# JUVENILE SALMON AND NEARSHORE FISH USE IN SHALLOW INTERTIDAL HABITAT ASSOCIATED WITH CORNET BAY RESTORATION, 2012

2006 oblique aerial photo of Cornet Bay Day Use Area (photo WA Department of Ecology).
Restoration area in red box.

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Island County Marine Resources Committee Juvenile Salmon Seining Project
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## PURPOSE OF THIS PROJECT

In 2006, the Island County Marine Resources Committee secured grant funding to initiate a shoreline restoration project in Island County. The site selected was the Cornet Bay day use area of Deception Pass State Park. Anticipated elements of restoration included removing creosote contaminated bulkheads that extended well below the high tide line, removing imported fill covering the upper intertidal zone, re-establishing forage fish spawning habitat and native vegetation, and restoring sediment transport processes. Finally, the project would be a vehicle for increasing public understanding of the importance of nearshore habitat restoration to salmon recovery.

Data collection on use of the nearshore at Cornet Bay by juvenile salmon and other fish began in 2009 as part of the characterization process of the bay prior to nearshore habitat enhancement projects at this location. The Island County Marine Resources Committee is working on this project collaboratively with WSU Beach Watchers, the Northwest Straits Foundation, and Washington State Parks.

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). The Beach Watchers have been a part of these research efforts since 2005 (Beamer et al. 2006, Beamer 2007, Beamer et al. 2007, Henderson et al. 2007, Kagley et al. 2007, Beamer et al. 2011, 2012).

This report is meant to inform local citizens and Cornet Bay project partners about fish populations currently using the Cornet Bay area. It focuses on fish species composition and relative abundance along the altered shoreline at the Cornet Bay Day Use Area and adjacent natural nearshore habitat in spring 2012, the fourth and final sampling season prior to restoration. Results of the previous three years were reported in Keystone Ecological (2009) and Schmidt (2010, 2012).

## STUDY AREA

Cornet Bay is located on the northern shoreline of Whidbey Island, in Deception Pass (Figure 1). This bay is located behind Ben Ure Island on the south shoreline of Deception Pass. The bay shoreline has been developed with boating and other recreational facilities; a road along the shoreline; and residences.

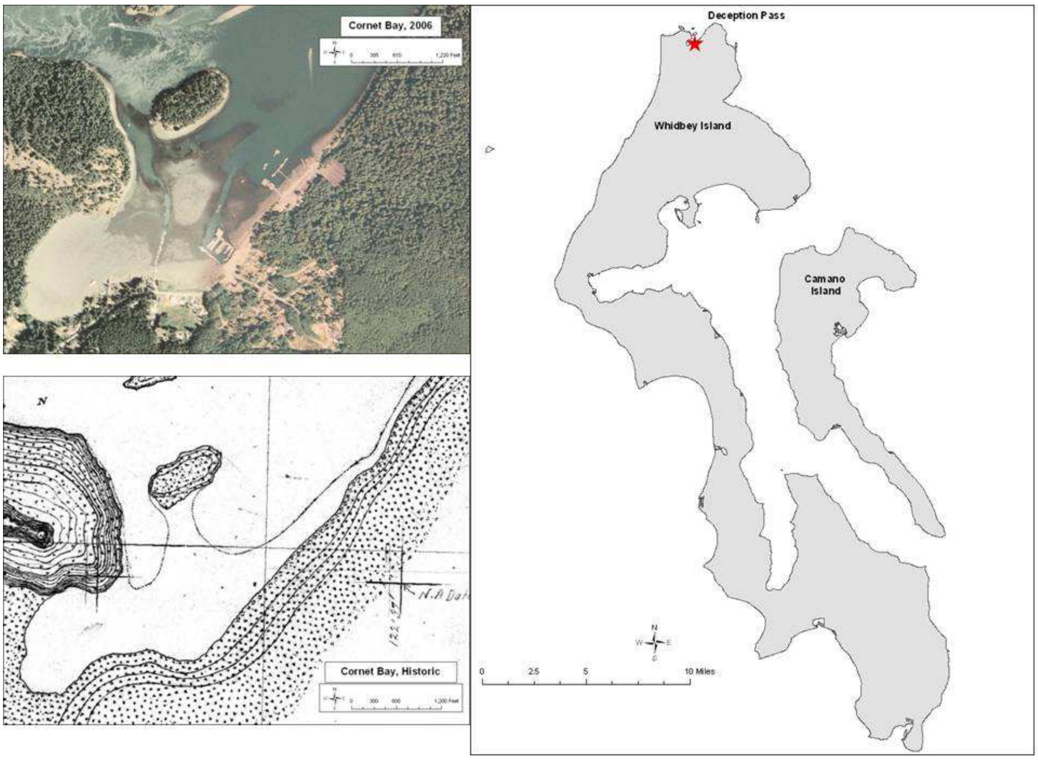


Figure 1. Location of Cornet Bay on north Whidbey Island, along with contemporary (2006) and historic (1871) views of the site. 2006 view from aerial photo, National Agriculture Imagery Program. Historic view from T-sheet 1252 (U.S. Coast and Geodetic Survey), available at the Puget Sound River History Project, University of Washington (http://riverhistory.ess.washington.edu).

## METHODS

Small beach seines were used to sample for fish in shallow intertidal areas along the shoreline of the Cornet Bay day use area within Deception Pass State Park.

