Summary of Habitat and Fish Monitoring Data from East Fork and Upper Mainstem Lobster Creeks: 1988-2011

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Oregon Department of Fish and Wildlife

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 2010-11 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 2007-2011. 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).

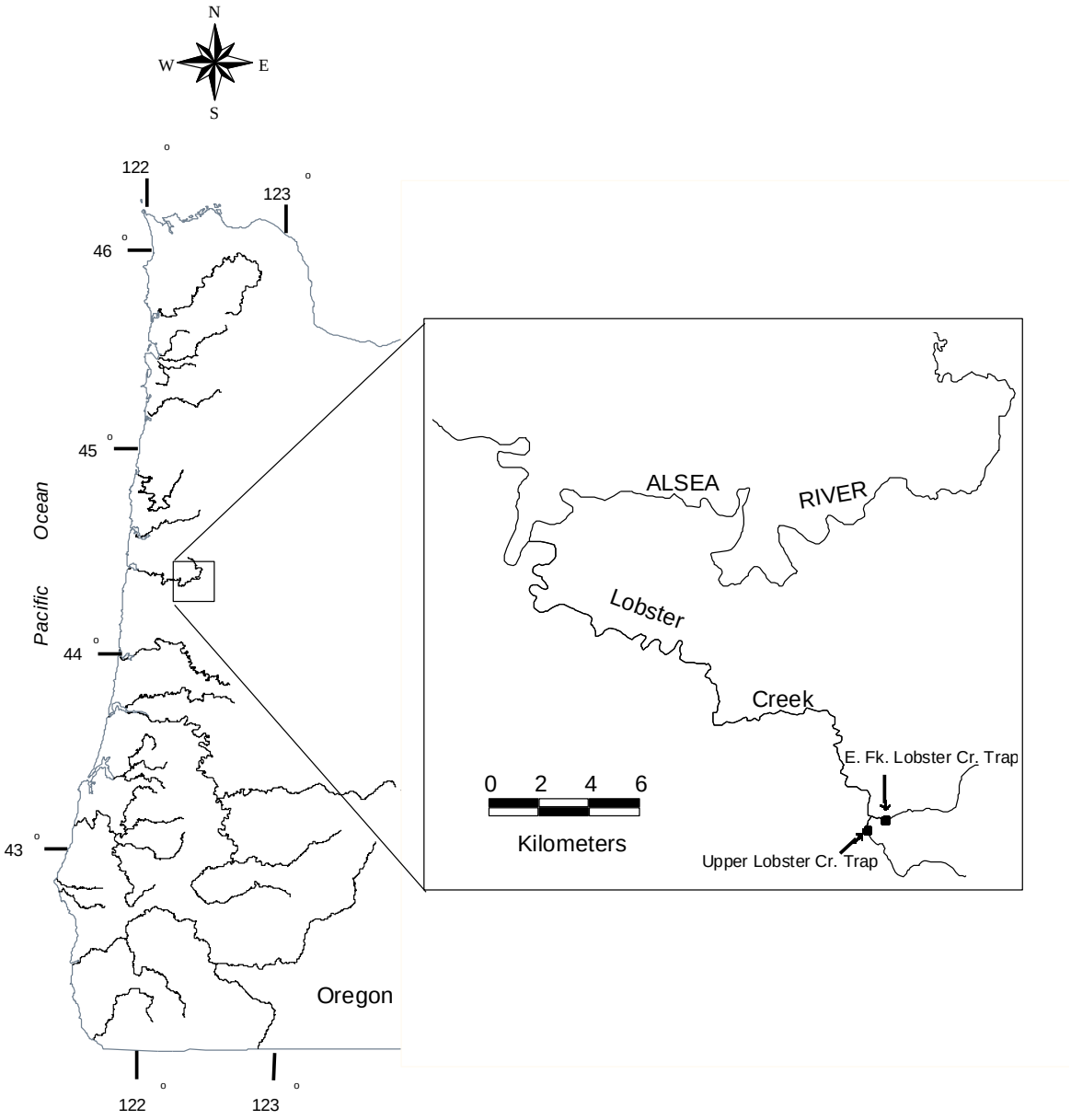

Figure 1. Locations of traps in East Fork and Upper Mainstem Lobster creeks in the Alsea Basin.

