

COMMENCEMENT BAY RESTORATION FISH MONITORING —
2002 FIELD SAMPLING AND DATA SUMMARY.
December, 2002.

Casey Rice, Dan Lomax, Cathy Laetz, Wynnae Osenga, and Tracy Collier

From April through October, 2002, members of the Environmental Conservation Division (ECD) of the Northwest Fisheries Science Center (NWFSC) conducted field sampling for the fish component of the Commencement Bay community-based restoration site monitoring. This document summarizes sampling effort, data and samples collected, and also presents selected catch and length results for 2002.

Six established sites and one yet to be constructed site (Figure 1) were successfully sampled for fish assemblage composition, salmonid diets, chemical contamination of sediments (where possible) and chemical contamination of fish tissue from selected species. Fish sampling occurred on an approximately biweekly basis through June, and continued monthly into October. The majority of sediment sampling occurred in late June, with an extra collection at Olympic View in May, before extensive substrate manipulation activities occurred at the site.

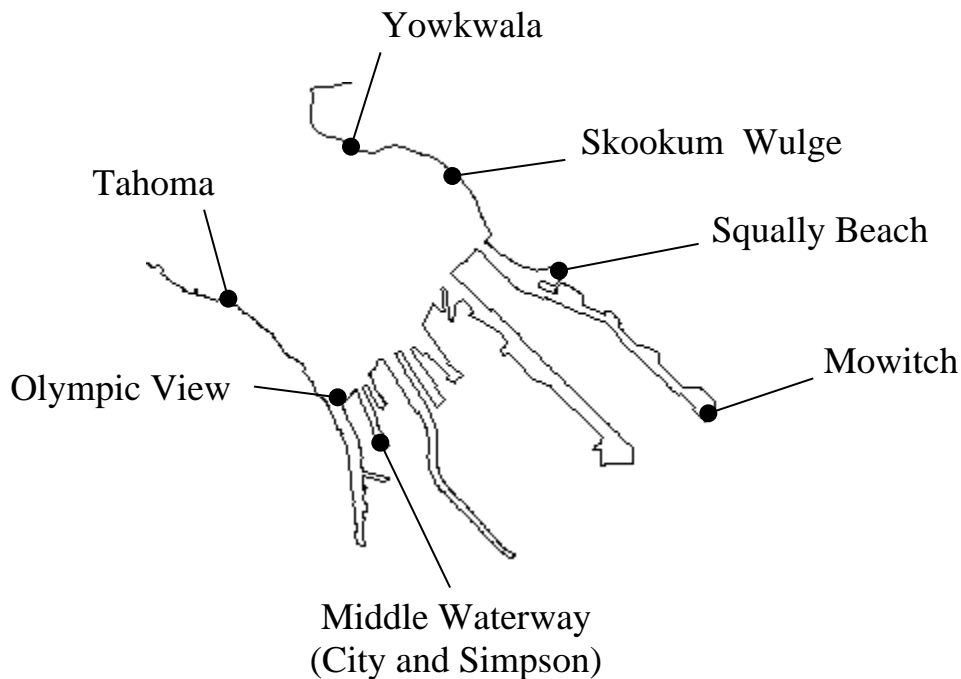


Figure 1. Commencement Bay restoration sites to be sampled during 2002 field season. Note: two adjacent sites (City and Simpson) are located at the head of Middle Waterway; Tahoma Salt Marsh is not yet constructed.

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Fishing Effort

Due to the variety of site characteristics (topography, elevation, currents, etc.), distance between sites, and the timing of appropriate tides, sampling logistics were challenging. However, the customized fishing gear built for the project functioned as intended, with a few small modifications. Over the seven-month sampling period, 158 individual net sets were completed (Table 1). Beach seine samples were conducted with a 37-m floating “Puget Sound” beach seine. Two basic block net designs were deployed: four, 37-m x 13.5-m nets made of 1-cm mesh were used at Mowitch, and 9.7-m x 1.8-m nets made of 0.5-cm mesh in various configurations (additional wings, etc.) were used at Middle Waterway City (one net), and Squally Beach (four nets). It is important to note that caution must be exercised when comparing catch results from the various sites because of differences in habitat, gear selectivity, and areas sampled.

Fish Catch

Complete catch records were kept for all sampling events, and lengths were recorded for selected species. The total number of species (species richness, SR) peaked in late spring/early summer (Figure 2), and ranged from three at Squally Beach, to 30 at Olympic View (Table 2, figure 3), with different patterns among sites (Figure 4). Juvenile salmonids were encountered at all sites except Squally Beach (Figures 6, 7, 8, and 11). The seasonal pattern of salmonid species abundance was as expected with peak abundances occurring in late spring/early summer (Figures 5, 9, 10, and 11), and chinook having the latest peak and broadest temporal distribution. Catches of chinook and coho salmon were dominated by hatchery fish (Figures 8 and 9). Mean lengths of coho (Figure 12A) were fairly similar over time (except for occasional catches of adults in beach seines at Yowkwala), indicative of fairly transitory and uniform population. In contrast, chinook lengths over the year (Figure 12B) show evidence of multiple life history types migrating through, and possibly rearing in, the system. Increasing size of pink and chum over the season (Figure 12C-D) also suggest rearing by these species.

Abundances of English sole (one of the primary target species) were quite low, resulting in a lack of samples for certain analyses.

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Site	Gear Type	April 1-3	April 18	April 29-May 1	May 13-14	May 28-29	June 11-13	June 24-28	July 22-26	August 12-20	September 5-10	October 3-9	Total
Yowkwala	Beach seine	3	3	3	3	3	3	3	3	3	3	3	33
Skookum Wulge	Beach seine	1	1	3	1	2	2	2	3	2	2	2	21
Squally Beach	Block net	0	0	0	0	0	0	4	4	0	4	4	16
Mowitch	Block net	4	4	4	0	4	4	4	4	4	4	0	36
Middle Waterway (Simpson)	Beach seine	3	0	2	0	3	0	2	3	0	3	3	19
Middle Waterway (City)	Block net	1	0	1	0	1	0	1	1	1	1	1	8
Olympic View	Beach seine	3	1	1	2	2	2	2	2	1	1	1	18
Tahoma	Beach seine	0	0	0	0	1	2	1	1	1	0	1	7
Total		15	9	14	6	16	13	19	21	12	18	15	158

Table 1. Summary of fishing effort (net sets per sampling period) by site and sampling period for 2002.

