2011 SALMON SPAWNER SURVEYS KELSEY CREEK, WEST TRIBUTARY, RICHARDS CREEK, AND COAL CREEK BELLEVUE SALMON SPAWNER SURVEYS

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

AUC	area under the curve
CWT	coded-wire tag
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FL	fork length
GPS	global positioning unit
LWD	large woody debris
NOAA	National Oceanic and Atmospheric Administration
POH	postorbital to hypural plate
RM	river mile
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

1 ABSTRACT

The City of Bellevue monitored spawning activity in the Kelsey Creek and Coal Creek basins in 2011, marking the 11th and 4th consecutive years, respectively, that this information has been collected. In the Kelsey Creek basin, weekly spawning ground surveys were conducted in Kelsey Creek, the West Tributary (of Kelsey Creek), and Richards Creek. Kelsey Creek and the West Tributary were surveyed from September 6, 2011 through November 28, 2011, for 13 consecutive weeks. A total of seven surveys of Richards Creek were conducted every other week from September 9, 2011 through November 28, 2011. In the Coal Creek basin, a total of 22 surveys were conducted weekly, and twice a week in December, from September 6, 2011 through December 29, 2011.

Observations of salmon and redds were very low in 2011. There was no evidence, other than one Chinook carcass in the West Tributary, of Chinook salmon (*Oncorhynchus tschawytscha*) spawners or redds during surveys of Kelsey Creek, West Tributary, Richards Creek, or Coal Creek. The Chinook carcass in the West Tributary had been mostly eaten by a predator. Due to the lack of Chinook during the 2011 survey period, there were no hatchery-versus-wild-utilization patterns to assess. Based on redd counts, the 2011 Chinook salmon escapement in Kelsey Creek is zero, which was the same as 2010 and lower than 2008 (n=20) and 2009 (n=13). The low Chinook returns between 2008 and 2011 are in contrast to higher observed returns in 2006 and 2007 (n=180 to 193 per year), but similar to the escapement estimates from 2001 through 2005 (n=0 to 10 per year).

No coho salmon (*O. kisutch*) or redds were observed in the Kelsey Creek basin during 2011. Based on redd counts, the 2011 coho escapement to the Kelsey Creek basin is zero. Seven coho spawners, one carcass, and one redd were documented in Coal Creek in 2011. Based on the presence of one redd (assume 2.5 adults per redd), the coho salmon escapement estimate for 2011 is 2.5. However, we know at least eight coho returned to Coal Creek because we counted eight fish (seven spawners and one carcass) during the surveys.

Observations of sockeye salmon (*O. nerka*) in 2011 were limited to one spawner and one carcass in the Kelsey Creek basin. Both of these observations were in Kelsey Creek, but no sockeye redds were documented. No sockeyes spawners, carcasses, or redds were seen in the

West Tributary or Richards Creek. One sockeye spawner was observed in Coal Creek, but no sockeye carcasses or redds were documented.

The total number of Chinook salmon counted going through the Chittenden Locks during 2011 (4,904) was close to the low recorded in 2000 (4,451) and well below the average (13,663). Chinook escapement in Kelsey and Coal Creek basins was not expected to be very high based on these numbers. Beaver dams in the Kelsey Creek basin had the potential to hinder Chinook and sockeye passage because flows are usually low when these fish return in September and October. Several large beaver dams exist in the lower reaches of Kelsey, West Tributary, and Richards creeks. However, Chinook or sockeye still should have been seen as holding fish or carcasses in the vicinity of the beaver dams if many Chinook were using the creeks. The absence of coho salmon in the Kelsey basin and low numbers in the Coal basin were not anticipated because twice as many coho passed the Chittenden Locks (also known as Ballard Locks) in 2011 over 2010. In 2011, the coho salmon count as measured at the Chittenden Locks was 7,858. There is no observed reason why coho were absent from the Kelsey Creek drainage this year and low in Coal Creek. Sockeye salmon numbers were also very low. The 2011 total sockeye salmon count as measured at the Chittenden Locks was 43,724. Sockeye typically spawn in the Cedar River and Bear Creek, so it is not unexpected for zero sockeye to spawn in the Kelsey and Coal Creek basins in a low escapement year.

2 INTRODUCTION

In the Pacific Northwest, Pacific salmon (*Oncorhynchus* spp.) is an important economic, biological, and cultural resource that embodies the values of the region. Habitat degradation and fragmentation, coupled with harvest and hatchery practices, have led to an acute decline in the abundance of Pacific salmon, culminating in several listings under the Endangered Species Act (ESA). In 1999, the Puget Sound Chinook salmon (*O. tshawytscha*) Evolutionarily Significant Unit (ESU) was listed as threatened under the ESA (Federal Register 1999). In turn, federal, state, local, and tribal governments and citizens have engaged in salmon recovery planning to develop watershed-specific recovery strategies for Chinook salmon within the Puget Sound ESU. The goals of these efforts are to implement scientifically based recovery plans that will result in the recovery (de-listing) of Chinook salmon stocks within the Puget Sound ESU, which includes 22 independent and 16 extant populations (Ruckelshaus et al. 2006).

The Cedar-Sammamish watershed (Water Resource Inventory Area [WRIA] 8) is the most highly urbanized watershed within the Puget Sound ESU. Fall Chinook salmon primarily spawn in Cedar River, Bear Creek, and Issaquah Creek. In addition, there are several subbasins within the watershed that consistently have spawning Chinook salmon, including Kelsey, North, Swamp, May, Lewis, Little Bear, McAleer, and Thornton creeks (Kerwin 2001). Two Chinook hatcheries are operated within the watershed—one at Portage Bay, operated by the University of Washington, and the other on Issaquah Creek, operated by the Washington Department of Fish and Wildlife (WDFW). Over the past decade, greater attention has been placed on accurately assessing the abundance of spawning salmon across the Cedar/Sammamish watershed, including the Kelsey Creek and Coal Creek watersheds.

Historically, Kelsey Creek supported runs of Chinook, coho (*O. kisutch*), and sockeye (*O. nerka*) salmon, as well as both cutthroat (*O. clarki*) and steelhead/rainbow (*O. mykiss*) trout. As the watershed became more developed in the 20th century, Kelsey Creek became less hospitable to supporting fish populations (Scott et al. 1986). The combination of altered flow regimes and resulting changes in sediment transport processes are thought to be primarily responsible for the decline in native fishes within the Kelsey Creek Watershed (Richey 1982).

Chinook salmon counts at the Chittenden Locks suggested that the return in 2011 would be less than the average over the past 11 years. During the past 11 years, the peak Chinook salmon count was 31,631 during 2007, while the fewest (4,451) were counted in 2000. The average yearly total of returning Chinook salmon during the past 11 years is 12,867. Figure 1 depicts the timing and abundance of Chinook salmon counted migrating through the locks over the past 16 years.

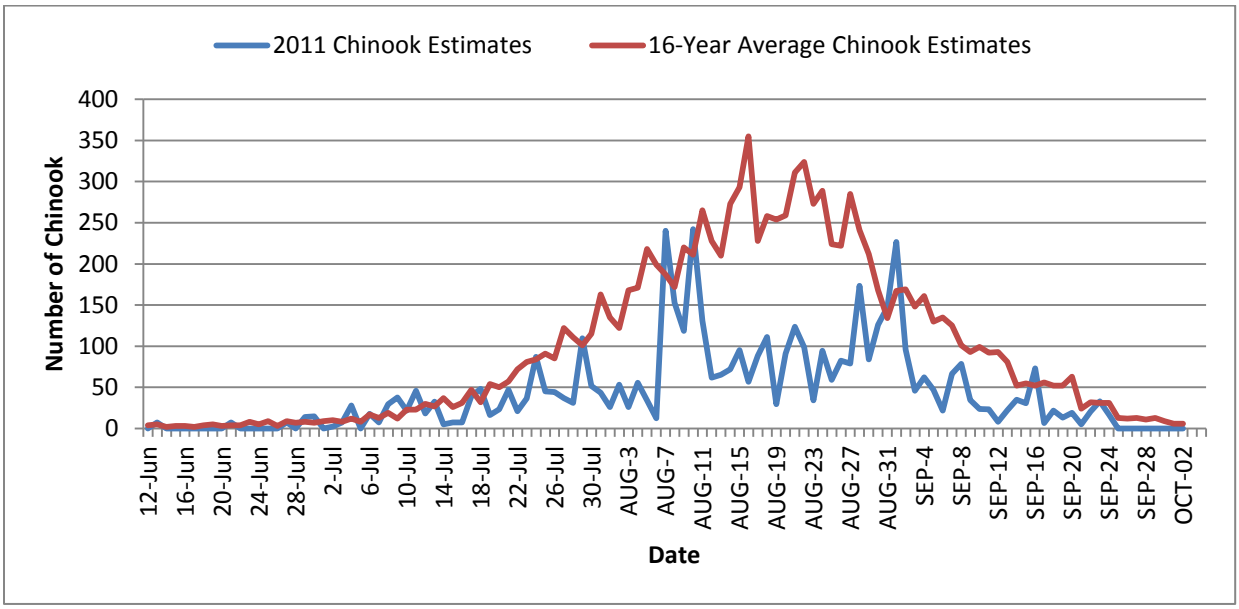


Figure 1

Estimates of Chinook Salmon Migrating Upstream of the Hiram M. Chittenden Locks

Data provided by Aaron Bosworth, Washington Department of Fish and Wildlife

3 METHODS

In 2011, spawning ground surveyors from WDFW, City of Bellevue, and Anchor QEA surveyed index reaches of Kelsey Creek, West Tributary, Richards Creek, and Coal Creek. Weekly spawning ground surveys were conducted for 13 consecutive weeks in Kelsey Creek and the West Tributary from September 6, 2011 through November 28, 2011. A total of seven surveys of Richards Creek were conducted every other week from September 9, 2011 through November 28, 2011. Coal Creek surveys were conducted weekly from September 6, 2011 through November 21, 2011. Coal Creek was then surveyed twice a week from November 28, 2011 through December 29, 2011, for a total of 22 surveys.

The purpose of this work was to document the timing, abundance, and biological characteristics of naturally spawning salmon in Bellevue streams. Since only a portion of each stream is surveyed, escapement estimates are not possible. Instead, the data included in this report represents an index of escapement, although it is thought that greater than 75 percent of the spawning habitat is included within the index area (Watershed Company 2009).

3.1 Study Area and Reach Descriptions

In the Kelsey Creek and Richards Creek basins, there are nine survey index reaches in Kelsey Creek mainstem, five in the West Tributary, and five in Richards Creek (Figure 2). In the Coal Creek basin, there are two survey reaches on Coal Creek. Index reaches have been established over the past decade, and the index reaches in 2011 were the same as those used in 2010 (DEA 2011) except for the addition of the Wetland Reach (downstream of Reach A) in Kelsey Creek, Reach 5 (between the northern boundary of Glendale Golf Course and NE 8th) in the West Tributary, and Reach 2 in Coal Creek (upstream of Coal Creek Parkway). Index reaches were usually walked by the same survey crew members. Specific survey protocols are discussed in Sections 3.2 and 3.3.

