A SALMON SPAWNING SURVEY

FOR PORTIONS OF

TEN MILE RIVER, CASPAR CREEK AND GARCIA RIVER

1995-96

Prepared for

Humboldt County Resource Conservation District

by

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ABSTRACT

Spawning surveys were conducted in portions of three streams located in Mendocino County. These three coastal streams were the Ten Mile River, Caspar Creek and Garcia River. Spawning population estimates were derived with four separate estimation procedures using carcass mark-recapture techniques, area-under-the-curve live fish counts and two redd based methodologies. Indices of steelhead abundance are also developed for these areas. Coho spawning populations were estimated to be between 105 and 351 in the portions of the Ten Mile River surveyed but the most likely ranges was estimated to be between 190 and 250. The Ten Mile chinook run was estimated to be less than ten fish. In Caspar Creek, coho population estimates ranged from a low of 71 to a high of 323 fish. The most likely range was believed to be between 127 and 170. A comparison to past spawning surveys indicated the 1995-96 coho run in both Ten Mile and Caspar were the highest in recent years surveyed. No evidence of coho or chinook salmon spawning was found in the four tributaries of the Garcia River surveyed. The steelhead run in the Ten Mile was similar to other years based on late season redd densities and live steelhead observations. In Caspar Creek. this steelhead run was typical for recent years but considerably less than in the 1990-91 spawning season.

Ten Mile river coho carcasses were examined for returns of marked 1992 brood coho salmon. None were observed. The portion of the fish taken in an ongoing adult trapping program was evaluated . The 12 trapped adult coho taken for egg collection from the South Fork accounted for roughly 14 percent of the run and the 12 taken from Bearhaven Creek was estimated to be about 25 percent of that population. The results of spawning survey was used to make recommendations regarding the best location to release trapped coho progeny.

Recent fish habitat structure installation work in Garcia River tributaries was evaluated with regard to ability to withstand high winter flows and degree utilized as cover by spawning fish. Restoration work remained intact over winter. Spawning fish were not observed utilizing habitat structures for cover, however, limited sighting of spawning fish in area and limited number of surveys reduced the observation opportunities.