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Table 2. All fish species captured during 2002 by site. (Several sculpin and salmon samples await confirmation of species identification via preserved voucher specimens.)

Site	Species Captured
Middle Waterway (City, block net)	Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Chum salmon (<i>Oncorhynchus keta</i>) Pink salmon (<i>Oncorhynchus gorbuscha</i>) Starry flounder (<i>Platichthys stellatus</i>) Speckled sanddab (<i>Citharichthys stigmaeus</i>) Staghorn sculpin (<i>Leptocottus armatus</i>) Sculpin – (unidentified; 2 spp.) Shiner perch (<i>Cymatogaster aggregata</i>)
Middle Waterway (Simpson, beach seine)	Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Coho salmon (<i>Oncorhynchus kisutch</i>) Chum salmon (<i>Oncorhynchus keta</i>) Pink salmon (<i>Oncorhynchus gorbuscha</i>) Starry flounder (<i>Platichthys stellatus</i>) Staghorn sculpin (<i>Leptocottus armatus</i>) Sculpin – (unidentified; 2 spp.) Surf smelt (<i>Hypomesus pretiosus</i>) Shiner perch (<i>Cymatogaster aggregata</i>) Pile perch Threespine stickleback (<i>Gasterosteus aculeatus</i>) Snake prickleback (<i>Lumpenus sagitta</i>) Pacific herring (<i>Clupea pallasii</i>)
Mowitch	Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Coho salmon (<i>Oncorhynchus kisutch</i>) Chum salmon (<i>Oncorhynchus keta</i>) Cutthroat trout (<i>Oncorhynchus clarkii</i>) Starry flounder (<i>Platichthys stellatus</i>) Staghorn sculpin (<i>Leptocottus armatus</i>) Sculpin – (unidentified; 2spp.) Surf smelt (<i>Hypomesus pretiosus</i>) Shiner perch (<i>Cymatogaster aggregata</i>) Striped perch (<i>Embiotoca lateralis</i>) Pile perch (<i>Damalichthys vacca</i>) Penpoint gunnel (<i>Apodichthys flavidus</i>) Crescent gunnel (<i>Pholis laeta</i>) Saddleback gunnel (<i>Pholis ornate</i>) Threespine stickleback (<i>Gasterosteus aculeatus</i>) Snake prickleback (<i>Lumpenus sagitta</i>) Pacific herring (<i>Clupea pallasii</i>) Sandlance (<i>Ammodytes hexapterus</i>) Shad (<i>Alosa sapidissima</i>)
Olympic View	Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Chum salmon (<i>Oncorhynchus keta</i>) Pink salmon (<i>Oncorhynchus gorbuscha</i>) English Sole (<i>Parophrys vetulus</i>)

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Site	Species Captured
	Starry flounder (<i>Platichthys stellatus</i>) Rock Sole (<i>Lepidopsetta bilineata</i>) Speckled Sandab (<i>Citharichthys stigmaeus</i>) Staghorn sculpin (<i>Leptocottus armatus</i>) Silverspot sculpin (<i>Blepsias cirrhosus</i>) Buffalo sculpin (<i>Enophrys bison</i>) Tidepool sculpin (<i>Oligocottus maculosus</i>) Sailfin sculpin (<i>Nautichthys oculofasciatus</i>) Sculpin (unidentified; 2 spp.) Surf smelt (<i>Hypomesus pretiosus</i>) Shiner perch (<i>Cymatogaster aggregata</i>) Stripped perch (<i>Embiotoca lateralis</i>) Pile perch (<i>Damalichthys vacca</i>) Penpoint gunnel (<i>Apodichthys flavidus</i>) Crescent gunnel (<i>Pholis laeta</i>) Saddleback gunnel (<i>Pholis ornate</i>) Tubesnout (<i>Aulorhynchus flavidus</i>) Pipefish (<i>Syngnathus leptorhynchus</i>) Threespine stickleback (<i>Gasterosteus aculeatus</i>) Snake prickleback (<i>Lumpenus sagitta</i>) Pacific herring (<i>Clupea pallasii</i>) Sandlance (<i>Ammodytes hexapterus</i>) White Spot Greenling (<i>Hexagrammos stelleri</i>) Sturgeon Poacher (<i>Agonus acipenserinus</i>) Sebastes – unidentified (<i>Sebastes sp.</i>)
Skookum Wulge	Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Coho salmon (<i>Oncorhynchus kisutch</i>) Chum salmon (<i>Oncorhynchus keta</i>) Pink salmon (<i>Oncorhynchus gorbuscha</i>) Salmon (unidentified) Cutthroat trout (<i>Oncorhynchus clarkii</i>) Starry flounder (<i>Platichthys stellatus</i>) Flatfish – unidentified Staghorn sculpin (<i>Leptocottus armatus</i>) Sculpin – (unidentified; 2spp.) Surf smelt (<i>Hypomesus pretiosus</i>) Shiner perch (<i>Cymatogaster aggregata</i>) Pipefish (<i>Syngnathus leptorhynchus</i>) Tubesnout (<i>Aulorhynchus flavidus</i>) Threespine stickleback (<i>Gasterosteus aculeatus</i>) Sandlance (<i>Ammodytes hexapterus</i>) Pacific herring (<i>Clupea pallasii</i>) Northern Anchovy (<i>Engraulis mordax</i>)
Squally Beach	Staghorn sculpin (<i>Leptocottus armatus</i>) Shiner perch (<i>Cymatogaster aggregata</i>) Threespine stickleback (<i>Gasterosteus aculeatus</i>)
Tahoma	Chinook salmon – wild (<i>Oncorhynchus tshawytscha</i>)

