JUVENILE SALMON AND NEARSHORE FISH USE IN SHALLOW INTERTIDAL HABITAT ASSOCIATED WITH CORNET BAY, 2010

July 2010

2006 oblique aerial photo of Cornet Bay (courtesy WA Department of Ecology)

Data collection by:
Jim Somers, Bob Buck, Finn Gatewood, Melissa Merickel, Jill Hein,
Bob Gentz, Ken Urstad, Tom Albrecht, Carla Corin, Mary Hulbert, Sandra Pollard,
Flossy Pearson, Joe Beck, Lee Chavez, Tillie Scruton, Terry and Gary Skorheim
Island County Beach Watchers Juvenile Salmon Seining Project
PO Box 5000; Coupeville WA 98239

Compiled by Sarah Schmidt, 243 Rhodena Drive, Coupeville, WA 98239
Integrated into 2009 report by Keystone Ecological LLC; PO Box 1165; Yelm WA 98597

ACKNOWLEDGEMENTS

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- Many thanks go to Kurt Fresh (NOAA Fisheries biologist) for making this project possible.
- 2010 seining conducted by WSU Beach Watchers
- Cornet Bay project partners: Island County Marine Resources Committee and Washington State Parks
- The format of this report is based on the template developed by Skagit River System Cooperative staff for other juvenile salmon seining projects.

NOTE: Much of the content of the 2009 report is repeated here. Text that has been updated or modified for 2010 is shown in green.

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PURPOSE

The WSU Island County Beach Watchers are working collaboratively with the Island County Marine Resources Committee and Washington State Parks. Collecting data about juvenile salmonid use of the nearshore at Cornet Bay is a part of the characterization process of the bay prior to nearshore habitat enhancement projects that are occurring at this location. The focus of this report is on fish abundance and size in Cornet Bay in 2010. This report is meant to inform local citizens and Cornet Bay project partners about fish populations currently using the Cornet Bay area.

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. The Beach Watchers have been a part of these research efforts since 2005.

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 shoreline has been developed with boating and other recreational facilities; a road along the shoreline; and residences.

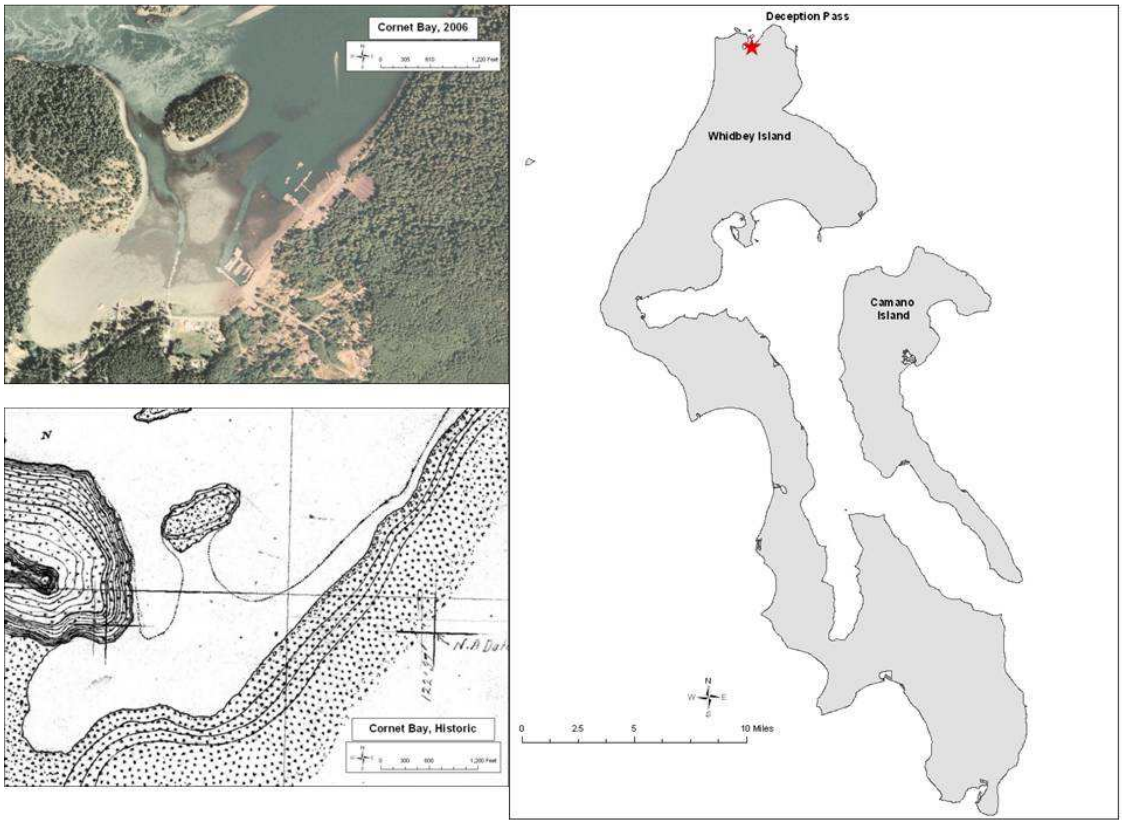

Figure 1. Location of Cornet Bay on north Whidbey Island, along with contemporary (2006) and historic views of the site. The 2006 view is from an aerial photo, National Agriculture Imagery Program. The historic view is from the T-sheet (U.S. Coast and Geodetic Survey), available at the Puget Sound River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

METHODS

Nearshore areas like Cornet Bay and its vicinity can potentially have many different local-scale habitat types based on variations in water depth, aquatic vegetation, substrate, protection from wave energy, and freshwater inputs (creeks or seeps). The illustration of these different habitats is from Skagit River System Cooperative and provides a conceptual nearshore beach cross-section that includes a lagoon impoundment behind a spit beach (Figure 2). For this study, small beach seines were used to sample for fish in shallow intertidal areas within the bay.

