Integration of Joint City of Bainbridge Island/Suquamish Tribal Beach Seining Results into Shoreline Management and Salmon Recovery Efforts in Kitsap County, Washington

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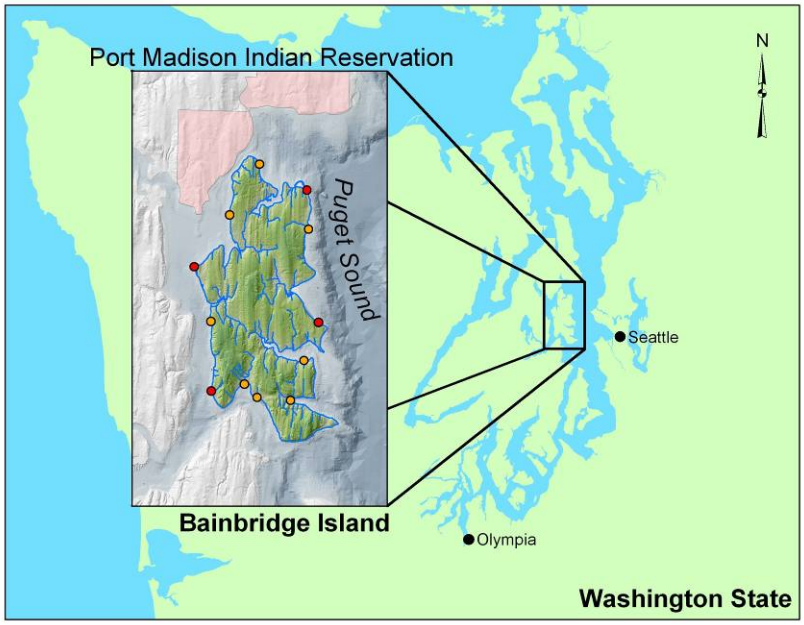
Introduction. Puget Sound estuarine and nearshore habitats support a rich assemblage of numerous vertebrates, invertebrates, and marine algae. This habitat is not as well understood as the terrestrial landscape, but is affected by, and modified by human land use activities (Aitkin 1998; Haring 2000; May and Peterson 2003). The recovery of listed Puget Sound salmon populations depends, in part, upon the quality of these marine habitats (Fresh, 2004). The City of Bainbridge Island (COBI), Suquamish Tribe (Tribe), and Washington Department of Fish and Wildlife (WDFW) have partnered since 2002 on a beach seining study designed to identify fish populations utilizing most shorelines of Bainbridge Island, WA. Bainbridge Island is located in Central Puget Sound, is approximately 28-square miles in size, has 53 miles of shorelines, and contains no Chinook bearing streams. Bainbridge Island is adjacent to the Tribe's Port Madison Indian Reservation. All Bainbridge Island marine waters are within the Tribe's usual and accustomed fishing grounds and are utilized by both the Tribe's salmon enhancement program and local natural salmon runs. Fifty-six fish species were identified over the first three years of this study, 2002-2004, and the study continues in 2005.

Figure 1: Study Area and Sample Sites (red = regular, orange = rotating sites).



The study's multiple objectives are to (1) identify the distribution, abundance, origin (by coded wire tag recovery), and timing of both wild and hatchery salmon, (2) compare the condition factors of hatchery to wild Chinook juveniles, (3) identify forage fish use of the nearshore, and (4) document all other fish and most of the larger invertebrate species encountered. A unique aspect of this research was the use of trained volunteers to provide most of the field labor. Eighty volunteers donated 640 hours of their time. The

results of this study represent a baseline inventory that will be incorporated into the City's shoreline management programs and salmon recovery activities and will be used by the Suquamish Tribe to modify its hatchery program, if necessary, to avoid impacting listed species. Future seine efforts are anticipated to be used in adaptive management elements of these COBI and Tribal programs.

