Salmonid Presence and Habitat Use in the Lower Duwamish River, Winter 2004/2005

-FINAL DATA REPORT-

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ACRONYMS

°C	degrees Celcius
cfs	cubic feet per second
cm	centimeter
CPUE	catch per unit effort
CWT	Coded Wire Tag
DO	dissolved oxygen
ft	feet
GPS	Global Positioning System
ha	hectares
in	inch
m	meter
MIT	Muckleshoot Indian Tribe
MLLW	mean lower low water
mg/L	milligrams per liter
mm	millimeter
mS/cm	millisiemens per centimeter
NOAA	National Oceanographic and Atmospheric Administration
NTU	Nephelometric turbidity units
pH	a measure of acidity
ppt	parts per thousand
PSP	Puget Sound Protocols
RM	River Mile
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WSP	Washington State Patrol
WRIA	water resource inventory area
yoy	young of the year

EXECUTIVE SUMMARY

The Green River watershed, which includes the Lower Duwamish Waterway, supports nine different species of salmonids, each with a slightly different life history and run-timing. These species include Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), and sockeye salmon (*O. nerka*), cutthroat (*O. clarki clarki*) and steelhead trout (*O. mykiss*), and to a lesser extent pink salmon (*O. gorbuscha*), bull trout (*Salvelinus confluentus*) and mountain whitefish (*Prosopium williamsoni*). Two stocks of these species are federally listed as threatened salmonids; Puget Sound Chinook and bull trout. The Lower Duwamish Waterway is an industrialized waterway utilized by both industrial and recreational vessels. As such, the federal navigation channel is dredged by the USACE to maintain navigable depths. The portion of the waterway that has been historically dredged to maintain navigation safety extends from Elliott Bay upriver approximately 5.5 river miles to the Turning Basin. Approximately 2,000 linear feet of the channel in the vicinity of the Turning Basin is dredged on a biannual basis. The present study was conducted to estimate the usage of the Lower Duwamish Waterway by listed salmonids as a means to evaluate the potential for maintenance dredging at the Turning Basin to affect these species.

Although past studies have shown Green River Chinook fry emerge from the gravel in late February through April, with peak migration not occurring until mid April (Dunstan 1955, Hilgert and Jeanes 1999, Jeanes and Hilgert 2000), surveys conducted from 2001-2003 by Nelson *et al*. (2004) observed juvenile Chinook salmon in the Duwamish estuary as early as January and February. This observation overlapped with the timing of the winter "dredging window" of October to February. In response to these findings, the USACE initiated this study to investigate the arrival, presence, and habitat use of the Duwamish Waterway by juvenile salmonids, notably Chinook salmon, during the normal winter dredging work window. This study included a rigorous study design that was consistent with the ongoing spring and summer WRIA 9 beach seine studies including methodology and site selection. However, this study varied from past/current WRIA9 surveys by being conducted in the winter months and incorporating a paired day/night beach seining at five sites in the Duwamish River, in addition to using a research purse seine deployed from a commercial purse seine vessel at five primary sites during both day and night. By designing the study in this manner the intent was to: 1) investigate the relative timing of occurrence of young of the year (yoy) Chinook; 2) investigate whether this species occurred with any difference in frequency in the Turning Basin compared to other sites; 3) investigate whether there was a difference in habitat use (relative occurrence along the shoreline compared to the dredged channel); 4) investigate whether there was a difference in occurrence as related to time of day; 5) investigate any difference in the winter season site use; and 6) investigate if there was a difference in occurrence between marked (hatchery) and natural origin fish.

The findings of this study support the findings of Nelson *et al*. (2004) that yoy Chinook salmon arrive in the Duwamish estuary earlier than previously believed, as indicated in this study by their arrival in mid-January. But as indicated by their premature condition upon arrival (yolk sacs present), they may not be able to occur in the estuary much sooner than this time. Upon arrival these yoy Chinook were more prevalent at the Turning Basin followed by the Trimaran site, both located in the upper portion of the estuary near the fresh water-salt water transition zone, than the downstream sites. Yoy fish were only detected in shoreline habitats, away from the USACE-maintained channel. In addition, yoy Chinook were twice as abundant in the nighttime shoreline sampling compared to the daytime efforts. For yoy Chinook, once they arrived in the estuary in mid-January they were detected during each shoreline sampling day for the duration of the study. None of the yoy Chinook were marked as hatchery origin fish, however age-1+ Chinook were caught in each month in both shoreline and channel habitat, but were more abundant during the day along the shoreline, and at night in the channel, with beach seines finding greatest abundances at Kellogg Island and purse seines at Powerline.

1.0 INTRODUCTION

The Green River watershed, which includes the Lower Duwamish Waterway, supports nine species of salmonids, each with a slightly different life history and run-timing. These species include Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), and sockeye salmon (*O. nerka*), cutthroat (*O. clarki clarki*) and steelhead trout (*O. mykiss*), and to a lesser extent pink salmon (*O. gorbuscha*), bull trout (*Salvelinus confluentus*) and mountain whitefish (*Prosopium williamsoni*). Two stocks of these species are federally listed as threatened species: Puget Sound Chinook and bull trout. However, the Lower Duwamish Waterway is a heavily industrialized waterway utilized by both industrial and recreational vessels. As such, the federal navigation channel needs to be maintained by the USACE. The portion of the waterway that has been historically dredged to maintain navigation safety extends from Elliott Bay upriver approximately 5.5 river miles to the Turning Basin. Approximately 2,000 linear feet of the channel in the vicinity of the Turning Basin is dredged on a biannual basis.

Although past studies have shown Green River Chinook fry emerge from the gravel in late February through April with peak migration not occurring until mid April (Dunstan 1955, Hilgert and Jeanes 1999, Jeanes and Hilgert 2000), surveys conducted from 2001-2003 by Nelson *et al*. (2004) observed juvenile Chinook salmon in the Duwamish estuary as early as January and February. This observation coincided with the timing of the winter "dredging window" of October to February. In response to these findings, the U.S. Army Corps of Engineers Seattle District (USACE) designed this study to better understand the arrival of juvenile salmonids and their habitat use in the Lower Duwamish during the maintenance dredging window. The winter survey study design presented here is an effort by the USACE to investigate the observations of Nelson *et al*. (2004) that juvenile salmonids may occur in the Lower Duwamish estuary earlier in the year than previously believed, to document the presence or absence of juvenile Chinook salmon in time periods prior to previous sampling by Nelson *et al.* (2004) and in areas such as offshore areas of the dredged channel, which have never been thoroughly sampled, and to particularly focus on the routinely dredged portion of the Waterway at the Turning Basin (Figure 1).

1.1 Purpose

The purpose of this study was to determine salmonid presence and habitat use in the Lower Duwamish during the traditional winter "dredging window" of October to February for maintenance dredging. These surveys were conducted using two methods: beach seines to capture potentially occurring salmonids along the shoreline, and purse seines to capture potentially occurring salmonids in the navigation channel. Understanding the life histories, run-timings and habitat use of the various salmonid species within this system will assist the USACE in determining the best strategy to maintain the federal navigation channel in the Lower Duwamish River while minimizing the impact of this action of juvenile salmonids.

1.2 Objectives

This study was funded by the Navigation Section of the USACE. The objective of this study was to determine whether and to what extent salmonids, particularly juvenile and sub-adult Chinook salmon and bull trout, are present within the navigation channel, Turning Basin, and associated shoreline habitats during the traditional winter "dredging window" of October to February.

Figure 1. High-resolution multibeam bathymetric survey conducted in the Turning Basin, August 2003, by David Evans and Associates, Inc. Horizontal Datum: NAD 83/91 State Plane Coordinate System: Washington North Zone Vertical Datum: NAVD88 and MLLW (1960 - 1978 tidal epoch) Units: U.S. Survey Feet.

2.0 METHODS

Prior to each sampling event, state and tribal enforcement and fishery agencies were informed of the upcoming sampling effort to maintain constant communication with regional fisheries enforcement as well as coordination with the tribal fishing schedule. The agencies contacted included the Washington State Patrol (WSP), Washington Department of Fish and Wildlife (WDFW) (Sgt. Kim Chandler and/or District Biologist Chad Jackson), and Muckleshoot Indian Tribe (MIT) Enforcement (Glen Santamont) and Fishery Managers (Paul Hage or Mike Mahavolich). In addition, NOAA Fisheries contacted and provided permit approval for the USACE existing Section 10 permit (number 315) for capture and take of juvenile Chinook salmon (permit holder Fred Goetz), the USACE had an existing Section 10 permit for bull trout and a Washington State scientific collection permit.

2.1 Beach Seining

Beach seine surveys were conducted using a 121 ft-long, 6.5-ft-deep (37- X 2-m) Puget Sound Protocols (PSP) beach seine constructed of two 59-ft (18-m) wings, each composed of 0.25-inch (6-mm) mesh (Figure 2). The central collection bag measured 6.5-ft (2-m) deep by 3-ft (1-m) wide and was constructed of 0.2-inch (5-mm) treated knotless nylon mesh. Each wing was attached to 2-in. (51 mm) diameter, 4.0-ft (1.2-m) long wooden poles with a stainless steel ring at the center of the leads. The beach seine was deployed by boat using 100-ft (30-m) long lead ropes attached to the stainless steel rings. One end of the seine was pulled in a semi-circular fashion while the other end was secured to the shore using a fluke-style anchor. The seine was manually retrieved parallel to shore using the lead ropes for the first 66 ft (20-m) with wings approximately 130 ft (40-m) apart, and from a distance of approximately 33 ft (10-m) apart for the final 33 ft (10-m) to shore. As utilized in this configuration, the beach seine surveys an area of approximately 5,597 ft^2 (520 m^2) and volume of 27,915 ft^3 (790 m^3). Except for a slightly smaller mesh size than the King County PSP beach seine, the beach seining effort for this study, including net design and deployment, is identical to the protocols utilized for the WRIA 9 Juvenile Salmonid Survival Studies outline in Nelson *et al.* (2004).

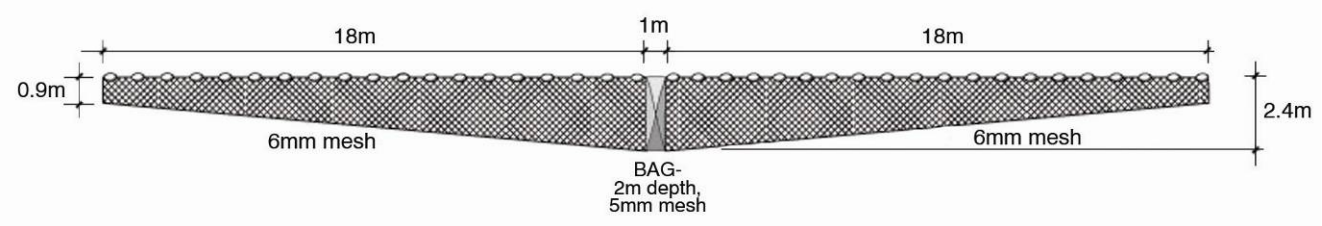

Figure 2: Dimensions of the Puget Sound Protocols beach seine used in this survey.

Beach seine sites were chosen to maintain a general consistency with past Lower Duwamish Surveys such as Nelson *et al.* (2004), WRIA 9 surveys, and Port of Seattle surveys, while maintaining a focus on the needs for determining the presence of juvenile salmonids in the portion of the river that requires dredging to maintain the navigation channel. In addition, this portion of the waterway is coincident with the estuarine transition zone and has been shown in previous studies to hold some of the higher concentrations of juvenile salmonids in their downstream migration (Nelson *et al.* 2004, Ruggerone *et al.* 2004). With that focus, the beach seine survey sites included: Trimaran (RM 6.5), Turning Basin (RM 5.5), Powerline (RM 5.3), Pit Bull (RM 4.0), and Kellogg Island (RM 1.6) (Figures 3 and 4).

Figure 3. Site Map – Duwamish Waterway Seining Locations, Winter 2004–2005.

Figure 4:Beach Seining Trimaran and the Turning Basin, Winter 2004-2005.

All beach seine surveys were conducted on the flood tidal cycle. The first survey was conducted during the day on December 3, 2004 thereafter weekly surveys were conducted both during the night and during the day (every other week) through March 3, 2005 for a total of 20 survey dates (13 night surveys; 7 day surveys) (Table 1). On each survey date, two seine hauls were pulled at each of five sites (in upstream to downstream order): Trimaran; Turning Basin; Powerline; Pit Bull; and Kellogg Island; for a total of 10 seine hauls per trip and 200 seine hauls over the duration of the study.

All fish were collected immediately from the bag and transferred to a holding tank (live car) where they were identified, enumerated, and measured to the nearest mm fork length (salmonids) and total length (other species). Salmonids were anesthetized with 70 $mg \cdot L^{-1}$ buffered tricaine methanesulfonate (MS-222), measured to the nearest mm fork length, allowed to recover in the live car filled with ambient water, and released within 150 ft of their capture location.

Water quality measurements were collected at each site at three depths in the water column; on the surface, at mid-depth, and on the bottom. Water quality parameters were obtained using a Hydrolab Quanta® portable multi-parameter water quality datasonde. Water temperature (to the nearest 0.01 ºC), salinity (to the nearest 0.01 ppt), dissolved oxygen (to the nearest 0.01 mg/l), pH (to the nearest 0.01) and conductivity (to the nearest 0.01 mS/cm) were collected from each beach seine site during each survey date. The water quality monitoring meter was calibrated per manufacturer's instructions each week before the survey was conducted. Discharge (cubic-feet per second [cfs]) in the Green River near Auburn was obtained from the U.S. Geological Survey (USGS) online stream gage station USGS No. 1213000.

The catch data were transformed to a catch per unit effort (CPUE) of $fish \bullet hectatare^{-1}$ using the number of seine hauls and the area (520 m^2) on each seine haul for all sites, except Powerline. At Powerline, the area seined (260 m^2) was constrained by a submerged shipwreck. Chinook salmon data were categorized as age-0 (yoy) and age-1+ (juvenile) as well as marked (presence of fin clip or coded wire tag) and unmarked (no fin clip or coded wire tag). Other salmonids were also distinguished by age class and marks denoting hatchery origin. All fish and water quality data were entered electronically using MS Excel™ and cross-referenced with original field data forms for quality assurance purposes.

2.2 Purse Seining

Purse seining was conducted using a 750 ft long, 60 ft deep (230 X 18 m) purse seine constructed of multiple mesh sizes. The bottom framing of the seine and the leading wing of the first 360 ft of the seine were comprised of 1 ¼" (32 mm) and 1" (25 mm) mesh respectively. The shoulder (center) 300 ft of the seine was comprised of 7/16" (11 mm) mesh, while the 90 ft bunting (collection bag) was made of ¼" (6 mm) mesh. The 1 ¼" and 1" mesh helped keep the net on the bottom and was more resistant to tearing than the smaller mesh sizes. It also allowed for the net to be pulled upstream against the current. Each purse seine set was deployed in an initial downstream direction from the privately owned and operated commercial purse seining vessel F/V Chasina contracted for this study. The seine was pulled initially downstream from the stern of the Chasina by the seine skiff which then arched the net upstream in a U-shaped manner (Figure 5). Both the F/V Chasina and the seine skiff motored upstream for the duration of seine deployment. Once the entire net was deployed the seine skiff and F/V Chasina came together at the top of the forming circle, which was immediately followed by the seine being pursed closed using the vessel's power block. The approximate area fished per set was 1.03 acres (0.42 ha). In nearly every deployment the total height of the purse seine was greater than the depth of the water. As a result, the total volume of water within the deployed net was sampled during each deployment, but this volume was highly variable as it was dependent on site characteristics (e.g. channel depth, bank slope) as well as tidal stage. Therefore, CPUE density estimates are based on estimated total area, not volume, fished.

Event	Day / Night	Date	No. Sets	Trimaran	Turn Basin	Powerline	Pit Bull	Kellogg
1	Day	12/3/2004	10					
2	Night	12/10/2004	10					
3	Day	12/13/2004	10					
4	Night	12/14/2004	10					
5	Night	12/23/2004	10					
6	Day	12/29/2004	10					
7	Night	12/30/2004	10					
8	Night	1/7/2005	10					
9	Day	1/13/2005	10					
10	Night	1/14/2005	10					
11	Night	1/20/2005	10					
12	Day	1/26/2005	10					
13	Night	1/27/2005	10					
14	Night	2/1/2005	10					
15	Night	2/8/2005	10					
16	Day	2/9/2005	10					
17	Night	2/17/2005	10					
18	Day	2/24/2005	10					
19	Night	2/25/2005	10					
20	Night	3/3/2005	10					
Total Sets	13 Nights / 7 Days		200	40	40	40	40	40

= sampled during the day
= sampled at night

Table 1: Duwamish River Beach Seine Sampling Schedule, 2004-2005.

Figure 5: Purse Seining Deployment and Retrieval at the Turning Basin, Winter 2004-2005.

Purse seine sampling stations generally represented sites that could be sampled in the channel just offshore of the beach seining sites. However, the size of the F/V Chasina (58 ft) prohibited sampling the Trimaran station due to the low bridge immediately upstream of the Turning Basin. However, to maintain consistency to the maximum extent practicable with the beach seine sites, purse seining occurred at Turning Basin (RM 5.5), Powerline (RM 5.3), Delta Marine (RM 4.8), Pit Bull (RM 4.0), and Kellogg Island (RM 1.6) (Figure 3). Additional sites were added on survey days when the F/V Chasina could not sample the primary five stations, these additional sites included T115 (RM 1.5) and Slip 2 (RM 2.2) (Figure 3).

Purse seines were designed to be conducted on 12 nights and 6 days over a period of 12 weeks. Due to conditions beyond the control of the study sampling plan, purse seining efforts were not based on tidal cycle. These conditions included the need for the 1st Avenue South Bridge to open to allow the F/V Chasina to pass underneath, the repeated grounding of the vessel in the vicinity of the Turning Basin, Powerline, and Delta Marine and the few occasions where debris (pilings, logs, unidentified snags) damaged the purse seine so that it required repair. Additionally, on February 12, 2005 the purse seine sampling team had sufficient time to sample an additional site following the completion of the five standard sites (for a total of 6 daily sets). However, due to barge traffic the F/V Chasina could not sample the usual additional sites: Slip 2 or T115. As a result, the team decided to sample Kellogg Island in the opposite direction (the seine pulled upstream from the F/V Chasina by the seine skiff) from all other purse seine sets.

As with beach seining, all fish were collected immediately from the collection bag and transferred to a holding tank (live car) where they were identified and enumerated. Due to the large numbers of fish captured in purse seines, only salmonids were measured (to the nearest mm fork length). Salmonids were anesthetized with 70 $mg \cdot L^{-1}$ buffered tricaine methanesulfonate (MS-222) prior to being measured. All age-1+ salmonids caught in purse seines, with the exception of mountain whitefish, were sampled for gut content using the non-lethal gastric lavage method, then allowed to recover in the live car filled with ambient water, and released within 150 ft of their capture location. The stomach contents were immediately placed in a jar with a 10% buffered formalin solution. For this report, a cursory investigation was completed to provide a general indication of the contents. A more comprehensive analysis of these contents may be completed by the USACE at a later date. Nine age-1+ natural Chinook were retained for otolith analysis. These fish were placed in a 10% buffered formalin solution to maintain otolith integrity until the analysis could be completed. Additionally, four age-1+ hatchery Chinook and one adult coho salmon were kept due to the Coded Wire Tag (CWT) wand indicating the presence of a tag. The otolith and CWT fish retained during this survey were provided to the USACE for future analysis.

Water quality measurements were collected at each site at three depths in the water column: on the surface, at mid-depth, and immediately above the bottom. Water quality parameters were obtained using a Hydrolab portable multi-parameter water quality datasonde. Water temperature (to the nearest 0.1 ºC), salinity (to the nearest 0.1 ppt), dissolved oxygen (to the nearest 0.01 mg/l), and turbidity (to the nearest 0.1 NTU) were collected from each purse seine site during each survey date. Discharge (cubic-feet per second [cfs]) in the Green River near Auburn was obtained from the U.S. Geological Survey (USGS) online stream gage station USGS No. 1213000. Tidal height estimates were based on the Nobeltec *Tides & Currents*™ Version 3.3 monitoring program based on the estimate for the Duwamish River at Eighth Avenue South with estimates provided in 20 minute intervals.

The catch data were transformed to a CPUE of $fish \bullet hecatare^{-1}$ using the number of seine hauls and the area (1.03 acres [0.42 ha]) on each seine haul for all sites. Other than the 10 adult chum salmon caught, one fungus-covered coded wire tagged coho or Chinook adult and one age 2+ Chinook, all salmonids were of the age-1+, so there was no need for a distinction between yoy and 1+ age classes for purse seine

caught salmonids. However, as with beach seining, all salmonids were identified as either marked (presence of fin clip or coded wire tag) or unmarked (no fin clip or coded wire tag). All fish and water quality data were entered electronically using MS Excel™ and cross-referenced with original field data forms for quality assurance purposes.

3.0 RESULTS

3.1 Beach Seining

3.1.1 Total Catch

A total of 29 different species and 6,668 individual fish were captured during the duration of this study (Tables 2 and 3). The species composition was dominated by shiner perch (*Cymatogaster aggregata*), which made up 54.4% (n=3,630) of the catch. Other numerically dominant species included: three-spine stickleback (*Gasterosteus aculeatus*) which accounted for 21.6% (n=1,442) of the catch, yoy Chinook salmon which made up 5.7% (n=380) of the catch, Pacific staghorn sculpin (*Leptocottus armatus*) which accounted for 5.1% (n=339) of the catch, and Pacific herring (*Clupea harengus pallasi*) which comprised 2.9% (n=194) of the catch (Tables 2 and 3).