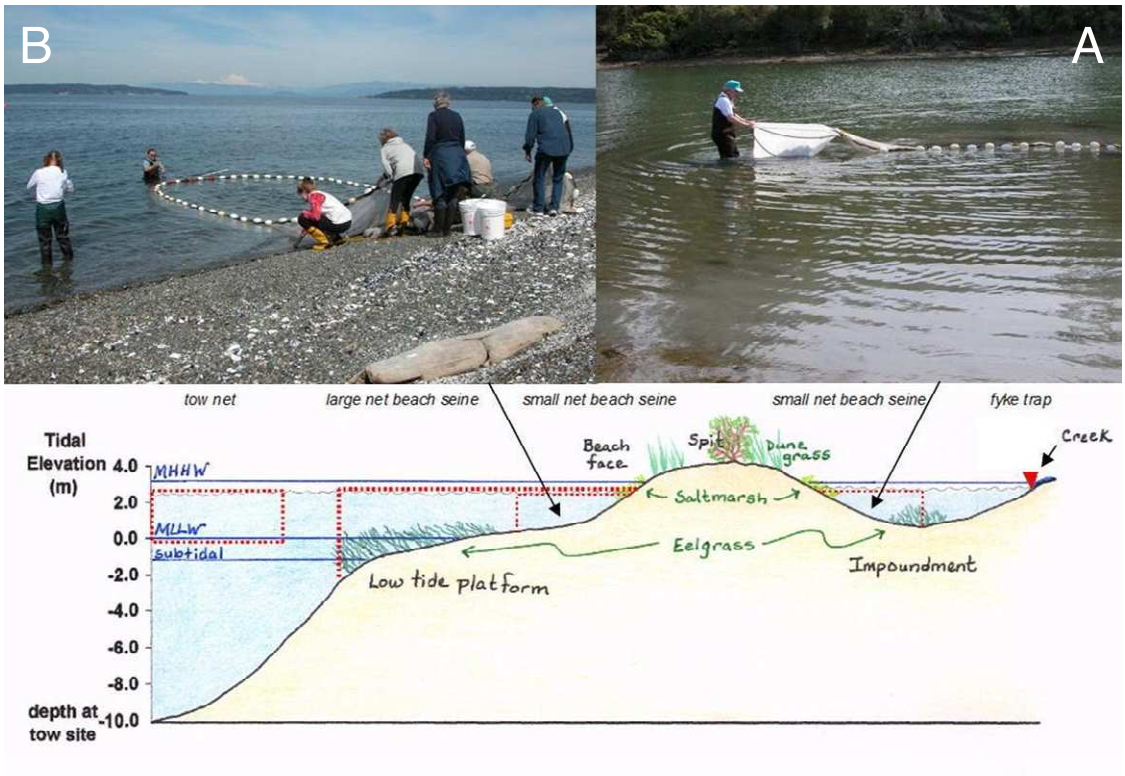

Figure 2. WSU Beach Watcher volunteers working with NOAA staff to beach seine sites at Harrington Lagoon. The diagram is a cross-sectional view of a nearshore beach that includes a coastal lagoon. The red dotted lines illustrate the relative difference in depth, cross-sectional area of the water column, and position along the nearshore continuum that each gear type effectively samples. The different gear types are labeled directly above the red dotted lines. The two photos are of small net beach seine sets at Harrington Lagoon. This study did not sample any deeper nearshore or offshore habitat adjacent to the Cornet Bay beaches. (Skagit River System Cooperative)

This study focused on only one of five habitat types shown in Figure 2 (briefly described above), the beach face. These sites were sampled on 10 days about two weeks apart, from mid-February through June, using a small beach seine. The study did not sample the deeper intertidal-subtidal fringe habitats with larger beach seines or offshore habitat with tow nets. No tidal creeks or blind tidal channels are present within Cornet Bay, so use of fyke traps was not necessary.

The specific beach seine locations are shown in Figure 3. 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). 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. 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.

For each beach seine set, we identified and counted the catch by species, and sub-sampled individual fish lengths by species. We also recorded the time and date of each beach seine set and measured several physical habitat parameters associated with each set, including:

- Tidal stage (ebb, flood, high, low)
- Surface and bottom water temperature of the area seined using YSI meter.
- Surface and bottom salinity of the area seined using YSI meter.
- Maximum depth of area seined

Beach seine sites were along the Cornet Bay shoreline (Figure 3). The sampling sites were selected to compare the fish community, including juvenile salmon, at different sites along the Deception Pass State Park area of Cornet Bay actively used for recreation and boating. Six sites are along the modified shoreline west of the boat ramps and four along the natural shoreline east of the boat ramps. In this report results are summarized for each sampling date.

