

JUVENILE SALMON AND NEARSHORE FISH USE IN SHALLOW INTERTIDAL HABITAT ASSOCIATED WITH CORNET BAY - 2014



2013 Aerial view of Cornet Bay nearshore area restored in 2012.

Source: www.SkagitCounty.net/maps/Imap, 2014

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INTRODUCTION

This report summarizes the results of beach seine fish sampling conducted in 2014 in association with nearshore habitat restoration at the Cornet Bay Day Use Area of Deception Pass State Park in Island County, Washington (Figure 1). The project, initiated in 2009 by the Island County Marine Resources Committee (MRC) and conducted in collaboration with Washington State Parks and the Northwest Straits Marine Conservation Foundation includes the restoration of approximately 1.24 acres of modified shoreline to natural habitat conditions.



Figure 1. Satellite photo showing Deception Pass Bridge upper left and Cornet Bay lower center.

The yellow line indicates approximate boundary of Cornet Bay with Skagit Bay. Red box delineates area of Cornet Bay Restoration Project in Deception Pass State Park (Schmidt, 2013a).

The area selected for restoration contains four boat launch ramps, a T-shaped public pier used for mooring boats and for fishing, and a Washington State Parks' Marine Crew maintenance pier, closed to the public (Figure 2). Shoreline modifications and fill imported on-site in the 1970s, converted the upper intertidal shoreline into a flat upland bench planted with grass (Figure 3).

Shoreline restoration completed in 2012 to improve nearshore habitat in Cornet Bay included the removal 65.1 tons (approximately 750 linear feet) of creosote bulkhead and 79.8 tons of contaminated fill, re-grading of the topography to natural slope conditions, the placement of 1,200 tons of beach spawning gravel in the intertidal zone. Native emergent and upland shoreline buffer vegetation was installed in approximately 0.5 acres of the project site (Figure 4).



Figure 2. The red box in this 2006 photo outlines the area selected for restoration (Schmidt, 2013a).



Figure 3. Photo looking northeast at modified shoreline, including bulkhead at the west end of the project area prior to restoration. Photo taken at established Photo Monitoring Station 1 on March 20, 2009.



Figure 4. Photo of restored shoreline taken at on March 4, 2013. Bulkhead and fill removed and shoreline topography restored to enhance nearshore habitat for fish and other species.

Source: - Schmidt, 2013b (Appendix B)

The project supports annual fish sampling and public outreach and education at one of the most used boat launch sites in the state parks system. Fish sampling conducted annually since 2009, four years prior to the 2012 restoration, helped to characterize fish population and use at the project site. The sampling completed in 2013 represented the first year of post-restoration monitoring at the site. This 2014 report represents the sixth year of

monitoring after project initiation and the second year of sampling after the nearshore restoration was completed.

Additional information regarding the Cornet Bay restoration project and annual reports documenting the results of fish sampling in years 2009 – 2013 are available on the Island County Marine Resources Committee website:

(<http://www.islandcountymrc.org/Projects/Marine-Habitats/Cornet-Bay-Restoration.aspx>).

The template for this report is based on prior report formats and data.

METHODS

The use of beach seining techniques to understand juvenile salmon utilization of coastal lagoon habitats and adjacent beach sites started in Island County in 2002 with research focused on juvenile Chinook at sites in Skagit Bay (Beamer et al. 2003). Since then a number of studies have utilized this technique to assess nearshore fish use throughout Island County.

Small beach seine methodology uses an 80-foot (24.4 m) by 6-foot (1.8 m) by 1/8-inch (0.3 cm) mesh knotless nylon net. Average beach seine set area is 96 square meters (Skagit System Cooperative, 2003).

The small beach seines are used to sample fish in shallow intertidal areas at ten locations along the shoreline of Cornet Bay Day Use Area within Deception Pass State Park. Established in 2009, the sampling locations include four sites (#1-3 and #10) along the natural shoreline east of the boat ramps and six sites (#4-#9) to the west, where creosote armoring along the modified shoreline was targeted for removal during restoration (Figure 5). The selected seine areas are typically less than four feet deep (1.2 m).

Based on their outmigration patterns from natal freshwater rivers, juvenile salmon are expected to use the project's nearshore area from mid-February to mid-June. Sampling, generally scheduled to occur during +9 to +5 feet tides every two weeks, was conducted on February 21, March 7, March 21, April 4, April 18, May 2, May 16, May 30 and June 13, 2014.

