Summary of Habitat and Fish Monitoring Data from East Fork and Upper Mainstem Lobster Creeks: 1988-2010

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For the Bureau of Land Management

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Since 1988, the Oregon Department of Fish and Wildlife (ODFW) has monitored juvenile salmonid summer abundance, smolt abundance, adult spawner abundance, and stream habitat parameters in East Fork and Upper Mainstem Lobster Creeks of the Alsea watershed (Figure 1). The primary purpose of this monitoring is to study the effects of stream habitat modification on the freshwater survival and abundance of coho salmon (*Oncorhynchus kisutch*). This work has been partially funded by the Bureau of Land Management's (BLM) Salem District Office since 1996. The purpose of this report is to provide the BLM with an update of ODFW's sampling in East Fork Lobster Creek (East Fork) and Upper Mainstem Lobster Creek (Upper Mainstem) during the 2009-10 sampling season and to put these data in context with past data collected by ODFW.

The watershed characteristics of the two study streams are shown in Table 1. In 1991, extensive in-stream habitat modification was conducted by the BLM in Upper Mainstem as part of a before-after-control-impact (BACI) study to determine the effect of habitat modification on survival rate and smolt abundance of juvenile salmonids. East Fork acted as the control stream during this study, which lasted from 1988 through 1995. A detailed description of this study is in Solazzi et al. (2000). During a February 1996 flood, a number of large debris torrents entered Upper Mainstem and significantly impacted the habitat structures, resulting in the loss of considerable overwinter habitat for juvenile coho salmon. Similar high stream flows in the winter of 1998-99 caused significant channel changes in East Fork. In the summer of 1999, the BLM used 65 pieces of large wood with a total volume of 265m^3 to create seven in-channel debris jams in East Fork.

Table 1. Watershed characteristics of East Fork and Upper Mainstem Lobster creeks.

Stream	Basin Area (km^2)	Stream Length (km)	Mean summer wetted width (m)	Average gradient (%)
E.F. Lobster Cr.	14.2	3.5	3.3	4.0
U.M. Lobster Cr.	12.4	4.7	3.4	2.6

Habitat Inventory

From 1988-2002 and in 2006, we completed physical habitat surveys during late summer (late August – early September) using the methods of Hankin and Reeves (1988) in East Fork (Table 2) and Upper Mainstem (Table 3). No physical habitat surveys were completed in the summers of 2003-2005, or 2007-2010. Physical habitat surveys were completed in the winter in both streams in the winters of 1990-91, 1991-92, 1995-96, 1996-97, and 2004-05. An additional winter habitat survey was also completed in Upper Mainstem Lobster in the winter of 1993-94 (Table 4). Additional details about sampling methods involved in the physical habitat surveys may be found in Solazzi et al. (2000) and Solazzi and Johnson (2002).

