine life. Skagit County Beach Watchers, Skagit MRC members and students and staff of Shannon Point Marine Center will be on hand to lead the sampling effort and identify and measure fish caught in the net. Sampling will take place from 3:00 to 5:00 PM. To find out more information or to volunteer for this event, call Paul Dinnel at 360-293-2188 (mornings) or 360-299-8468 (afternoons, evenings, weekends) or e-mail: padinnel@aol.com.

Future Community Beach Seining Events

Community Beach Seining events may be held in 2013 and future years but will depend on the availability of continued funding from some source. The original source, the Northwest Straits Commission, no longer has funds to support Marine Resources Committee projects due to the deletion of "earmark" funds by Congress. The most recent sampling effort (August 2012) was supported by private funding (Burning Foundation).

References

Dinnel, P. and H. Seyl. 2011. Investigation into the historic status of Cannery Pond, and its potential for restoration as a future pocket estuary. Final Report by Shannon Point Marine Center, Western Washington University for the Skagit County Marine Resources Committee and the Northwest Straits Commission, Mt. Vernon, WA. 51 pp.

Dinnel, P. and J. Apple. 2012. Community beach seining at Ship Harbor, Fidalgo Island, Washington, 2011 and 2012. Final Report by Shannon Point Marine Center, Western Washington University for the Skagit County Marine Resources Committee and the Northwest Straits Commission, Mt. Vernon, WA. 33 pp.

Hart, J.L. 1973. Pacific Fishes of Canada. Bulletin 180, Fisheries Research Board of Canada, Ottawa, Canada. 740 pp.

Kramer, D.E., W.H. Barass, B.C. Paust and B.E. Bracken. 1995. Northeast Pacific Flatfishes. Marine Advisory Bulletin No. 47, Alaska Sea Grant Program, University of Alaska Fairbanks. 104 pp.

SRSC (Skagit River System Cooperative). 2003. Estuarine fish sampling methods, March 2003. Beach seine and fyke trap sampling protocol. 8 pp.

Steele, E. 2011. Juvenile salmon identification. http://fisheries.btc.ctc.edu/Handout/Juvenile%20Salmon.pdf.

The Mountaineers. 1984. Mac's field guide to northwest coastal fish. Laminated field guide, Seattle, WA.

Table 1. Total beach seine fish catches by species, August 8, 2011, June 14, 2012 and August 13, 2012 from Ship Harbor, NW Fidalgo Island. The entries are the total number of fish caught in each of the three replicate (Rep) sets on each date and total for each date.

	8/8/11				6/14/12				8/13/12			
Species	Rep 1	Rep 2	Rep 3	**Total**	Rep 1	Rep 2	Rep 3	**Total**	Rep 1	Rep 2	Rep 3	**Total**
Sockeye salmon	0	0	0	**0**	2	0	0	**2**	0	0	0	**0**
Chinook salmon	0	0	0	**0**	0	5	8	**13**	2	3	3	**8**
Coho salmon	1	0	1	**2**	0	0	1	**1**	0	0	0	**0**
Chum salmon	0	0	0	**0**	0	2	1	**3**	0	0	0	**0**
Pink salmon	0	0	0	**0**	46	175	2	**223**	0	0	0	**0**
Surf smelt	0	0	0	**0**	37	2	3	**42**	0	0	310	**310**
Pacific sandlance	0	0	0	**0**	2	3	1	**6**	1	3	2	**6**
English sole	22	39	41	**102**	157	149	48	**354**	63	147	67	**277**
Starry flounder	4	16	12	**32**	8	14	14	**36**	18	4	15	**37**
Speckled sanddab	0	0	0	**0**	0	0	0	**0**	0	0	1	**1**
Shiner perch	60	53	78	**191**	0	60	136	**196**	303	1052	428	**1783**
Snake prickleback	0	6	0	**6**	15	18	5	**38**	87	494	219	**800**
Greenling[1]	0	2	1	**3**	1	0	0	**1**	3	3	1	**7**
Pacific tomcod	0	0	0	**0**	0	0	0	**0**	1	0	0	**1**
Threespine stickleback	0	0	2	**2**	1	0	0	**1**	1	0	2	**3**
Gunnel[1]	0	1	7	**8**	5	6	4	**15**	3	2	1	**6**
Pacific herring	0	0	0	**0**	0	2	1	**3**	0	0	0	**0**
Staghorn sculpin	9	19	19	**47**	40	100	31	**171**	48	55	72	**175**
Buffalo sculpin	1	0	0	**1**	0	2	0	**2**	0	0	0	**0**
Other sculpin sp.	0	0	0	**0**	7	0	28	**35**	0	0	0	**0**
Larval rockfish	0	0	0	**0**	0	0	3	**3**	0	0	0	**0**

[1]Identified to genus only.

Figures

Figure 1. Location of the beach seining site at Ship Harbor, just east of the San Juan Island Ferry Terminal, northwest Fidalgo Island. Photo source: Washington Department of Ecology.

Figure 2. Beach seine being set by volunteers and the Research vessel *Fauna*.

Figure 3. Volunteer and citizen beach seine training session prior to setting the net.

Figure 4. Volunteers and citizens from the community pulling in the beach seine.