This beach seine project is just one component of larger management efforts. Some aspects of COBI's shoreline management efforts were presented at the 2003 Georgia Basin/Puget Sound Research Conference (Best 2004). The Bainbridge Island Nearshore Assessment and Summary of Best Available Science may be downloaded from the COBI website (www.bainbridge-isl.wa.us\nearshore.asp) (Williams et al. 2003 and 2004). The Tribe's Hatchery Genetic Management Plans and Resource Management Plan may be downloaded from (www.nwr.noaa.gov/lsrd/Propagation).

Methods. Sampling frequency occurred approximately every other week at four regular sites and ten rotating sites shown in Figure 1. Winter sampling was conducted monthly and not all winters were sampled as shown in Table 1. Sites were chosen to represent different habitat conditions (altered, natural, and vegetation), within different geomorphic settings, and geographically distributed around Bainbridge Island. The sites were generally seined only once each day and during daylight hours. The sites were randomly sampled during different tidal elevations to capture variability associated with depth, tidal direction, and current.

Table 1: Number of Beach Seine Sampling Days (x) by Year and Month

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2002				1x		2x	2x	2x	2x			
2003				1x	2x	2x	2x	2x	2x	1x	1x	1x
2004	1x	1x	2x	2x	2x	2x	1x	2x	2x	1x	1x	1x

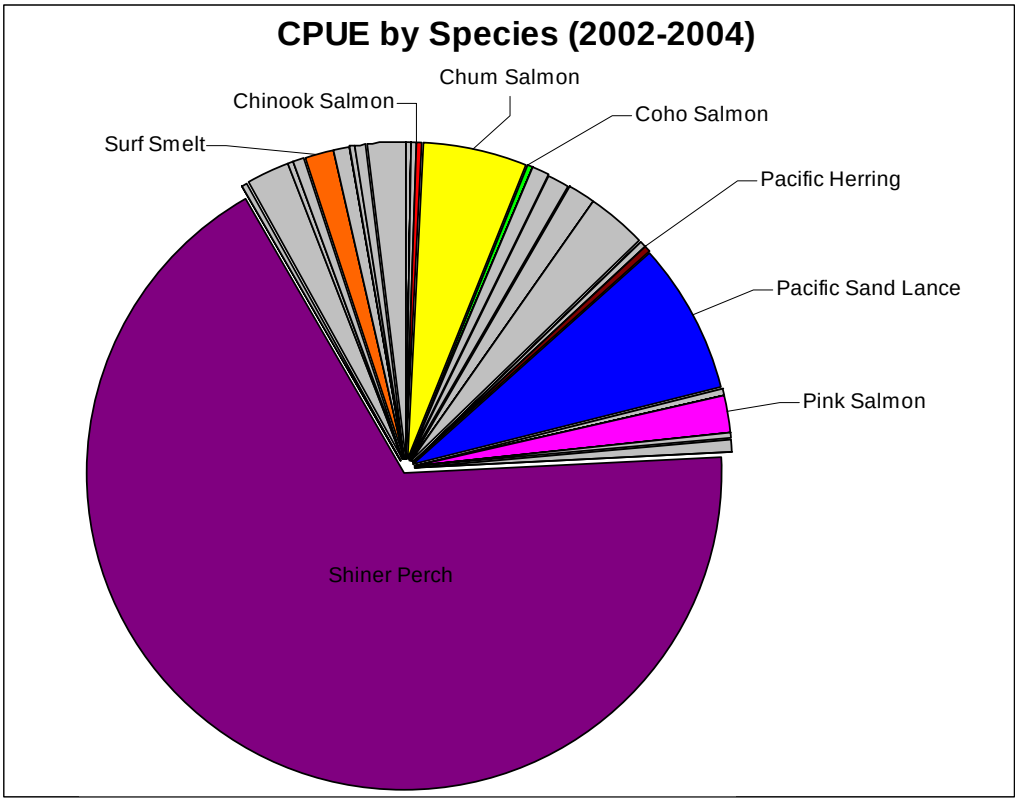
Sampling methodology employed a 37 m floating beach seine with tapered wings sized 2 m at the bag to 1 m at the end. The mesh sizes were 3 cm in the wings and 3 mm knotless nylon in the bag. The seine was deployed from a boat set approximately 33 m and parallel to shore. Lines on the end of the net were pulled towards the shore by several people on each end. The net was pulled so that it remained approximately parallel to shore for the first 20 m. The two lines were then drawn together for the last 10 m to close the net (Simenstad et al. 1991). The two sides were pulled at the same rate of speed so that the collection bag remained in the center of the net and parallel to shore as it was pulled into shore.