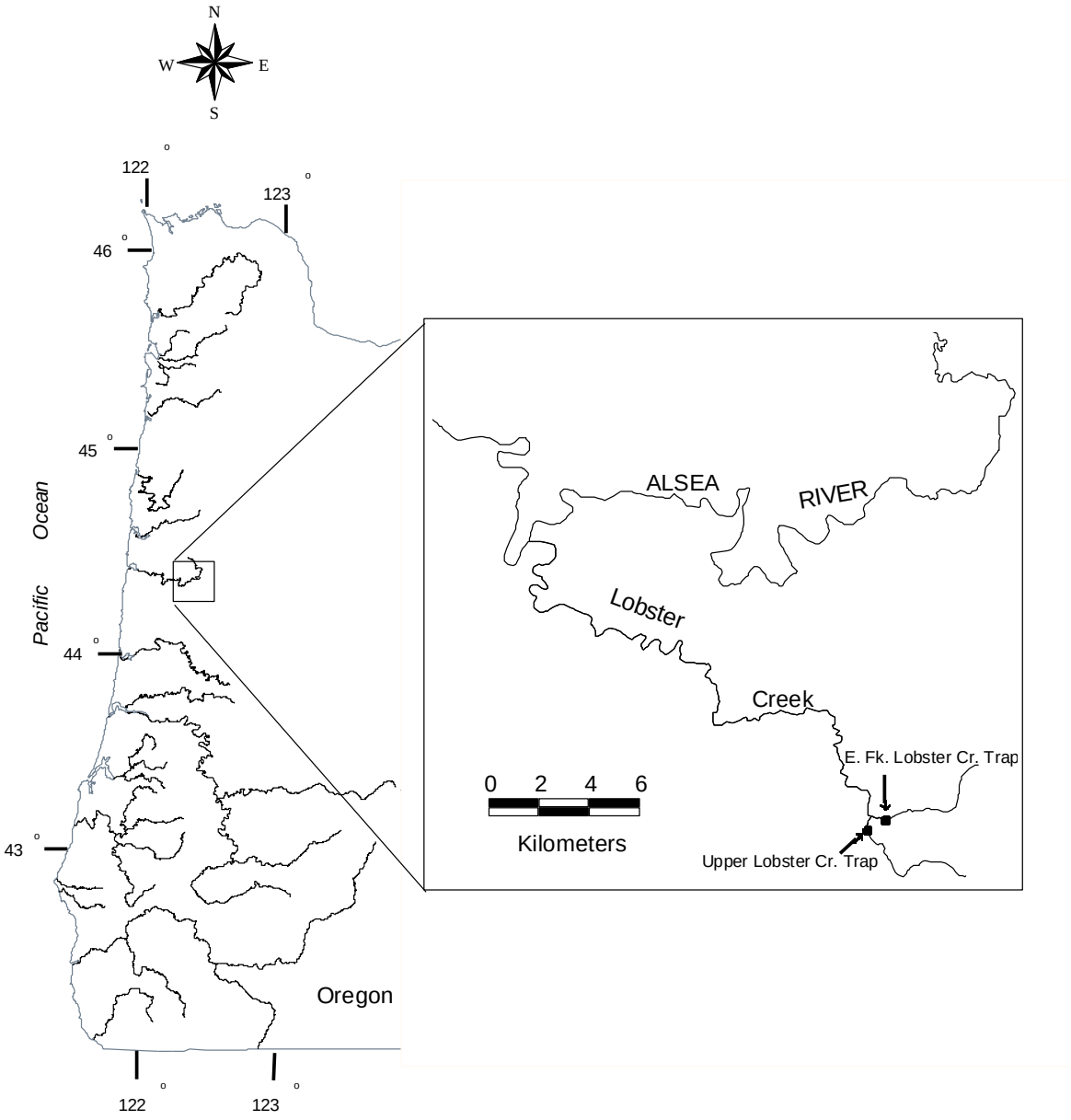

Figure 1. Locations of traps in East Fork and Upper Mainstem Lobster creeks in the Alsea Basin.

Table 2. Habitat survey results for East Fork Lobster Creek, 1988-2002 and 2006.

	Year																
Habitat Variable	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2006	Average
Glide (m^2)	1,252	2,108	2,737	1,474	912	1,842	1,144	1,635	1,801	1,259	781	735	804	787	834	1,091	1,325
Cascade (m^2)	32	0	39	0	0	32	30	0	0	28	0	50	0	30	65	47	22
Rapid (m^2)	1,965	1,948	4,398	4,723	3,933	6,132	2,678	1,915	1,433	6,187	4,756	5,445	3,350	6,919	4,201	5,549	4,096
Riffle (m^2)	3,257	2,428	1,847	1,849	1,662	3,046	3,900	5,479	4,392	2,860	4,532	2,707	6,143	2,562	1,997	2,458	3,195
Lateral Scour Pool (m^2)	2,160	2,075	2,710	3,048	2,753	2,613	1,990	1,397	2,440	2,355	2,440	2,361	2,239	2,148	1,782	2,811	2,333
Plunge Pool (m^2)	0	344	667	340	238	234	133	214	113	65	52	19	35	15	37	0	157
Alcove Pool (m^2)	166	12	0	91	281	270	28	11	10	0	0	0	0	0	0	0	54
Dam Pool (m^2)	1,673	1,273	168	170	145	354	211	0	82	25	0	169	115	0	0	0	274
Beaver Dam Pool (m^2)	2,885	1,759	687	1,081	1,160	1,622	991	263	273	463	458	369	430	0	72	180	793
Trench Pool (m^2)	585	716	62	60	60	30	40	0	0	0	47	15	17	16	17	0	104
Straight Scour Pool (m^2)	1,299	1,575	1,661	2,454	1,893	2,690	2,109	1,810	924	2,370	2,692	1,299	937	2,073	1,534	1,723	1,815
Backwater Pool (m^2)	0	22	231	52	105	318	187	147	0	44	70	23	99	58	37	56	91
Isolated Pool (m^2)	0	0	211	204	244	193	91	108	245	241	195	167	134	92	280	179	161
% Clay	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
% Silt	N/A	5.1	4.2	5.8	7.4	7.3	7.0	4.4	1.2	7.3	4.9	2.1	1.3	5.6	1.2	1.3	4.4
% Sand	N/A	2.2	1.1	0.2	0.9	1.4	3.4	2.0	10.0	2.0	1.5	3.0	2.4	2.6	2.4	3.3	2.6
% Gravel	N/A	37.5	28.2	25.8	20.1	39.9	33.0	38.0	39.8	23.6	30.3	29.1	22.8	26.7	23.2	25.7	29.6
% Cobble	N/A	32.6	37.1	43.6	40.7	30.7	36.1	32.5	27.1	36.8	32.7	42.5	35.9	36.4	46.8	42.6	36.9
% Small Boulder	N/A	15.2	23.8	19.0	25.0	15.1	15.2	16.3	14.7	24.2	20.6	14.6	29.3	21.3	20.1	20.5	19.7
% Large Boulder	N/A	0.6	0.1	0.3	0.2	0.4	0.3	0.4	0.1	0.1	3.2	0.6	0	0.3	0.6	0.4	0.5
% Bedrock	N/A	6.8	5.5	5.4	5.7	5.2	4.9	6.3	7.1	6.6	6.8	8.0	8.3	7.1	5.8	6.2	6.4
No. Large Boulders	N/A	0.8	0.6	0.9	0.7	0.5	0.6	0.2	0.7	0.8	0.4	0.8	0.7	0.6	0.8	0.6	0.6
Wood Complexity	N/A	1.7	1.9	1.8	2.0	1.7	1.6	1.6	1.6	1.6	1.4	1.7	1.6	1.8	1.8	1.8	1.7
% Shade	N/A	76.4	76.9	87.9	81.8	80.7	82.0	73.8	80.1	80.0	63.0	82.8	83.8	84.4	84.5	89.4	80.5
Width (m)	N/A	3.3	3.3	3.5	3.2	3.9	3.0	3.2	3.2	3.4	3.5	3.2	3.7	3.2	3.0	3.6	3.3

Table 3. Habitat survey results for Upper Mainstem Lobster Creek, 1988-2002 and 2006.