Figure 5. Volunteers and community members identifying, measuring and recording fish caught in the beach seine.

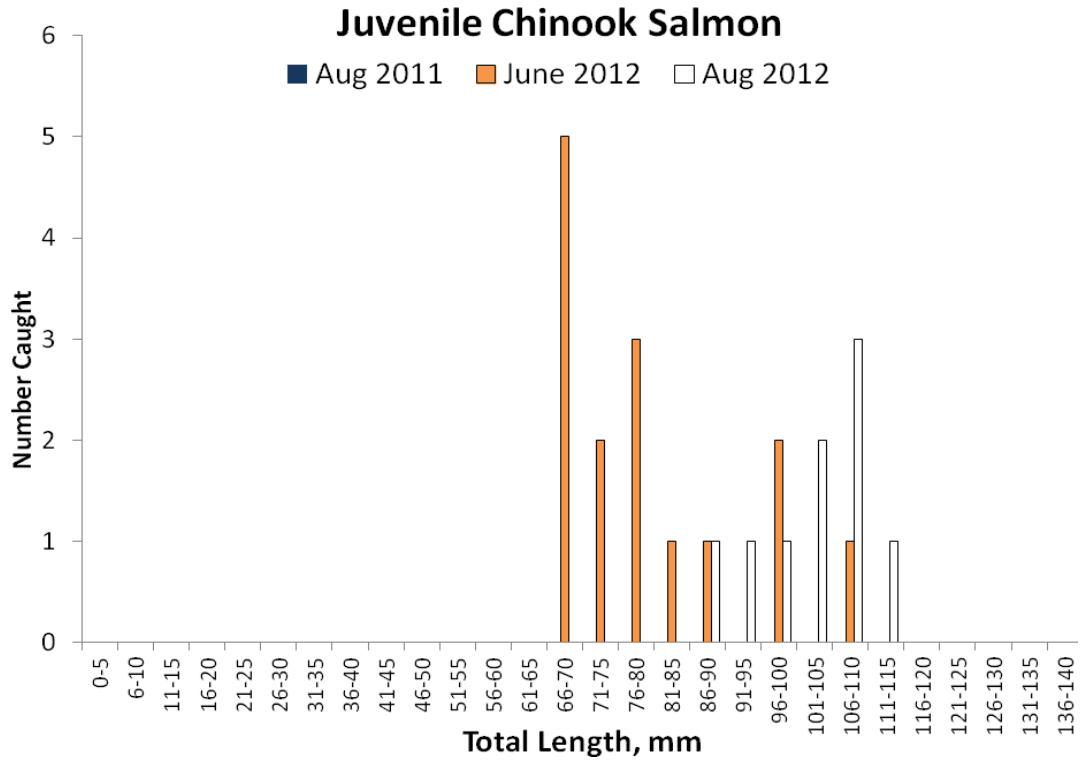

Figure 6. Size frequency distribution for juvenile Chinook salmon caught in June and August 2012. No Chinook salmon were caught in August 2011.

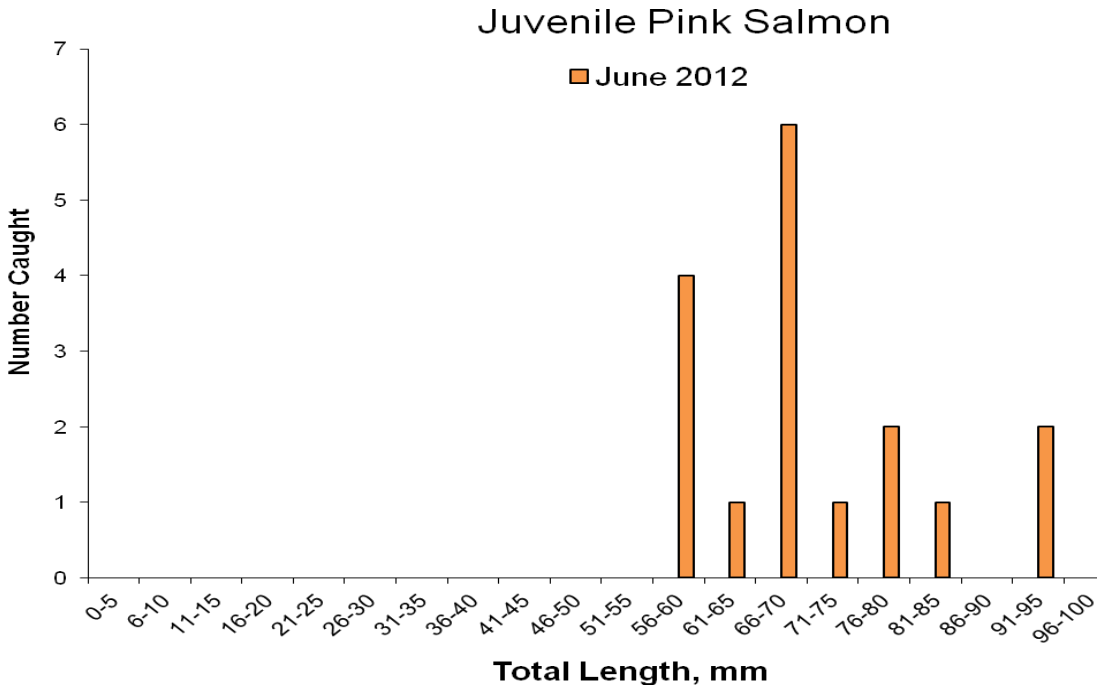

Figure 7. Size frequency distribution for juvenile pink salmon caught in June 2012. No pink salmon were caught in August 2011 or August 2012.