Overall, an average CPUE of 652.50•fish·hectare^{-1} were captured on each seine haul throughout the sampling period (Tables 4-8). Kellogg Island had the highest total fish mean CPUE at 2,156.73 fish•hectare^{-1}, followed by Turning Basin (475.96 fish• hectare^{-1}), Trimaran (251.44 fish• hectare^{-1}), Pit Bull (263.94 fish• hectare^{-1}), and Powerline (114.42 fish• hectare^{-1}) (Tables 4-8).

All Sites

Species/ Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Total	Percent of total
Chinook yoy					1						31	45	68	80	37	11	39	14	26	28	**380**	**5.70%**
Chinook juv	10	2	1	1	1	2	5	2	2		3	1	1	3	3		1	3	3		**44**	**0.66%**
Coho juv									1												**1**	**0.01%**
Cutthroat juv					1		1			3						2					**7**	**0.10%**
Chum adult			1					1													**2**	**0.03%**
Chum yoy																	1	1		1	**3**	**0.04%**
Pink yoy																				1	**1**	**0.01%**
Rainbow juv										1								1			**2**	**0.03%**
Whitefish juv		7	4	8	5	1		21	8		21	3	18	5			1		63	4	**169**	**2.53%**
C.R. Sculpin		1									1										**2**	**0.03%**
Cyprinid sp.													2								**2**	**0.03%**
L. Smelt					1						1		2		2						**6**	**0.09%**
L.N. Dace	1	6	3	2	2			1	2	1	4		5	9	4						**40**	**0.60%**
L.S. Sucker		4				2	1				2								1	1	**11**	**0.16%**
M. Sculpin											4										**4**	**0.06%**
P. Herring	11	10	31	50			74	1						1	3		1		3	9	**194**	**2.91%**
P. Lamprey			2	1					1				1	1	1						**7**	**0.10%**
P. Sandlance		3	15	2							1										**21**	**0.31%**
P. Sculpin				1		2					39		1	1	2						**46**	**0.69%**
P. Tomcod		5			7		1	4			4			3							**24**	**0.36%**
P.S. Sculpin	1	78	4	15	16	2	8	8	5	9	56	3	4	66	2	2	28		10	22	**339**	**5.08%**
Peamouth			1																		**1**	**0.01%**
Pumpkinseed			1																		**1**	**0.01%**
R. Lamprey														1							**1**	**0.01%**
S. Flounder	2	15	2	5	5	4		3	1	2	13	6	4	4		2	4	1	2	5	**80**	**1.20%**
S. Lance												2									**2**	**0.03%**
S. Perch	96	673	59	34	670	32	406	168	140	5	605	1	108	237	46		46		73	231	**3,630**	**54.44%**
S. Prickleback		12			4																**16**	**0.24%**
S. Seaperch	1				1																**2**	**0.03%**
S. Smelt	37	5	20	3	3	1			3		21	8		3		1			1	3	**109**	**1.63%**
Sculpin sp.	1	12				1			1		54	2	1	3	1	2					**78**	**1.17%**
Smelt sp.								1													**1**	**0.01%**
T.S. Stickleback	8	119	70	306	30	3	8	707	75	2	20	12	11	54	7	2	1		4	3	**1,442**	**21.63%**
TOTAL	*168*	*952*	*214*	*428*	*747*	*50*	*504*	*917*	*239*	*23*	*880*	*83*	*226*	*471*	*108*	*22*	*122*	*20*	*186*	*308*	**6,668**	**100.00%**

Table 2: Total number of fish captured during beach seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Species	Trimaran	Turning Basin	Substation	Pit Bull	Kellogg Island	Total
Chinook yoy	106	140	38	80	16	380
Chinook juv	2	22	2	3	15	44
Coho juv			1			1
Cutthroat juv	2			5		7
Adult chum	1	1				2
Chum yoy		2		1		3
Pink yoy				1		1
Rainbow juv		1		1		2
Whitefish juv	109	45	3	11	1	169
C.R. Sculpin			1		1	2
Cyprinid		1	1			2
L. Smelt	1	3	2			6
L.N. Dace	14	19	4	3		40
L.S. Sucker	8	2	1			11
M. Sculpin	4					4
P. Herring		2	2	4	186	194
P. Lamprey	2	4		1		7
P. Sandlance	1			11	9	21
P. Sculpin	22	3	20		1	46
P. Tomcod		1		1	22	24
P.S. Sculpin	78	50	4	67	140	339
Peamouth	1					1
Pumpkinseed		1				1
R. Lamprey		1				1
S. Flounder	25	14	1	11	29	80
S. Lance					2	2
S. Perch	76	640	17	289	2608	3630
S. Prickleback					16	16
S. Seaperch				1	1	2
S. Smelt		18	2	7	82	109
Sculpin sp.	61	5	5	5	2	78
Smelt sp.		1				1
T.S. Stickleback	10	15	15	47	1355	1442
TOTAL	*523*	*991*	*119*	*549*	*4486*	*6668*

Table 3: Total number of fish captured at each site during beach seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Species/Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
Trimaran																					
Chum adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	182.69	153.85	96.15	0.00	250.00	48.08	105.77	163.46	50.96
Chinook juv	0.00	0.00	0.00	0.00	9.62	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Cutthroat juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.96
L. Smelt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
L.N. Dace	0.00	19.23	28.85	19.23	9.62	0.00	0.00	9.62	0.00	0.00	0.00	0.00	9.62	28.85	9.62	0.00	0.00	0.00	0.00	0.00	6.73
L.S. Sucker	0.00	38.46	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	3.85
M. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.92
P. Lamprey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.96
P. Sandlance	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
P. Sculpin	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	173.08	0.00	9.62	0.00	9.62	0.00	0.00	0.00	0.00	0.00	10.58
P.S. Sculpin	0.00	336.54	19.23	115.38	9.62	9.62	0.00	0.00	9.62	0.00	153.85	0.00	19.23	9.62	0.00	0.00	0.00	0.00	19.23	48.08	37.50
Peamouth	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
S. Flounder	9.62	76.92	9.62	38.46	19.23	0.00	0.00	0.00	0.00	0.00	38.46	0.00	19.23	0.00	0.00	0.00	0.00	0.00	9.62	19.23	12.02
S. Perch	0.00	28.85	0.00	0.00	230.77	288.46	0.00	115.38	19.23	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	28.85	36.54
Sculpin sp.	0.00	105.77	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	471.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.33
T.S. Stickleback	0.00	9.62	0.00	0.00	9.62	0.00	0.00	9.62	9.62	9.62	19.23	0.00	0.00	19.23	0.00	0.00	0.00	0.00	9.62	0.00	4.81
Whitefish juv	0.00	28.85	38.46	76.92	28.85	9.62	0.00	153.85	0.00	0.00	76.92	0.00	86.54	0.00	0.00	0.00	9.62	0.00	500.00	38.46	52.40
TOTAL	9.62	653.85	105.77	250.00	317.31	355.77	0.00	307.69	48.08	9.62	990.38	9.62	336.54	211.54	144.23	19.23	259.62	48.08	644.23	307.69	**251.44**

Table 4: Catch per unit effort (fish•hectare^{-1}) during beach seine surveys conducted at the Trimaran survey site in the Duwamish River, King County, Washington, 2004-2005.

Species/Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
Turning Basin																					
Chum adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.69	76.92	298.08	480.77	76.92	9.62	67.31	57.69	144.23	76.92	67.31
Chinook juv	96.15	0.00	0.00	0.00	0.00	9.62	0.00	9.62	19.23	0.00	0.00	0.00	0.00	19.23	9.62	0.00	9.62	9.62	28.85	0.00	10.58
Chum yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	0.00	0.00	0.96
Cyprinid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
L. Smelt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
L.N. Dace	9.62	19.23	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	28.85	0.00	38.46	48.08	19.23	0.00	0.00	0.00	0.00	0.00	9.13
L.S. Sucker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.96
P. Herring	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.96
P. Lamprey	0.00	0.00	19.23	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	1.92
P. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
P. Tomcod	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.48
P.S. Sculpin	0.00	57.69	0.00	19.23	28.85	0.00	0.00	0.00	28.85	19.23	76.92	0.00	19.23	144.23	0.00	9.62	19.23	0.00	38.46	19.23	24.04
Pumpkinseed	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
R. Lamprey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Rainbow juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.48
S. Flounder	0.00	9.62	9.62	9.62	9.62	0.00	0.00	0.00	9.62	0.00	9.62	28.85	19.23	0.00	0.00	0.00	0.00	9.62	9.62	9.62	6.73
S. Perch	0.00	1,192.31	0.00	28.85	259.62	0.00	0.00	182.69	1,019.23	0.00	0.00	0.00	375.00	788.46	96.15	0.00	0.00	0.00	451.92	1,759.62	307.69
S. Smelt	9.62	9.62	0.00	0.00	9.62	0.00	0.00	0.00	9.62	0.00	0.00	76.92	0.00	28.85	0.00	0.00	0.00	0.00	9.62	19.23	8.65
Sculpin sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	9.62	19.23	0.00	0.00	0.00	0.00	2.40
Smelt sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
T.S. Stickleback	0.00	0.00	9.62	9.62	9.62	0.00	0.00	38.46	0.00	0.00	0.00	0.00	28.85	9.62	19.23	0.00	0.00	0.00	9.62	9.62	7.21
Whitefish juv	0.00	38.46	0.00	0.00	19.23	0.00	0.00	38.46	28.85	0.00	76.92	0.00	86.54	38.46	0.00	0.00	0.00	0.00	105.77	0.00	21.63
TOTAL	115.38	1,326.92	48.08	76.92	336.54	9.62	0.00	288.46	1,134.62	28.85	298.08	182.69	894.23	1,596.15	230.77	38.46	115.38	96.15	807.69	1,894.23	**475.96**

Table 5: Catch per unit effort (fish•hectare-^{1}) during beach seine surveys conducted at the Turning Basin survey site in the Duwamish River, King County, Washington, 2004-2005.

Species/Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
Powerline																					
C.R. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	211.54	57.69	269.23	57.69	57.69	0.00	0.00	38.46	36.54
Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	0.00	0.00	0.00	0.00	0.00	0.00	1.92
Coho juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Cyprinid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
L. Smelt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.46	0.00	0.00	0.00	0.00	0.00	1.92
L.N. Dace	0.00	19.23	0.00	0.00	19.23	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	3.85
L.S. Sucker	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
P. Herring	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.46	0.00	0.00	0.00	0.00	0.00	1.92
P. Sculpin	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	346.15	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	19.23
P.S. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	38.46	0.00	0.00	0.00	0.00	19.23	0.00	3.85
S. Flounder	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.96
S. Perch	0.00	153.85	0.00	57.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.15	0.00	0.00	0.00	0.00	19.23	16.35
S. Smelt	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.92
Sculpin sp.	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	57.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81
T.S. Stickleback	0.00	0.00	0.00	0.00	0.00	19.23	38.46	38.46	76.92	0.00	0.00	0.00	19.23	38.46	38.46	0.00	19.23	0.00	0.00	0.00	14.42
Whitefish juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.88
TOTAL	0.00	192.31	0.00	76.92	38.46	19.23	57.69	38.46	173.08	0.00	500.00	19.23	269.23	192.31	500.00	57.69	76.92	0.00	19.23	57.69	**114.42**

Table 6: Catch per unit effort (fish•hectare-^{1}) during beach seine surveys conducted at the Powerline survey site in the Duwamish River, King County, Washington, 2004-2005.

Species/Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
Pit Bull																					
Chinook yoy	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	201.92	317.31	48.08	67.31	48.08	67.31	0.00	0.00	0.00	9.62	38.46
Chinook juv	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
Chum yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.48
Cutthroat juv	0.00	0.00	0.00	0.00	9.62	0.00	9.62	0.00	0.00	28.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40
L.N. Dace	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	1.44
P. Herring	0.00	0.00	38.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.92
P. Lamprey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
P. Sandlance	0.00	9.62	67.31	19.23	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.29
P. Tomcod	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
P.S. Sculpin	0.00	153.85	0.00	9.62	57.69	0.00	9.62	0.00	0.00	9.62	67.31	0.00	0.00	163.46	0.00	0.00	48.08	0.00	9.62	115.38	32.21
Pink yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.48
Rainbow juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
S. Flounder	0.00	28.85	0.00	0.00	9.62	19.23	0.00	0.00	0.00	0.00	0.00	9.62	0.00	19.23	0.00	9.62	0.00	0.00	0.00	9.62	5.29
S. Perch	0.00	326.92	0.00	38.46	576.92	0.00	442.31	230.77	105.77	28.85	38.46	0.00	163.46	384.62	48.08	0.00	48.08	0.00	48.08	298.08	138.94
S. Seaperch	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
S. Smelt	0.00	0.00	48.08	9.62	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.37
Sculpin sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	19.23	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	2.40
T.S. Stickleback	48.08	9.62	19.23	0.00	125.00	19.23	28.85	0.00	28.85	9.62	48.08	9.62	0.00	48.08	9.62	9.62	0.00	0.00	19.23	19.23	22.60
Whitefish juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	48.08	0.00	19.23	28.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.29
TOTAL	57.69	548.08	173.08	86.54	798.08	38.46	490.38	240.38	182.69	86.54	423.08	384.62	221.15	711.54	105.77	86.54	96.15	0.00	76.92	471.15	**263.94**

Table 7: Catch per unit effort (fish•hectare-^{1}) during beach seine surveys conducted at the Pit Bull survey site in the Duwamish River, King County, Washington, 2004-2005.

Species/Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
Kellogg Island																					
C.R. Sculpin	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	19.23	38.46	0.00	0.00	28.85	28.85	0.00	0.00	7.69
Chinook juv	0.00	19.23	9.62	0.00	0.00	9.62	48.08	0.00	0.00	0.00	9.62	9.62	0.00	0.00	19.23	0.00	0.00	19.23	0.00	0.00	7.21
P. Herring	105.77	96.15	259.62	480.77	0.00	0.00	711.54	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	0.00	0.00	0.00	28.85	86.54	89.42
P. Sandlance	0.00	9.62	76.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.33
P. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.48
P. Tomcod	0.00	38.46	0.00	0.00	67.31	0.00	9.62	38.46	0.00	0.00	38.46	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	10.58
P.S. Sculpin	9.62	201.92	19.23	0.00	57.69	9.62	67.31	76.92	0.00	57.69	240.38	28.85	0.00	298.08	19.23	9.62	201.92	0.00	19.23	28.85	67.31
S. Flounder	9.62	28.85	0.00	0.00	9.62	19.23	0.00	28.85	0.00	19.23	76.92	19.23	0.00	9.62	0.00	9.62	38.46	0.00	0.00	9.62	13.94
S. Lance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
S. Perch	932.69	4,846.15	567.31	230.77	5,375.00	19.23	3,461.54	1,086.54	201.92	19.23	5,778.85	9.62	500.00	1,105.77	230.77	0.00	394.23	0.00	201.92	125.00	1,254.33
S. Prickleback	0.00	115.38	0.00	0.00	38.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.69
S. Seaperch	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
S. Smelt	346.15	38.46	144.23	19.23	0.00	9.62	0.00	0.00	9.62	0.00	201.92	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	9.62	39.42
Sculpin sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
T.S. Stickleback	28.85	1,125.00	644.23	2,932.69	144.23	0.00	28.85	6,730.77	644.23	0.00	125.00	105.77	67.31	423.08	19.23	9.62	0.00	0.00	0.00	0.00	651.44
Whitefish juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.48
TOTAL	1,432.69	6,528.85	1,721.15	3,663.46	5,701.92	67.31	4,326.92	7,961.54	855.77	96.15	6,500.00	211.54	586.54	1,913.46	307.69	38.46	663.46	48.08	250.00	259.62	**2,156.73**

Table 8: Catch per unit effort (fish•hectare-^{1}) during beach seine surveys conducted at the Kellogg Island survey site in the Duwamish River, King County, Washington, 2004-2005.

3.1.2 Salmonids

A total of 609 salmonids (9.1% of total fish catch) were captured over the course of the study (Table 2). Chinook salmon (both yoy and age-1+) were numerically dominant (n=424), comprising 69.6% of the salmonid catch (Tables 9 and 10). The next most numerous salmonid species was juvenile mountain whitefish (n=169) comprising 27.8% of the salmonid catch, followed by juvenile cutthroat trout, chum salmon, juvenile rainbow trout, yoy pink salmon, and juvenile coho salmon (Table 2).

The mean CPUE for all salmonids caught by beach seine over the course of the study was 62.79 fish•hectare^{-1}, with the highest catch rate occurring at Trimaran (105.77 fish•hectare^{-1}). Turning Basin (101.44 fish•hectare^{-1}) had the second highest catch, followed by Pit Bull (49.04 fish•hectare^{-1}), Powerline (42.31 fish•hectare^{-1}), and Kellogg Island (15.38 fish•hectare^{-1}) (Table 11).

3.1.3 Chinook

Overall, a total of 380 yoy Chinook (89.6% of Chinook) and 44 age-1+ Chinook (10.4% of Chinook) were captured during the beach seine surveys (Table 9). Total mean Chinook CPUE at all sites over the sampling period was 11.15 fish•hectare^{-1} (Table 11). The highest mean site Chinook salmon CPUE was at the Turning Basin (77.88 fish•hectare^{-1}), followed by Trimaran (51.92 fish•hectare^{-1}), Pit Bull (39.90 fish•hectare^{-1}), Powerline (38.46 fish•hectare^{-1}), and Kellogg Island (14.90 fish•hectare^{-1}) (Table 11).

The overall mean CPUE for marked Chinook was 1.73 fish•hectare^{-1}, while the mean CPUE for non-clipped fish was 20.58 fish•hectare^{-1} (Table 11). All (n=380) Chinook salmon yoy were unmarked, as well as 8 of the age-1+ Chinook (18.1% of Chinook age-1+ catch); 36 age-1+ Chinook salmon (81.8% of Chinook age-1+ catch) were marked with an adipose fin clip. A single (n=1) age-1+ Chinook (adipose fin clip) possessed a coded-wire tag. During the paired day-night sampling period, mean total Chinook CPUE was higher during night surveys (376.60 fish• hectare^{-1}) compared to day survey trips (28.85 fish• hectare^{-1}). Catch indices for both marked and unmarked Chinook salmon followed the same pattern of higher densities during night surveys when compared to daytime survey events (Tables 12 and 13). Mean lengths of marked Chinook juveniles were greater (193.7 mm) and more variable (st. dev. = 43.5 mm) than unmarked Chinook smolts (Table 14).

Ten age-1+ Chinook salmon (mean fork length = 183 mm) were captured on the first day of beach seining (December 3, 2004) immediately following a December freshet. All ten of these fish were marked fish and all were captured at the Turning Basin (Tables 10 and 11).

The total Chinook salmon CPUE was highest on February 1, 2005 (836.54 fish•hectare^{-1}), followed by January 27, 2005 (778.85 fish• hectare^{-1}), February, 8 2005 (519.23 fish• hectare^{-1}), and January, 26 2005 (451.92 fish• hectare^{-1}) (Table 11). In a nearly two week period from January 20-February8, 2005, immediately following the January freshet, the beach seines captured 64% of all Chinook salmon caught during the course of nearly thirteen weeks of beach seining.