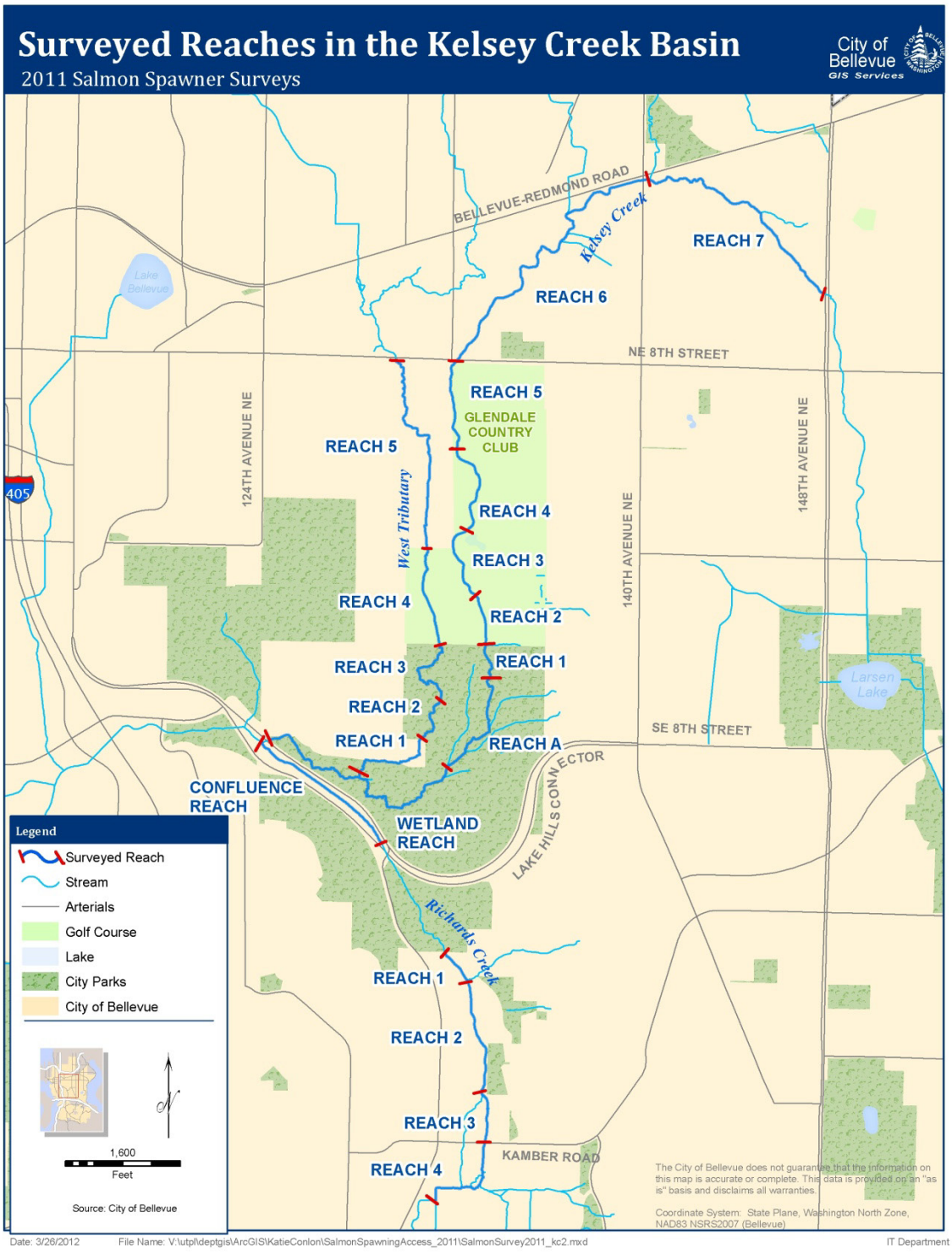


Figure 2

Map of 2011 Survey Reaches in the Kelsey Creek Watershed

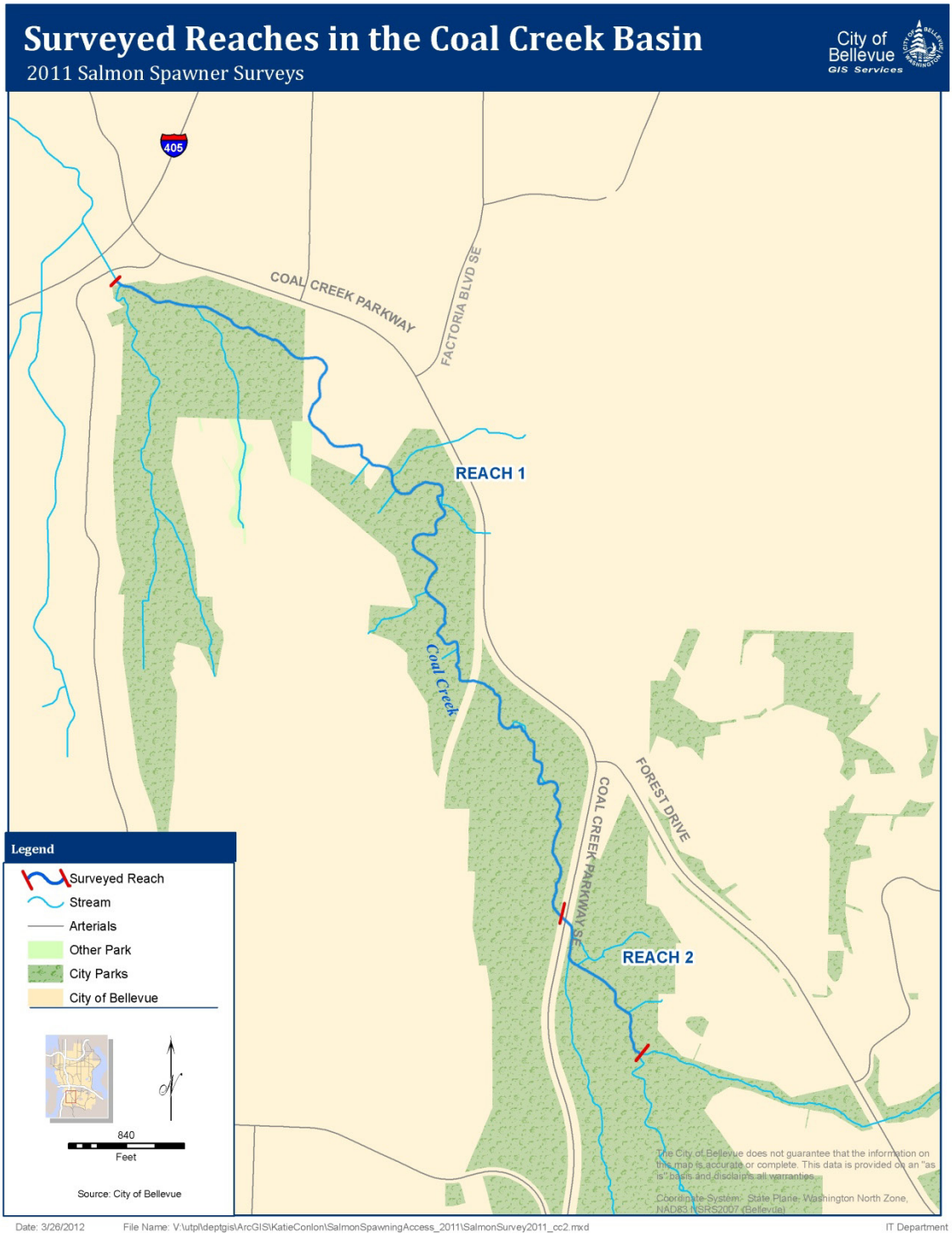


Figure 3

Map of 2011 Survey Reaches in the Coal Creek Watershed

3.1.1 Kelsey Creek

In Kelsey Creek, the Wetland Reach begins at the Richards Creek confluence (river mile [RM] 2.4) and ends at Reach A in Kelsey Creek Park (Figure 4). Reach A begins within the Kelsey Creek Park at the lower extent of stream gravel and ends at a bend within Kelsey Creek, where Reach 1 starts (approximately RM 3.2). Reach 1 continues upstream to the footbridge near the boundary of the park, where Reach 2 begins. Reach 2 continues from the footbridge to the southern property boundary of the Glendale Golf Club property, where Reach 3 starts. Reach 3 extends upstream to the first weir adjacent to the pump house at Reach 4. Reach 4 ends at a footbridge with an armored bank, and Reach 5 extends upstream to the northern boundary of the Glendale Golf Club at the culvert underneath NE 8th Street. Reach 6 was longer than in previous years (pre-2009) due to gaining access permission between NE 8th Street and 134th Avenue NE. Reach 6 began at NE 8th Street and continued to Valley Creek. Reach 7 extends upstream from the confluence of Valley Creek to 148th Avenue NE. Figure 3 includes typical habitat photos for Kelsey Creek.

3.1.2 West Tributary

In the West Tributary, Reach 1 begins at the confluence with Kelsey Creek and extends upstream to the first footbridge in Kelsey Creek Park (Figure 5). Reach 2 starts at the end of Reach 1 and continues to the second footbridge. Reach 3 continues upstream to the southern boundary of the Glendale Golf Club. Reach 4 begins at the downstream boundary of the golf course and ends at its northern boundary. Reach 5 extends from the northern boundary of the golf course to the culvert under NE 8th Street. Figure 4 includes typical habitat photos in the West Tributary.

3.1.3 Richards Creek

Index reaches of Richards Creek begin at its confluence with Kelsey Creek and extend upstream. The Confluence Reach is from the confluence to the intersection of Richards Road and Lake Hills Connector. The area upstream in Bannerwood Park has extensive beaver dams and is not surveyed. Reach 1 begins at the culvert in Bannerwood Park and continues upstream to the next culvert crossing. Reach 2 extends upstream to the confluence with East Creek, and Reach 3 continues upstream to the culvert underneath Kamber Road.

Wetland Reach (October 28, 2011)

Reach A (October 28, 2011)

Reach 1 (December 6, 2011)

Reach 2 (October 28, 2011)

Reach 3 (December 6, 2011)

Reach 4 (December 6, 2011)

Reach 5 (December 6, 2011)

Reach 6 (December 6, 2011)

Reach 7 (September 19, 2011)

Figure 4

Kelsey Creek Typical Habitat Photos from 2011

Reach 1 (September 19, 2011)

Reach 2 (December 6, 2011)

Reach 3 (December 6, 2011)

Reach 4 (September 19, 2011)

Reach 5 (December 6, 2011)

Figure 5

West Tributary Typical Habitat Photos from 2011

Reach 4 includes the segment of stream between Kamber Road and the confluence of Richards Creek and Sunset Creek. During 2011, surveys were limited to the Confluence Reach due to the presence of at least eight beaver dams between the Confluence Reach and Reach 1, any one of which could be a barrier to upstream migration.

3.1.4 Coal Creek

Index reaches of Coal Creek start at the upstream side of Interstate 405 (I-405) and continue above the culvert at Coal Creek Parkway to approximately RM 2.0 (Figure 6). Reach 1 extends from I-405 culvert to the Coal Creek Parkway and Reach 2 extends 0.3 miles above Coal Creek Parkway. Figure 6 includes typical habitat photos in Coal Creek.

Reach 1 (December 8, 2011)

Reach 2 (December 1, 2011)

Figure 6

Coal Creek Typical Habitat Photos from 2011

3.2 Survey Protocol

Polarized sunglasses were worn by surveyors to increase visibility, and all live and dead fish were recorded. When possible, streams were walked from downstream to upstream to improve salmon detection by the survey crew (Ames 1984). Surveys avoided walking on redds and disturbance of fish on redds. Surveys were not conducted if water conditions were dangerously high or fast; if turbidity impaired visual detection of fish; or upstream of migration blockages, especially on Richards Creek. If conditions permitted, all index reaches were sampled on a single survey date.

All observed salmon carcasses were retrieved and identified during each spawning ground survey. All carcasses were examined for the presence of external marks (tags or adipose fin-clip), then scanned for presence of a coded-wire tag (CWT) in the snout. If a fish was found to have an adipose fin-clip or a CWT, we considered it to be marked and of hatchery origin. Both postorbital to hypural plate (POH) and fork length (FL) were measured on carcasses to the nearest centimeter, sex was recorded, and females were examined for egg retention (termed spawning success). The body cavity was opened on females and checked for egg retention. Egg retention of 0 to 5 percent was assigned a 0, 6 to 25 percent was assigned to the 25 category, 26 to 50 percent was assigned to the 50 category, 51 to 75 percent was assigned to the 75 category, and 76 to 100 percent was assigned to the 100 category. The tail of each carcass was removed to ensure it would not be recounted during subsequent survey efforts.

Six scales were removed from each Chinook carcass to determine age. Scales were removed from the area several rows above the lateral line between the posterior end of the dorsal fin and the anterior insertion of the anal fin (INPFC 1963). Scales were mounted on gummed scale cards and read by WDFW staff at the Scale and Otolith Lab in Olympia, Washington. Age notation used the Gilbert-Rich system, with the total age noted normally, and the freshwater age represented as a subscript (Koo 1962). For the purposes of this report, we will use the total age without the freshwater subscript, since greater than 95 percent of the Chinook in the Cedar/Sammamish watershed spend less than one year rearing in freshwater. Although an attempt was made to collect all the data on all carcasses, carcasses were often either highly decomposed or preyed upon such that not all data could be collected from every carcass recovered during the various survey events. Redds were noted whenever encountered, and their location was recorded on a global positioning system (GPS) receiver. The location of redds was also marked with flagging to ensure redds are not counted again or disturbed during subsequent survey events. Due to the occurrence of sympatric salmon species, redds were positively identified by attending species, size of redd (if no attending species), and timing.

3.3 Data Analysis

There are several methods of generating escapement estimates, including using cumulative redd counts, determining the area under the curve (AUC) based on live counts, and using peak spawner counts to generate a relative abundance estimate. The AUC escapement method is dependent on an accurate estimate of fish stream residence time, which is generally lacking for the surveyed streams. Therefore, this report uses primarily the redd-based method to generate an escapement estimate by taking the total number of redds documented in each stream, and then multiplying that number by the average number of fish per redd. In this case, the spawning ground escapement, Er, is estimated by:

$$\text{Er} = R * \Phi$$

Where:

R is the total number of redds

Φ represents the average number of fish per redd

In the Cedar/Sammamish watershed, we assume that Φ is 2.5 with one female and 1.5 males per redd. The reason the ratio is 1.5 males per redd is to account for the fact that more than one male often fertilizes a single redd (Briggs 1953; Healey and Prince 1998; Berejikian et al. 2000).

3.4 Coho Pre-spawn Mortality Study

In 2011, the Ecotoxicology Program at the Northwest Fisheries Science Center, together with regional partners (including the City of Bellevue), investigated the phenomenon of adult coho salmon dying prematurely when they return to spawn in Puget Sound urban streams. These protocols provide guidance for conducting stream surveys to document the presence or absence of affected coho in urban and non-urban watersheds. When coho were documented in Coal Creek on November 21, 2011, we started surveying twice a week to implement the Coho Pre-spawn Mortality Survey Protocols (Appendix B). These protocols describe the equipment and methods used to determine and document coho pre-spawn mortality.