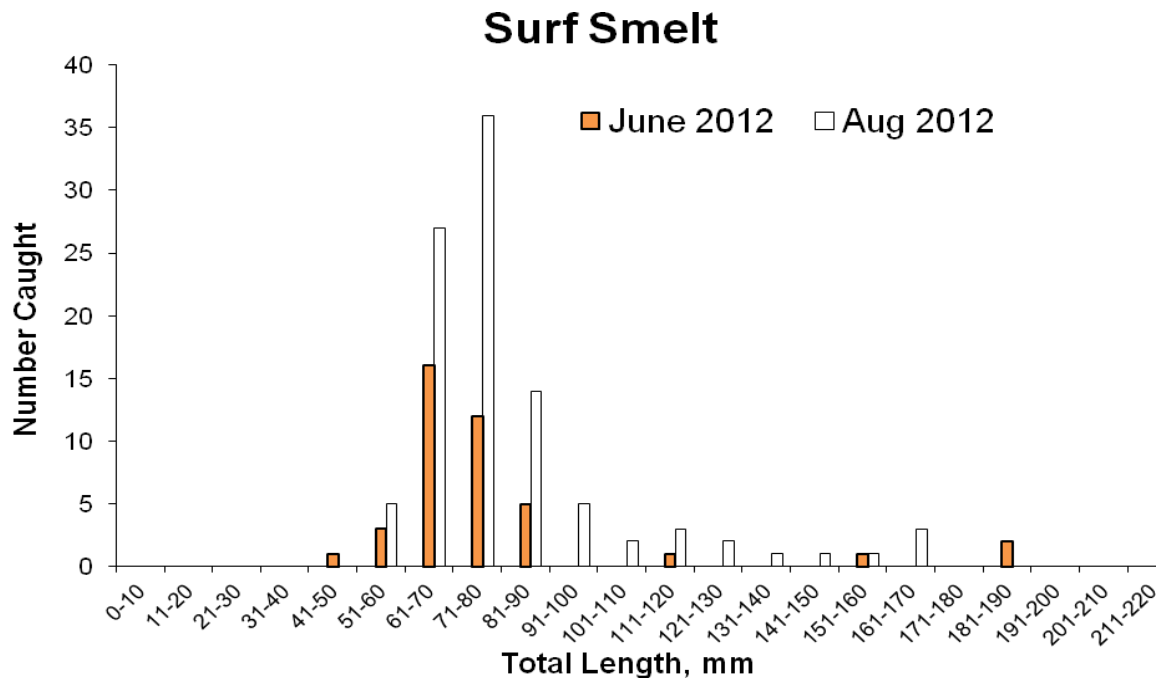

Figure 8. Size frequency distribution for surf smelt caught in June and August 2012. No surf smelt were caught in August 2011.