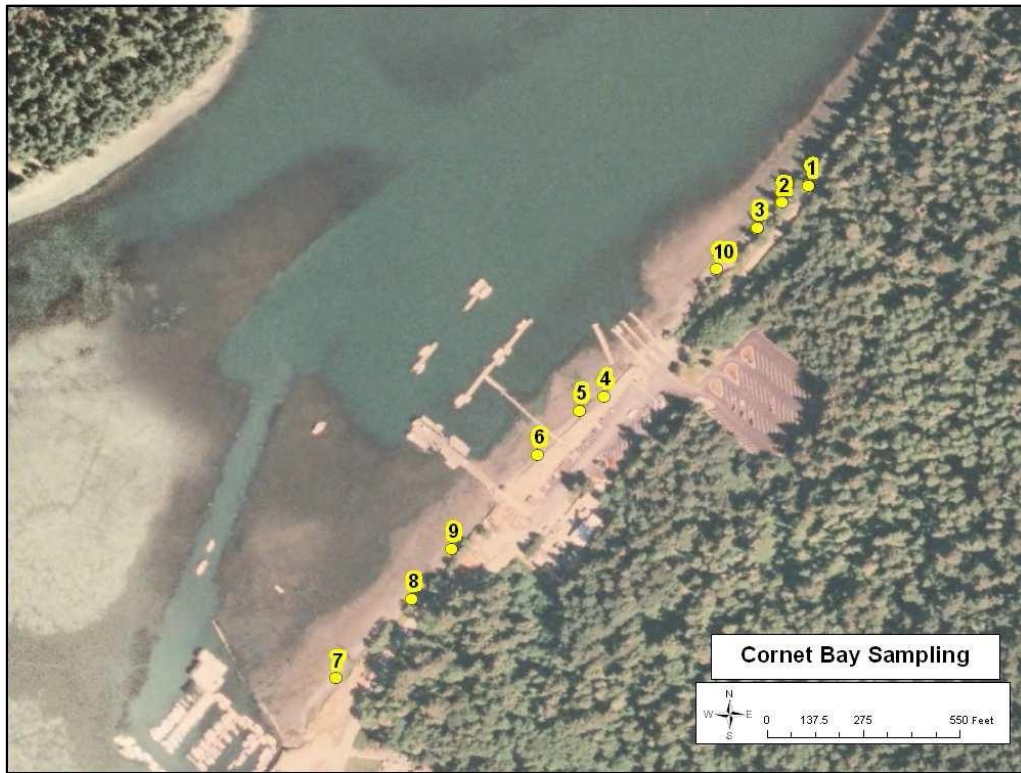


Figure 5. Established beach seine fish sampling locations at Cornet Bay (Keystone Environmental LLC, 2009).

One beach seine set was made at each of the 10 sites per sampling day. Recorded data for each beach seine set includes the time of net deployment, estimate of the percent of the net used and the maximum depth of the net, measured with a meter stick at the location furthest from the beach where the net was set. An YSI meter is used to measure water quality parameters, including water temperature, salinity and dissolved oxygen levels at each sample site at the time the seine is set. Water temperature and salinity measurements are taken on the bottom and on the surface of the water column at the maximum depth (called ‘full length’) and then again at the estimated halfway point back to shore (called ‘half length’). Dissolved oxygen levels are measured during the bottom parameter readings at the net edge farthest from shore.

Fish catch are identified and counted by species. The first 20 fish of each species are measured by fork length in millimeters at each of the ten sites. If the species of a particular

fish is in question, it is placed in a Photarium and a photograph is taken for verification later. All fish are released at site of capture.

RESULTS AND DISCUSSION

Beach Seine Effort

The Cornet Bay sampling effort in 2014 consisted of 90 beach seine sets made during the February to June time period (Table 1).

Table 1. Summary of beach seine sampling effort at Cornet Bay sites in 2014.

<i>Sampling effort (number of beach seine sets)</i>	
<u>Month</u>	<u>Seine</u>
February	10
March	20
April	20
May	30
June	10
Total	90

Environmental Conditions During Beach Seine Sampling

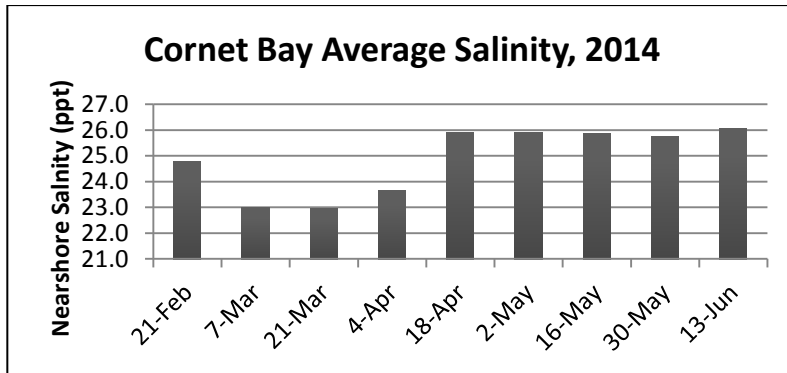
Salinity, Temperature, and Dissolved Oxygen

In 2014, the minimum daily salinity measured during fish sampling was 23.0 parts per thousand (ppt) and the maximum was 26.1 ppt. Average salinity measurements recorded during each sampling session are shown in Figure 6. It should be noted that water quality parameter readings recorded during beach seining are spot measurements and do not represent a continuously measured record for interpreting overall basin conditions.