	Year																
Habitat Variable	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2006	Average
Glide (m^2)	1,442	2,522	2,320	2,041	1,590	2,592	3,086	3,209	2,334	N/A	2,339	1,182	1,146	1,467	1,070	1,081	1,979
Cascade (m^2)	84	65	584	14	71	37	6	0	20	N/A	84	76	0	50	0	0	73
Rapid (m^2)	1,168	2,072	4,726	1,552	1,552	1,814	1,213	1,232	2,407	N/A	5,929	7,795	6,643	2,722	5,553	6,349	3,515
Riffle (m^2)	6,610	4,892	5,134	3,063	3,414	4,498	3,800	5,528	8,574	N/A	4,214	3,744	4,706	7,230	3,627	3,379	4,827
Lateral Scour Pool (m^2)	3,424	4,020	3,891	3,639	3,609	2,120	2,312	1,154	4,667	N/A	3,920	5,599	5,212	4,009	3,393	4,235	3,680
Plunge Pool (m^2)	811	891	1,243	1,573	1,228	931	832	1,288	1,141	N/A	512	657	343	281	405	646	852
Alcove Pool (m^2)	175	0	0	1,072	847	1,108	731	834	118	N/A	131	245	222	108	204	78	392
Dam Pool (m^2)	2,506	384	1,411	6,931	6,784	6,445	5,165	4,410	1,277	N/A	0	0	283	286	274	509	2,444
Beaver Dam Pool (m^2)	0	4,946	992	1,564	2,548	1,968	1,928	1,792	558	N/A	243	127	412	947	771	0	1,253
Trench Pool (m^2)	113	245	194	0	0	0	0	0	0	N/A	13	99	19	15	0	0	47
Straight Scour Pool (m^2)	1,552	1,579	0	1,067	985	4,017	2,553	2,851	3,664	N/A	4,049	2,655	3,950	3,487	4,020	4,234	2,711
Backwater Pool (m^2)	0	95	645	90	76	127	125	60	30	N/A	70	116	60	63	49	40	110
Isolated Pool (m^2)	0	0	72	41	59	58	9	14	22	N/A	112	58	23	38	88	56	43
% Clay	N/A	0.0	N/A	0.0	0.0	0.0	0.0	0.0	N/A	N/A	0.0	0.1	0.0	0.0	0.0	0	0.0
% Silt	N/A	20.1	N/A	32.9	29.8	33.8	30.0	24.0	N/A	N/A	8.5	15.6	4.1	10.4	7.6	5.8	18.5
% Sand	N/A	4.7	N/A	2.1	2.5	5.0	17.9	21.9	N/A	N/A	8.3	14.1	9.8	12.3	9.3	7.9	9.7
% Gravel	N/A	31.1	N/A	30.6	36.7	32.1	33.2	33.4	N/A	N/A	29.7	25.1	30.0	29.7	30.8	31.9	31.2
% Cobble	N/A	27.0	N/A	21.6	21.2	17.1	12.9	13.5	N/A	N/A	32.1	28.6	33.5	30.2	34.4	34.4	25.5
% Small Boulder	N/A	13.8	N/A	11.1	8.0	10.1	3.8	5.3	N/A	N/A	16.5	11.5	16.6	12.6	12.6	15.8	11.5
% Large Boulder	N/A	1.0	N/A	0.3	0.4	0.2	0.3	0.3	N/A	N/A	1.6	2.2	1.9	1.7	2.0	0.4	1.0
% Bedrock	N/A	2.2	N/A	1.5	1.5	1.7	2.1	2.3	N/A	N/A	3.3	2.8	4.1	3.2	3.4	3.9	2.7
No. Large Boulders	N/A	2.2	N/A	1.0	1.0	1.1	0.5	0.9	N/A	N/A	1.5	2.0	1.2	1.1	1.7	1.1	1.3
Wood Complexity	N/A	1.8	N/A	2.6	2.0	2.0	1.8	1.8	N/A	N/A	1.7	1.8	1.8	1.8	1.8	1.9	1.9
% Shade	N/A	78.0	N/A	75.3	72.2	88.5	82.3	74.8	N/A	N/A	64.5	59.0	65.3	65.9	70.5	72.7	72.4
Width (m)	N/A	3.0	N/A	3.3	3.1	3.9	3.1	3.4	N/A	N/A	3.3	3.7	3.8	3.5	3.4	3.7	3.4

Table 4. Winter habitat survey results for East Fork and Upper Mainstem Lobster creeks in select years between 1990-91 and 2004-05.