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Site	Species Captured
	<p>Chinook salmon – hatchery (<i>Oncorhynchus tshawytscha</i>) Coho salmon – wild (<i>Oncorhynchus kisutch</i>) Coho salmon – hatchery (<i>Oncorhynchus kisutch</i>) Chum salmon (<i>Oncorhynchus keta</i>) Pink salmon (<i>Oncorhynchus gorbuscha</i>) Salmon – unidentified Staghorn sculpin (<i>Leptocottus armatus</i>) Buffalo sculpin (<i>Enophrys bison</i>) Tidepool sculpin (<i>Oligocottus maculosus</i>) Sculpin (unidentified; 2 spp.) Shiner perch (<i>Cymatogaster aggregata</i>) Striped perch (<i>Embiotoca lateralis</i>) Pile perch (<i>Damalichthys vacca</i>) Penpoint gunnel (<i>Apodichthys flavidus</i>) Saddleback gunnel (<i>Pholis ornata</i>) Pipefish (<i>Syngnathus leptorhynchus</i>) Pacific herring (<i>Clupea pallasii</i>) Sandlance (<i>Ammodytes hexapterus</i>)</p>
Yowkwala	<p>Chinook salmon (<i>Oncorhynchus tshawytscha</i>) Coho salmon (<i>Oncorhynchus kisutch</i>) Chum salmon (<i>Oncorhynchus keta</i>) Pink salmon (<i>Oncorhynchus gorbuscha</i>) Cutthroat trout (<i>Oncorhynchus clarkii</i>) Starry flounder (<i>Platichthys stellatus</i>) Staghorn sculpin (<i>Leptocottus armatus</i>) Silverspot sculpin (<i>Blepsias cirrhosus</i>) Great sculpin (<i>Myoxocephalus polyacanthocephalus</i>) Buffalo sculpin (<i>Enophrys bison</i>) Sculpin (unidentified; 2 spp.) Surf smelt (<i>Hypomesus pretiosus</i>) Shiner perch (<i>Cymatogaster aggregata</i>) Striped perch (<i>Embiotoca lateralis</i>) Pile perch (<i>Damalichthys vacca</i>) Penpoint gunnel (<i>Apodichthys flavidus</i>) Crescent gunnel (<i>Pholis laeta</i>) Saddleback gunnel (<i>Pholis ornata</i>) Threespine stickleback (<i>Gasterosteus aculeatus</i>) Tubesnout (<i>Aulorhynchus flavidus</i>) Pacific herring (<i>Clupea pallasii</i>) Sandlance (<i>Ammodytes hexapterus</i>) Shad (<i>Alosa sapidissima</i>) Rat fish (<i>Hydrolagus colliei</i>) Whitespot greenling (<i>Hexagrammos stelleri</i>)</p>

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Species Richness at All Sites

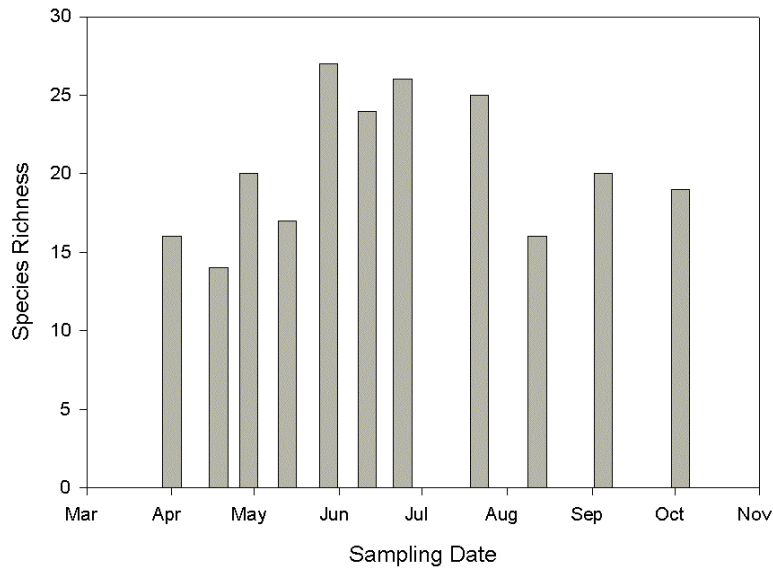


Figure 2. Total number of species captured over time in 2002, all sites combined (not adjusted for fishing effort).

Species Richness at Each Site

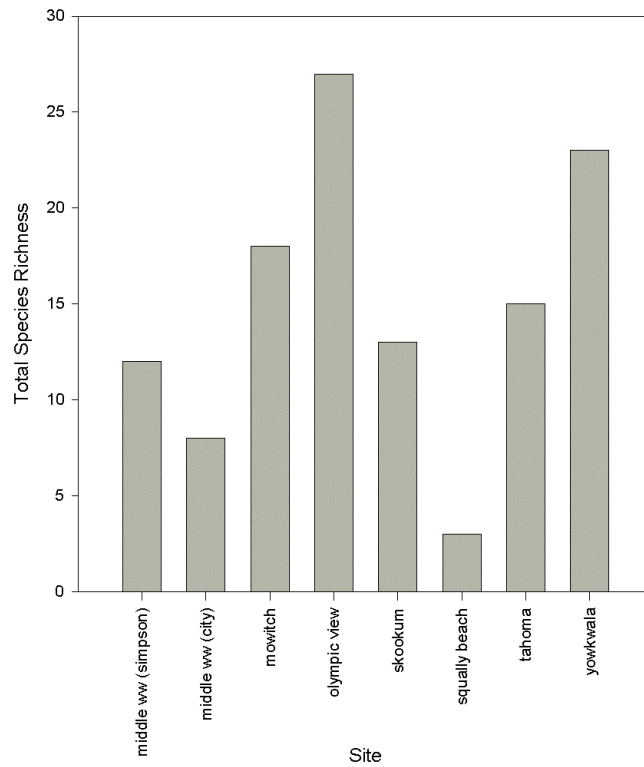


Figure 3. Total number of species captured by site in 2002 (not adjusted for fishing effort; unidentified taxa not yet included in plot).