All fish, and most macro invertebrates, were identified to species and the first thirty of each species length was recorded (in mm) with the balance of the fish being counted. All salmonids were anaesthetized with MS-222 and measured for fork length. Chinook and coho smolts were electronically scanned for coded wire tags and visually checked for an adipose fin clip, indicating hatchery origin, and most were weighed. Beginning in June, for 2002 only, Chinook were also examined using a black light to determine the color, if present, of fluorescent dye used in a Sinclair Inlet WDFW research project

(Fresh et al. 2004). Additional data collected at each station included water quality (dissolved oxygen, temperature, salinity, and secchi), habitat (beach slope, substrate type, and vegetation), tidal stage/elevation, and meteorological conditions (air temperature, cloud cover, wind, and wave height). All data was entered into a Microsoft Access database (ArcGIS geodatabase) maintained at the City of Bainbridge Island and Suquamish Tribe, QA/QCed, and queried to generate finished figures and tables.

Results. A total of 84,818 fish and invertebrates were recorded, with 57,303 of this total, or 68%, comprised of shiner perch. Figure 2 details the proportional CPUE for all species illustrating that most species were present in relatively low abundance or seasonally. A low abundance does not presume low significance however, as the relatively few Chinook observed are listed as "threatened" under the US Endangered Species Act. We have little, if any, knowledge of the ecological significance of many of sparsely observed individual species. A more complete analysis of all vertebrate and invertebrates will be documented in a full report, along with the entire dataset, that will be downloadable from the COBI website (www.ci.bainbridge-isl.wa.us\seine) in the near future.

Figure 2: Proportional CPUE by Species



Juvenile Chinook were most numerous around Bainbridge Island during part of the current US Army Corps of Engineers (COE) marine regulatory work window (July 2 – March 2) and WDFW marine regulatory work window (June 15 – March 14) as seen in Figure 3 and Table 2, Juvenile Chinook were observed outside these work windows in

increasing number from April to June. The Chinook CPUE's are comparable to recent studies by WDFW in Sinclair Inlet (Fresh et al. 2004), Dyes Inlet (Suquamish Tribe 2003), and King County (Brennan et al. 2004). In the Sinclair and Dyes Inlet studies, juvenile Chinook generally left these inlets by July whereas King County observed a pattern similar to COBI of extended juvenile Chinook presence from spring through late fall. Chinook CPUE's in Sinclair Inlet were significantly greater at night than during the day. The Bainbridge data is for daylight observations only.

Figure 3: Chinook and Coho CPUE with Current Regulatory Work Windows.

