DISTRIBUTION AND ABUNDANCE OF JUVENILE COHO AND STEELHEAD IN GAZOS, WADDELL AND SCOTT CREEKS IN 1995

Jerry J. Smith
Department of Biological Sciences
San Jose State University
San Jose, CA 95192
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ABSTRACT: In 1995 previously sampled representative sites on Waddell Creek, Gazos Creek and in the Scott Creek watershed were sampled by electroshocker to assess distribution and abundance of steelhead and 1995 year class coho. Few juvenile coho were captured in Waddell (24 coho) and Gazos (1 coho) creeks, indicating weak and precarious year classes. Storm damage to redds may have been a factor. The 1995 coho year class on Scott Creek was relatively strong (223 juvenile coho captured), apparently due to spawning by precocial (2 year old) hatchery-reared females and successful spawning in Mill Creek and an unnamed upper Scott Creek tributary, despite January and March floods. Steelhead were generally slightly more abundant on Scott and Waddell creeks than in 1992-94, but were much more abundant on Gazos Creek than in 1992-3.

The strong wild coho production in 1995 on Scott Creek suggests that the limited hatchery-reared Scott Creek coho should be stocked in Waddell Creek or grown to large size to induce precocial maturation of females. Electroshock sampling has provided a reliable, relatively low effort, low mortality method to index coho status in Gazos, Waddell and Scott Creek over the last 4 years, and should be continued.

INTRODUCTION

Since all wild female southern coho (Oncorhynchus kisutch) spend one year in the stream and two years in the ocean prior to spawning (Shapovalov and Taft 1954), three consecutive years of study are necessary to determine the status of the three numerically independent year classes. Status of native, wild coho south of San Francisco has been evaluated, with at least three consecutive years of study, only in Waddell and Scott creeks in Santa Cruz County (Smith 1992b, 1994b; Smith and Davis 1993), although they also been recently reported from Gazos (Smith 1994a), Pescadero (Steve Maskel, pers. comm. and Pete Adams, National Marine Fisheries Service, pers. comm.) and Purisima creeks (Pete Adams, pers. comm.) in San Mateo County. Differences in abundance among coho in different years in the same stream can be substantial, because the restricted spawning period, single spawning attempt, and rigid ages of smolting and spawning (Shapovalov and Taft 1954) make them susceptible to drought, floods or other "disasters" within small watersheds (Smith 1994c). For example, Redwood Creek in Marin County had

very strong coho year classes in 1992, 1993, and 1995, but the 1988 and 1994 year classes were less than 5 percent as large (Smith 1995), apparently reflecting impacts to that three year brood cycle prior to 1988. Steelhead (O. mykiss), however, have extended spawning periods, can spawn more than once, and are variable in ages of smolting and maturation (Shapovalov and Taft 1954). Therefore, steelhead juvenile abundance is more likely to indicate yearly habitat conditions, and populations are affected less by, and will recover quickly from, bad years.

Previous electroshock sampling on Scott Creek found strong juvenile coho year classes in 1988 and 1993, but very weak year classes in 1992 and 1994 (Smith 1992b, 1994a, 1994c). Smolt trapping by the California Department of Fish and Game (Nelson 1993) indicated that the strong 1988 year class produced only a very weak 1991 year class, apparently because of poor adult access in winter 1990-91.

Previous sampling on Waddell Creek found weak year classes in 1988 and 1992, a stronger year class in 1993, but no apparent juvenile production in 1994 (Smith 1992, 1994c; Smith and Davis 1993). Smolt trapping in the spring of 1992 captured no coho (Smith 1992a), so the year class loss may have occurred in 1991, rather than 1994.

Gazos Creek was sampled in 1992 and 1993, with coho collected only in 1993 (Smith 1992, 1994a). However, those fish were collected at upstream sites not sampled in 1992.

This report presents results of sampling for juvenile coho and steelhead on Gazos, Waddell and Scott creeks in September through November 1995 and sampling for adults on Waddell Creek in December 1994. It also relates those results to status of coho and steelhead in the three streams and makes recommendations for restoration and monitoring strategies.

METHODS

A trap and weir was used to sample adult steelhead and salmon migrants in Waddell Creek from mid December to 1 January. The trap was removed on 6 January 1995, and the weir was destroyed by high water the next day. Captured fish were measured (standard, fork and total lengths), weighed, tagged with a numbered floy tag, and scales were taken.

