TEN MILE RIVER

HABITAT AND FISHERY EVALUATION SURVEY

FOR

SALMON RESTORATION ASSOCIATION, INC

BY

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This report summarizes the Habitat Typing efforts and fish stock assessments in the Ten Mile River conducted in the fall of 1991.

INTRODUCTION

In the Ten Mile River basin, approximately 28 miles, 48 acres, and 46 acre-feet of stream were assessed by Habitat Typing. In this survey procedure, Habitat units were classified as belonging to one of 24 habitat types as outlined in the California Department of Fish and Game's Habitat Restoration Manual. Measurement taken for each habitat unit were length, mean width, mean depth, maximum depth, and pool tail crest depth. Estimates of embeddedness, type and extent of cover, substrate composition, canopy, and bank composition type were made. Additionally, air and water temperature were taken as well as measurements to determine flow.

RESULTS OF HABITAT TYPING

A map of the Ten Mile River System is shown in Figure 1. The areas "typed" are shown in Figure 2 by the tributary and by reach. They include the North Fork between the Middle Fork and Little North Fork (LNF) a distance of 2.1 miles: the Middle Fork between the mouth and Little Bearhaven Creek (LBHC) about 7 miles; the South Fork between Smith Creek and Churchman Creek (6.8 miles) and from the mouth of Redwood to a distance 0.7 miles upstream. The tributaries surveyed in the North Fork basin were the Little North Fork from the mouth to fork 3.2 miles upstream; 0.7 miles of Buckhorn Creek, a Little North Fork tributary; Bald Hills Creek to fork about 1 mile upstream.

In the Middle Fork Basin, Bearhaven Creek (BHC) was surveyed for a distance of 1.8 miles; the South Fork Bearhaven (SFBHC) for .25 miles; Little Bearhaven Creek (LBHC) 0.4 miles; and Booth Gulch .19 miles. In the South Fork drainage the tributaries surveyed were Smith Creek for a distance of about 1.25 miles; Campbell Creek for about 1.6 miles; and Redwood Creek from mouth to bridge about 0.7 miles.

The breakdown of these areas into the respective categories pools, riffles, ect., is shown on Tables 1A and 1B. For the three main forks, the percent of these habitats are quite similar with the exception of there being dry river-bed in the South Fork. When comparing surface area and water volume, the South Fork appears to have relatively more pool habitat than the other two streams. The South Fork has the lowest percentage of riffle and glide but this relationship is influenced by the dry habitat areas and these relative distributions would change if surveys were taken at higher flow levels.

At the bottom of table 1B, are the percentages of the stream surface covered by canopy. The streams with the least amount of canopy were the North Fork, Smith Creek, Redwood and especially the upper South Fork. The areas of greatest canopy were the smallest streams surveyed; Booth Gulch, SFBHC, Buckhorn Creek, and LBHC. These areas are also areas with relatively high values of conifer canopy.

To compare the relative amounts of pool habitat, the total surface of the stream is compared to the surface area of pools. In this comparison, the SFBH had the highest relative amount of pool habitat with LBHC following with just slightly less. Smith, Campbell, BHC, Upper South Fork(USF) all had about 45 percent of their area composed of pool habitat The LNF, Bald Hills Creek, and Booth follow behind at 36 percent. Buckhorn Creek's pool composition had the lowest rating but it was influenced by it's

Figure 1. The Map of the Ten Mile River Basin and Adjacent Streams.