Small-net 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 (SRSC Research Department, 2003). The areas seined are typically less than four feet deep (1.2 m), and have relatively homogeneous habitat features (water depth, velocity, substrate, and vegetation). 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 "upstream" against the water current (if present), hauling the net in a floating tote (Figure 2A), and then returning to the shoreline in a half circle. Both ends of the net are then retrieved (Figure 2B), yielding a catch. One beach seine set was made at each site per sampling day. Average beach seine set area is 96 square meters.

Figure 2A. Hauling the net in a floating tote.

Figure 2B. Setting the seine in "round haul" fashion.

For each beach seine set, we identified and counted the catch by species. Fork length was recorded on the first 20 of each species. We recorded the time and date of each beach seine set and measured several physical habitat parameters associated with each set, including water temperature, salinity and dissolved oxygen using a YSI meter.

Ten beach seine locations were established at the beginning of the study in 2009 (Figure 3). In 2012 these sites were sampled on six days from March through June. The sampling sites were selected to compare the fish community, including juvenile salmon, at different sites along Deception Pass State Park's Cornet Bay Day Use Area that is used for recreation and boating. Six sites (#4-9) were along the modified shoreline west of the boat ramps and four (#1-3, 10) were along the natural shoreline east of the boat ramps.

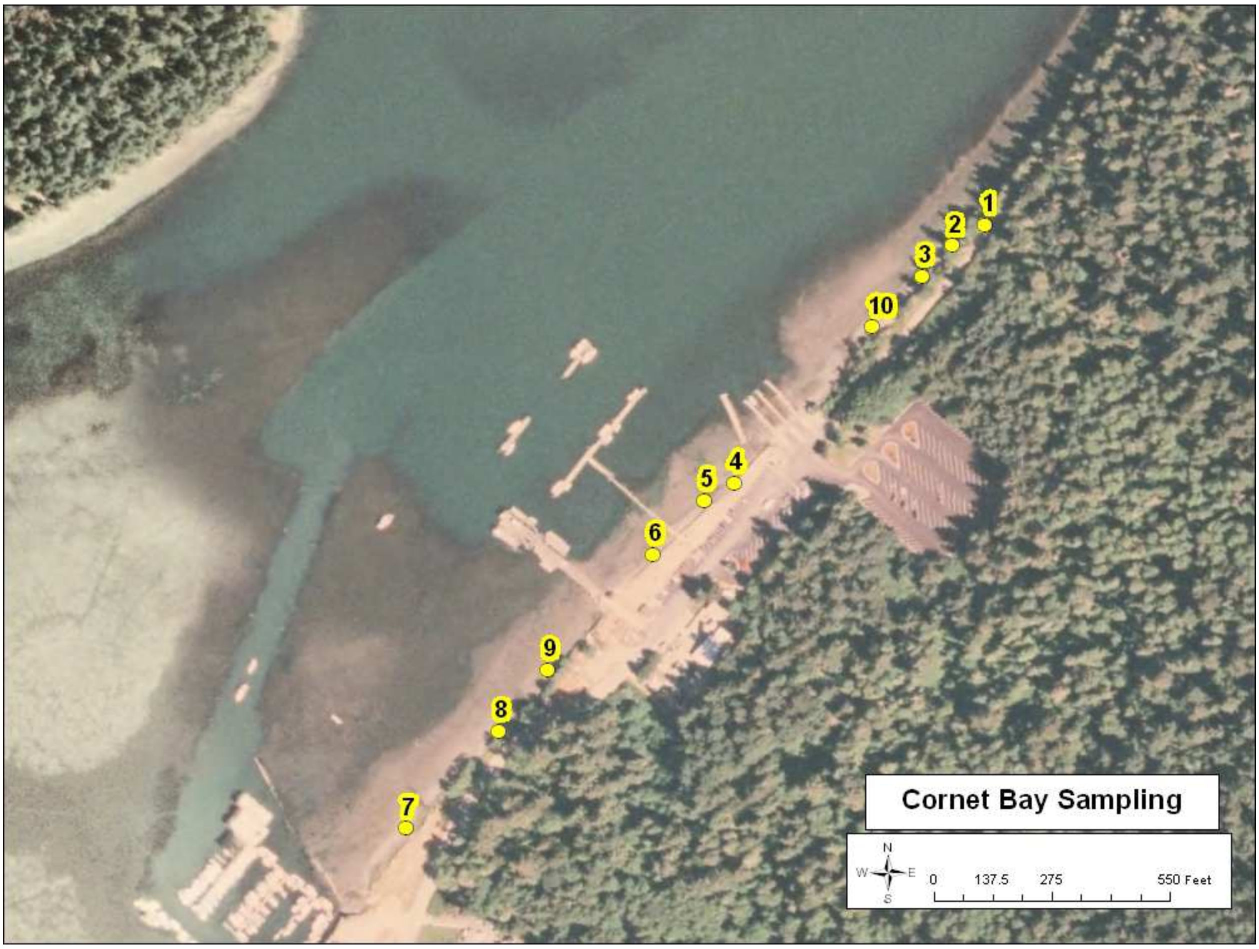


Figure 3. Location of beach seine sites at Cornet Bay, 2012. Yellow circles represent sampling sites. Beach seining was always done at the water's edge, independent of tidal stage.