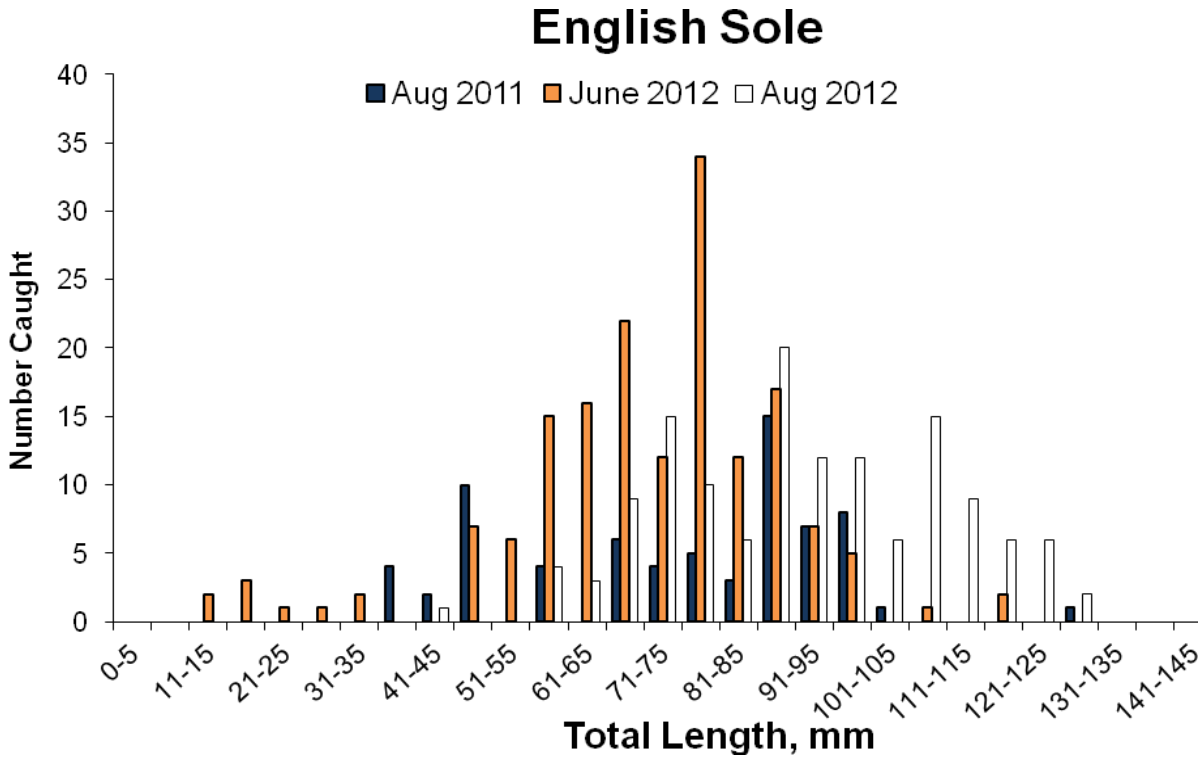

Figure 9. Size frequency distribution for English sole caught in August 2011 and June and August 2012.

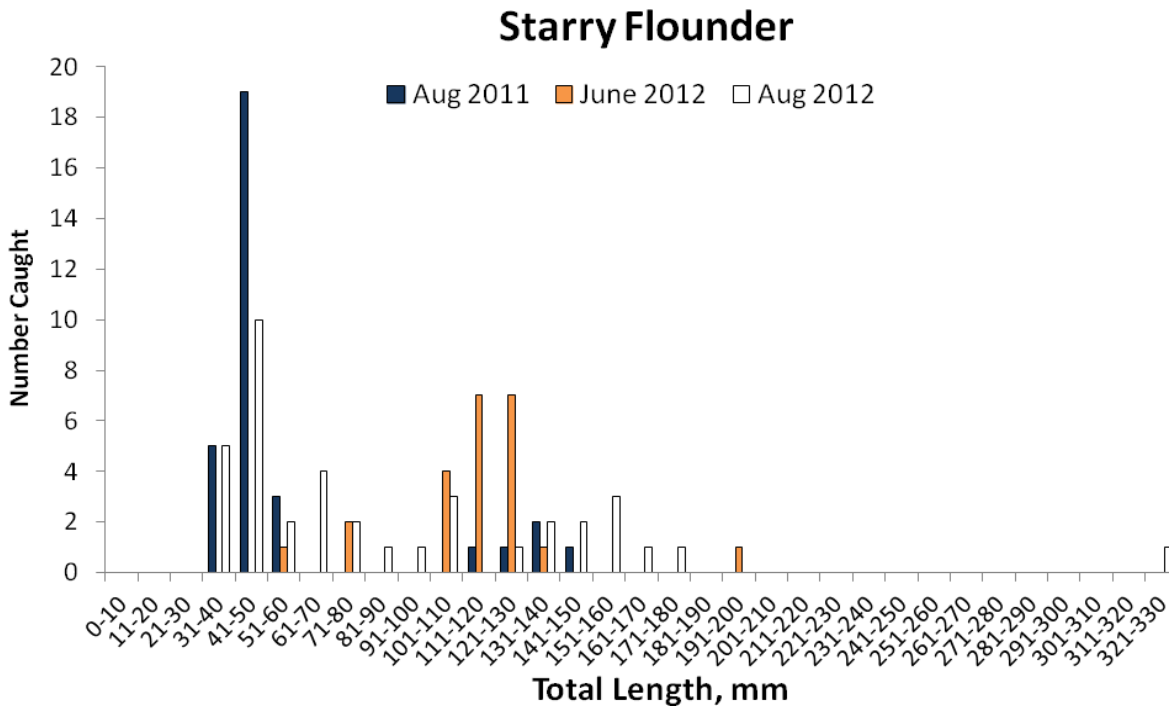

Figure 10. Size frequency distribution for starry flounder caught in August 2011 and June and August 2012.