In September 1995 twelve sites on Waddell Creek were sampled by electroshocking, covering all but one site where juvenile coho had been collected in 1992 or 1993 (Table 1). In October twelve Scott Creek watershed sites were sampled, including all where coho had been collected in 1993 or 1994 (Table 2). In early November all four previously sampled Gazos Creek sites were sampled (Table 3). At resampled sites on each stream the same habitats were resampled, if possible. Where the heavy runoff in 1995 had modified habitats, similar replacement stations were

substituted. The length of stream and habitat types sampled in 1995 were similar to previous efforts in 1992, 1993 and 1994 (Table 4).

The primary goal of the sampling was to look for the presence and abundance of coho, so sampling was concentrated in pool and glide habitats. At each site, usually three to five individual habitat "units" (a glide or pool, with its contiguous glide and run habitat) were sampled by 2 to 3 passes with a backpack electroshocker (Smith-Root Type 7, smooth pulse). Length, width, depth, cover (escape and overhead), and substrate conditions were determined, and percentage of habitat type assigned for each habitat unit. Channel type was determined, and relative abundance of pool, glide, run and riffle habitat types was also estimated for the site (Tables 1,2,3).

The partially closed lagoon at Waddell Creek was sampled by seine in September and twice in December to look for presence of coho and to determine sizes and abundance of juvenile steelhead.

Juvenile fish were measured (standard length, SL) in 5 mm increments, and young-of-year steelhead were separated from older fish, based upon length-frequency at each site. Holdover hatchery steelhead were recognized by fin clips and/or worn, short dorsal fins.

RESULTS

Coho

Twelve adult coho were captured in the migrant trap on 17 December to 31 December (Figure 1). Ten of the fish were of hatchery origin, including the 2 females captured. All fish were determined from scale analysis to have spent only 1 summer in the ocean, although 3 of the fish, including both females, exceeded 550 mm fork length. Back calculation from scales indicated that the three largest fish exceeded 220 mm SL at first annulus.

On Waddell Creek juvenile coho were collected at 7 of the 12 sampled stream sites (58%), but only a total of 24 coho were captured (Table 1). Low densities (1.5-2.9 per 100 feet of sampled habitat) were found from mile 2.6 through mile 4.7 (West Fork), while only single fish were collected (0.3-0.5 per 100 feet) at the most downstream sites (miles 0.6 and 1.35). No coho were collected on the East Fork of Waddell Creek, in Henry Creek, or in the lagoon.

Coho were collected at all but one of the twelve Scott Creek watershed sites (92%) in 1995 (Table 2). A total of 223 coho were collected, and overall density was 13 times higher than in Waddell Creek. Lowest coho densities in the Scott Creek watershed were in Big Creek (where only 1 coho was captured at the 2 sampled sites) and on Scott Creek at the lowermost site

(mile 0.9) and at the two uppermost sampled sites (mile 5.85-6.5); overall coho density for those 5 sites was only 2.0 per 100 feet of sampled habitat. At the five sites on Scott Creek between miles 2.55 and 4.9 and on Mill Creek coho densities ranged between 23 to 28 per 100 feet of sampled habitat.

Only a single juvenile coho was captured from the four sites sampled on Gazos Creek in 1995 (Table 3).

Mean size of coho was generally slightly larger than steelhead from the same habitat (Figures 2-5) and also showed some differences among sites (Figure 2). In the Scott Creek watershed, where abundance was sufficient for comparisons, coho at the two downstream sites were larger, and coho in Mill Creek and on the upper 3 Scott Creek sites were smaller, than in the remaining sites from the middle of the watershed.

Steelhead

Overall steelhead density on Waddell Creek was 79 young-of-year and 14 yearlings and older fish per 100 feet of sampled habitat (Table 1). Young-of-year densities were highest at the three sites immediately downstream of the East and West Forks (128-139 fish per 100 feet). The 9 sites up and downstream of those sites had much lower densities (31-78 fish per 100 feet). Yearlings had a similar range in densities (6-24 fish per 100 feet), but showed no clear density pattern among sites. There was also no clear pattern in the age structure among sites; older fish made up an average of 15 percent of estimated steelhead abundance (range: 9 - 26 percent). The number of juvenile steelhead in the lagoon at Waddell Creek was estimated to be 2684, based upon fish marked on 22 December and upon recapture ratio on 29 December.