	East Fork Lobster					Upper Mainstem Lobster					
Habitat Variable	1990-91	1991-92	1995-96	1996-97	2004-05	1990-91	1991-92	1993-94	1995-96	1996-97	2004-05
Glide (m^2)	1,911	3,558	631	274	594	4,538	2,412	2,146	804	752	219
Cascade (m^2)	296	217	159	172	65	403	171	66	48	1,108	88
Rapid (m^2)	10,307	5,857	6,907	10,263	9,333	9,299	4,461	1,535	5,526	8,298	5,784
Riffle (m^2)	6,223	7,392	12,734	10,783	6,882	7,816	7,001	8,733	12,644	14,097	14,847
Lateral Scour Pool (m^2)	3,523	2,586	2,790	3,265	3,287	2,643	2,854	3,383	5,204	3,060	3,748
Plunge Pool (m^2)	1,167	937	666	309	103	1,431	1,384	1,125	2,790	1,097	600
Alcove Pool (m^2)	0	26	251	0	0	0	892	997	1,124	0	73
Dam Pool (m^2)	1,048	841	246	0	484	1,347	8,032	5,943	5,603	850	80
Beaver Dam Pool (m^2)	558	673	357	0	161	24	1,670	1,321	173	0	0
Trench Pool (m^2)	0	103	0	0	61	0	24	0	0	0	0
Straight Scour Pool (m^2)	2,003	2,271	1,837	1,912	1,724	2,975	1,637	1,319	2,727	4,573	6,210
Backwater Pool (m^2)	529	155	290	249	155	417	93	127	362	91	417
Isolated Pool (m^2)	81	91	25	13	0	0	16	16	0	278	37
% Clay	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% Silt	4.4	3.1	2.4	0.2	2.6	4.2	17.8	24.8	3.5	1.8	0.6
% Sand	2.2	2.7	3.5	2.9	3.5	3.7	7.4	9.4	11.4	10.7	10.3
% Gravel	39.5	34.3	43.2	34.0	26.0	34.6	37.0	38.7	53.6	41.1	10.1
% Cobble	37.1	40.4	31.9	41.0	40.2	33.2	25.2	18.7	19.7	34.1	60.3
% Small Boulder	11.9	13.5	13.7	15.4	24.0	20.1	9.8	4.8	8.1	8.2	14.4
% Large Boulder	0.4	0.6	0.5	0.1	0.3	1.7	1.3	0.3	0.7	1.9	0.1
% Bedrock	4.4	5.2	4.9	6.4	5.4	2.5	1.7	2.6	2.9	1.5	4.0
No. Large Boulders	0.8	1.2	0.7	1.0	2.5	2.0	1.8	0.9	1.2	1.7	3.0
Wood Complexity	2.1	2.0	2.1	2.0	2.1	2.2	2.5	2.3	2.4	2.2	1.7
Width (m)	N/A	5.3	6.1	6.0	6.0	N/A	5.0	5.4	6.6	6.4	5.7

Juvenile Salmonid Summer Population Estimates

The estimated summer rearing populations of juvenile salmonids from 1988 through 2010 are shown in Table 5 for both streams. Each summer from 1988-2002, we estimated the number of young-of-the-year coho salmon, young-of-the-year trout (steelhead and cutthroat combined), age 1+ steelhead, and age 1+ cutthroat trout. To estimate the number of fish rearing in the pools, a diver counted the number of each species and age class in every third pool. These counts were adjusted for each species by a calibration factor derived from electrofishing population estimates in a subset of the snorkeled pools. Finally, the mean of the adjusted values was multiplied by the total number of pools in each stream (Hankin and Reeves 1988). Snorkel estimates were impractical in habitat with shallow depths; therefore, we estimated the mean density of fish for a subset of glide, riffle, and rapid habitats by electrofishing, employing a removal population estimate with two or more passes (Serber and Lecren 1967). For each habitat type, we then multiplied the mean density by the surface area of the habitat type in the entire stream (Hankin 1984).

Table 5. Juvenile salmonid summer population estimates in East Fork Lobster and Upper Mainstem Lobster creeks, 1988-2010.

	E.F. Lobster Creek				U.M. Lobster Creek			
Sample Year	Coho	Trout <90mm	Steelhead ≥90mm	Cutthroat ≥90mm	Coho	Trout <90mm	Steelhead ≥90mm	Cutthroat ≥90mm
1988	11,462	5,098	530	368	10,667	2,916	437	338
1989	13,694	2,279	792	961	6,406	3,242	248	596
1990	19,278	2,837	474	1,811	18,161	2,288	766	792
1991	9,964	3,490	543	686	7,633	1,776	235	525
1992	7,716	3,096	363	1,255	8819	2951	216	1268
1993	15,842	2,298	672	2,793	23,012	1,327	148	3,337
1994	6,432	2,278	468	998	15,486	2,562	150	729
1995	8,085	2,884	803	583	9,619	3,357	112	1,288
1996	3,767	2,355	412	592	940	2,501	520	893
1997	11,055	4,619	133	444	N/A	N/A	N/A	N/A
1998	4,863	3,516	667	827	6,842	3,153	909	1,018
1999	2,358	5,012	578	917	1,690	10,346	806	2,296
2000	8,011	5,478	800	488	9,385	4,815	1,300	788
2001	10,280	3,288	667	682	17,086	1,772	778	1,165
2002	10,954	4,121	276	1,315	14,247	3,053	127	1,579
2003	10,047	3,437	---	---	21,751	4,580	---	---
2004	10,937	3,686	---	---	14,842	2,431	---	---
2005	8,017	3,400	---	---	10,843	1,879	---	---
2006	11,456	2,100	---	---	15,434	1,589	---	---
2007	3,672	3,890	---	---	11,093	1,130	---	---
2008	8,370	---	---	---	12,806	---	---	---
2009	11,002	---	---	---	16,039	---	---	---
2010	6,673	---	---	---	10,877	---	---	---
Average	9,302	3,458	545	981	11,985	3,035	482	1,187

Table 6. Regression of Hankin-Reeves population estimate (y) on pool dive count (x) of juvenile salmonids in East Fork Lobster and Upper Mainstem Lobster creeks. Data collected from 1991-2002 were used for the regression analysis. Regression equations were used to determine the Hankin-Reeves population estimate for coho salmon in each stream for the summer of 2003 through 2010.