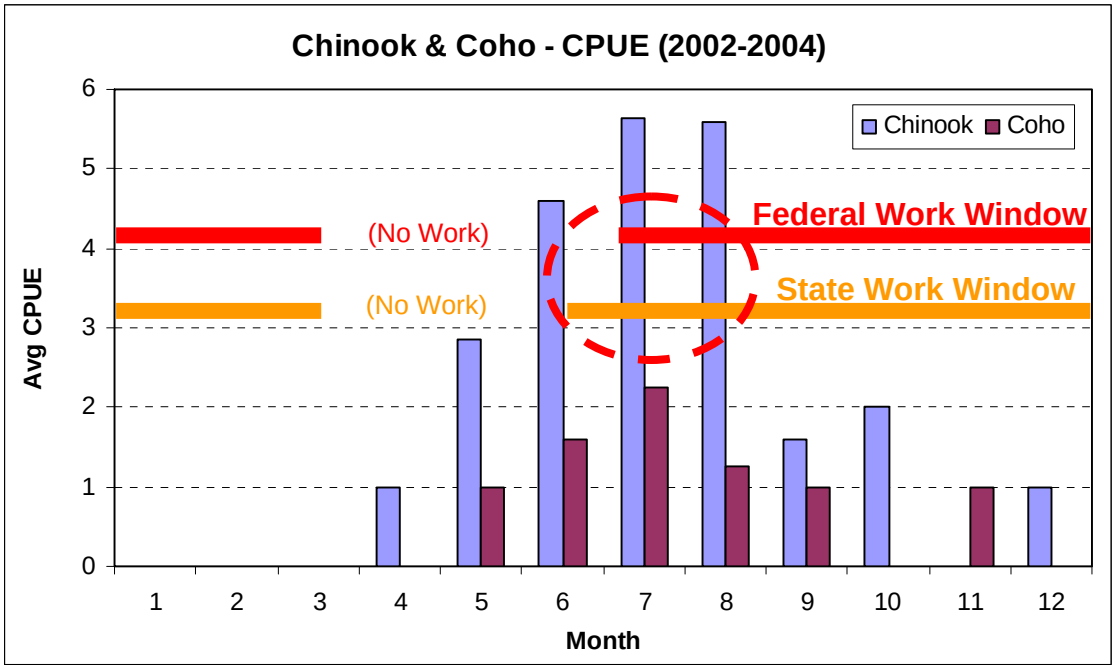


Table 2: Total Catch of Juvenile Salmonids and Forage Fish (2002-2004)

Month	Chinook	Coho	Chum	Pink	Herring	Surf Smelt	Sand Lance
1							
2				7			
3			593	174			3
4	1		1,734	771	2	58	117
5	20	1	2,136	567	3	123	22
6	69	8	32	7	192	133	5,153
7	107	18	6		27	94	320
8	84	5	10		15	123	313
9	8	1	5		3	9	12
10	6				8	151	720
11		1	1		31	279	2
12	1				3	22	
Total	296	34	4,517	1,526	284	992	6,662

The juvenile coho abundance, timing, and presence documented in Figure 3 and Table 2 was less than the observed juvenile Chinook data. Coho were also observed during

regulatory work windows. Juvenile chum and pink salmon were present in much larger numbers than Chinook and coho as seen in Figure 4 and Table 2. Chum and pink salmon were observed around Bainbridge Island through September, with one individual captured in November, but except for March, the abundance was highest during closed Federal and State regulatory work windows. Pink salmon are most abundant in even years due to the much larger odd year adult spawning runs.

Figure 4: Chum and Pink CPUE with Current Regulatory Work Windows.