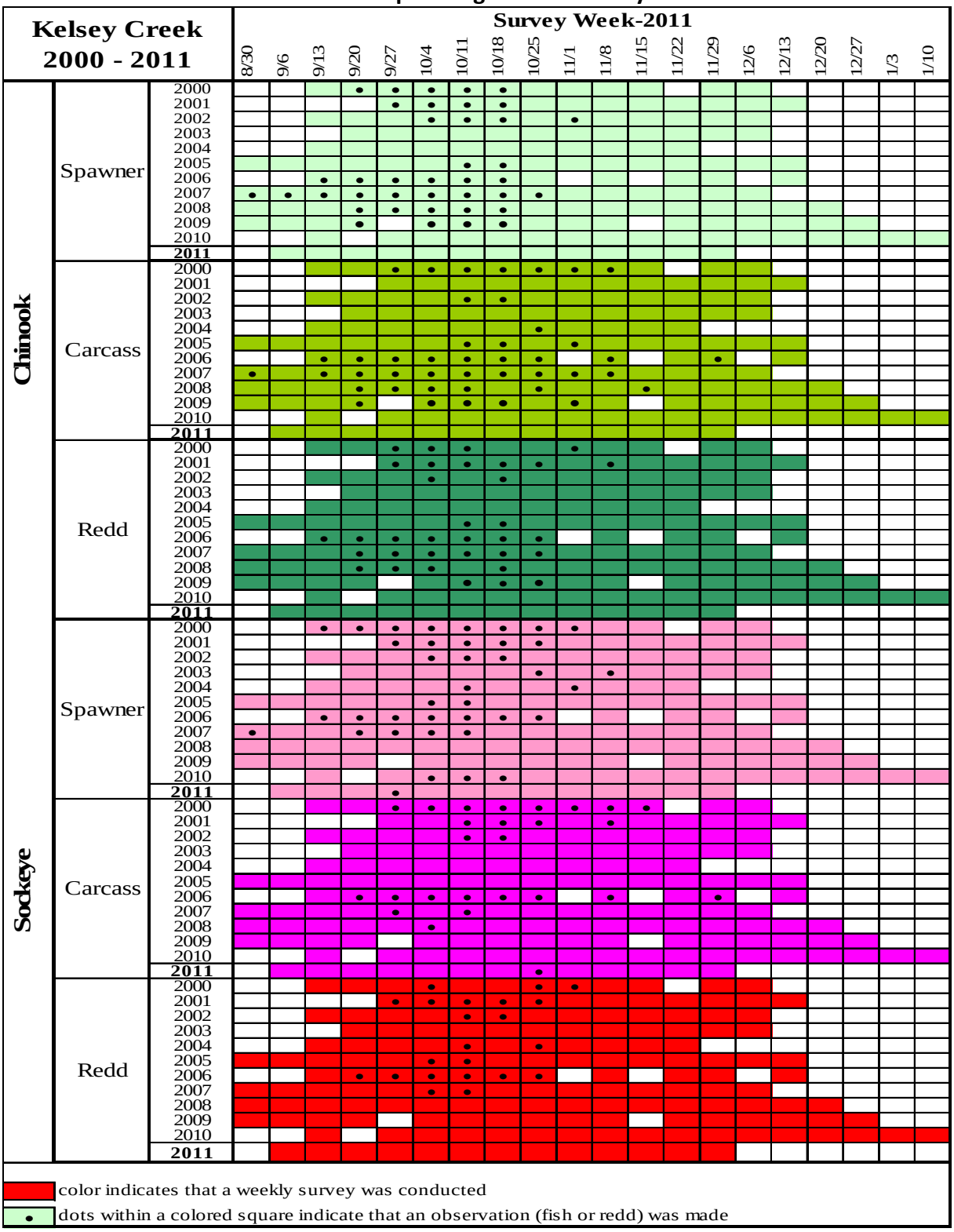
4 RESULTS

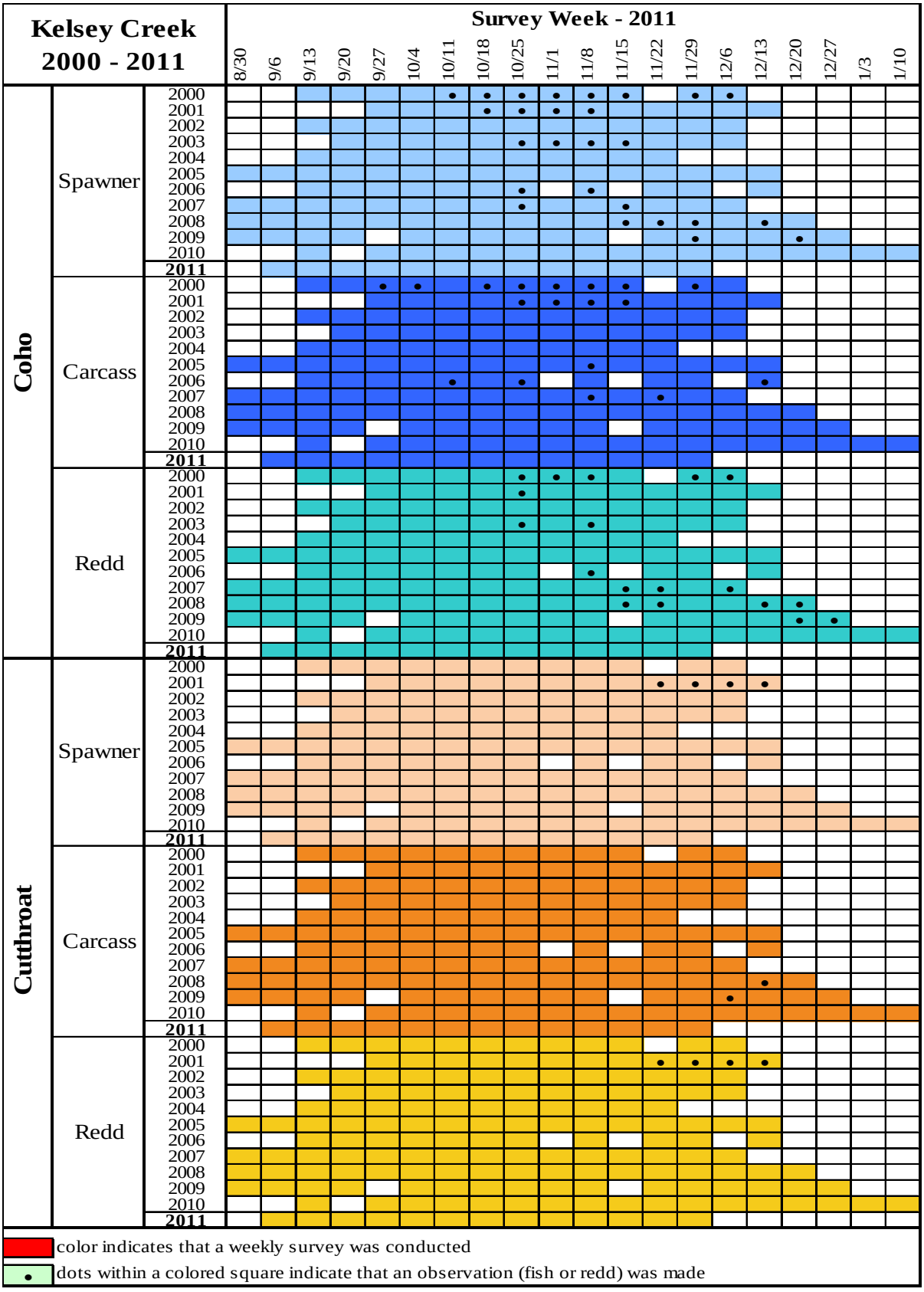
The City of Bellevue, King County, Washington Department of Fish and Wildlife, and numerous volunteers have been conducting salmon spawning surveys within various tributaries for over 10 years. Over this time period, the sampling frequency and number of streams surveyed has increased in order to improve the quality and quantity of data available to resource managers. The following report documents the salmon spawning results for 2011 within the mainstem of Kelsey Creek and its major tributaries (West Tributary and Richards Creek), and Coal Creek. Coal Creek has historically not been surveyed systematically over the entire spawning season. However, Coal Creek was surveyed weekly throughout the spawning season in 2010 and 2011.

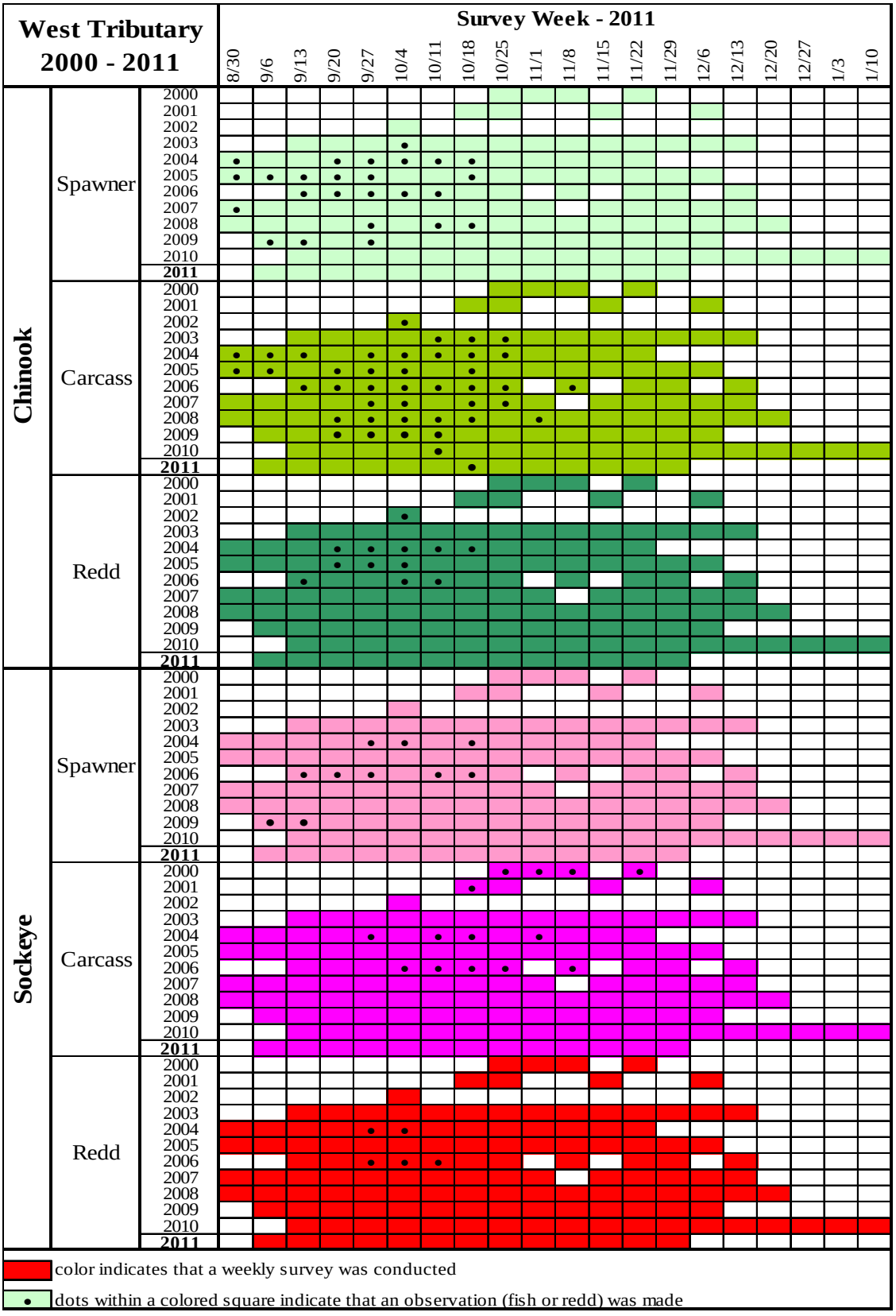
The level of survey effort, timing, and general results are summarized in Table 1. Survey conditions were mostly good to excellent in 2011, and survey accuracy is thought to be high.

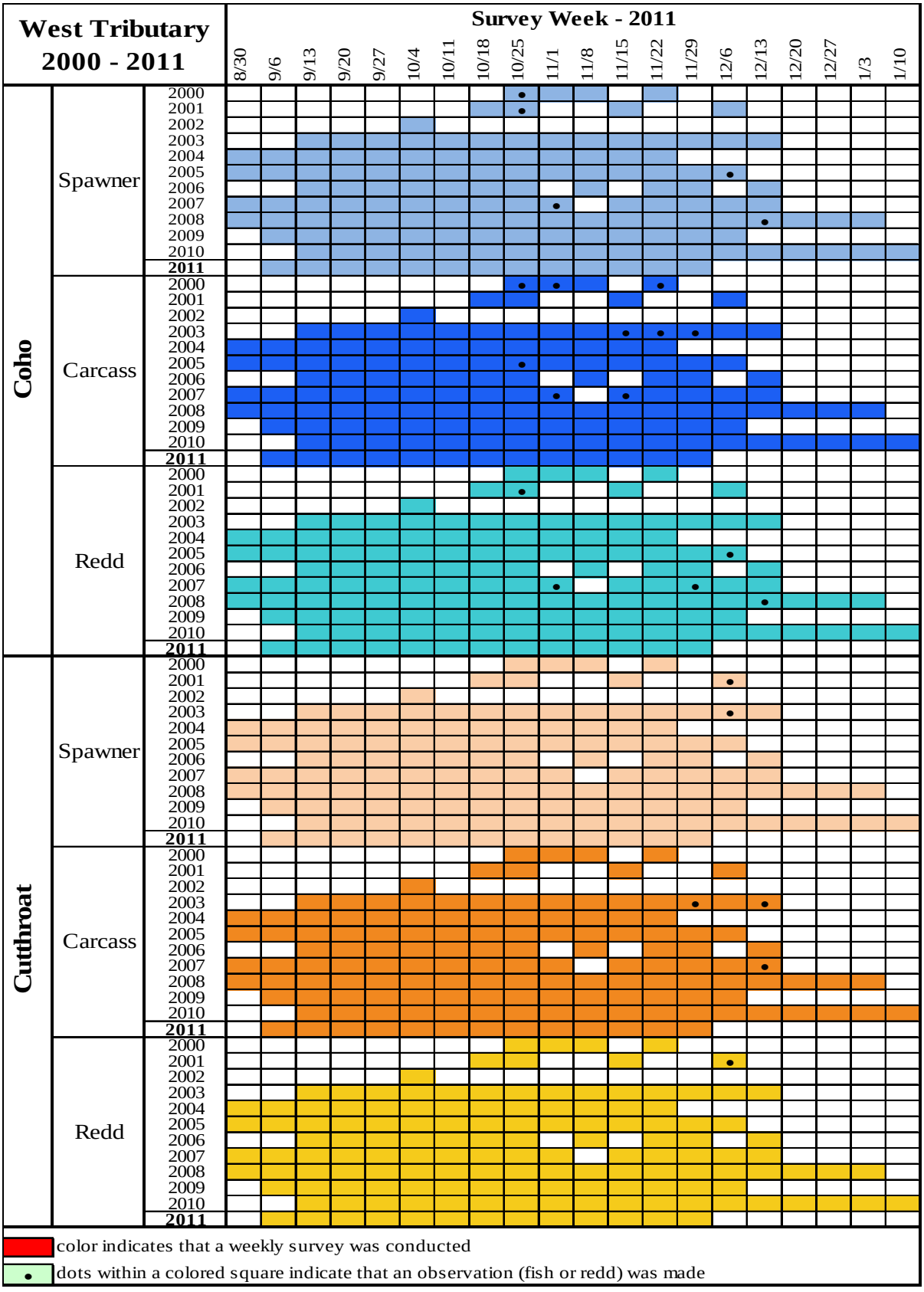
Surveys in the Kelsey and Coal Creek basins began on September 6, 2011, and continued until December 29, 2011. Results of the 2011 spawning ground surveys indicate that salmon use within the Kelsey Creek and Coal Creek basins was extremely low. A total of one sockeye spawner and carcass and one Chinook carcass were observed in the Kelsey Creek basin. The sockeye were observed in Kelsey Creek on September 19, 2011 (spawner) and October 28, 2011 (carcass), and the Chinook carcass was observed in Reach 1 of the West Tributary on October 17, 2011, while no salmon were documented in Richards Creek. No coho salmon or salmonid redds from any species were observed in the Kelsey Creek basin during 2011. Documented salmon use in Coal Creek during 2011 included seven coho spawners, one carcass, one redd, and one sockeye spawner. The coho salmon redd in Coal Creek was encountered in Reach 1 approximately 500 feet upstream from the new sediment pond at 125th Avenue SE.