Stream	Species	Regression Equation	N	R^2	p value
East Fork	Coho	y =1.35356x + 614.296	12	0.736	0.0004
East Fork	0+ trout	y =2.51335x + 1439.24	12	0.424	0.022
East Fork	Steelhead ≥90mm	y =1.33392x + 311.81	12	0.299	0.066
East Fork	Cutthroat ≥90mm	y =2.22139x + 670.77	12	0.076	0.387
Upper Mainstem	Coho	y =1.63557x – 741.6	11	0.942	0.0000007
Upper Mainstem	0+ trout	y =4.09322x – 49.081	11	0.818	0.00013
Upper Mainstem	Steelhead ≥90mm	y =1.91800x + 29.61	11	0.372	0.0462
Upper Mainstem	Cutthroat ≥90mm	y =1.23459x + 1075.26	11	0.015	0.720

In the summers of 2003-2010, as in previous years, we completed dive counts in every third pool; however, we did not use electrofishing equipment to calibrate the diver counts or to estimate population size of juvenile salmonids in fast water habitat. In order to make comparable estimates to the number of juvenile salmonids rearing in each stream from past years, we applied the 2003-2010 uncalibrated diver estimates in pool habitat to the regression of total population estimate for all habitat units (derived from Hankin-Reeves survey methods) on uncalibrated diver counts in pool habitat (Table 6). Data collected from the summer of 1991-2002 on each stream were used to develop the regression equations. The relationship between uncalibrated diver counts in pool habitat and the Hankin-Reeves population estimate (all habitat types) was significant for coho salmon and age 0 trout for both streams. Thus, we used the regression equations in Table 6 to obtain the Hankin-Reeves population estimates given in Table 5 for coho salmon in summers 2003-10. Population estimates were also made for age 0 trout in summers 2003-07, but not in subsequent years due to concerns about variability in counts among observers and the relatively weak relationship between the Hankin-Reeves population estimates and dive counts in East Fork (Table 6). For steelhead and cutthroat trout (≥90mm), relationships between pool dive counts and the Hankin-Reeves population estimates were generally very poor (Table 6). Therefore, no estimates of summer population size are provided for steelhead or cutthroat trout (≥90mm) in 2003-2010 (Table 5).

In the summer of 2010, we estimated the summer rearing population of juvenile coho salmon to be 6,673 in East Fork and 10,877 in Upper Mainstem. Both estimates fell below the long-term averages for these sites and were far lower than the previous year's rearing population estimates. The summer rearing population in East Fork was clearly influenced by a log jam that restricted all but a few adult spawners to the lower half of the stream during the 2009-10 spawning season. The juvenile coho rearing density below this point was similar to that observed in summer 2009, but the rearing density was much lower above the log jam. The relatively small summer rearing population in Upper Mainstem is more difficult to explain, as the number of spawners at this site in 2009-10 was the highest observed in several years (see below). An unusually cold and wet spring in 2010, however, may have led to increased mortality and outmigration of coho fry.

Downstream Migrant Juvenile Sampling

In the spring, a motor driven floating scoop trap is operated in each study stream to estimate the number of juvenile fish emigrating downstream from each stream. A detailed description of the methods used to operate these traps may be found in Solazzi et al. (2000).

The estimated numbers of juvenile salmonids migrating downstream in East Fork in the spring of 2010 are shown in Table 7. The number of 1+ coho salmon migrants in East Fork in 2010 (2,891 fish) was higher than in the previous spring, and exceeded the long-term average for this site (Table 8). The increasing trend in coho smolt abundance over the last three years follows a very similar trend in adult spawners and summer rearing populations for the 2006-2008 broods. The week of peak migration in 2010 was March 22-28, which is not unusual for this site, where the peak in migration often occurs in late March or early April (Table 9). The mean fork length of coho smolts was 77 mm during the week of peak migration (Table 9). Mean smolt size tends to increase throughout the trapping season and the relatively small size of smolts in 2010 reflects, at least in part, the relatively early timing of the peak migration week.

The number of coho salmon fry migrants in East Fork has increased dramatically over the last four years, and the 2010 estimate was the third highest since monitoring began in 1988 (Table 8). The abundance of coho fry migrants in the spring generally follows trends in spawner abundance the previous winter, but the increase in fry numbers between 2009 and 2010 was much larger than would have been expected given the comparable adult spawning estimates. The concentration of spawning in the lower portion of East Fork during the winter of 2009-10 (see below) may have contributed to the increase in coho fry migrants. The number of cutthroat trout (≥90mm) migrants was above average for this site, while the number of steelhead (≥90mm) was below the long-term average (Table 8).

Table 7. Weekly estimates of the number of juvenile salmonids migrating downstream from East Fork Lobster Creek, spring 2010.

Week	Coho 1+	Coho Fry	Trout Fry	Chinook Fry	Trout 60-89mm	Steelhead ≥90mm	Cutthroat ≥90mm
FEB 22-28	41	28	0	0	4	0	0
MAR 1-7	189	9306	0	0	4	7	6
MAR 8-14	146	16,945	0	0	33	36	24
MAR 15-21	287	33,531	0	0	60	0	12
MAR 22-28	489	36,071	0	0	37	14	79
MAR 29-APR 4	149	8,084	0	0	4	0	6
APR 5-11	323	30188	41	0	34	7	27
APR 12-18	432	43,190	203	0	120	22	116
APR 19-25	254	20,681	446	0	76	0	95
APR 26-MAY 2	309	19,121	81	0	25	6	104
MAY 3-9	95	10,659	176	0	10	11	64
MAY 10-16	112	8,712	781	0	103	58	333
MAY 17-23	35	1,833	1102	0	49	38	138
MAY 24-30	15	433	479	0	11	6	37
MAY 31-JUNE 6	15	1,333	1,179	0	6	6	51
Total	2,891	240,115	4,488	0	576	211	1,092

Table 8. The estimated number of juvenile salmonids migrating downstream each spring in East Fork Lobster Creek 1988-2010.