Steelhead density for sampled habitats on Scott Creek averaged 90 young-of-year and 10 older fish per 100 feet (Table 2). Lowest densities of young-of-year steelhead were on Mill Creek and on the upper three sites on Scott Creek (46-77 fish per 100 feet). Older steelhead made up a smaller portion (10 percent) than in Waddell Creek, but, as for Waddell Creek, there was no pattern to either yearling abundance or the proportion of older fish among estimated steelhead (range: 6 - 19 percent). Only four holdover hatchery-reared steelhead were collected.

Steelhead densities on Gazos Creek were similar to those found at upstream habitats on Waddell and Scott creeks, with young-of-year averaging 68 and yearlings averaging 14 fish per 100 feet of sampled stream (Table 3). Overall, yearlings made up 17 percent of estimated steelhead density (range: 9 - 27).

As seen for coho, steelhead showed differences in mean size among sites (Figures 3-5). The biggest difference was that lagoon steelhead at Waddell Creek were almost exclusively in the yearling size range (Figure 3), even though scale analysis showed that most of the fish were young-of-year. Within the Waddell

Creek watershed young-of-year steelhead at all 6 main stem sites (Figure 3) were generally larger than those in the East or West Forks.

In the Scott Creek watershed, the two sites downstream of Big Creek had generally larger young-of-year steelhead than the rest of the watershed (Figure 4). Big Creek and the middle sites on Scott Creek (sites 2-7) had intermediate-sized young-of-year. Mill Creek and the upper Scott Creek sites (9-11A) had the smallest young-of-year steelhead (Figure 4).

Gazos Creek (Figure 5) also showed a general pattern of smaller young-of-year fish at upstream sites.

DISCUSSION

Coho

Both Scott and Waddell Creeks had very poor wild coho production in 1992 (Table 4), and because wild females mature at three years (Shapovalov and Taft 1954), few wild spawning pairs were expected in winter 1994-95. In addition, the heavy January and March 1995 storms should have destroyed many redds or emerging fry of early-spawning salmon. Both situations should have resulted in low juvenile coho abundance in 1995. Although Waddell Creek coho density was low in 1995, and similar to that of 1992 (Table 4), Scott Creek 1995 coho density substantially increased over 1992 (Table 4). These results are apparently due to the effects of hatchery-reared fish and to the differential impacts of the floods on the two watersheds.

The Number of potential spawners in 1995 was substantially augmented by hatchery-reared fish in both Scott and Waddell Creeks. Although wild coho production on Scott Creek in 1992 was low, 1800 hatchery-reared smolts were also released in spring of 1993 (Dave Streig, pers. comm.). In addition, hatchery-reared Scott Creek coho smolts were planted in both Waddell and Scott creeks in spring of 1994; apparently this action unexpectedly contributed to 1995 production of juvenile coho. Although wild female coho mature at three years (Shapovalov and Taft 1954), some of the hatchery-reared females spawned in 1995 as two year olds. Two of the 12 coho captured during limited trapping on Waddell Creek were precocial, hatchery-reared females (Figure 1). On Scott Creek precocial females were also apparently common, and all 6 females captured for brood stock at the Big Creek Hatchery were 2 year olds (Dave Streig, pers. comm.). The two females captured on Waddell Creek were back-calculated from scales to be atypically large at release; apparently very fast hatchery growth triggered early maturation.

The distributional pattern of juvenile coho abundance in 1995 suggests that storms probably impacted redds or fry survival or distribution. In the Scott Creek watershed juvenile coho were

apparently almost absent from Big Creek and were rare at upper Scott Creek sites. On Waddell Creek juvenile coho were apparently absent from the East Fork, Henry Creek, the uppermost West Fork site, and were absent or rare in the lower 2.25 miles of stream. These are sites on both streams that have sandy spawning gravels and/or steeper gradient prone to redd destruction or fry dispersal from storms. On Waddell Creek these are also sites where spawning took place in 1992, 1993 and 1996. In the Waddell Creek watershed the best spawning gravels, and most stable streambeds in floods, are primarily in the West Fork upstream to between sites 9 and 10 (Buck Creek). Most (22 of 24) of the collected juvenile coho were in the lower West Fork and in the 1/2 mile of stream downstream of the confluence of the forks. However, the low density, spread over the middle 2 miles of stream, suggests severe redd damage from the storms and/or widespread dispersal from a few redds.