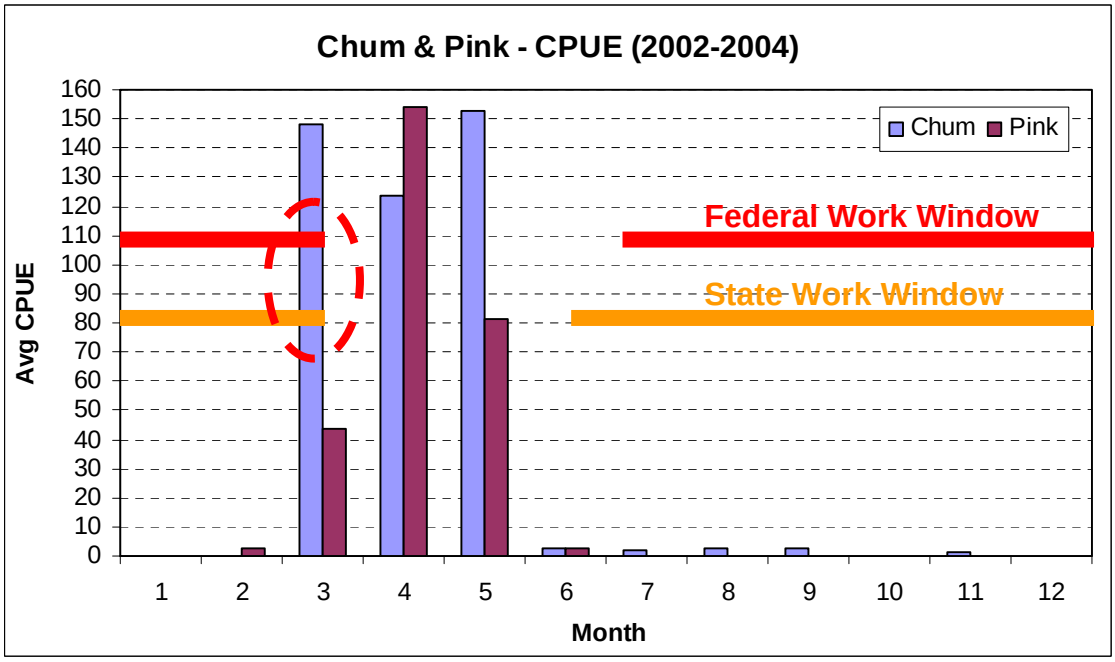
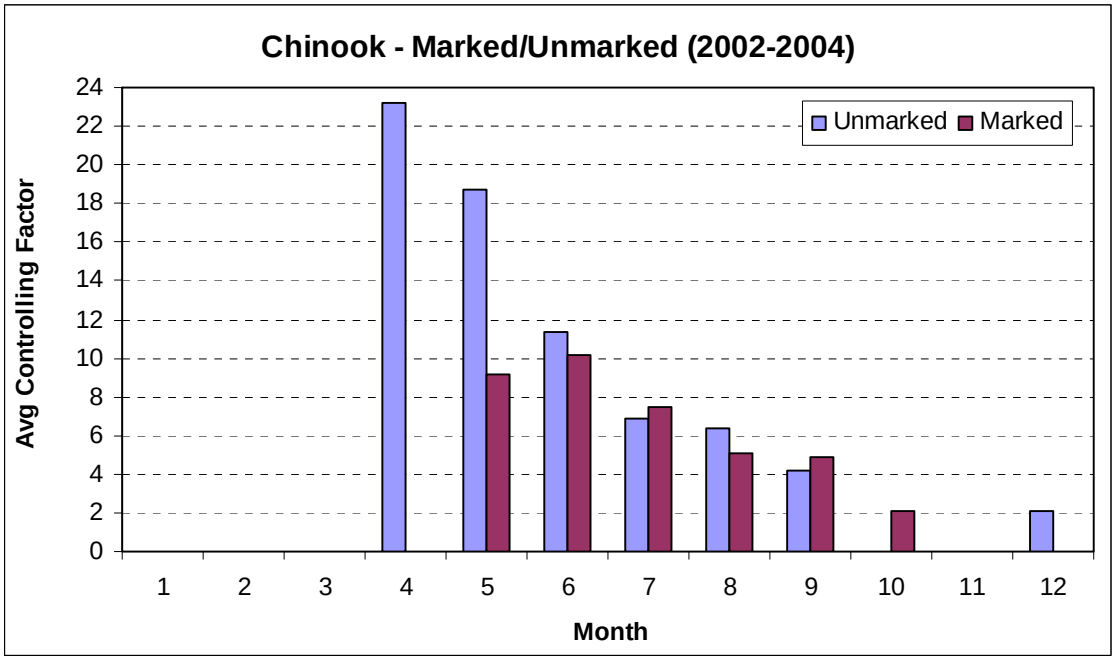


Figure 5: Condition Factor of Marked and Unmarked Chinook.