Trap Year	Trap Start Date	Coho 1+	Coho Fry	Trout Fry	Chinook Fry	Trout 60-89mm	Steelhead ≥90mm	Cutthroat ≥90mm
1988	9-Mar-88	1,178	19,044	3,204	2,130	14[a]	15[a]	15[a]
1989	1-Mar-89	2,691	48,133	3,594	264,733	43	1[a]	268
1990	5-Feb-90	3,549	22,736	4,381	0	99	32	110
1991	4-Feb-91	2,121	8,422	2,984	0	76	45	296
1992	4-Feb-92	2,627	6,992	1,486	0	123	49	251
1993	3-Feb-93	2,055	46,550	1,875	0	202	117	699
1994	1-Feb-94	3,641	4,266	5,529	0	102	26	738
1995	1-Feb-95	892	8,130	5,549	0	55	21	187
1996	12-Feb-96	985	6,302	33[a]	0	116	3[a]	7[a]
1997	3-Mar-97	1,055	42,715	13,609	0	25	14[a]	5[a]
1998	2-Mar-98	1,286	18,416	14,584	0	464	455	523
1999	1-Mar-99	909	3,251	3,413	228	247	169	839
2000	28-Feb-00	1,189	17,108	8,025	0	737	714	691
2001	28-Feb-01	4,121	44,651	20[a]	0	1,131	1,371	999
2002	26-Feb-02	2,945	30,585	10,370	0	90	147	1,231
2003	28-Feb-03	2,054	329,809	10,523	5,951	426	76	842
2004	1-Mar-04	2,968	278,736	21,958	0	853	762	1,454
2005	27-Feb-05	4,580	115,706	94[a]	0	644	422	802
2006	26-Feb-06	2,552	84,096	5,693	0	216	332	1,902
2007	1-Mar-07	2,531	5,203	72[a]	32,175	24[a]	28[a]	1,723
2008	29-Feb-08	848	44,636	7,350	0	251	28[a]	835
2009	28-Feb-09	2,612	152,718	6,593	0	626	43[a]	1,014
2010	27-Feb-10	2,891	240,115	4,488	0	576	211	1,092
Average		2,273	68,623	7,116[b]	13,270	338[b]	309[b]	825[b]

[a]Few marked fish recaptured, thus trap efficiency is not available. Number shown is total fish captured, not an expanded estimate of total migrants using trap efficiency.

[b]Average only includes years for which trap efficiency estimates are available.

Table 9. Number of coho salmon smolts (±95% CI), week of peak migration, and mean fork length of smolts during week of peak migration in East Fork Lobster Creek.

Sample Year	Smolts ± CI	Peak Week	Mean FL (mm) ± CI
1988	1,178 ± 144	3/21-3/27	79.1 ± 5.0
1989	2,691 ± 280	3/20-3/26	72.4 ± 3.5
1990	3,549 ± 266	3/23-3/29	76.2 ± 4.4
1991	2,121 ± 130	5/6-5/12	91.6 ± 4.4
1992	2,627 ± 166	4/6-4/12	na
1993	2,055 ± 219	4/19-4/25	89.9 ± 3.6
1994	3,641 ± 226	5/2-5/8	91.5 ± 2.8
1995	892 ± 153	5/1-5/7	95.0 ± 3.0
1996	985 ± 220	2/12-2/18	73.3 ± 6.4
1997	1,055 ± 205	4/21-4/27	84.8 ± 4.3
1998	1,286 ± 189	4/27-5/3	96.4 ± 3.8
1999	909 ± 103	3/15-3/21	74.9 ± 3.2
2000	1,189 ± 172	4/17-4/23	99.4 ± 2.9
2001	4,121 ± 256	4/23-4/29	93.1 ± 4.3
2002	2,945 ± 192	4/8-4/14	78.3 ± 3.7
2003	2,054 ± 221	4/14-4/20	84.7 ± 5.1
2004	2,968 ± 250	3/22-3/28	78.0 ± 5.3
2005	4,580 ± 363	3/21-3/27	77.9 ± 2.5
2006	2,552 ± 172	4/24-4/30	89.0 ± 3.7
2007	2,531 ± 244	5/7-5/13	93.0 ± 4.1
2008	848 ± 134	5/12-5/18	107.1 ± 2.7
2009	2,612 ± 282	4/6-4/12	81.2 ± 4.7
2010	2,891 ± 275	3/22-3/28	76.9 ± 4.8

The estimated numbers of juvenile salmonids migrating downstream from Upper Mainstem in the spring of 2010 are shown in Table 10. The estimated number of age 1+ coho salmon migrants in 2010 (5,052) was lower than in 2009, but was still among the highest estimates in the past 15 years and far exceeded the long-term average for this site. The relatively high number of coho smolt migrants in 2010 can be explained by the large summer rearing population in 2009 and overwinter survival in 2009-10 that was slightly above average (see below). The week of peak migration of age 1+ coho salmon in 2010 in Upper Mainstem was April 12-18. The week of peak migration in Upper Mainstem has varied considerably over time, but often falls in the middle or latter part of April (Table 12). The mean fork length of age 1+ coho smolts during the peak week (81 mm) was slightly lower than other years with comparable peak migration timing (Table 12), but the overall size distribution of coho smolts was similar to previous years.

The number of coho salmon fry migrants in Upper Mainstem in 2010 (161,245) was the second highest estimate since monitoring began at this site, and far exceeded estimates from recent years (Table 11). The large increase in coho salmon fry migrants over the last three years is consistent with the trend in adult spawner abundance (see below). The number of cutthroat (≥90mm) migrants in 2010 (1,857) was very similar to estimates from the previous two years, and is nearly twice the long-term average for this site (Table 11). Very few steelhead migrants (≥90mm) were caught in Upper Mainstem in 2010, and an estimate of total migrants could not be made (Table 11).

Table 10. Weekly estimates of the number of juvenile salmonids migrating downstream from Upper Mainstem Lobster Creek, spring 2010.