Species/ Life Stage	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Total	Percent of Total
Chinook yoy					1						31	45	68	80	37	11	39	14	26	28	*380*	62.40%
Chinook juv	10	2	1	1	1	2	5	2	2		3	1	1	3	3		1	3	3		*44*	7.22%
Coho juv									1												*1*	0.16%
Cutthroat juv					1		1			3						2					*7*	1.15%
Chum adult			1					1													*2*	0.33%
Chum yoy																	1	1		1	*3*	0.49%
Pink yoy																				1	*1*	0.16%
Rainbow juv										1								1			*2*	0.33%
Whitefish juv		7	4	8	5	1		21	8		21	3	18	5			1		63	4	*169*	27.75%
TOTAL	*10*	*9*	*6*	*9*	*8*	*3*	*6*	*24*	*11*	*4*	*55*	*49*	*87*	*88*	*40*	*13*	*42*	*19*	*92*		*609*	100.00%

Table 9: Total number of salmonids captured during beach seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Site Species/Mark	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
	Day	Night	Day	Night	Night	Day	Night	Night	Day	Night	Night	Day	Night	Night	Night	Day	Night	Day	Night	Night	
Trimaran																					
Chum adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	182.69	153.85	96.15	0.00	250.00	48.08	105.77	163.46	50.96
Chinook juv	0.00	0.00	0.00	0.00	9.62	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Cutthroat juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.96
Whitefish juv	0.00	28.85	38.46	76.92	28.85	9.62	0.00	153.85	0.00	0.00	76.92	0.00	86.54	0.00	0.00	0.00	9.62	0.00	500.00	38.46	52.40
Turning Basin																					**105.77**
Chum adult	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Chum yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	0.00	0.00	0.96
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.69	76.92	298.08	480.77	76.92	9.62	67.31	57.69	144.23	76.92	67.31
Chinook juv	96.15	0.00	0.00	0.00	0.00	9.62	0.00	9.62	19.23	0.00	0.00	0.00	0.00	19.23	9.62	0.00	9.62	9.62	28.85	0.00	10.58
Rainbow juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.48
Whitefish juv	0.00	38.46	0.00	0.00	19.23	0.00	0.00	38.46	28.85	0.00	76.92	0.00	86.54	38.46	0.00	0.00	0.00	0.00	105.77	0.00	21.63
Powerline																					**101.44**
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	211.54	57.69	269.23	57.69	57.69	0.00	0.00	38.46	36.54
Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	0.00	0.00	0.00	0.00	0.00	0.00	1.92
Coho juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Whitefish juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.88
Pit Bull																					**42.31**
Chinook yoy	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	201.92	317.31	48.08	67.31	48.08	67.31	0.00	0.00	0.00	9.62	38.46
Chinook juv	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
Chum yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.48
Cutthroat	0.00	0.00	0.00	0.00	9.62	0.00	9.62	0.00	0.00	28.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40
Pink yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.48
Rainbow juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Whitefish juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	48.08	0.00	19.23	28.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.29
Kellogg Island																					**49.04**
Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	19.23	38.46	0.00	0.00	28.85	28.85	0.00	0.00	7.69
Chinook juv	0.00	19.23	9.62	0.00	0.00	9.62	48.08	0.00	0.00	0.00	9.62	9.62	0.00	0.00	19.23	0.00	0.00	19.23	0.00	0.00	7.21
Whitefish juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.48
																					15.38
TOTAL	96.15	86.54	48.08	86.54	76.92	28.85	57.69	230.77	125.00	38.46	586.54	480.77	951.92	884.62	519.23	153.85	432.69	182.69	884.62	346.15	**62.79**

Table 10: Total salmonid catch per unit effort (fish•hectare^{-1}) from beach seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Site Species/Mark	3 Dec Day	10 Dec Night	13 Dec Day	14 Dec Night	23 Dec Night	29 Dec Day	30 Dec Night	7 Jan Night	13 Jan Day	14 Jan Night	20 Jan Night	26 Jan Day	27 Jan Night	1 Feb Night	8 Feb Night	9 Feb Day	17 Feb Night	24 Feb Day	25 Feb Night	3 Mar Night	Mean
Trimaran																					
Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mark Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	9.62	182.69	153.85	96.15	0.00	250.00	48.08	105.77	163.46	50.96
Unmarked Chinook juv	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
TOTAL	0.00	0.00	0.00	0.00	9.62	0.00	0.00	9.62	0.00	0.00	9.62	9.62	182.69	153.85	96.15	0.00	250.00	48.08	105.77	163.46	**51.92**
Turning Basin																					
Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mark Chinook juv	96.15	0.00	0.00	0.00	0.00	9.62	0.00	0.00	19.23	0.00	0.00	0.00	0.00	19.23	9.62	0.00	9.62	9.62	19.23	0.00	9.62
Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.69	76.92	298.08	480.77	76.92	9.62	67.31	57.69	144.23	76.92	67.31
Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.96
TOTAL	96.15	0.00	0.00	0.00	0.00	9.62	0.00	9.62	19.23	0.00	57.69	76.92	298.08	500.00	86.54	9.62	76.92	67.31	173.08	76.92	**77.88**
Powerline																					
Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mark Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	211.54	57.69	269.23	57.69	57.69	0.00	0.00	38.46	36.54
Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	0.00	0.00	0.00	0.00	0.00	0.00	1.92
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	230.77	76.92	269.23	57.69	57.69	0.00	0.00	38.46	**38.46**
Pit Bull																					
Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mark Chinook juv	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Unmarked Chinook yoy	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	201.92	317.31	48.08	67.31	48.08	67.31	0.00	0.00	0.00	9.62	38.46
Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
TOTAL	0.00	0.00	0.00	9.62	9.62	0.00	0.00	0.00	0.00	0.00	221.15	317.31	48.08	67.31	48.08	67.31	0.00	0.00	0.00	9.62	**39.90**
Kellogg Island																					
Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mark Chinook juv	0.00	19.23	9.62	0.00	0.00	9.62	48.08	0.00	0.00	0.00	9.62	9.62	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	6.25
Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	19.23	38.46	0.00	0.00	28.85	28.85	0.00	0.00	7.69
Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.96
TOTAL	0.00	19.23	9.62	0.00	0.00	9.62	48.08	0.00	0.00	0.00	28.85	28.85	19.23	38.46	19.23	0.00	28.85	48.08	0.00	0.00	**14.90**
Mark Avg	**19.23**	**3.85**	**1.92**	**1.92**	**0.00**	**3.85**	**9.62**	**1.92**	**3.85**	**0.00**	**3.85**	**1.92**	**0.00**	**3.85**	**1.92**	**0.00**	**1.92**	**5.77**	**3.85**	**0.00**	***1.73***
Unmarked Avg	**0.00**	**0.00**	**0.00**	**0.00**	**3.85**	**0.00**	**0.00**	**1.92**	**0.00**	**0.00**	**63.46**	**88.46**	**155.77**	**163.46**	**101.92**	**26.92**	**80.77**	**26.92**	**51.92**	**57.69**	***20.58***
TOTAL Avg	**19.23**	**3.85**	**1.92**	**1.92**	**3.85**	**3.85**	**9.62**	**3.85**	**3.85**	**0.00**	**67.31**	**90.38**	**155.77**	**167.31**	**103.85**	**26.92**	**82.69**	**32.69**	**55.77**	**57.69**	***11.15***

Table 11: Chinook salmon catch per unit effort (fish•hectare^{-1}) from beach seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Site	Species/Life Stage/Mark	13 Dec Day	14 Dec Night	29 Dec Day	30 Dec Night	13 Jan Day	14 Jan Night	26 Jan Day	27 Jan Night	8 Feb Night	9 Feb Day	24 Feb Day	25 Feb Night	Mean
Trimaran	Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mark Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	9.62	182.69	96.15	0.00	48.08	105.77	36.86
	Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	9.62	182.69	96.15	0.00	48.08	105.77	**36.86**
Turning Basin	Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mark Chinook juv	0.00	0.00	9.62	0.00	19.23	0.00	0.00	0.00	9.62	0.00	9.62	19.23	5.61
	Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	76.92	298.08	76.92	9.62	57.69	144.23	55.29
	Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.62	0.80
	TOTAL	0.00	0.00	9.62	0.00	19.23	0.00	76.92	298.08	86.54	9.62	67.31	173.08	**61.70**
Powerline	Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mark Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	19.23	211.54	269.23	57.69	0.00	0.00	46.47
	Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	1.60
	TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	19.23	230.77	269.23	57.69	0.00	0.00	**48.08**
Pit Bull	Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mark Chinook juv	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
	Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	317.31	48.08	48.08	67.31	0.00	0.00	40.06
	Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL	0.00	9.62	0.00	0.00	0.00	0.00	317.31	48.08	48.08	67.31	0.00	0.00	**40.87**
Kellogg Island	Mark Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mark Chinook juv	9.62	0.00	9.62	48.08	0.00	0.00	9.62	0.00	0.00	0.00	19.23	0.00	8.01
	Unmarked Chinook yoy	0.00	0.00	0.00	0.00	0.00	0.00	19.23	19.23	0.00	0.00	28.85	0.00	5.61
	Unmarked Chinook juv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.23	0.00	0.00	0.00	1.60
	TOTAL	9.62	0.00	9.62	48.08	0.00	0.00	28.85	19.23	19.23	0.00	48.08	0.00	**15.22**
Mark Avg		**1.92**	**1.92**	**3.85**	**9.62**	**3.85**	**0.00**	**1.92**	**0.00**	**1.92**	**0.00**	**5.77**	**3.85**	6.97
Unmarked Avg		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**88.46**	**155.77**	**101.92**	**26.92**	**26.92**	**51.92**	19.51
Total Avg		**1.92**	**1.92**	**3.85**	**9.62**	**3.85**	**0.00**	**90.38**	**155.77**	**103.85**	**26.92**	**32.69**	**55.77**	13.24

Table 12: Chinook salmon catch per unit effort (fish•hectare^{-1}) from six paired day/night beach seine survey events conducted in the Duwamish River, King County, Washington, 2004-2005.

Survey Strata	Mark	Unmarked	Total
Day	2.88	23.72	26.60
Night	2.88	51.60	54.49
Total	5.77	75.32	81.09

Table 13: Average Chinook salmon catch per unit effort (fish•hectare^{-1}) from six paired day/night beach seine survey events conducted in the Duwamish River, King County, Washington, 2004-2005.

Species/Life Stage	Mark	3 Dec	10 Dec	13 Dec	14 Dec	23 Dec	29 Dec	30 Dec	7 Jan	13 Jan	14 Jan	20 Jan	26 Jan	27 Jan	1 Feb	8 Feb	9 Feb	17 Feb	24 Feb	25 Feb	3 Mar	Mean
Chinook yoy	Unmark					36.0						36.7	39.6	39.4	41.2	42.9	41.7	43.3	43.8	45.4	47.7	41.6
Chinook juv	Mark	185.3	217.5	170.0	155.0		175.5	232.8	161.0	207.5		183.0	170.0		230.5	115.0		211.0	303.7	187.5		193.7
Chinook juv	Unmark					125.0			158.0			145.0		112.0	112.0	111.5				127.0		127.2
Chum yoy	Unmark																	45.0	38.0		38.0	40.3
Pink yoy	Unmark																				34.0	34.0
Coho juv	Mark									95.0												95.0
Cutthroat juv	Unmark					309.0		310.0			295.7						331.5					309.9
Rainbow juv	Unmark										258.0								239.0			248.5
Whitefish juv	Unmark		154.9	158.8	153.5	151.4	142.0		151.0	146.6		152.3	149.0	148.4	142.8			161.0		152.5	134.8	151.1

Table 14: Mean fork length (mm) of salmonids captured during beach seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

3.2 Purse Seining

The total number of purse seine stations sampled per day was based on the ability of the F/V Chasina to reach and effectively deploy the seine each site. The days this vessel was available for this study was limited by its use in other surveys such as the NOAA Fisheries abundance estimate surveys. As a result, the purse seine sampling schedule sometimes necessitated sampling under sub-standard tidal conditions which led to repeated vessel groundings. To avoid these groundings the F/V Chasina avoided sampling the upper stations during the lowest tidal flows (-3.4 feet Mean Lower Low Water [MLLW]) that occurred on January 10, 2005. Additionally, due to the clearance necessary for the F/V Chasina, there were times when tides, and Washington Department of Transportation (WSDOT) Duwamish River bridge operations and failures affected the ability to sample according to the predetermined surveying schedule. As a result, although the focus remained on sampling the five primary sites: Turning Basin, Powerline, Delta Marine, Pit Bull and Kellogg Island, if conditions did not allow for purse seining all of the primary sites, or as time allowed to increase the total number of sites surveyed in a day to >5, additional sites were surveyed (Table 15). These conditions did not allow for paired night and day sampling with the purse seine.

3.2.1 Total Catch

A total of 37 different species and 86,242 individual fish were captured in purse seines during the course of this study (Tables 16 and 17). The species composition was dominated by shiner perch (*Cymatogaster aggregata*), which made up 64.6% (n=55,683) of the catch. Other numerically dominant species included Pacific herring (*Clupea harengus pallasi*) which accounted for 22.8% (n=19,618) of the catch; surf smelt (*Hypomesus pretiosus pretiosus*) which made up 7.5% (n=6,502) of the catch; and starry flounder (*Platichthys stellatus*) which comprised 2.2% (n=1,861) of the catch (Tables 16 and 17).

Based on a total of 88 purse seine sets at all sites during the period of the survey, the average CPUE for all fish combined was of 2,356.20•fish·hectare^{-1}. Kellogg Island had the highest total mean CPUE at 3,702.2 fish• hectare^{-1}, followed by Powerline (2,610.9 fish• hectare^{-1}), Turning Basin (2,480.09 fish• hectare^{-1}), Delta Marine (1,729.8 fish• hectare^{-1}), Pit Bull (1,635.56 fish• hectare^{-1}), T115 (1,458.88 fish• hectare^{-1}), and Slip 2 (302.96 fish• hectare^{-1}) (Tables 18-25). Additionally, Kellogg-B, which happened to be a set deployed in the opposite direction of all other purse seines (made possible due to a slow-moving tide), resulted in a CPUE of 4,772.78 fish• hectare^{-1}.

Event	Day / Night	Date	No. Sets	Kellogg	Turn Basin	Delta	Powerline	Pit Bull	T115	Slip 2
1	Day	12/4/2004	5							
2	Night	12/10/2004	4				A			
3	Night	12/17/2004	5							
4	Day	12/18/2004	5							
5	Night	12/20/2004	4					B		
6	Night	12/27/2004	5					C		
7	Day	12/28/2004	6							
8	Night	1/7/2005	4					D		
9	Night	1/10/2005	4		E	F		G		
10	Day	1/11/2005	5							
11	Night	1/17/2005	5							
12	Night	1/28/2005	5							
13	Day	1/29/2005	6							
14	Night	2/4/2005	5							
15	Night	2/11/2005	5							
16	Day	2/12/2005	6	2 sets*						
17	Night	2/18/2005	4					H		
18	Night	2/20/2005	5							
Total Sets	12 Nights / 6 Days		88	19	17	17	17	13	4	1

= sampled during the day
= sampled at night

Notes

A	Due to extended processing time of large catches at the other stations Powerline was not sampled this night.
B	Two large tears in the net at Delta requiring extended time to repair resulted in Pit Bull not being sampled this night.
C	Pit Bull was not sampled this night because the water depth was <10 feet deep at this site.
D	Again, Pit Bull was not sampled this night because the water depth was <10 feet deep at this site.
E, F, G	Due to a -3.4 tide the Chasina could not seine these sites. Therefore, T115 and Slip 2 were sampled as supplemental sites.
H	A large tear in the net at Delta that required a few hours to repair ended the nights sampling.
2 sets*	Due to additional available time an extra set (in the opposite direction of all other sets) was conducted at Kellogg on 2/12/05.

Table 15: Duwamish River Purse Seine Sampling Schedule, 2004-2005.

Species	4-Dec	10-Dec	17-Dec	18-Dec	20-Dec	27-Dec	28-Dec	7-Jan	10-Jan	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	11-Feb	12-Feb	18-Feb	20-Feb	Total	Percent of Total
Bay goby															2	1		3	**6**	**0.01%**
Big Skate											1								**1**	**0.00%**
Buffalo Sculpin	2																		**2**	**0.00%**
Chinook juv.	1	8	5		1	1	1	9	4		9		4	3	3	3	4	1	**57**	**0.07%**
Chum adult		5	3	2															**10**	**0.01%**
C.R Sculpin												8		50	3	1	15	20	**97**	**0.11%**
Coho adult		1																	**1**	**0.00%**
English Sole	1							2	2	1									**6**	**0.01%**
Eulachon												2	2	1					**5**	**0.01%**
Gunnel												1				1			**2**	**0.00%**
Longfin Smelt		113	60	22	21	15	1	64	9	1	42	12	9	22	7	2	10	5	**415**	**0.48%**
Mtn. Whitefish								5			1								**6**	**0.01%**
N. Anchovy													2						**2**	**0.00%**
P. Herring	183	129	100	16241	153	148	955	107	321	174	266	33	148	170	28	210	121	131	**19618**	**22.75%**
P. sanddab								1											**1**	**0.00%**
P. Sandfish					1														**1**	**0.00%**
P. Sandlance		3	1	2	2														**8**	**0.01%**
P. Tomcod	1	40	21		10	83		29	5		4	10	4	9	6	1		1	**224**	**0.26%**
Pile Perch	3	12		5	6	1	2	1	2					1		1	1	1	**36**	**0.04%**
Prickly Sculpin					2	2		43	5	1	6								**59**	**0.07%**
Rat fish									1										**1**	**0.00%**
R. Lamprey		4																	**4**	**0.00%**
Rock Sole								1	1										**2**	**0.00%**
Sand sole									1										**1**	**0.00%**
Sanddab / Sole		1																	**1**	**0.00%**
Shad	2	3	13	24	10	36	5	75	9	21	32	394	12	340	64	17	164	206	**1427**	**1.65%**
Shiner Perch	1675	7447	7118	3014	12650	4821	993	3163	1500	300	2947	2764	1281	2824	637	1248	537	764	**55683**	**64.57%**
Snailfish											1								**1**	**0.00%**
Snailfish (marbled?)																		4	**4**	**0.00%**
S. Prickleback						1		2	1				2	2	1				**9**	**0.01%**
Spckled sanddab		1																	**1**	**0.00%**
P.S. Sculpin	6	19	10		5	12	2	10	5		18	6	1	28	8	1	9	15	**155**	**0.18%**
Starry Flounder	103	236	68	117	62	327	41	116	64	5	78	124	26	151	159	26	45	113	**1861**	**2.16%**
Steelhead juv.		2			1			2	1									1	**7**	**0.01%**
Striped Perch		2																	**2**	**0.00%**
Strgn poacher		1						1	1										**3**	**0.00%**
Surf Smelt	74	99	121	1421	285	32	295	159	1512	15	71	8	655	19	6	1581	9	140	**6502**	**7.54%**
T.S. Stickleback	3		1				7			6			2	2					**21**	**0.02%**
Total Count	*2054*	*8126*	*7521*	*20848*	*13209*	*5479*	*2302*	*3790*	*3444*	*524*	*3476*	*3362*	*2148*	*3622*	*924*	*3093*	*915*	*1405*	**86242**	**100.0%**

Table 16: Total number of fish captured during purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Species	Turning Basin	Power Line	Delta Marine	Pit Bull	Kellogg	Kellogg-B	Slip 2	T115	Total
Bay goby		2	1	3					6
Big Skate					1				
Buffalo Sculpin					2				2
Chinook	12	14	10	6	13	1		1	57
Chum	5	3	1		1				10
Coast Range Sculpin	8	68	10	10	1				97
Coho/Chinook			1						1
English Sole		1		1	3			1	6
Eulachon	3		1	1					5
Gunnel				2					2
Longfin Smelt	209	59	54	88				5	415
Mtn. Whitefish	5			1					6
Northern Anchovy		1						1	2
P. Herring	607	399	237	163	17038	80	3	1091	19618
P. sanddab					1				1
P. Sandfish		1							1
P. Sandlance	4		3	1					8
P. Tomcod	14	46	95	51	12	1	4	1	224
Pile Perch	1	4	3	15	12	1			36
Prickly Sculpin	4	51	1	1	1			1	59
Rat fish					1				1
River Lamprey	1		3						4
Rock Sole					2				2
Sand sole					1				1
Sanddab / Sole				1					1
Shad	350	719	273	79	3			3	1427
Shiner Perch	15760	16528	10861	7604	3123	1090	112	605	55683
Snailfish		1							1
Snailfish (marbled?)	2	2							4
Snake Prickleback	1		1	2	4			1	9
Speckled sanddab					1				1
Staghorn Sculpin	68	25	19	30	12			1	155
Starry Flounder	323	425	562	350	143	8	6	44	1861
Steelhead	2	2	1	1	1				7
Striped Perch			2						2
Sturgeon poacher					3				3
Surf Smelt	156	108	89	431	4250	804	1	663	6502
Threespine Stickleback		1	1	2	8			9	21
TOTAL	*17535*	*18460*	*12229*	*8843*	*24636*	*1985*	*126*	*2427*	*86242*

Table 17: Total number of fish captured at each site during purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Turning Basin

Species	4-Dec	11-Dec	17-Dec	18-Dec	20-Dec	27-Dec	28-Dec	7-Jan	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	11-Feb	12-Feb	18-Feb	20-Feb	Mean
Chinook juv.	0.00	0.00	4.81	0.00	2.40	0.00	2.40	2.40	0.00	12.02	0.00	2.40	2.40	0.00	0.00	0.00	0.00	1.70
Chum adult	0.00	9.62	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71
Coast Range Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.43	0.00	0.00	2.40	2.40	1.13
Eulachon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	2.40	0.00	0.00	0.00	0.00	0.00	0.42
Longfin Smelt	0.00	257.27	52.90	9.62	9.62	9.62	0.00	84.15	0.00	50.49	2.40	0.00	7.21	0.00	0.00	14.43	4.81	29.56
Mtn. Whitefish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71
P. Herring	209.18	9.62	88.96	45.68	199.57	28.85	36.07	170.71	0.00	302.96	50.49	0.00	64.92	4.81	2.40	132.24	113.01	85.85
P. Sandlance	0.00	2.40	2.40	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
P. Tomcod	0.00	7.21	2.40	0.00	7.21	12.02	0.00	0.00	0.00	0.00	0.00	0.00	4.81	0.00	0.00	0.00	0.00	1.98
Pile Perch	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Prickly Sculpin	0.00	0.00	0.00	0.00	2.40	0.00	0.00	2.40	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
River Lamprey	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Shad	0.00	4.81	7.21	12.02	12.02	24.04	0.00	84.15	0.00	38.47	60.11	2.40	57.71	21.64	2.40	151.48	363.07	49.50
Shiner Perch	1353.7	8220.7	4277.5	1344.1	9528.7	408.75	48.09	4443.4	9.62	4282.3	646.79	12.02	1829.8	48.09	0.00	706.90	733.35	2229.04
Snailfish (marbled?)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	0.28
Snake Prickleback	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Staghorn Sculpin	2.40	19.24	2.40	0.00	7.21	2.40	0.00	19.24	0.00	33.66	9.62	0.00	45.68	0.00	0.00	9.62	12.02	9.62
Starry Flounder	60.11	278.91	14.43	2.40	40.88	24.04	4.81	60.11	0.00	105.79	9.62	2.40	110.60	4.81	0.00	31.26	26.45	45.68
Steelhead juv.	0.00	2.40	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Surf Smelt	9.62	12.02	19.24	60.11	55.30	14.43	21.64	74.54	0.00	52.90	16.83	0.00	2.40	7.21	0.00	9.62	19.24	22.06
Total density (#/ha) at **Turning Basin**	1635.0	8826.6	4472.2	1476.3	9872.6	524.16	113.01	4957.9	9.62	4883.4	800.67	21.64	2139.9	86.56	4.81	1057.9	1279.2	2480.09

Table 18: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the Turning Basin survey site in the Duwamish River, King County, Washington, 2004-2005.