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INTRODUCTION

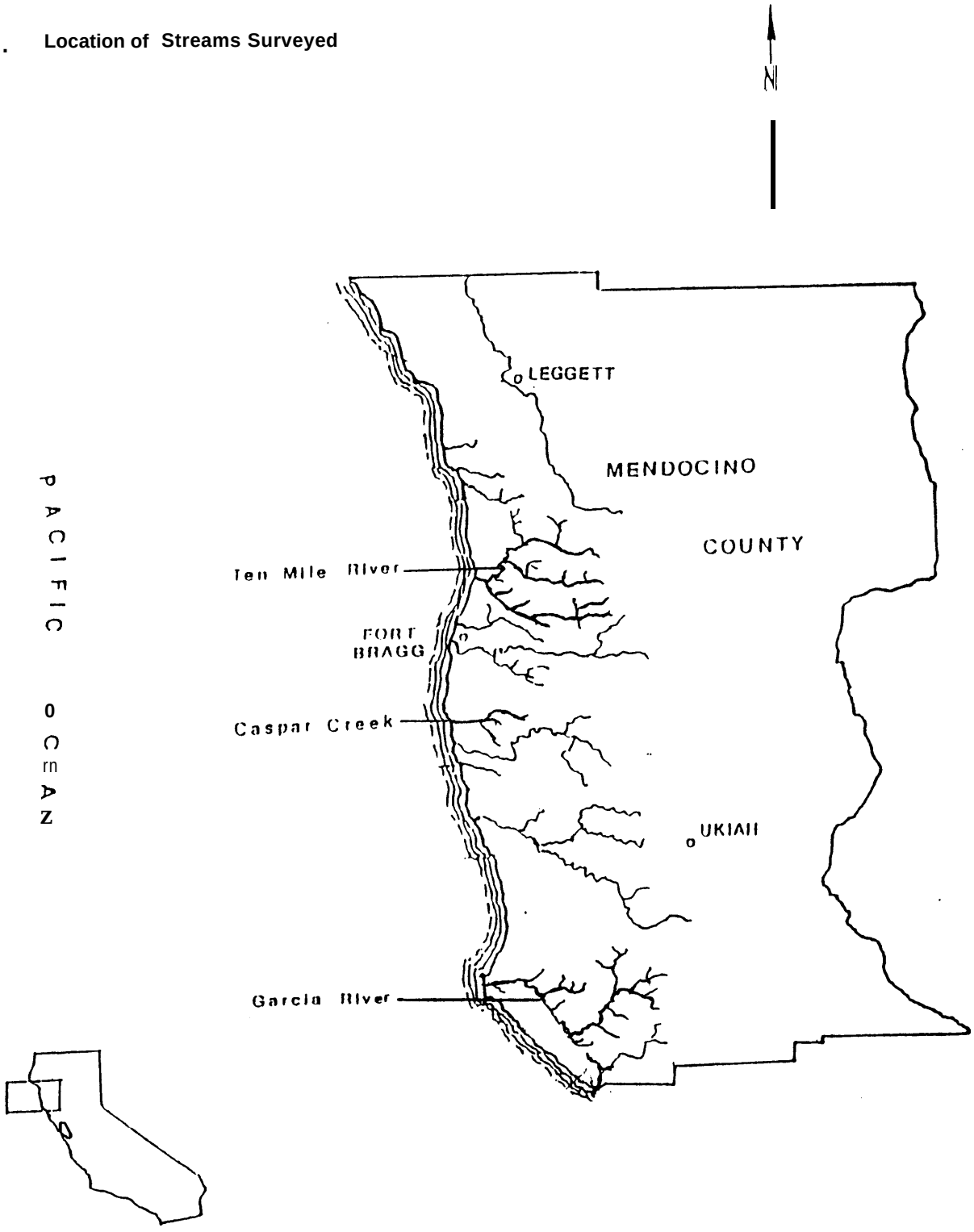
Salmon spawning ground surveys were conducted in three rivers in Mendocino County and were funded through the National Emergency Assistance Program (NEAP) for commercial salmon fisherman effected by recent fishery closures to protect stocks in unusually low abundance's brought on by drought and El Nino conditions. Spawner surveys are conducted to determine if adults are returning to and spawning within a stream reach or basin area. They are also used to determine which species are present and their relative abundance.

Surveys were conducted in portions of the Ten Mile River, Caspar Creek and the Garcia River (Figure 1). Surveys in Ten Mile were primarily targeting an evaluation of a salmon trapping and rearing program which has been rearing and releasing both coho salmon and steelhead trout. Due to restricted access (weekends only) to most of the Ten Mile River, it was not feasible to survey all of the river so most survey time was directed to key areas where returning progeny from rearing projects were expected to occur and to those areas where populations of coho have been observed in recent years. Caspar Creek was surveyed as a control stream to judge the magnitude of current spawning year for coho salmon and steelhead. This stream has been one of the most consistently surveyed coastal stream in Mendocino County with both spawning surveys and juvenile salmonid outmigrant trapping, and has not had recent hatchery supplementation or habitat restoration work. Garcia River tributaries, Signal, Inman, and Pardaloe Creek were surveyed to determine whether coho were present in areas where habitat restoration work had recently occurred and to determine to what extent spawners were utilizing installed habitat structures for cover. One additional stream, Mill Creek, was surveyed as a Garcia River control stream. It was chosen for its easy access, recent reports of coho spawning and the apparent quality of habitat present.

Estimates of spawning escapement for coho and chinook salmon are made in this report. Indices of steelhead abundance's are also made. The size of individual redds were measured and categorized in an attempt to refine spawner estimates based on the number or redds observed.

High flow conditions inhibited the ability to survey streams this year. Flows during the later halves of January and February were generally too high to allow surveys. This resulted in survey intervals of as long as two to three weeks in some instances, reducing the reliability of spawning estimates.

Figure 1. Location of Streams Surveyed



The spawning survey results were used to make recommendations regarding which areas of the basin should receive plants of juvenile coho raised as part of a native coho rearing program. These recommendations take advantage of areas receiving little or no coho spawning activity this past season and where conditions would indicate suitable habitat exists.