Week	Coho 1+	Coho Fry	Trout Fry	Chinook Fry	Trout 60-89mm	Steelhead ≥90mm	Cutthroat ≥90mm
FEB 22-28	0	0	0	0	0	0	0
MAR 1-7	79	821	0	0	0	0	37
MAR 8-14	202	4,684	0	0	1[a]	1[a]	25
MAR 15-21	637	15,009	0	0	1[a]	0	78
MAR 22-28	548	16,026	10	0	3[a]	0	130
MAR 29-APR 4	474	8,905	0	0	1[a]	0	31
APR 5-11	262	18,536	460	0	1[a]	0	29
APR 12-18	790	34,932	1235	0	0	0	165
APR 19-25	510	22,178	2,089	0	2[a]	0	257
APR 26-MAY 2	437	18,443	507	0	1[a]	1[a]	208
MAY 3-9	194	8,374	1022	0	0	1[a]	77
MAY 10-16	506	7,122	1402	0	1[a]	1[a]	494
MAY 17-23	263	4,016	549	0	0	1[a]	209
MAY 24-30	75	642	167	0	0	0	85
MAY 31-JUNE 6	75	1,557	783	0	0	0	32
Total	5,052	161,245	8,224	0	11[a]	5[a]	1,857

[a]Few marked fish recaptured, thus trap efficiency is not available. Number shown is total fish captured, not an expanded estimate of total migrants using trap efficiency.

Table 11. The estimated number of juvenile salmonids migrating downstream each spring in Upper Mainstem Lobster Creek 1988-2010.

Trap Year	Trap Start Date	Coho 1+	Coho Fry	Trout Fry	Chinook Fry	Trout 60-89mm	Steelhead ≥90mm	Cutthroat ≥90mm
1988	9-Mar-88	1,337	4,311	4,100	1[a]	3[a]	2[a]	21[a]
1989	1-Mar-89	832	1,570	1,370	1[a]	1[a]	0	22
1990	5-Feb-90	974	5,419	1,218	0	5[a]	14	55
1991	4-Feb-91	3,455	6,702	449	0	7[a]	36	319
1992	4-Feb-92	4,171	2,430	9[a]	0	15[a]	284	762
1993	3-Feb-93	2,666	21,077	1,138	0	21[a]	209	382
1994	1-Feb-94	8,909	8,628	21[a]	0	37[a]	101	579
1995	1-Feb-95	5,797	1,759	12[a]	0	0	10[a]	606
1996	12-Feb-96	428	0	0	0	1[a]	2[a]	73
1997	3-Mar-97	214	1,266	6,561	0	0	6[a]	7[a]
1998	2-Mar-98	2,913	3,915	1,406	0	584	484	1,391
1999	1-Mar-99	1,481	353	9,135	0	24[a]	147	398
2000	28-Feb-00	377	5,811	20,006	0	799	494	645
2001	28-Feb 01	4,173	18,238	1,947	0	665	347	1,134
2002	25-Feb-02	4,506	11,486	2,272	0	9[a]	196	761
2003	28-Feb-03	5,059	218,174	15,769	3,439	212	21[a]	1,459
2004	1-Mar-04	4,814	147,083	14,250	0	9[a]	23[a]	1,514
2005	27-Feb 05	4,924	69,203	618	0	4[a]	46	1,647
2006	26-Feb 06	4,187	43,583	1,043	0	70	20[a]	1,556
2007	1-Mar-07	3,848	36,753	5,258	67,068	1[a]	14[a]	2,463
2008	29-Feb-08	2,720	23,153	2,760	0	3[a]	14[a]	1,909
2009	28-Feb-09	5,370	97,191	2,406	0	89	6[a]	1,854
2010	27-Feb-10	5,052	161,245	8,224	0	11[a]	5[a]	1,857
	Average	3,400	38,667	4,997[b]	3,357[b]	302[b]	197[b]	1,018[b]

[a]Few marked fish recaptured, thus trap efficiency is not available. Number shown is total fish captured, not an expanded estimate of total migrants using trap efficiency.

[b]Average only includes years for which trap efficiency estimates are available.

Table 12. Number of coho salmon smolts (±95% CI), week of peak migration, and mean fork length of smolts during week of peak migration in Upper Mainstem Lobster Creek.

Sample Year	Smolts ± CI			Peak Week	Mean FL (mm) ± CI		
1988	1,337	±	210	4/4-4/10	80.3	±	3.4
1989	832	±	240	3/6-3/12	67.8	±	1.6
1990	974	±	103	4/23-4/29	98.0	±	4.1
1991	3,455	±	153	4/1-4/7	75.4	±	2.7
1992	4,171	±	198	3/30-4/5	na		
1993	2,666	±	175	4/19-4/25	94.8	±	3.6
1994	8,909	±	351	3/28-4/3	74.3	±	3.1
1995	5,797	±	279	4/24-4/30	90.0	±	5.0
1996	428	±	235	4/29-5/5	109.0	±	4.0
1997	214	±	351	4/14-4/20	112.1	±	4.0
1998	2,913	±	333	4/20-4/26	92.4	±	4.5
1999	1,481	±	184	5/3-5/9	92.2	±	3.8
2000	377	±	151	5/8-5/14	98.3	±	2.8
2001	4,173	±	411	3/26-4/1	81.2	±	2.6
2002	4,506	±	316	4/8-4/14	79.6	±	3.7
2003	5,059	±	279	4/7-4/13	83.0	±	3.8
2004	4,814	±	349	4/5-4/11	82.5	±	4.2
2005	4,924	±	404	3/28-4/3	79.6	±	3.3
2006	4,187	±	230	5/15-5/21	101.5	±	3.2
2007	3,848	±	261	4/9-4/15	82.9	±	3.6
2008	2,720	±	186	4/28-5/4	88.2	±	3.7
2009	5,370	±	305	4/27-5/3	89.8	±	3.6
2010	5,052	±	306	4/12-4/18	81.4	±	3.3

Overwinter Survival

The estimated 2009-10 overwinter survival of juvenile coho salmon (2008 brood year) was 26.3% in East Fork and 31.5% in Upper Mainstem, indicating that overwinter survival during the winter of 2009-10 was similar to the long-term average in East Fork and slightly above average in Upper Mainstem (Table 13). The estimated overwinter survival rate was higher in Upper Mainstem that East Fork for the fifth consecutive year, reversing a trend from 1998-2003, when the overwinter survival rate was generally higher in East Fork.