Powerline

Species	4-Dec	17-Dec	18-Dec	20-Dec	27-Dec	28-Dec	7-Jan	10-Jan	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	11-Feb	12-Feb	18-Feb	20-Feb	Mean
Bay goby	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	0.28
Chinook juv.	2.40	2.40	0.00	0.00	0.00	0.00	12.02	4.81	0.00	7.21	0.00	0.00	0.00	0.00	0.00	4.81	0.00	1.98
Chum adult	0.00	4.81	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
C.R. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.83	0.00	84.15	0.00	0.00	31.26	31.26	9.62
English Sole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Longfin Smelt	0.00	24.04	2.40	0.00	4.81	0.00	36.07	21.64	0.00	12.02	7.21	0.00	14.43	4.81	4.81	7.21	2.40	8.34
N. Anchovy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.14
P. Herring	64.92	48.09	98.58	4.81	33.66	0.00	16.83	62.52	197.16	161.10	4.81	4.81	98.58	9.62	113.01	21.64	19.24	56.43
P. Sandfish	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
P. Tomcod	0.00	4.81	0.00	0.00	96.18	0.00	4.81	2.40	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	6.51
Pile Perch	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	2.40	0.00	0.57
Prickly Sculpin	0.00	0.00	0.00	2.40	2.40	0.00	100.99	9.62	0.00	7.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.21
Shad	0.00	14.43	7.21	7.21	55.30	0.00	88.96	21.64	16.83	36.07	334.21	0.00	750.18	69.73	36.07	235.63	55.30	101.69
Shiner Perch	509.7	4448.2	2284.2	18593.4	2979.1	76.94	2135.1	711.7	60.11	1846.6	1322.4	694.9	2880.5	411.16	201.97	391.92	192.35	2337.7
Snailfish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Snailfish (mrbled)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	0.28
P.S. Sculpin	0.00	0.00	0.00	0.00	9.62	0.00	4.81	0.00	0.00	4.81	2.40	0.00	14.43	0.00	0.00	12.02	12.02	3.54
Starry Flounder	31.26	55.30	31.26	86.56	201.97	40.88	122.63	62.52	4.81	24.04	96.18	0.00	98.58	26.45	2.40	67.32	69.73	60.11
Steelhead juv.	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Surf Smelt	28.85	9.62	21.64	0.00	2.40	48.09	36.07	14.43	19.24	40.88	0.00	2.40	9.62	2.40	21.64	2.40	0.00	15.28
T.S. Stickleback	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Total density (#/ha) at **Powerline**	639.6	4611.7	2447.7	18696.8	3385.4	168.3	2563.1	913.7	300.6	2142.3	1786.5	704.50	3952.9	524.2	379.9	776.6	391.9	2610.9

Table 19: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the Powerline survey site in the Duwamish River, King County, Washington, 2004-2005.

Delta Marine

Species	4-Dec	11-Dec	17-Dec	18-Dec	20-Dec	27-Dec	28-Dec	7-Jan	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	11-Feb	12-Feb	18-Feb	20-Feb	Mean
Bay goby	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.14
Big Skate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Chinook juv.	0.00	4.81	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	7.21	0.00	2.40	2.40	1.41
Chum adult	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
C.R. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.64	0.00	0.00	2.40	0.00	1.41
Coho/Chinook	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Eulachon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.14
Longfin Smelt	0.00	2.40	7.21	0.00	40.88	9.62	0.00	33.66	0.00	4.81	14.43	0.00	4.81	9.62	0.00	2.40	0.00	7.64
P. Herring	21.64	0.00	14.43	21.64	33.66	2.40	4.81	2.40	199.57	0.00	14.43	60.11	55.30	45.68	81.75	2.40	9.62	33.52
P. Sandlance	0.00	2.40	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
P. Tomcod	0.00	43.28	7.21	0.00	16.83	84.15	0.00	55.30	0.00	4.81	4.81	0.00	9.62	2.40	0.00	0.00	0.00	13.44
Pile Perch	2.40	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
Prickly Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
R. Lamprey	0.00	7.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
Shad	0.00	2.40	9.62	33.66	4.81	7.21	12.02	7.21	28.85	0.00	430.39	7.21	2.40	31.26	0.00	7.21	72.13	38.61
Shiner Perch	937.73	3380.62	5655.2	543.40	2053.4	7222.9	7.21	1026.7	442.41	312.58	2154.4	868.00	997.84	254.87	9.62	4.81	242.85	1536.1
S. Prickleback	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.14
P.S Sculpin	7.21	4.81	2.40	0.00	4.81	12.02	0.00	0.00	0.00	0.00	0.00	0.00	4.81	4.81	0.00	0.00	4.81	2.69
Starry Flounder	67.32	146.67	91.37	31.26	21.64	504.93	21.64	76.94	4.81	38.47	117.82	24.04	88.96	52.90	12.02	0.00	50.49	79.49
Steelhead juv.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.14
Striped Perch	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Surf Smelt	16.83	33.66	50.49	2.40	24.04	0.00	9.62	31.26	14.43	2.40	0.00	12.02	9.62	4.81	0.00	0.00	2.40	12.59
T.S. Stickleback	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Total density (#/ha) at **Delta Marine**	1053.1	3637.89	5845.2	637.17	2202.5	7845.6	55.30	1233.5	690.07	367.88	2736.2	973.79	1199.8	413.56	103.39	21.64	389.52	1729.8

Table 20: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the Delta Marine survey site in the Duwamish River, King County, Washington, 2004-2005.

Pit Bull

Species	4-Dec	10-Dec	17-Dec	18-Dec	28-Dec	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	11-Feb	12-Feb	20-Feb	Mean
Bay goby	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	2.40	0.00	0.55
Chinook juv.	0.00	9.62	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	1.11
C.R. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	7.21	0.00	14.43	1.85
English Sole	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
Eulachon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.18
Gunnel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	2.40	0.00	0.37
Longfin Smelt	0.00	12.02	60.11	40.88	2.40	2.40	33.66	4.81	21.64	26.45	2.40	0.00	4.81	16.28
Mtn. Whitefish	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.18
P. Herring	21.64	19.24	84.15	62.52	36.07	0.00	52.90	9.62	14.43	76.94	7.21	0.00	7.21	30.15
P. Sandlance	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
P. Tomcod	2.40	38.47	33.66	0.00	0.00	0.00	4.81	16.83	4.81	7.21	12.02	0.00	2.40	9.43
Pile Perch	4.81	16.83	0.00	12.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.77
Prickly Sculpin	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
Sanddab / Sole	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
Shad	4.81	0.00	0.00	4.81	0.00	2.40	2.40	122.63	7.21	7.21	31.26	2.40	4.81	14.61
Shiner Perch	1180.57	5818.71	2729.02	2918.97	0.00	180.33	411.16	2522.24	351.05	690.07	817.50	12.02	651.60	1406.40
S. Prickleback	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.37
P.S. Sculpin	4.81	12.02	19.24	0.00	4.81	0.00	2.40	2.40	0.00	2.40	14.43	2.40	7.21	5.55
Starry Flounder	86.56	117.82	2.40	28.85	19.24	2.40	14.43	74.54	31.26	38.47	298.15	4.81	122.63	64.73
Steelhead juv.	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
Surf Smelt	24.04	31.26	189.95	81.75	627.55	0.00	69.73	2.40	0.00	9.62	0.00	0.00	0.00	79.72
T.S. Stickleback	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37
Total density (#/ha) at **Pit Bull**	1336.86	6083.19	3118.54	3149.80	690.07	189.95	593.89	2760.28	435.20	863.19	1197.40	26.45	817.50	1635.56

Table 21: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the Pit Bull survey site in the Duwamish River, King County, Washington, 2004-2005.

Kellogg Island

Species	4-Dec	10-Dec	17-Dec	18-Dec	20-Dec	27-Dec	28-Dec	7-Jan	10-Jan	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	12-Feb	12-Feb	18-Feb	20-Feb	Mean
Buffalo Sculpin	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30
Chinook juv.	0.00	4.81	0.00	0.00	0.00	2.40	0.00	7.21	4.81	0.00	2.40	0.00	0.00	2.40	4.81	4.81	2.40	0.00	1.95
Chum adult	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
C.R. Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.15
English Sole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
P. Herring	122.63	281.32	4.81	38822	129.84	33.66	9.62	67.32	694.88	21.64	122.63	67.34	60.13	113.01	31.27	84.70	134.65	165.91	2560.4
P. sanddab	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
P. Tomcod	0.00	7.21	2.40	0.00	0.00	4.81	0.00	9.62	0.00	0.00	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	1.80
Pile Perch	0.00	12.02	0.00	0.00	9.62	0.00	2.40	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80
Prickly Sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Rat fish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Rock Sole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30
Sand sole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Shad	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.45
Shiner Perch	45.68	485.69	4.81	156.29	240.44	521.76	2255.4	0.00	22523	28.85	233.23	495.43	12.03	391.92	153.89	2.40	187.55	16.83	469.31
S. Prickleback	0.00	0.00	0.00	0.00	0.00	2.40	0.00	2.40	0.00	0.00	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.60
Speckled sanddab	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
P.S. Sculpin	0.00	9.62	0.00	0.00	0.00	4.81	0.00	0.00	9.62	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	1.80
Starry Flounder	2.40	24.04	0.00	187.55	0.00	12.02	7.21	19.24	21.64	0.00	4.81	2.40	0.00	26.45	12.02	12.02	9.62	2.40	21.49
Steelhead juv.	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
S. poacher	0.00	2.40	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
Surf Smelt	98.58	161.10	21.64	3250.8	605.91	0.00	0.00	240.44	3618.7	2.40	4.81	26.46	2.40	14.43	0.00	1846.6	9.62	314.98	638.68
T.S. Stickleback	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.43	0.00	0.00	0.00	4.81	0.00	0.00	0.00	0.00	1.20
Total density (#/ha) at **Kellogg**	274.10	990.62	36.07	42416	988.22	581.87	2274.6	358.26	6621.8	69.73	370.28	608.46	74.56	553.02	204.39	2149.6	343.83	500.12	3702.2

Table 22: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the Kellogg Island survey site in the Duwamish River, King County, Washington, 2004-2005.

Species	27-Dec	28-Dec	10-Jan	29-Jan	Mean
Chinook juv.	0.00	0.00	0.00	2.40	0.60
English Sole	0.00	0.00	2.40	0.00	0.60
Longfin Smelt	12.02	0.00	0.00	0.00	3.01
Northern Anchovy	0.00	0.00	0.00	2.40	0.60
P. Herring	257.27	2209.67	7.21	149.07	655.81
P. Tomcod	2.40	0.00	0.00	0.00	0.60
Prickly Sculpin	2.40	0.00	0.00	0.00	0.60
Shad	0.00	0.00	0.00	7.21	1.80
Shiner Perch	459.25	0.00	372.69	622.75	363.67
Snake Prickleback	0.00	0.00	2.40	0.00	0.60
Staghorn Sculpin	0.00	0.00	2.40	0.00	0.60
Starry Flounder	43.28	4.81	55.30	2.40	26.45
Surf Smelt	60.11	2.40	0.00	1531.62	398.53
T.S Stickleback	0.00	16.83	0.00	4.81	5.41
Total density (#/ha) at T115	836.74	2233.71	442.41	2322.67	1458.88

Table 23: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the T115 survey site in the Duwamish River, King County, Washington, 2004-2005.

Slip 2

Species	10-Jan-05
P. Herring	7.21
P. Tomcod	9.62
Shiner Perch	269.30
Starry Flounder	14.43
Surf Smelt	2.40
Total density (#/ha) at Slip 2	302.96

Table 24: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted at the Slip 2 survey site in the Duwamish River, King County, Washington, 2004-2005.

Species	12-Feb
Chinook juv.	2.40
P. Herring	192.35
P. Tomcod	2.40
Pile Perch	2.40
Shiner Perch	2620.82
Starry Flounder	19.24
Surf Smelt	1933.16
Total Fish density (#/ha) at Kellogg-B	4772.78

Table 25: Catch per unit effort (fish•hectare^{-1}) during purse seine surveys conducted in a set deployed in the opposite direction (downstream) as all other sets at the Kellogg Island-B survey site in the Duwamish River, King County, Washington, 2004-2005.

3.2.2 Salmonids

A total of 81 salmonids (representing 0.09% of total fish catch) were captured in purse seines over the course of the study (Tables 26 and 27), and all species combined resulted in a density of 2.42salmonids•hectare^{-1} (Table 28). Age-1+ Chinook salmon were numerically dominant (n=57), comprising 70.4% of the salmonid catch (Table 26) and occurred in a density of 1.56 Chinook• hectare^{-1}. The next most numerous salmonid species was adult chum salmon (n=10) comprising 12.4% of the salmonid catch, followed by juvenile steelhead (n=7), and mountain whitefish (n=6) (Table 26).

Of the mean density of 2.21 fish• hectare^{-1} for all salmonids combined over the course of the study highest catch rate occurring at Turning Basin (3.4 fish• hectare^{-1}) (Table 28). Of the more commonly surveyed stations Powerline (2.68 fish• hectare^{-1}) had the second highest catch, followed by Kellogg Island (2.0 fish• hectare^{-1}), Delta Marine (1.83 fish• hectare^{-1}), and Pit Bull (1.47 fish• hectare^{-1}) (Table 28). One set was made at Kellogg Island in the opposite direction of all other sets. This reverse set resulted in the capture of 1 Chinook (2.40 fish• hectare^{-1}). Other less frequently sampling stations included T115 where 4 sets caught 1 Chinook (0.60 fish• hectare^{-1}), and Slip 2 where the only set made caught no fish (Table 28).

No young of the year (yoy) salmonids were caught in the purse seine survey. Except for the 10 adult chum salmon caught, only one other adult salmonid (fungus covered coho/Chinook) was captured. The remaining Chinook and steelhead were 1 and possibly 2-year old fish, ranging from 108-352mm fork length. The mean fork length over the entire survey at all stations for unmarked age-1+ Chinook salmon was 198.86 mm (n=11), with an increase to 261.21 mm for marked fish (n=46) (Table 31). The mean fork length for juvenile steelhead over the course of the survey was 229.80 mm (n=7) (Table 31).

3.2.3 Chinook Salmon

The total mean Chinook CPUE at all sites over the purse seine sampling period was 1.56 fish•hectare-1. For the five main sampling sites, the highest mean site for age-1+ Chinook salmon CPUE was at Powerline (1.98 fish•hectare-1), followed by Kellogg Island (1.74 fish•hectare-1), Turning Basin (1.70 fish•hectare-1), Delta Marine (1.41 fish•hectare-1), and Pit Bull (1.11 fish•hectare-1) (Table 28). Purse seine catches did not catch any of the Chinook yoy that appeared immediately after the January 19, 2005 freshet. In fact, there was no trend of Chinook salmonid density caught in purse seines over time (Table 28)

Chinook salmon were caught more frequently at night (n=50, density= 1.37 fish•hectare-1) than during the day (n=7, density=0.19 fish•hectare-1) (Table 28-30). Catch indices for marked fish also varied by whether it was a nighttime or daytime sampling event. Catch indices for marked Chinook caught in purse seines at night (86.0% marked fish) were twice the mark rate of Chinook caught during the day (42.9%) (Tables 30-31). Some (~10) of the age-1+ hatchery Chinook were marked with a small hole punch in the caudal fin upon capture, then released following processing. One of these fish (205 mm, 95 g) was recaptured in the Turning Basin on February 4, 2005.

Species	4-Dec	10-Dec	17-Dec	18-Dec	20-Dec	27-Dec	28-Dec	7-Jan	10-Jan	11-Jan	17-Jan	28-Jan	29-Jan	4-Feb	11-Feb	12-Feb	18-Feb	20-Feb	Total	Percent of Salmonids Caught
Chinook juv. marked		7	5			1	1	7	4		9		1	3	3	1	3	1	46	56.8%
Chinook juv. unmarked	1	1			1			2					3		2		1		11	13.6%
Chum adult		5	3	2															10	12.4%
Coho adult		1																	1	1.2%
Mtn. Whitefish								5			1								6	7.4%
Steelhead juv.		2			1			2	1									1	7	8.6%
TOTAL	*1*	*16*	*8*	*2*	*2*	*1*	*1*	*16*	*5*	*0*	*10*	*0*	*4*	*3*	*5*	*1*	*4*	*2*	*81*	*100.00%*

Table 26: Total number of salmonids captured during purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Species	4-Dec Day	10-Dec Night	17-Dec Night	18-Dec Day	20-Dec Night	27-Dec Night	28-Dec Day	7-Jan Night	10-Jan Night	11-Jan Day	17-Jan Night	28-Jan Night	29-Jan Day	4-Feb Night	11-Feb Night	12-Feb Day	18-Feb Night	20-Feb Night	Total
Turning Basin																			
Chinook juv.	**0**	**0**	**2**	**0**	**1**	**0**	**1**	**1**	**-**	**0**	**5**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**12**
Chum adult	0	4	0	1	0	0	0	0	-	0	0	0	0	0	0	0	0	0	5
Mtn. Whitefish	0	0	0	0	0	0	0	5	-	0	0	0	0	0	0	0	0	0	5
Steelhead juv.	0	1	0	0	0	0	0	1	-	0	0	0	0	0	0	0	0	0	2
Power Line																			
Chinook juv.	**1**	**-**	**1**	**0**	**0**	**0**	**0**	**5**	**2**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**14**
Chum adult	0	-	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Steelhead juv.	0	-	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Delta Marine																			
Chinook juv.	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**-**	**0**	**0**	**0**	**1**	**0**	**3**	**0**	**1**	**1**	**10**
Chum adult	0	1	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	1
Coho adult	0	1	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	1
Steelhead juv.	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	1	1
Pit Bull																			
Chinook juv.	**0**	**4**	**0**	**0**	**-**	**-**	**0**	**-**	**-**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**-**	**0**	**6**
Mtn. Whitefish	0	0	0	0	-	-	0	-	-	0	1	0	0	0	0	0	-	0	1
Steelhead juv.	0	1	0	0	-	-	0	-	-	0	0	0	0	0	0	0	-	0	1
Kellogg																			
Chinook juv.	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**3**	**2**	**0**	**1**	**0**	**0**	**1**	**2**	**0**	**1**	**0**	**13**
Chum adult	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Steelhead juv.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Kellogg-B																			
Chinook juv.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**	-	-	**1**
T115																			
Chinook juv.	-	-	-	-	-	**0**	**0**	-	**0**	-	-	-	**1**	-	-	-	-	-	**1**
Slip 2	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	0
TOTAL	1	16	8	2	2	1	1	16	5	0	10	0	4	3	5	1	4	2	81

Table 27: Total number of salmonids capture by site during purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Species	4-Dec-04 Day	10-Dec-04 Night	17-Dec-04 Night	18-Dec-04 Day	20-Dec-04 Night	27-Dec-04 Night	28-Dec-04 Day	7-Jan-05 Night	10-Jan-05 Night	11-Jan-05 Day	17-Jan-05 Night	28-Jan-05 Night	29-Jan-05 Day	4-Feb-05 Night	11-Feb-05 Night	12-Feb-05 Day	18-Feb-05 Night	20-Feb-05 Night	Mean
Turning Basin																			**3.40**
Chinook juv.	0.00	0.00	4.81	0.00	2.40	0.00	2.40	2.40	-	0.00	12.02	0.00	2.40	2.40	0.00	0.00	0.00	0.00	1.70
Chum adult	0.00	9.62	0.00	2.40	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71
Mtn. Whitefish	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.02	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71
Steelhead juv.	0.00	2.40	0.00	0.00	0.00	0.00	0.00	2.40	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Power Line																			**2.68**
Chinook juv.	2.40	-	2.40	0.00	0.00	0.00	0.00	12.02	4.81	0.00	7.21	0.00	0.00	0.00	0.00	0.00	4.81	0.00	1.98
Chum adult	0.00	-	4.81	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
Steelhead juv.	0.00	-	0.00	0.00	0.00	0.00	0.00	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Delta Marine																			**1.83**
Chinook juv.	0.00	4.81	4.81	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	2.40	0.00	7.21	0.00	2.40	2.40	1.41
Chum adult	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Coho adult	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Steelhead juv.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.14
Pit Bull																			**1.47**
Chinook juv.	0.00	9.62	0.00	0.00	-	-	0.00	-	-	0.00	0.00	0.00	2.40	2.40	0.00	0.00	-	0.00	1.11
Mtn. Whitefish	0.00	0.00	0.00	0.00	-	-	0.00	-	-	0.00	2.40	0.00	0.00	0.00	0.00	0.00	-	0.00	0.18
Steelhead juv.	0.00	2.40	0.00	0.00	-	-	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.18
Kellogg																			**2.0**
Chinook juv.	0.00	4.81	0.00	0.00	0.00	2.40	0.00	7.21	4.81	0.00	2.40	0.00	0.00	2.40	4.81	0.00	2.40	0.00	1.74
Chum adult	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Steelhead juv.	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
Kellogg-B																			**2.40**
Chinook juv.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.40	-	-	2.40
T115																			**0.60**
Chinook juv.	-	-	-	-	-	0.00	0.00	-	0.00	-	-	-	2.40	-	-	-	-	-	0.60
Slip 2	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	**0.00**
Mean salmonid density (#/ha)	0.48	9.62	3.85	0.96	1.20	0.48	0.40	9.62	3.01	0.00	4.81	0.00	1.60	1.44	2.40	0.40	2.40	0.96	2.42