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	162
% Clay	N/A	0	0	0	0	0	0	0	0.1	0	0	0.1	0	0.1	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	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	1,961
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	4,828
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	N/A	0	0	0	0	0	N/A	N/A	0	0.1	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	18.6
% 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	0.1	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 2011 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).

In the summers of 2003-2011, 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 2003-2011 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 2003-11. 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 2003-2011 (Table 5).

In 2011, we estimated the summer rearing population of juvenile coho salmon to be 8,460 in East Fork and 11,913 in Upper Mainstem. Both estimates were similar to long-term averages for these sites and were higher than population estimates in summer 2010, despite the fact that we observed fewer adult spawners in winter 2010-11 compared to the previous year (see below). The increase in the summer rearing population in East Fork was related in part to changes in a large log jam located in the lower half of the stream. In winter 2009-10, this log jam was not passable for adult coho for much of the spawning season, and the limited spawning activity upstream resulted in low juvenile coho rearing densities above the log jam in summer 2010. In winter 2010-11, changes in flow patterns through the log jam allowed many more adult coho to move past it and spawn upstream, and this was reflected in higher coho rearing densities above the log jam in summer 2011.

Table 5. Juvenile salmonid summer population estimates in East Fork Lobster and Upper Mainstem Lobster creeks, 1988-2011.

	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	8,819	2,951	216	1,268
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	---	--	---	10,887	---	--	---
2011	8,460	---	--	---	11,913	---	--	---
Average	9,266	3,458	545	981	11,983	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 2011.

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	0.72

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 2011 are shown in Table 7. The number of 1+ coho salmon migrants in East Fork in 2011 (1,625 fish) was below average for this site, and was one of the lowest estimates over the past 10 years (Table 8). As discussed above, the 2009 brood had a relatively large number of spawners, but a restricted spawning distribution contributed to a low summer rearing population in 2010. The overwinter survival rate for this brood was also slightly below average (see below), resulting in a relatively small number of smolt out-migrants. The week of peak migration in 2011 was March 28-April 3, which is not unusual for this site (Table 9). The mean fork length of coho smolts was 81.5 mm during the week of peak migration (Table 9). Mean smolt size tends to increase throughout the trapping season and the size of smolts in 2011 was fairly typical given the timing of the peak migration week.

Table 7. Weekly estimates of the number of juvenile salmonids migrating downstream from East Fork Lobster Creek, spring 2011.

Week	Coho 1+	Coho Fry	Trout Fry	Chinook Fry	Trout 60-89mm	Steelhead ≥90mm	Cutthroat ≥90mm
FEB 28-MAR 6	102	1,553	0	0	34	4	13
MAR 7-13	91	2,770	0	0	61	4	53
MAR 14-20	39	5,476	0	0	7	0	0
MAR 21-27	131	9,653	44	0	14	0	46
MAR 28-APR 3	210	10,720	0	0	31	4	33
APR 4-10	129	10,352	0	0	21	4	13
APR 11-17	114	17,282	22	0	65	8	25
APR 18-24	74	29,438	0	0	24	3	10
APR 25-MAY 1	146	19,990	1,006	0	112	7	61
MAY 2-8	160	21,700	1,792	0	59	6	32
MAY 9-15	152	2,599	321	0	81	7	276
MAY 16-22	143	3,196	247	0	30	3	196
MAY 23-29	116	3,930	1,454	0	10	13	114
MAY 30-JUNE 5	13	945	703	0	10	0	69
JUNE 6-12	5	1,000	1,102	0	20	0	52
Total	1,625	140,604	6,691	0	579	63	993

Table 8. The estimated number of juvenile salmonids migrating downstream each spring in East Fork Lobster Creek, 1988-2011.