## RESULTS AND DISCUSSION

### Beach Seine Effort

The Cornet Bay sampling effort in 2012 consisted of 60 beach seine sets made during the March through June time period (Table 1). The study design anticipated 7 or 8 sampling days, approximately 2 two weeks apart, between late February and mid-June. In 2012, 5 sampling days from March through May were completed under NMFS Scientific Research Permit 16612. This permit authorized capture of 150 juvenile Chinook salmon. The fish were so abundant that by the end of the field session on May 11, 138 Chinook had been netted. Another draw of the net could have exceeded the permit limit, so the seining surveys were halted. However, thanks to the support of the Skagit River System Cooperative who conducted a survey on June 11, we were able to add a sixth day of data for 2012.

Table 1. Summary of beach seine effort (number of sets) at Cornet Bay, 2012.

| ***Sampling effort (number of beach seine sets)*** | |
|---|---|
| Month | Seine Sets |
| March | 20 |
| April | 20 |
| May | 10 |
| June | 10 |
| Total | 60 |

### Environmental Conditions During Beach Seine Sampling

Tidal Stage and Water Depth

The majority of beach seine sampling occurred at depths slightly shallower than one meter of water (Table 2). Sampling dates were selected for tides that fell between +9 and +5.

Table 2. Water depth during beach seine sampling at Cornet Bay sites in 2012.

| ***Depth of beach area seined*** | |
|---|---|
| Maximum | 1.1 meters |
| Minimum | 0.2 meters |
| Average and 1 standard deviation (in parentheses) | 0.9 (0.13) meters |

Salinity, Temperature, and Dissolved Oxygen

Measurements of salinity, water temperature, and dissolved oxygen during each sampling session are shown in Figures 4A, 4B, and 4C. For each date, measures were recorded at each net set, then averaged for that day. Skagit River flow, which accounts for the majority of freshwater influencing Deception Pass, is shown in Figure 4D.[1]

In 2012 the minimum salinity measured was 20.7 ppt and the maximum was 29.5 ppt, with a particularly low reading on 27 April. Water temperature in the Cornet Bay nearshore showed a seasonal increase from March through June. Minimum water temperature was 7.1 degrees Celsius

[1] Because our Cornet Bay salinity, temperature and dissolved oxygen measurements are spot measures taken during the time of beach seining and are not a continuously measured record, they are likely insufficient for determining whether the monthly pattern of salinity for Cornet Bay varies as a function of overall Whidbey Basin salinity, which is known to be strongly influenced by the major rivers flowing into the Whidbey Basin.

and the maximum was 12.2 degrees Celsius. Dissolved oxygen fluctuated between 7.3 mg/L and 9.1 mg/L.

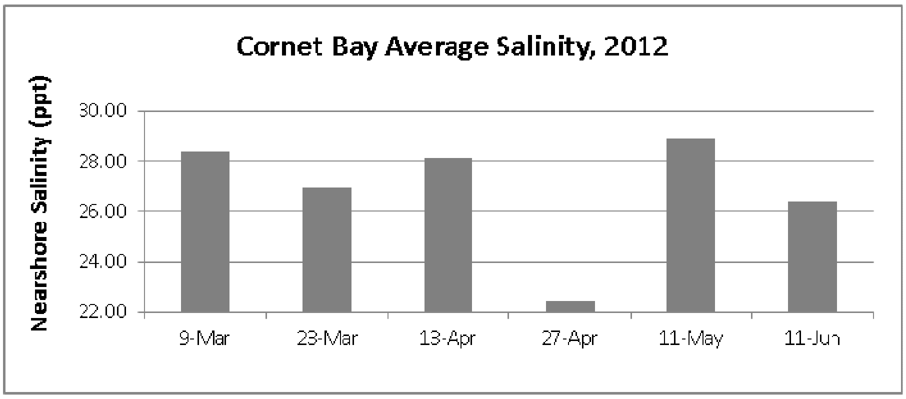


Figure 4A. Average salinity at Cornet Bay beach seine sites during the time of beach seining in 2012.

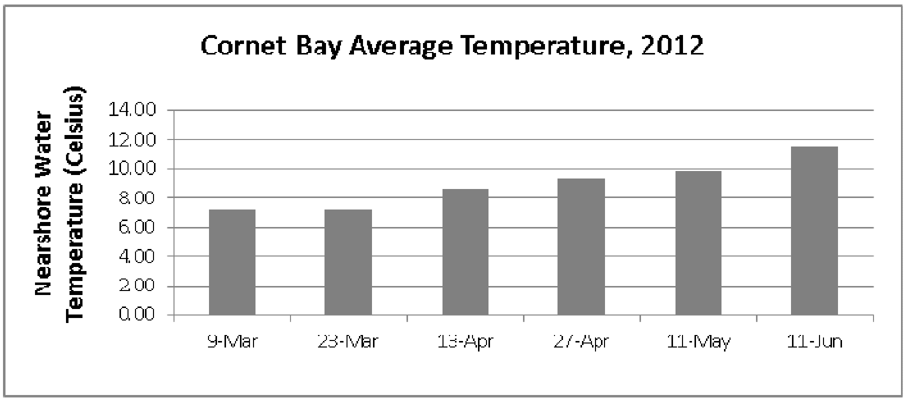


Figure 4B. Average temperature at Cornet Bay beach seine sites during the time of beach seining in 2012.