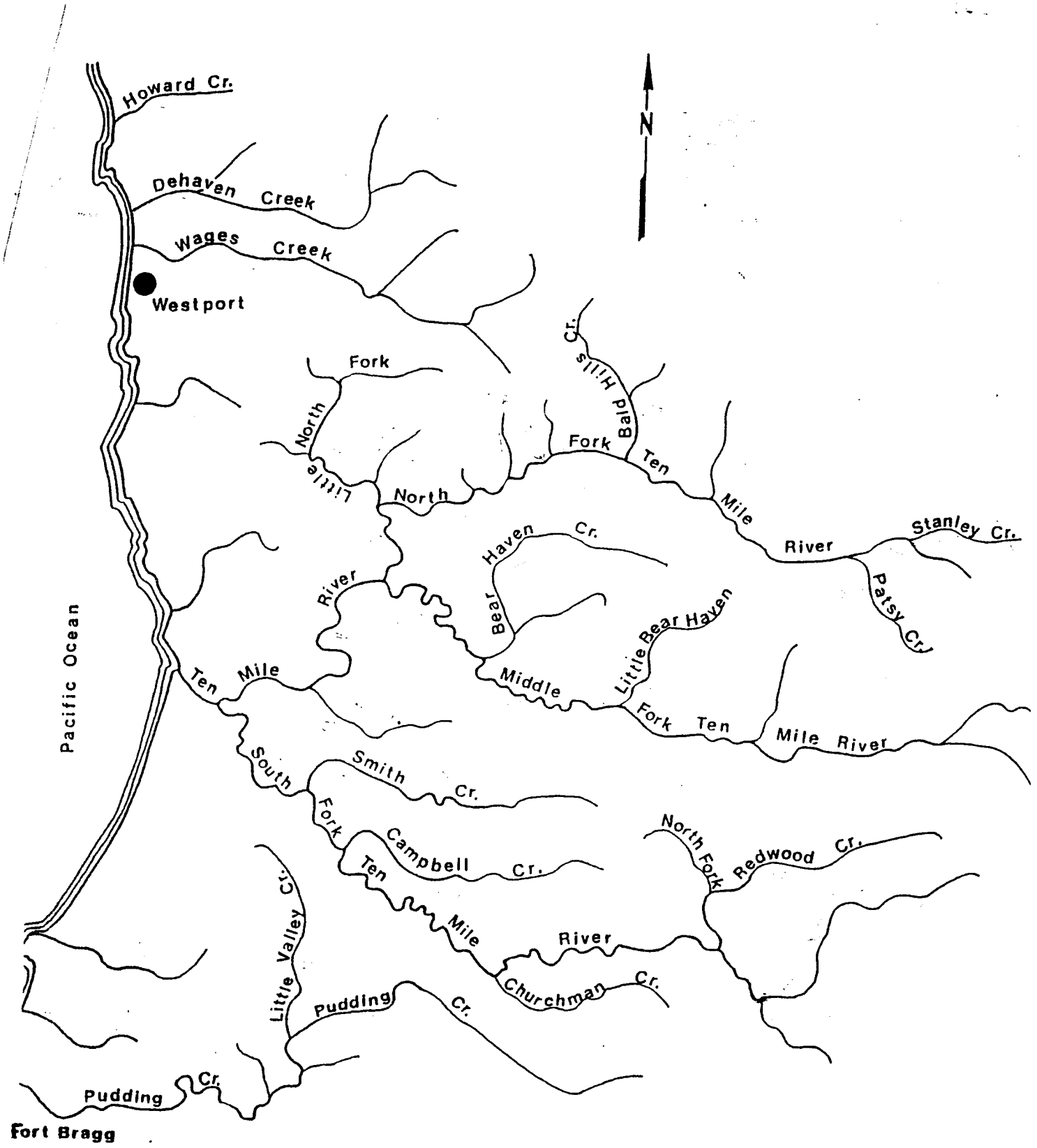

FIGURE 2. Areas Habitat Typed and Electro-shocked in the Ten Mile River Basin. Electro-shock sites are denoted by triangles.

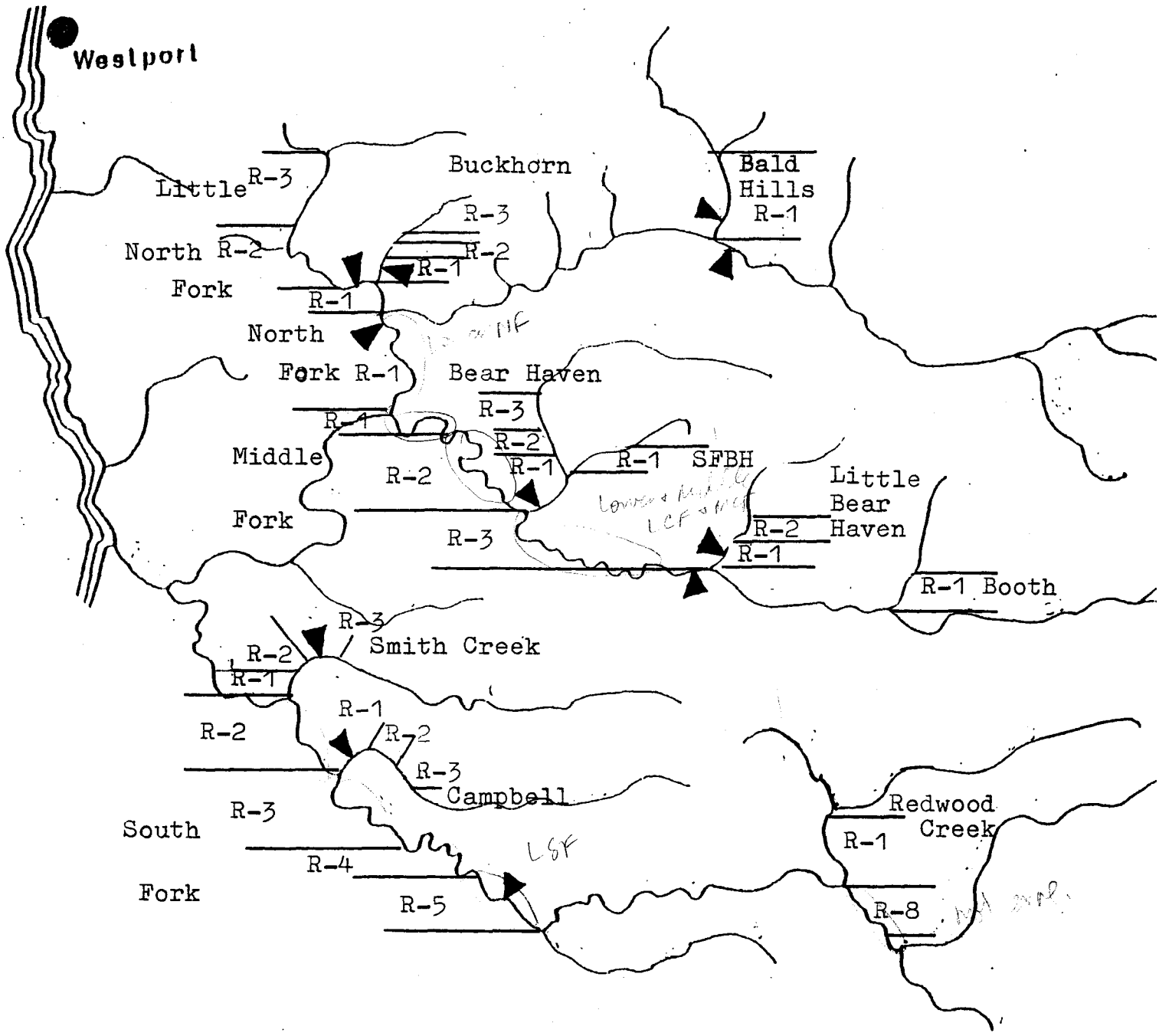

TABLE 1A. Percent of Habitat units, Total Length, Area, Water Volume, Composed by Pools, Riffles, Flatwater and Dry Habitats in all Streams Surveyed