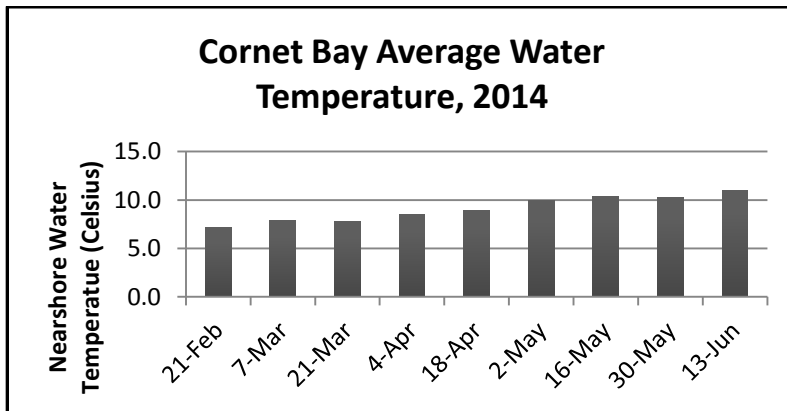
Water temperature in the Cornet Bay nearshore showed a seasonal increase from February through June. (Figure 7). Minimum and maximum water temperature measurements recorded during fish sampling in 2014 were 7.1 degrees Celsius and 11.0 degrees Celsius, respectively. The lowest and highest water temperatures measured to date during project beach seining were recorded as 5.9 degrees Celsius and 12.2 degrees Celsius in 2009 and 2012, respectively (Keystone, 2009 and Schmidt, 2013b).

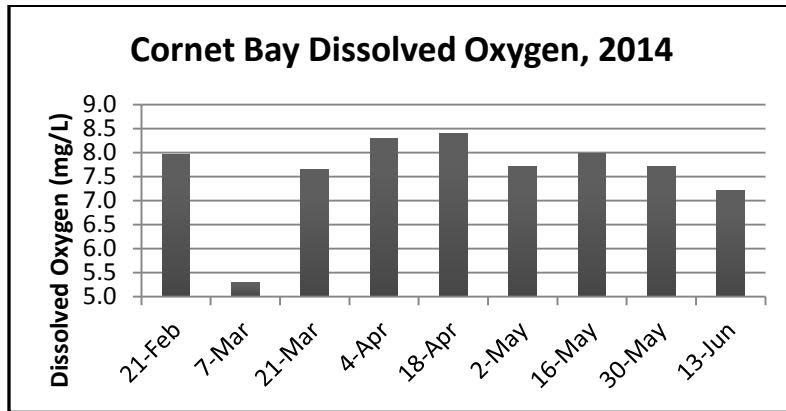
Dissolved oxygen (DO) fluctuated between 5.3 mg/L and 8.4 mg/L (Figure 8). Based on a review of prior years of project data, the March 7, 2014 DO reading of 5.3 mg/L is the lowest recorded during project fish sampling. Minimum DO readings between 6.1 mg/L and 7.3 mg/L have been recorded in prior years, which the exception of 2013 when a DO reading of

5.5 was recorded. The highest DO level recorded in association with project beach seining was recorded as 10.4 mg/L in 2009 (Keystone, 2009).



Figures 6, 7 and 8. Average salinity, water temperature and dissolved oxygen at Cornet Bay during beach seine fish sampling in 2014.





Catch by Species

A total of 20,080 fish representing at least 20 different species were caught during sampling in 2014 (Tables 2 and 3). Although all species in Table 2 were identified on one or more occasions, accuracy of identification of sculpin, gunnel and flatfish species was variable depending on the knowledge of the crew and the intensity of the catch on any given day. Therefore for quantitative analysis in Table 3 they are combined under unidentified sculpins, gunnels and flatfish.

Table 2. Fish species captured in 2014

<i>Fish Species</i>
Pink salmon <i>Oncorhynchus gorbusha</i>
Chum salmon <i>Oncorhynchus keta</i>
Chinook salmon <i>Oncorhynchus tshawytscha</i>
Coho salmon <i>Oncorhynchus kisutch</i>
Pacific staghorn sculpin <i>Leptocottus armatus</i>
Buffalo sculpin <i>Enophrys bison</i>
Great sculpin <i>Myoxocephalus polyacanthocephalus</i>
Sharpnose sculpin <i>Clinocottus acuticeps</i>
Starry flounder <i>Platichthys stellatus</i>
English sole <i>Parophrys vetulus</i>
Surf smelt, postnatal <i>Hypomesus pretiosus</i> Pacific
Sandlance <i>Ammodytes hexapterus</i>
Penpoint gunnel <i>Apodichthys flavidus</i>
Saddleback gunnel <i>Pholis ornate</i>
Shiner perch <i>Cymatogaster aggregate</i>
Snake prickleback <i>Lumpenus sagitta</i>
Threespine stickleback <i>Gasterosteus aculeatus</i>
Unidentified greenling
Lingcod <i>Ophiodon elongatus</i>
Dwarf wrymouth <i>Cryptacanthodes aleutensis</i>