In wet years in the Scott Creek watershed, Mill Creek probably suffers less flood damage to redds, because it has a relatively small, narrow watershed, which does not generate severe flood peaks. Mill Creek also has a headwaters reservoir which further reduces peaks flows. In 1995 many spawning coho were observed in Mill Creek and in a low-gradient left bank tributary near Site 7 on Upper Scott Creek (Dave Streig, pers. comm.). The small tributary has a small watershed and also probably has low flood flows and redd damage. These two locations, which are both accessible and protected during wet years, provide a very valuable type of spawning refuge not found in the Waddell Creek watershed, and probably account for the relatively high density of coho present in 1995 in Mill Creek and on Scott Creek between sites 1 and 7. These flood year refuges may also have mitigated wet year impacts in the past (1982, 1983, 1986?) and may explain why Scott Creek coho densities were higher than Waddell Creek densities in 1988 and other years (Table 4), despite good rearing habitat on Waddell Creek.

The single coho collected from four scattered sites on Gazos Creek indicates very limited spawning success in 1995. The severe 1995 storms and confined channel in the upper half of the watershed should have resulted in loss of redds and fry, and prevented localized concentrations of coho. No coho were collected in Gazos Creek 1992 (Table 4), so the "reappearance" of coho in 1995 may be due to insufficient sampling in 1992 and/or to strays of hatchery fish from Waddell or Scott Creek plants in spring of 1994.

Juvenile coho abundance in Gazos, Waddell and Scott creeks in 1995 indicates substantial recovery of the year class in Scott Creek, but precarious status in the other two streams. In all three streams the sampling was biased towards the pools that coho prefer, so the density means in Tables 1-3 probably overestimate coho abundance. However, in Waddell Creek the largest and deepest pools could not be sampled, and these pools are common downstream of the forks, where coho were present. If the coho density of the sampled habitats on Waddell Creek was applied to

the 5.5 miles of potential coho habitat, total coho production in 1995 was only about 320 fish. At a 2-4% return rate only 3-6 pairs of coho spawners might return in 1998. Such low abundance would be insufficient to produce a strong year class, and is similar to the abundance of the 1988 year class (Table 4), which apparently resulted in loss of the 1991 year class (Smith 1992a). The extremely low coho abundance on Gazos Creek, when applied to 5 miles of potential coho habitat, indicates 1995 production of as few as 60 fish. Even at a 4% return rate only 1 pair of spawners might return in 1998. For Scott Creek the outcome is much more optimistic. Even if the observed density were cut in half, to compensate for the pool bias in sampling, 7.5 miles of potential coho habitat would have produced about 2800 fish. At a 2% return rate there would be 28 pairs of spawners in 1998, probably sufficient to seed available rearing habitat.

Steelhead

Young-of-year steelhead densities in 1995 on Scott Creek were similar to those seen in 1992, but substantially higher than for the 1988, 1993 and 1994 year classes (Table 5). Sampling of the 1993 year class was not done until January 1994, so its density value may not be comparable. The lower 1988 and 1994 densities may reflect low streamflows in those years. The similar densities in 1992 (average) and 1995 (wet) indicate that factors other than spring and summer streamflows regulated young-of-year abundance. Young-of-year were larger, especially downstream of Big Creek, than in drier years, with a significant portion probably large enough to smolt as yearlings. Yearling abundance in 1995 was substantially less than in 1992, 1993, and 1994, when similar habitats were sampled; heavy winter and spring runoff may have caused overwinter loss of yearlings and/or higher spring growth and smolting rate of yearlings in 1995.

Steelhead young-of-year on Waddell Creek in 1995 were slightly more abundant (79 per 100 feet) than the remarkably consistent values for previous years (45-61 per 100 feet) (Table 5). Fish sizes in the main stem were also larger than for previous years, with a significant portion probably large enough to smolt as yearlings (Figure 2).

Although the sandbar at Waddell Creek did not close in 1995, and the salinity-stratified bottom waters had low oxygen, an estimated 2684 steelhead reared in the lagoon; almost all were yearling sized. At the mean yearling density found in the stream in 1995 (14 per 100 feet), the lagoon produced more yearling-sized than 3.5 miles of stream habitat. Even this figure underestimates the importance of the lagoon, as lagoon fish were larger and the stream density figure for yearlings is biased upwards by the heavy sampling of pools (preferred habitat for yearling steelhead, as well as for coho).