Table 13. The estimated overwinter survival rate of juvenile coho salmon in East Fork Lobster and Upper Mainstem Lobster Creek. Survival was calculated by dividing the number of downstream migrating 1+ coho salmon captured in brood year + 2 by the summer population of juvenile coho in brood year +1.

Brood Year	E.F. Lobster Cr.	U.M. Lobster Cr.
1987	23.5%	7.8%
1988	25.9%	15.2%
1989	11.0%	19.0%
1990	26.4%	54.6%
1991	26.6%	30.2%
1992	23.0%	38.7%
1993	13.9%	37.4%
1994	12.2%	4.4%
1995	28.0%	22.8%
1996	11.6%	N/A
1997	18.7%	21.6%
1998	50.4%	22.3%
1999	51.4%	44.5%
2000	28.6%	26.4%
2001	18.8%	35.5%
2002	29.5%	22.1%
2003	41.9%	33.2%
2004	31.8%	38.6%
2005	22.1%	24.9%
2006	23.1%	24.5%
2007	31.2%	41.9%
2008	26.3%	31.5%
Average	26.2%	28.4%

Spawning Adult Surveys

From October 29, 2009 through February 9, 2010, we conducted weekly surveys to count adult salmon and steelhead in each stream. A single observer walking the entire salmon-bearing length of each study stream counted the number of redds and the number of live and dead salmon and steelhead. Area-under-the-curve (AUC) extrapolation techniques (Biedler and Nickelson 1980; Neilson and Geen 1981; Solazzi 1984) were used to estimate the total number of spawning salmon from the survey data.

Counts of live adult coho spawners during the 2009-10 spawning season are shown in Table 14. Coho spawning took place over an extended period beginning in November and continuing through early February, which is typical for these streams. Based on AUC adjusted estimates, a total of 257 and 468 adult coho salmon were estimated to have spawned in East Fork and Upper Mainstem, respectively. These estimates far exceed the long-term averages for these sites and continue an increasing trend in adult spawner abundance over the last four years (Table 15). The increase in spawner abundance was much greater in Upper Mainstem than in East Fork, where the estimated number of spawners in 2009-10 was only slightly higher than in 2008-09. This difference between the two sites can be explained by the small number of adults that returned to spawn in East Fork in 2006-07 (Table 15), which resulted in far fewer smolt outmigrants from East Fork in 2008 (2006 brood that returned to spawn in 2009-10) compared with Upper Mainstem. As noted above, the distribution of spawning in East Fork during the 2009-10 season was strongly influenced by a large log jam located approximately 1.3 km above the smolt trapping site. This log jam functioned as a barrier to adult fish passage for much of the spawning season, and very few coho spawned above this point.

Only one adult Chinook salmon spawner was observed in Upper Mainstem in 2009-10, and no Chinook salmon spawners were observed in East Fork (Table 14). As is often the case, low stream flow conditions persisted through October and early November in 2009, limiting access to these streams for spawning Chinook salmon. We did not capture any Chinook salmon fry during the 2010 juvenile trapping season, further indicating that there was no Chinook spawning in surveyed reaches.

Table 14. Spawning ground counts for live adult coho and Chinook salmon in East Fork Lobster and Upper Mainstem Lobster creeks during the winter of 2009-10.

Date	E.F. Lobster Cr.		U.M Lobster Cr.	
	Coho	Chinook	Coho	Chinook
10/29/2009	0	0	0	0
11/4/2009	0	0	0	0
11/12/2009	22	0	20	1
11/18/2009	48	0	63	0
11/25/2009	61	0	91	0
12/3/2009	34	0	51	0
12/9/2009	9	0	5	0
12/17/2009	32	0	28	0
12/23/2009	32	0	127	0
12/30/2009	30	0	65	0
1/5/2010	17	0	65	0
1/11/2010	19	0	48	0
1/20/2010	7	0	15	0
1/28/2010	2	0	2	0
2/2/2010	2	0	3	0
2/9/2010	0	0	0	0

Table 15. Area-under-the-curve estimates of the number of adult coho and Chinook salmon spawning in East Fork Lobster and Upper Mainstem Lobster creeks, 1986-2010 brood years.

Brood Year	E.F. Lobster Cr.		U.M. Lobster Cr.	
	Coho	Chinook	Coho	Chinook
1986	159	14	31	0
1987	90	8	32	0
1988	302	112	22	0
1989	154	0	40	0
1990	32	0	9	0
1991	21	0	11	0
1992	272	0	284	0
1993	20	0	47	0
1994	30	0	25	0
1995	36	0	34	0
1996	25	0	23	0
1997	47	0	25	0
1998	6	0	1	0
1999	21	1	39	0
2000	105	0	107	0
2001	52	53	52	0
2002	671	7	802	0
2003	753	1	824	1
2004	167	0	183	0
2005	492	0	487	1
2006	21	37	85	78
2007	53	0	138	0
2008	245	0	292	0
2009	257	0	468	1
Average	168	10	169	3

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