

Table 1. Fish use survey schedule 2004

Date	Survey Type	Habitat	Water temperature <sup>1</sup> (°C)	Estimated visibility <sup>2</sup>	Mean discharge <sup>3</sup> (cfs)
July 29	Snorkel (reconnaissance)	Mainstem (units #1–42)	ND	ND	814
August 5	Snorkel	Mainstem (units #1–23)	16.1–25.5 (MS#3, 23)	15–25 feet	665
August 11	Snorkel	SCC side channel network	14.3–24.1 (SBA, SCC3)	15–25 feet	707
August 12	Snorkel	Mainstem (units #24A–48)	18.4–22.3 (MS#48)	20–25 feet	676
August 17	Snorkel	SCB side channel network	15.6–29.0 (SCB1)	15–25 feet	595
September 6	Snorkel	Mainstem (units #49–74)	14.3–16.6 (MS#53, 58B)	20 feet	1376
September 30	Spawning	Mainstem (units #1–74); SCB	ND	20–25 feet	1432
October 11	Spawning	Mainstem (units #1–74); SCA, SCB, SCC	ND	10–15 feet	2444
November 9	Spawning	Mainstem (units #1–74); SCA, SCB, SCC	12 (MS#58D)	5–10 feet	3597
November 13	Snorkel	Mainstem (subsample)	6.7 (MS#3)	5–15 feet	2581
December 1	Spawning	SCD side channel network*	ND	ND	3304
December 20	Snorkel	Mainstem below unit #74 and SCD side channels**	ND	ND	—
December 27	Snorkel	SCC side channels (subsample – night)	4.2–6.7 (SCC1, SCC)	5–10 feet	2231
December 28	Snorkel	SCC side channels (subsample – day)	2.4–7.2 (SCC1, SCC)	10–20 feet	2046

<sup>1</sup>Site of temperature measurements indicated in parentheses. MS#, mainstem habitat unit number; other listed sites are side channels (cf. Figs 2, 5, 7).

<sup>2</sup>The maximum distance at which adult fish could be identified. For all snorkel surveys, an effective visibility of 10 feet was used to calculate fish densities (see Methods).

<sup>3</sup>Average discharge in Skykomish River mainstem on date of survey; data from USGS gage 12134500.

\*An attempt was also made on this date to survey spawning activity in mainstem habitat units adjacent to side channel network SCD (i.e. below the mouth of the Sultan River; Skykomish rm 33–34.5), but poor visibility precluded the collection of redd and carcass data.

\*\*Snorkel survey could not be performed due to poor visibility.

ND, no data collected.

Table 2. Proportional allocation subsampling protocol for seasonal mainstem snorkel survey (after EPA, 2002).

	<b>River Segment I</b> Gold Bar (habitat unit #1) to Startup (habitat unit #48)				<b>River Segment II</b> Startup (habitat unit #49) to Sultan (habitat unit #74)			
	Pool	Rifle	Glide	Total (S)	Pool	Rifle	Glide	Total (S)
Total count (H):	8	22	19	49	9	11	7	27
% Total <sup>1</sup> :	16.3	44.9	38.8	100.0	33.3	40.7	25.9	100.0
Number of units to subsample <sup>2</sup> (n):	13				7			
Sampling fraction <sup>3</sup> (F):	0.263				0.263			
Subsample count <sup>4</sup> (I):	2	6	5		2	3	2	
% subsample total <sup>5</sup> :	15.7	47.1	39.3		27.5	41.3	27.5	
Randomly selected units for subsample survey:	#23 #31	#41 #9 #43 #1 #26 #18	#21 #34 #48 #44 #10		#58A #68	#59 #73 #69	#70+71 #56	

$$^1 \frac{H}{S} \times 100.$$

$$^2 \frac{S}{R} \times N \text{ (closest integer).}$$

$$^3 \frac{n}{S}.$$

$$^4 H \times F \text{ (closest integer).}$$

$$^5 \frac{I}{n} \times 100.$$

H, number of habitat units within a given unit type; S, number of habitat units within river segment; R, number of habitat units within entire study reach (rm 34.5–43.3); N, number of habitat units to be subsampled within entire study reach (selected as 20 for fall 2004 subsample survey).