On Gazos Creek young-of-year steelhead density in 1995 was more than twice that found for the 1992 and 1993 rearing years (Table

5). Fish at the 2 downstream sites were also substantially larger than in 1992. Both the density and size increases probably were due to the higher streamflows in 1995.

Implications for Coho Recovery

There apparently was no 1994 coho year class at Waddell Creek, and the the 1995 year class was scarce and is at risk of loss. Waddell Creek appears to be much more prone to redd destruction than is Scott Creek, but is less likely to have its sandbar remain closed during drought winters (like 1991). Rebuilding the runs of coho in Waddell Creek is important for recovery of coho south of San Francisco, but is also important to provide a backup to Scott Creek in drought years.

Scott Creek now apparently has 2 strong coho year classes (1993, 1995). Future management concerns for Scott Creek should be guided by 3 observations: 1) a strong year class (1988) can be turned into a weak one (1991) in a single cycle due to drought (Smith 1994b; Nelson 1993); 2) precocial hatchery-reared fish were probably a major factor in the restoration of a strong 1995 year class; and 3) returns from the 1994 year class in 1996-97 will be very weak (Smith 1994b). The limited hatchery production of 1995 Scott Creek coho is not needed to supplement the relatively strong wild production of coho. Therefore the hatchery-reared fish might better be used in restoration of southern coho by either: 1) planting the fish in Waddell Creek to bolster the weak wild production in that stream, or 2) inducing rapid growth during their remaining hatchery stay to trigger the precocial maturation of females in winter 1996-97.

Hatchery-reared Scott Creek fish were planted in Waddell Creek in spring 1994 and contributed, or will contribute, genetically to both the 1995 and 1996 year classes. In addition, at least hatchery-origin strays were common in Waddell Creek in 1992 (Smith 1992a). The two streams should now be considered one genetic unit and managed for the optimal mix of strong year classes among the two streams.

Implications for Monitoring

Electroshock sampling of juvenile coho and steelhead at representative sites on Gazos, Waddell and Scott creeks has provided a valuable index to status over the last four years. The value is partially because the consistent method, locations and intensity of sampling among years allows reasonable comparisons. However, electroshocking also appears to give repeatable results, relatively unaffected by weather (as are redd or carcass counts or adult or smolt trapping) or between-habitat sampling differences (as are visual observations) due to depth, escape cover or visibility. Juvenile or smolt numbers are also a much better measure of year class success, as spawning success varies greatly in these stream with winter storm flows; juvenile

electroshock sampling takes far less effort. The following comments are based upon sampling in the three streams and in other streams south of San Francisco.

1. Electroshock sampling 3-5 habitat stations at a large number of sites gives a good <u>index</u> of year-to-year salmonid density and geographical distribution (Tables 1,2,3). At low abundance coho tend to be very patchy in distribution, so the number of sites may be more important than number of habitats sampled per site in determining coho status (Tables 1,2,3).

2. A mix of habitat types should be sampled at each site to determine fish density (at least a variety of pool types and depths, glides, runs). At low abundance the few coho present may concentrate in the best habitat (deep, woody pools). As abundance increases, coho are found in a greater variety of habitats; sampling only the best habitats underestimates the overall density differences between good and bad years (Tables 1,2,3). The same approximate habitat mix should be sampled in each year, with the habitats sampled clearly indicated (Tables 4,5). Sampling should be by habitat or habitat sequence (pool with adjacent glide), not by arbitrary lengths of stream.

3. Because wild coho females are all 3 year olds, and spawn at most once, three consecutive years of sampling are necessary to determine status. Coho regularly show weak year classes or gaps, due to drought access or redd damage from floods (Table 4). Steelhead abundance is more regular and probably mostly reflects year-to-year rearing and spawning conditions (Table 5).

4. Electroshock sampling is less sensitive to between habitat sampling bias (except for deep pools) and gives good results. Careful electroshock sampling results in low mortality of handled fish (Table 6) and overall very low impact to stream fish populations. Electroshock sampling is quite repeatable, and allows reasonable comparisons with presently available data.

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Table 1. Site locations; habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet () at sites on Waddell Creek in September 1995. (site #s agree with earlier reports).