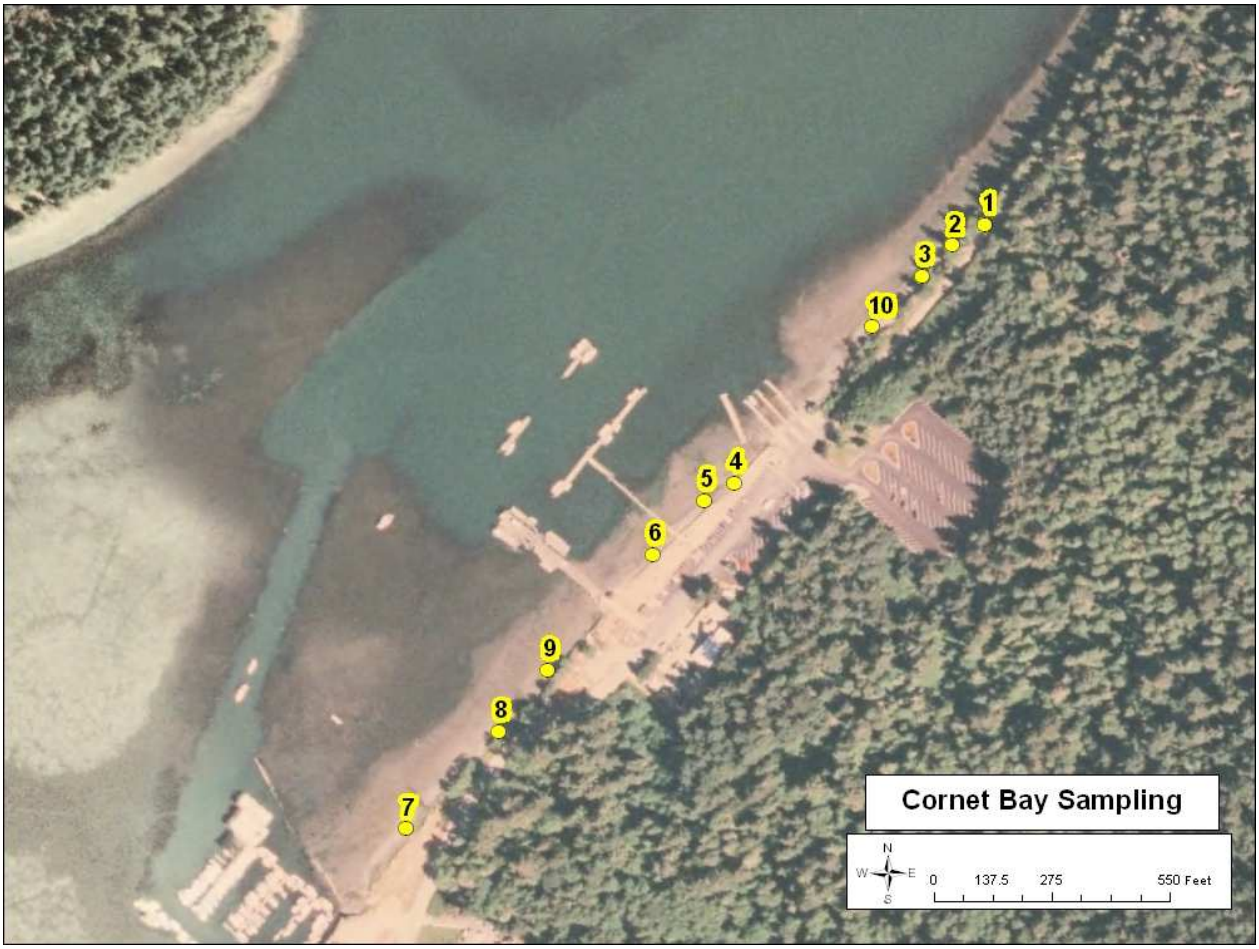

Figure 3. Location of beach seine sites at Cornet Bay, 2010. Yellow circles represent sampling sites. Beach seining was always done at the water's edge, independent of tidal stage.

RESULTS AND DISCUSSION

Beach Seine Effort

The Cornet Bay sampling effort in 2010 consisted of 99 beach seine sets made during the February through June time period (Table 1).

Table 1. Summary of beach seine sampling effort at Cornet Bay sites in 2009.

Sampling effort (number of beach seine sets)

Month	Seine Sets
February	10
March	20
April	30
May	19
June	20
Total	99

Environmental Conditions During Beach Seine Sampling

Tidal Stage, Water Depth, and Substrate

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 feel between +9 and +5. If sites 4-9 were not seined before the tide fell to +5 the substrate was too soft to walk in safely.

We have found that data sheet notations of substrate type (i.e., gravel, mixed coarse, mixed fines, mud) were subjective and inconsistent and did not accurately portray the variation in substrate conditions that the seining crew experienced along the natural and altered shoreline. This year a sediment sampling protocol will be adopted and specific sediment surveys conducted.

Table 2. Water depth during beach seine sampling at Cornet Bay sites in 2010.

Depth of beach area seined	
	Depth
Maximum	1.2 meters
Minimum	0.45 meters
Average and 1 standard deviation (in parentheses)	0.99 (0.1) meters

Temperature, Salinity, and Dissolved Oxygen

Monthly patterns of salinity, water temperature, and dissolved oxygen in Cornet Bay are shown in Figures 4A, 4B, and 4C. Due to malfunction of the YSI meter, readings were not taken on February 19 or April 16. Skagit River flow, which accounts for the majority of freshwater influencing Deception Pass, is shown in Figure 4D. The salinity, temperature and dissolved oxygen measurements are spot measures taken during the time of beach seining and are not a continuously measured record.

As reported last year, higher Skagit River flows in the 2009 seining season appeared correlated with lower salinities at Cornet Bay sites, but this pattern is not reflected in the spot measures for 2010 (compare Figure 4A with Figure 4D). Likely two spot measures a month are insufficient for determining whether the monthly pattern of salinity for Cornet Bay varies as a function of overall Whidbey Basin salinity, which is strongly influenced by the major rivers flowing into the Whidbey Basin. In 2010 the minimum salinity was 26.2 ppt and the maximum salinity measured was 28.8 ppt.

Water temperature in the Cornet Bay nearshore shows a seasonal increase from March through June (Figure 4B). The minimum water temperature was 7.9 degrees Celsius and the maximum measurement was 11.0 degrees Celsius. Dissolved oxygen in the Cornet Bay nearshore fluctuated between 6.1 mg/L and 9.5 mg/L.