In this report are comparisons between this years spawning survey results and results from a recent spawning survey covering years 1989-90 through 1991-92. Also, data from these past surveys, which have not previously been reported, were used to compare this years steelhead and coho runs to prior runs.

METHODS

The targeted stream reaches were surveyed on a weekly basis if flow and other factors indicated that spawning activity was likely or reasonable to expect. Surveyors recorded any live salmonids observed and tagged and measured any carcasses encountered. They also took scale samples for aging where the carcass's length could be determined. Jaws were tagged with an aluminum numbered tag by attaching it with a plastic tie. The carcass tag number was recorded along with the "condition" of carcass. The carcasses condition was a description of the degree to which they were intact, or complete. Surveyors were given a key showing examples of the codes that were to be used. A copy of the data sheets used is included in Appendix II. Surveyors were also asked to record stage of decomposition of carcass as either fresh, old, or rotten. The tail was also punched with a hole punch if tail was present. Carcasses which were found without a jaw but with a caudal fin were also hole punched and condition noted as a "T" for tail only. Whenever a previously tagged carcass was encountered, surveyors noted tag number and "condition" of carcass. All caudal fins encountered were examined for hole punches. Live fish observations were recorded to species when identifiable. Where not, fish were noted as "species unknown".

Each carcass was also examined for any hatchery mark or fin clip. A release of maxillary clipped coho were made on 1992 brood coho. These clips were observed as grilse in 1994-95 in an adult trapping program.

To prevent double counting, each redd observed was marked by attaching flagging to an adjacent streamside branch. The length and width of each redd was recorded on data sheet and the date and size of redd was written on flagging. The length of redds were

measured from the upstream end of digging to lower end of deposition and width was taken at the widest point.

The spawning population estimation was made based on four estimation procedures; a carcass mark/recapture method; live fish observations; and estimates based on the number and size of redds observed. The carcass method and live fish estimates were the same as used in previous Ten Mile and Caspar spawning surveys (Maahs and Gilleard 94).

The carcass method, called the Carcass Retention or CR method utilizes the recapture rate of tagged carcasses to determine the average daily retention rate of carcasses. This daily retention rate is used to reconstruct the number of carcasses deposited during a survey interval From the number of carcasses found in each survey. For example, if the daily retention rate of carcasses was 80 percent, the number of carcasses found on a given survey were 10 and the survey interval was 4 days, the carcass population for that survey interval would be:

$$\text{Carcass Population} = \frac{\text{Carcass x Days}}{\text{Sum of Daily Retentions}} = 10 \text{ x } 4 / \text{ sum}(.8+.64+.5\ \ 12+.41) = 17 \text{ carcasses.}$$

The live fish method is the area-under-the-curve (AUC) model (Beidler and Nickelson 1980). In this method, the number of live fish observed is multiplied by the number days between surveys to create to total number of "Fish Days" in the spawning season and this is divided by 11, the average number of days a live coho is estimated to live on the spawning grounds.

Two redd-based population estimation procedures are used in this report. One method, previously described in Maahs and Gilleard 1994, develops a spawning escapement range from the number of redds observed. In that study, known numbers of female coho were released to spawn which allowed a comparison between the number of female spawners and the number of redds observed (only the female coho are known to dig redd). Results indicated that redds per female varied between different areas from 1 redd per female to 4 redds per female. From this range and the number of redds observed estimates were developed as shown below where the spawning population was assumed to consist of half female spawners:

$$\frac{\text{Number of Redds}}{1 \text{ redd}} \text{ x } 2 = \text{Upper Range} \qquad \frac{\text{Number of Redds}}{4 \text{ redds}} \text{ x } 2 = \text{Lower Range}$$

This range is believed to encompass the possible range in the number of spawners which have spawned. For comparison, Van den Berghe and Gross (1984) found female coho constructed on average 2.07 redds/female and found individual female coho making between 1 and 4 redds each in a Washington State stream.