As documented during the prior five years of sampling, juvenile salmon have consistently comprised the large majority of fish captured (Table 4). Juvenile salmon represented 91% of the total catch in 2014.

Table 3. Total fish catch (and mean catch per beach seine set in parentheses) by fish species at Cornet Bay sites in 2014.

<i>Fish species</i>	<i>Nearshore Catch</i>	
<u>Juvenile salmon:</u>		
Pink salmon <i>Oncorhynchus gorbuscha</i>	19,883	(220.92)
Chum salmon <i>Oncorhynchus keta</i>	201	(2.23)
Chinook salmon <i>Oncorhynchus tshawytscha</i>	71	(0.79)
Coho salmon <i>Oncorhynchus kitsutch</i>	11	(0.12)
Total juvenile salmon	20,166	(224.07)
<u>Sculpin species:</u>		
Unidentified sculpin	1,435	(15.94)
Total	1,435	
<u>Flatfish species:</u>		
Unidentified flatfish	242	(0.29)
Total	242	
<u>Forage fish species:</u>		
Surf smelt <i>Hypomesus pretiosus</i>	27	(0.30)
Pacific sand lance <i>Ammodytes hexapterus</i>	3	(0.0)
Total Forage Fish:	30	(0.33)
<u>Gunnel species:</u>		
Unidentified gunnel	65	(0.72)
Total	65	
<u>Other nearshore or estuarine fish species:</u>		
Unidentified greenling	17	(0.19)
Snake prickleback <i>Lumpenus sagitta</i>	44	(0.49)
Threespine stickleback <i>Gasterosteus aculeatus</i>	19	(0.21)
Shiner perch <i>Cymatogaster aggregate</i>	58	(0.63)
Lingcod <i>Ophiodon elongates</i>	3	(0.03)
Dwarf wrymouth <i>Cryptacanthodes aleutensis</i>	1	(0.01)
Total catch	22,080	(245.33)

Pink salmon dominate the fish catch in even years. The juvenile salmon catch in 2014 was dominated by pink (over 19,883), but included 201 chum, 71 Chinook and 11 coho salmon. Cutthroat trout, represented by one fish in 2011, and by two in 2013, was not present in the 2014 catch. The number of chum recorded during sampling in 2014 was less than counts recorded in prior years. In 2013, fish sampling resulted in the catch of 14,114 chum salmon, the highest count for this species since project sampling was initiated in 2009 (Schmidt, 2013b).

Table 4. 2009-2014 fish seining at Cornet Bay – salmonid species.

Year	No. of days	No. of sets	Total catch-all fish species	Salmonid Species:					% catch salmonid
				Chinook	Chum	Pink	Coho	Cutthroat trout	
2009	7	65	6,877	2	5,058	0	0	0	74%
2010	10	99	17,152	102	396	15,893	0	0	95%
2011	8	80	8,260	31	7,625	0	0	1	93%
2012	6	60	50,596	139	778	49,029	38	0	97%
2013	9	90	15,583	71	14,114	0	2	2	91%
2014	9	90	22,080	71	201	19,88	11	0	91%

Among non-salmon species, the most abundant have been sculpin, flatfish and gunnel species (Table 5). Sculpins, primarily Pacific staghorns, accounted for 6.5% of the total catch. Additional sculpin species identified included sharpnose, great and Buffalo. The other 2.2% of the catch included flatfish Starry flounder and English sole, Saddleback and penpoint gunnels, threespine stickleback, snake prickleback, greenling, lingcod, surf smelt, Pacific sandlance, dwarf wrymouth, and shiner perch. The number of perch (58) counted in 2014 was more than double the amount recorded during sampling in prior years.

Table 5. Non-salmon species caught in Cornet Bay seining 2009-2014 (all species with >20 captures in one or more years).

Year	Other fish species	Sculpin sp.	Flatfish sp.	Gunnel sp.	Greenling sp.	Snake prickle-back	Surf smelt	Herring	Shiner perch	% catch not salmonid
2009	1,817	1173	366	154	31	62	2	22	0	26%
2010	761	447	27	67	43	48	18	2	28	5%
2011	600	509	39	7	19	9	14	0	2	8%
2012	612	353	139	17	4	5	89	0	1	3%
2013	1,394	784	94	147	65	243	15	1	21	9%
2014	1,914	1435	242	65	17	44	27	0	58	9%

Juvenile Salmon

Table 6 details the number of each of the four salmon species caught during each sampling event in 2014. Juvenile coho were caught during sampling in the project area only in May. Chinook were caught during sampling in March, April and May. Chums were present from February through May. Pink salmon were present throughout the sampling period; however by mid June only 1 fish was caught.