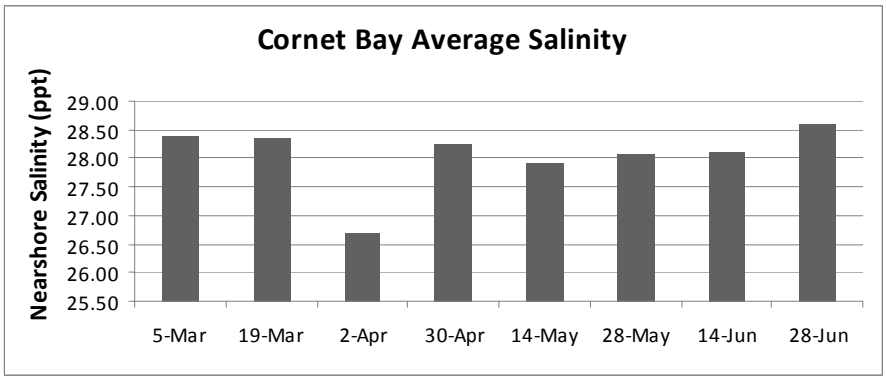

Figure 4A. Average salinity at Cornet Bay taken at the beach seine sites during the time of beach seining in 2010.

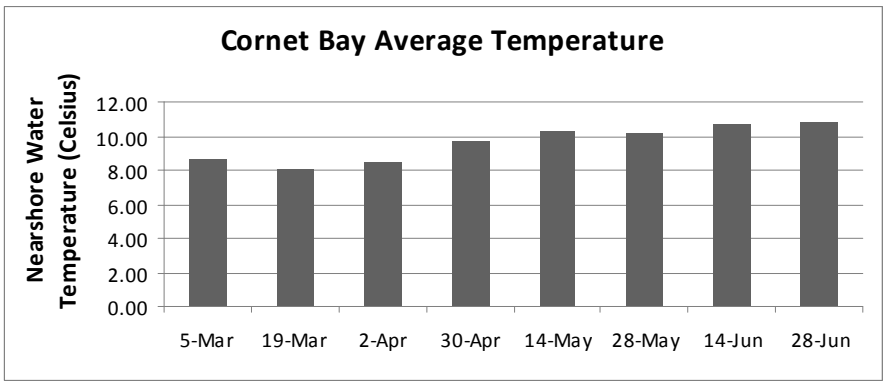

Figure 4B. Average temperature at Cornet Bay taken at the beach seine sites during the time of beach seining in 2010.

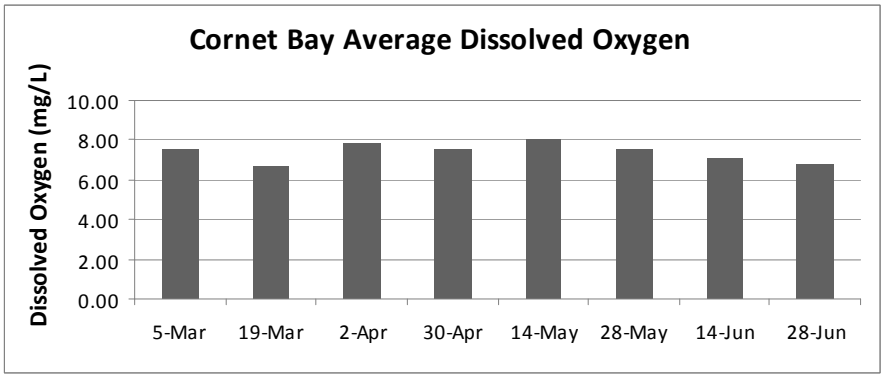

Figure 4C. Average dissolved oxygen at Cornet Bay taken at the beach seine sites during the time of beach seining in 2010.

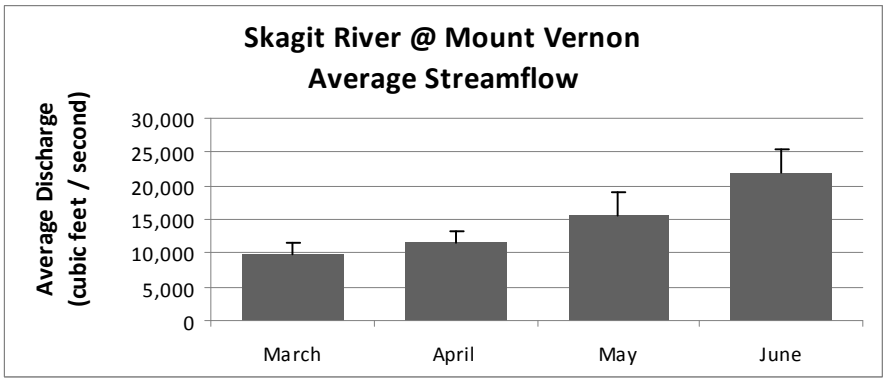

Figure 4D. Monthly average streamflow of the Skagit River at Mount Vernon for 2010.

Catch by Species

We caught over 17,150 fish representing at least 20 different species during the sampling period February through June, 2010 (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 on any given day. Therefore for quantitative analysis they are combined under unidentified sculpins, gunnels and flatfish.

Juvenile salmon represented over 95% of the total catch. The juvenile salmon catch was dominated by pink (over 15,000), but included 396 chum and 102 Chinook salmon. No other salmonid species were caught.

Sculpins, primarily Pacific staghorns, accounted for 2.6% of the total catch. The other 2.4% of the catch included gunnels, tubesnout, snake prickleback, greenling, flatfish, shiner perch, surf smelt, snailfish, threespine stickleback and herring.

Table 3. Total fish catch (and mean catch per beach seine set in parentheses) by fish species at Cornet Bay sites in 2010.