The second method was developed here as a improvement to the original method to better define spawning numbers. To better document redd construction, each redd was measured in this study. Based on the range of 1 to 4 redds per female and the size of redds measured, redds were categorized into three groups. Redds measuring over 5.1 sq. meters were assumed to represent one female spawner. Each redd between 5 and 2.1 Sq. meters was assumed to be half the redd area of a female spawner and redds 2 Sq. meters or less were assumed to be l/4 of the total area made by a female coho. For example, if there was one redd 10 sq. M, two at 3.5 sq. M and four at 1.5 sq. M, then three female coho would have been estimated to have spawned. This would be expanded to six to account for males and females in the population.

All redds in December and January were assumed to be coho redds except in Clark Fork where chinook were observed. Also, the redds found in the first week of February were assumed to be coho redds if live coho or coho carcasses were found during February. This seemed appropriate since surveys had not been conducted for two weeks prior due to high flow conditions. Redds found during the first survey of February were considered to be coho in Bearhaven, Smith and Campbell Creek and also in the LNF in the Ten Mile River as well as in Caspar Creek (locations shown in Figure 2 & 3). In Clark Fork, since half of the January carcasses and live fish observations were chinook, half of the redds were assumed to be chinook and the male to female ratio was assumed to be 50 percent.

Besides the data recorded for live fish, carcasses and redds, surveyors took air and stream temperatures at the beginning and end of surveys, recorded estimates of turbidity, and collected flow information. Flow data included three depth measurements at three cross sections in a given length of stream and three timed drifts of a floating object through the measured reach.

PART I

RESULTS OF SPAWNING SURVEY

In 1995-96, spawning surveys in the Ten Mile River (Figure 2) were conducted in Clark Fork, South Fork and the Little North Fork, including most tributaries. In Caspar Creek, (Figure 3) survevs were conducted in its North Fork from its mouth to a weir 1.9 miles upstream, the South Fork from the mouth to the weir about one half mile, and the mainstem from the forks down 2 miles. In the Garcia River, four tributaries were surveyed, Signal and Inman Creeks and in the headwaters, Mill and Pardaloe Creeks (see Figure 4).

Table 1 shows for all areas surveyed the lengths of the survey reaches and the total number of surveys miles as well as summaries of the number of live fish, carcasses and redds found. Data is broken into two (December-January and February-April) time periods. This early/late breakdown is given to compare with prior survey reports which utilized these periods to separate salmon from steelhead spawning. In the Ten Mile River, 19 miles of tributaries were surveyed and 25 miles in two of the three main forks. Surveys were not conducted in the North Fork (mainstem). In the early period, December-January, most areas of the Ten Mile had 1 to 4 surveys and the later period from 2 to 7. More frequent surveys were conducted in Caspar in the early period with fewer the later period due to an active logging operation. In the Garcia River one survey was conducted in the early period and 2 to 3 in the later period. Flow estimates by survey week are shown in Appendix I.

Ten Mile Early Period Observations

For the Ten Mile tributaries, the early period summary shows live fish observations totaling 40 fish. This is a summary of daily observations which may include some fish being counted more than once. In the twqmainstems, Clark and South Fork, 46 fish were observed. Peak daily coho counts were 9, 7 and 5 in the LNF, South Fork and Campbell Creek , respectively. The highest density of live counts were 1.4/mile in the LNF, 1.2 in Smith and 1 .l/mile in lower Clark Fork. These densities are per mile of