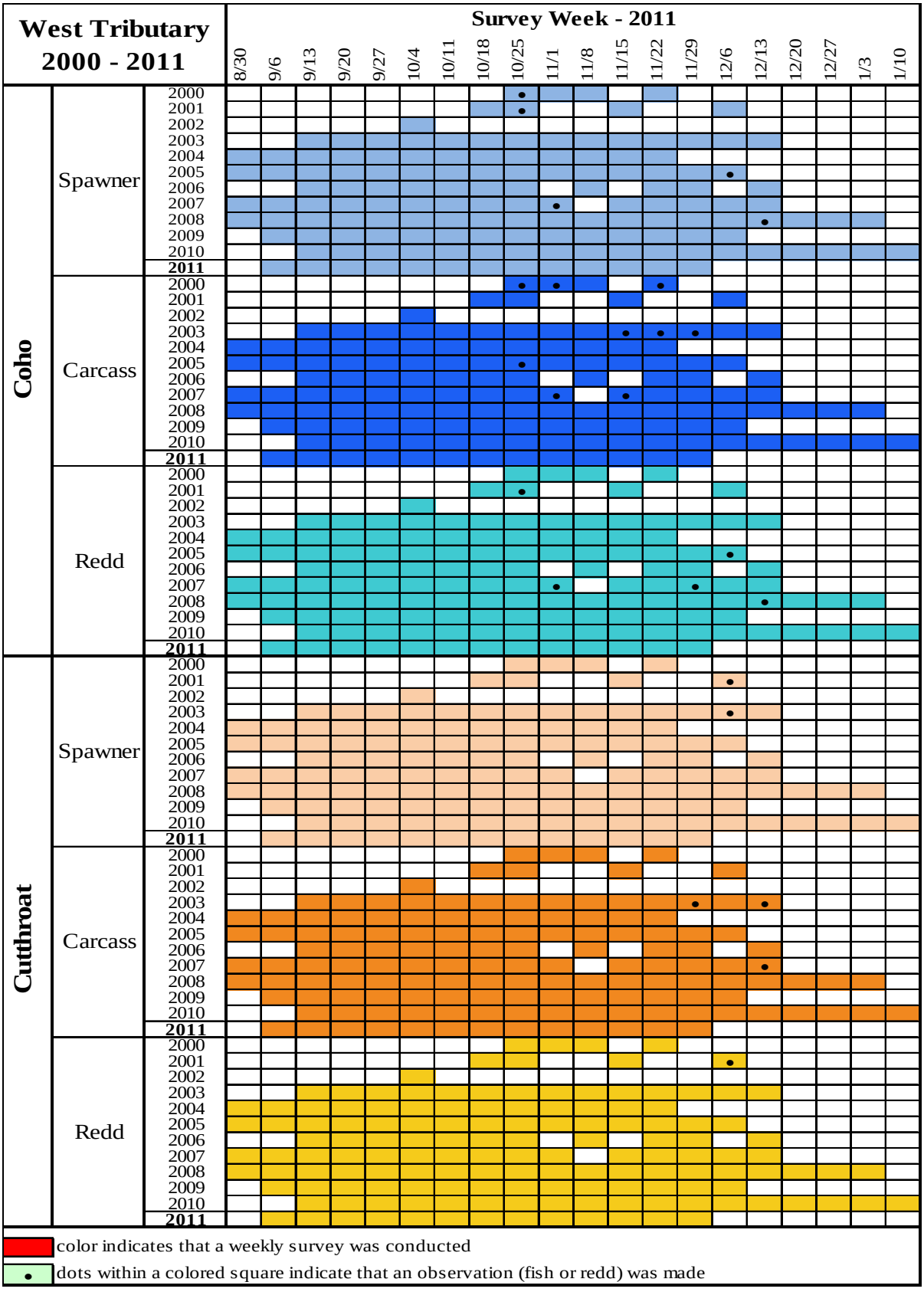
Table 1
2011 Spawning Ground Surveys




Kelsey Creek
2000 - 2011
Survey Week - 2011
8/30
9/6
9/13
9/20
9/27
10/4
10/11
10/18
10/25
11/1
11/8
11/15
11/22
11/29
12/6
12/13
12/20
12/27
1/3
1/10
Coho
Spawner
Carcass
Redd
Cutthroat
Spawner
Carcass
Redd
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
color indicates that a weekly survey was conducted
dots within a colored square indicate that an observation (fish or redd) was made


West Tributary
2000 - 2011
Survey Week - 2011
8/30
9/6
9/13
9/20
9/27
10/4
10/11
10/18
10/25
11/1
11/8
11/15
11/22
11/29
12/6
12/13
12/20
12/27
1/3
1/10
Chinook
Spawner
Carcass
Redd
Sockeye
Spawner
Carcass
Redd
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
color indicates that a weekly survey was conducted
dots within a colored square indicate that an observation (fish or redd) was made


West Tributary
2000 - 2011
Survey Week - 2011
8/30
9/6
9/13
9/20
9/27
10/4
10/11
10/18
10/25
11/1
11/8
11/15
11/22
11/29
12/6
12/13
12/20
12/27
1/3
1/10
Coho
Spawner
Carcass
Redd
Cutthroat
Spawner
Carcass
Redd
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
color indicates that a weekly survey was conducted
dots within a colored square indicate that an observation (fish or redd) was made


West Tributary
2000 - 2011
Survey Week - 2011
8/30
9/6
9/13
9/20
9/27
10/4
10/11
10/18
10/25
11/1
11/8
11/15
11/22
11/29
12/6
12/13
12/20
12/27
1/3
1/10
Coho
Spawner
Carcass
Redd
Cutthroat
Spawner
Carcass
Redd
2000
2001
2002
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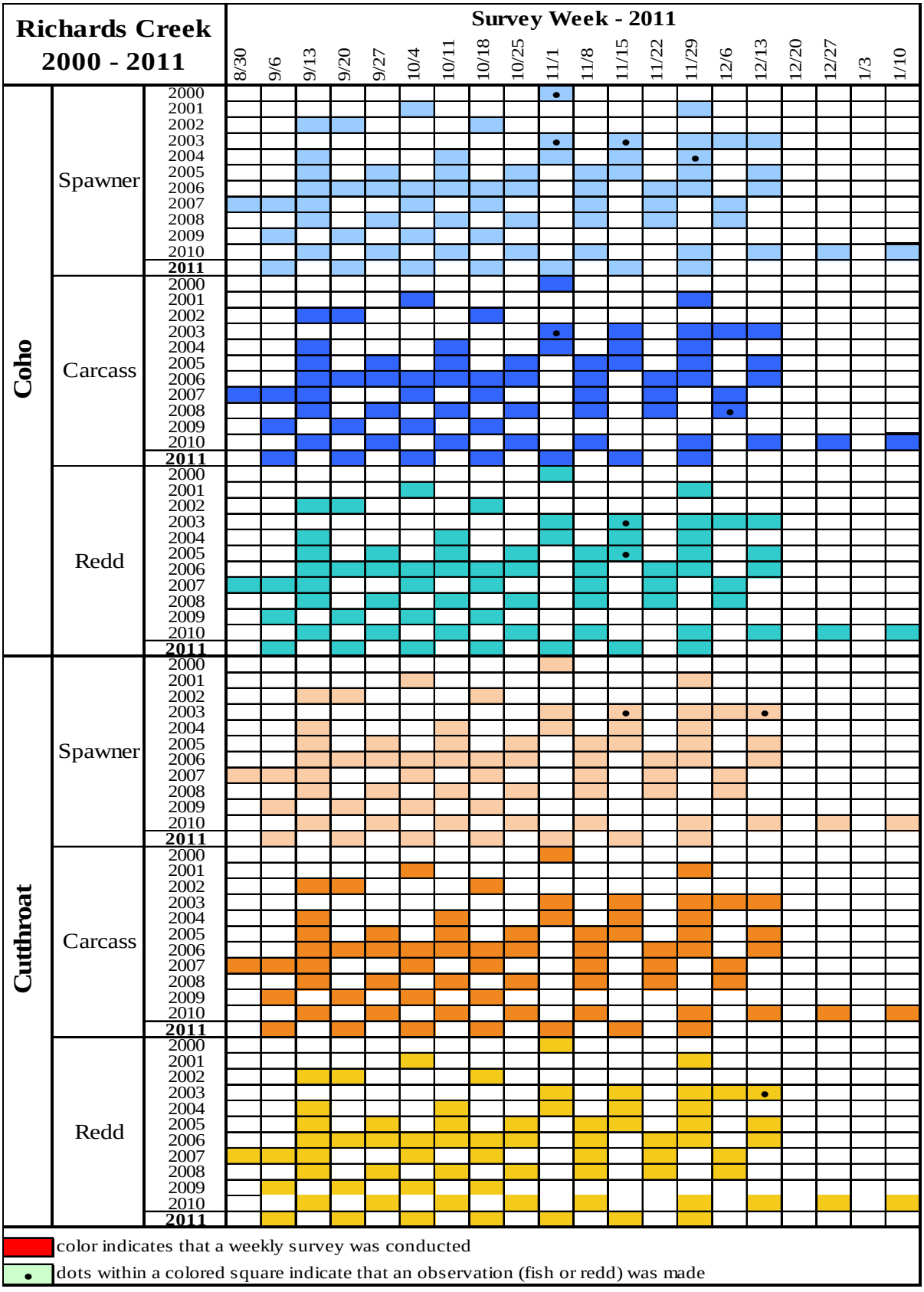
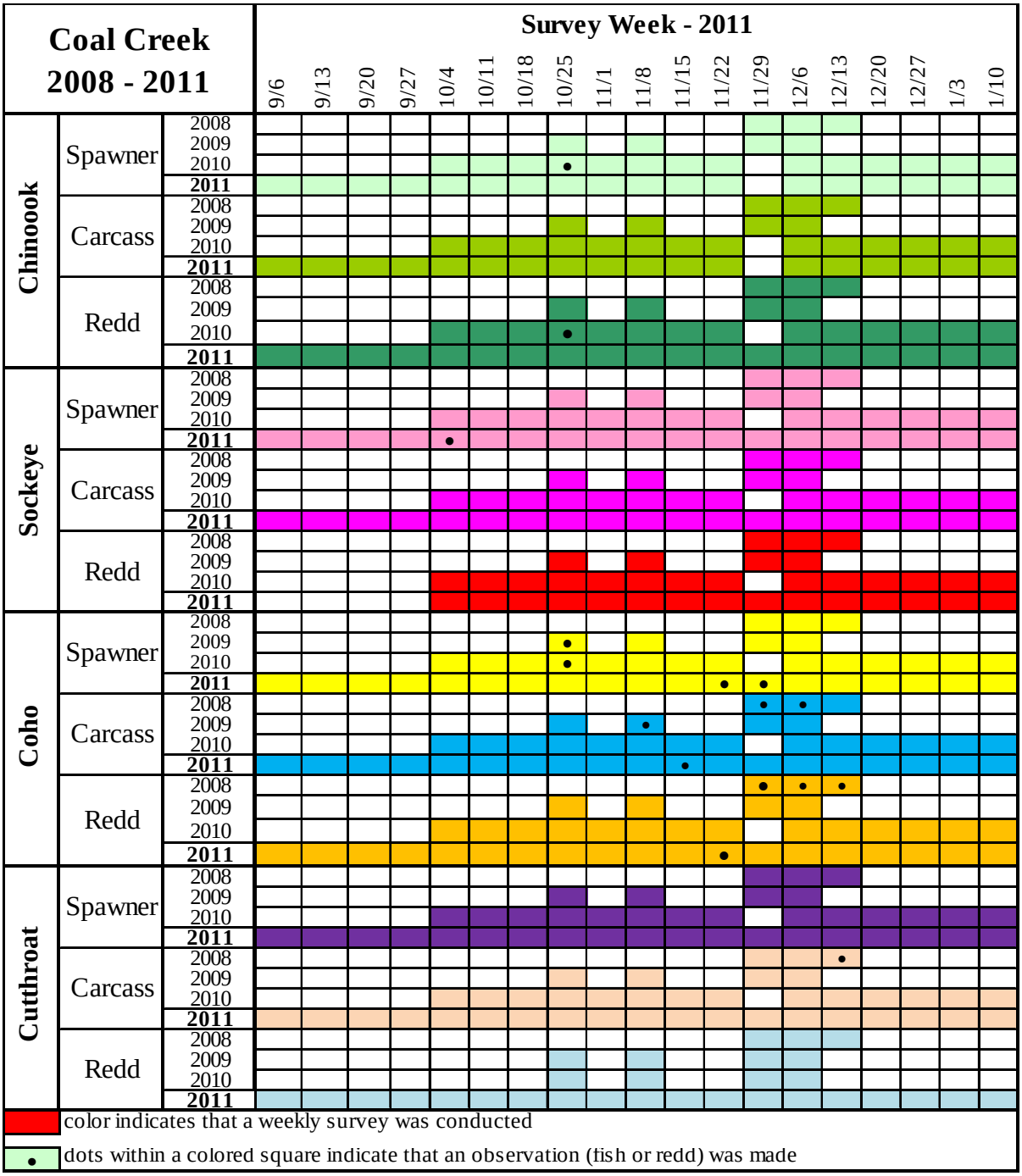
2004
2005
2006
2007
2008
2009
2010
2011
color indicates that a weekly survey was conducted
dots within a colored square indicate that an observation (fish or redd) was made


Richards Creek
2000 - 2011
Survey Week - 2011
8/30
9/6
9/13
9/20
9/27
10/4
10/11
10/18
10/25
11/1
11/8
11/15
11/22
11/29
12/6
12/13
12/20
12/27
1/3
1/10
Coho
Spawner
Carcass
Redd
Cutthroat
Spawner
Carcass
Redd
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
color indicates that a weekly survey was conducted
dots within a colored square indicate that an observation (fish or redd) was made


Coal Creek
2008 - 2011
Survey Week - 2011
9/6
9/13
9/20
9/27
10/4
10/11
10/18
10/25
11/1
11/8
11/15
11/22
11/29
12/6
12/13
12/20
12/27
1/3
1/10
Chinook
Sockeye
Coho
Cutthroat
Spawner
Carcass
Redd
2008
2009
2010
2011
color indicates that a weekly survey was conducted
dots within a colored square indicate that an observation (fish or redd) was made

4.1 Chinook Salmon

The only observation of Chinook during 2011 was a carcass on October 17, 2011, in Reach 1 of the West Tributary (Appendix A). This carcass apparently did not spawn due to predation and is recorded as a pre-spawn mortality (Table 2). Based on the available data, the redd-based escapement estimate for Chinook salmon in the Kelsey and Coal Creek basin during 2011 was zero.