Note that the total number of mainstem units surveyed during summer 2004 (76) exceeds the number assigned to the most downstream unit in the study reach (#74). This discrepancy reflects the division of certain adjacent but distinct units using alphanumeric codes (e.g. #24A and #24B; cf. Fig. 3).

Table 3. Side channel snorkel-survey sites and habitat unit count

Network	Channel	Summer 2004 (day)				Winter 2004 (day)				Winter 2004 (night)			
		Pool	Riffle	Glide	Total	Pool	Riffle	Glide	Total	Pool	Riffle	Glide	Total
SCB	SCB	3	2	2	7	ND				ND			
	SCB1	8	7	0	15	ND				ND			
SCC	SCC	7	3	0	10	3	0	0	3	1	0	0	1
	SCC1	3	0	0	3	1	0	0	1	1	0	0	1
	SCC3	7	0	0	7	7	0	0	7	3	0	0	3
	SBA	3	1	0	4	2	1	0	3	2	1	0	3
	SBA1	1	1	0	2	ND				ND			
	SBA2	1	0	0	1	ND				ND			
	SBA3	1	0	0	1	1	0	0	1	1	0	0	1
	SBA4	2	0	0	2	ND				ND			
Total:		36	14	2	52	14	1	0	15	8	1	0	9

ND, no data collected.

Table 4. Summer 2004 Skykomish River braided reach mainstem and side channel fish densities

Species		Relative Density <sup>1</sup> (count m <sup>-2</sup> )			
		Mainstem (76 habitat units)		Side channel (52 habitat units)	
		Mean	S.E.M.	Mean	S.E.M.
<b>Adult</b>	Bull trout	<0.0001	<0.0001		
	Chinook salmon	0.0012	0.0008		
	Chum salmon				
	Coho salmon				
	Cutthroat trout	<0.0001	<0.0001	0.0006	0.0005
	Rainbow trout	0.0003	0.0001	0.0006	0.0004
	Steelhead trout	0.0001	0.0001		
	Unidentified salmonid	<0.0001	<0.0001		
	Sculpin	<0.0001	<0.0001	0.0003	0.0002
	Stickleback			0.4222	0.4132
	Largescale sucker	0.0079	0.0021		
	Mountain whitefish	0.0427	0.0128	0.0020	0.0019
<b>Juvenile</b>	Bull trout	<0.0001	<0.0001		
	Chinook salmon	0.0015	0.0006	0.0058	0.0046
	Coho salmon	0.0020	0.0010	0.9828	0.4028
	Trout <sup>2</sup>	0.0108	0.0025	0.1488	0.0457
	Unidentified salmonid	0.0016	0.0013	0.0004	0.0004
	Sculpin				
	Largescale sucker	0.0147	0.0134	0.1537	0.0826
	Mountain whitefish	<0.0001	<0.0001	0.0019	0.0010
	Other <sup>3</sup>	0.0002	0.0002		
<b>Summary<sup>4</sup></b>	All fish species	0.0831	0.0187	1.7267	0.6707
	All salmonids, total	0.0175	0.0032	1.1466	0.3989
	All salmonids, adults	0.0017	0.0008	0.0012	0.0009
	All salmonids, juveniles	0.0158	0.0032	1.1379	0.3990
	ESA-listed (Chinook and bull trout)	0.0027	0.0010	0.0058	0.0046

<sup>1</sup>Densities reported as average daytime counts per square meter of survey area for all habitat units surveyed in summer 2004, including units in which no fish were observed. Side channel densities are pooled averages for side channel networks SCB and SCC. Zero densities (reflecting no fish observed in any habitat unit surveyed) have been omitted from the table. S.E.M., standard error of the mean.

<sup>2</sup>Juvenile rainbow trout and/or cutthroat trout.

<sup>3</sup>Unidentified non-salmonid juvenile.

<sup>4</sup>These species categories summarize relative densities of juveniles and adults collectively, except where noted. The three 'salmonid' categories do not include mountain whitefish (*Prosopium williamsoni*).

