DISTRIBUTION AND ABUNDANCE OF JUVENILE COHO AND STEELHEAD IN REDWOOD CREEK IN FALL 2000

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ABSTRACT: The 2000 year class of juvenile coho in Redwood Creek in Marin County was extremely weak and confined primarily to the upper reaches of the stream, in Muir Woods National Monument. A weak or absent coho year class was also found in San Mateo and Santa Cruz County streams. The weak wild coho abundance in the 3 counties appears to be due to previous drought and flood impacts to the year class and to poor juvenile overwintering in 1997-98 and/or floods in 2000. Young-of-year steelhead showed abundance and sizes similar to previous non-drought years, but yearling steelhead were more abundant than usual.

INTRODUCTION

Wild southern coho *(Oncorhynchus kisutch)* females are exclusively 3 year olds (Shapovalov and Taft 1954). Therefore, the 3 year classes in the 3-year cycle are numerically independent, and each year class may reflect the stochastic effects of floods, droughts or other impacts on previous year classes (Smith 1994A), as well as conditions during the spawning/rearing year. Previous sampling on Redwood Creek in Marin County has shown strong juvenile coho year classes in two of the year classes (1992/1995/1998 and 1993/1996)(Smith 1996; Smith 1998B). However, the third year class was very weak in 1988 (Hofstra and Anderson 1989) and 1994 (Smith 1994B). Similar pronounced and persistent year class variation has been seen in Waddell and Scott creeks in Santa Cruz County and Gazos Creek in San Mateo County (Smith 1994A; Smithl998A). However, in 1997 that year class had recovered to about one-half strength in Redwood Creek (Smith 1997).

In October 2000 sites previously sampled on Redwood Creek were resampled to determine the distribution and abundance of coho and steelhead *(O. mykiss)*. Primary interest was in the coho year class, as it was only at half strength in 1997, and may have been impacted by overwintering conditions in the El Nino winter of 1997-98 and/or by flooding in 2000.

METHODS

Electroshock sampling was conducted on 14 October at 4 sites regularly sampled on Redwood Creek; three of the sites had been sampled in most years 1992-98 and the fourth had been sampled 3 times between 1994 and 1998 (Table 1). A single deep pool/glide was also sampled downstream of Kent Canyon at a site (site 4) sampled previously only in 1994. On 18 October the previously sampled (1992-98) site near the parking lot of Muir Woods National Monument was sampled by Darren Fong, and his data are included to provide comparisons to previously sampled years. At each site many of the same individual pool, glide and run habitats were sampled as in previous years. Substantial changes in channel configuration resulted in some changes in habitats sampled, especially at sites 3, 5 and 7. Amount and composition of sampled habitat were generally similar to previous years (Table 2), although a higher proportion of pool habitat was sampled in an attempt to locate juvenile coho.

Individual habitats or habitat units (i.e. continuous pool/glide sequences) were block-netted and sampled with 2 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 (YOY) were distinguished from yearlings and older fish by length frequencies at each site. Sampled habitats were habitat typed, and depths and cover rating determined. Densities were estimated from depletion results of the multiple passes.

RESULTS AND DISCUSSION

Habitat Effects of the 2000 Storms

Although the winter of 1999-2000 was not excessively wet, channel effects from a few large storms were substantial. At sites 5 (3^{rd} bridge) and 7 (1^{st} bridge) several pool habitats that were shallower after the 1998 El Nino winter, but otherwise stable from 1992-98, were radically reconfigured in 2000. At site 3 (upstream of Kent Canyon) one pool was completed rearranged, and a second was scoured deeply under a bay tree which fell in 1998. Most pools were similar to 1998 or were shallower. In general, the amount of riffle habitat was sharply reduced in 1998, and replaced by run habitat (Smith 1998B); the amount of riffle had not significantly increased by 2000.

Despite the channel changes due to storm flows in 2000, there were no new downed trees or logjams at any of the sites. Even in 1998 only one large tree was added to the channel by large sustained stormflows, and large wood continues to be relatively scarce in the channel (Smith 1998B). This contrasts with sandier Santa Cruz and San Mateo county streams where streamside alders are regularly toppled into the channel, and numerous jams are produced in wetter years (Smith 1998A). Most pools in Redwood Creek are relatively shallow and associated with alder roots or channel bends. Deeper pools are primarily associated with large

wood. Salmonid summer and overwintering habitat could be substantially improved by adding large logs or downed trees to the channel.

The delay in winter storms until late January and the occurrence of channel-forming storms in February make it likely that some fresh coho redds were destroyed in 2000.

Coho

Only a single coho juvenile was captured at the lower 5 sites sampled in 2000. Upstream, within Muir Woods, coho were more common, but still very rare (<20%) compared to all other years except 1994. Overall coho density for the 6 sites was lower than all previous sample years, with steelhead outnumbering coho by more than 50 to 1 (Table 2).

The weak 1994 year class had rebounded to about half strength in 1997 (Table 2), but the severe El Nino winter of 1997-1998 may have severely reduced juvenile overwinter survival. In addition, adults returning to spawn in 2000 may have had poor spawning success. Access was delayed until late January storms, and then a heavy storm 2 weeks later may have destroyed many of the vulnerable new redds. Similar impacts apparently nearly eliminated the 2000 year class of coho in Scott Creek in Santa Cruz County (Smith 2000), the only stream south of San Francisco which still retains that year class.

At Scott Creek any weak year classes can potentially be filled in by returns of hatchery-reared precocial (2-year old) females (Smith 1998B). At Redwood Creek the very weak year class may be lost, unless augmented by strays from other streams (such as Lagunitas Creek?). However, the 1997 Redwood Creek coho population did manage to substantially rebound from the severely weak 1994 year class (Table 2).