HABITAT TYPE	N. FORK	LNF	BUCK.CR.	BALD H.	MID.FK	BEAR H.	SFBH	LBH	BOOTH G.	S.FORK	SMITH	CAMPBELL	Up.SF	REDWOOD
	PERCENT OF HABITAT UNITS													
Pool	43	40	34	33	37	33	43	40	32	38	41	36	30	34
Riffle	23	32	35	25	29	39	36	21	41	22	32	34	39	39
Flatwater	34	28	23	42	34	28	13	33	24	33	27	30	28	25
Cascade	0	0	0	0	0	0	2	1	3	0	0	0	0	1
Dry	0	0	8	0	0	0	6	5	0	7	0	0	3	1
	PERCENT OF STREAM LENGTH													
Pool	35	32	14	27	31	29	43	33	23	34	36	29	21	27
Riffle*	19	33	41	26	22	34	40	24	46	12	28	38	40	48
Flatwater	46	35	15	47	47	37	12	36	31	39	36	33	36	24
Dry	0	0	0	0	0	0	5	8	0	15	0	0	3	1
	PERCENT OF STREAM AREA													
Pool	38	36	28	35	31	45	57	52	38	49	45	44	45	44
Riffle*	16	28	49	24	19	25	30	16	29	8	24	24	32	29
Flatwater	47	36	22	41	50	30	13	33	33	44	31	32	22	27
	PERCENT OF STREAM VOLUME													
Pool	61	56	51	61	50	65	84	74	62	68	68	71	74	76
Riffle*	6	13	34	11	6	9	9	5	13	1	10	6	8	6
Flatwater	33	31	16	28	44	26	7	21	24	31	22	23	18	18

* Includes habitat classified as cascade.

TABLE 1B. Number Pools, Riffles, Flatwater, Cascade, and Dry Habitat Units and the Area and Volume that these Habitats Occupy with the Percent of the Unit Area Covered by Canopy

HABITAT TYPE	N. FORK	LNF	BUCK.CR.	BALD H.	MID.FK	BEAR H.	SFBH	LBH	BOOTH G.	S.FORK	SMITH	CAMPBELL	Up.SF	REDWOOD
Pool	55	158	33	48	210	82	20	32	13	234	94	98	19	29
Riffle	29	126	34	37	165	97	17	17	17	138	73	92	25	34
Flatwater	44	108	23	62	190	69	6	26	10	202	61	80	18	22
Cascade	0	0	0	0	0	0	1	1	1	1	0	0	0	1
DRY	0	0	8	0	0	0	3	4	0	45	0	1	2	1
TOT.UNITS	128	392	98	147	565	248	47	80	41	620	228	271	64	88
LENGTH HABITAT BY TYPE														
Pool	3935	5633	533	1466	11615	2771	476	716	225	12726	2517	2370	776	979
Riffle*	2128	5862	1529	1438	8318	3256	440	526	452	4450	1988	3156	1457	1724
Flatwater	5090	6151	581	2583	17507	3604	144	792	311	14287	2488	2731	1311	855
Dry	0	0	1110	0	0	0	53	166	0	5424	0	10	105	30
Total	11153	17646	3752	5487	37440	9631	1113	2200	988	36887	6993	8267	3649	3588
SQUARE FEET BY TYPE														
Pool	95467	62762	4266	21445	227058	46939	3788	6611	1468	270024	26602	27814	12499	16142
Riffle*	40011	48964	7528	14550	136788	25906	1977	2041	1116	41913	14115	14757	8880	10749
Flatwater	118812	61749	3423	24765	367443	31329	873	4173	1245	243369	18168	19944	6122	9936
Total	254290	173475	15217	60760	731289	104174	6638	12825	3829	555306	58885	62515	27501	36827
CUBIC FEET BY TYPE														
Pool	131885	66942	4461	25429	367741	66482	4544	5959	1097	444041	22667	29200	16253	29505
Riffle*	12512	15204	2996	4567	43787	9273	489	427	237	9114	3411	2613	1678	2317
Flatwater	70151	37616	1375	11689	319640	26772	377	1688	423	201912	7460	9389	3891	7085
Total	214548	119762	8832	41685	731168	102527	5410	8074	1757	655067	33538	41202	21822	38907
PERCENT CANOPY														
Total	21	54	71	58	45	47	84	74	72	56	25	40	11	21
Deciduous	20	39	35	48	43	37	64	42	58	53	23	37	9	7
Conifer	1	15	36	10	2	10	20	32	14	3	2	3	2	14

Number Habitat Units =	3017
Total Length in Feet =	148794
Total Area in sq. ft =	2103531
Tot. Volume in cu.ft =	2024299

dry habitat (30 percent of it's length was dry). Generally it is the smaller streams which had higher ratios of pool to other habitat types.

A more specific representation of the various habitat types and their distribution throughout the surveyed areas of the basin are shown in Table 2. Here, some of the streams surveyed are broken down into different reaches because either changes were in stream characteristics were evident, survey procedures changed (from a total sampling procedure to a subsampling procedure), or simply because of obvious landmarks such as confluence of an important tributary. This table is useful for demonstrating differences in the types of habitat that occur between streams and within streams. For example, it can be noted that High Gradient Riffles (HGR) are found in the higher reaches of streams and in streams that are found at higher elevations; that Step Runs occurred primarily in the Bald Hills Creek area and the LBHC area.