The decline in salmon numbers in the project area's nearshore by late June is not necessarily evidence that they have left the vicinity of Cornet Bay. Smaller juvenile Chinook salmon (< 70 mm) appear to prefer low gradient, shallow water with fine-grained substrates (silts and mud), low salinity and low wave energy. As they increase in size, they move to deeper water and use a greater diversity of Puget Sound habitats. Habitat use for chum salmon also appears to be size dependent. Chum fry < 50-60 mm tend to migrate along the shore in water < 2 meters deep, and to move farther offshore as they increase to more than 60 mm in size (Fresh, 2006).

Table 6. Number of salmon captured at Cornet Bay sites in 2014 on each survey day, by species.

	<i>Chinook</i>	<i>Chum</i>	<i>Pink</i>	<i>Coho</i>	<i>Total salmon</i>
21-Feb	0	1	388	0	389
7-Mar	1	0	49	0	50
21-Mar	21	12	701	0	734
4-Apr	10	11	835	0	856
18-Apr	21	147	10,017	0	10,185
2-May	11	22	5,302	1	5,336
16-May	1	6	2,545	3	2,555
30-May	6	2	45	7	60
13-Jun	0	0	1	0	1

Fish Size

The size of juvenile salmon is characterized by measuring fork length. Figure 7 illustrates the mean fork length calculated for each of the salmon species on each sampling date.

Chinook

Average fork lengths ranged from 38 mm to 72 mm, with an average of 56 mm. (Figure 10). The average size of Chinook increased successively from the beginning of March through May (Figure 6).

Chum

Average fork lengths for measured Chum salmon ranged from 44 mm to 96 mm, with an average of 57 mm. Similar to Chinook, the average size of Chum increased successively from the beginning of sampling in February through May (Figure 6).

Pink

Average fork lengths for measured pink salmon ranged from 31 mm to 96 mm, with an average size of 39 mm. Similar to Chinook and chum, the average size of juvenile pink salmon increased successively from the beginning of sampling in February through May (Figure 6). The only fish caught on June 13 measured 50 mm in fork length.

Coho

The average fork length of the 11 Coho salmon caught during May sampling in 2014 is 97.3mm. The measured fork length of the 1 salmon caught on May 2 measured 100mm. The average fork lengths for coho measured on May 16 and May 30 were 93mm and 99mm, respectively.

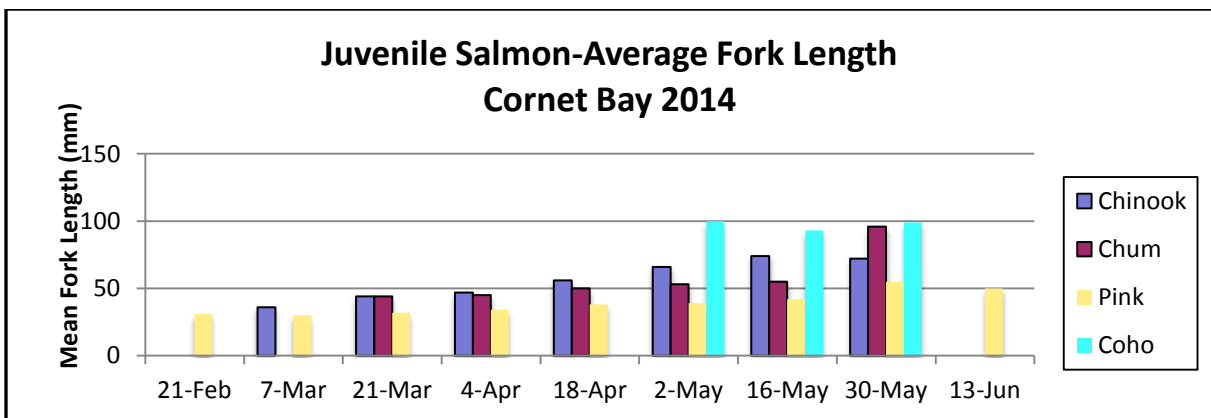


Figure 7. Average fork length of juvenile salmon measured at Cornet Bay, 2014.

Fish Community Composition

As in prior years, salmon and sculpin together represented over 99% of the total catch. Other fish species, comprising less than 1% of the catch, have been combined (Figure 8). Peak fish density, driven by juvenile pink salmon, occurred on April 18, 2014. Early in the season juvenile salmon dominated the fish community. By June, the fish community was dominated by other species, primarily sculpins.