Site	Mile >Hwy1	Chan Type	%Hab Avail PL	GL	RN	RF	%Hab Sampl PL	GL	RN	RF	Sample Length	#SHT 0+	1+	COHO
1 >Div	0.6	C4	43	35	15	7	64	36	-	-	216'	94 (54)	30 (15)	1 (0.5)
2 <Alder Camp	1.35	C4	40	40	10	10	44	44	10	3	315	228 (78)	24 (8)	1 (0.3)
3 Twin Redwoods	1.8	C4	40	45	10	5	69	25	4	2	221	119 (69)	26 (14)	
4 Peri- winkle	2.2	C4	30	45	20	5	53	32	12	3	170	173 (139)	19 (24)	
5 Pullout <Herbert	2.6	C3	45	25	20	10	74	18	8	-	179	209 (138)	38 (22)	4 (2.2)
6 Camp Herbert	3.1	C3	45	25	20	10	86	7	6	2	201	230 (128)	32 (15)	3 (1.5)
7 E Fork > Ford	3.2	C3	45	25	20	10	83	10	7	1	243	130 (76)	26 (15)	
8 W Fork	3.3	C4	35	35	20	10	38	35	15	7	235	105 (53)	13 (6)	6 (2.7)
9 Mill Site	3.9	C4	45	30	15	10	72	23	2	3	209	88 (47)	26 (13)	5 (2.6)
10 Trib @ Bridge	4.7	C1 C3	40	30	20	10	59	23	16	2	245	131 (74)	20 (8)	4 (2.9)
11 HenryCr Trail	5.25	B1	30	25	25	20	63	33	4	-	199	56 (31)	18 (11)	
Slippery Falls	5.35													
13 HenryCr >Trail	0.2	F	45	10	25	20	64	-	36	-	65	29 (56)	11 (17)	
Totals											2498'	1592 1865	273	24
Mean of 12 Sites			40	31	18	11	64	24	10	2		(79)	(14)	(1.1)

Table 2. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet () at sites on Scott Creek in October 1995. (Site #s agree with earlier reports).

Site	Mile >Hwy1	Chan Type	%Hab Avail PL	GL	RN	RF	%Hab Sampl PL	GL	RN	RF	Sample Length	#SHT 0+	1+	COHO
A Near Diversion	0.9	C4	40	40	15	5	66	23	10	1	169'	103 (89)	12 (7)	2 (1.2)
1 <Little Creek	1.9	C3	40	35	15	10	71	23	6	-	162	140 (97)	9 (6)	21 (14)
Big Creek	2.15													
2 Pullout >Big Cr.	2.55	C4	35	40	20	5	57	43	-	-	206	160 (98)	30 (15)	39 (29)
3 <Mill Creek	3.05	C4	45	35	15	5	60	32	8		130	120 (97)	19 (15)	36 (28)
4 <Swanton Road	3.55	C4	30	50	15	5	43	48	9	-	147	147 (104)	15 (11)	38 (26)
7 Pullout <Big Cr. Gate	4.9	C4	30	40	23	7	58	35	8	-	130	165 (145)	12 (10)	29 (23)
9 0.15 mi > bridge	5.15	C4	25	35	30	10	39	31	18	11	69	35 (55)	8 (13)	6 (12)
11 Upper Ford	5.85	C3	40	45	10	5	51	35	14	-	208	94 (46)	8 (6)	10 (5)
11A 4th Trail Xing	6.5	B3	30	10	45	15	73	16	11	-	153	82 (71)	25 (17)	2 (2.6)
12 Big Cr. Swanton Rd.		C3	20	20	35	25	55	45	-	-	104	86 (86)	8 (12)	1 (1.0)
12A Big Cr. Below Hatchery		B3	25	10	50	15	62	38	-	-	66	42 (118)	7 (11)	-
13 Mill Cr. <Swanton Rd.		C3	45	25	15	15	77	10	13	-	143	95 (77)	12 (9)	39 (28)
Totals											1686'	1269 1434	165	223
Mean of 12 Sites			34	32	24	10	59	32	8	1		(90)	(10)	(14)

Table 3. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet () at sites on Gazos Creek in November 1995.