Figure 2 Ten Mile River

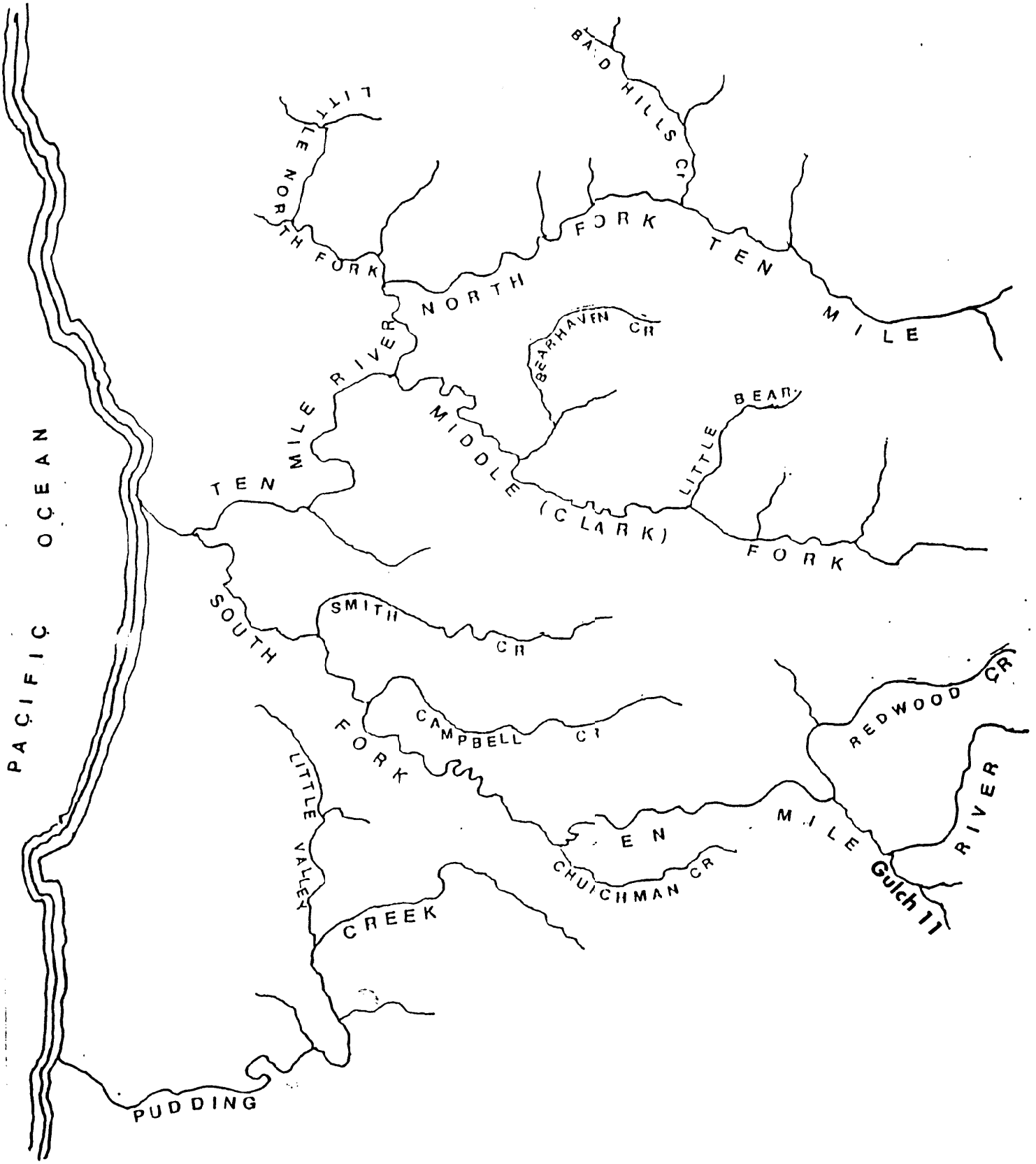