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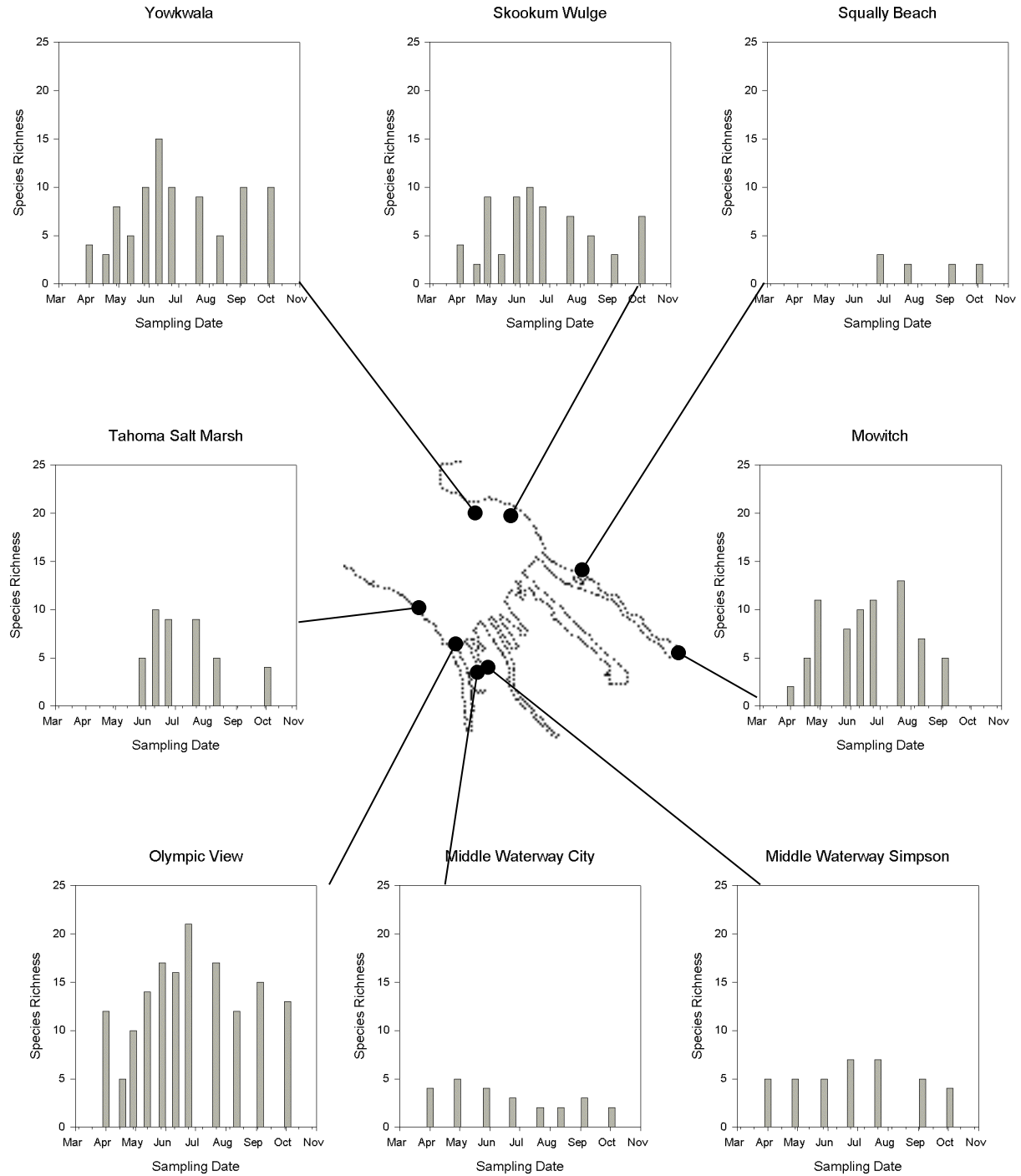


Figure 4. Total number of species captured over time at each site in 2002 (not adjusted for fishing effort).

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Total Number of All Salmon Species

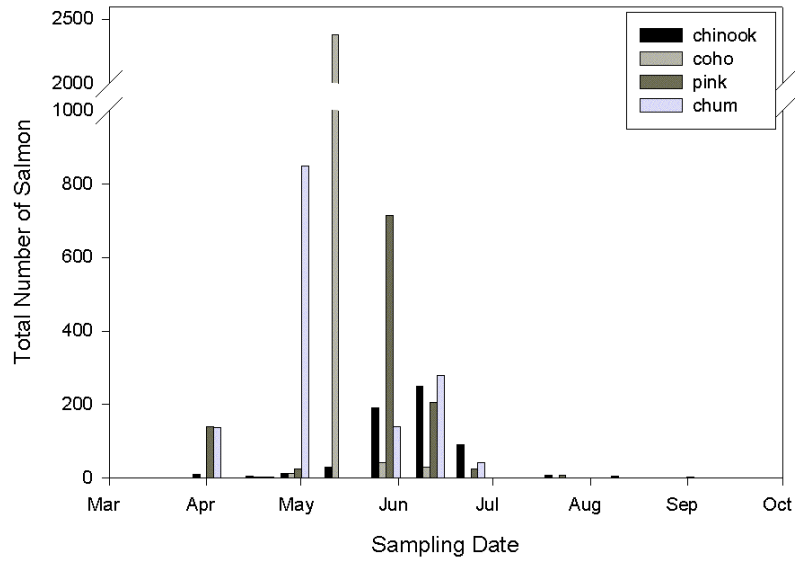


Figure 5. Total catch of all salmonids by month in 2002 (not adjusted for fishing effort).

Total Number of All Salmon Species at Each Site

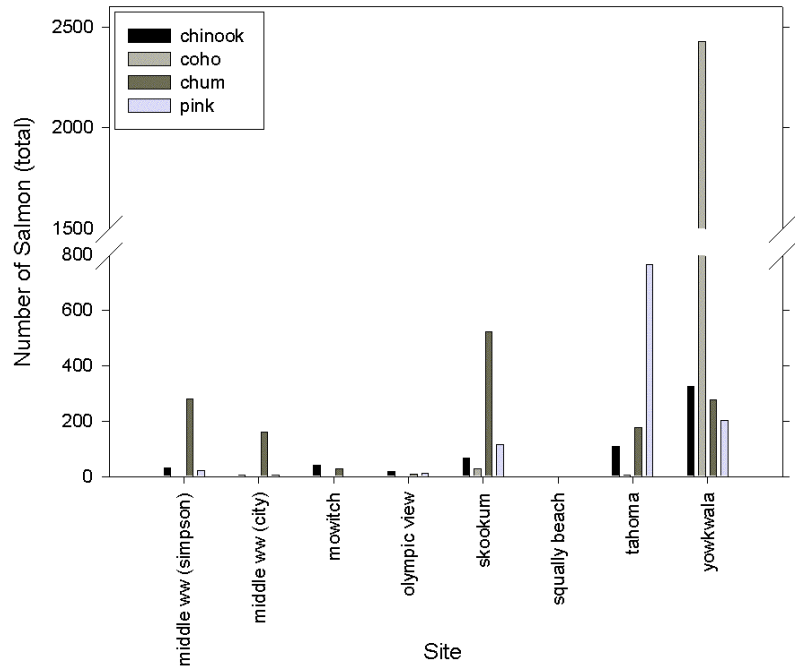


Figure 6. Total catch of all salmonids by site in 2002 (not adjusted for fishing effort).