Table 2
2011 Chinook Salmon Survey Summary

Stream	Total Surveys	Total Live Count	Total Carcass Count	Total Redd Count	Pre-spawn mortality	Redd-based Escapement Estimate
Kelsey	13	0	0	0	0	0
West Trib.	13	0	1	0	1	0
Richards Creek	7	0	0	0	0	0
Coal Creek	22	0	0	0	0	0
Total	55	0	1	0	1	0

The Chinook salmon carcass in the West Tributary was too mutilated to obtain sex, FL, POH, or age data.

4.2 Sockeye Salmon

Observations of sockeye salmon within the surveyed streams were limited to one spawner and carcass in Kelsey Creek and one spawner in Coal Creek (Table 3). No redds were observed during 2011. The Kelsey Creek spawner was documented on September 19, 2011, and the carcass was seen on October 28, 2011. The Coal Creek spawner was seen on October 4, 2011. Since no redds were observed, the redd-based escapement estimate for sockeye in all streams surveyed is zero.

Table 3
2011 Sockeye Salmon Survey Summary

Stream	Total Surveys	Total Live Count	Total Carcass Count	Total Redd Count	Pre-spawn mortality	Redd-based Escapement Estimate
Kelsey	13	1	1	0	1	0
West Trib.	13	0	0	0	0	0
Richards Creek	7	0	0	0	0	0
Coal Creek	22	1	0	0	0	0
Total	55	2	1	0	1	0

The sockeye spawners were located in Reach 5 of Kelsey Creek and Reach 1 of Coal Creek. These were individual fish that were unable to be sexed or checked for fin-clips. The Kelsey Creek carcass was a male 100 percent full of milt and apparently did not spawn. The carcass was found outside of the wetted channel by approximately 10 feet and there were no signs of predation. It is likely this fish was stranded outside the ordinarily wetted channel after high flows receded. This carcass may have had difficulty migrating upstream due to beaver dam blockages. There were at least three significant beaver dams across the main channel of Kelsey Creek in the Wetland Reach. Operation & Maintenance crews performed dam maintenance upon request to ensure fish passage.

4.3 Coho Salmon

No coho salmon were observed in Kelsey Creek, West Tributary, or Richards Creek during 2011 (Table 4). Two coho salmon, one male and one female, were documented in Coal Creek on November 21, 2011, in Reach 1 and these fish were actively building a redd. The redd was approximately 500 feet upstream of the new sediment pond at 125th Ave SE at latitude 47°33'43.06" North by longitude 122°10'14.35" West.

Table 4
2011 Coho Salmon Survey Summary

Stream	Total Surveys	Total Live Count	Total Carcass Count	Total Redd Count	Pre-spawn mortality	Redd-based Escapement Estimate
Kelsey	13	0	0	0	0	0
West Trib.	13	0	0	0	0	0
Richards Creek	7	0	0	0	0	0
Coal Creek	22	7	1	1	0	2.5
Total	55	7	1	1	0	2.5

Five coho spawners were seen on December 1, 2011, approximately 500 feet downstream of the new sediment pond. One carcass was reported on October 15, 2011. Only the head of the carcass was recovered so no sex, lengths, or age data was obtained. The five spawners from December 1, 2011, consisted of two jacks, one male, and two females.

4.4 Cutthroat Trout

Although spawning cutthroat trout are occasionally observed in Kelsey and Coal Creeks, none were observed during 2011. Cutthroat spawning is believed to occur later in winter and early spring. Observations of large cutthroat spawners and carcasses occurred during salmon spawner surveys in 2001, 2008, and 2009. These fish are likely anadromous or adfluvial life history types (Wydoski and Whitney 2003). Resident or juvenile cutthroat trout are the most abundant salmonid species collected during past and recent annual electrofishing sampling in the surveyed streams (Ludwa et al. 1996). Based on the shear density of cutthroat inhabiting the Kelsey and Coal Creek basins, it is obvious that habitat conditions are conducive to reproduction and spawning is successful. This is a common observation in urbanized creeks in Puget Sound.

5 DISCUSSION

5.1 Spawning Escapement

In 2011, salmon spawning escapement (redd-based) for the Kelsey Creek basin was estimated at zero Chinook, zero sockeye, and zero coho. Although one Chinook carcass and one sockeye spawner were observed, no redds were recorded during 13 surveys of Kelsey Creek and the West Tributary and seven surveys of Richards Creek. Similar low to no escapements of these species were documented during 2003, 2004, and 2010 (Figure 7).

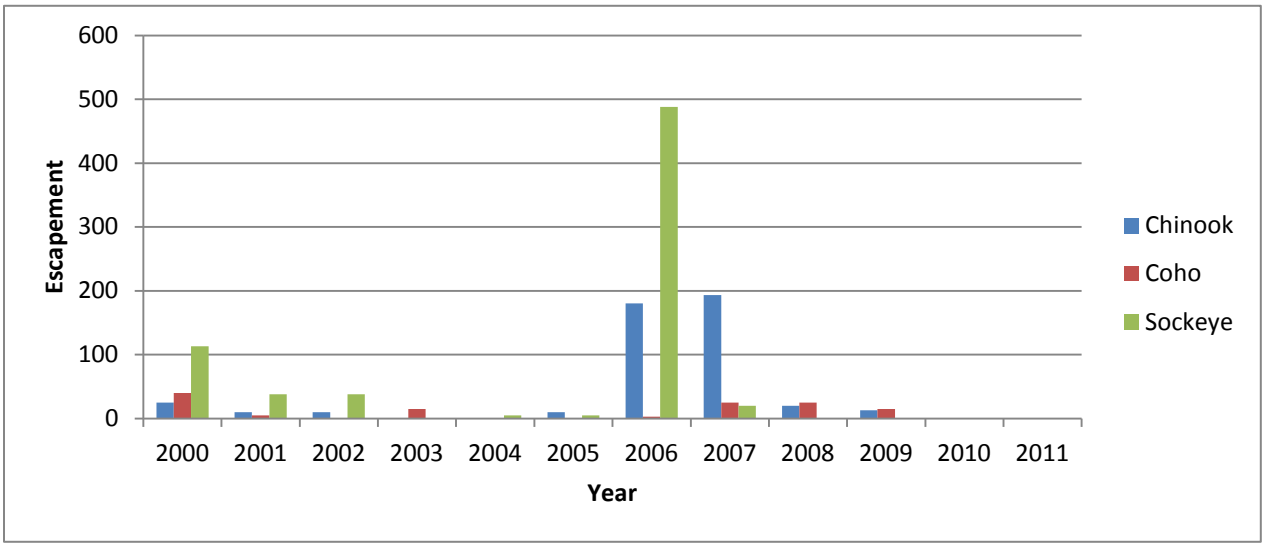


Figure 7
Kelsey Creek Salmon Redd-based Escapement

Chinook salmon escapement in the Kelsey Creek basin is typically below 20, while the arithmetic mean is approximately 42. The mean of 42 is skewed due to high escapement estimates in 2006 and 2007 that ranged from 180 to 193. The median data for the 12 years of Chinook escapement estimates is 10. This number is less skewed by outlier years when looking at the 12 years of data (Figure 8).

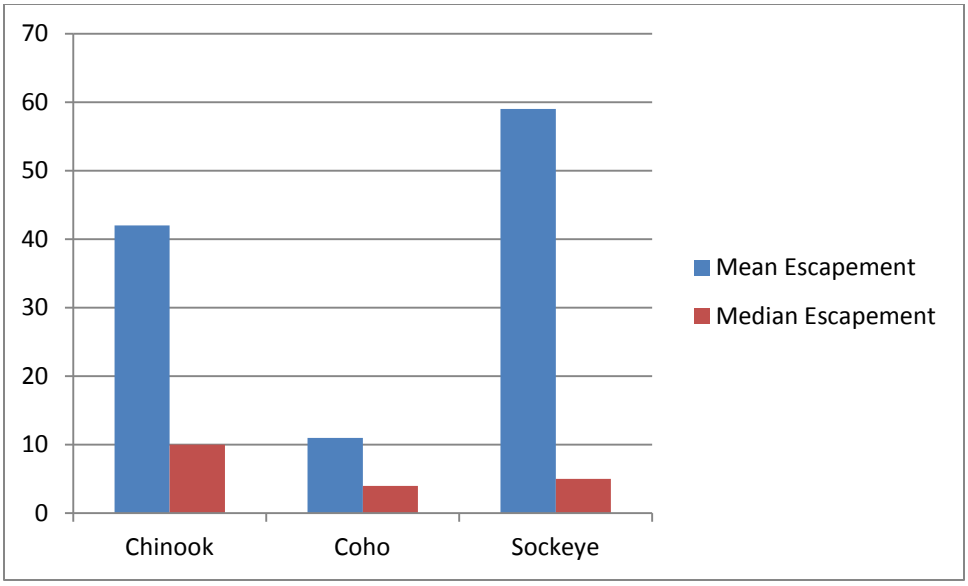


Figure 8
Mean and Median Escapement in Kelsey Creek from 2000 through 2011.

coho salmon escapement in the Kelsey Creek basin is variable and ranged from zero in 2002, 2004, 2005, 2010, and 2011 to a peak of 40 during 2000. The arithmetic mean is 11 and the median is 4.

Sockeye salmon escapement is also variable, ranging from zero in 2003, 2008, 2009, 2010, and 2011 to a peak of 488 in 2006 and 178 in 2000. Based on the available data from 2000 through 2011, the arithmetic mean escapement for sockeye salmon in Kelsey Creek is approximately 59, while the mean passing through the Chittenden Locks during this same time period is 240,516. The median data for the 12 years of sockeye escapement estimates to Kelsey Creek is 5. This number is less skewed by outlier years (i.e., 2006) when looking at the 12 years of data.

The total number of Chinook salmon counted going through the Chittenden Locks during 2011 was 4,904, close to the low recorded in 2000 of 4,451, and well below the past 11 year average of 12,867 (see Figure 9). Chinook escapement in Kelsey and Coal basins were not expected to be very high. Beaver dams may have hindered fish passage, but carcasses or holding fish would have been observed in the vicinity of the beaver dams if the numbers of migrating Chinook were high. The absence of coho salmon in the Kelsey basin and low

numbers in Coal basin were not anticipated because twice as many fish passed the Chittenden Locks in 2011 over 2010. The 2011 total coho salmon count as measured at the Chittenden Locks was 7,858. There is no apparent reason why coho were absent from the Kelsey Creek drainage this year and low in Coal Creek. Although beaver dams were present in the lower reaches of Kelsey, West Tributary, and Richards Creeks, it is unlikely the beaver dams hindered fish passage as carcasses or holding fish would have been observed in the vicinity of the beaver dams if there were significant numbers of fish attempting to move upstream. Sockeye salmon numbers were also very low. The 2011 total sockeye salmon count as measured at the Chittenden Locks was 43,724. This is the third lowest year on record since 2000.