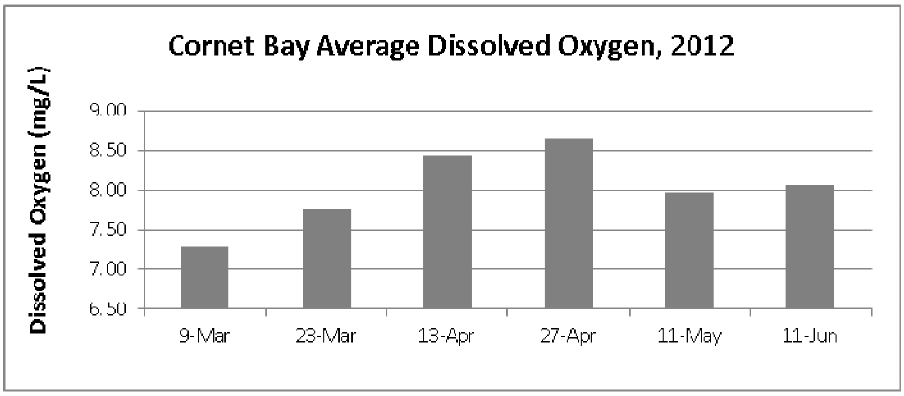


Figure 4C. Average dissolved oxygen at Cornet Bay beach seine sites during the time of beach seining in 2012.

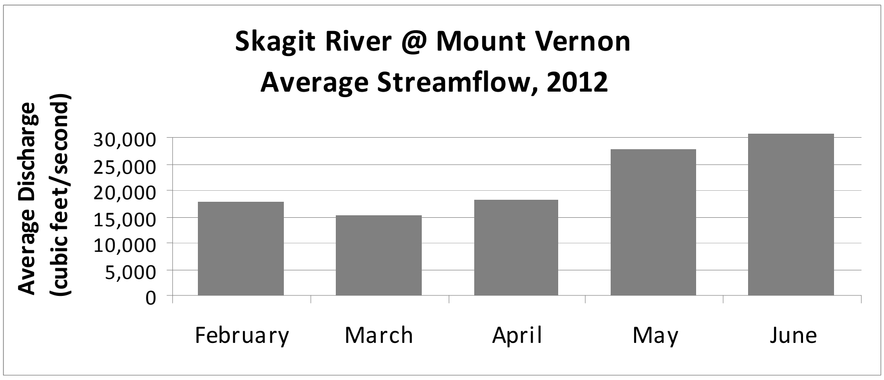


Figure 4D. Monthly average streamflow of the Skagit River at Mount Vernon for 2012.

## Catch by Species

We recorded 50,596 fish representing at least 17 different species during the sampling period March through June, 2012 (Tables 3 and 4). Although all species in Table 4 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 to be processed on any given day. Therefore for quantitative analysis they are combined under “unspecified" sculpins, flatfish and gunnels.

Juvenile salmon represented 97% of the total catch (Table 5). The salmon catch was dominated by pink (49,029), but included 778 chum and 38 coho as well as 139 Chinook salmon.

Less than 2% of the catch consisted of 13 other fish species: sculpins, primarily Pacific staghorns, flatfish, surf smelt, gunnels and a very small number of the other species.

Table 3. Total fish catch by species at Cornet Bay sites in 2012. (Mean catch per beach seine set is in parentheses; there were 60 sets.)

| ***Fish species*** | ***Nearshore catch*** | |
|---|---|---|
| Juvenile salmon: | | |
| Chinook salmon *Oncorhynchus tshawytscha* | 139 | (2.3) |
| Chum salmon *Oncorhynchus keta* | 778 | (12.0) |
| Coho Salmon *Oncorhynchus kisutch* | 38 | (0.6) |
| Pink Salmon *Oncorhynchus gorbuscha* | 49,029 | (817.1) |
| **Total juvenile salmon** | 49,984 | |
| Sculpin species: | | |
| Unspecified sculpin | 353 | (5.9) |
| Flatfish species: | | |
| Unspecified flatfish | 139 | (2.3) |
| Forage fish species: | | |
| Sandlance *Ammodytes hexapterus* | 1 | (<0.1) |
| Surf smelt *Hypomesus pretiosis* | 89 | (1.5) |
| Gunnel species: | | |
| Unspecified gunnel | 17 | (0.3) |
| Other nearshore or estuarine fish species: | | |
| Whitespot greenling *Hexagrammos stelleri* | 4 | (<0.1) |
| Threespine stickleback *Gasterosteus aculeatus* | 2 | (<0.1) |
| Snake prickleback *Lumpenus sagitta* | 5 | (<0.1) |
| Shiner perch *Cymatogaster aggregata* | 1 | (<0.1) |
| Pacific tomcod *Microgadus proximus* | 1 | (<0.1) |
| **All fish** | **50,596** | **(843)** |

Table 4. Fish species captured in 2012.

| |
|---|
| Chinook salmon *Oncorhynchus tshawytscha* |
| Chum salmon *Oncorhynchus keta* |
| Pink salmon *Oncorhynchus gorbuscha* |
| Coho salmon *Oncorhynchus kisutch* |
| Pacific staghorn sculpin *Leptocottus armatus* |
| Sharpnose sculpin *Clinocottus acuticeps* |
| Silverspot sculpin *Blepsias cirrhosus* |
| Starry flounder *Platichtys stellatus* |
| Surf smelt, postnatal *Hypomesus pretiosis* |
| Sandlance *Ammodytes hexapterus* |
| Whitespot greenling *Hexagrammos stelleri* |
| Saddleback gunnel *Pholis ornate* |
| Crescent gunnel *Pholis laeta* |
| Threespine stickleback *Gasterosteus aculeatus* |
| Snake prickleback *Lumpenus sagitta* |
| Shiner perch *Cymatogaster aggregate* |
| Pacific tomcod *Microgadus proximus* |

This was the fourth consecutive year that fish were sampled at these shallow intertidal habitat sites in Cornet Bay. Juvenile salmon have consistently comprised the large majority of fish captured. Even years are dominated by pink salmon, and 2012 saw a large run in Cornet Bay (Figure 4). With less than 2/3 as many sampling days as the last pink year in 2010, more than three times as many pinks were captured in 2012 (Table 5).