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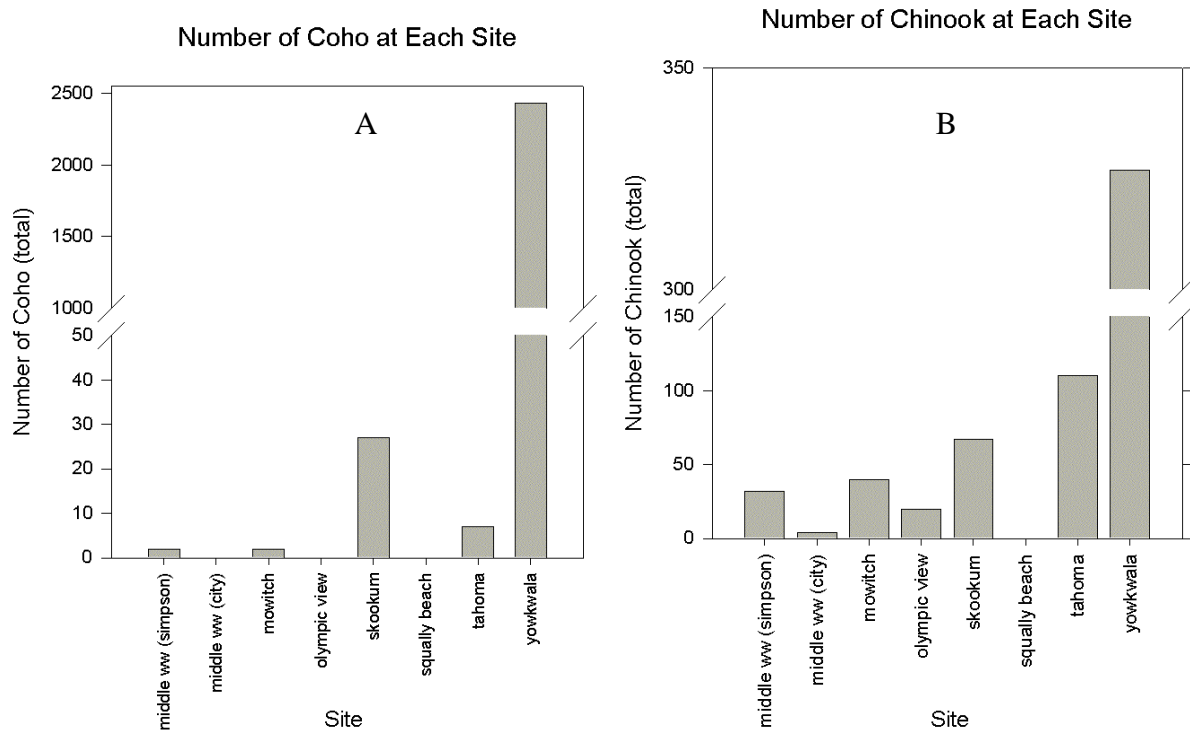


Figure 7. Total catch of all coho (A) and Chinook (B) by site in 2002.

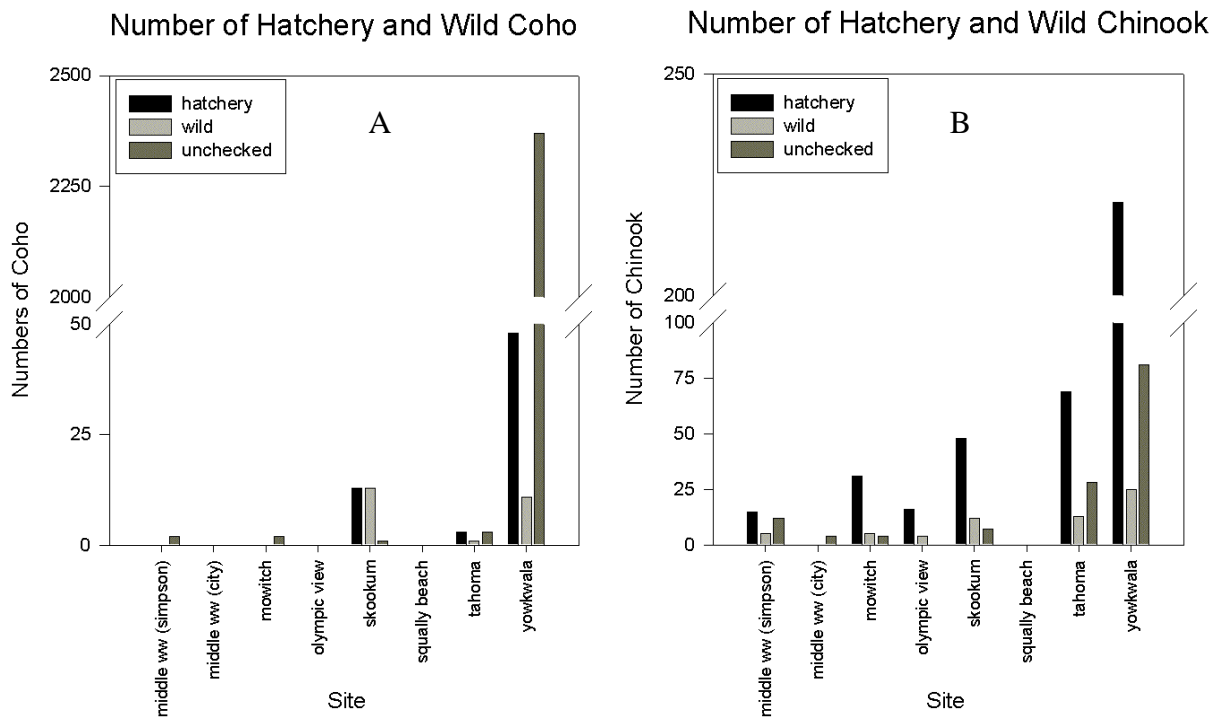


Figure 8. Total catch of marked, unmarked, and unchecked coho (A) and Chinook (B) by site in 2002.

