DISTRIBUTION AND ABUNDANCE OF COHO AND STEELHEAD IN REDWOOD CREEK IN FALL 1997

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ABSTRACT: Juvenile coho abundance in 1997 was about one-half of that present in 1995 and 1996, but represented a substantial rebound from the very weak 1994 (parental) year class. Density would have been even higher except for the loss of coho at 2 downstream sites, due to drying of the stream bed to isolated pools with low dissolved oxygen.

INTRODUCTION

Previous sampling on Redwood Creek has shown strong juvenile coho (Oncorhynchus kisutch) year classes in 1992, 1993, 1995 and 1996 and very weak year classes in 1988 and 1994 (Hofstra and Anderson 1989; Smith 1994b, 1995a). Southern wild female coho are exclusively 3 year olds (Shapovalov and Taft 1954). Therefore, the weak year classes in 1988 and 1994 may represent the impacts of the 1976 drought and/or the 1982 flood on subsequent years in a 3-year cycle. Similar pronounced and persistent year class variation has been seen in Waddell and Scott creeks in Santa Cruz County (Smith 1994a).

The weak 1994 year class should have produced few female adults for winter 1996-7 and resulted in a relatively weak juvenile coho year class in 1997. Therefore sites sampled in previous years were resampled in September and October 1997 to determine abundance of juvenile coho and steelhead (0. mykiss) and especially to see whether coho abundance remained weak or recovered; loss of the year class was also a possibility, as has happened in Santa Cruz County streams (Smith 1994b).

METHODS

Electroshock sampling was conducted on 27 September at 4 Redwood Creek sites which had been previously sampled from 1992 to 1995 and on 5 October at 1 site previously sampled only in 1994 (Table 2). At each site most of the same individual pool, glide, run and riffle habitats were sampled. Changes in channel configuration resulted in some changes in habitats sampled, but the amount and composition of sampled habitat remained similar (Table 2).

Individual habitats or habitat units (i.e. continuous pool/glide sequences) were block-netted and sampled with 2-3 passes with a backpack electroshocker (Smith-Root, Type 7). Salmonids were measured in 5 mm increments (standard length) and released to the habitat from which they were captured. Steelhead young-of-year were distinguished from yearlings and older fish by length frequencies at each site. Sampled habitats were habitat typed, and depths and cover ratings determined. Densities were estimated from the depletion results of the multiple passes.

RESULTS AND DISCUSSION

Coho

Juvenile coho abundance rebounded from the very low level present in 1994, the previous year in the 3-year cycle (Table 1). Mean density for the *b* sites sampled in 1997 was about half of that found in 1992-3 and 1995-6 (23 versus 43 fish per 100 feet), but more than 10 times that of 1994 (Table 1). The recovery was even more substantial if only the upstream sites are considered. At sites 2 and 5, which have been sampled each year from 1992 to 1997, the 1997 densities were about two-thirds of the mean densities and similar to densities for 2 of the 4 years of the healthy year classes (Table 2).

Despite the weak juvenile coho year class in 1994, a substantial number of adult coho were observed in Redwood Creek in winter 1996-7 (Fong 1997); with as many as 53 fish seen in one day. However, many of those fish were precocial 2-year old males ("jacks") from the strong 1995 year class. The juvenile densities observed in 1994 should have produced only several hundred smolts (Smith 1994b). With a 2 percent return rate (Shapovalov and Taft 1954), that should have resulted in less than half a dozen spawning females. However, the few coho juveniles present in 1994 were relatively large (Figure 1), which should have improved ocean survival and return.

Although major storms occurred in December and the beginning of January, they were at the beginning of the coho spawning season; fortunately the potential for redd damage or destruction in winter 1996-7 was much less than in most years. A bad winter, with late floods or delayed access due to drought, could have eliminated the weak year class, as occurred on Waddell Creek in 1991 (Smith 1994a). Instead, year class strength has been substantially restored.

The lack of a nearly full recovery in juvenile coho density was due to the loss of coho from the two downstream sites, due to late season drying of much the streambed to isolated pools. On both sample days the streambed at site 6, downstream of the MBCSD well, contained primarily isolated pools; of the 5 sample pools a small trickle of flow was present between only two. At 9:00 on 5 October dissolved oxygen levels in the pools ranged between 1.1 and 3.9 parts per million (ppm), with the highest level in the pool receiving surface flow. Water stains over the riffles and higher pool depths on 5 October, compared to 27 September, indicated that surface flow was present sometime between the 2 dry weekend sampling days. At site 7, at the bridge to Muir Beach, a small trickle of flow was present between most pools on both sample days and dissolved oxygen levels at 8:45 on 5 October were between 3.4 and 5.8 ppm. However, blackened leaf mats on the bottom of pools at both sites indicated at least periodic cessation of flow and hypoxic conditions.