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
2011	2-Mar-11	1,625	140,604	6,691	0	579	63	993
Average		2,246	71,622	7,095[b]	12,717	349[b]	295[b]	833[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
2011	1,625 ± 154	3/28-4/3	81.5 ± 6.5

Although the 2009 coho brood in East Fork produced relatively few smolts, it is interesting to note that this brood had an unusually large number of fry migrants (2010 trap year, Table 8) compared with other broods with similar spawner abundance. This was likely related to the concentration of spawning in the lower portion of the stream above the trap and the numerous spring freshets that occurred in 2010. Many of these fry may have successfully reared downstream from East Fork, but it is unknown how these migrants affect overall smolt abundance in Lobster Creek. The estimated number of coho salmon fry migrants in East Fork in 2011 was also high compared to the long-term average for this site and relative to other years with similar numbers of spawners, with wet spring weather again being a potentially important factor. The number of cutthroat trout (≥90mm) migrants in 2011 was above average for this site, while the number of steelhead (≥90mm) was low compared to estimates in recent years (Table 8).

The estimated numbers of juvenile salmonids migrating downstream from Upper Mainstem in the spring of 2011 are shown in Table 10. The estimated number of age 1+ coho salmon migrants in 2011 (2,731) was significantly lower than the previous two years, and fell below the long-term average for this site (Table 11). A relatively small summer rearing population in 2010 and below-average overwinter survival both contributed to the drop in smolt abundance in 2011. The 2009 brood in Upper Mainstem had a large number of adult coho spawners, but had low freshwater survival (egg to smolt) and produced far fewer smolts than most other broods in recent years. The week of peak migration of age 1+ coho salmon in 2011 in Upper Mainstem was April 25-May 1. 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 (88.1 mm) was very similar to other years with comparable peak migration timing (Table 12).

Table 10. Weekly estimates of the number of juvenile salmonids migrating downstream from Upper Mainstem Lobster Creek, spring 2011.

Week	Coho 1+	Coho Fry	Trout Fry	Chinook Fry	Trout 60-89mm	Steelhead ≥90mm	Cutthroat ≥90mm
FEB 28-MAR 6	33	1,137	0	0	2[a]	0	19
MAR 7-13	172	1,200	0	0	2[a]	0	115
MAR 14-20	137	2,237	0	0	0	0	19
MAR 21-27	163	10,180	0	0	1[a]	0	38
MAR 28-APR 3	262	21,663	0	0	0	0	23
APR 4-10	155	14,599	0	0	0	0	20
APR 11-17	180	11,945	0	0	0	0	139
APR 18-24	170	14,978	0	0	0	2[a]	100
APR 25-MAY 1	418	14,365	4[a]	0	2[a]	0	192
MAY 2-8	322	3,172	25[a]	0	0	0	205
MAY 9-15	144	891	6[a]	0	0	0	294
MAY 16-22	281	341	4[a]	0	0	0	361
MAY 23-29	231	1,358	10[a]	0	0	0	195
MAY 30-JUNE 5	50	859	3[a]	0	0	0	76
JUNE 6-12	13	772	18[a]	0	1[a]	0	22
Total	2,731	99,697	70[a]	0	8[a]	2[a]	1,818

[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, 1988-2011.