Table 5. Summary of 2009-2012 fish seining at Cornet Bay.

| ***Year*** | ***No. of days*** | ***No. of sets*** | ***Total catch*** | ***Chinook salmon*** | ***Chum salmon*** | ***Pink salmon*** | ***Coho salmon*** | ***Other fish species*** | ***% catch salmonid*** |
|---|---|---|---|---|---|---|---|---|---|
| 2009 | 7 | 65 | 6,877 | 2 | 5,058 | 0 | 0 | 1,817 | **74%** |
| 2010 | 10 | 99 | 17,152 | 102 | 396 | 15,893 | 0 | 761 | **95%** |
| 2011 | 8 | 80 | 8,260 | 31 | 7,625 | 0 | 0 | 600 | **93%** |
| 2012 | 6 | 60 | 50,596 | 139 | 778 | 49,029 | 38 | 612 | **97%** |

Figure 4. As many as 7,000 fry sized pink salmon might be netted in a single haul. They were transferred to a tub of aerated water for identification and counting before being released at the site of capture.

**Juvenile Salmon**

In this section we discuss the timing, abundance, and size of juvenile salmon in Cornet Bay. Peak salmon abundance was in April-May (Table 6).

Table 6. Number of salmon captured at Cornet Bay sites in 2012 on each survey day, by species.

| | ***Chinook*** | ***Chum*** | ***Pink*** | ***Coho*** | ***Total salmon*** |
|---|---|---|---|---|---|
| 9-Mar | 1 | 3 | 125 | 0 | 129 |
| 23-Mar | 3 | 2 | 125 | 0 | 130 |
| 13-Apr | 13 | 91 | 4,407 | 1 | 4,512 |
| 27-Apr | 28 | 296 | 27,380 | 0 | 27,704 |
| 11-May | 93 | 327 | 16,946 | 36 | 17,402 |
| 11-Jun | 1 | 59 | 46 | 1 | 107 |

<u>Fish Size</u>

At each draw of the net, the first 20 fish of each species were measured before release. Additional fish were just counted and released. For abundant species therefore, the number measured (Figure 5) was much less than the overall number captured (Table 6). The size of juvenile salmon was characterized by measuring fork length. To compare them, we calculated mean fork length for each species on each sampling date (Figure 6). Coho were omitted from the figure due to small sampling size.

*Chinook*

Juvenile Chinook salmon were present from March to June. Of 139 captured, 137 were measured. Fork length ranged from 35 mm to 80 mm, with an average of 52 mm (1 standard deviation = 8.8).

*Chum*

Juvenile chum salmon were found from March to June. Of 778 captured, 389 were measured. Fork length ranged from 30 mm to 80 mm, with an average of 45 mm (1 standard deviation = 6.8).

*Pink*

The primary salmon species captured in 2012 was pink salmon. Juvenile pinks were present from March into June. Peak pink salmon abundance occurred in April and May, with a high of 27,380 captured on 27 April. Of 49,029 captured, 609 were measured. Fork length ranged from 20 mm to 67 mm, with an average of 39 mm (1 standard deviation = 6.6).

*Coho*

For the first time in four years of seining, we captured a number of juvenile coho salmon. Of 38 captured, 24 were measured. Fork length ranged from 52 mm to 125 mm, with an average of 78 mm (1 standard deviation = 21.2). Juvenile coho are larger than other salmon species when they reach Whidbey shorelines because they remain in their natal stream as fry for 1-3 years.

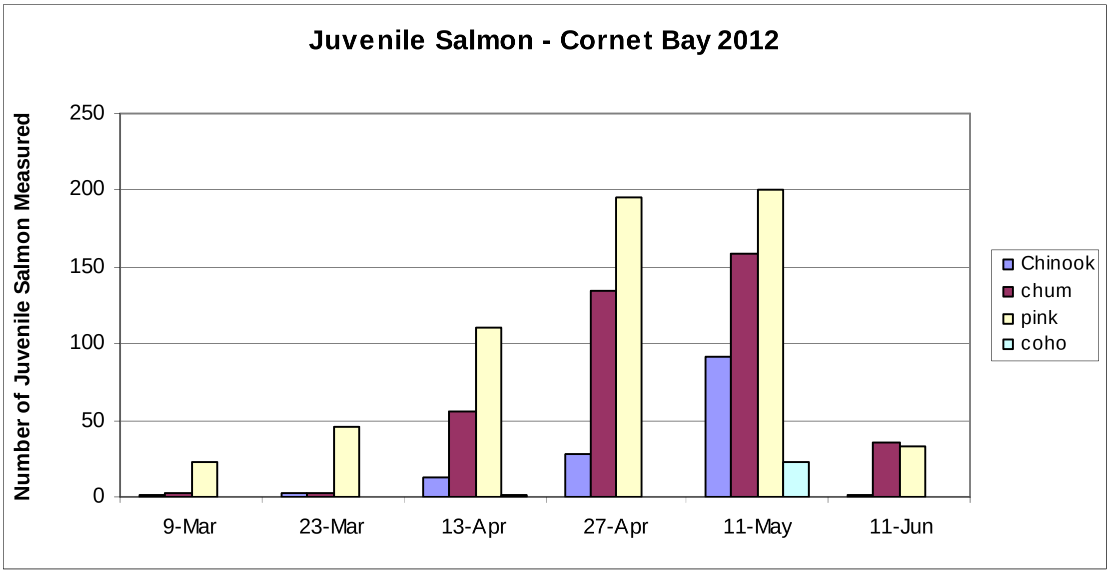


Figure 5. Number of juvenile salmon measured at Cornet Bay, 2012.