Pool data is further evaluated in Table 3 by separating pool types into their respective categories. It can be seen that backwater pools were most common in Smith Creek; log formed pools in BHC, LNF, and SFBHC; rootwad formed pools in LBHC and the South Fork; bedrock pools on LBHC and Booth Gulch; boulder formed pools in Upper SF, Bald Hills Cr., Redwood Cr. and the North Fork. The pools with the greatest depths were Bedrock formed pools. Main-channel Pools and Plunge Pools were second and third in average depth. The greatest amounts of cover were found in Corner and Backwater Pools. The streams with the greatest pool depth averages were Redwood and Upper SF. The South Fork had rather shallow mean pool depth compared to the other forks and was comparable to small tributaries such as LNF, SFBHC or BHC.

The cover values for the principle habitat types are shown on Table 4. These values represent subjective estimates of cover which fish can use to hide from predators. Undercut banks were of little significance except in LNF, Smith and Campbell Creeks. Small woody debris (SWD) was more important and large woody debris (LWD) was the single most important cover overall. The two areas most lacking LWD were the upper SF and Bald Hill Cr., but BHC, the North and South Fork were relatively low also.

Terrestrial vegetation was significant in the South Fork, Smith Cr., Campbell Cr., and the North Fork. The South Fork drainage in particular had aquatic vegetation as a common cover type. Boulders were most prevalent in Bald Hills Cr., Booth Gulch, and LBHC and were essentially non-existent in the North Fork. There was very little boulder cover in Smith, Campbell, or SFBHC. Bedrock was a very insignificant cover type with just a little in LBHC and Booth Gulch.

The gravel quantity varied between streams and within streams. In nearly every case, gravel embeddedness increased the farther upstream the surveys went (Table 5). The lowest level of fines were found in the lower Middle Fork, lower Smith and Campbell Creeks. The worst conditions were found in Redwood Cr., Upper SF., Booth Gulch, and upper Campbell Cr. Other streams with poor gravel conditions were Buckhorn Cr., Bald Hills Cr., upper LNF, LBHC, and most sections of the South Fork. Fair conditions were

TABLE 2. Nuaber of Habitat Units By Type in the Survey Areas within the Ten Mile River Basin

REACH	LGR	HGR	CAS	BRS	GLD	RUN	SRN	EDW	TRP	MCP	CCP	STP	CRP	LSL	LSR	LSBk	LSBo	PLP	SCP	BPB	BPR	BPL	DPL	DRY	TOTALS
NORTH FORK TEN MILE																									
1	28	1	0	0	32	12	0	0	0	3	0	0	2	26	10	6	6	0	0	0	0	1	1	0	128
LITTLE NORTH FORK TEN MILE																									
1	44	0	0	0	22	3	1	0	0	2	2	1	3	18	13	2	2	2	0	0	5	3	0	0	123
2	35	0	0	0	43	0	0	0	0	0	0	0	3	43	3	2	0	5	0	0	0	0	0	0	134
3	45	2	0	0	28	6	5	0	0	0	0	0	1	33	5	10	0	0	0	0	0	0	0	0	135
BUCKHORN CREEK																									
1	13	0	0	0	11	1	0	0	0	0	0	1	2	11	0	1	0	1	0	0	0	0	0	7	48
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
3	15	6	0	0	9	2	0	0	0	0	0	2	0	5	3	5	0	1	0	0	0	1	0	0	49
BALD HILLS CREEK																									
1	26	11	0	0	24	12	26	0	0	0	0	2	0	8	16	12	6	2	0	0	1	1	0	0	147
MIDDLE FORK TEN MILE																									
1	15	0	0	0	8	3	0	1	0	0	0	0	1	8	5	1	1	0	0	1	2	1	0	0	47
2	30	3	0	0	61	2	0	0	1	4	0	0	1	27	11	13	9	1	2	2	0	3	0	0	190
3	83	14	0	0	104	11	0	0	0	8	1	1	4	37	20	23	8	2	3	1	4	4	0	0	329
BEARHAVEN CREEK																									
1	46	0	0	0	24	9	0	0	0	1	1	0	1	25	6	2	0	0	0	0	0	0	0	0	115
2	14	0	0	0	5	0	0	0	0	0	0	0	0	10	1	0	7	0	0	0	0	0	0	0	37
3	37	0	0	0	31	0	0	0	0	0	0	0	0	25	1	0	0	0	0	0	0	1	1	0	96
SOUTH FORK BEARHAVEN CREEK																									
1	16	1	1	0	6	0	0	0	0	0	0	2	0	12	4	1	0	1	0	0	0	0	0	3	47
LITTLE BEARHAVEN CREEK																									
1	4	1	0	1	9	2	6	0	0	0	0	4	0	0	2	8	1	0	0	0	0	2	0	0	40
2	8	4	0	0	7	0	2	0	0	0	0	0	0	2	10	1	0	2	0	0	0	0	0	4	40
BOOTH GULCH																									
1	8	8	1	0	8	0	2	0	0	1	0	1	1	2	3	4	0	0	0	2	0	0	0	0	41
SOUTH FORK TEN MILE																									
2	15	0	0	0	36	3	0	0	0	7	1	0	1	16	24	0	3	1	2	0	0	1	0	24	134
3	20	0	0	0	29	0	0	0	0	1	0	0	0	16	6	0	0	0	0	0	0	0	0	14	86
4	47	1	0	0	63	2	0	0	1	3	0	0	3	28	22	1	3	0	7	1	1	2	1	7	193
5	51	4	1	0	66	3	0	0	0	5	0	0	8	18	31	3	8	4	5	0	0	0	0	0	207
8	22	3	0	0	18	0	0	0	0	1	0	0	2	6	2	5	3	0	0	0	0	0	0	2	64
SMITH CREEK																									
1	5	0	0	0	4	4	0	0	0	2	0	0	0	2	1	0	1	1	0	0	0	0	0	0	20
2	5	0	0	0	4	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	12
3	73	0	0	0	51	10	0	0	0	5	0	3	9	29	22	0	2	4	6	2	6	4	0	0	226
CAMPBELL CREEK																									
1	29	1	0	0	29	0	0	0	0	0	0	0	7	14	13	0	0	0	0	0	2	0	1	0	96
2	33	0	0	0	24	2	0	0	0	0	0	0	10	21	4	0	0	0	0	0	0	0	1	0	95
3	26	2	0	0	13	0	0	0	0	0	0	0	4	12	1	0	1	2	0	0	0	2	0	1	64
REDWOOD CREEK																									
1	26	8	1	0	22	0	0	0	0	2	1	0	0	15	1	7	3	0	0	0	0	0	0	1	87