A large percentage of Puget Sound hatchery juvenile Chinook are “marked” by clipping their adipose fin. The Suquamish Tribe releases over 3 million Chinook into East Kitsap marine waters annually and uses this mark to identify hatchery Chinook from wild Chinook (the progeny of naturally spawning adult hatchery Chinook, or progeny of listed Chinook stocks) to help assess the impact of hatchery fish on natural fish in the estuary and nearshore. Figure 5 documents the observed differences in the condition factor (length divided by weight) between hatchery and wild juvenile Chinook collected in the Bainbridge nearshore sampling locations. The wild juvenile Chinook observed were present in April with a significantly higher condition factor than the hatchery Chinook, which are normally released in May. The condition factors of both hatchery and wild Chinook merge in June, and follow a similar pattern for the remainder of the year, suggesting that competition for prey resources may not be limiting

Table 3: Chinook CWT Origin (2002-2004)

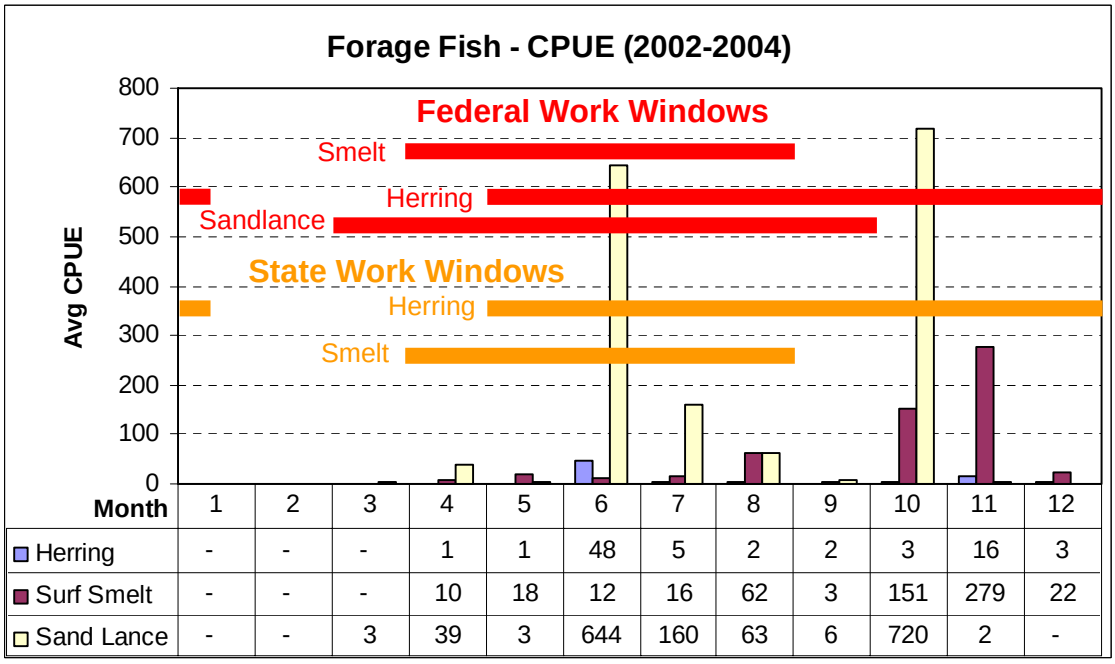
WRIA	Release Location	2002	2003	2004	**Total**
9	Big Soos (Green River)	5			**5**
10	Clarks Creek			1	**1**
15	Clear Creek			1	**1**
15	Gorst Creek	1	4	2	**7**
15	Grovers Creek		13	4	**17**
8	Issaquah Creek		2		**2**
15	Minter Creek			2	**2**
11	Nisqually River	1			**1**
10	Voight Creek			1	**1**
7	Wallace River			3	**3**
10	White River	1			**1**
	Total	**8**	**19**	**14**	**41**

The analysis of the CWT recoveries shown in Table 3 documents that juvenile hatchery Chinook salmon using Bainbridge Island nearshore originate from south, central, and north Puget Sound. This pattern is reflected in the King County, Sinclair, and Dyes studies. If juvenile hatchery Chinook migratory behavior is assumed to be surrogate for wild juvenile Chinook behavior, Bainbridge Island nearshore may be utilized by listed Puget Sound juvenile Chinook salmon from many rivers emptying into Puget Sound.