Fish species	***Nearshore Catch***
Juvenile salmon:	
Pink salmon *Oncorhynchus gorbuscha*	15,893 (160.54)
Chum salmon *Oncorhynchus keta*	396 (4.00)
Chinook salmon *Oncorhynchus tshawytscha*	102 (1.03)
Total juvenile salmon	**16,391**
Sculpin species:	
Unidentified sculpin	447 (4.52)
Total sculpins	**447**
Flatfish species:	
Unidentified flatfish	27 (0.27)
Total flatfish	**27**
Forage fish species:	
Pacific herring *Clupea pallasii*	2 (0.02)
Surf smelt *Hypomesus pretiosis*	18 (0.18)
Gunnel species:	
Unidentified gunnel	67 (0.68)
Total gunnels	**67**
Other nearshore or estuarine fish species:	
Unidentified greenling	43 (0.43)
Unidentified snailfish	12 (0.12)
Threespine stickleback *Gasterosteus aculeatus*	9 (0.09)
Snake prickleback *Lumpenus sagitta*	48 (0.43)
Shiner perch *Cymatogaster aggregata*	28 (0.28)
Tubesnout *Aulorhynchus flavidus*	60 (0.61)
Total catch	**17,152 (173.25)**

Table 4. Fish species captured in 2010

Fish Species
Pink salmon *Oncorhynchus gorbuscha*
Chum salmon *Oncorhynchus keta*
Chinook salmon *Oncorhynchus tshawytscha*
Pacific staghorn sculpin *Leptocottus armatus*
Buffalo sculpin *Enophrys bison*
Great sculpin *Myoxocephalus polyacanthocephalus*
Sharpnose sculpin *Clinocottus acuticeps*
Silverspotted sculpin *Blepsias cirrhosus*
Starry flounder *Platichtys stellatus*
Pacific herring *Clupea pallasii*
Surf smelt, postnatal *Hypomesus pretiosis*
Penpoint gunnel *Apodichthys flavidus*
Saddleback gunnel *Pholis ornate*
Crescent gunnel *Pholis laeta*
Unidentified greenling
Unidentified snailfish
Threespine stickleback *Gasterosteus aculeatus*
Snake prickleback *Lumpenus sagitta*
Shiner perch *Cymatogaster aggregata*
Tubesnout *Aulorhynchus flavidus*

Juvenile Salmon

In this section we discuss the timing, abundance, and size of juvenile salmon in Cornet Bay.

Chinook

Juvenile Chinook salmon were present in Cornet Bay from March through early June (Figure 5). Of the 102 captured, 59 were measured. Fork length ranged from 59 mm to 120 mm, with an average of 87 mm (1 standard deviation 19.2).

Chum

Juvenile chum salmon were present in Cornet Bay from early March through late June. Peak chum salmon abundance occurred in April and May. There was just one juvenile chum caught at the end of June. Of 396 captured, 166 were measured. Fork length ranged from 32 mm to 80 mm, with an average of 48 mm (1 standard deviation 8.3).

Pink

Juvenile pink salmon were present in Cornet Bay from February through mid June. In 2009, no pink salmon were captured; in 2010, over 15,800 pink salmon were netted, comprising 93% of the total catch. Of the 15,893[1] captured, 488[2] were measured. Fork length ranged from 20 mm to 110 mm, with an average of 40 mm (1 standard deviation 9.2).

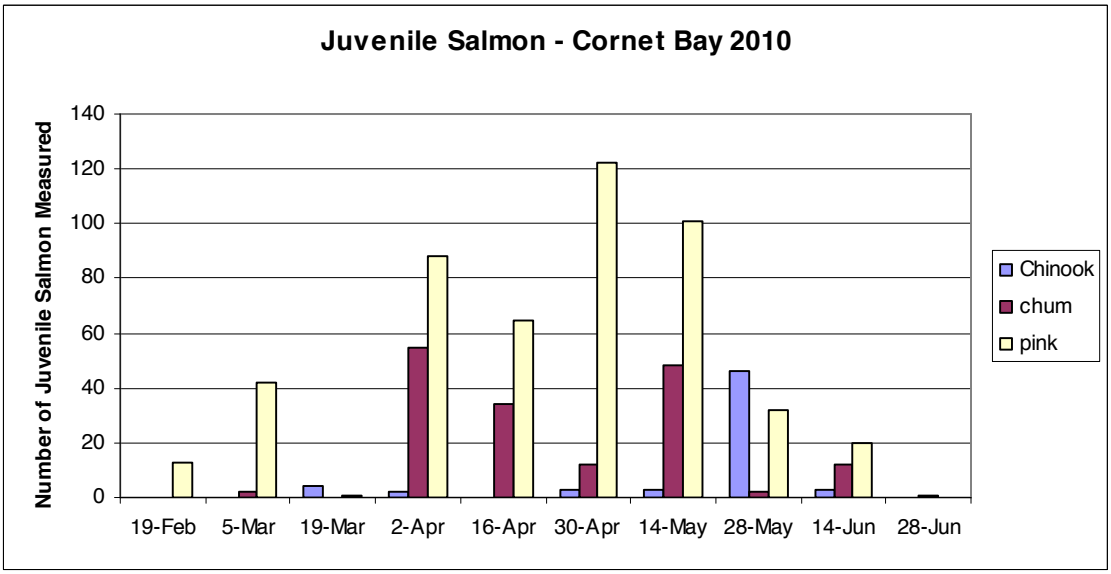

Figure 5. Number of juvenile salmon measured at Cornet Bay, 2010.

[1] The total number of pink salmon includes some estimated numbers from April 30 and May 14 when they were so numerous in a few sets that before counting could be completed, they had to be estimated and released due to stress.

[2] Four clipped pink salmon were netted, three of which were longer than any of the other pinks. They measured 75, 83, 105 and 110 mm. Excluding the latter three, maximum pink fork length was 80 mm.