Table 5. Summer 2004 daytime fish counts for mainstem habitat units

Species	Pool (N=17)			Riffle (N=33)			Glide (N=26)			All Units (N=76)		
	Total	Mean	C.I. <sup>1</sup>	Total	Mean	C.I.	Total	Mean	C.I.	Total	Mean	C.I.
<b>Adult</b>												
Bull trout	1	0.1	0.1	2	0.1	0.1	6	0.2	0.5	9	0.1	0.2
Chinook salmon	162	9.5	17.8	4	0.1	0.2	3	0.1	0.2	169	2.2	4.0
Chum salmon												
Coho salmon												
Cutthroat trout							2	0.1	0.1	2	0.0	0.0
Rainbow trout	8	0.5	0.4	20	0.6	0.5	4	0.2	0.2	32	0.4	0.2
Steelhead trout	1	0.1	0.1	5	0.2	0.2	3	0.1	0.1	9	0.1	0.1
Unidentified salmonid	1	0.1	0.1							1	0.0	0.0
Sculpin	1	0.1	0.1	1	0.0	0.1				2	0.0	0.0
Stickleback												
Largescale sucker	678	39.9	31.7	114	3.5	4.7	438	16.8	11.5	1230	16.2	8.8
Mountain whitefish	917	53.9	25.0	1689	51.2	32.9	1092	42.0	25.8	3698	48.7	17.5
<b>Juvenile</b>												
Bull trout				1	0.0	0.1				1	0.0	0.0
Chinook salmon	47	2.8	3.2	46	1.4	2.1	200	7.7	10.1	293	3.9	3.7
Coho salmon	143	8.4	13.0	20	0.6	0.6	400	15.4	23.8	563	7.4	8.7
Trout <sup>2</sup>	155	9.1	8.3	692	21.0	10.8	184	7.1	5.6	1031	13.6	5.5
Unidentified salmonid				101	3.1	5.9	51	2.0	3.6	152	2.0	2.8
Sculpin												
Largescale sucker	955	56.2	78.1	1	0.0	0.1	24	0.9	1.7	980	12.9	17.9
Mountain whitefish				2	0.1	0.1				2	0.0	0.0
Other <sup>3</sup>	32	1.9	3.7							32	0.4	0.8
<b>All Fish</b>	<b>3101</b>	<b>182.4</b>	<b>99.6</b>	<b>2698</b>	<b>81.8</b>	<b>43.3</b>	<b>2407</b>	<b>92.6</b>	<b>54.6</b>	<b>8206</b>	<b>108.0</b>	<b>35.3</b>

<sup>1</sup>95% confidence interval around the mean.

<sup>2</sup>Juvenile rainbow trout and/or cutthroat trout.

<sup>3</sup>Unidentified non-salmonid juvenile.

Note that zero counts have been omitted from Tables 5–10.

Table 6. Fall 2004 daytime fish counts for mainstem habitat units (subsample)

Species	Pool (N=4)			Riffle (N=9)			Glide (N=7)			All Units (N=20)		
	Total	Mean	C.I. <sup>1</sup>	Total	Mean	C.I.	Total	Mean	C.I.	Total	Mean	C.I.
<b>Adult</b>												
Bull trout												
Chinook salmon												
Chum salmon	23	4.6	4.0	106	8.8	14.5	42	6.0	7.0	171	7.1	2.9
Coho salmon				4	0.3	0.4				4	0.2	0.1
Cutthroat trout												
Rainbow trout												
Steelhead trout												
Unidentified salmonid	2	0.4	0.5							2	0.1	0.0
Sculpin							1	0.1	0.3	1	0.0	0.0
Stickleback												
Largescale sucker	7	1.4	2.7	13	1.1	1.3	17	2.4	2.8	37	1.5	0.6
Mountain whitefish				61	5.1	7.5	49	7.0	10.9	110	4.6	1.8
<b>Juvenile</b>												
Bull trout												
Chinook salmon												
Coho salmon												
Trout <sup>2</sup>												
Unidentified salmonid							1	0.1	0.3	1	0.0	0.0
Sculpin												
Largescale sucker												
Mountain whitefish												
Other <sup>3</sup>												
<b>All Fish</b>	<b>32</b>	<b>6.4</b>	<b>4.5</b>	<b>189</b>	<b>15.8</b>	<b>22.1</b>	<b>110</b>	<b>15.7</b>	<b>16.3</b>	<b>326</b>	<b>13.8</b>	<b>5.5</b>

<sup>1</sup>95% confidence interval around the mean.