Numbers of Hatchery and Wild Chinook

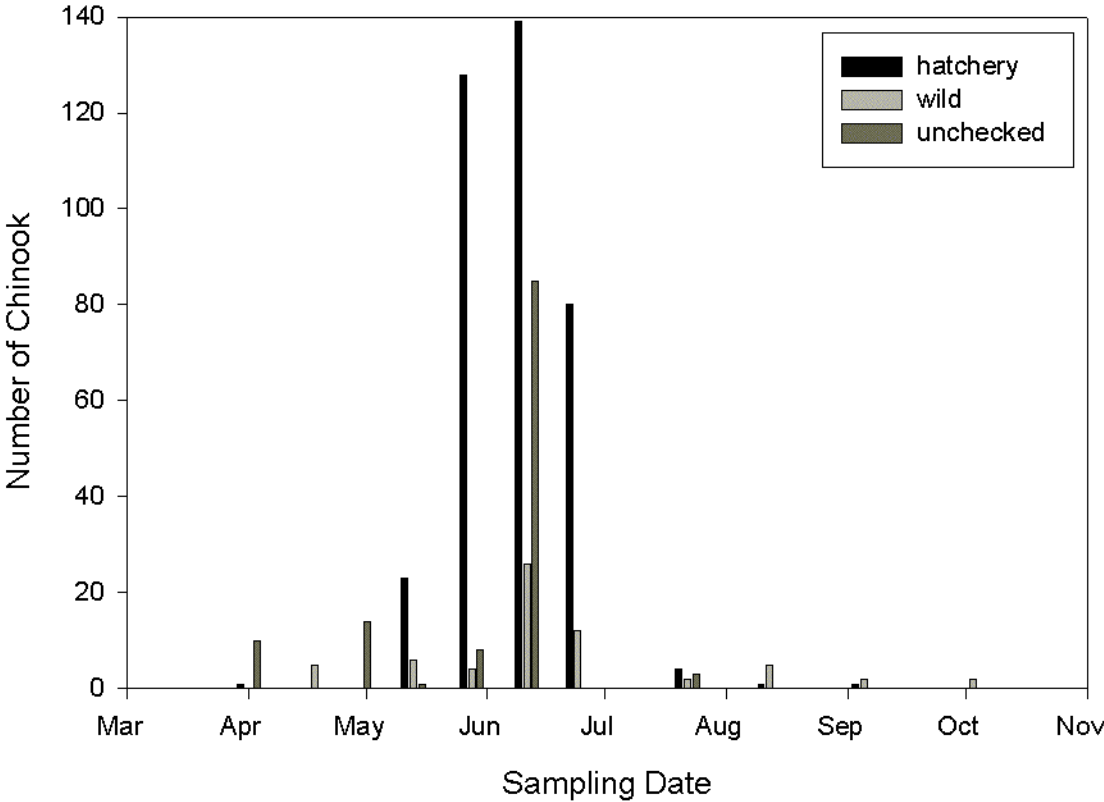


Figure 9. Total catch of hatchery (unmarked), wild (unmarked), and unchecked chinook salmon in 2002, all sites combined.

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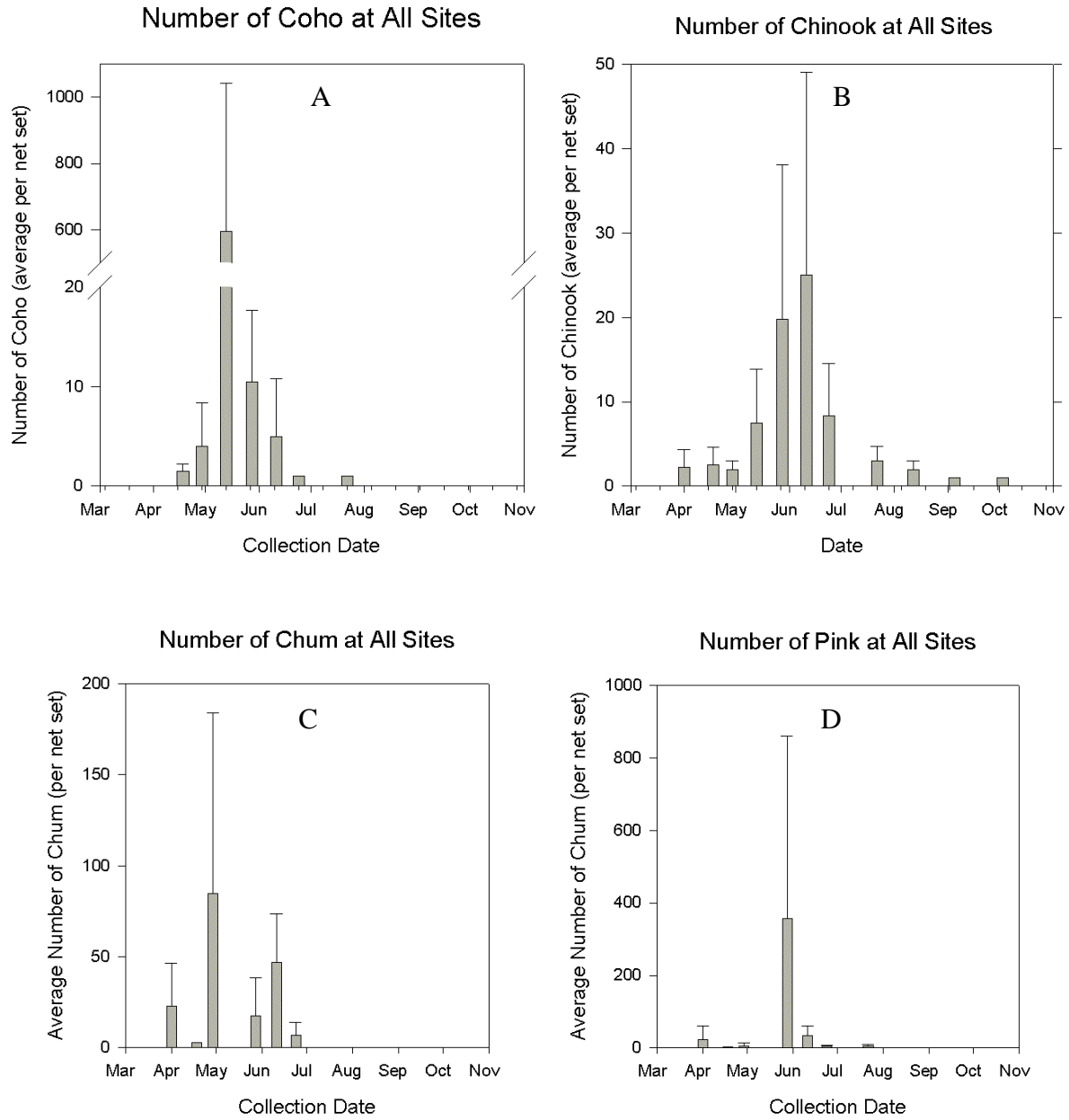


Figure 10. Total catch over time of coho (A) and Chinook (B), chum (C), and pink (D) salmon in 2002, all sites combined.