Fish Size

The size of juvenile salmon was characterized by measuring fork length on 59 Chinook, 166 chum, and 488 pink salmon caught at Cornet Bay sites (Figure 6). To compare them, we calculated mean fork length for each species on each sampling date. For Chinook, mean fork length ranged from 53 mm to 94 mm. Average fork length for chum was from 40 mm to 60 mm. For pink salmon, mean fork length ranged between 32 and 60 mm.

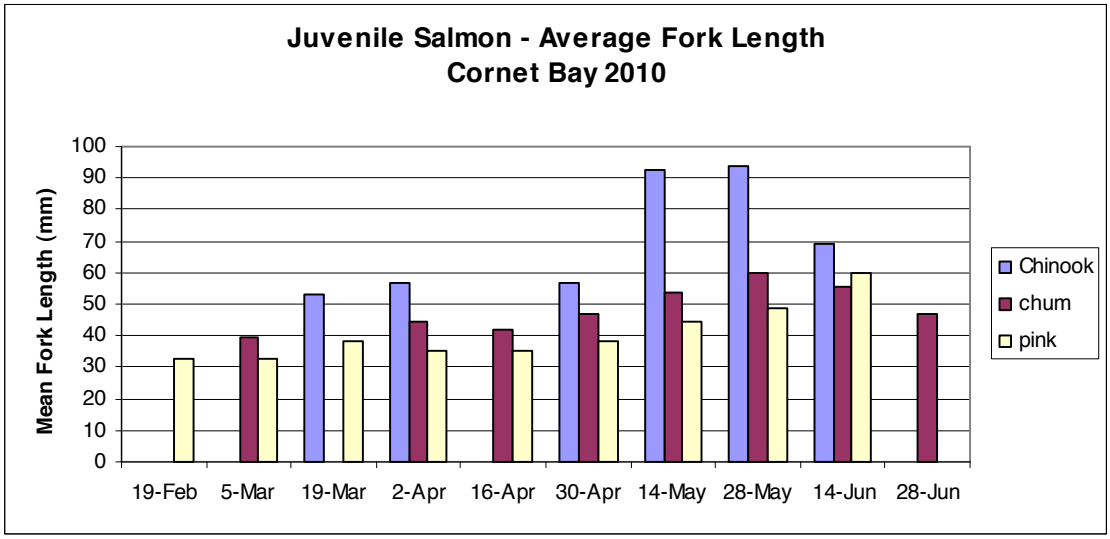

Figure 6. Average fork length of juvenile salmon measured at Cornet Bay, 2010.

Figures 7A, 7B and 7C show fork length frequency for each of the salmon species. Chinook were largest, the smallest being 46 mm and the longest 120 mm. Chum ranged from 32 to 80 mm. Pink salmon ranged from 20 to 65 mm.

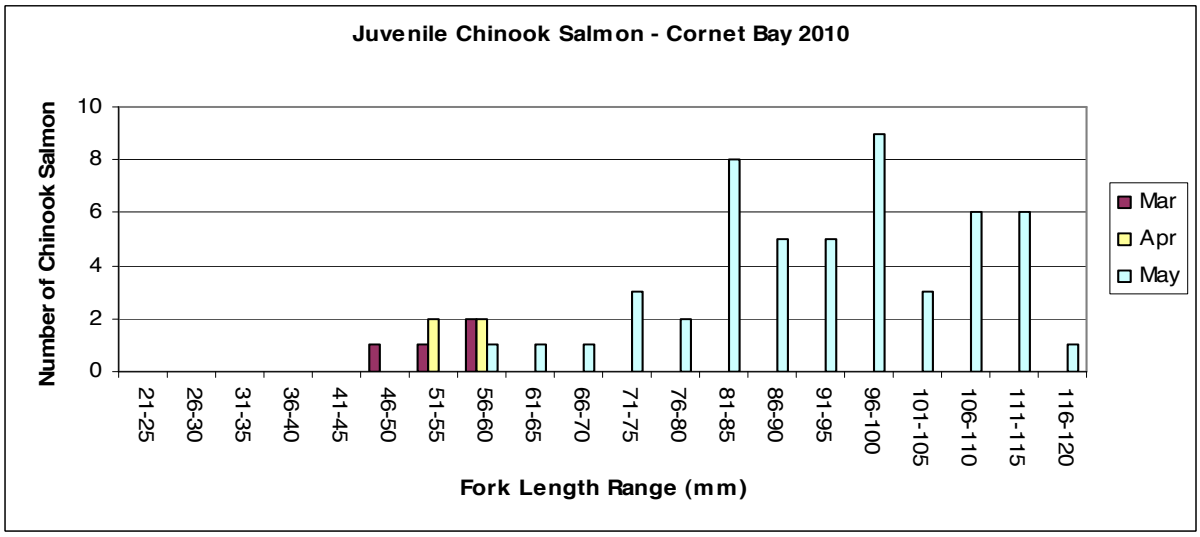

Figure 7A. Fork length frequency distribution of juvenile Chinook salmon captured at Cornet Bay sites in 2010. (Chart scaled for visual size comparison with charts below.)