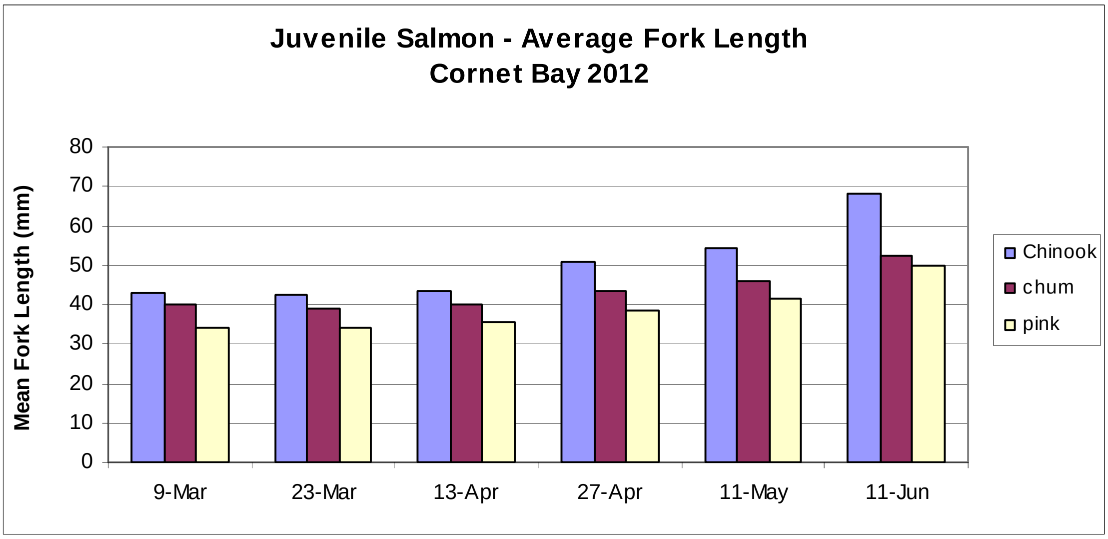


Figure 6. Average fork length of juvenile salmon measured at Cornet Bay, 2012.
Note variation in sample size (Figure 6). Coho omitted due to small sample size.

## Fish Community Composition

During the 2012 March to June sampling period in Cornet Bay, salmon and sculpin represented over 99% of the total catch. Other fish species, comprising less than 1% of the catch, have been combined (Figure 7). Peak fish density was on April 27 and was driven by juvenile pink salmon. By June the fish assemblage was dominated by non-salmon species, primarily sculpin.

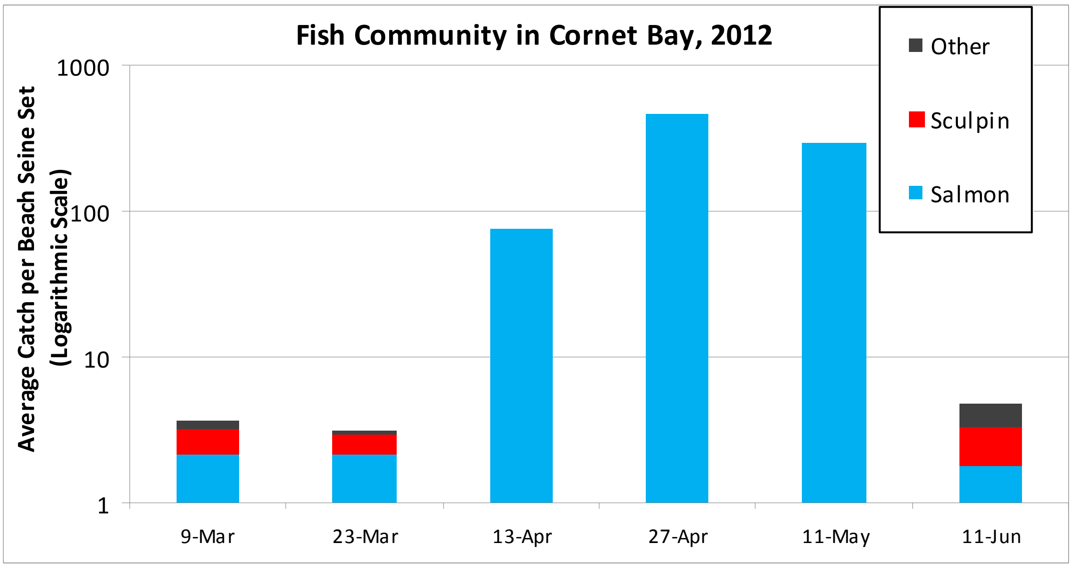


Figure 7. Fish community and relative abundance in Cornet Bay, 2012.