Table 28: Total salmonid catch per unit effort (fish•hectare^{-1}) from purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Station		4-Dec Day	10-Dec Night	17-Dec Night	18-Dec Day	20-Dec Night	27-Dec Night	28-Dec Day	7-Jan Night	10-Jan Night	11-Jan Day	17-Jan Night	28-Jan Night	29-Jan Day	4-Feb Night	11-Feb Night	12-Feb Day	18-Feb Night	20-Feb Night	Mean
Turning Basin	Unmarked	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	-	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.28
	Marked	0.00	0.00	4.81	0.00	0.00	0.00	2.40	2.40	-	0.00	12.02	0.00	0.00	2.40	0.00	0.00	0.00	0.00	1.41
Power Line	Unmarked	2.40	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
	Marked	0.00	-	2.40	0.00	0.00	0.00	0.00	12.02	4.81	0.00	7.21	0.00	0.00	0.00	0.00	0.00	4.81	0.00	1.84
Delta Marine	Unmarked	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	2.40	0.00	4.81	0.00	0.00	0.00	0.57
	Marked	0.00	2.40	4.81	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	2.40	0.00	2.40	2.40	0.85
Pit Bull	Unmarked	0.00	0.00	0.00	0.00	-	-	0.00	-	-	0.00	0.00	0.00	2.40	0.00	0.00	0.00	-	0.00	0.18
	Marked	0.00	9.62	0.00	0.00	-	-	0.00	-	-	0.00	0.00	0.00	0.00	2.40	0.00	0.00	-	0.00	0.92
Kellogg	Unmarked	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	0.00	0.40
	Marked	0.00	4.81	0.00	0.00	0.00	2.40	0.00	2.40	4.81	0.00	2.40	0.00	0.00	2.40	4.81	0.00	0.00	0.00	1.34
Kellogg-B	Unmarked	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	-	-	0.00
	Marked	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.40	-	-	2.40
T115	Unmarked	-	-	-	-	-	0.00	0.00	-	0.00	-	-	-	0.00	-	-	-	-	-	0.00
	Marked	-	-	-	-	-	0.00	0.00	-	0.00	-	-	-	2.40	-	-	-	-	-	0.60
Slip 2	Unmarked	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	0.00
	Marked	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	0.00
Average Unmarked		0.48	0.60	0.00	0.00	0.60	0.00	0.00	1.20	0.00	0.00	0.00	0.00	1.20	0.00	0.96	0.00	0.60	0.00	0.31
Average Marked		0.00	4.21	2.40	0.00	0.00	0.48	0.40	4.21	2.40	0.00	4.33	0.00	0.40	1.44	1.44	0.48	1.80	0.48	1.36
Total Unmarked		2.40	2.40	0.00	0.00	2.40	0.00	0.00	4.81	0.00	0.00	0.00	0.00	7.21	0.00	4.81	0.00	2.40	0.00	1.47
Total Marked		0.00	16.83	12.02	0.00	0.00	2.40	2.40	16.83	9.62	0.00	21.64	0.00	2.40	7.21	7.21	2.40	7.21	2.40	6.14

Table 29: Chinook salmon catch per unit effort (fish•hectare^{-1}) from purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

Day/Night	Unmarked	Unmarked Density	Marked	Marked Density	Total	Total Density
Day	4	0.291	3	0.219	7	0.510
Night	7	0.306	43	1.880	50	2.186
Total	11	0.301	46	1.257	57	1.557

Table 30: Total number and density of Chinook salmon caught separated by day and night purse seine sampling events conducted in the Duwamish River, King County, Washington, 2004-2005.

Species	Mark	4-Dec Day	10-Dec Night	17-Dec Night	18-Dec Day	20-Dec Night	27-Dec Night	28-Dec Day	7-Jan Night	10-Jan Night	11-Jan Day	17-Jan Night	28-Jan Night	29-Jan Day	4-Feb Night	11-Feb Night	12-Feb Day	18-Feb Night	20-Feb Night	Mean	StdDev
Chinook juv.	Unmark	108.00	175.00			215.00			170.00					188.00		246.00		290.00		198.86	58.54
Chinook juv.	Marked		210.57	213.00	724.50		222.00	205.00	208.00	226.75		219.33		240.00	234.33	256.40	228.00	229.00	240.00	261.21	134.10
Chum adult	Unmark	715.00	786.66	724.50																734.97	49.19
Coho adult	Marked	520.00																		520.00	
Steelhead juv.	Unmark	206.50				202.00			208.50	275.00									257.00	229.80	33.74

Table 31: Mean fork length (mm) of salmonids captured during purse seine surveys conducted in the Duwamish River, King County, Washington, 2004-2005.

3.2.4 Salmonid Stomach Content Analysis

All age-1+ salmonids (57 age-1+ Chinook, 7 age-1+ steelhead) captured in purse seines were sampled for stomach content using the gastric lavage method. None of the salmonids captured in beach seines were sampled for gut content as the large majority of these fish were yoy. Due to time limitations during the beach seining effort, the few age-1+ salmonids that were caught were not sampled for stomach content. Of the 57 age-1+ Chinook sampled, food was recovered from 27 (47%) of these fish. The station with the highest percentage of stomach contents recovered from age-1+ Chinook was Pit Bull where 5 of the 6 (83%) age-1+ Chinook captured had food recovered from their stomachs. This was followed by Kellogg Island (64%), Delta (40%), Powerline (36%), Turning Basin (33%), and T115 (0%) (Table 32). Other than station T115 where only one age-1+ Chinook was caught, the three stations with the lowest percentage of gut content recovered from age-1+ Chinook were the three stations in the marine/freshwater mixing area: Turning Basin, Powerline, and Delta. Although gastric lavage does not give a statistically reliable number for degree of stomach fullness given that a "no gut content recovered" fish may not necessarily have an empty stomach, it is a generally useful tool to gain insight into whether or not there is a relationship between diet and relative occurrence of this fish at time of capture.

Stomach contents were only recovered from two of the 7 steelhead (29%) caught in purse seines. One of these fish had 13 salmon eggs in its stomach, while the other had shrimp parts and unidentifiable vegetation matter (Table 32). There did not appear to be any correlation between juvenile Chinook salmon or steelhead size and food presence, or absence, when sampled using gastric lavage (Table 32).

Although, in general, the total number of stomach content samples collected and analyzed were too few to provide much in the way of statistical support for dietary preferences based on habitat use, the data that was collected does indicate a preference for benthic feeding in the freshwater/marine water mixing area, and a preference for piscivorous behavior in the lower, more marine stations (Table 32). At Delta Marine 3 of the 4 Chinook for which gut content was recovered preyed on benthic organisms. Each of the 5 fish for which stomach contents were recovered at Powerline consisted of benthic organisms, with 1 sample also including a forage fish. Three of the 4 fish caught at Turning Basin had gut contents consistent with benthic food, while the fourth sample was a forage fish. At Kellogg Island 8 of the 9 recovered Chinook gut content samples consisted of forage fish, with only 1 that included benthic prey. At Pit Bull all 5 samples were comprised of fish, 4 samples were made up of forage fish, with the fifth containing 2 shiner perch (Table 32).

Date	Sampling Day/Night	Station	Species	Length (mm)	Weight (g)	Adipose Present	CWT Detect	Hatchery Fish	Comments
12/11/04	Night	Delta Marine	Chinook	175	50	1	0	0	-
1/29/05	Day	Delta Marine	Chinook	219	116	1	0	0	1 amphipod
2/11/05	Night	Delta Marine	Chinook	245	185	1	0	0	-
2/11/05	Night	Delta Marine	Chinook	247	160	1	0	0	-
12/11/04	Night	Delta Marine	Chinook	225	120	0	0	1	1.5 sandlance
12/17/04	Night	Delta Marine	Chinook	210	98	0	0	1	-
12/17/04	Night	Delta Marine	Chinook	213	110	0	0	1	-
2/11/05	Night	Delta Marine	Chinook	233	147	0	0	1	-
2/18/05	Night	Delta Marine	Chinook	240	153	0	0	1	1 polychaete (still alive)
2/20/05	Night	Delta Marine	Chinook	240	165	0	0	1	1 shrimp
1/7/05	Night	Kellogg Island	Chinook	168	48	1	0	0	1 forage fish
1/7/05	Night	Kellogg Island	Chinook	172	50	1	0	0	2 *Jassa* sp. and vegetation
2/18/05	Night	Kellogg Island	Chinook	290	245	1	0	0	-
12/10/04	Night	Kellogg Island	Chinook	240	150	0	0	1	1 forage fish
12/10/04	Night	Kellogg Island	Chinook	258	220	0	0	1	1 sandlance
12/27/04	Night	Kellogg Island	Chinook	222	110	0	0	1	1 large forage fish
1/7/05	Night	Kellogg Island	Chinook	205	75	0	0	1	-
1/10/05	Night	Kellogg Island	Chinook	217	130	0	1	1	1 forage fish
1/10/05	Night	Kellogg Island	Chinook	235	154	0	0	1	-
1/17/05	Night	Kellogg Island	Chinook	257	205	0	0	1	1 sandlance and vegetation
2/5/05	Night	Kellogg Island	Chinook	287	298	0	0	1	-
2/12/05	Day	Kellogg Island	Chinook	228	140	0	0	1	-
2/12/05	Night	Kellogg Island	Chinook	205	105	0	0	1	1 large forage fish
2/12/05	Night	Kellogg Island	Chinook	352	1105	1	1	1	2 forage fish
1/29/05	Day	Pit Bull	Chinook	222	144	1	0	0	2 shiner perch (65 and 72 mm).
12/10/04	Night	Pit Bull	Chinook	175	60	0	0	1	2 sandlance
12/10/04	Night	Pit Bull	Chinook	183	70	1	1	1	1 forage fish
12/10/04	Night	Pit Bull	Chinook	195	85	0	0	1	1 sandlance
12/10/04	Night	Pit Bull	Chinook	198	100	0	0	1	1 forage fish
2/4/05	Night	Pit Bull	Chinook	211	98	0	0	1	-
12/4/04	Day	Power Line	Chinook	108	38	1	0	0	-
12/17/04	Night	Power Line	Chinook	234	170	0	0	1	-
1/7/05	Night	Power Line	Chinook	160	38	0	0	1	-
1/7/05	Night	Power Line	Chinook	200	83	0	0	1	-
1/7/05	Night	Power Line	Chinook	220	94	0	0	1	-
1/7/05	Night	Power Line	Chinook	220	112	0	0	1	Indet. food mass
1/7/05	Night	Power Line	Chinook	223	130	0	0	1	-
1/10/05	Night	Power Line	Chinook	212	108	0	0	1	-
1/10/05	Night	Power Line	Chinook	243	173	1	1	1	1 forage fish / multiple *Jassa* sp. and parts

Date	Sampling Day/Night	Station	Species	Length (mm)	Weight (g)	Adipose Present	CWT Detect	Hatchery Fish	Comments
1/17/05	Night	Power Line	Chinook	210	105	0	0	1	Shrimp parts
1/17/05	Night	Power Line	Chinook	212	98	0	0	1	3 *Jassa* sp.
1/17/05	Night	Power Line	Chinook	217	108	0	0	1	-
2/18/05	Night	Power Line	Chinook	215	108	0	0	1	-
2/18/05	Night	Power Line	Chinook	232	135	0	0	1	Shrimp parts and vegetation
1/29/05	Day	T115	Chinook	240	150	0	0	1	-
12/20/04	Night	Turning Basin	Chinook	215	110	1	0	0	1 forage fish
1/29/05	Day	Turning Basin	Chinook	123	18	1	0	0	-
12/17/04	Night	Turning Basin	Chinook	195	63	0	0	1	-
12/17/04	Night	Turning Basin	Chinook	213	105	0	0	1	2 salmon eggs
12/28/04	Day	Turning Basin	Chinook	205	80	0	0	1	13 *Jassa* sp.
1/7/05	Night	Turning Basin	Chinook	228	132	0	0	1	-
1/17/05	Night	Turning Basin	Chinook	211	92	0	0	1	-
1/17/05	Night	Turning Basin	Chinook	215	104	0	0	1	-
1/17/05	Night	Turning Basin	Chinook	217	95	0	0	1	-
1/17/05	Night	Turning Basin	Chinook	217	114	0	0	1	-
1/17/05	Night	Turning Basin	Chinook	218	110	0	0	1	-
2/4/05	Night	Turning Basin	Chinook	205	95	0	0	1	4 *Corophium*
2/20/05	Night	Delta Marine	Steelhead	257	155	1	0	0	-
12/20/04	Night	Kellogg Island	Steelhead	202	85	1	0	0	-
12/10/04	Night	Pit Bull	Steelhead	215	100	1	0	0	-
1/7/05	Night	Power Line	Steelhead	212	94	1	0	0	-
1/10/05	Night	Power Line	Steelhead	275	197	0	0	0	Shrimp parts and vegetation
12/11/04	Night	Turning Basin	Steelhead	198	80	1	0	0	13 salmon eggs
1/7/05	Night	Turning Basin	Steelhead	205	83	1	0	0	-

For Adipose Present, CWT Detect and Hatchery Fish 1 = yes, 0 = no.

Table 32: Juvenile Salmonid Stomach Content Analysis.

3.3 Water Quality

3.3.1 River Flow

During the winter 2004/05 survey, flow rates were well below normal due to lower than normal levels of precipitation. In fact, the February Green River flows were the lowest on record (70 years) for that month. From November 13, 2004 through March 7, 2005 the average river flow (cfs) at the Green River water gage near Auburn, Washington (USGS Gage 1213000) was 1,460 cfs. During this time the gage measured three different peaks (Figure 6). On November 26, one week prior the first day of seining, there was a freshet that resulted in spike in flow up to 3,663 cfs. By December 7, 2004 the river level was reduced again to a lower flow of 1,120 cfs. However, with the arrival of another storm system a few days later the river flow increased again, rising to a level of 5,380 cfs on December 11, 2004 before lowering back down to 1,480 cfs on December 21, 2004 (Figure 6). Then due to the relative absence of precipitation over the next few weeks the river level dropped to a very low flow of 483 cfs by January 15, 2005. Soon thereafter, another winter storm with heavy precipitation arrived and the river level began to rise to a flow of 915 cfs on January 17, 2005 then peaking at a high flow of 8,420 cfs on January 19, 2005 before returning to a more moderate flow of 1,310 on January 29, 2005 (Figure 6).

3.3.1.1 Water Quality – salinity, temperature, and dissolved oxygen.

Salinities and temperatures were stratified by depth at all survey sites, with lower salinities and temperatures typically occurring near the surface and at the upstream-most survey site (Trimaran) and highest salinities and temperatures on the bottom of the water column at the downstream survey site, Kellogg Island (Appendices B & C). Salinity levels in the study reach were lowest throughout the entire study period during the high flow event occurring in mid-January 2005 when discharge in the Green River peaked at 8,420 cfs (Figure 6).

Similarly, dissolved oxygen (DO) was stratified by depth at all survey sites other than Trimaran, with greater levels of DO typically occurring near the surface and at the upstream-most survey site (Trimaran), and lower levels of DO on the bottom of the water column at the downstream survey site, Kellogg Island (Appendices B & C). However, there appeared to be no specific trend in DO at Trimaran. Although at times the water column reflected the same stratification pattern observed at other sites, at other times this pattern was reversed. Although the waters at Trimaran are tidally-influenced it is the upper-most site in the estuarine mixing zone and is immediately downstream of a tidally-influenced riffle, which likely contributes to the differences in DO observed at this site compared to the other sites.

Turbidity was greatest near the surface than at depth for all stations except Kellogg Island where turbidity was greatest near the bottom (Table 33). However, there was no consistent trend in the water column of the least turbid portion of the water column between stations. Sometimes it was least turbid in the middle of the water column (Delta Marine and Pit Bull) while at other sites it was least turbid near the bottom (Turning Basin and Powerline). A large increase in turbidity was observed at all stations immediately following the January 16, 2005 freshet, but was most prominent in upstream stations and at the surface (Table 33).

In general, the water quality data measurements and stratification at the Turning Basin site were generally consistent with those stations downstream. One slight difference at the Turning Basin is that salinity is slightly lower than at those sites further downstream. This difference is likely related to the Turning Basin being located in the estuarine mixing zone where the water quality is tidally influenced. However, other than this slight difference observed in the salinity data, the water quality trends at Turning Basin were reflective of the data trend for all other parameters at sites downstream.

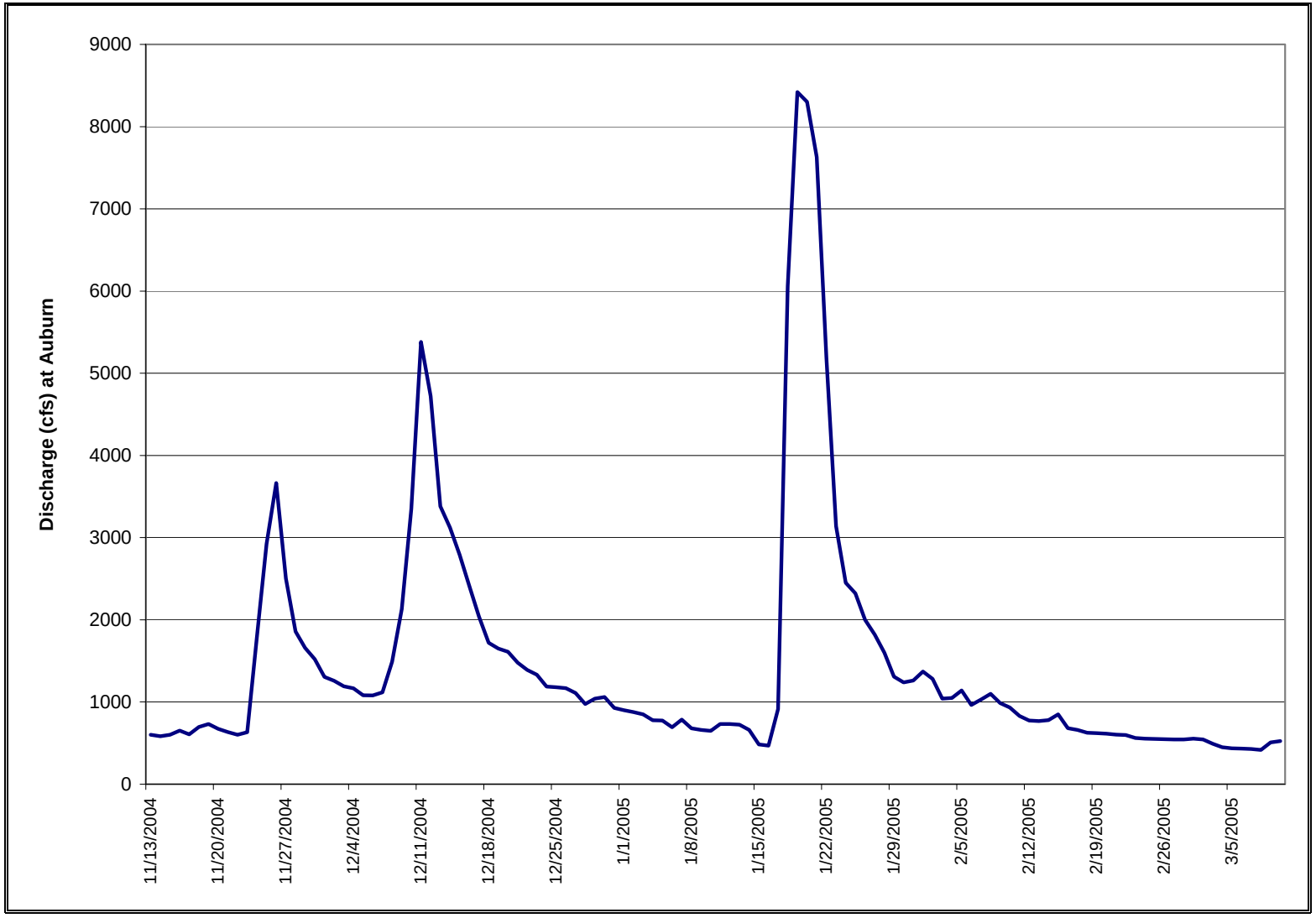

Figure 6: Discharge (cfs) in the Green River, near Auburn, Washington 2004-2005 (USGS Gage 1213000).