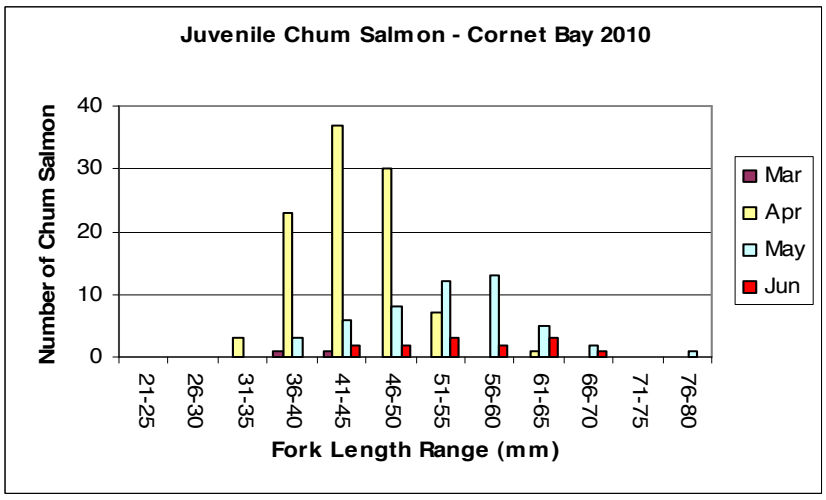

Figure 7B. Fork length frequency distribution of juvenile chum salmon captured at Cornet Bay sites in 2010.

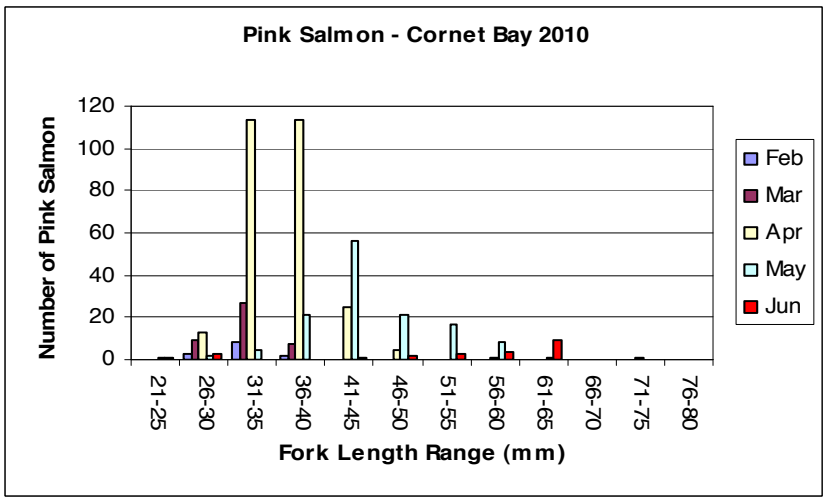

Figure 7C. Fork length frequency distribution of juvenile pink salmon captured at Cornet Bay sites in 2010

Fish Community Composition

This section describes the fish community composition over the 2010 February through June sampling period in Cornet Bay. The four fish species groups that represent 99% of the total catch are included in this section. The four species groups are: juvenile salmon, sculpins, gunnels, and tubesnout (Figure 8).

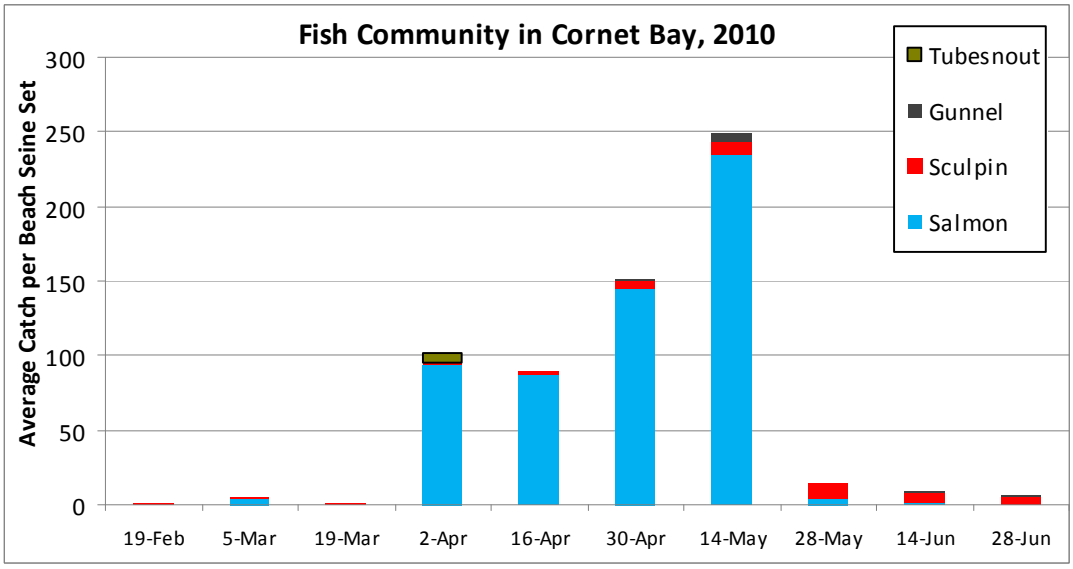

Figure 8. Fish Community and Relative Abundance in Cornet Bay, 2010.

Early in the season the fish community was dominated by juvenile salmon. The peak fish density was in May and was driven by juvenile pink salmon (Figure 8). By late May the fish community was dominated by other species, primarily sculpins.

Variation in Fish Catch Among Sites

In this section we examine the difference in quantity of fish netted at each sample site for 2010 and 2009 (Figures 9A and 9B). All fish captures over the season at each site were combined. The trend in both years was for the fewest fish at the three western-most sites and the highest number of fish captures at the sites along unmodified shoreline east of the boat launch. Between boat launch and marine pier, in both years more fish were caught at Site 6, in front of the accreting beach east of the marine pier, than at sites 4 and 5 which are in front of the taller bulkhead where there is greater beach scour.. Although this includes all fish species, most fish both years were juvenile salmon. (See Figure 3 for visual location of sites.)