## Variation in Fish Catch Among Sites

The number of fish netted at each sample site might indicate differences in fish use among the ten sites, particularly between the “altered” and “natural” shoreline. For the following graphs, all fish captures at each site over the season were combined. In 2009 and 2010 the fewest fish were caught at the three western-most sites and the highest number of fish captures were at the sites along unmodified shoreline east of the boat launch (Figures 8A and 8B). In 2011 the numbers were more evenly dispersed and the highest number of fish captures were at site 9 west of the marine pier (Figure 8C). Fish captures in 2012 were broadly spread along the whole extent of the survey area (Figure 8D).

These graphs cannot be used to draw conclusions about shoreline areas preferred by fish. Netting a single large school of fish can have a strong influence on the data. In future we plan to examine species-specific data to determine whether any variation among sites can be statistically supported.

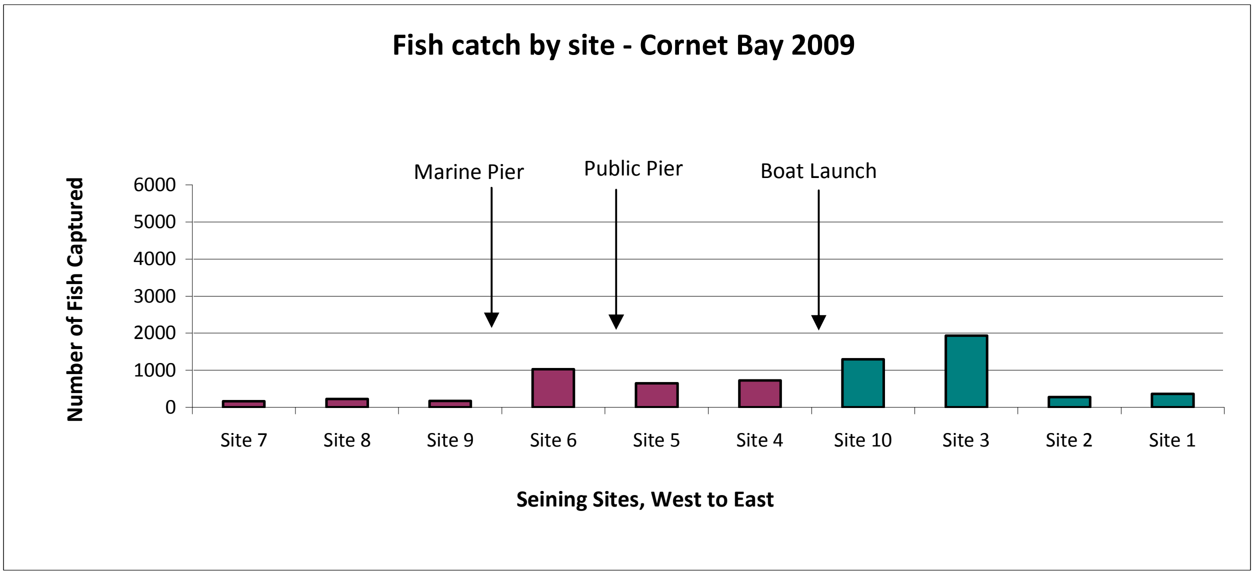


Figure 8A. Fish captures Cornet Bay, 2009: green sites on “natural shoreline, red on “altered” shoreline.

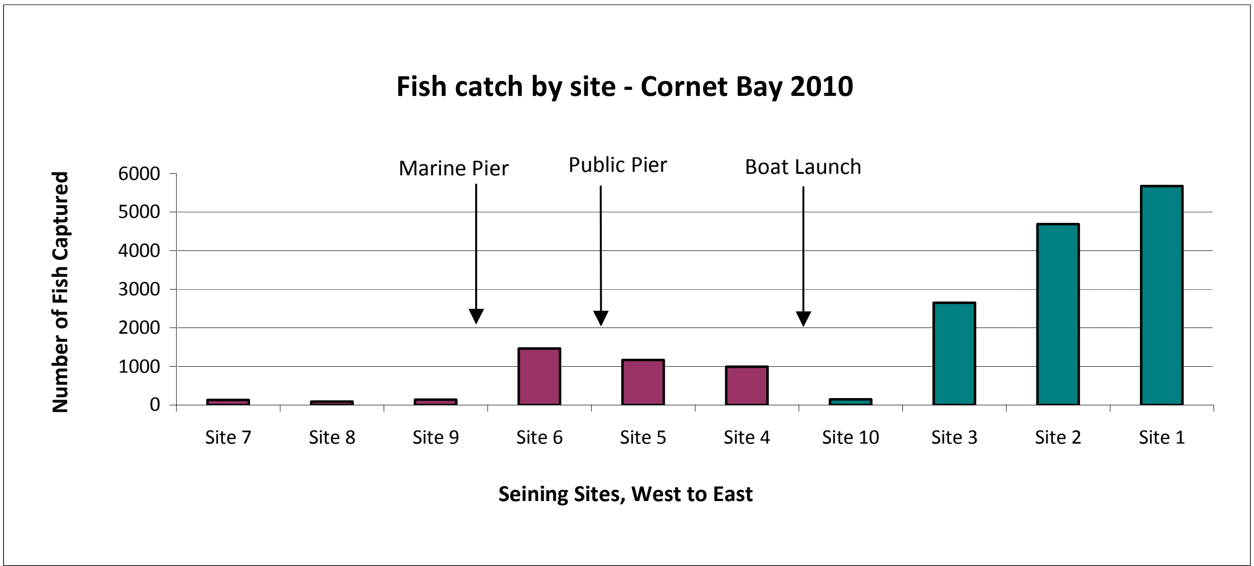


Figure 8B. Fish captures Cornet Bay, 2010: green sites on “natural shoreline, red on “altered” shoreline.