TABLE 3. Number (percentage) and Relative Abundance of the Various Pool Types Found. Mean Depth, Mean-Maximum Depth, Percent Cover, and Area for Seven Pool Types

POOL TYPE	N.FORK	LNF	BUCK Cr	BALD H.	MID FK	BEAR H.	SF BH	LBH	BOOTH	S. FORK	SMITH	CAMPBELL	Up. SF REDWOOD	
Main	3 (5)	5 (3)	3 (9)	2 (4)	15 (7)	2 (2)	2 (10)	4 (13)	2 (15)	18 (8)	9 (10)	0 (0)	1 (2)	3 (10)
Scour	50 (91)	147 (92)	29 (87)	44 (92)	175 (83)	79 (96)	18 (90)	26 (81)	10 (77)	196 (83)	67 (71)	89 (91)	18 (98)	26 (90)
Backwater	2 (4)	8 (5)	1 (3)	2 (4)	20 (10)	2 (2)	0 (0)	2 (6)	1 (8)	20 (9)	18 (19)	9 (9)	0 (0)	0 (0)
SCOUR POOLS														
Corner	2 (4)	7 (5)	2 (7)	0 (0)	7 (4)	1 (1)	0 (0)	0 (0)	1 (10)	12 (6)	9 (13)	21 (24)	2 (11)	0 (0)
Log	26 (52)	94 (64)	16 (55)	8 (18)	72 (41)	60 (77)	12 (67)	2 (8)	2 (20)	78 (40)	29 (43)	47 (53)	5 (33)	15 (57)
Root Wad	10 (20)	20 (12)	3 (10)	16 (36)	36 (21)	8 (10)	4 (23)	12 (46)	3 (30)	83 (42)	22 (34)	18 (20)	2 (11)	1 (4)
Bedrock	6 (12)	14 (10)	6 (21)	12 (27)	37 (22)	2 (2)	1 (5)	9 (35)	4 (40)	4 (2)	1 (1)	0 (0)	4 (28)	7 (27)
Boulder	6 (12)	2 (1)	0 (0)	6 (14)	18 (10)	7 (9)	0 (0)	1 (4)	0 (0)	14 (7)	2 (3)	1 (1)	3 (17)	3 (12)
Plunge	0 (0)	7 (5)	2 (7)	2 (5)	3 (2)	0 (0)	1 (5)	2 (8)	0 (0)	5 (3)	4 (6)	2 (2)	0 (0)	0 (0)
CORNER POOL														
Depth	.83	1.23	.95		1.02	1.1			.83	2.17	.93	.9	1.8	
Max Depth	1.1	2.32	2.25		1.83	2.4			1.3	3.82	1.92	2.01	3	
Cover	.05	.23	.36		.3	.5			.2	.48	.55	.19	.1	
Sq. Feet	238	518	399		230	475	0	0	192	3653	478	291	1620	0
LATERAL SCOUR POOL- LOG ENHANCED														
Depth	1.08	1.02	.66	.95	1.28	1.26	.86	.67	.45	1.09	.75	.99	.96	1.5
Max Depth	2.91	2.17	1.1	1.78	2.69	2.1	1.3	1.33	.98	2.01	1.37	1.85	1.77	2.2
Cover	.11	.24	.32	.15	.23	.19	.29	.37	.19	.26	.27	.27	.21	.31
Sq. Feet	1682	497	87	320	1282	564	176	22	98	970	282	311	420	549
LATERAL SCOUR POOL- ROOT WAD ENHANCED														
Depth	1.95	1.17	.53	1.03	1.37	1.28	.64	.91	.47	1.4	.88	.82		
Max Depth	3.82	2.2	1.07	2.01	2.85	2.45	1.4	1.5	1.1	2.74	1.93	1.65		
Cover	.12	.24	.48	.15	.27	.18	.18	.29	.27	.37	.32	.29		
Sq. Feet	1138	388	140	546	717	868	156	250	139	1221	335	241		
LATERAL SCOUR POOL- BEDROCK FORMED														
Depth	2.1	1.76	1.26	1.43	1.62	1.27	2	.95	.96	1.3			.96	1.42
Max Depth	6	2.89	1.94	2.42	3.46	2.5	3	1.56	1.8	2.2			2.03	2.76
Cover	.08	.15	.26	.13	.05	.18	.25	.11	.14	.1			.05	.07
Sq. Feet	2632	488	126	373	1574	784	300	199	74	1972	0		600	732
LATERAL SCOUR POOL- BOULDER FORMED														
Depth	1.6	1.55		.9	1.77	1.07		.55		1.02	.5	1	.93	1.3
Max Depth	4.5	2.78		1.7	3.45	1.76		1.1		1.74	1.12	1.9	2.03	2
Cover	.19	.2		.14	.15	.06		.2		.36	.18	.2	.11	.1
Sq. Feet	2140	1023	0	412	1325	370	0	195	0	464	240	225	412	270
PLUNGE POOL														
Depth		1.22	1.5	1.4	1.19		1	1.1			.65	1.5		
Max Depth		2.54	2	2.8	1.97		2.8	2.45			1.2	3.6		
Cover		.12	.47	.35	.18		.25	.29			.19	.15		
Sq. Feet		226	222	230	344	0	225	213	0	0	239	580	0	0
MAIN CHANNEL POOL														
Depth	1	1.7	.73	1	1.35	1.65	1.35	.8	.75	1.06	.72		2.5	2
Max Depth	2.5	2.7	1.17	2.2	2.73	2.6	2.35	1.6	1.65	2.01	1.42		3.5	4.5
Cover	.1	.22	.34	.47	.16	.05	.31	.28	.19	.2	.44		.2	.05
Sq. Feet	1892	365	200	614	1426	571	264	174	166	1517	190	0	361	560
BACKWATER POOL														
Depth	1	1.25	.7		.81	.85		.45	.7	.85	.61	.75		
Max Depth	4.5	2.04	.9		1.62	1.3		.63	1	1.34	1.05	1.19		
Cover	.15	.57	.2		.38	.13		.17	.05	.53	.51	.2		
Sq. Feet	4750	166	36		314	178	0	25	36	332	188	182	0	0