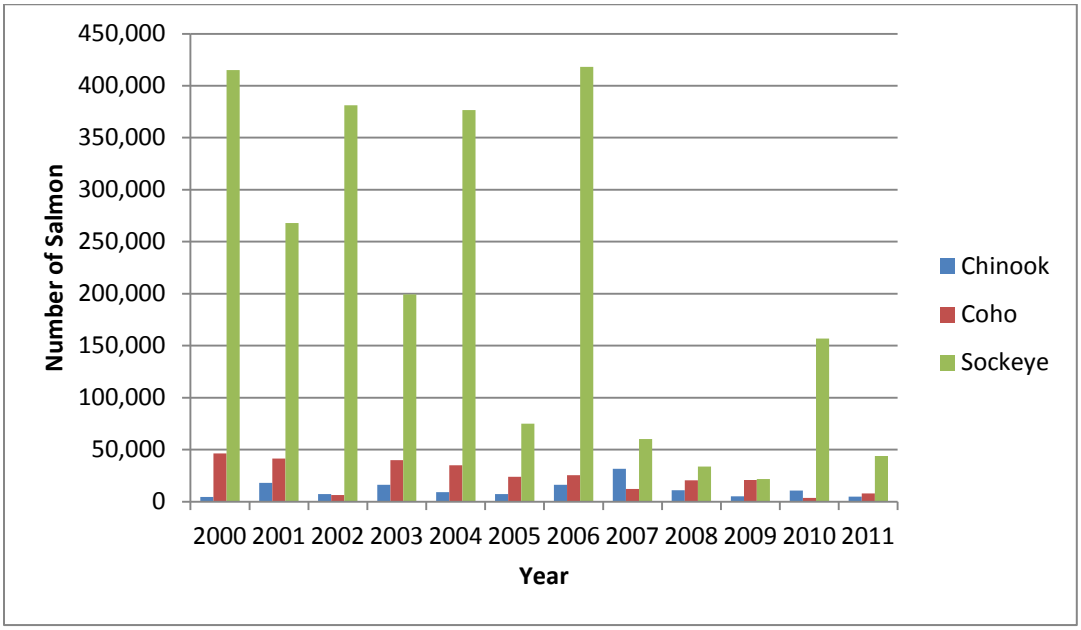


Figure 9
Chinook, Coho, and Sockeye Salmon Counts from the Chittenden Locks from 2000 through 2011

5.2 Redd Distribution

Since no redds were documented in the Kelsey basin during 2010 or 2011, a brief history of the redd distribution within Kelsey Creek is presented. Chinook salmon redd distribution within the mainstem Kelsey Creek from 2000 through 2009 varied in location and concentration. The use of Reach A for spawning spiked in 2006, when a total of 14 Chinook

redds were counted (Figure 10). However, Reach A surveys began in 2003 and gravel movement into this reach may have made it more conducive to spawning. The most observed Chinook redds were observed in Reach 7 in 2007; however, the reach has not been regularly used for salmon spawning even though there are favorable habitat conditions (i.e., larger stream buffer and more vegetation cover). The distribution of Chinook salmon redds in mainstem Kelsey Creek during 2009 was restricted to the lower most reaches, which was unlike previous years.

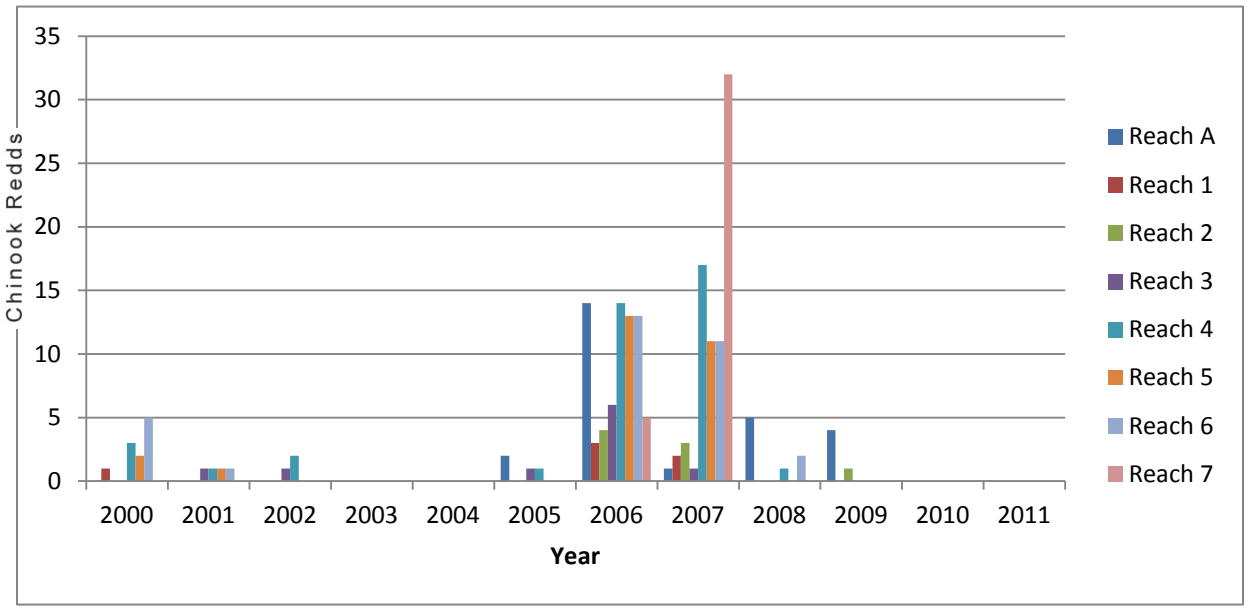


Figure 10
Yearly Kelsey Creek Chinook Salmon Redd Distribution by Reach from 2000 through 2011

The overall presence of Chinook redds in Kelsey Creek Reaches since 2000 has predominately occurred in Reaches 4, 6, and 3, and to a lesser extent in Reaches A and 5 (see Figure 11). These reaches are located on private lands with the exception of Reach A, which is located within the City of Bellevue's Kelsey Creek Farm Park. Chinook spawning in Reaches 1, 2, and 7 has been limited for all survey years. This may be due to a combination of issues such as inadequate flow velocities, gravel sizes, lack of cover/pools, or other issues.

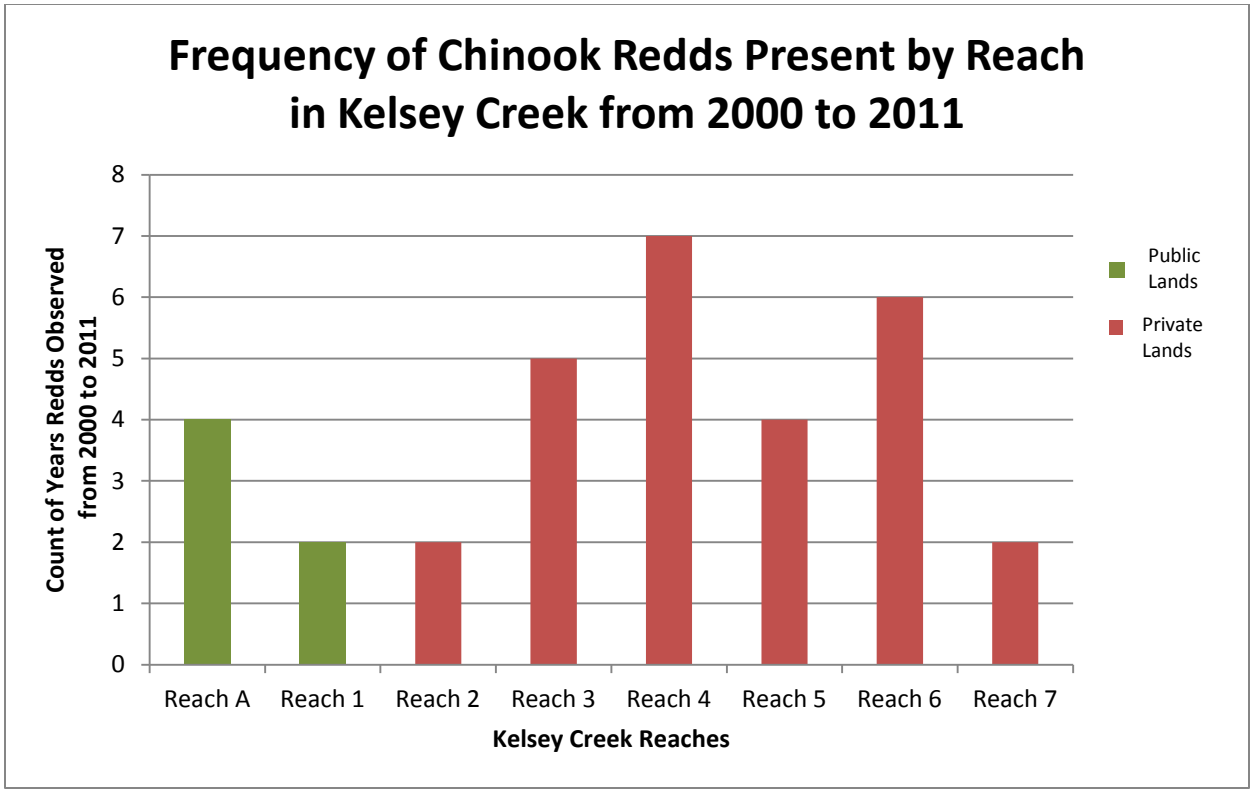


Figure 11
Frequency of Kelsey Creek Chinook Salmon Redd Present by Reach from 2000 through 2011

Since spawning surveys began in Coal Creek in 2008, very few Chinook or sockeye salmon have been observed and none have previously been documented upstream of I-405 with the exception of one Chinook in 2010. The documentation of a Chinook salmon redd at approximately RM 0.32 in Coal Creek during the 2010 survey was the first documented spawning upstream of I-405. Chinook and sockeye salmon have likely always spawned upstream of I-405, but recently, salmon spawning surveys in Coal Creek have been conducted earlier in the season, more frequently, and over longer distances which is providing additional information on the abundance and distribution of Chinook and sockeye within the Coal Creek basin.

coho salmon were the most abundant species in Coal Creek in 2011 and historically (Figure 12). The 2011 escapement for coho salmon based on one redd in Reach 1 is 2.5 spawners.

However, we counted a total of seven coho spawners and one carcass during the surveys. The one documented coho redd was located approximately 500 feet upstream of the new sediment pond at 125th Avenue SE.

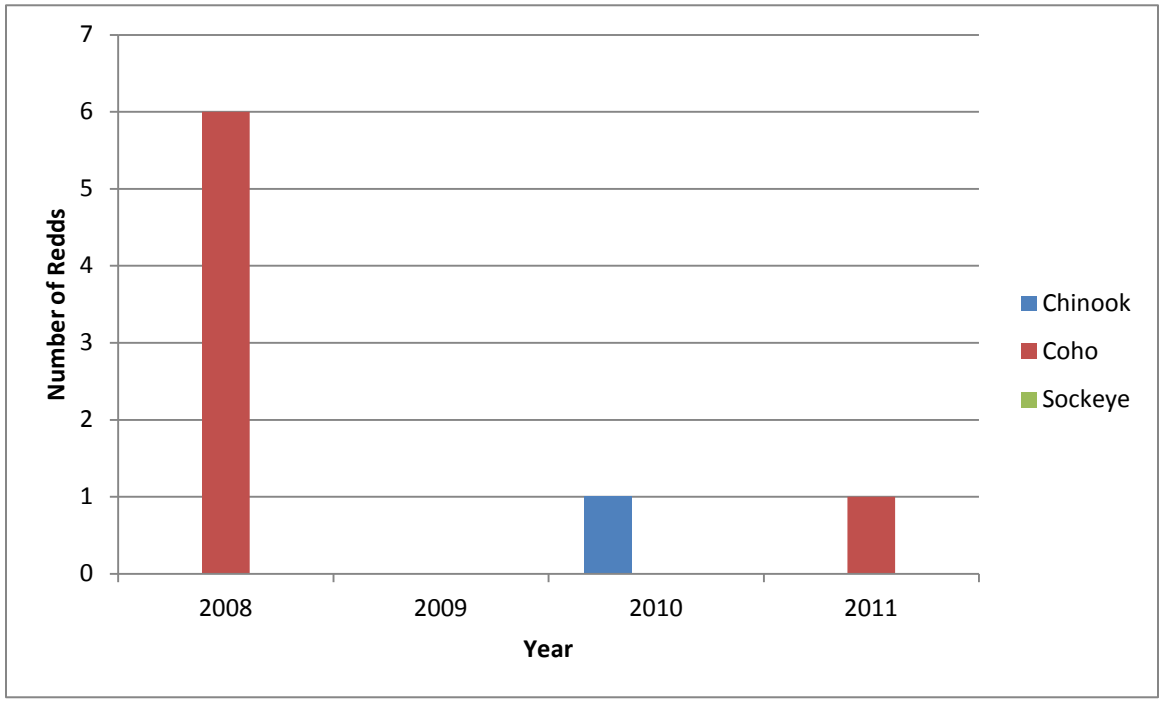


Figure 12
Coal Creek Redds 2008 to 2011

5.3 Wild/Hatchery Origin and Gender

Hatchery Chinook and coho salmon are adipose fin-clipped before being released into the wild. Due to the extent of predation on carcasses found in 2011, adipose fins could not be examined and no data on hatchery origin versus natural production is available. In past years, a large percentage of the Chinook salmon observed in Kelsey Creek were of hatchery origin (DEA 2010; DEA 2011; and Watershed Company 2009). For instance, a total of 20 Chinook salmon carcasses were observed during 2009 in the Kelsey Creek basin. Eleven were clipped, two were not clipped, and seven were unknown due to predation or decomposition. Based on 13 carcasses being in good enough condition to determine origin, 85 percent were of hatchery origin and 15 percent presumed natural origin.

A historical comparison based on the percentage clipped, unclipped, and unknown origin Chinook for the mainstem Kelsey Creek from 2005 through 2011 is outlined in Figure 13.

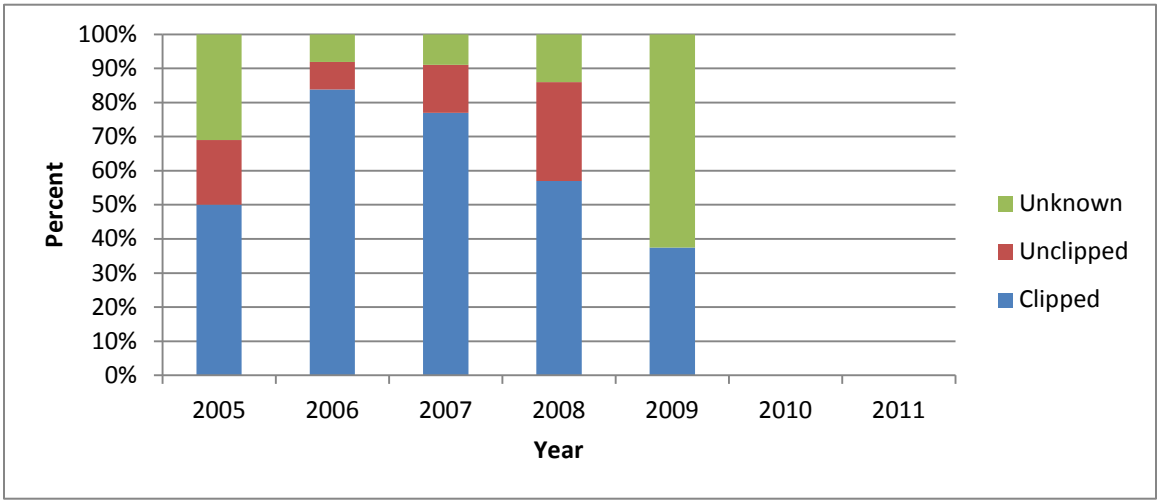


Figure 13
Chinook Salmon Origin (Percentage) in Mainstem Kelsey Creek

In general, a high percentage of returning Chinook in Kelsey Creek were of hatchery origin. These fish were likely strays from the other hatcheries in the Cedar/Lake Washington basin. For instance, the 2006 and 2007 returns of Chinook through the locks were high and the percent of clipped Chinook in Kelsey Creek was also high. The amount of available high quality spawning habitat in the Cedar/Lake Washington basin is limited and when salmon escapement is high competition for space forces some fish to spawn in lower quality habitat.