		Turning Basin			Power Line			Delta Marine			Pit Bull			Kellogg		
Date	**Parameter**	**Top**	**Mid**	**Bottom**	**Top**	**Mid**	**Bottom**	**Top**	**Mid**	**Bottom**	**Top**	**Mid**	**Bottom**	**Top**	**Mid**	**Bottom**
4-Dec-04	Turbidity	2	1.8	2.5	-	-	-	1.7	1.7	2	1.8	0.8	1.3	1.4	1.4	110*****
10-Dec-04	Turbidity	-	-	-	-	-	-	-	-	-	7.4	11	4.1	4.9	3.8	5.3
11-Dec-04	Turbidity	11	-	5.4	-	-	-	12	12	12	-	-	-	-	-	-
17-Dec-04	Turbidity	3.2	2.4	1.8	3.2	1.9	2.3	3.3	3	1.9	3.2	1.3	13.5	2.6	2.1	1.7
18-Dec-04	Turbidity	3.3	2	1.6	3.2	1.8	1.7	3.2	2.1	1.9	3.4	2.2	1.7	2.4	1.2	0.9
20-Dec-04	Turbidity	3.6	3.2	2.5	3.2	3.2	3.1	2.9	2.3	5.3	-	-	-	3	1.7	1.4
27-Dec-04	Turbidity	2.1	1.6	1.8	-	-	-	2.4	3.9	12	-	-	-	2.4	1.7	1.4
28-Dec-04	Turbidity	0	0	0	-	-	-	3.3	1.7	2.15	3.7	1.8	2.61	3.1	2.6	2.3
7-Jan-05	Turbidity	4	2.7	-	-	-	-	3.1	5.1	6.4	-	-	-	3.1	1.3	2.1
10-Jan-05	Turbidity	-	-	-	3.13	5.62	-	-	-	-	-	-	-	2.5	1.9	2.6
11-Jan-05	Turbidity	2.3	2	2.3	-	-	-	2.2	2	1.9	2.6	2.2	1.8	2.4	1.2	1.1
17-Jan-05	Turbidity	18.7	14.9	5.16	-	-	-	16.9	3.5	3.1	16.4	2.4	2.49	9	1.6	2.5
28-Jan-05	Turbidity	4.82	2.72	2.19	-	-	-	4.2	3.6	2.62	4.5	5.1	4.21	-	-	-
29-Jan-05	Turbidity	5.76	3.19	3.34	-	-	-	4.9	3.1	3.2	4	3.1	3.3	8.5	6.4	7.6
4-Feb-05	Turbidity	4.9	12.4	3.93	-	-	-	4.6	3.2	3.1	3.8	2.4	2.7	-	-	-
5-Feb-05	Turbidity	-	-	-	-	-	-	-	-	-	-	-	-	3.6	1.8	2.2
11-Feb-05	Turbidity	2.6	2.2	2.5	-	-	-	2.3	2	2.3	2.5	2.3	3.2	-	-	-
12-Feb-05	Turbidity	3.4	2.7	3.1	-	-	-	3.1	3.4	-	2.7	2.7	3.3	4.4	7.5	4
18-Feb-05	Turbidity	2.7	2.9	2.5	-	-	-	2.2	2.18	3.13	-	-	-	2.6	2.3	27
20-Feb-05	Turbidity	3.3	10.3	2.9	-	-	-	3.8	3.1	3.4	3	3.7	4.3	-	-	-
21-Feb-05	Turbidity	-	-	-	-	-	-	-	-	-	-	-	-	3.2	2.1	1.7
	Average	***4.57***	***4.19***	***2.72***	***3.18***	***3.13***	***2.37***	***4.48***	***3.40***	***4.15***	***4.54***	***3.15***	***3.73***	***3.69***	***2.54***	***4.25***

***** This value was excluded from the average calculation as the sampler came in contact with the river bottom.

Table 33: Turbidity (NTU) at Purse Seine Sites in the Green River, near Auburn, Washington 2004-2005.

4.0 DISCUSSION

This study was initiated by the USACE to investigate the arrival, presence and habitat use of the Duwamish Waterway by juvenile salmonids, notably Chinook salmon, during the normal winter dredging work window. This study included a rigorous study design that was consistent with the ongoing spring and summer WRIA 9 beach seine studies, including methodology and site selection. However, this study varied from past/current WRIA9 surveys by being conducted in the winter months and incorporating a paired day/night beach seining at five sites in the Duwamish River, in addition to using a research purse seine deployed from a commercial purse seine vessel at five primary sites during both day and night. By designing the study in this manner, the intent was to: 1) investigate the relative timing of occurrence of young of the year (yoy) Chinook; 2) investigate whether this species occurred with any difference in frequency in the Turning Basin compared to other sites; 3) investigate whether there was a difference in habitat use (relative occurrence along the shoreline compared to the dredged channel); 4) investigate whether there was a difference in occurrence as related to time of day; 5) investigate any difference in the winter season site use; and 6) investigate if there was a difference in occurrence between hatchery and natural origin fish.

The findings of this report demonstrate that yoy Chinook salmon arrive in the estuary as early as mid-January, but as indicated by their premature condition upon arrival (yolk sacs present), may not be able to occur in the estuary much sooner than this time. Upon arrival these yoy Chinook were most prevalent at the Turning Basin followed by the Trimaran site, which are both located in the upper portion of the estuary near the fresh water-salt water transition zone. Yoy fish were only detected in shoreline habitats, away from the USACE-maintained navigation channel. In addition, yoy Chinook were twice as abundant in the nighttime shoreline sampling compared to the daytime efforts.

Age-1+ Chinook caught along the shorelines (in beach seines) were more prevalent at the Turning Basin than any other site. However, age-1+ Chinook caught in the channel (in purse seines) occurred at Powerline and Kellogg Island more frequently than at the Turning Basin. While age-1+ Chinook salmon caught along the shorelines were twice as abundant during the night compared to day, those that were caught offshore were eight times more abundant at night than during the day.

Although a few other salmonid species occurred in low numbers, the vast majority of winter-occurring juvenile salmonids in the estuary are Chinook salmon. However, other than two yoy pink salmon and one yoy chum salmon, all non-Chinook salmonids caught were age-1+ fish. This is due to differences in run-timing between species with no large pulses of yoy for other species expected to occur in this system during this December through early March sampling effort. Additionally, no bull trout were caught during this study.

Although past studies have shown Green River Chinook fry emerge from the gravel in late February through April, with peak migration not occurring until mid April (Dunstan 1955, Hilgert and Jeanes 1999, Jeanes and Hilgert 2000), surveys conducted from 2001-2003 by Nelson *et al.* (2004) observed juvenile Chinook salmon in the Duwamish estuary as early as January and February. In January and February 2001, Chinook fry were observed in the upper Duwamish estuary transition zone at Trimaran and the Turning Basin (Nelson *et al.* 2004, Ruggerone *et al.* 2004). In 2002 and 2003, juvenile Chinook salmon were caught in beach seines at Trimaran and the Turning Basin (RM5.5-6.5) in late February (Nelson *et al.* 2004). The findings of this survey support the initial observations by Nelson *et al.* (2004) that yoy Chinook salmon arrive in the Duwamish estuary earlier than previously believed. Additionally, as stated in both Nelson *et al.* (2004) and Ruggerone *et al.* (2004), the findings here support the previous observations that juvenile salmonids, upon arrival to the estuary, tend to concentrate in the upper estuarine transition portion of the estuary around Trimaran and the Turning Basin.

Young of the year Chinook salmon were most abundant at the two uppermost sites sampled during this survey. Within beach seines, yoy Chinook were most abundant at the Turning Basin (36.8%) followed by Trimaran with 27.9%, (Table 3). The next most abundant station for yoy Chinook was Pit Bull with 21.1%. For age-1+ Chinook salmon, 50% of these fish caught in beach seines were captured at the Turning Basin, with Kellogg Island (34.1%) representing most of the remaining age-1+ Chinook captured in beach seines (Table 3). Age-1+ Chinook caught in purse seines occurred slightly less frequently at the Turning Basin than at other sites, with age-1+ Chinook most abundant at Powerline (24.6%) followed by Kellogg Island (22.8%) and the Turning Basin (21.1%) (Tables 17-22).

Seasonality of juvenile Chinook salmon occurrence in the Duwamish estuary was directly related to age class. Young of the year Chinook salmon were absent in December, were only present in January after the mid-January freshet, and remained in the catch through the duration of the study. However, age-1+ Chinook were present in each month of the beach seine catches, but were most abundant in December (Table 7). Similarly, age-1+ Chinook were also present in purse seines in each month of the survey however they were most abundant in January catches.

The field surveys of this study were initiated in early December, approximately one week after a November 26 freshet. A small pulse (n=10) of age-1+ Chinook salmon were captured in beach seines on the first day of beach seining (December 3, 2004). During a December freshet, the river flow rose from a level of 1,120 cfs on December 7, 2004 (as measured by the USGS Green River gage near Auburn, USGS Gage 1213000) to 5,380 cfs on December 11, 2004, a change of 4,260 cfs. Following this freshet, age-1+ juvenile Chinook numbers caught in beach seines decreased from ten caught on December 3, to two caught on December 10, and one caught on December 13, one on December 14 and one age-1+ and one yoy caught on December 23 (Table 2). In fact, over the next six weeks only one yoy Chinook was caught in beach seines, compared to twelve age-1+ Chinook. Then the January freshet occurred, raising the river level from 483 cfs on January 15, 2005 to a level of 8,420 cfs on January 19, 2005, a change of 7,937 cfs. Immediately following this freshet, yoy Chinook increased from only one yoy fish caught in the first six weeks to 31 on January 20, 45 on January 26, and 80 on February 1, 2005. These fish were recently emerged fish, with either a yolk sac or not completely buttoned up, indicating early or forced emergence. From the January 20 sampling through the end of these surveys in early March, an average of 37.9 yoy Chinook and 1.8 age-1+ Chinook were caught each sampling day using beach seines (Table 2). No yoy Chinook were caught in purse seines, either before or after the freshets. It did not appear as though the occurrence of age-1+ Chinook caught in purse seines was directly related to the freshets. In ten days of sampling prior to the large January freshet (47 sets) a total of 30 age-1+ Chinook were captured in purse seines. In the eight days of sampling during and immediately after the freshet (41 sets) 27 age-1+ Chinook were captured.

The relative absence of Chinook in the beach seine catches immediately following the December freshet could be related to both physical and biological factors. The December freshet was not as large as the one in January and may have allowed some refuge habitat such as root wads and undercut banks to still provide enough sheltered habitat for yoy Chinook. However, it is more likely that juveniles did not appear in the catches because fry emergence in the Green River generally occurs from January to April, with peak migration occurring in March to April (Dunstan 1955, Hilgert and Jeanes 1999, Jeanes and Hilgert 2000, Nelson *et al*. 2004, Ruggerone *et al*. 2004).

Had the Chinook fry emerged prior to the December freshet, they may have been stimulated to migrate as a result of the increased flows as suggested by Nelson and Boles (2002) and Seiler *et al*. (2002). Yet, no pulse of yoy fish were detected downstream which suggests no fish had emerged by the December 11, 2004 freshet suggesting these fish were not developed enough to survive any potential forced or early emergence. The absence of yoy Chinook in the December freshet but their appearance immediately following the January freshet may indicate a late December-early January time period as the temporal

limit for their arrival in the estuary under the specific conditions, such as the observed winter 2004/2005 freshets.

This freshet-outmigration correlation appears to be limited to the months of January and first half of February. Although, in general, peak flow rates in the Duwamish Waterway are minimized by the operations of Howard Hanson Dam, located at approximately RM 64.5 on the Green River, the river is allowed to experience natural "run-of-the-river" flow regimes from mid-November to mid-February (Goetz, pers. comm.., as cited in Ruggerone *et al*. 2004). As a result, Chinook fry outmigrating in late February in the Green/Duwamish River watershed may experience fewer and less intense peaks flows flushing them downstream than they did before the completion of the dam in 1961. However, Chinook fry that emerge and migrate downstream prior to mid-February experience more natural flows, which may have contributed to their capture in January beach seines.

Our data confirm what recent data from other studies have suggested: that juvenile Chinook salmon aggregate, and may temporarily rear, in the upper estuary's low velocity, freshwater-saltwater transition zone earlier than previously believed (Nelson and Boles 2002, Nelson *et al*. 2004, Ruggerone *et al*. 2004). This support was indicated by the yoy Chinook caught along the shorelines in beach seines, away from the dredged channel. The mean CPUE for beach seine-caught yoy Chinook over the course of the study was 14.78 fish•hectare^{-1}, with the highest catch rate occurring at Turning Basin (67.31 fish•hectare^{-1}), and the second highest occurring at Trimaran (50.96 fish•hectare^{-1}) (Tables 10-11). The mean CPUE for beach seine-caught age-1+ Chinook over the course of the study was 1.71 fish•hectare^{-1}, with the highest catch rate occurring at Turning Basin (10.58 fish•hectare^{-1}), with the second highest occurring at Kellogg Island (7.21 fish•hectare^{-1}) (Tables 10-11). The reason for the increased abundance of yoy Chinook salmon in the upper sites may be the result of these fish acclimating to the estuarine conditions at the freshwater-marine water transition zone. The majority of these yoy Chinook salmon either had a yolk sac or were not completely buttoned up and may have trouble adjusting to the change in salinity, therefore residing as far upstream as possible. Another factor is suitable habitat. When these early emerging yoy Chinook salmon reach the Turning Basin they experience decreased flows and more suitable shoreline habitat that may provide them refuge from predators and the higher upstream river flows.

The mean CPUE for purse seine-caught age-1+ Chinook over the course of the study was 1.56 fish•hectare^{-1}. There were no significant trends in abundance for age-1+ Chinook in purse seines related to river mile, with each of the five main survey sites being somewhat similar in abundance. Densities ranged from a high of 1.98 fish•hectare^{-1} at Powerline and 1.70 fish•hectare^{-1} at Turning Basin to a low of 1.11 fish•hectare^{-1} at Pit Bull (Table 28).

Over the course of this study, juvenile Chinook were more prevalent at night than during the day. In beach seines, Chinook salmon were twice as abundant during the night (54.49 fish•hectare^{-1}) as they were during the day (26.60 fish•hectare^{-1}) (Table 13). In purse seines, age-1+ Chinook salmon were four times more prevalent in the night purse seine surveys (2.19 fish•hectare^{-1}) than the day time surveys (0.51 fish•hectare^{-1}) (Table 30).

The absence of yoy Chinook in the purse seine catch data was not unexpected. Juvenile salmonids are known to prefer rearing habitats such as marshes, sloughs and tidal channels that are protected from the variable flows of the mainstem. It is also possible that some portion of the yoy Chinook that could have been encircled in the purse seine would have been able to escape through the larger mesh of this net. If that were the case, the only fish that would have been retained were those too large to escape through the mesh, such as age-1+. However, during the purse seine surveys, a number of juvenile surf smelt (~40-50 mm) were caught, indicating that at least some percentage of yoy Chinook, had they occurred in purse seine sets, would have been recovered. This indicates that yoy Chinook were not caught in the purse seine because they are not present or occur in low abundance in the main channel.

The clearest difference between beach seines and purse seines is that the beach seines (shoreline sampling) captured yoy Chinook while the entire purse seine Chinook catch (channel sampling) was comprised only of age-1+ fish. To allow for a comparison between sampling methods the data was evaluated between similar age-class Chinook (age-1+). When comparing both time and sampling method of daytime-caught age-1+ Chinook salmon, the data shows that these fish were ten times more abundant during the day along the shorelines (5.22 fish•hectare^{-1}) than in the channel (0.51 fish•hectare^{-1}). Nighttime surveys showed a similar, although slightly less steep, pattern with shoreline catches 1.7 times greater (3.70 fish•hectare^{-1}) than in the channel (2.19 fish•hectare^{-1}). This indicates that, to some degree, age-1+ Chinook salmon move from shoreline habitat during the day to offshore channel waters at night.

Within beach seines, marked fish appear to represent a lower proportion of the age-1+ salmon catch at night compared to during the day. For all beach seine caught Chinook salmon combined, unmarked fish (51.6 fish•hectare^{-1}) were nearly eighteen times more abundant at night than marked fish (2.88 fish•hectare^{-1}) (Table 11). During the day the difference was close to eight times as many unmarked Chinook (23.72 fish•hectare^{-1}) than marked fish (2.88 fish•hectare^{-1}). Within purse seines, marked fish appear to represent a higher proportion of the age-1+ salmon catch at night compared to during the day. For age-1+ Chinook captured at night, purse seines caught six times as many marked (hatchery) Chinook (1.88 fish•hectare^{-1}) as unmarked (natural) Chinook (0.31 fish•hectare^{-1}) (Table 30). However, during the day the difference was not as large, with marked fish (0.22 fish•hectare^{-1}) occurring only slightly less frequently than unmarked fish (0.29 fish•hectare^{-1}) (Table 30).

Although no bull trout were captured in this study, they have been detected in the Green/Duwamish River in the past (Jeanes *et al*. 2003). Bull trout have been observed entering and using North Puget Sound marine waters predominantly during the spring and early summer with very small numbers of fish in freshwater tidal and marine areas in the late fall and winter. Sub-adult bull trout were found first migrating to nearshore areas in early March, with adults usually migrating later in April and May. The highest number of detections occurred in May and June. The end of the spring summer marine residence period varied between years; in 2002 98% of all fish had left nearshore marine areas by late July (one remained in brackish water until August 12), while in 2003 over 95% of the fish left marine areas by early July. Warmer water temperatures in 2003 may be the reason for the earlier marine exit timing. Results from longer term monitoring in the Skagit River delta and bay indicate there may be greater variability in areas immediately adjacent to the Skagit River than what were observed for areas from the Snohomish to the Skagit.

There is some uncertainty as to whether the channelization and habitat alterations that have occurred in the Duwamish estuary have limited its capacity as juvenile salmonid rearing habitat (Ruggerone *et al*. 2004). A central focus on this topic is the ability of the freshwater-marine water transition portion of the estuary to provide a sufficient food source for the juvenile salmonids rearing there. Although answering this question was not a central focus of this survey, the gut content analysis (all from age-1+ salmonids) appears to show that during the early part of the migration period (January/February), benthic food resources were the dominant diet component of juvenile Chinook and steelhead occurring in the transition zone (Table 32). Further downstream, at Kellogg Island, where forage fish were most abundant, the stomach content data shows that age-1+ juveniles preyed more frequently on forage fish than on benthic organisms (Table 32).

Conclusion

Although past studies have shown Green River Chinook fry emerge from the gravel in late February through April, with peak migration not occurring until mid April (Dunstan 1955, Hilgert and Jeanes 1999, Jeanes and Hilgert 2000), surveys conducted from 2001-2003 by Nelson *et al*. (2004) observed juvenile Chinook salmon in the Duwamish estuary as early as January and February. This observation overlapped

with the timing of the winter "dredging window" of October to February, and prompted the USACE to initiate this study to better understand the arrival of juvenile Chinook salmon and their habitat use in the Lower Duwamish during the maintenance dredging window.

The findings of this survey support the initial observations by Nelson *et al*. (2004) that yoy Chinook salmon arrive in the Duwamish estuary earlier than previously believed. This conclusion is based on their capture in late January beach seines and their continued presence thereafter. This early arrival appears to be tied to high winter water flows. However, the absence of yoy salmonids in the Duwamish immediately following a large December freshet, and their developmental state upon their capture (yolk sacs) may indicate January as the temporal limit for their arrival in the estuary. Additionally, upon their arrival, yoy Chinook were most prevalent at the Turning Basin and Trimaran sites respectively, in the upper estuarine mixing zone. Once detected, these fish occurred in every beach seine set through the end of this study in the first week of March. There appeared to be a strong dependence on shoreline habitat for these yoy Chinook, as they were only captured along the shorelines, with no yoy Chinook detected while sampling waters of the deeper navigation channel.

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7.0 REFERENCES

Dunstan, W. 1955. Green River downstream migration. Puget Sound stream studies, progress report. Washington Department of Fisheries.

Healey, M.C. 1991. Life history of Chinook salmon. Pp. 310-393 *In* Groot, C., and L Margolis (Eds.), Pacific Salmon Life Histories. University of British Columbia Press, Vancouver.

Hilgert, P.J., and E.D. Jeanes. 1999. Juvenile salmonid use of lateral stream habitats middle Green River, Washington. 1998 data report. Prepared by R2 Resource Consultants, Inc. for the U.S. Army Corps of Engineers, Seattle District, and City of Tacoma Public Utilities, Tacoma Water. January 1999. 150 pp.

Jeanes, E.D., and P.J. Hilgert. 2000. Juvenile salmonid use of lateral stream habitats middle Green River, Washington. 1999 data report. Prepared by R2 Resource Consultants, Inc. for the U.S. Army Corps of Engineers, Seattle District. July 2000. 200 pp.

Jeanes, E., Morello, C., and M. Appy. 2003. Native Char Utilization Lower Chehalis River and Grays Harbor Estuary, Aberdeen, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District by R2 Resource Consultants. March 2003. Redmond, Washington. 150 pp.

Nelson, T., and M. Boles 2002. WRIA 9 juvenile salmonid survival studies: year 2001 pilot study-lower Green River (Draft). Water and Land Resources Division, King County, Seattle, Washington.

Nelson, T.S., G. Ruggerone, H. Kim, R. Schaefer, and M. Boles. 2004. Juvenile Chinook migration, growth and habitat use in the Lower Green River, Duwamish River and nearshore Elliott Bay, 2001-2003. Draft report prepared by the King County Department of Natural Resources and Parks, Water and Land Resources Division, Science Section. 214 pp. (including appendices).

Ruggerone, G., D. Weitkamp, J. Noble, J. Hall, L. Reinelt, K. Gellenbeck, and T. Nelson. 2004. WRIA 9 Chinook salmon research framework, identifying key research questions about Chinook salmon life histories and habitat use in the middle and lower Green River, Duwamish Waterway, and marine nearshore nreas, Final Report. July 2004. 115 pp.