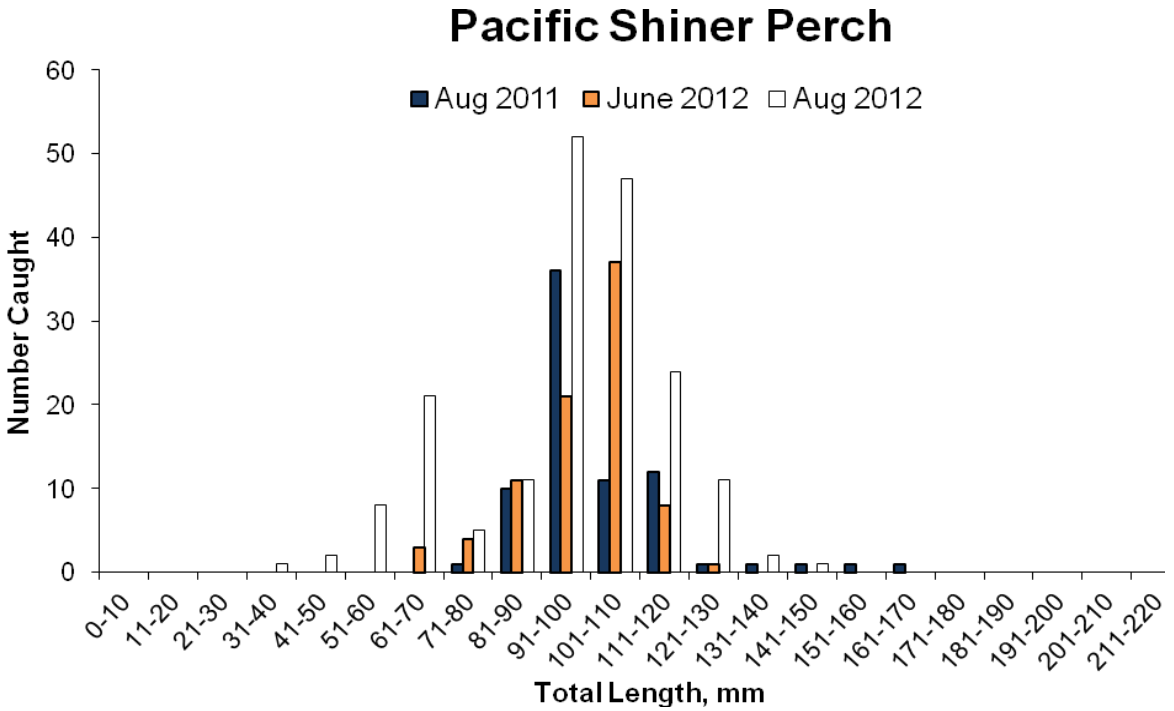

Figure 11. Size frequency distribution for Pacific shiner perch caught in August 2011 and June and August 2012.

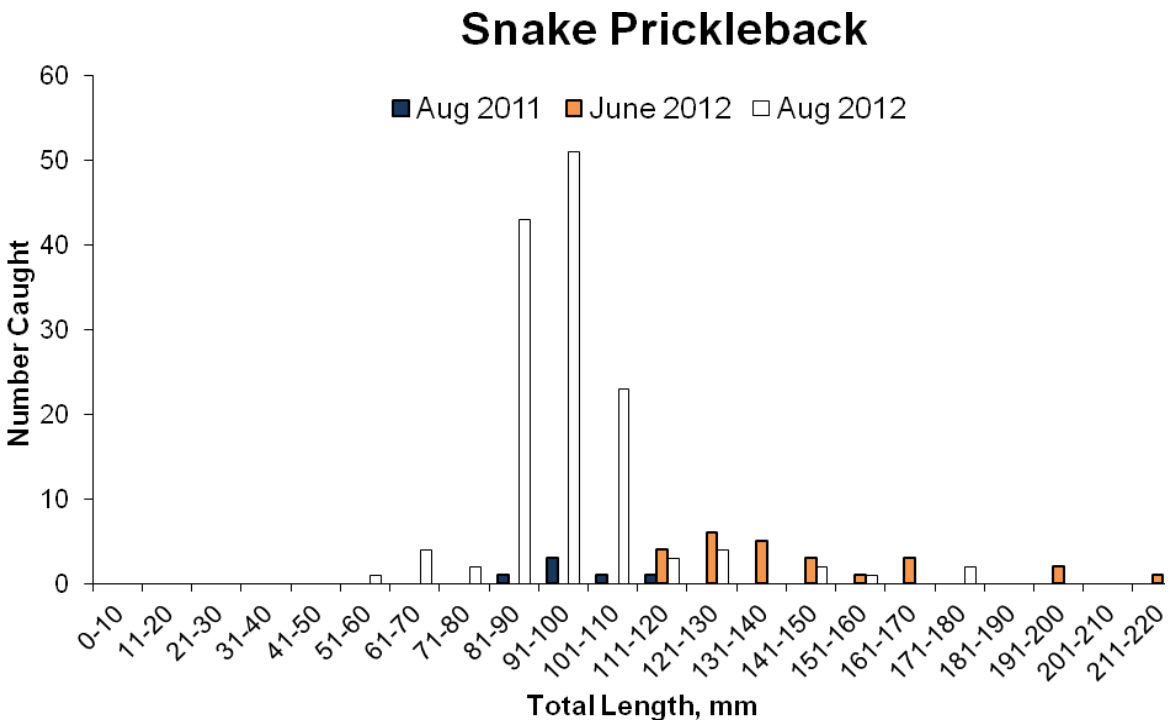

Figure 12. Size frequency distribution for snake prickleback caught in August 2011 and June and August 2012.