The fin-clips or sexes of the sockeye spawners in Kelsey and Coal Creek or the Chinook carcass in the West Tributary could not be determined in 2011. In Coal Creek four males (57 percent) and three females (43 percent) were observed in 2011. This percent of males is slightly larger than the numbers observed in the past in the West Tributary (Table 5). Whether the coho observed in Coal Creek in 2011 were clipped could not be determined.

Table 5
Relative Abundance of Male and Female Salmonids in West Tributary

Species	Year	Total Observed	Male	Female
Chinook	2003	6	33%	67%
	2004	81	30%	70%
	2005	40	43%	58%
	2006	59	49%	51%
	2007	7	33%	67%
	2008	16	50%	50%
	2009	5	40%	60%
	2010	1	100%	0%
	2011	1	unknown	unknown
Sockeye	2003	0	NA	NA
	2004	10	30%	70%
	2005	0	NA	NA
	2006	37	35%	65%
	2007	0	NA	NA
	2008	0	NA	NA
	2009	0	NA	NA
	2010	0	NA	NA
	2011	0	NA	NA
Coho	2003	2	50%	50%
	2004	0	NA	NA
	2005	2	0%	100%
	2006	1	0%	100%
	2007	3	33%	67%
	2008	0	NA	NA
	2009	0	NA	NA
	2010	0	NA	NA
	2011	0	NA	NA

5.4 Pre-spawn Mortality

Each year, in the Kelsey and Coal Creek basins (as in other urban streams), a number of salmon experience pre-spawn mortality; that is, they die before they spawn. Female salmon that die before they spawn typically have 100 percent egg retention, unless subject to predation or decomposition. Inspection of female carcasses is typically done to determine pre-spawn mortality, but male pre-spawn mortality is not tracked because it is difficult to determine by carcass inspection. Some pre-spawn mortality may be missed because surveys

are only conducted once per week. This year, an additional survey was added to Coal Creek once the coho salmon were documented there. This survey was specifically added to document symptoms related to unknown cause of coho salmon pre-spawn mortality in urban streams (Appendix B). We did not observe any of these symptoms in 2011.

In 2011, there were two cases of pre-spawn mortality in Kelsey Creek, one sockeye and one Chinook. The sockeye appeared to be stranded due to beaver dam impacts. The Chinook was preyed upon. In 2009, the last year with a significant number of returning Chinook, a total of five female Chinook carcasses were recovered. The overall rate of pre-spawn mortality for Chinook in 2009 was 33 percent (DEA 2011). In recent years in the Kelsey Creek basin, pre-spawn mortality is frequently observed below the beaver dams where adult salmon become stranded in the dam debris while attempting to pass the structure. The stranded fish then become easy prey for opportunistic predators such as river otters, coyotes, or raccoons. The dams also act as a choke-point that, depending on flow, will result in some salmon holding below the dam until higher flows improve upstream passage. This may result in an ideal situation for predators to feed upon adult salmon congregated below the dams.

For purposes of comparison, Chinook pre-spawn mortality in the Cedar River ranged from 1.5 percent in 2003, 3 percent in 2004, and 0.8 percent in 2005 (Berge et al. 2006). Pre-spawn mortality in Bear Creek ranged from 8 percent in 2003, 4 percent in 2004, and 6.5 percent in 2005. Pre-spawn mortality in Issaquah Creek ranged from 23 percent in 2003 to 22.7 percent in 2005. Bellevue rates of pre-spawn mortality are higher, perhaps due to the small number of fish (i.e., small sample size), passage barriers, and urban water quality.

5.5 Conclusions and Recommendations

The results of the 2011 salmonid spawning surveys indicate production of anadromous salmonids in the Kelsey Creek and Coal Creek basins was low for all species. 2011 marks the second year in a row when there was no salmon escapement to the Kelsey Creek basin and the third year with low returns for the Coal Creek basin. A similar situation occurred between 2003 through 2005 in the Kelsey Creek basin when there was a very small

escapement of salmon. This low period of salmon escapement was followed by two of the largest escapements of salmon in 2006 and 2007 in the Kelsey Creek basin.

There is not a strong correlation between salmon use of the Kelsey Creek basin for spawning and the total number of adults returning to the Cedar-Sammamish Watershed. In most years, the salmon return counts between the Locks and at Kelsey Creek basin are highly variable. Although, the largest returns for sockeye and Chinooks to pass through the Locks since 2000 mirror the peak returns for Kelsey Creek basin (i.e., sockeye in 2006 and Chinook in 2007 [compare Figures 7 and 9]). The variability could be a function of random hatchery fish straying during low to average year's escapements and competition for space in other parts of the basin during years with high escapements past the Chittenden Locks.

Other factors likely contribute to the low abundance of salmon in the Kelsey basin, including (Kerwin 2001):

- Fine sediment levels in spawning gravels can be as high as 39 percent
- Large woody debris (LWD; less than 17 pieces per mile), pool frequency (less than 13 pools per mile), and floodplain connectivity (less than 25 percent) all serve to limit salmonid productivity
- A multispectral analysis of riparian buffers found approximately 18 percent impervious surface within 50 feet of Kelsey Creek
- Storm peak flows in Kelsey Creek have increased 2 to 3 times from historic levels
- Stream water temperatures and the presence of pesticides may limit the natural

Beaver dam passage barriers are a concern in the lower reaches of the Kelsey Creek basin. Beaver dams contribute to fish passage problems, adult salmon migration delays, and increased predation of salmon. However, beaver dams are beneficial to salmon and create pools that form habitat for aquatic species, control flooding and erosion, improve water quality by reducing downstream suspended sediment, and raise water tables (Johnson 2001). The beaver problem exists and there is no easy solution, but ultimately the beaver population is beneficial to the Kelsey Creek system. In general, the use of pond leveling devices has had moderate success in controlling water levels and maintaining fish passage in existing beaver ponds in the Kelsey Creek Basin. Included with the habitat restoration efforts (discussed

above), the pond-leveling device is the best mechanism currently available to ensure fish passage. Dam removal has proven to be only a very short-term solution. A long-term solution should include stormwater management efforts that work towards returning flow regimes from urban flow conditions to more natural flow conditions. A natural flow regime will gradually return to the base flow rate after storm peaks and will allow salmon an opportunity to pass across beaver dams, thus reduce stranding.

Despite the low returns of salmon over the past two years, suitable habitat for salmon species and cutthroat exists in the Kelsey and Coal Creek basins. An ongoing metric in the performance of habitat restoration in the basin is the health and production of salmon. Based on the findings of this report and the need to monitor salmon populations as a gauge of habitat restoration success, the following recommendations are proposed:

1. Continue annual salmon spawner surveys. Conduct surveys two times per week in the Kelsey and Coal Creek basins during coho salmon spawn timing, per National Oceanic and Atmospheric Administration (NOAA) and U.S. Geological Survey (USGS) recommendations for documenting pre-spawn mortality. The twice weekly frequency documented more coho spawners that may have been missed with less frequent surveys. Work with USGS and NOAA on identifying pre-spawn mortality issues and solutions.
2. Map beaver dam location, condition, and document if they are potential barriers. This task needs to be done early in the summer before Chinook and sockeye return. Install beaver pond levelers where necessary.
3. Continue stream habitat enhancement efforts focusing on reducing fine sediment and summer temperatures, improving riparian habitat and channel complexity, and restoring natural flow and biological processes.
4. Continue improving access for both adult and juvenile fish resources by removing or fixing migration barriers.
5. Conduct thorough stream habitat surveys and monitor flow conditions. The purpose of these surveys should be to increase knowledge of existing conditions and guide future restoration efforts.
6. Work with WDFW and WRIA 8 to implement out-migrant surveys to determine actual productivity of Kelsey Creek.

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APPENDIX A
SALMON SPAWNER SURVEY DATA

Table A-1
2011 Bellevue Stream Survey Data

		Sockeye Live	Sockeye Dead	Sockeye Redds	Chinook Live	Chinook Dead	Chinook Redds	Coho Live	Coho Dead	Coho Redd	Other Live	Other Dead	Other Redd
Kelsey Creek													
	September 2011 total	1	0	0	0	0	0	0	0	0	0	0	0
	October 2011 total	0	1	0	0	0	0	0	0	0	0	0	0
	November 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	December 2011 total												
	Survey Total	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
West Tributary													
	September 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	October 2011 total	0	0	0	0	1	0	0	0	0	0	0	0
	November 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	December 2011 total												
	Survey Total	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Richards													
	September 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	October 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	November 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	December 2011 total												
	Survey Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Coal													
	September 2011 total	0	0	0	0	0	0	0	0	0	0	0	0
	October 2011 total	1	0	0	0	0	0	0	0	0	0	0	0
	November 2011 total	0	0	0	0	0	0	2	1	1	0	0	0
	December 2011 total	0	0	0	0	0	0	5	0	0	0	1	0
	Survey Total	**1**	**0**	**0**	**0**	**0**	**0**	**7**	**1**	**1**	**0**	**1**	**0**

Table A-2
2011 Bellevue Stream Survey Data--Kelsey Creek

Survey Date	Stream	Stream Code	Reach Description	RM Start	RM Stop	Reach	Sockeye Live	Sockeye Dead	Sock Redds	Chinook Live	Chinook Dead	Chinook Redds	Coho Live	Coho Dead	Coho Redd	Other Live	Other Dead	Other Redd	Weather	Flows	Riffles	Pools	Crew	Comments
9/6/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	T.Parra	Silty
9/6/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	T.Parra	Silty
9/6/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	T.Parra	
9/6/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	T.Parra	
9/6/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	T.Parra	
9/6/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	T.Parra	
9/6/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Numerous 0+ Trout and coho
9/6/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	As above, small Excellentcluded area for installed weirs
9/12/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Silty
9/12/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Silty
9/12/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	
9/12/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	
9/12/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	
9/12/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	
9/13/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Numerous 0+ Trout and coho
9/13/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	L.Jeroue	As above, small excluded area for installed weirs
9/19/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	Silty
9/19/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	Silty
9/19/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	
9/19/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	
9/19/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	1	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	
9/19/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	
9/19/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Numerous 0+ Trout and coho
9/19/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	As above, small Excellentcluded area for installed weirs
9/26/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	J.Parr	Silty
9/26/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	J.Parr	Silty
9/26/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	J.Parr	
9/26/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	J.Parr	
9/26/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	J.Parr	
9/26/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	J.Parr	
9/26/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Poor	Poor	L.Jeroue	Numerous 0+ Trout and coho
9/26/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Rainy	Medium	Excellent	Excellent	L.Jeroue	As above, small Excellentcluded area for installed weirs
10/3/2011	Kelsey	8.0259	Wetland	2.4	3	KSY-W	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Good	J. Shannon/K. Jensen	Reed Canary grass is thick in places. Beaver dams abundant and in need of maintenance.
10/3/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silty
10/3/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silty
10/3/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	
10/3/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Poor	J.Parr	
10/3/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Poor	J.Parr	
10/3/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Poor	J.Parr	
10/3/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	M.Reeder	
10/3/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	M.Reeder	
10/10/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Low	Very Good	Good	J.Parr	Silty
10/10/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Low	Very Good	Good	J.Parr	Silty
10/10/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Low	Very Good	Good	J.Parr	
10/10/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Low	Very Good	Fair	J.Parr	
10/10/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Low	Very Good	Poor	J.Parr	
10/10/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Low	Very Good	Poor	J.Parr	
10/11/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Medium	Fair	Poor	J.Parr	
10/11/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Rain	Medium	Fair	Poor	L.Jeroue	
10/17/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
10/17/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
10/17/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
10/17/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Fair	J.Parr	
10/17/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Poor	J.Parr	
10/17/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Poor	J.Parr	
10/17/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Fair	M.Reeder	
10/17/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Fair	M.Reeder	
10/24/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	J.Parr	
10/24/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	J.Parr	
10/24/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	J.Parr	
10/24/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	J.Parr	
10/24/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	J.Parr	
10/24/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	J.Parr	
10/24/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	M.Reeder	
10/24/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Poor	Poor	M.Reeder	
10/25/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	repeated, 10/24 vis was<50%
10/25/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/25/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/25/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	