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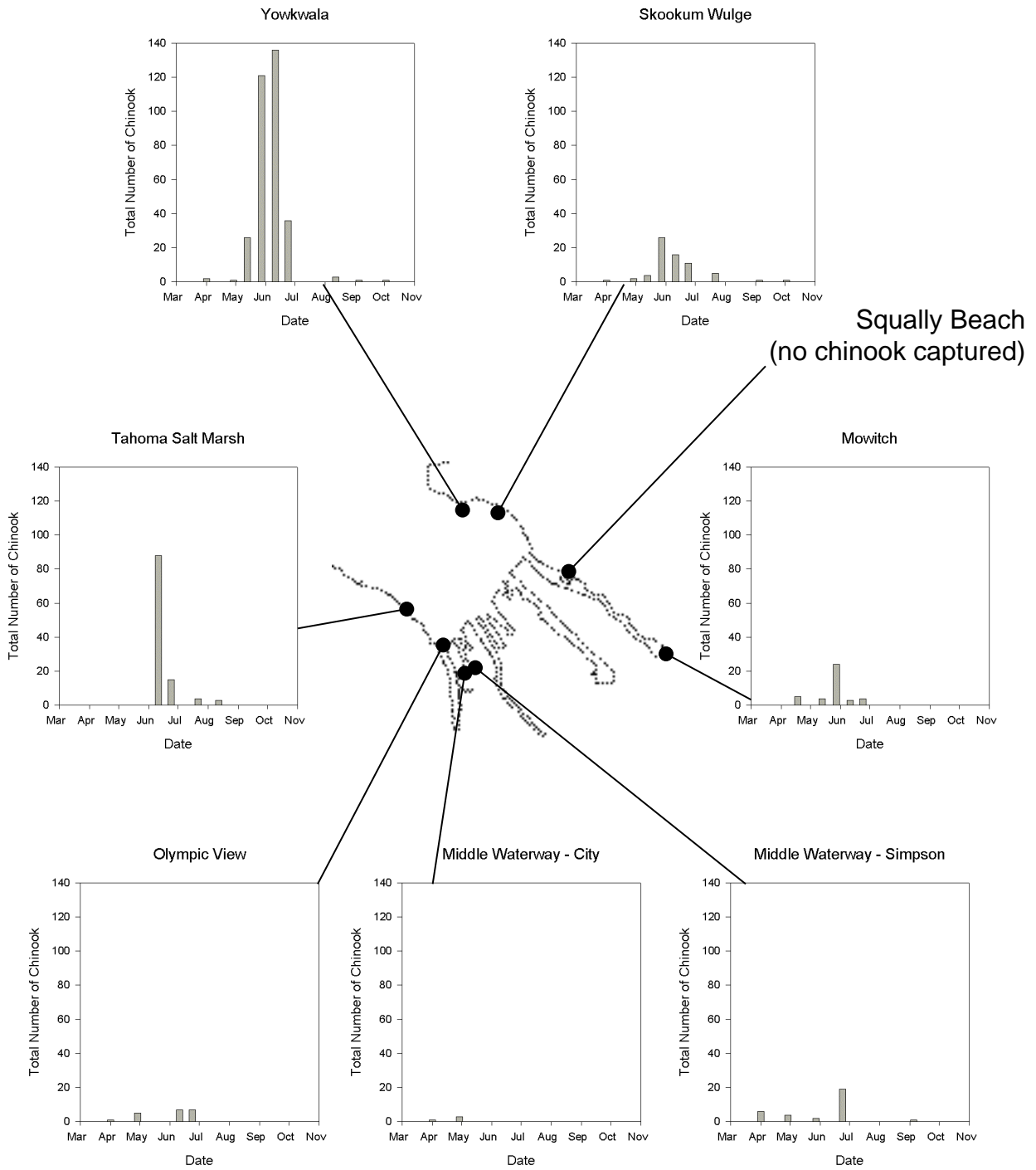


Figure 11. Total number of chinook captured over time at each site in 2002.