Forage fish are documented as important in the diet of salmon and utilize the nearshore for both reproduction and feeding. Figure 6 and Table 2 illustrate that forage fish utilize Bainbridge Island nearshore over much of the year and that their abundance is highly variable. Federal and State regulatory work windows vary by forage fish species but the Bainbridge Island data documents that the greatest abundance of forage fish was observed during these regulatory work windows.

Figure 7 documents the 2004 dissolved oxygen (DO) measurements at the four regular beach seine locations around Bainbridge Island. The lowest DO occurred in November and follows a pattern observed by the Puget Sound Ambient Monitoring Team. These observations were during cool weather and generally clear water conditions. Given the

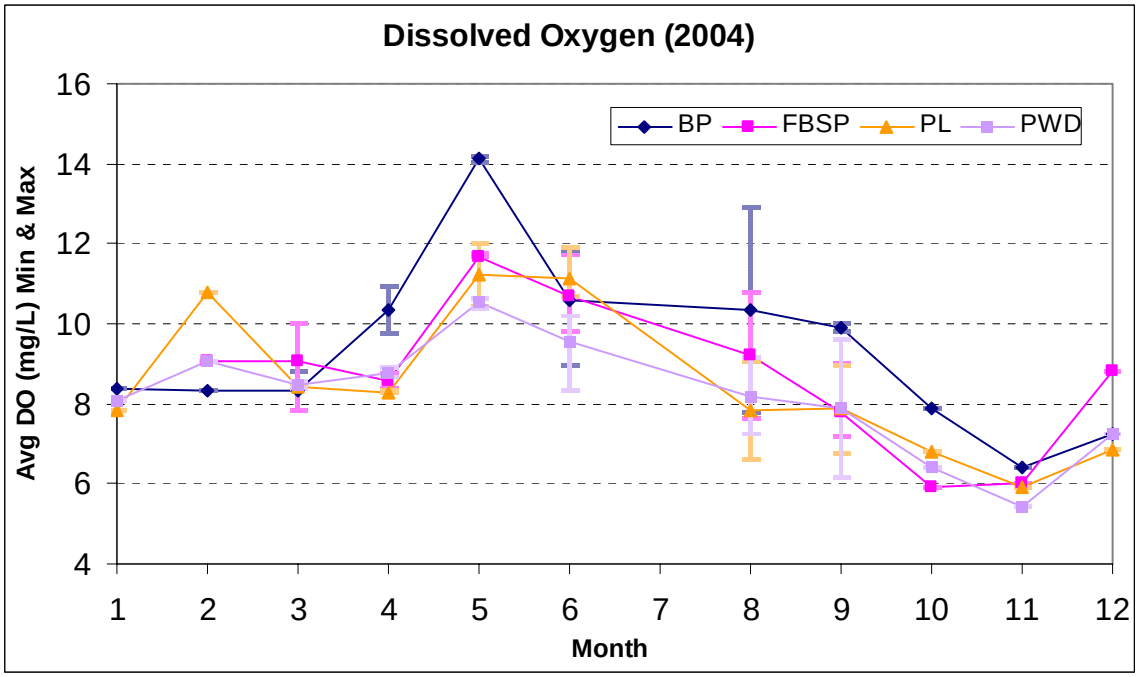
Figure 6: Forage Fish CPUE with Current Regulatory Work Windows.



Month	1	2	3	4	5	6	7	8	9	10	11	12
Herring	-	-	-	1	1	48	5	2	2	3	16	3
Surf Smelt	-	-	-	10	18	12	16	62	3	151	279	22
Sand Lance	-	-	3	39	3	644	160	63	6	720	2	-

low DO problems in Hood Canal, continued monitoring of Puget Sound DO levels would be important to insure nearshore habitat remains productive and can support the recovery of listed Puget Sound salmon stocks.

Figure 7: Dissolved Oxygen at Regular Sample Sites.



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