<sup>2</sup>Juvenile rainbow trout and/or cutthroat trout.

<sup>3</sup>Unidentified non-salmonid juvenile.

Table 7. Summer 2004 daytime fish counts for side channel network SCB habitat units

Species	Channel SCB									
	Pool (N=3)			Riffle (N=2)			Glide (N=2)			
	Total	Mean	C.I. <sup>1</sup>	Total	Mean	C.I.	Total	Mean	C.I.	
<b>Adult</b>										
Bull trout										
Chinook salmon										
Chum salmon										
Coho salmon										
Cutthroat trout										
Rainbow trout										
Steelhead trout										
Unidentified salmonid										
Sculpin	1	0.3	0.7							
Stickleback										
Largescale sucker										
Mountain whitefish										
<b>Juvenile</b>										
Bull trout										
Chinook salmon	37	12.3	9.8				10	5.0	9.8	
Coho salmon	55	18.3	22.5	50	25.0	49.0				
Trout <sup>2</sup>	82	27.3	22.9	3	1.5	2.9	14	7.0	13.7	
Unidentified salmonid										
Sculpin										
Largescale sucker	770	256.7	440.9				162	81.0	158.8	
Mountain whitefish										
Other <sup>3</sup>										
<b>All Fish</b>	<b>945</b>	<b>315.0</b>	<b>428.4</b>	<b>53</b>	<b>26.5</b>	<b>51.9</b>	<b>186</b>	<b>93.0</b>	<b>135.2</b>	

<sup>1</sup>95% confidence interval around the mean.

<sup>2</sup>Juvenile rainbow trout and/or cutthroat trout.

<sup>3</sup>Unidentified non-salmonid juvenile.

Table 7. Summer 2004 fish counts for side channel network SCB habitat units (continued)

Species	Channel SCBI						All Network SCB Units (N=22)		
	Pool (N=8)			Rifle (N=7)			Total	Mean	C.I.
	Total	Mean	C.I.	Total	Mean	C.I.			
<b>Adult</b>									
Bull trout									
Chinook salmon									
Chum salmon									
Coho salmon									
Cutthroat trout									
Rainbow trout									
Steelhead trout									
Unidentified salmonid									
Sculpin	1	0.1	0.2				2	0.1	0.1
Stickleback	300	37.5	73.5				300	13.6	26.7
Largescale sucker									
Mountain whitefish									
<b>Juvenile</b>									
Bull trout									
Chinook salmon							47	2.1	2.2
Coho salmon	230	28.8	20.4	69	9.9	16.5	404	18.4	10.5
Trout	514	64.3	57.9	220	31.4	25.0	833	37.9	23.7
Unidentified salmonid	15	1.9	3.7				15	0.7	1.3
Sculpin									
Largescale sucker	2930	366.3	632.0				3862	175.5	236.8
Mountain whitefish	6	0.8	1.5				6	0.3	0.5
Other									
<b>All Fish</b>	<b>3996</b>	<b>499.5</b>	<b>684.8</b>	<b>289</b>	<b>41.3</b>	<b>34.0</b>	<b>5469</b>	<b>248.6</b>	<b>259.7</b>



Table 9. Summer 2004 daytime fish counts for side channel network SCC habitat units in spring brook system

Species	Channel											
	SBA			Riffle (N=1)			Pool (N=1)			SBAI		
	Total	Mean	C.I. <sup>1</sup>	Total	Mean	C.I.	Total	Mean	C.I.	Total	Mean	C.I.
<b>Adult</b>												
Bull trout												
Chinook salmon												
Chum salmon												
Coho salmon												
Cutthroat trout	8	2.7	5.2									
Rainbow trout	4	1.3	2.6									
Steelhead trout												
Unidentified salmonid												
Sculpin	1	0.3	0.7									
Stickleback												
Largescale sucker												
Mountain whitefish	30	10.0	19.6									
<b>Juvenile</b>												
Bull trout												
Chinook salmon												
Coho salmon	560	186.7	227.8				500					
Trout <sup>2</sup>	20	6.7	13.1	30	—	—	1	—	—	300	—	—
Unidentified salmonid												
Sculpin												
Largescale sucker												
Mountain whitefish							17					
Other <sup>3</sup>												
<b>All Fish</b>	<b>623</b>	<b>207.7</b>	<b>251.4</b>	<b>30</b>	<b>—</b>	<b>—</b>	<b>518</b>	<b>—</b>	<b>—</b>	<b>300</b>	<b>—</b>	<b>—</b>

<sup>1</sup>95% confidence interval around the mean.