Site	Mile >Hwy1	Chan Type	%Hab Avail PL	GL	RN	RF	%Hab Sampl PL	GL	RN	RF	Sample Length	#SHT 0+	1+	#Coho
1	0.9	C4	30	25	30	15	48	15	37	-	100	53 (57)	21 (22)	- -
2	1.8	C4	25	25	35	15	57	36	7	-	129	57 (52)	14 (12)	1 (0.8)
3	3.15	B3	35	15	30	20	70	13	13	4	112	90 (96)	12 (11)	- -
4	4.4	B3	20	35	25	20	56	12	25	7	84	50 (68)	8 (10)	- -
Totals:											425'	250	55	1
												305		
Mean of 4 Sites			28	25	30	18	58	19	21	3		(68)	(14)	(0.2)

Table 4. Number of sites, amount and type of habitat sampled, number of coho collected and estimated density (per 100 feet) for Gazos, Scott, Waddell and Redwood creeks in 1988, 1992, 1993, 1994 and 1995.

Stream and Date		Number of Sites Sampled	Length (feet)	Habitat Percent Pl	Gl	Rn	RF	% Sites w/coho	Coho #	Dens. (/100')
<u>Gazos Creek</u>										
Aug	1992	2	275	44	56	0	0	0	0	0
Jan	1994	4	503	65	22	12	1	50	9	2.2
Nov	1995	4	425	58	19	21	3	25	1	0.2
	1996	4								
<u>Scott Creek</u>										
Jul-Sep	1988	14	3535	41	25	21	12	84	364	15.5
Aug-Oct	1992	13	1624	66	30	4	0	46	42	4.3
Jan	1994	11	1554	49	32	19	0	100	376	27.2
Aug	1994	13	1744	59	36	6	0	46	17	1.1
Oct	1995	12	1686	59	32	8	1	92	223	14.2
<u>Waddell Creek</u>										
Jun-Aug	1988	8	1817	54	19	23	5	63	19	1.3
Jul-Aug	1992	13	2858	67	31	2	0	38	19	0.6
Oct/Dec	1993	12	1857	38	21	28	14	75	58	3.6
July	1994	12	2367	66	24	7	2	0	0	0
Sep	1995	12	2498	64	24	10	2	58	24	1.1
	1996									
<u>Redwood Creek</u>										
Jun-Sep	1992	4	1032	37	40	5	7	100	426	45.3
Jun-Aug	1993	4	951	48	25	18	9	100	355	46.3
July	1994	7	1287	58	25	12	6	43	24	1.9
Aug	1995	4	796	41	30	19	10	100	308	42.0

Table 5. Number of sites, amount and type of habitat sampled, and estimated density (per 100 feet) of steelhead for Gazos, Scott, Waddell and Redwood creeks in 1988, 1992, 1993, 1994 and 1995.

Stream and Date		Number of Sites Sampled	Length (feet)	Habitat Percent Pl	Gl	Rn	RF	Density Age 0+	Age 1/2+
<u>Gazos Creek</u>									
Aug	1992	2	275	44	56	0	0	24	12
Jan	1994	4	503	65	22	12	1	29	9
Nov	1995	4	425	58	19	21	3	68	14
<u>Scott Creek</u>									
Jul-Sep	1988	14	3535	41	25	21	12	57	7
Aug-Oct	1992	13	1624	66	30	4	0	89	21
Jan	1994	11	1554	49	32	19	0	39	21
Aug	1994	13	1744	59	36	6	0	52	18
Oct	1995	12	1686	59	32	8	1	90	10
<u>Waddell Creek</u>									
Jun-Aug	1988	8	1817	54	19	23	5	45	7
Jul-Aug	1992	13	2858	67	31	2	0	56	10
Oct/Dec	1993	12	1857	38	21	28	14	54	8
July	1994	12	2367	66	24	7	2	61	19
Sep	1995	12	2498	64	24	10	2	79	14
<u>Redwood Creek</u>									
Jun-Sep	1992	4	1032	37	40	5	7	23	4
Jun-Aug	1993	4	951	48	25	18	9	56	4
July	1994	7	1287	58	25	12	6	69	14
Aug	1995	4	796	41	30	19	10	96	4

Table 6. Electroshock mortality for juvenile steelhead and coho on Scott Creek in October 1995.