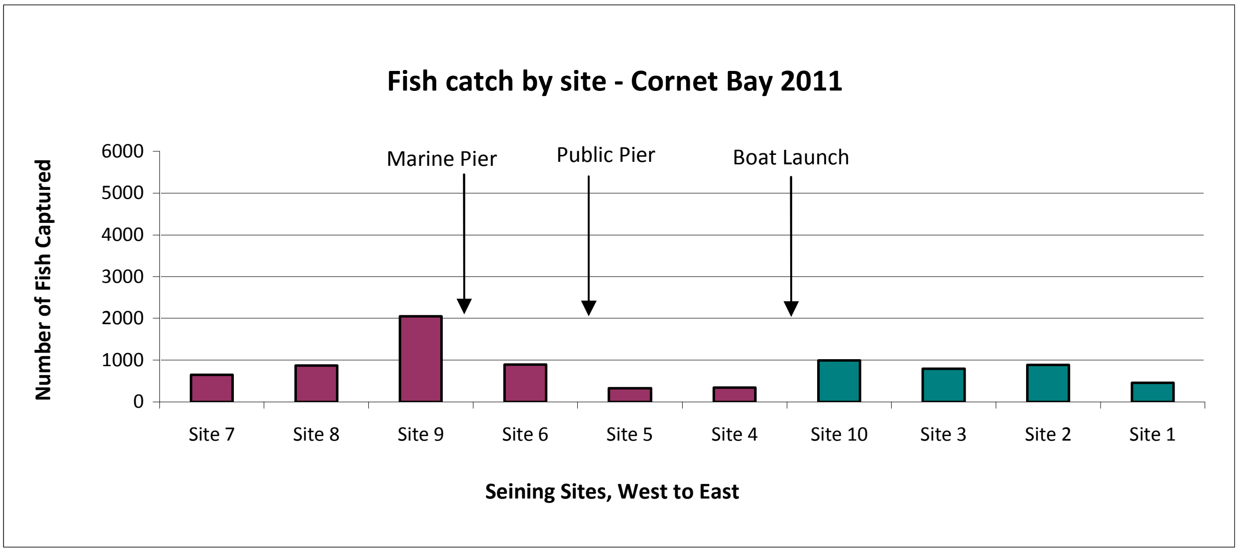


Figure 8C. Fish captures Cornet Bay, 2011: green sites on “natural shoreline, red on “altered” shoreline.

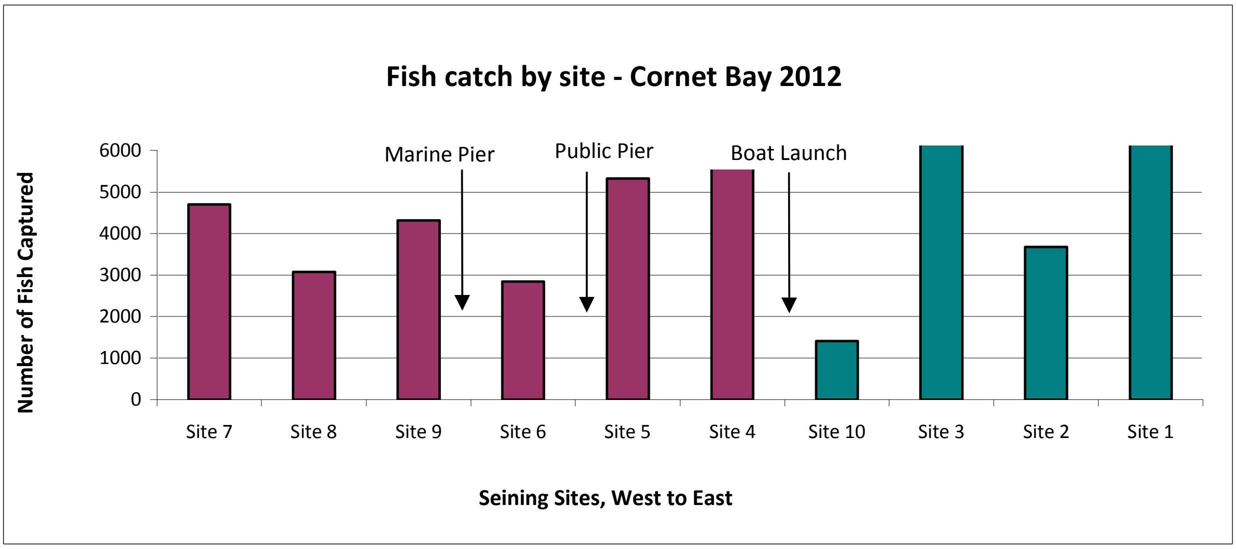


Figure 8D. Fish captures Cornet Bay, 2012: green sites on “natural shoreline, red on “altered” shoreline..

## SUMMARY

Four years of seining surveys at the Cornet Bay day use area have established consistent use of shallow nearshore waters by juvenile salmon—predominantly fry sized pink salmon (even years) and chum salmon (odd years). We have also documented the presence of juvenile wild Chinook salmon every year. In 2012 we also netted a small number of coho salmon. Other fish living in the Cornet Bay nearshore include sculpins, flatfish, gunnels, greenling, prickleback, surf smelt, Pacific herring, shiner perch and sandlance.

The 2012 surveys conclude four years of pre-restoration monitoring. Beach restoration took place in autumn 2012 and planting of native vegetation was completed in spring 2013.

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