Seiler, D., G. Volkhardt, L. Kishimoto, and P. Topping. 2002. 2000 Green River juvenile salmonid production evaluation. Washington Department of Fish and Wildlife, Olympia, Washington

8.0 APPENDICES

8.1 Appendix A. Site Descriptions.

These descriptions are based on the site descriptions of Nelson *et al*. (2004) with slight adjustments made to river mile based on Figure 3 in this report.

Duwamish River – **Trimaran**		
Position: N 47° 30.13, W 122° 17.46	**River Mile**: 6.5	**Salinity Range**: 0-30 ppt
Habitat Type: Estuarine Transition Zone		
Sampling Methods: Beach Seine		
Comments: The Trimaran Site occurs in the upper estuarine transition zone, the usual winter/spring upstream extent of the salt wedge penetration. The bed is composed of mud and sand with nearby embedded logs, piles and sandbars. A riffle occurs immediately upstream of the sampling site at low tide, creating a large eddy.		

Duwamish River – **Turning Basin**		
Position: N 47° 30.43, W 122° 18.08	**River Mile**: 5.5	**Salinity Range**: 0-30 ppt
Habitat Type: Estuarine Transition Zone		
Sampling Methods: Beach Seine and Purse Seine		
Comments: The Turning Basin Site occurs in the estuarine transition zone. The bed is composed of mud on a gently sloping beach that slopes toward the deeper, routinely dredged channel. This site occurs at one of the widest sections of the Duwamish River, leading toward decreased flow velocities. The approximate width of the river at site during high tide is 200 meters.		

Duwamish River – **Powerline**		
Position: N 47° 30.92, W 122° 18.23	**River Mile**: 5.3	**Salinity Range**: 2-30 ppt
Habitat Type: Estuarine Transition Zone		
Sampling Methods: Beach Seine and Purse Seine		
Comments: The Powerline Site occurs in the lower portion of the estuarine transition zone. This site is directly across from the Hamm Creek restoration site. The bed here is similar to that of the Turning Basin with a mudflat that slopes toward the deeper waters of the channel. The approximate width of the river at site during high tide is 180 meters.		

Duwamish River – **Delta Marine**		
Position: N 47° 31.34, W 122° 18.46	**River Mile**: 4.8	**Salinity Range**: 2-30 ppt
Habitat Type: Estuarine Mudflat		
Sampling Methods: Beach Seine and Purse Seine		
Comments: The Delta Marine Site occurs in the lower portion of the estuarine transition zone, immediately downstream of the Delta Marine marina. The bed here is composed of steeper sloping beaches, lined with cobble. The eastern shoreline includes some embedded pilings, while the western shoreline includes private vessels moored at docks. The approximate width of the river at site during high tide is 120 meters.		

Duwamish River – **Pit Bull**		
Position: N 47° 31.54, W 122° 18.08	**River Mile**: 4.0	**Salinity Range**: 2-30 ppt
Habitat Type: Estuarine Mudflat		
Sampling Methods: Beach Seine and Purse Seine		
Comments: The Pit Bull site is a small pocket beach that was created in conjunction with the Duwamish River Park. The site is comprised of an eroding mud-comprised beach that slopes gently toward the river channel. The approximate width of the river at site during high tide is 150 meters.		

Duwamish River – **Slip 2**		
Position: N47° 32.69, W122° 20.30	**River Mile**: 2.8	**Salinity Range**: 2-30 ppt
Habitat Type: Estuarine-Industrial		
Sampling Methods: Purse Seine		
Comments: The Slip 2 site occurs directly upstream from T115 and downstream from the 1st Ave South Bridge. This site is heavily industrialized and is bordered on both banks by barges tied to docks and piers. There is little or no shoreline habitat aside from the docks and piers. This site has no natural habitat (e.g. mudflat). This site was only sampled with the purse seine when other sites could not be sampled due to tides or Duwamish bridge operations. The channel at this site was very difficult to maneuver in when multiple barges were tied up alongside each other.		

Duwamish River – **T115**		
Position: N47° 33.21, W122° 20.53	**River Mile**: 2.2	**Salinity Range**: 2-30 ppt
Habitat Type: Estuarine-Industrial		
Sampling Methods: Purse Seine		
Comments: The T115 site occurs directly upstream from Kellogg Island and downstream from the 1st Ave South Bridge. Similar to Slip 2, this site is heavily industrialized and is bordered on both banks by barges tied to docks and piers. There is little or no shoreline habitat (e.g. mudflat) due to the presence of docks and piers. This site was only sampled with the purse seine when other sites could not be sampled due to tides or Duwamish bridge operations. As with Slip 2, the channel at this site was very difficult to maneuver in when multiple barges were tied up alongside each other.		

Duwamish River - **Kellogg Island**		
Position: N47.33.26°, W122.20.45°	**River Mile**: 1.6	**Salinity Range**: 2-30 ppt
Habitat Type: Estuarine Mudflat		
Sampling Methods: Beach Seine and Purse Seine		
Comments: The eastern portion of the island was sampled with the beach seine. Likewise, the purse seine was deployed to the east of the island, approximately 50-60 meters, with an effort to sample directly in the center of the Duwamish River channel. The eastern bank of the island has a gently sloping beach comprised of mud, angular rock, and other debris. The river is approximately 150 meters wide at this site.		

8.2 Appendix B. Beach Seine Water Quality Data

Depth (ft), water temperature (C), salinity (ppt), dissolved oxygen (mg/L), pH, and conductivity (mS/cm) collected at fish survey sites, Duwamish River, King County, Washington, December 4, 2004 through March 3, 2005.

		Trimaran			Turning Basin			Powerline			Pit Bull			Kellogg Island		
Date	**Parameter**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**
3-Dec-04	Depth (ft)	10	6	0.5	9	4.5	0.5	12	6	0.5	7.5	3.75	0.5	14	7	0.5
	Temperature (°C)	9.84	7.00	6.45	10.59	9.43	5.97	10.61	9.56	6.63	7.4	7.1	6.98	10.69	10.13	7.93
	Salinity (ppt)	24.14	3.85	0.15	25	24.32	0.75	27.9	25.65	0.89	3.84	1.15	1.01	28.11	24.84	9.4
	Dissolved Oxygen (mg/L)	6.58	10.35	10.95	6.4	6.7	10.5	6.4	6.4	10.75	10.9	10.9	11.1	6.85	7.08	9.17
	pH	7.7	7.81	8.17	7.9	7.75	8.1	7.92	7.82	8.11	7.71	7.85	7.73	8.08	8.1	7.95
	Conductivity (mS/cm)	39	5.9	0.315	42.3	41.7	1.93	44.5	40.6	1.83	7.86	1.95	1.87	44.6	39.7	16.9
10-Dec-04	Depth (ft)	12	6	0.5	9.5	4.5	0.5	14	7	0.5	8	4	0.5	10	5	0.5
	Temperature (°C)	7.01	6.93	6.94	9.57	7.01	6.97	9.32	7.45	6.51	7.30	7.10	7.09	10.28	8.35	8.01
	Salinity (ppt)	0.06	0.01	0.01	22.56	1.22	0.43	23.45	2.1	0.51	3.84	1.07	0.99	27.05	13.05	6.13
	Dissolved Oxygen (mg/L)	12.1	12.2	12.7	7.47	10.06	11.24	7.85	10.21	11.1	10.82	10.8	11.08	6.8	8.6	10.01
	pH	7.53	7.27	7.17	7.83	8.03	7.9	8.01	7.81	7.71	7.71	7.89	7.78	8.07	7.98	7.95
	Conductivity (mS/cm)	1.24	0.93	0.78	36.8	2.41	0.901	35.6	3.12	0.942	7.86	2.35	1.99	43.2	21.6	11.03
13-Dec-04	Depth (ft)	12	6	0.5	14.5	6	0.5	15	7.5	0.5	11	6	0.5	16	8	0.5
	Temperature (°C)	6.03	6.03	6.03	7.20	6.13	6.11	7.1.0	6.25	6.05	6.30	6.22	6.20	10.08	7.84	6.84
	Salinity (ppt)	0.03	0.03	0.03	10.45	0.13	0.12	12.45	0.58	0.1	1.51	0.69	0.64	26.9	13.04	3.88
	Dissolved Oxygen (mg/L)	11.98	11.95	12.08	11.9	11.51	11.4	11.9	11.47	11.29	12.77	11.7	11.58	9.62	9.37	10.39
	pH	6.81	6.9	6.97	7.59	8.19	7.77	7.6	7.8	7.73	7.3	7.47	7.51	8	7.92	8.05
	Conductivity (mS/cm)	0.066	0.066	0.066	15.8	0.279	0.264	16.1	0.352	0.251	2.54	1.45	1.38	42.8	21.2	7.2
14-Dec-04	Depth (ft)	11	6	0.5	13	6.5	0.5	17	9	0.5	11	5.5	0.5	15	8	0.5
	Temperature (°C)	6.43	6.42	6.43	9.16	6.40	6.34	9.87	6.38	6.39	10.00	6.51	6.42	10.19	9.81	6.98
	Salinity (ppt)	0.03	0.03	0.03	20.3	0.08	0.04	25.44	0.41	0.06	26.27	0.95	0.39	27.74	25.58	4.31
	Dissolved Oxygen (mg/L)	12.13	11.72	11.71	7.8	9.89	11.1	7.2	9.37	11.3	7.5	9.27	10.66	7	7.15	9.85
	pH	6.88	6.97	7.01	7.86	8.44	8.14	7.92	8.21	8.12	7.98	8.28	8.05	8.06	8.08	7.97
	Conductivity (mS/cm)	0.065	0.065	0.065	33.9	0.3	0.074	40.8	0.753	0.124	42	2.07	0.767	44	40.3	7.83

		Trimaran			Turning Basin			Powerline			Pit Bull			Kellogg Island		
Date	**Parameter**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**
23-Dec-04	Depth (ft)	11	5.5	0.5	23	12	0.5	9.5	5	0.5	10	5	0.5	12	6	0.5
	Temperature (°C)	7.67	5.93	5.90	9.92	9.80	6.02	6.26	6.07	6.04	9.79	6.74	6.01	9.86	8.98	6.41
	Salinity (ppt)	12.72	0.17	0.09	27.1	26.12	0.29	1.72	0.073	0.072	26.26	3.72	0.8	26.68	20.79	6.29
	Dissolved Oxygen (mg/L)	8.76	9.74	10.29	6.2	6.44	8.35	11.01	10.75	10.85	6.7	9.29	8.05	7.92	7.62	7.3
	pH	7.54	8.28	7.9	8.03	8.03	8.47	7.77	7.82	7.71	8.05	7.8	9.85	8.12	8.09	7.95
	Conductivity (mS/cm)	21.5	0.288	0.194	43.2	41.7	0.547	2.99	1.48	1.469	42.4	6.9	1.55	42.8	33.9	11.32
29-Dec-04	Depth (ft)	12	6	0.5	9	4.5	0.5	10.5	5.75	0.5	11	5	0.5	12	6.5	0.5
	Temperature (°C)	8.80	7.51	5.59	9.20	7.72	5.93	9.10	7.85	5.83	9.32	6.26	5.71	9.60	9.24	7.05
	Salinity (ppt)	22.19	14.32	1.23	25.27	14.9	3.16	24.92	15.21	2.87	25.07	4.68	2.08	26.32	24.52	11
	Dissolved Oxygen (mg/L)	6.85	7.45	8.8	7.69	8.03	8.56	7.8	8.1	8.45	7.13	8.41	8.86	6.25	6.35	7.62
	pH	7.87	7.84	7.96	8.01	7.89	7.88	7.99	7.83	7.8	8.06	7.8	7.8	8.12	8.11	8
	Conductivity (mS/cm)	36	22.5	2.38	41	25.3	5.83	39.6	21.12	4.96	40.5	8.45	4.1	42.4	39.3	19.5
30-Dec-04	Depth (ft)	12	6	0.5	13	6.5	0.5	8	4	0.5	12	6	0.5	13.8	7	0.5
	Temperature (°C)	9.16	5.61	5.55	7.26	6.11	5.63	8.62	6.2	5.7	9.51	6.28	6.21	9.15	7.48	7.35
	Salinity (ppt)	24.38	0.17	0.07	24.93	4.04	0.57	21.85	6.1	0.91	26.11	4.78	4.38	24.18	17.77	12.27
	Dissolved Oxygen (mg/L)	6.17	7.95	8.85	6.56	8.18	8.63	7.5	7.91	8.52	6.64	8.31	9.18	6.71	8.02	7.92
	pH	7.89	8.35	8.06	7.97	7.84	7.92	7.91	7.83	8.02	8.02	7.97	7.76	8.06	7.95	7.95
	Conductivity (mS/cm)	39.3	0.4	0.165	40	6.88	1.236	35.1	9.98	1.9	41.7	8.75	8.08	38.7	22.1	20.9
7-Jan-05	Depth (ft)	10	5	0.5	12	6	0.5	9	5	0.5	9	4.5	0.5	14	7	0.5
	Temperature (°C)	7.33	5.4	3.45	8.79	7.13	3.23	8.42	6.16	3.35	8.48	7.35	3.4	8.59	8.3	6
	Salinity (ppt)	19.66	10.91	1.95	25.18	18.59	1	24.21	19.32	1.16	24.62	19.79	1.78	26.68	23.99	14.21
	Dissolved Oxygen (mg/L)	7.21	8.1	8.94	6.3	6.95	8.48	6.32	6.7	8.2	6.55	6.86	8.99	7.07	6.9	7.58
	pH	7.74	7.72	7.93	7.94	7.93	8.22	7.94	7.86	8.18	8.04	7.95	8.02	8.13	8.11	7.95
	Conductivity (mS/cm)	32.4	19.1	3.81	40.5	30.9	1.97	38.8	29.6	2.79	39.5	32.7	3.45	42.7	38.9	24.3

		Trimaran			Turning Basin			Powerline			Pit Bull			Kellogg Island		
Date	**Parameter**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**
13-Jan-05	Depth (ft)	8	4	0.5	12	6	0.5	8	4	0.5	10.5	6	0.5	15	7	0.5
	Temperature (°C)	4.98	4.63	4.57	8.75	7.61	4.57	8.55	8.21	5.42	9.08	8.26	5.57	9.11	8.52	6.50
	Salinity (ppt)	2.54	2.32	2.13	25.66	20	2.08	24.96	22.9	6.4	27.47	24.13	8.81	27.74	24.55	14.34
	Dissolved Oxygen (mg/L)	9.66	9.13	9.14	7.2	7.24	8.73	6.9	6.67	7.75	6.26	6.22	7.99	6.15	6.3	7.19
	pH	7.48	7.63	7.59	8.03	7.98	8.09	7.99	7.99	7.98	8.1	8.07	7.92	8.12	8.12	8.04
	Conductivity (mS/cm)	7.61	4.62	4	41.2	32.8	3.82	40.3	37.6	12.2	43.8	38.9	15.6	44.4	39.4	25.8
14-Jan-05	Depth (ft)	12	6	0.5	10	5	0.5	14	7	0.5	10	5	0.5	9	5	0.5
	Temperature (°C)	4.77	4.76	4.75	6.85	5.67	4.74	8.78	5.89	4.85	7.78	5.85	5.08	8.41	7.00	6.90
	Salinity (ppt)	0.17	0.15	0.13	15.45	7.75	0.77	25.79	9.25	1.34	20.91	9.18	5.71	24	17.28	16.42
	Dissolved Oxygen (mg/L)	9.55	9.3	9.24	9.35	10.02	9.25	7.3	8.14	9.26	8.2	9.05	9.27	7.74	7.95	7.96
	pH	7.59	7.23	7.15	7.81	7.8	8.05	8.05	7.95	8.1	8.01	7.87	7.88	8.03	8.01	8
	Conductivity (mS/cm)	0.37	0.324	0.271	25.4	13.77	1.52	41.5	16.1	2.59	32.5	15.9	10.6	39	28.5	27.8
20-Jan-05	Depth (ft)	10	5	0.5	12	6	0.5	8	4	0.5	10	5	0.5	14	7	0.5
	Temperature (°C)	6.80	6.80	6.80	6.77	6.75	6.80	6.81	6.80	6.80	6.75	6.75	6.74	7.08	6.97	6.65
	Salinity (ppt)	0.02	0.02	0.02	0.03	0.02	0.02	0.25	0.19	0.13	0.42	0.41	0.42	6.68	2.38	1.97
	Dissolved Oxygen (mg/L)	8.3	8.1	8.05	8.53	8.38	8.37	8.02	7.43	7.8	8.18	8.3	8.31	9.52	8.6	8.65
	pH	7.02	6.94	6.97	7.42	7.02	6.93	7.05	7.07	7.06	7.27	7.22	7.19	7.42	7.68	7.57
	Conductivity (mS/cm)	0.046	0.045	0.045	0.073	0.066	0.047	0.501	0.252	0.245	0.998	0.854	0.858	11.97	4.51	3.67
26-Jan-05	Depth (ft)	15	7.5	0.5	14	7	0.5	10	5	0.5	10	5	0.5	14	7	0.5
	Temperature (°C)	7.40	7.40	7.41	8.73	7.35	7.38	7.37	7.37	7.38	7.39	7.41	7.40	8.99	8.22	7.67
	Salinity (ppt)	0.04	0.03	0.03	22.12	0.24	0.1	0.5	0.2	0.2	2.85	1.89	1.48	24.57	14.91	4.59
	Dissolved Oxygen (mg/L)	11.25	11.03	10.94	7.3	10.3	10.72	11.01	11.13	10.95	10.95	10.93	10.85	7.55	7.61	10.03
	pH	6.43	6.31	6.34	7.47	7.56	7.29	7.45	7.12	6.99	7.22	7.26	7.24	7.63	8.71	7.55
	Conductivity (mS/cm)	0.076	0.074	0.074	35.9	0.572	0.199	0.458	0.407	0.375	5.43	3.65	2.87	39.6	24.3	8.42

		Trimaran			Turning Basin			Powerline			Pit Bull			Kellogg Island		
Date	**Parameter**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**
27-Jan-05	Depth (ft)	9	4	0.5	15	7.5	0.5	12	6	0.5	10	5	0.5	16	8	0.5
	Temperature (°C)	7.18	7.18	7.16	8.71	7.16	7.08	8.82	7.08	7.09	8.91	7.91	7.14	8.97	7.75	7.36
	Salinity (ppt)	0.04	0.05	0.05	21.51	0.26	0.08	23	0.2	0.15	24.09	9.71	0.75	24.5	6.56	4.14
	Dissolved Oxygen (mg/L)	11.5	11.32	11.22	7.86	10.2	11	7.66	11.04	11	7.84	9.37	10.76	8.14	9.92	10.28
	pH	6.64	6.51	6.55	7.52	7.93	7.64	7.57	7.37	7.26	7.64	7.49	7.6	7.71	7.5	7.45
	Conductivity (mS/cm)	0.099	0.098	0.098	35.1	0.532	0.178	37.2	0.327	0.311	39	16.9	1.5	39.1	11.61	7.71
1-Feb-05	Depth (ft)	9	4	0.5	10	5	0.5	9	4.5	0.5	10	5	0.5	10	5	0.5
	Temperature (°C)	7.32	7.32	7.31	8.18	7.44	7.44	8.64	7.47	7.46	8.76	7.48	7.72	8.67	8.51	8.21
	Salinity (ppt)	0.005	0.007	0.007	5.84	0.26	0.26	19.71	0.37	0.25	21.18	1.97	0.82	19.11	14.92	8.54
	Dissolved Oxygen (mg/L)	11.88	11.8	11.56	10.59	11.1	11.2	7.68	10.22	10.84	7.8	9.86	10.68	8.25	8.59	9.42
	pH	6.5	6.46	6.51	7.14	7.37	7.09	7.41	7.88	7.35	7.55	7.63	7.46	7.59	7.55	7.48
	Conductivity (mS/cm)	0.147	0.149	0.151	10.05	0.563	0.542	32.6	0.748	0.532	35.4	4.03	1.61	31.5	25.1	15.1
8-Feb-05	Depth (ft)	10	5	0.5	10	5	0.5	10	5	0.5	9	5	0.5	15	7.5	0.5
	Temperature (°C)	6.55	5.93	5.95	8.32	7.93	6.21	8.41	7.07	5.23	8.39	7.40	5.43	8.13	8.44	7.78
	Salinity (ppt)	3.77	1.19	0.42	20.09	15.61	0.78	21.3	7.42	0.49	21.23	11.05	1.5	24.9	22.38	12.01
	Dissolved Oxygen (mg/L)	11.36	11.31	11.39	8.38	8.6	10.94	7.82	9.49	10.89	8.25	9.1	10.65	7.69	7.8	9.16
	pH	7.16	7.21	7.13	7.61	7.55	7.6	7.64	7.47	7.64	7.67	7.66	7.68	7.75	7.73	7.61
	Conductivity (mS/cm)	6.72	2.35	0.89	33	27.6	1.6	34.5	13.07	1.01	34.7	19.2	3.01	4.01	35.7	21.5
9-Feb-05	Depth (ft)	9	5	0.5	11	5.5	0.5	12	6.5	0.5	11	5.5	0.5	13	6.5	0.5
	Temperature (°C)	6.14	6.16	6.18	8.09	6.52	6.30	8.45	6.67	6.56	8.26	6.70	6.89	8.70	8.37	7.61
	Salinity (ppt)	0.12	0.09	0.01	18.17	4.46	0.75	21.64	5.38	0.78	20.69	4.16	3.9	24.22	20.63	7.79
	Dissolved Oxygen (mg/L)	11.05	11.03	11.05	8.53	10.06	10.85	8.04	9.18	10.38	8.42	10.39	10.49	7.85	7.97	9.83
	pH	6.77	6.77	6.75	7.52	7.46	7.5	7.63	7.6	7.67	7.63	7.55	7.35	7.74	7.7	7.54
	Conductivity (mS/cm)	0.24	0.211	0.213	30.6	9.15	13.68	35.2	10.01	1.59	33.6	7.77	7.22	39.1	33.8	13.79