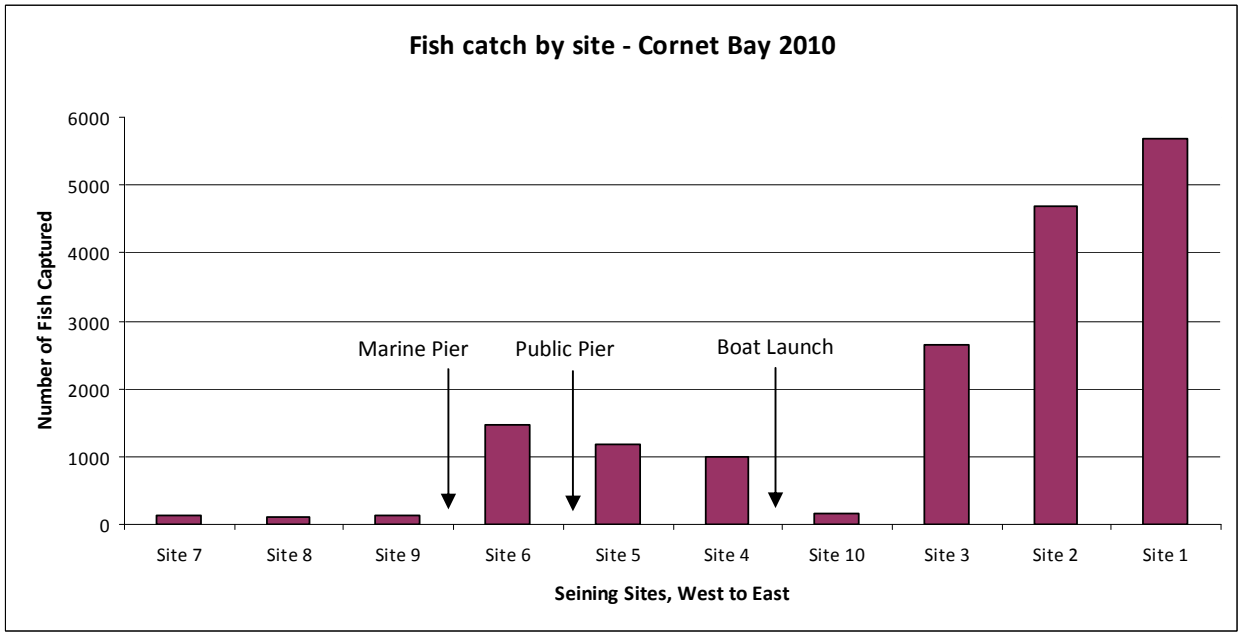

Figure 9A. Fish captures at each site in Cornet Bay, 2010.

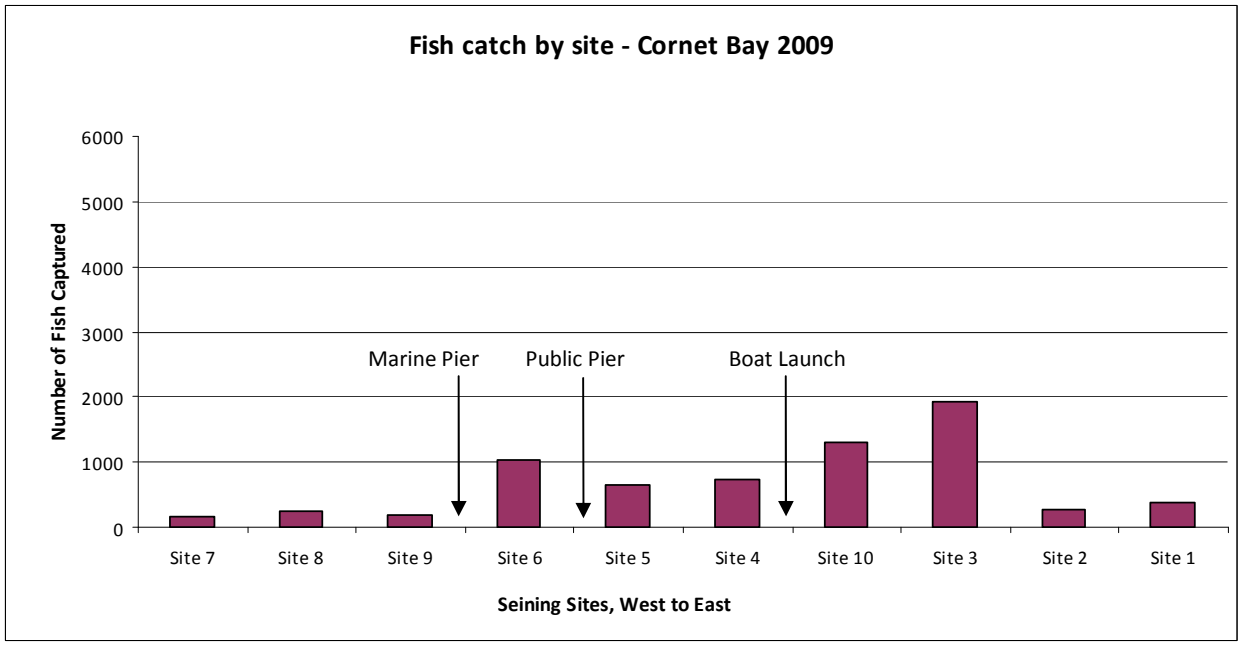

Figure 9B. Fish captures at each site in Cornet Bay, 2009.

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Beamer, EM, A McBride, R Henderson, and K Wolf. 2003. The importance of non-natal pocket estuaries in Skagit Bay to wild Chinook salmon: an emerging priority for restoration. Skagit River System Cooperative, LaConner, WA. Available at www.skagitcoop.org.

Skagit System Cooperative. 2003. Estuarine fish sampling methods. Skagit River System Cooperative, LaConner,WA. Available at www.skagitcoop.org.