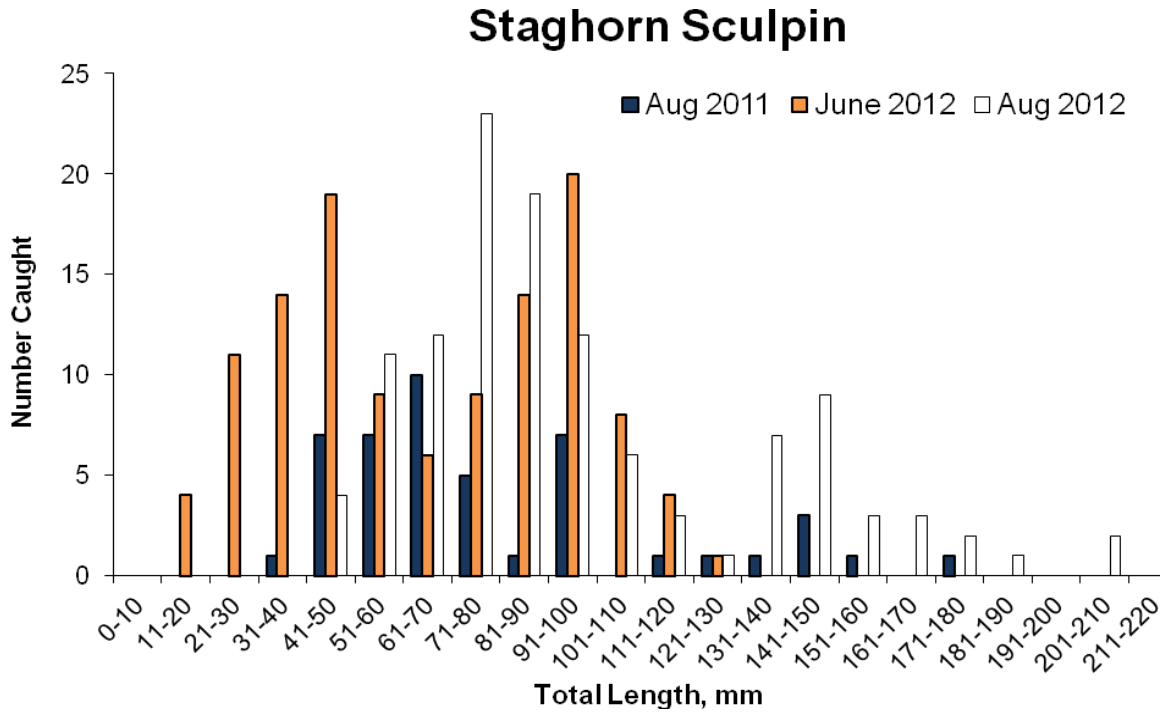

Figure 13. Size frequency distribution for staghorn sculpin caught in August 2011 and June and August 2012.

Appendix 1. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012. Only a subset of fish were measured from each replicate seine when a given species was very numerous.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
1	103		60	121	330		100	95	105	70	90	123	146
1	115			90	80		107	90	105			145	141
1				105	70		103	90	110			116	70
1				90	45		110	180					85
1				110	40		95	100					165
1				113	80		97	90					160
1				68	110		92	110					165
1				85	153		122	90					95
1				60	135		111	85					90
1				84	40		65	95					90
1				90	100		113	110					100
1				124	70		112	100					90
1				130	90		105	90					140
1				90	110		97	100					145
1				94	70		115	85					175
1				110	45		99	105					110
1				130	50		99	90					155
1				92			90	104					147
1				88			94	86					155
1				110			105	90					165
1				105			97	95					119
1				112			101	96					66
1				82			110	120					60
1				74			85	102					106
1				95			95	102					140
1				74			120	92					130
1				88			110	96					120
1				98			105	94					70
1				113			105	102					90
1				100			100	90					80
1				100			100	110					75
1				70			115	90					80
1				120			105	90					65
1				110			120	105					75

Appendix 1, continued. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
1				95			105	100					42
1				90			105	110					115
1				80			100	105					135
1				95			95	130					80
1				115			95	100					85
1				95			105	95					80
1				70			100	110					65
1				70			115	90					140
1				85			110	100					140
1				90			95	105					135
1				100			105	90					95
1				95			130	90					55
1				100			65	100					
1				110			125	90					
1				125			100	100					
1				80			100	105					
1				115			100	95					
1				110			90	150					
1				92			110	90					
1				70			100	90					
1							100						
1							100						
1							110						
1							110						
1							110						
1							100						
1							100						
1							100						
1							100						
1							60						
1							90						
1							90						
1							60						

Appendix 1, continued. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
1							100						
1							95						
1							100						
1							105						
1							105						
1							70						
1							60						
1							60						
2	100		80	120	180		68	100	108			120	100
2	95		60	80	165		65	80	120			120	70
2	110		80	80	155		150	90	120				80
2				150	58		100	110					60
2				110			120	130					80
2				90			100	90					100
2				100			60	99					85
2				100			65	85					80
2				80			110	95					80
2				70			100	95					70
2				102			75	90					210
2				105			105	110					90
2				105			40	130					75
2				80			65	110					80
2				90			90	100					105
2				95			80	85					60
2				45			60	95					70
2				75			100	94					75
2				100			50	105					85
2				60			50	93					90
2				75			65	95					185
2				85			55	95					90
2				90			115	92					45
2				80			75	130					65
2				65			60	110					85

Appendix 1, continued. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
2				110			70	90					90
2				90			65	65					50
2				95			70	70					75
2				125			100	69					55
2				120			70	85					45
2				110			70						
2				75			95						
2				120			65						
2				75			110						
2				95			105						
2				90			95						
2				90			60						
2				60			65						
2				90			65						
2							65						
2							60						
2							110						
2							100						
2							70						
2							75						
3	103	63	85	68	110	50	122	89	110		70	110	205
3	86	63	75	109	43		109	94			90		70
3	110	78		70	39		117	81					70
3	110	70		90	150		106	93					52
3		73		119	130		126	84					80
3		65		109	48		110	99					59
3		70		119	70		116	105					100
3		102		109	45		110	79					79
3		90		62	36		140	91					75
3		81		112	42		110	89					70
3		84		121	45		130	95					146
3		71		90	137		100	90					141
3		69		105	40		107	90					70