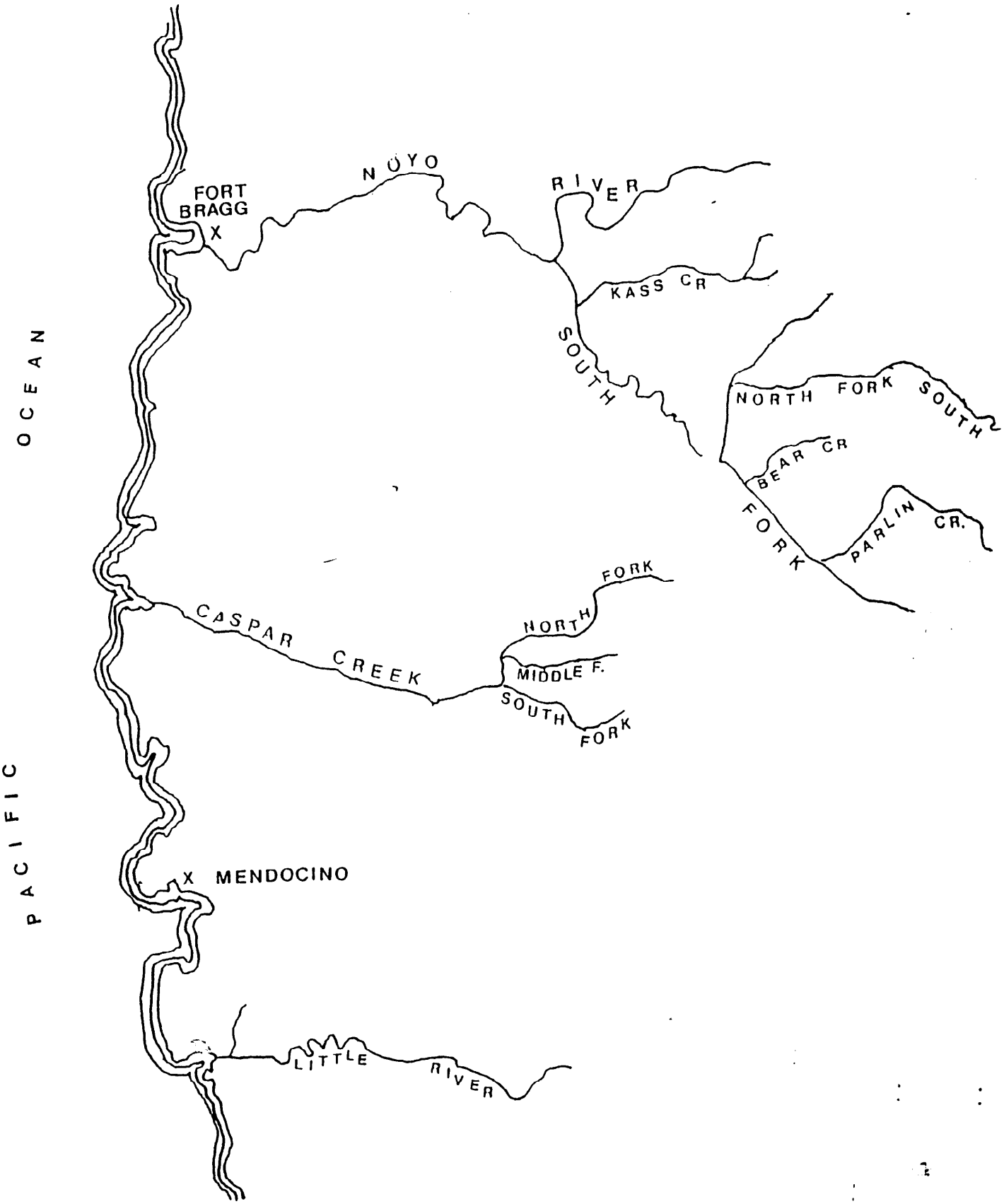