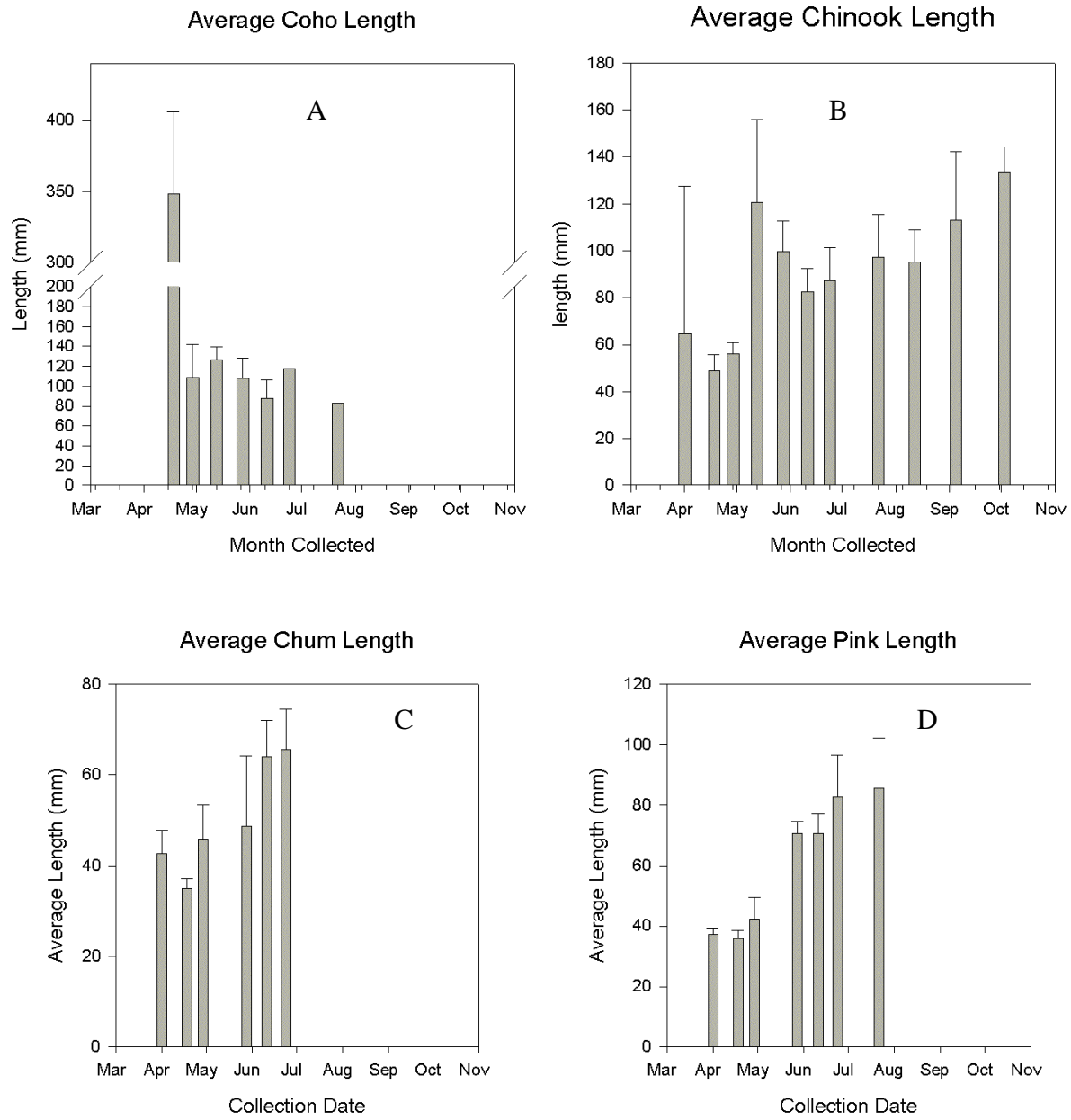


Figure 12. Average coho (A), chinook (B), chum (C), and pink (D) salmon lengths by month, all sites combined.

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Diet and Chemistry

Stomach Taxonomy and tissue chemistry samples were taken for all salmonid species (except for wild chinook where only taken as a result of incidental catch mortality) at nearly all time points and sites when available. Total samples collected by species are listed in Table 3. Sediment samples are listed in Table 4. Taxonomic and chemistry analyses are presently being conducted by contractors.

Table 3. Number of diet and chemistry samples collected by species and sampling date.

Date	Diet				Chemistry			
	Chinook	Coho	Chum	Pink	Chinook	Coho	Chum	Pink
4/1/2002	0	0	20	10	0	0	18	27
4/18/2002	3	0	3	3	0	0	0	0
4/29/2002	1	1	50	17	1	0	38	7
5/13/2002	16	0	0	0	0	20	0	0
5/28/2002	33	13	42	13	14	0	22	5
6/11/2002	41	20	21	21	11	0	10	10
6/24/2002	48	1	28	23	19	0	9	3
7/22/2002	7	1	0	1	0	0	0	0
8/12/2002	1	0	0	0	0	0	0	0
9/5/2002	1	0	0	0	0	0	0	0
10/3/2002	0	0	0	0	0	0	0	0
Total	151	36	164	88	45	20	97	52

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Table 4. Sites, dates, positions, and substrates for sediment chemistry samples collected during 2002.

Site name	Date	Latitude	Longitude	Substrate Type
Olympic View	5/31/02	47 15.81°N	122 26.06 °W	Sand/mud
Olympic View	5/31/02	47 15.78 °N	122 26.11 °W	Mud in eelgrass
Olympic View	5/31/02	47 15.76 °N	122 26.16 °W	
Olympic View	6/24/02	47 15.716 °N	122 26.169 °W	Sand/mud
Olympic View	6/24/02	47 15.724 °N	122 26.165 °W	Sand/mud
Olympic View	6/24/02	47 15.738 °N	122 26.155 °W	Sand/mud
Skookum Wulge	6/24/02	47 17.35 °N	122 24.55 °W	Mud/sand
Skookum Wulge	6/24/02	47 17.36 °N	122 24.58 °W	Mud/sand
Skookum Wulge	6/24/02	47 17.39 °N	122 24.57 °W	Sand
Middle Waterway- Simpson	6/24/02	47 15.37 °N	122 25.71 °W	Mud
Middle Waterway- Simpson	6/24/02	47 15.356 °N	122 25.713 °W	Sand/mud
Middle Waterway- Simpson	6/24/02	47 15.36 °N	122 25.68 °W	Fine mud/sand
Middle Waterway- Simpson	6/24/02	47 15.34 °N	122 25.67 °W	Fine mud
Middle Waterway- City	6/24/02	47 15.45 °N	122 25.67 °W	Fine mud
Middle Waterway- City	6/24/02	47 15.41 °N	122 25.63 °W	Mud
Middle Waterway- City	6/24/02	47 15.40 °N	122 25.64 °W	Mud
Squally Beach	6/26/02	47 16.877 °N	122 23.527 °W	Mud over sand/gravel
Squally Beach	6/26/02	47 16.885 °N	122 23.559 °W	Mud over sand/gravel
Squally Beach	6/26/02	47 16.889 °N	122 23.564 °W	Mud over sand/gravel
Squally Beach	6/26/02	47 16.888 °N	122 23.574 °W	Fine mud
Squally Beach	6/26/02	47 16.875 °N	122 23.56 °W	Fine mud
Squally Beach	6/26/02	47 16.874 °N	122 23.54 °W	Fine mud
Mowitch	6/26/02	47 15.582 °N	122 21.495 °W	Fine mud
Mowitch	6/26/02	47 15.573 °N	122 21.478 °W	Mud/gravel
Mowitch	6/26/02	47 15.607 °N	122 21.538 °W	Fine mud
Mowitch	6/26/02	47 15.599 °N	122 21.51 °W	Mud/gravel
Mowitch	6/26/02	47 15.637 °N	122 21.588 °W	Mud/gravel
Mowitch	6/26/02	47 15.625 °N	122 21.557 °W	Mud/gravel
Mowitch	6/26/02	47 15.663 °N	122 21.608 °W	Mud/gravel
Mowitch	6/26/02	47 15.649 °N	122 21.588 °W	Mud/gravel