Species/age group	Number Handled	Number Killed	Percent Mortality
Coho	223	1	0.45
Steelhead age 0+	1269	23	1.81
Steelhead age 1/2+	165	2	1.21
Total	1656	26	1.57

Figure 1. Sizes of hatchery and wild coho captured on Waddell Creek in December 1994 (M = male; F = female).

Fork Length	Hatchery Origin	Wild
425-449 mm	M	M
450-474	MMMM	M
475-499	M	
500-524	M	
525-549		
550-574	F	
575-599	M	
600-624	F	

Figure 2. Standard lengths (mm) of coho from Gazos, Waddell and Scott creeks in August - November 1995.

Standard Lengths	Waddell & Gazos creeks (n=25)	---------Scott Creek Watershed--------- Sites A-1 (n=21)	Sites 2-7 & Big Creek (n=144)	Sites 9-11A & Mill Creek (n=58)
40 - 44 mm				1
45 - 49				
50 - 54	*		*3	***9
55 - 59	****		*****15	****13
60 - 64	*******		*************39	*******22
65 - 69	********	*	**************44	***11
70 - 74	****	**	*************39	1
75 - 79	*	*********	**8	1
80 - 84		********	1	
85 - 89			1	

Figure 3. Standard Lengths (mm) of steelhead from Waddell Creek in September 1995. Site 1 sizes were typical of those at main stem sites (1-6); Site 8 sizes were typical of those on the east and west forks (7-13).

Standard Length	Site 1 (n=124)	Site 8 (n=118)	Lagoon (n=348)
30 - 34 mm		2	
35 - 39		***10	
40 - 44		****14	
45 - 49	1	********25	
50 - 54	***6	*****16	
55 - 59	****14	****12	
60 - 64	******18	**8	
65 - 69	****13	**7	2
70 - 74	****12	**6	1
75 - 79	****13	*5	*3
80 - 84	***9		2
85 - 89	**6	*3	*4
90 - 94	2	*3	***10
95 - 99	*3	1	****13
100-104	*5	1	****14
105-109	*5		*****17
110-114	*3		*****17
115-119	2	2	*********28
120-124	1	1	*****15
125-129	*3		******18
130-134	2		**********30
135-139	*3		****************48
140-144	1	1	*************39
145-149	1		**********31
150-154		1	*********28
155-159			****12
160-164	1		*5
165-169			*3
170-174			1
175-179			1
180+			1

Figure 4. Standard Lengths (mm) of steelhead from Scott Creek in October 1995. Site A sizes were typical of those downstream of Big Creek (sites 1 & 2); Site 2 sizes were typical of Big Creek and sites 3-6 on Scott Creek; Site 9 & 11 sizes were typical of upper Scott Creek and Mill Creek (sites 9-11A, 13).

Standard Length	Site A (n=115)	Site 2 (n=190)	Sites 9 & 11 (n=145)
30 - 34 mm			*5
35 - 39		*4	*****17
40 - 44		***********33	********25
45 - 49		*********29	*******23
50 - 54	1	********25	********26
55 - 59	**7	******19	******19
60 - 64	***11	*********27	***9
65 - 69	*********29	*****16	*4
70 - 74	******19	*****16	2
75 - 79	******20	***11	1
80 - 84	****13	2	*3
85 - 89	****12	2	
90 - 94	**8	*4	1
95 - 99	*3	2	*3
100-104	*4	*5	
105-109		1	1
110-114		2	*3
115-119	*3	2	
120-124	1	1	1
125-129	2	1	
130-134	1		1
135-139			
140-144			1
145-149			
150-154			
155-159	1		
160-164			
165-169	1		
170-174			
175-179	1		
180+			

Figure 5. Standard Lengths (mm) of steelhead from Gazos Creek in November 1995.

Standard Length	Sites 1 & 2 (n=145)	Site 3 (n=102)	Site 4 (n=58)
30 - 34 mm			
35 - 39		1	2
40 - 44		*4	**6
45 - 49		****13	****13
50 - 54	2	*********28	*****15
55 - 59	****12	******18	***9
60 - 64	*******22	****13	*5
65 - 69	********24	**7	
70 - 74	****12	*5	2
75 - 79	****14	2	
80 - 84	****12	2	1
85 - 89	**6	1	1
90 - 94	2		
95 - 99	2	3	
100-104	*3	1	1
105-109	*3	1	1
110-114	*3		
115-119	2	1	
120-124			
125-129			
130-134	*3		
135-139	1		1
140-144	1		