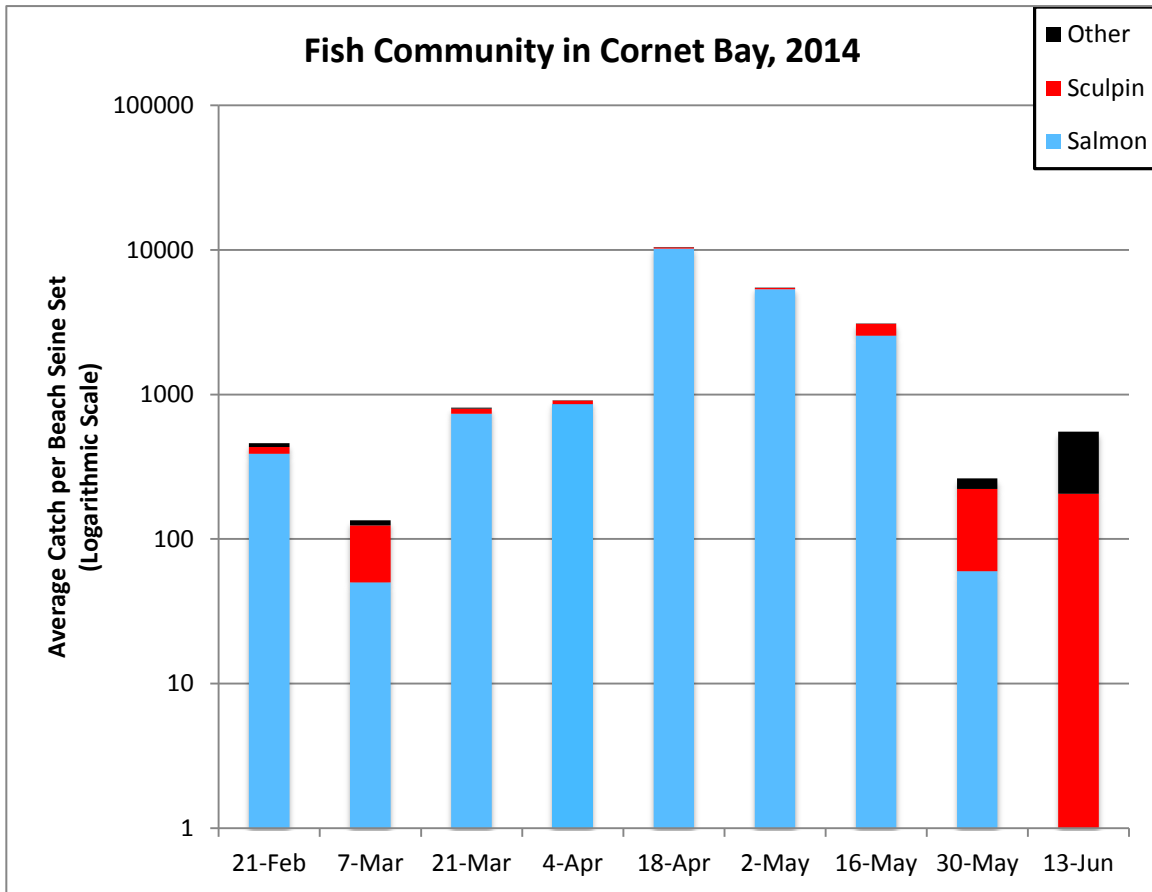


Figure 8. Fish community and relative abundance in Cornet Bay, 2014.