Table A-2
2011 Bellevue Stream Survey Data--Kelsey Creek

Survey Date	Stream	Stream Code	Reach Description	RM Start	RM Stop	Reach	Sockeye Live	Sockeye Dead	Sock Redds	Chinook Live	Chinook Dead	Chinook Redds	Coho Live	Coho Dead	Coho Redd	Other Live	Other Dead	Other Redd	Weather	Flows	Riffles	Pools	Crew	Comments
10/25/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/25/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/25/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	M.Reeder	
10/25/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	M.Reeder	
10/28/2011	Kelsey	8.0259	Wetland	2.4	3	KSY-W	0	1	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, K.Jensen	Male sockeye mort full of milt. Out of OHWM by a few feet.
10/28/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Shannon, K.Jensen	
10/28/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Shannon, K.Jensen	
10/28/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Shannon, K.Jensen	
10/28/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Shannon, K.Jensen	
10/28/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Shannon, K.Jensen	
10/28/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Shannon, K.Jensen	
10/31/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/31/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/31/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/31/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/31/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/31/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	J.Parr	
10/31/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	M.Reeder	
10/31/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	High	Excellent	Good	M.Reeder	
11/7/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	J.Parr	
11/7/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	J.Parr	
11/7/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	J.Parr	
11/7/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	J.Parr	
11/7/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	J.Parr	
11/7/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	J.Parr	
11/7/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	M.Reeder	
11/7/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Good	M.Reeder	
11/15/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
11/15/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
11/15/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
11/15/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
11/15/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
11/15/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Good	J.Parr	
11/15/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Medium	Excellent	Good	M.Reeder	
11/15/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Medium	Excellent	Good	M.Reeder	
11/21/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	L.Jeroue	
11/21/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	L.Jeroue	
11/28/2011	Kelsey	8.0259	Reach A	3	3.2	KSY-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	Weather was sunny; roughly low 40s 'F. Water visibility was decent, 90% in the shallows and 70% in the deepest portions of the weir pools.
11/28/2011	Kelsey	8.0259	Reach 1	3.2	3.4	KSY-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	
11/28/2011	Kelsey	8.0259	Reach 2	3.4	3.6	KSY-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	
11/28/2011	Kelsey	8.0259	Reach 3	3.6	3.8	KSY-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	
11/28/2011	Kelsey	8.0259	Reach 4	3.8	4	KSY-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	
11/28/2011	Kelsey	8.0259	Reach 5	4	4.3	KSY-6	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	
11/28/2011	Kelsey	8.0259	Reach 6	4.4	5.1	KSY-7	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				L.Jeroue	
11/28/2011	Kelsey	8.0259	Reach 7	5.1	5.8	KSY-8	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				L.Jeroue	

Table A-3
2011 Bellevue Stream Survey Data--West Tributary

Survey Date	Stream	Stream Code	Reach Description	RM Start	RM Stop	Reach	Sockeye Live	Sockeye Dead	Sock Redds	Chinook Live	Chinook Dead	Chinook Redds	Coho Live	Coho Dead	Coho Redd	Other Live	Other Dead	Other Redd	Weather	Flows	Riffles	Pools	Crew	Comments
9/7/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Silt/fine substrate, lots of rip veg
9/7/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Silty slough, lots of rip veg
9/7/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Park restoration zone, gravels apparent, embeddedness
9/7/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Golf course, mostly open waterway, some gravels.
9/7/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Travels through very urban area, peoples back yards. Gravels much better shape up here.
9/12/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Silt/fine substrate, lots of rip veg
9/12/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Silty slough, lots of rip veg
9/12/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Park restoration zone, gravels apparent, embeddedness
9/12/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Golf course, mostly open waterway, some gravels.
9/12/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Excellent	Excellent	J.Parr	Travels through very urban area, peoples back yards. Gravels much better shape up here.
9/19/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Very Good	L.Jeroue	Silt/fine substrate, lots of rip veg
9/19/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Silty slough, lots of rip veg
9/19/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Park restoration zone, gravels apparent, embeddedness
9/19/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Golf course, mostly open waterway, some gravels.
9/19/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Travels through very urban area, peoples back yards. Gravels much better shape up here.
9/27/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silt/fine substrate, lots of rip veg
9/27/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	L.Jeroue	Silty slough, lots of rip veg
9/27/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	L.Jeroue	Park restoration zone, gravels apparent, embeddedness
9/27/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	L.Jeroue	Golf course, mostly open waterway, some gravels.
9/27/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Travels through very urban area, peoples back yards. Gravels much better shape up here.
10/4/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silt/fine substrate, lots of rip veg
10/4/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silty slough, lots of rip veg
10/4/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Park restoration zone, gravels apparent, embeddedness
10/4/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Golf course, mostly open waterway, some gravels.
10/4/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Travels through very urban area, peoples back yards. Gravels much better shape up here.
10/10/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silt/fine substrate, lots of rip veg
10/10/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Silty slough, lots of rip veg
10/10/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Park restoration zone, gravels apparent, embeddedness
10/10/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Golf course, mostly open waterway, some gravels.
10/10/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	J.Parr	Travels through very urban area, peoples back yards. Gravels much better shape up here.
10/17/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	1	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	J.Parr	Parts of the lower portion were dry. The two dams restricting a lot of what little flow there was.
10/17/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Fair	M.Reeder	
10/17/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	M.Reeder	
10/17/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	M.Reeder	
10/17/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	M.Reeder	
10/25/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Good	J.Parr	hummocks in the mid reach of R1 are still blocking flow
10/25/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Very Good	Fair	L.Jeroue	
10/25/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Very Good	Very Good	L.Jeroue	
10/25/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Very Good	Very Good	L.Jeroue	
10/25/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	M.Reeder	
11/1/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Good	J.Parr	Noticeable improvement in flow conditions in the lowest portions of R1.
11/1/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Very Good	Fair	J.Parr	New beaver dams (3) constructed in the narrow channel portions below the old collapsed pump house structure.
11/1/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Very Good	Very Good	J.Parr	
11/1/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Very Good	Very Good	J.Parr	
11/1/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	J.Parr	
11/7/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Good	J.Parr	
11/7/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Fair	M.Reeder	
11/7/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Very Good	M.Reeder	
11/7/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Very Good	M.Reeder	
11/7/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0						
11/15/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Good	L.Jeroue	
11/15/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Fair	L.Jeroue	
11/15/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	L.Jeroue	
11/15/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Very Good	L.Jeroue	
11/15/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0						
11/21/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/21/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	L.Jeroue	
11/21/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	L.Jeroue	
11/21/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	L.Jeroue	
11/21/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Fair	Fair	J.Parr	
11/28/2011	W. Trib	8.0264	Swamp/Rip zone	0	0.3	KWT-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	Weather was sunny; roughly low 40s 'F. Water visibility was good, 100% in the shallows and 70% in the deeper areas, pretty strong flows.
11/28/2011	W. Trib	8.0264	Lower half of park	0.3	0.5	KWT-2	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				L.Jeroue	
11/28/2011	W. Trib	8.0264	Upper half of park	0.5	0.7	KWT-3	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				L.Jeroue	
11/28/2011	W. Trib	8.0264	Golf course	0.7	0.9	KWT-4	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				L.Jeroue	
11/28/2011	W. Trib	8.0264	Golf course to NE 8th	0.9	1.3	KWT-5	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	

Table A-4
2011 Bellevue Stream Survey Data--Richards Creek

Survey Date	Stream	Stream Code	Reach Description	RM Start	RM Stop	Reach	Sockeye Live	Sockeye Dead	Sock Redds	Chinook Live	Chinook Dead	Chinook Redds	Coho Live	Coho Dead	Coho Redd	Other Live	Other Dead	Other Redd	Weather	Flows	Riffles	Pools	Crew	Comments
9/9/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Very brushy, meanders through constrained clay banks, then opens up into beaver pond slough
9/20/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr/L.Jeroue	
10/4/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Very Good	Very Good	J.Parr/L.Jeroue	
10/18/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	
11/1/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0					J.Parr	
11/15/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0						
11/28/2011	Richards	8.0261	Confluence	0	0.3	RICH-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				J.Parr	

Table A-5
2011 Bellevue Stream Survey Data--Coal Creek

Survey Date	Stream	Stream Code	Reach Description	RM Start	RM Stop	Reach	Sockeye Live	Sockeye Dead	Sock Redds	Chinook Live	Chinook Dead	Chinook Redds	Coho Live	Coho Dead	Coho Redd	Other Live	Other Dead	Other Redd	Weather	Flows	Riffles	Pools	Crew	Comments
9/6/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	J.Parr	Lots of silt, scour of weir structure holding steady, trash rack clean.
9/13/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Excellent	L.Jeroue	Lots of silt, scour of weir structure holding steady, trash rack clean.
9/20/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Fair	J.Parr	Lots of silt, scour of weir structure holding steady, trash rack clean.
9/27/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Good	Fair	L.Jeroue	Lots of silt, scour of weir structure holding steady, trash rack clean.
10/4/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	1	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Low	Good	Good	J.parr	
10/11/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	poor	Poor	J.parr	
10/18/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Medium	Very Good	Fair	J.parr	
10/25/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Very Good	Fair	J.parr	
11/1/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Very Good	L.Jeroue	
11/8/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny	Low	Excellent	Very Good	L.Jeroue	
11/15/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	1	0	0	0	0	Sunny	Low	Excellent	Very Good	M.Reeder	
11/21/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	2	0	1	0	0	0	Cloudy	Medium	Poor	Poor	J.Parr	A coho pair on a redd was detected upstream of the settling pond.
11/28/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Sunny				L.Jeroue	Weather was sunny; low 40s' F. Water visibility was good, 80% on riffles, 80% in pools and glides throughout the survey, with moderate flows.
12/1/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	5	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, K.Jensen	Coho spawners: 2 jack, 1 male, 2 female. No prespawn mort symptoms. No redds.
12/1/2011	Coal	8.0268	Coal Crk Parkway to footbridge	1.7	2	Coal-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, K.Jensen	
12/5/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0						
12/8/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, J.Parr	Wide riparian buffer in places. High fine sediment %.
12/12/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0						
12/15/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, J.Parr, McCrink	Light rain. Fingerling trout in pool below foot bridge.
12/19/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0						
12/22/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, McCrink	Light recent rain. No sign of fish.
12/22/2011	Coal	8.0268	Coal Crk Parkway to footbridge	1.7	2	Coal-2	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, McCrink	
12/26/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	1	0						
12/29/2011	Coal	8.0268	I-405 to Coal Creek Parkway	0.8	1.7	Coal-1	0	0	0	0	0	0	0	0	0	0	0	0	Cloudy	Medium	Good	Good	J.Shannon, J.Parr	

APPENDIX B
SURVEY INSTRUCTIONS

Coho Pre-Spawn Mortality Study
Survey Instructions

The Ecotoxicology Program at the Northwest Fisheries Science Center, together with regional partners, is investigating a phenomenon of adult coho salmon dying prematurely when they return to spawn in Puget Sound urban streams. This document provides guidance for conducting stream surveys to document the presence or absence of affected coho in urban and non-urban watersheds. If questions arise regarding these procedures, please contact Steve Damm (206-302-2464; Steve_Damm@fws.gov) and Barbara French (206-860-3452; Barbara.French@noaa.gov).

EQUIPMENT LIST

Coho PSM Survey Worksheets/clipboard/pencils/pens
Spawning knife
Serrated knife for tail removal to avoid "double counting" on subsequent surveys
Tape measure
Camera (if available) to take digital photos of dead fish and video of live symptomatic fish
Rain gear, boots, waders, gloves

DEFINITIONS / STREAM SURVEYING INSTRUCTIONS

Live Symptomatic Fish display various behaviors including gaping (opening/closing mouth rapidly), lying on the bottom of the stream, swimming with head out of the water, loss of equilibrium, fin splaying, and spasms. Record information on the Coho PSM Survey Worksheet as instructed below; be sure to assign a FISH ID# and note the appearance and behavior of the symptomatic fish. If possible, collect digital video to document the symptomology and designate an associated filename on worksheet. Video documentation of symptomatic fish is very valuable, both for male and female spawners.

Our definition of **Pre-Spawn Mortality** is an adult coho female found dead in a stream with a high degree of egg retention (> 50%; see representative photo below) and no obvious alternative causes of death, such as overt lesions or other indicators of poor physical condition, evidence of predation, or evidence of fish becoming trapped and dewatered in side channel habitats. Record information on the Coho PSM Survey Worksheet; be sure to assign a FISH ID# and record the % egg retention. Also check the appropriate box if the carcass shows evidence of predation (or scavenging), and describe this in the notes.

Post-Spawn Mortality is an adult coho female that has successfully spawned (no or little egg retention) and died. Record information on the Coho PSM Survey Worksheet.

Dead Males. Dead males are recorded, but are not used to calculate rates of overall spawner mortality because it is generally difficult to determine whether or not a male has spawned successfully. Therefore, mark the spawning status of males as "unknown" (UNK) on the Coho PSM Survey Sheet. Collect and record all other information for dead males just as you would for dead females on the Coho PSM Survey Worksheet.

THE COHO PSM SURVEY WORKSHEET

Please follow directions listed below to complete the Coho PSM Survey Worksheet. Each stream survey should have its own worksheet (one worksheet per day per site).

1. Record the **DATE**.
2. Record the **SITE.** Site is the stream name (e.g. Curley Creek).
3. Record the **SURVEYOR'S NAME.**
4. Record the **SPECIES**. For example, coho, chum, etc.
5. Record the **FISH ID#**. The number assigned to each fish (1, 2, 3, etc.). Both live symptomatic and dead fish should receive FISH ID numbers.
6. Record the **SEX**. M = male, F = female, UNK = unknown
7. Record the **FORK LENGTH** in centimeters. This measurement is from the tip of the nose to the indent of the tail.
8. Record whether or not **ADIPOSE FIN** is present. Y = yes, N = no.
9. **SPAWNING CONDITION.** Check one of the following:
    - Pre-spawn **(PSM)** for females with eggs.
    - Post-spawn **(POST)** for females that are spawned out..
    - **(UNK)** for males or if you cannot determine the spawning condition of a female.
10. **% EGG RETENTION**. If you have a female with eggs, choose from 0-50% or 50-100%. See picture for guidance.
11. **PREDATION?** Be sure to fill in this box on the worksheet. Y=yes, N=no. If a fish has been preyed upon, it cannot be used as a data point in the coho pre-spawn mortality study due to the fact that the fish's death may have been caused by predation.
12. If digital pictures or videos are taken of live or dead fish, identify the filename in the column headed **"PICTURE OR VIDEO?"**
13. Record your observations. Take **NOTES** on the general appearance of the fish (i.e. bright or dark, external fungus, signs of disease, etc.).

Representative example of an adult coho female spawner affected by the pre-spawn mortality phenomenon. The carcass was found in a stream during a daily survey with nearly 100% egg retention. This fish was otherwise in good physical condition.