Adult returns in winter 2002-2003 and juveniles in late summer 2003 should be carefully monitored to determine the status of the year class. Observations of adult coho should pay particular attention to sizes and sexes of the fish, as most fish are likely to be 2-year old males from the strong year class that is likely to be produced in 2001. Few 3-year old females are likely to be present, and their number will control egg and juvenile production. Genetic samples from carcasses can be checked for evidence of straying from other streams.

Steelhead

Unlike coho, YOY steelhead were similar in abundance to previous years (Table 2). The more flexible life history of steelhead and their tendency to spawn later in winter, after damaging storms, prevents the year class fluctuations seen in coho (Shapovalov and Taft 1954; Smith 1998B). Overall YOY steelhead abundance was greater than in 1992, 1994 and 1997, when drying of parts of the stream bed downstream of the municipal well sharply reduced fish abundance in the lower 1 mile of stream.

YOY steelhead site abundances were nearly identical those from 1998 at 4 of the 5 sites sampled in both years. YOY were more abundant in 1998 at the downstream site, reflecting shallower conditions in several of the pools in 2000. YOY steelhead abundance might be expected to increase due to competitive release in years like 2000 when coho are very scarce. However, site results from 1992 - 2000 show no relationship between coho and YOY steelhead abundance. YOY steelhead abundance in Redwood Creek appears to respond primarily to streamflow (which affects the utility of shallow run and riffle habitats), pool quality (which provide depth and escape cover) and very dense shading (which reduces insect production and feeding ability). Site 5 (upstream of the 3rd bridge) is very densely shaded (95+% canopy closure) by alders and consistently has had the lowest YOY steelhead densities among perennial sites.

Sizes of YOY steelhead were generally similar among sites in 2000, although fish at heavily shaded site 5 did tend to be somewhat smaller (Figure 1). Even within site 5, fish tended to be smaller in the most densely shaded habitats. Steelhead YOY were somewhat smaller in 2000 than in 1995, 1996 and 1998, which were wetter years (Figure 2). Fish from 1994 and 1997, which were dry years, were substantially smaller (Figure 2). Previous results have shown that both YOY steelhead and coho are much smaller in dry years like 1997 (Smith 1998B), presumably because insect abundance and the ability to feed on drifting insects are reduced by low spring and summer stream flows.

Yearling steelhead were more abundant than in previous years. Part of the apparent increase in density may have been due to the more intensive sampling of pools (Table 2), in an attempt to capture coho.

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Table 1, Habitats sampled and density estimates (number of fish per 100 feet) by site for juvenile coho and steelhead in October 2000.

Site		Sample Date	Habitat Types Sampled				Length Sampled (feet)	Density		
			Pol	Gld	Run	Rif		Coho	Steelhead 0+	Steelhead 1,2+
2.	Lower Muir Woods (Mile 2.8)	18 Oct*					219	5.9	58	11
3.	0.35 mi > Kent Canyon (mile 2.1)	14 Oct	74	24	2	0	210	0.5	42	14
4.	Trail < Kent (mile 1.65)	14 Oct	73	27	0	0	55	0	47	26
5.	> 3rd Bridge (mile 1.25)	14 Oct	71	29	0	0	216	0	21	8
6.	Downstream of Diversion (mile 0.85)	14 Oct	55	34	11	0	190	0	28	12
7.	1st Bridge (mile 0.35)	14 Oct	80	20	0	0	187	0	36	17
	Totals		71	27	3	0	1077	1.1	38.7	14.6

* Data from Darren Fong

Table 2. 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 1992-1998 and 2000.

Number of Sites	Sample Date	Habitat Types Sampled				Length Sampled	Density		
		Pol	Gld	Run	Rif	(feet)	Coho	Steelhead 0+	Steelhead 1,2+
4 sites	Oct 88					436+	5	---16---	
4 sites	Jun-Sep 92	47	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
5 sites	Oct 98	58	25	15	1	1174	32	47	4
6 sites	Oct 00	71	27	3	0	1077	1.1	39	15

Figure 1. Standard lengths (mm) of young-of-year steelhead at sites 3, 4, 5, 6 and 7 on Redwood Creek in October 2000.

	Site 3 n = 81	Site 4 n = 22	Site 5 n = 45	Site 6 n = 54	Site 7 n = 61
35-39	1				
40-44	2	1	1	*3	1
45-49	*5	*3	***10	***9	
50-54	**7	*3	***9	**7	******18
55-59	******* 22	2	**6	****13	*****16
60-64	******20	*4	**6	**7	*****16
65-69	**** 13	**8	**6	**8	**8
70-74	**7		**7	*5	**7
75-79	*3			1	
80-84	1			1	

Figure 2. Standard lengths (mm) of young-of-year steelhead at sites 3 and 5 on Redwood Creek in 1994, 1997, 1998 and 2000 and site 5 in 1995 and 1996.

	1994 n = 53	1995 n = 59	1996 n = 36	1997 n = 41	1998 n= 142	2000 n= 126
35-39						1
40-44	***7			*2		*3
45-49	*******14	*2	1	******12	**7	*****15
50-54	***7	*****11	1	*****10	******18	*****17
55-59	*****10	*******15	****9	****9	**********38	*********28
60-64	***6	*******14	********16	*2	*********27	********26
65-69	****8	***6	***6	**5	********25	******19
70-74	1	***6	*2	1	*****16	****14
75-79		*2			**5	*3
80-84		*2	1		**5	1
85-89		1			1	