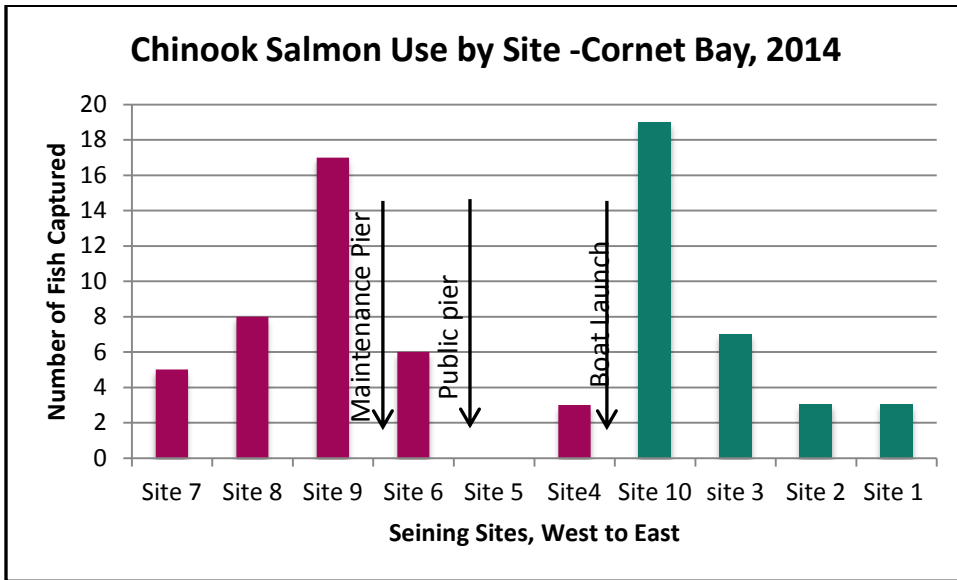
Variation in Fish Catch Among Sites

The number of fish netted each year at each sample site has been compared to determine whether there might be any clear differences in fish use among the ten sites (Schmidt, 2013a). All fish captured at each site over the season were combined. In 2009 and 2010 the fewest fish were caught at the three westernmost sites (#7-#9) and the highest number of fish captures were at the sites along unmodified shoreline east of the boat launch at Sites #1-#3 and #10. Between the boat launch and marine pier, more fish were caught at Site #6, in front of the accreting beach east of the marine pier, than at Sites #4 and #5, where beach scour from the bulkhead modifications occurred (Schmidt, 2010). This trend however did not continue in 2011, when the numbers of fish caught were more evenly dispersed and the highest number of fish captures were at Site #9 west of the marine maintenance pier (Schmidt, 2012). Fish captures in 2012 were broadly spread along the whole extent of the survey area (Schmidt 2013b). It was recognized that netting a single large school of fish can have a strong influence on the data.

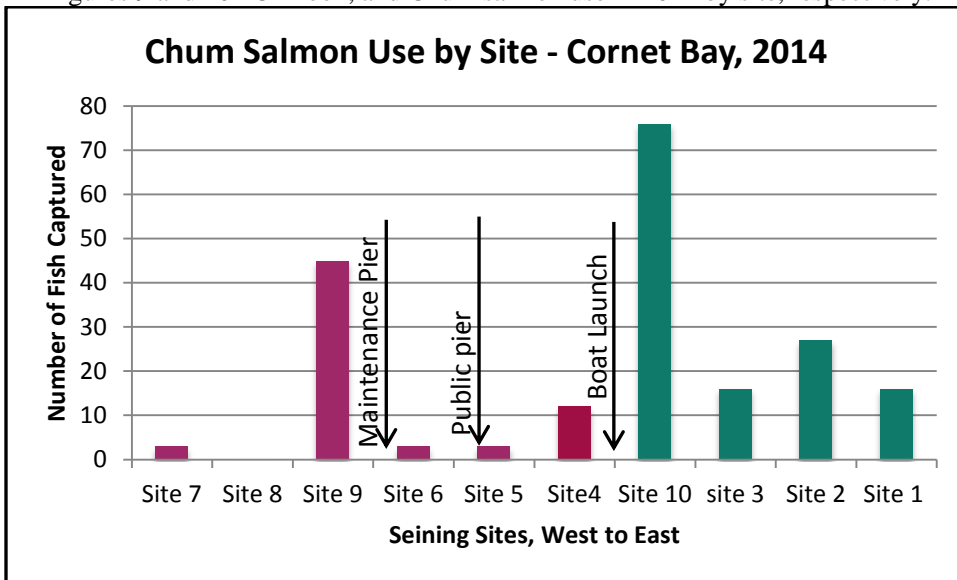
The 2013 fish sampling report concluded that the sampling sites should be examined on a species by species basis as a means to identify any variation in fish use among altered versus natural sites, or differences within sites pre- versus post-restoration. (Schmidt, 2013a). Although such differences are more likely to occur in resident non-salmon species than in the migratory salmon, this section presents site-specific data for the four salmon species caught in 2014. The four survey sites located along the “natural” shoreline northeast of the day use area in Figures 9 – 12 are shown in green, the six sites along the altered shoreline, now restored, are in red.