TABLE 4. Percent Cover for Each Stream Surveyed and Percent Cover by Cover Type for Four Habitat Types in the Ten Mile River Basin.

HABITAT TYPE	N. FORK	LNF	BUCK.CR.	BALD H.	MID.FK	BEAR H.	SFBH	LBH	BOOTH G.	S.FORK	SMITH	CAMPBELL	Up.SF	REDWOOD
******** PERCENT UNIT COVER ********														
LGR	2.5	7.6	7.6	17.1	7.4	6.2	7.5	2.8	4.6	7	11	8	11.1	1.5
GLD	2.2	13.7	15.3	11.3	10.4	7.1	30	18.2	14.5	17.6	32.7	13.3	2.7	4
CRP	5	22.9	37.1		30	49.9			20	48.2	54.8	19.2	10	
LSL	10.8	23.5	32.5	14.5	23.3	18	29.2	37	19.3	26.4	26.8	27	20.6	31
LSR	11.7	24.4	48.2	14.6	20.7	17.7	18.4	28.9	26.9	36.6	32	28.6		
LSBk	8	15.3	26	12.6	6.4	18.2	25	11.1	13.8	10				6.7
LSBo	19.1	19.9		13.6	14.6	6.3		20		35.8	17.9	20	4.9	10
PLP		12.1	47.3	35	18		25	29.2			19.1	15	11.3	
******** PERCENT UNIT UNDERCUT BANKS ********														
LGR	0	1.95	2.4	0	.5	.6	1.7	.1	0	.1	.2	.4	0	.3
GLD	.2	4.8	3.9	0	.2	1.1	2.8	1.4	0	1.8	1.6	2.1	1.3	.8
LSL	.8	5.6	1.1	1.4	1.7	2	6.8	0	.9	.5	2.1	4.2	0	3.5
LSR	.9	4.7	0	0	1.3	1.5	3.2	.2	0	4.9	7.9	11.6		
*********PERCENT UNIT SMALL WOODY DEBRIS*********														
LGR	0	2	1.6	.9	1.5	2.8	4.1	1.1	0	3	2.6	2.6	0	0
GLD	.6	3.8	4.6	.8	1.9	2.4	16.8	5.1	3.4	5.5	6.4	1.4	0	1.2
LSL	2.9	3.4	1.6	.5	4.5	5.4	9.6	10.8	0	6.3	8.9	6.6	4.5	6.7
LSR	.2	2.8	20.2	4.2	3	.7	1.9	9.4	.9	6.3	4	3.9		
*********PERCENT UNIT LARGE WOODY DEBRIS*********														
LGR	.2	2	.1	0	1.1	1.4	1.1	0	.5	.5	.7	.2	0	0
GLD	.1	2.4	3.6	1.1	1.6	2.2	10.4	5.4	3.1	3.5	3.9	2.8	.3	.6
LSL	4.5	10.7	27.1	4.4	11.2	8.9	11.8	22.5	6.9	9.9	13.5	11.7	8	15.7
LSR	2.8	6.9	21.2	5.6	7.5	5.3	2.7	11.3	17.5	8.1	8.5	2.5		
********* PERCENT UNIT ROOTMASS *********														
LGR	.1	.5	0	0	.2	.2	0	0	0	0	.1	.4	0	0
GLD	0	2.1	.8	0	.1	.6	0	0	0	.1	0	1.4	0	0
LSL	1.3	3.4	1.3	3.4	2.4	1.5	.7	0	0	.8	0	2.3	0	.5
LSR	3.3	9.4	4.5	.7	13.7	8.8	10.2	3.6	0	11.7	8.3	8.6		
******** PERCENT TERRESTRIAL VEGATATION ********														
LGR	.7	.8	1	1.5	2.5	.2	.2	0	0	.7	1.4	1.1	0	.4
GLD	1.5	.5	.1	.1	3	.2	0	0	0	5.3	4.3	4.5	0	0
LSL	1.2	.4	0	0	2.1	.1	0	0	0	3.3	1.8	1.9	0	0
LSR	4.5	.6	0	0	2	.3	0	.2	.8	3.4	1.9	1.7	0	
******** PERCENT AQUADIC VEGATATION ********														
LGR	.1	.2	0	0	.2	0	0	0	.3	1.8	5.6	3.3	11.1	0
GLD	.3	0	0	0	.3	.1	0	0	.2	.5	1.6	1	0	.7
LSL	.1	0	0	0	.1	0	0	0	0	1.1	.4	0	0	0
LSR	0	0	0	0	0	0	.4	0	0	1.7	1.1	.4	0	
******** PERCENT BOULDER ********														
LGR	1.4	0	2.2	11.9	1.1	.9	.4	1.5	3.4	.9	.2	0	0	.3
GLD	0	0	1.9	8.9	1.6	.5	0	8.1	7.8	.3	0	.2	1.1	.6
LSL	0	0	1.4	4.4	1.3	.2	.3	0	11.5	.3	.1	.2	1.2	4.3
LSR	0	0	2.4	4.1	0	.1	0	1.5	5.6	.5	0	0		
******** PERCENT BEDROCK ********														
LGR	0	0	.1	0	.1	0	0	0	0	0	0	0	0	0
GLD	0	0	0	.4	.1	0	0	.3	0	0	0	0	0	.1
LSL	0	0	0	.4	0	0	0	3.7	0	0	0	0	0	0
LSR	0	0	0	0	0	0	0	.7	2.1	0	0	0	0	