		Trimaran			Turning Basin			Powerline			Pit Bull			Kellogg Island		
Date	**Parameter**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**	**Bottom**	**Mid**	**Surface**
17-Feb-05	Depth (ft)	7	3.5	0.5	7	3.5	0.5	7	3.5	0.5	8	4	0.5	12	6	0.5
	Temperature (°C)	4.64	4.66	4.65	7.39	4.94	4.35	6.08	4.83	4.76	7.94	5.41	4.34	8.29	7.14	5.27
	Salinity (ppt)	0.8	0.77	0.7	17.75	1.99	1.49	8.27	1.87	1.54	20.68	3.12	1.21	22.98	15.07	7.5
	Dissolved Oxygen (mg/L)	11.22	11.2	11.11	8.73	10.63	10.9	9.86	11.02	10.95	7.75	10.55	11.08	8.18	8.95	10.3
	pH	6.99	6.91	6.9	7.5	7.68	7.29	7.46	7.43	7.2	7.61	7.8	7.52	7.71	7.65	7.62
	Conductivity (mS/cm)	1.55	1.53	1.44	29.4	3.77	2.93	14.93	3.28	3.05	33.8	5.92	2.4	37.2	25.4	12.33
24-Feb-05	Depth (ft)	8	4	0.5	9	4.5	0.5	9.5	4.75	0.5	8.5	4.25	0.5	8.5	4.75	0.5
	Temperature (°C)	7.69	7.16	6.22	8.26	6.68	6.70	8.33	6.98	7.13	8.12	6.94	7.39	8.25	8.07	7.65
	Salinity (ppt)	18.55	12.77	0.43	23.79	7.66	2.01	24.13	11.19	1.31	22.7	9.88	5.28	23.93	21.29	13.67
	Dissolved Oxygen (mg/L)	8.85	9.65	11.55	8.4	10.33	11.03	8.25	9.69	10.15	8.45	9.95	10.54	8.62	8.59	9.37
	pH	7.34	7.38	7.56	7.55	7.42	7.27	7.53	7.48	7.63	7.58	7.53	7.37	7.65	7.63	7.53
	Conductivity (mS/cm)	31.1	22.7	0.829	38.6	13.7	3.85	38.9	19.4	2.68	37.1	16.7	9.61	38.6	34.6	23.5
25-Feb-05	Depth (ft)	9	4.5	0.5	9	4.5	0.5	9	4.5	0.5	9	4.5	0.5	10	5	0.5
	Temperature (°C)	6.43	6.37	6.35	7.84	7.46	6.17	8.04	7.54	6.13	8.21	7.07	6.10	8.29	8.02	6.83
	Salinity (ppt)	2.43	1.14	0.79	20.34	16.97	0.78	22.63	18.35	0.86	23.92	12.51	3.87	24.95	21.62	10.81
	Dissolved Oxygen (mg/L)	11.35	11.43	11.3	8.73	8.93	10.81	8.4	8.66	10.67	8.19	9.17	10.52	8.69	8.54	9.44
	pH	7.12	7.06	7.01	7.6	7.52	7.67	7.59	7.56	7.94	7.65	7.55	7.5	7.74	7.54	7.6
	Conductivity (mS/cm)	4.68	2.07	1.79	33.2	27.7	1.59	36.7	30	20.3	38.8	21.6	7.22	40.2	35	18.9
3-Mar-05	Depth (ft)	9	4.5	0.5	7	3.5	0.5	8	4	0.5	8	4	0.5	9	4.5	0.5
	Temperature (°C)	9.42	9.43	9.37	8.80	9.06	9.52	8.68	9.25	9.06	8.80	9.49	8.78	8.76	8.92	9.29
	Salinity (ppt)	7.47	2.8	0.66	21.52	15.58	1.59	23.81	13.58	1.18	22.39	10.67	1.86	23.75	21.72	12.62
	Dissolved Oxygen (mg/L)	9.55	9.45	9.99	7.75	8.15	9.76	7.65	8.62	9.83	8.1	8.88	9.78	8.47	8.18	8.91
	pH	7.11	7.27	7.45	7.51	7.51	7.75	7.53	7.49	7.71	7.61	7.48	7.64	7.7	7.68	7.56
	Conductivity (mS/cm)	13.72	12.49	1.316	35.4	28.5	3.06	38.5	23.1	2.15	36.3	18.4	3.74	38.4	35.3	21.8

8.3 Appendix C. Purse Seine Water Quality Data

Depth (ft), water temperature (C), salinity (ppt), dissolved oxygen (mg/L), turbidity (NTU), pH, and conductivity (mS/cm) collected at fish survey sites, Duwamish River, King County, Washington, December 4, 2004 through March 3, 2005.

Due to the draft of the F/V Chasina and the limited depth of the upper stations (Turning Basin, Powerline, and Delta), if the tide was going out upon arrival at the site, the time required to gather water quality information would put the vessel at risk of becoming stuck, which happened on more than one occasion. In addition, due to the close proximity of the three upper stations it was agreed upon in the field that if collecting water quality data at all three stations, especially during a falling tide, may result in the F/V Chasina not being able to seine any one of these stations, that water quality would only be done at one of those stations. As a result, under certain conditions no water quality data was gathered at a specific station.

		Turning Basin				Delta Marine				Pit Bull				Kellogg				Power Line		
Date	**Parameter**	**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**
4-Dec-04	Depth	0	3	5		0	3	5		0	3	5		0	5	6		-	-	-
	Conductivity	-	-	-		-	-	-		-	-	-		-	-	-		-	-	-
	DO	-	-	-		-	-	-		-	-	-		-	-	-		-	-	-
	Salinity	5	28	34		4	30	33		4	31	33		8	33	35		-	-	-
	Turbidity	2	1.8	2.5		1.7	1.7	2		1.8	0.8	1.3		1.4	1.4	110		-	-	-
	Water Temp	8	10	11		7.2	9.8	11		7	10.2	11		7	10.2	10.2		-	-	-
10-Dec-04	Depth	-	-	-		-	-	-		0	3	5		0	3.5	7		-	-	-
	Conductivity	-	-	-		-	-	-		2080	2300	3400		9276	1800	4340		-	-	-
	DO	-	-	-		-	-	-		9.37	9.14	7.11		8.99	7.6	5.87		-	-	-
	Salinity	-	-	-		-	-	-		-	-	-		5.2	-	2.3		-	-	-
	Turbidity	-	-	-		-	-	-		7.4	11	4.1		4.9	3.8	5.3		-	-	-
	Water Temp	-	-	-		-	-	-		7.9	7.9	9.3		5.2	8.5	10.1		-	-	-
11-Dec-04	Depth	0	3	5		0	3	5		-	-	-		-	-	-		-	-	-
	Conductivity	371	850	2000		697	1040	2000		-	-	-		-	-	-		-	-	-
	DO	9.5	9.37	8.04		9.68	9.64	8.68		-	-	-		-	-	-		-	-	-
	Salinity	-	-	-		-	-	-		-	-	-		-	-	-		-	-	-
	Turbidity	11	-	5.4		12	12	12		-	-	-		-	-	-		-	-	-
	Water Temp	7.9	7.9	8.9		7.9	7.9	8.6		-	-	-		-	-	-		-	-	-
17-Dec-04	Depth	0	3	5		0	3	5		0	3	5		0	3	5		0	3	5
	Conductivity	317	2297	43430		1347	2752	43435		1480	6710	43819		9932	35460	39904		512	6642	43566
	DO	9.7	9.01	5.8		9.35	9.45	5.88		9.65	8.73	5.8		7.9	6.7	6.6		9.88	6.9	9.7
	Salinity	-	-	28		-	-	28		-	3.7	28.2		5.6	22.3	25.5		-	3.6	-
	Turbidity	3.2	2.4	1.8		3.3	3	1.9		3.2	1.3	13.5		2.6	2.1	1.7		3.2	1.9	2.3
	Water Temp	6.6	7	9.8		6.7	6.7	9.8		6.7	7	9.8		7.3	8.8	9.5		6.6	6.9	9.7

		Turning Basin				Delta Marine				Pit Bull				Kellogg				Power Line		
Date	**Parameter**	**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**
18-Dec-04	Depth	0	3	5		0	3	5		0	3	5		0	3	5		0	3	5
	Conductivity	1849	42929	43055		3770	30419	43506		4822	42104	40248		6180	41502	44325		2160	41643	43440
	DO	9.4	5.64	5.7		9.39	6.6	5.9		9.13	5.67	5.88		8.7	5.91	6		9.18	5.63	5.51
	Salinity	-	27.6	27.7		-	18.9	28		2.6	27	25.7		3.4	26.6	28.6		-	26.7	28
	Turbidity	3.3	2	1.6		3.2	2.1	1.9		3.4	2.2	1.7		2.4	1.2	0.9		3.2	1.8	1.7
	Water Temp	6.9	9.7	9.8		7.1	9.1	9.8		7.3	9.5	9.5		6.9	9.7	9.9		7	9.6	9.8
20-Dec-04	Depth	0	3	4		0	3	4.5		-	-	-		0	3	5		0	3	5
	Conductivity	395	1925	43075		1600	5185	42632		-	-	-		12459	27190	37654		1089	2097	43693
	DO	9.3	8.82	5.14		9.5	9.04	5.6		-	-	-		8.53	7.4	6.91		9.34	8.77	4.84
	Salinity	-	-	27.7		-	2.8	27.4		-	-	-		7.1	16.7	23.9		-	-	28.2
	Turbidity	3.6	3.2	2.5		2.9	2.3	5.3		-	-	-		3	1.7	1.4		3.2	3.2	3.1
	Water Temp	6.5	6.7	9.6		6.7	6.7	9.8		-	-	-		7.6	8.5	9.6		6.6	6.9	9.7
27-Dec-04	Depth	0	3	5		0	3	4		-	-	-		0	3	5		-	-	-
	Conductivity	1195	16228	42118		5265	13233	28876		-	-	-		8037	38451	43152		-	-	-
	DO	9.5	7.73	5.77		9.09	8.48	7.03		-	-	-		8.9	6.43	6.29		-	-	-
	Salinity		9.5	27		2.8	7.6	17.8		-	-	-		4.5	24.4	27.8		-	-	-
	Turbidity	2.1	1.6	1.8		2.4	3.9	12		-	-	-		2.4	1.7	1.4		-	-	-
	Water Temp	6.1	7.4	9.4		6.3	6.9	8.1		-	-	-		6.7	9.1	9.4		-	-	-
28-Dec-04	Depth	0	3	5		0	3	5		0	3	5		0	3	5		-	-	-
	Conductivity	4947	40662	43344		7525	38470	43025		5873	30673	43273		19472	42381	45190		-	-	-
	DO	9.6	6.11	5.9		9.02	6.21	5.79		10.07	8.28	7.7		9.02	7.35	7.44		-	-	-
	Salinity	2.6	26	27.9		4.1	24.4	27.7		3.2	19	27.9		11.6	27.2	29.2		-	-	-
	Turbidity	0	0	0		3.3	1.7	2.15		3.7	1.8	2.61		3.1	2.6	2.3		-	-	-
	Water Temp	5.8	9.2	9.5		6.3	6.9	8.1		6	8.3	9.5		7.2	9.4	9.7		-	-	-

		Turning Basin				Delta Marine				Pit Bull				Kellogg				Power Line		
Date	**Parameter**	**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**
7-Jan-05	Depth	0	3	5		0	3	5		-	-	-		0	3	5		-	-	-
	Conductivity	934	34332	-		3607	16509	23880		-	-	-		16914	39145	43112		-	-	-
	DO	11.2	7.32	-		9.95	8.67	7.73		-	-	-		9.32	7.36	6.84		-	-	-
	Salinity	-	21.5	-			9.7	14.5		-	-	-		9.9	24.9	27.7		-	-	-
	Turbidity	4	2.7	-		3.1	5.1	6.4		-	-	-		3.1	1.3	2.1		-	-	-
	Water Temp	3.9	7.1	-		4.1	5.3	6.2		-	-	-		5	8.1	8.6		-	-	-
10-Jan-05	Depth	-	-	-		-	-	-		-	-	-		0	3	5		0	3	4
	Conductivity	-	-	-		-	-	-		-	-	-		2922	32906	39234		1448	6524	-
	DO	-	-	-		-	-	-		-	-	-		7.91	7.02	6.36		10.3	9.5	-
	Salinity	-	-	-		-	-	-		-	-	-		-	20.6	25		-	3.6	-
	Turbidity	-	-	-		-	-	-		-	-	-		2.5	1.9	2.6		3.13	5.62	-
	Water Temp	-	-	-		-	-	-		-	-	-		5.7	7.3	8.2		4.2	4.5	-
11-Jan-05	Depth	0	3	5		0	3	5		0	3	5		0	3	5		-	-	-
	Conductivity	14446	39775	40575		18850	30739	41957		17588	33571	40718		23348	40148	42916		-	-	-
	DO	9.31	6.63	6.52		8.45	7.31	6.27		9.08	7.09	6.37		8.37	6.9	6.57		-	-	-
	Salinity	8.4	25.4	25.9		11.2	19.1	26.9		10.4	21	26		14.1	25.6	27.6		-	-	-
	Turbidity	2.3	2	2.3		2.2	2	1.9		2.6	2.2	1.8		2.4	1.2	1.1		-	-	-
	Water Temp	5	8.1	8.3		5.6	7.1	8.6		5.4	7.5	8.4		5.9	8.3	8.7		-	-	-
17-Jan-05	Depth	0	3	5		0	3	4		0	3	5		0	3	5		-	-	-
	Conductivity	759	3570	40966		2000	7480	32722		2559	18224	41400		23663	38407	43757		-	-	-
	DO	10.43	10.04	6.13		9.81	8.7	7.05		9.65	8.3	6.23		8.4	8.36	7.95		-	-	-
	Salinity	-	-	26.2		-	4.1	20.4		-	10.8	26.5		14.3	24.4	28.2		-	-	-
	Turbidity	18.7	14.9	5.16		16.9	3.5	3.1		16.4	2.4	2.49		9	1.6	2.5		-	-	-
	Water Temp	5.7	5.7	8.1		5.9	6.1	7.3		5.9	6.3	8.4		6.8	8	8.7		-	-	-

		Turning Basin				Delta Marine				Pit Bull				Kellogg				Power Line		
Date	**Parameter**	**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**
28-Jan-05	Depth	0	3	5		0	3	5		0	3	5		-	-	-		-	-	-
	Conductivity	789	38547	42581		3227	10840	42867		4416	8005	41823		-	-	-		-	-	-
	DO	9.7	6.28	5.98		9.23	8.6	5.93		9.02	8.39	5.83		-	-	-		-	-	-
	Salinity	-	24.5	27.4		-	6.1	27.6		2.3	4.4	26.8		-	-	-		-	-	-
	Turbidity	4.82	2.72	2.19		4.2	3.6	2.62		4.5	5.1	4.21		-	-	-		-	-	-
	Water Temp	7.3	8.5	8.7		7.4	7.6	8.7		7.3	7.4	8.7		-	-	-		-	-	-
29-Jan-05	Depth	0	3	5		0	3	5		0	3	5		0	3	5		-	-	-
	Conductivity	2900	29762	41615		5204	15879	41569		5534	16261	40568		22223	60350	75643		-	-	-
	DO	9.37	7.39	5.97		8.88	8.13	6.12		9.11	8.13	6.73		16.88	14.95	13.54		-	-	-
	Salinity	-	18.4	26.7		2.8	9.3	26.6		3	9.5	25.9		12.7	37.4	48		-	-	-
	Turbidity	5.76	3.19	3.34		4.9	3.1	3.2		4	3.1	3.3		8.5	6.4	7.6		-	-	-
	Water Temp	6.9	8.1	8.7		7.1	7.5	8.6		7.1	7.6	8.6		15.1	16.4	17		-	-	-
4-Feb-05	Depth	0	3	4		0	3	4		0	3	5		-	-	-		-	-	-
	Conductivity	9555	9325	0		1449	20661	36437		2846	28521	37509		-	-	-		-	-	-
	DO	9.22	7.54	-		9.28	7.71	6.31		8.48	7.25	6.67		-	-	-		-	-	-
	Salinity	5.4	5.2	0		-	12.3	23		-	17.6	23.8		-	-	-		-	-	-
	Turbidity	4.9	12.4	3.93		4.6	3.2	3.1		3.8	2.4	2.7		-	-	-		-	-	-
	Water Temp	7.7	7.9	0		7.6	8.1	8.4		7.3	8.3	8.4		-	-	-		-	-	-
5-Feb-05	Depth	-	-	-		-	-	-		-	-	-		0	3	5		-	-	-
	Conductivity	-	-	-		-	-	-		-	-	-		22467	36444	42183		-	-	-
	DO	-	-	-		-	-	-		-	-	-		7.97	6.04	6.6		-	-	-
	Salinity	-	-	-		-	-	-		-	-	-		13.5	23	27.1		-	-	-
	Turbidity	-	-	-		-	-	-		-	-	-		3.6	1.8	2.2		-	-	-
	Water Temp	-	-	-		-	-	-		-	-	-		8	8.4	8.6		-	-	-

		Turning Basin				Delta Marine				Pit Bull				Kellogg				Power Line		
Date	**Parameter**	**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**
11-Feb-05	Depth	0	3	5		0	3	5		0	3	5		-	-	-		-	-	-
	Conductivity	3556	39392	41829		6357	29647	41385		10307	18446	17491		-	-	-		-	-	-
	DO	9.44	6.71	6.61		9.21	7.7	6.78		9.52	8.35	8.16		-	-	-		-	-	-
	Salinity	-	25.1	26.8		3.5	18.3	26.5		5.8	10.9	10.3		-	-	-		-	-	-
	Turbidity	2.6	2.2	2.5		2.3	2	2.3		2.5	2.3	3.2		-	-	-		-	-	-
	Water Temp	5.3	8	8.2		5.5	7.2	6.8		5.7	6.4	6.3		-	-	-		-	-	-
12-Feb-05	Depth	0	3	5		0	3	4		0	3	5		0	3	5		-	-	-
	Conductivity	10329	38173	40572		7525	38470	-		14326	23528	41602		32840	75711	83797		-	-	-
	DO	9.5	7.24	6.71		9.01	8.2	-		8.98	8.12	6.64		17.39	14.87	14.66		-	-	-
	Salinity	5.8	24.2	25.9		4.1	24.4	-		8.3	14.2	26.7		19.2	48	53.8		-	-	-
	Turbidity	3.4	2.7	3.1		3.1	3.4	-		2.7	2.7	3.3		4.4	7.5	4		-	-	-
	Water Temp	5.9	7.9	8.1		6.2	6.6	-		6.3	6.8	8.2		12.6	15.7	16.4		-	-	-
								-												
18-Feb-05	Depth	0	3	4		0	3	4		-	-	-		0	3	3.5		-	-	-
	Conductivity	1073	28969	43063		1645	35288	42766		-	-	-		16058	35497	4		-	-	-
	DO	9.7	7.24	5.61		10.07	6.95	6.26		-	-	-		8.71	7.28	42125		-	-	-
	Salinity	-	17.9	27.7		-	22.2	27.5		-	-	-		9.4	22.4	6.63		-	-	-
	Turbidity	2.7	2.9	2.5		2.2	2.18	3.13		-	-	-		2.6	2.3	27		-	-	-
	Water Temp	5.1	7	8.3		2.6	7.7	8.2		-	-	-		6.3	7.7	2.1		-	-	-
20-Feb-05	Depth	0	3	4		0	3	4		0	3	4		-	-	-		-	-	-
	Conductivity	1078	13584	43175		7570	9837	42522		6123	12656	-		-	-	-		-	-	-
	DO	9.9	8.71	5.85		8.94	9.05	5.85		9.75	8.95	-		-	-	-		-	-	-
	Salinity	-	7.8	27.8		4.2	5.5	27.3		3.3	7.3	-		-	-	-		-	-	-
	Turbidity	3.3	10.3	2.9		3.8	3.1	3.4		3	3.7	4.3		-	-	-		-	-	-
	Water Temp	5.2	6	8.3		5.4	5.7	8.2		6	8.3	-		-	-	-		-	-	-

		Turning Basin				Delta Marine				Pit Bull				Kellogg				Power Line		
Date	**Parameter**	**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**		**Top**	**Mid**	**Bottom**
21-Feb-05	Depth	-	-	-		-	-	-		-	-	-		0	3	4		-	-	-
	Conductivity	-	-	-		-	-	-		-	-	-		10783	36364	42718		-	-	-
	DO	-	-	-		-	-	-		-	-	-		9.37	7.29	6.7		-	-	-
	Salinity	-	-	-		-	-	-		-	-	-		6.1	23	27.5		-	-	-
	Turbidity	-	-	-		-	-	-		-	-	-		3.2	2.1	1.7		-	-	-
	Water Temp	-	-	-		-	-	-		-	-	-		5.3	7.7	8.2		-	-	-