<sup>2</sup>Juvenile rainbow trout and/or cutthroat trout.

<sup>3</sup>Unidentified non-salmonid juvenile.

Table 9. Summer 2004 fish counts for side channel network SCC habitat units in spring brook system (continued)

Species	Channel						All SCC Spring Brook Units (N=10)			
	SBA2 (N=1)			SBA3 (N=1)			SBA4 (N=2)			
	Total	Mean	C.I.	Total	Mean	C.I.	Total	Mean	C.I.	
<b>Adult</b>										
Bull trout										
Chinook salmon										
Chum salmon										
Coho salmon										
Cutthroat trout							8	0.8	1.6	
Rainbow trout							4	0.4	0.8	
Steelhead trout										
Unidentified salmonid										
Sculpin							1	0.1	0.2	
Stickleback										
Largescale sucker										
Mountain whitefish							30	3.0	5.9	
<b>Juvenile</b>										
Bull trout										
Chinook salmon										
Coho salmon	25	—	—	200	—	—	20	10.0	19.6	130.5
Trout										114.3
Unidentified salmonid										35.1
Sculpin										58.1
Largescale sucker										
Mountain whitefish										
Other										17
										1.7
										3.3
<b>All Fish</b>	<b>25</b>	<b>—</b>	<b>—</b>	<b>200</b>	<b>—</b>	<b>—</b>	<b>20</b>	<b>10.0</b>	<b>19.6</b>	<b>1716</b>
										<b>171.6</b>
										<b>119.4</b>

Table 10. Winter 2004 day and night fish counts for side channel network SCC habitat units

Species	Channel												
	SCC		SCC1		SCC3		SBA		SBA		SBA3		
	Pool		Pool		Pool		Rifle		Rifle		Pool		
Day (N=3)	Night (N=1)	Day (N=1)	Night (N=1)	Day (N=7)	Night (N=3)	Day (N=2)	Night (N=2)	Day (N=1)	Night (N=1)	Day (N=1)	Night (N=1)	Day (N=15)	Night (N=9)
<b>Adult</b>													
Bull trout							0.5					0	0.1
Chinook salmon													
Chum salmon					1.6	3.0	5.0	1	1			1.2	2.3
Coho salmon					0.1		0.5					0.1	0.1
Cutthroat trout							0.5					0	0.6
Rainbow trout							0.5					0	0.1
Steelhead trout													
Unidentified salmonid													
Sculpin	1				2.3		0.5		6			0	1.7
Stickleback	0.3	2			0.3		0.5			2		0.2	0.4
Largescale sucker													
Mountain whitefish													
<b>Juvenile</b>													
Bull trout	1											0	0.2
Chinook salmon											1		
Coho salmon	2.3				1.0		5.5		2	32		2.6	1.9
Trout <sup>1</sup>	0.3				20.7		3.5		1			0.1	7.9
Unidentified salmonid		3	1	10	0.1	174.3	10.0				40	0.1	66.2
Sculpin													
Largescale sucker													
Mountain whitefish													
Other <sup>2</sup>													
<b>All Fish</b>	3.0	7	1	12	1.9	203.3	27.0	3.0	10	34	41	4.2	81.6

Data tabulated as habitat-unit mean counts when N>1.

<sup>1</sup>Juvenile rainbow trout and/or cutthroat trout.

<sup>2</sup>Unidentified non-salmonid juvenile.