TABLE 5. Average Embededdness Estimates for Streams, by Reach, for Seven Different Habitat Types

REACH	N. FORK	LNF	BUCK.CR.	BALD H.	MID.FK	BEAR H.	SFBH	LBH	BOOTH G.	S.FORK	SMITH	CAMPBELL	REDWOOD
						LSR							
Reach-1	2.1	2-	3	2.8	1.7	2.3	2.1	3	3.4		2	1.6	3.8
Reach-2		2.2			2.7	2.7		3.3		2	2	2.5	
Reach-3		3.1	2.6		2.5	2.7				2.3	2.1	3.8	
Reach-4										3.6			
Reach-5										2.5			
Reach-8										3.5			
						MCP							
Reach-1	2	2				2							
Reach-2					2								
Reach-3					2						2		
Reach-4													
Reach-5													
Reach-8													
						LSL							
Reach-1	2.3	2.2	3.1	3.3	1.8	2.1	2	2	3.5			2.1	4
Reach-2		2.2			2.7	2.3				2		2.1	
Reach-3		3.1	3		2.8	2.8				3.1	2.2	3.5	
Reach-4										3.4			
Reach-5										2			
Reach-8										4			
						LSR							
Reach-1	2	2.4		3.2	1.7	2.3	2	2.5	3		1	1.8	
Reach-2		2						3.3		2		3.2	
Reach-3		2.5	3		2.2	3				2.8	2	4	
Reach-4										3.4			
Reach-5										3			
Reach-8													
						LSBk							
Reach-1	2		2	2.4	2	2	4	2.6	4				4
Reach-2		3			2.3			2					
Reach-3		2.4	2.2		2.4								
Reach-4													
Reach-5													
Reach-8										4			
						LSBo							
Reach-1	2	2.5		3.5				3			2		4
Reach-2					2	2.6					2.5		
Reach-3					3.5								
Reach-4										3			
Reach-5													
Reach-8										4			
						PLP							
Reach-1		2		3			2						
Reach-2		2.3			4			3.5					
Reach-3			3		3.5						2	4	
Reach-4													
Reach-5													
Reach-8													

found in the North Fork, LNF, BHC and it's south fork, upper Smith, and mid Campbell Cr.

Some habitats tended to produce better gravel conditions than others. LGR's and Main-channel Pools (MCP) were somewhat better than log or Rootwad Scour Pools. Clearly, Bedrock Scour Pools (BRP) had the highest embeddedness ratings.

Of interest also is the substrate composition of these streams. Figures showing the substrate composition of each reach surveyed are given in Appendix 1. For both the North Fork and LNF, the primary substrate element is gravel followed by small cobble. Buckhorn Creek, a tributary of LNF has vastly different substrate conditions. It is characterized by greater amounts of silt, large cobble and boulders. Bald Hills Creek is somewhat similar to Buckhorn Creek but lacks the high silt composition.

The Middle Fork is almost completely gravel and small cobble in reach 1 but has quite a bit of sand which gathers in gliders (GLD) and back end of Bedrock Pools (LSBK). Reach-2 is a steeper faster reach containing more large cobbles and boulders. The third reach, like each of the lower reaches, is dominated by small cobbles and gravel but has lower relative amounts of large cobble and boulders than the reach immediately below. All reaches of BHC, including it's SF., are fairly similar to each other, primarily gravel and small cobble. There is more large cobble in the SF. And reach – 2 than the other reaches. The two upper tributaries of the Middle Fork are LBHC and Booth Gulch. The lower section of LBHC is characterized by having fair amount large cobble, boulders, and bedrock in it's habitats with gravel as the single most common substrate type. The upper section has a high composition of silt and sand. Booth Gulch demonstrates a wide variety of substrate types with large cobble being the category of greatest significance.