Appendix 1, continued. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
3		71		90	43		103	180					150
3		75		65	50		110	100					110
3		79		78	51		95	90					90
3		66		100	153		97	110					75
3		97		115	148		92	90					80
3		77		75			122	85					90
3		74		75			111	95					55
3		73		75			65	110					51
3		75		75			113	100					90
3		133		75			112	90					174
3		120		95			105	90					110
3		83		90			97	100					95
3		75		125			115	60					93
3		80		100			99	100					85
3		75		86			99	100					105
3		70		75			90	100					90
3		130		110			94	100					60
3		65		100			105	100					80
3		75		75			97	100					75
3		65		80			101	100					54
3		170		60			110	95					143
3		70		110			85	92					92
3		120		99			95	100					92
3		80		108			110	70					135
3		75		72			135	90					143
3		65		77			110	90					97
3		65		66			90	145					78
3		60		115			100	82					75
3		80		72			130	90					94
3		85		82			75	100					
3		80		113			100	155					
3		76					105	90					
3		80					115	115					

Appendix 1, continued. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
3		84					90	100					
3		80					110	100					
3		75					130	90					
3		70					111	102					
3		70					128	115					
3		60					100	90					
3		70					113	85					
3		90					105						
3		150					65						
3		100					115						
3		80					110						
3		65					89						
3		75					102						
3		100					113						
3		70					114						
3		75					110						
3		55					110						
3		75					120						
3		80					120						
3		70					123						
3		90					96						
3		70											
3		65											
3		60											
3		90											
3		71											
3		75											
3		110											
3		60											
3		170											
3		156											
3		87											
3		80											

Appendix 1, continued. Total lengths (mm) of fish caught in three replicate sets of the Community Beach Seining, August 13, 2012.

Replicate Set	Chinook Salmon	Surf Smelt	Pacific Sandlance	English Sole	Starry Flounder	Speckled Sanddab	Shiner Perch	Snake Prickleback	Greenling Sp.	Pacific Tomcod	Threespine Stickleback	Gunnel Sp.	Staghorn Sculpin
3		82											
3		81											
3		80											
3		166											
3		76											
3		130											
3		70											
3		73											
3		96											
3		113											
3		70											
3		71											
3		62											
3		75											
3		76											
3		70											
3		84											
3		72											
3		70											
3		95											
3		70											

Appendix 2. Protocol used for the beach seine sampling.

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ESTUARINE FISH SAMPLING METHODS
March 2003

We sample estuarine habitat using three different methods (small net beach seine, large net beach seine, and fyke trap) depending on the habitat types.

Small net beach seine methods are used for sampling shallow intertidal shoreline areas of Skagit and Padilla Bays or distributary channel habitat in the Skagit tidal delta and Swinomish Channel. The areas seined are typically less than 4ft deep (1.2m) and have relatively homogeneous habitat features such as: water depth and velocity, substrate, and vegetation. Small net beach seine methodology uses an 80' (24.4m) by 6' (1.8m) by 1/8" (0.3cm) mesh knotless nylon net (Figure 1). The net is set in "round haul" fashion by fixing one end of the net on the beach while the other end is deployed by wading the net "upstream" against the water current using a floating tote, and then returning to the shoreline in a ½ circle. Both ends of the net are then retrieved yielding a catch. We typically conduct three sets per site.

Large net beach seine methods are used for sampling the intertidal-subtidal fringe of the Skagit and Padilla Bays. These areas are typically deeper than the areas seined by small net beach seine, ranging from 6-15ft (1.8-4.6m) requiring a longer and deeper net. Large net beach seine methodology uses a 120' (36.6m) by 12' (3.7m) by 1/8" (0.3cm) mesh knotless nylon net where one end of the net is fixed on the beach while the other end is set by boat across the current at an approximate distance of 60% of the net's length (Figure 2). After the set has been held open against the tidal current for a period of about 4 minutes, the boat end is brought to the shoreline edge and both ends are retrieved yielding a catch in the net's bunt section. We typically conduct three sets per site.

Fyke trap methods are used for sampling blind tidal channel habitat in the Skagit tidal delta, Swinomish Channel corridor, and southern Padilla Bay. Fyke trap methodology uses nets constructed of 1/8" (0.3cm) mesh knotless nylon with a 2' (0.6m) by 9' (2.7m) diameter cone sewn into the net to collect fish draining out of the blind channel site (Figure 3). Overall net dimensions (length and depth) are variable depending on the site's cross-sectional channel dimensions. All nets are sized to completely block fish access at high tide. The net is set across the blind channel site at high tide and "fished" through the ebb tide yielding a catch. The juvenile Chinook catch is adjusted by a trap recovery efficiency (RE) estimate that is derived from mark-recapture experiments using a known number of marked fish released upstream of the trap at high tide. RE is usually related to

hydraulic characteristics unique to the site (e.g., change in water surface elevation during trapping, or water surface elevation at the end of trapping). Multiple RE tests (several times per season) at each site are used to develop a regression model to convert the "raw" juvenile Chinook catch to an estimated population within the habitat upstream of the fyke trap on any sampling day.
Data collected for each beach seine set include:

- Time and date of set
- Tidal stage (ebb, flood, high tide slack, low tide slack)
- Water surface area seined
- Length of time the set is held open (large net only)
- Surface and bottom water temperature of area seined using YSI meter
- Surface and bottom salinity of area seined using YSI meter
- Maximum depth of area seined
- Average surface water velocity (small net only) using a flow meter
- Substrate of area seined following the definitions shown in Table 1 (small net only, unless substrate type is uniform for large net area)
- Vegetation of area seined following the definitions shown in Table 2 (small net only, unless vegetation type is uniform for large net area)
- Complete fish catch records by species following the coding shown in Table 3
- Sub-sample of individual juvenile chinook lengths and weights (following mark coding shown in Table 4)
- Sub-sample of individual lengths on all other fish species (following mark coding shown in Table 4)

Data collected for each fyke trap set include:

- Time at start and end of trapping
- Water surface elevation at start and end of trapping
- Surface and bottom water temperature at start and end of trapping
- Surface and bottom salinity at start and end of trapping
- Complete fish catch records by species following the coding shown in Table 3
- Sub-sample of individual juvenile chinook lengths and weights (following mark coding shown in Table 4)
- Sub-sample of individual lengths on all other fish species (following mark coding shown in Table 4)

REFERENCES

Dethier, M. N.. 1990. A marine and estuarine habitat classification system for Washington State. Washington Natural Heritage Program, Washington Department of Natural Resources. Olympia WA. 56 pages.

Table 1. Definitions of substrate types modified from Dethier (1990).

Substrate Type	Definition
Bedrock	75% of the surface is covered by bedrock, commonly forming bluffs and headlands.
Boulder	75% of the surface is covered by boulders (>256mm).
Cobble	75% of the surface is covered by clasts 64 to 256mm in diameter.
Gravel	75% of the surface is covered by clasts 4 to 64mm in diameter.
Mixed Coarse	No one size comprises > 75% of surface area. Cobbles and boulders are > 6%.
Fines With Gravel	No one clast size comprises more than 75% of the surface area. Cobbles and boulders make up > 6% of the surface area; Coarse sediments combined make up < 55%. Rich with epibenthic fauna.
Sand	More than 75% of the surface area consists of sand 0.06 to 4 mm in diameter.
Mixed Fines	Fine sand, silt, and clay comprise 75% of the surface area, with no one size class being dominant. May contain gravel (<15%). Cobbles and boulders make up < 6%. Walkable.
Mud	Silt and clay comprise 75% of the surface area. Often anaerobic, with high organics content. Tends to pool water on the surface and be un-walkable.
Artificial	Anthropogenic structures replacing natural substrate within the intertidal zone, including boat ramps, jetties, fill, and pilings.

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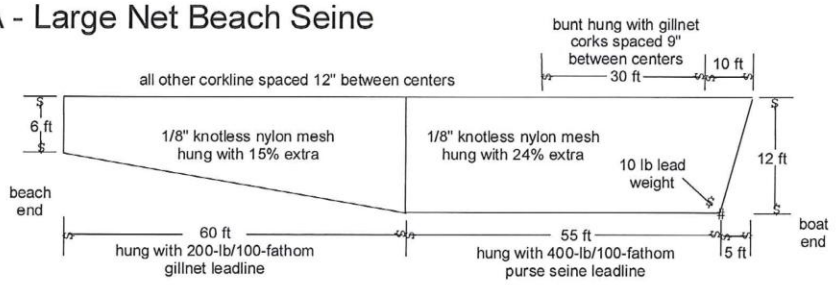
Artificial	Anthropogenic structures replacing natural substrate within the intertidal zone, including boat ramps, jetties, fill, and pilings.

Table 2. Definitions of vegetation types from Dethier (1990).

Vegetation Type	Definition
Eelgrass	More than 75% of vegetative cover is Zoster marina, Zoster japonica, Phyllospadix spp., Ruppia maratima.
Brown Algae	More than 75% of vegetative cover is brown algae belonging to taxonomic group Division Phaeophyta.
Green Algae	More than 75% of the vegetative cover is algae belonging to the taxonomic group Division Chlorophyta.
Red Algae	More than 75% of the vegetative cover is algae belonging to the taxonomic group Division Rhodophyta.
Mixed Algae	Areas in which red, green or brown algae coexist, no single type occupies more than 75% of vegetated cover.
Kelp	More than 75% of the vegetative cover is large brown algae (Order Laminariales).
Salt Marsh	More than 75% of the vegetative cover is emergent wetland plants.
Spit-Berm	More than 75% of the vegetative cover is plants such as dune grass, gumweed, and yarrow, which generally occur above the highest tides, but still receive salt influence.
Unvegetated	More than 75% of the total surface area is unvegetated.

A - Large Net Beach Seine



B

C

Figure 2. Large net beach seine methodology: A – design of net (not drawn to scale), B – towing on net, C – hauling net.