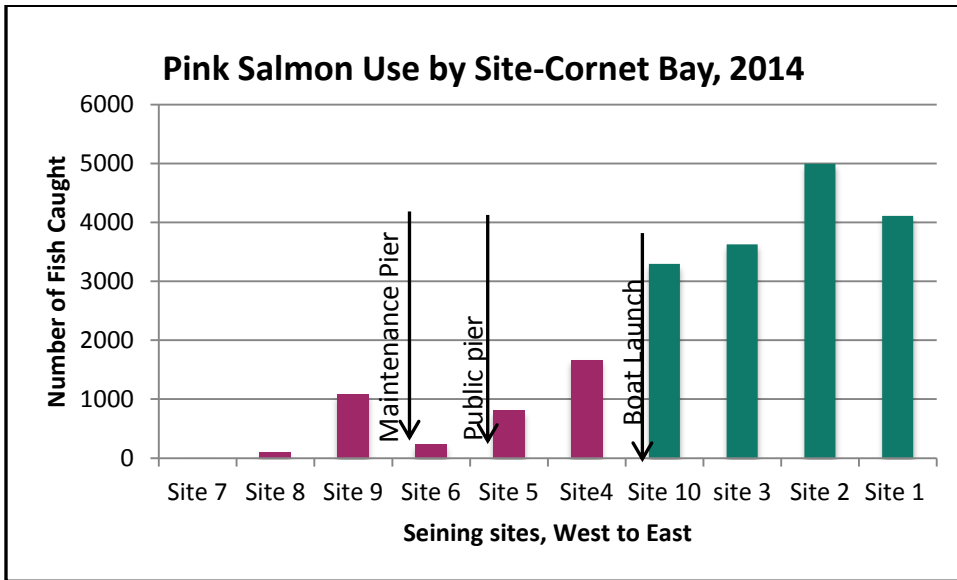
The total number of pink salmon (16,028) caught along the natural shoreline sites #1 -#3 and #10, located to the northeast of day use exceeded the total number of pink salmon (3,855) caught in the restored shoreline area (Figure 11). This trend was also realized for chum and coho salmon during the 2014 sampling (Figures 10 and 12). The total number of Chinook salmon caught at the restored western sites #4-#9 however was greater than those caught at the sites along the natural shoreline (Figure 9).

The largest catches of Chum and Chinook salmon (76 and 19 fish, respectively) recorded during the 2014 sampling were at Site #10, directly east of the boat launch. The second largest catches for each of these species (45 Chum, 17 Chinook) occurred at Site #9, west of the marine maintenance pier. The largest catches of pink (4,997) and coho (8) salmon occurred at Sites #2 and Sites #3, respectively. Catch sizes of over 3,000 pink salmon were recorded at each of the “natural” shoreline sites to the east of the boat launch. Pink salmon catch sizes to the west of the boat launch did not exceed 1,700.

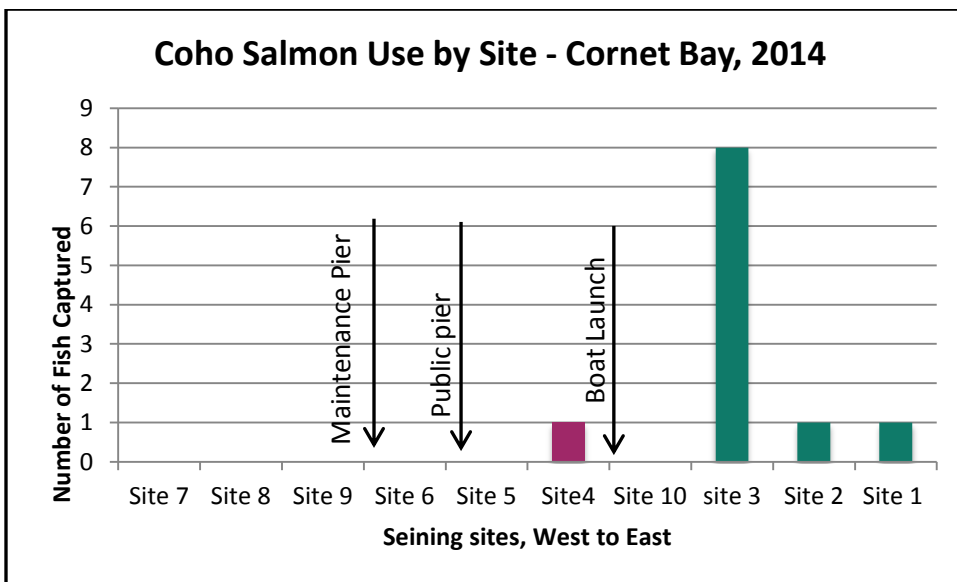


Figures 9 and 10 –Chinook, and Chum salmon use in 2014 by site, respectively.





Figures 10 and 11 –Pink and coho salmon use in 2014 by site, respectively.



SUMMARY

This report documents the sixth season of recording fish species composition and relative abundance in the shallow nearshore of the Cornet Bay day use area – four years of pre-restoration surveys along the altered shoreline and adjacent natural nearshore habitat, and two years of surveys after the restoration activity. At least two more years of post-restoration surveys are anticipated.

The surveys have established consistent use of the Cornet Bay shoreline by juvenile salmon in fry and parr stages, as well as by sculpins, gunnels, flatfish and other species. As the comparative pre- and post-restoration datasets accumulate, hypotheses should be established and tested statistically to look for effects of the restoration actions on the fish community.

Comparisons of the 2009-2014 project data with surveys of other areas of Skagit Bay shoreline has been recommended as a means to determine whether migratory salmon are more abundant in the Cornet Bay than other nearshore habitats.

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