No coho were captured by electroshocking at either of the downstream sites, but a few juvenile steelhead were present (Table 2). Similar late summer drying, poor oxygen conditions and severe loss of fish occurred at site 6 in 1992 and 1994 and at site 7 in 1994 (Smith 1994b and Table 2). In years when surface flow was maintained at sites 6 and 7 coho densities averaged 33 and 34 fish per 100 feet; density was similar to the 37 fish per 100 feet found at site 5, immediately upstream of the drying, in 1997 (Table 2). At those densities the flow reductions observed from channel mile 0.3 to 1.05 in 1997 would represent the loss of approximately 1300-1450 juvenile coho. Coho sizes in Redwood Creek also tend to show an increase at downstream sites (Figures 2 and 3), so the fish lost would have had relatively higher potential ocean survival than upstream fish.

<u>Steelhead</u>

Mean young-of-year steelhead density was lower in 1997 than any of the 1992-1996 sample years (Table 1). Part of the reason was the near total loss of fish from the 2 downstream sites, due to intermittent streamflows (Table 2); those two sites are also the only ones where steelhead mean densities are higher than coho densities (Table 2). Steelhead are more current-oriented in their feeding and are thus more sensitive than coho to lower streamflows. At Redwood Creek young-of-year steelhead showed greater density decline in dry years and more of a seasonal decline than coho (Table 2). Steelhead also show substantial average size differences between dry (1994 and 1997) and wet (1995 and 1996) years (Figure 4).

<u>Management Implications</u>

The lower portion of Redwood Creek represents a substantial portion (about 1/4) of the potential low-gradient coho rearing habitat in the watershed. Yet this valuable habitat has been impacted by intermittent streamflows in 3 of the last 6 years. Maintaining optimum flows, such as those which might be indicated by an Instream Flow Incremental Methodology study, is not feasible in late summer and fall in this dry watershed. However, ways should be found to maintain continuous surface flow through the reach during August through October; those ways might include late summer water conservation or water importation.

LITERATURE CITED

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Table 1. Habitats sampled and estimated mean densities (number of fish per 100 feet) for coho and steelhead on Redwood Creek in 1988 (Hofstra and Anderson 1989) and 1992-1997.

Number of Sites	Sample Date	Habitat Types Sampled				Length Sampled (feet)	Density		
		Pol	Gld	Run	Rif		Coho	Steelhead 0 +	Steelhead 1/2+
4 sites	Oct 88					436+	5	--16--	
4 sites	Jun-Sep 92	37	40	5	7	1032	45	23	4
4 sites	Jun-Aug 93	48	25	18	9	951	46	56	4
7 sites	Jul 94	58	25	12	6	1287	2	69	14
5 sites	Oct 94	83	10	4	3	1018	2	34	6
4 sites	Aug 95	41	30	19	10	796	42	97	4
3 sites	NOV 96	51	31	11	7	604	39	33	11
5 sites	Sep-Oct 97	72	18	9	1	984	23	15	5

Table 2. Density estimates (number of fish per 100 feet) for coho and steelhead collected on Redwood Creek in each year from 1992 through 1997 at the 5 sites sampled in 1997.

Site	Sample Date	Habitat Types Sampled				Length Sampled (feet)	--- Density ----		
		Pol	Gld	Run	Rif		Coho	Steelhead 0 +	Steelhead 1/2+
2. Lower Muir Woods	20 Aug 92	30	53	12	5	302	84	19	8
(Miles 2.5 & 2.8)	24 Jun 93	45	23	22	9	233	91	52	4
	7 Jul 94	47	32	15	6	256	0	56	12
	30 Oct 94	75	25			220	1	14	16
	22 Aug 95	37	30	21	11	276	45	57	6
	2 NOV 96	43	30	12	14	206	37	29	7
	27 Sep 97	54	19	21	6	216	41	32	8
Site Mean (excluding 1994)							60	38	7
3. 0.35 mi > Kent Cyn	26 Jul 94	75	13	7	5	179	9	60	9
(mile 2.1)	30 Oct 94	86	0	8	6	148	10	19	7
	5 Oct 97	83	5	13	0	191	50	15	6
5. >3rd Bridge (Mile 1.25)	19 Sep 92	60	15	7	19	166	30	16	7
	19 Aug 93	63	12	10	15	253	30	26	5
	7 Jul 94	63	10	14	13	136	0	45	14
	30 Oct 94	53	25	15	7	177	0	20	8
	22 Aug 95	75		16	10	127	43	51	7
	2 NOV 96	65	28	8		160	54	27	13
	27 Sep 97	65	35			210	26	7	6
Site Mean (excluding 1994)							37	25	8