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	1947	0	665	347	1,134
2002	26-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	5258	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
2011	2-Mar-11	2,731	99,697	70[a]	0	8[a]	2[a]	1,818
Average		3,372	41,210	4,997[b]	3,205[b]	302[b]	197[b]	1,055[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
2011	2,731 ± 204	4/25-5/1	88.1 ± 2.7

The number of coho salmon fry migrants in Upper Mainstem in 2011 (99,697) was down from the previous year (Table 11), consistent with the decreased number of spawners in winter 2010-11. Nevertheless, the estimated number of fry moving downstream past the trap in 2011 was still quite high relative to the long-term average for this site, and compared to other years with similar spawner abundance. As noted above for East Fork, wet conditions and numerous freshets in spring 2011 may have caused many newly emerged fry to be displaced downstream. The number of cutthroat (≥90mm) migrants in 2011 (1,818) was very similar to estimates from the past several years and nearly twice the long-term average for this site (Table 11). The estimated number of cutthroat migrants in Upper Mainstem over the last nine years has consistently been higher than during the first 15 years of monitoring. Only two steelhead migrants (≥90mm) were caught in Upper Mainstem in 2011, and an estimate of total migrants could not be made (Table 11).

Overwinter Survival

The estimated 2010-11 overwinter survival of juvenile coho salmon (2009 brood year) was 24.4% in East Fork and 25.1% in Upper Mainstem, indicating that overwinter survival during the winter of 2010-11 was slightly below average in both streams (Table 13). Overwinter survival appeared to be very similar between the two sites in 2010-11, in contrast to the previous five years when the estimated overwinter survival rate for juvenile coho rearing in Upper Mainstem was consistently higher than for those rearing in East Fork (Table 13).

Table 13. The estimated overwinter survival rate of juvenile coho salmon in East Fork Lobster and Upper Mainstem Lobster creeks. 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	Overwinter Survival Rate	
	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%
2009	24.4%	25.1%
Average	26.1%	28.3%

Spawning Adult Surveys

From October 22, 2010 through February 3, 2011, 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 2010-11 spawning season are shown in Table 14. Coho spawning took place over an extended period beginning in early November and continuing through January, which is typical for these streams. The peak in spawning activity occurred in December this past winter, and has varied from early November to the middle of January in previous years at these sites. Based on AUC adjusted estimates, a total of 113 and 193 adult coho salmon were estimated to have spawned in East Fork and Upper Mainstem, respectively. Adult spawner numbers were down significantly from the previous year at both sites. The number of smolt out-migrants was significantly higher in 2009 (2007 brood that returned to spawn in 2010-11) than in 2008 at East Fork and Upper Mainstem, and so the drop in spawner abundance in 2010-11 reflected a sharp decline in marine survival for coho salmon. At East Fork, the estimated number of spawners in 2010-11 was below the long-term average, while the adult spawner estimate for Upper Mainstem in 2010-11 was above average (Table 15). During the first 20 years of monitoring, adult spawner estimates in East Fork were often comparable to or even higher than estimates for Upper Mainstem. During the last five years, however, Upper Mainstem has consistently had significantly higher numbers of adult coho spawners than East Fork. This pattern is consistent with the larger number of smolts that Upper Mainstem has produced in the broods corresponding to these adult returns.

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 2010-11.

	E.F. Lobster Cr.		U.M Lobster Cr.	
Date	Coho	Chinook	Coho	Chinook
10/22/2010	0	0	0	0
10/28/2010	0	0	0	0
11/5/2010	5	0	6	0
11/12/2010	7	0	10	0
11/17/2010	7	0	7	0
11/24/2010	9	0	15	0
12/2/2010	19	0	37	0
12/8/2010	22	0	36	0
12/16/2010	20	0	54	0
12/23/2010	25	0	43	0
12/30/2010	14	0	16	0
1/6/2011	5	0	3	0
1/11/2011	2	0	1	0
1/19/2011	1	0	3	0
1/27/2011	1	0	0	0
2/3/2011	0	0	0	0

No adult Chinook salmon spawners were observed in East Fork or Upper Mainstem in 2010-11 (Table 14). As is often the case, low stream flow conditions persisted through October and early November in 2010, limiting access to these streams for spawning Chinook salmon. We did not capture any Chinook salmon fry at either site during the 2011 juvenile trapping season, further indicating that there was no Chinook spawning in surveyed reaches.

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
2010	113	0	193	0
Average	166	9	170	3

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