Within reaches 2-5 of the South Fork, little substrate variation is found. In reach –3 gravel is the dominate substrate while small cobble dominate in the other 3 reaches. This reach also has a higher composition of sand. In none of the reaches are the larger substrate items found. Smith Creek, like many of the Ten Mile areas is dominated by gravel and small cobble. It also has relatively high amounts on sand. Campbell Creek, in it's lower section, is much like Smith although sand as of less significance. In actuality, all of the reaches in the South Fork basin mentioned so far are rather similar. Upper Campbell, upper South Fork (reach-8), and Redwood Creek differ in that they have large cobbles and boulders present. In both reach-8 and adjacent Redwood Creek, the substrate has significant amounts of large cobbles and sand, contributing to the poor embeddedness rating for these areas.

ELECTRO-SHOCKING

During the last week of October, with the assistance of Weldon Jones of CDF&G, we completed our electro-shocking assessment. The sites electro-shocked are shown by the triangles on Figure 2. The results of this sampling are shown on Table 5. What is most apparent is the low density or lack of juvenile coho in the area sampled. The lack of coho in the Little North Fork and Campbell Creek and the coho (one) in Bald Hills Creek were not expected. Additionally, two samplings were done. These were single passes where an attempt was made to determine if coho were present ; no record of other species was kept. These were in Bald Hill Creek from approximately 200 yards above the logging road bridge to the mouth and from the mouth of Bald Hills Creek up the North Fork about 200 yards. No coho found.

Table 5. Length and Standing Crop Data for Salmonids Sampled in October 1991

Ten Mile Section	Species	Length Mean	Range	Density Fish/m2	Biomass kg/ha
North Fork	Steelhead	98	54-175	0.17	23.0
Little NF	Steelhead	74	54-153	0.80	50.1
Buckhorn	Steelhead	99	75-127	0.22	27.2
Bald Hills	Coho	59		0.01	0.4
	Steelhead	74	47-145	0.40	25.2
Middle Fork	Steelhead	80	44-175	0.61	41.6
Bear Haven	Coho	75	67-83	0.08	4.5
	Steelhead	58	38-132	0.62	7.2
Little BH	Steelhead	58	43-105	0.32	11.2
South Fork	Steelhead	123	85-179	0.22	53.0
Smith Cr.	Steelhead	94	53-176	0.34	43.7
Campbell	Steelhead	98	54-150	0.13	20.9

In a comparison between the three main forks, populations of juvenile steelhead (and /or resident rainbow trout) were relatively low in the North Fork with the highest biomass in the South Fork and the highest density in the Middle Fork. The average length of the South Fork steelhead juveniles were very high for coastal streams.

Between the other tributaries, the Little North Fork had the highest density and biomass. Bear Haven had relatively high density of steelhead but low biomass. This is indicative of relatively few large individuals.

FLOW ESTIMATES

Measurements were taken during the habitat evaluation surveys. These were done by taking the length, width and depth measurements and timing an object floating through the stream section. The results are given in Table 6 for each sampling site. The low estimates for the South Fork are probably due somewhat to higher sub-surface flow than found in the other streams.

Table 6. Ten Mile River Flow Estimates for October 1991, in cfs, by Reach.

Tributary or Fork	Reach	Flow
North Fork	1	9.3
Little North Fork	3	1.6
Buckhorn Creek	3	0.7
Bald Hills Creek	1	1.3
Middle Fork	1	4.7
Middle Fork	2	5.2
Bear Haven Creek	1	1.2
above SF	1	0.5
SF Bear Haven	1	0.2
Little Bear Haven	3	0.3
Booth Gulch	1	0.2
South Fork	3	0.0
South Fork	4	0.4
Smith Creek	1	0.7
Campbell Creek	1	0.3

WATER TEMPERATURES

The water temperatures encountered during this October evaluation (Table 7) were all well within estimates considered optimal for salmon and steelhead, but since this survey occurred after the critical months, this temperature data is of little significance. To attempt to determine how stream temperature was affected by air temperature; I calculated the ratio of the maximum water temperature to find which streams or reaches most susceptible to warming. The area which was most susceptible was the South Fork above Redwood Creek. The area least susceptible was reaches 4 and 5 of the Middle Fork.

Table 7. Water and Air Temperatures Found in the Ten Mile River and it's Tributaries during October 1991.

Tributary or Fork	Date	Reach	Water Temp Min	Water Temp Max	Air Temp Min	Air Temp Max
North Fork	10/23	1	50	54	47	63
LNF	10/7	1	54	56	55	66
	10/11	1	53	53	58	62
	10/21	2	51	53	51	64
Buckhorn	10/11	1	53	54	56	63
Bald Hills	10/22	1	53	55	54	64
Middle Fork	10/8	1	55	58	72	75
	10/17	2	53	55	53	67
	10/21	3	46	51	48	62
	10/16	4	54	56	67	74
	10/17	5	54	56	64	76
	10/21	5	45	51	48	68
	10/22	5	53	54	62	64
Bear Haven	10/10	1	52	54	60	65
	10/11	1	52	54	53	66
	10/15	2	51	53	49	65
	10/16	3	53	54	60	63
SF Bear H.	10/10	1	53	54	58	69
Booth Gulch	10/16	1	53	54	61	69
South Fork	10/23	2	45	46	50	54
	10/14	3	59	60	67	80
	10/18	4	52	57	62	70
	10/22	5	50	52	56	62
	10/23	8	48	52	42	57
Redwood	10/23	1	49	52	50	63
Smith	10/21	3	54	55	60	64
Campbell	10/14	1	52	56	61	73
	10/18	2	53	54	55	63