Table 2 (continued)

Site		Sample Date	Habitat Types Sampled				Length Sampled (feet)	--- Density ----		
								Coho	Steelhead	
			Pol	Gld	Run	Rif			0+	1/2+
6.	Downstream of Diversion (Mile 0.85)	19 Sep 92	19	37	dry		250 129 wet	13	6	1
		14 NOV 92					250	4	6	0.4
		24 Jun 93	55	29	9	7	210	25	90	3
		10 Sep 93	51	34	9	6	221	16	72	4
		7 Jul 94	41	36	17	6	231	0	148	9
		30 Oct 94	isolated pools				231	0	0	0
		23 Aug 95	39	36	19	6	209	56	132	3
		2 NOV 96	44	36	13	7	228	26	45	9
		27 Sep 97	isolated pools				251	0	2	0.8
	Site Mean (excluding 1992, 1994 and 1997)							33	83	5
7.	1st Bridge (Mile 0.35)	23 Jul 92 14 Aug 92	39	56	2	4	314	54	49	1
		14 NOV 92	39	56	2	4	314	33	29	2
		8 Jun 93	27	35	32	5	255	39	55	4
		10 Sep 93	26	49	16	9	271	14	34	1
		8 Jul 94	14	46	30	10	242	0.4	75	4
		30 Oct 94	isolated pools				242	0	6	0.4
		23 Aug 95	13	55	19	13	184	54	142	0.5
		27 Sep 97	87	13			115	0	12	5
	Site Mean (excluding 1994 and 1997)							34	68	1

Figure 1. Standard lengths (mm) of coho at site 3 (> Kent Canyon) in October 1994 and October 1997 and at site 2 (Muir Woods) in November 1996.

	1994	1996	1997
40 - 44			
45 - 49			*****
50 - 54		********	****************
55 - 59	*	*******************	************************
60 - 64	*	************************	****************
65 - 69	****	*************	*********
70 - 74	***	******	***
75 - 79	****	*	*
80 - 84		*	
85 - 89	*		
95 - 99			*

Figure 2. Standard lengths (mm) of coho at site 2 (Muir Woods), site 3 (> Kent Canyon) and site 5 (3rd Bridge) in September /October 1997.

	Site 2	Site 3	Site 5
40 - 44	*2		
45 - 49	**4	**5	
50 - 54	**************29	********16	
55 - 59	*************27	************24	*3
60 - 64	********16	********16	********16
65 - 69	**5	****9	*********19
70 - 74		*3	**5
75 - 79			1
80 - 84	1		1
85 - 89			1
90 - 94			
95 - 99		1	

Figure 3. Standard lengths of Coho (mm) from site 2 (Muir Woods), site 5 (3rd Bridge) and site 6 (downstream of diversion) in November 1996.

	Site 2	Site 5	Site 6
50 - 54	****8		1
55 - 59	*********19	***6	**4
60 - 64	************24	****8	***********22
65 - 69	******13	*************26	********17
70 - 74	***6	********17	********16
75 - 79	1	****8	*3
80 - 84	1		

Figure 4. Standard lengths (mm) of young-of-year steelhead at site 5 (Third Bridge) and site 3 (> Kent Canyon) in October 94 and September/October 1997 and at site 3 in August 1995 and November 1996.

	1994	1995	1996	1997
40 - 44	*******			**
45 - 49	**************	**	*	************
50 - 54	*******	***********	*	**********
55 - 59	**********	***************	*********	*********
60 - 64	******	**************	****************	**
65 - 69	********	******	******	*****
70 - 74	*	******	**	*
75 - 79		**	*	
80 - 84		**	***	
85 - 89		*		