Table 11. Summer 2004 fish counts for edge habitat within mainstem

Habitat Unit #	Unit Type	Edge Habitat Type	Edge Habitat Location	Count		Proportion Within Edge Habitat (% Unit Total)	Dominant Species <sup>1</sup>
				Unit Total	Edge Habitat		
9	Riffle	riprap	Right bank	626	492	78.6	adult whitefish, juvenile trout
23	Pool	LWD + riprap	Right bank	381	118	31.0	juvenile coho, juvenile Chinook
42	Pool	LWD	Right bank	667	426	63.9	juvenile coho, juvenile Chinook
50	Riffle	LWD	Left bank	237	227	95.8	juvenile unidentified salmonid, adult sucker
51A	Glide	LWD	Left bank	75	70	93.3	juvenile coho, adult whitefish
53	Glide	riprap	Right bank	101	63	62.4	juvenile unidentified salmonid, juvenile trout

<sup>1</sup>Species with highest relative abundance (rank order) within edge habitat.

LWD, large woody debris.

Table 12. 2004 salmon redd and carcass counts in Skykomish River braided reach (present study)

Survey Date	Chinook		Chum		Coho		Unidentified sp.	
	Redd Count*	Carcass Count	Redd Count*	Carcass Count	Redd Count*	Carcass Count	Redd Count*	Carcass Count
9/30/2004	85	16	0	0	0	0	0	0
10/11/2004	51	5	20	1	0	0	0	1
11/9/2004	0	0	719	395	0	0	0	1
12/1/2004	0	0	30	55	0	3	0	0
<b>Total</b>	<b>136</b>	<b>21</b>	<b>769</b>	<b>451</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>2</b>

\*Sum of confirmed and presumed redds (see Methods).

Table 13. 2004 Chinook salmon redd counts in Skykomish River (WDFW)<sup>1</sup>

Survey Reach	Count	Redds/rm
Mouth of Skykomish River–Monroe, WA	17	4.2
Monroe–Confluence with Sultan River	312	31.2
Sultan River–Gold Bar, WA (“Big Eddy”)	418	49.2
“Big Eddy”–Sunset Falls	93	11.6
<b>Total</b>	<b>840</b>	

<sup>1</sup>Data from aerial surveys by the Washington Department of Fish and Wildlife between September and November 2004. Coverage included both the mainstem channel and side channel networks. The number of redds per river mile in each survey reach was calculated using approximate mainstem reach distance. The Sultan-to-Gold Bar reach is the same as the braided reach sampled in this study. Source: Jackson (2005a).

Table 14. Skykomish River braided reach salmon carcass measurements

<b>Species</b>	<b>Fork Length (mean+S.D., inches)</b>	<b>Adipose fin present (%)*</b>	<b>Female:Male Ratio*</b>
Chinook	35.5±7.9	83 (86%)	0.70 (81%)
Chum	31.4±2.1	100 (39%)	0.58 (38%)
Coho	31.5±2.1	67 (100%)	0.50 (100%)
Unidentified salmonid	31.8±5.9	ND	ND

\*Adipose fin presence and sex were determined for a subsample of Chinook and chum carcasses. Percentages of total carcass counts (cf. Table 12) upon which tabulated data are based appear in parentheses.

ND, no data collected.

Table 15. Selected salmonid density data from summer snorkel surveys of northwest rivers

River System	Mean Relative Density <sup>1</sup> (count m <sup>-2</sup> )		
	Chinook salmon	Coho salmon	Rainbow trout
Large mainstems (>50 m bankfull width)	0.001–0.262 (Hillman and Chapman, 1989; Keefe et al., 1995; Jonasson et al., 1997)		0.001–0.015 (Hillman and Chapman, 1989)
Small mainstems (<50 m bankfull width)	0.007–0.185 (Keefe et al., 1995; Jonasson et al., 1997; Scarnecchia and Roper, 2000)	0.022–0.227 (Hankin and Reeves, 1988; Scarnecchia and Roper, 2000)	0.021–0.183 (Hankin and Reeves, 1988; Scarnecchia and Roper, 2000)
Side channels	0.003-0.007 (G. Pess, unpublished*)	0.120-2.179 (G. Pess, unpublished*)	0.081-0.221 (G. Pess, unpublished*)

<sup>1</sup>Mainstem densities reported as average counts per square meter of survey area for all habitat units surveyed, including units in which no fish were observed. Side channel values are adjusted relative densities (see text). All data are from summer snorkel surveys (July–September) for age 0+ and 1+ juveniles; densities are pooled averages for different habitat unit types (cf. Bartz et al., 2006).

\*NOAA Fisheries, Northwest Fisheries Science Center; data from snorkel surveys on the Elwha River (WA).