Figure 3 Caspar Cr



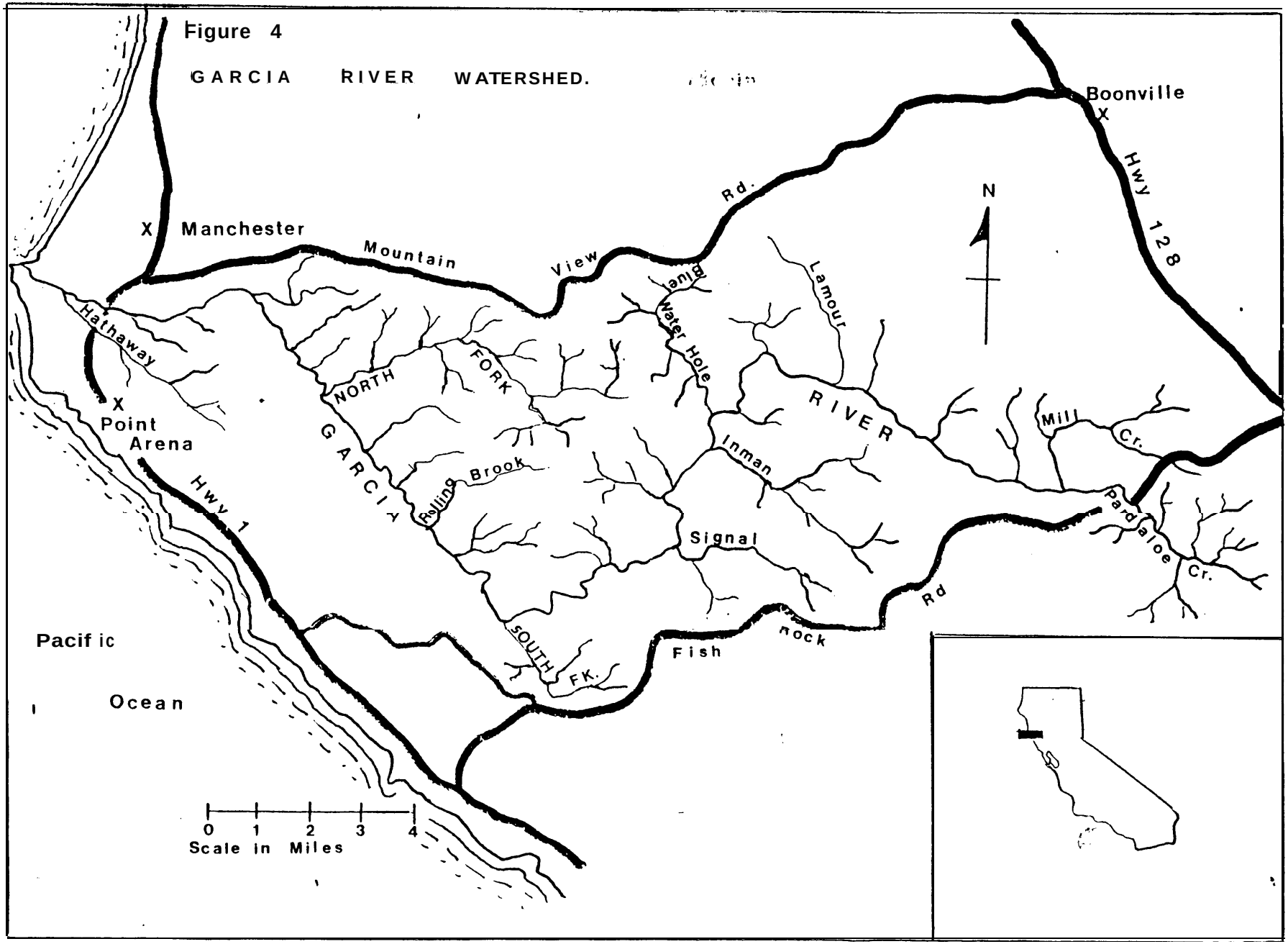


Figure 4
GARCIA RIVER WATERSHED.
Boonville
Hwy 128
Rd.
N
Manchester
Mountain View
Hathaway
Point Arena
Hwy 1
NORTH FORK
GARCIA
RIVER
Water Hole
Lamour
Inman
Mill Cr.
Falling Brook
Signal
Pardaloe Cr.
Rd
SOUTH FK.
Fish rock
Pacific Ocean
0 1 2 3 4
Scale in Miles

Table 1. Length of survey reach, total number of miles surveyed, number of surveys, number of live fish number redds, and number of carcasses jaw tagged during 199596 survey. Number in ( )'s are live fish per survey mile, redds per reach mile and number of carcasses found including jaw and tail punched fish. Data is separted into early (December-January) and late (February-April) periods.

	Reach	Survey Miles		Number of Surveys		Number Live Fish		Number Redds		Number Tagged Carcasses by Specie			
Stream	Len(mi)	Dec-Jan	Feb-Apr	Dec-Jan	Feb-Apr	Dec-Jan	Feb-Apr	Dec-Jan	Feb-Apr	Chinook	Coho	Steelhead	Unknown
		Ten Miles River Tributaries											
LNF	3.3	11.7	18.2	4	6	16(1.4)	2(0. 1)	25(7.6)	21(6.4)	0	10	1	1
Buckhom Cr.	1.2	0.6	1.8	1	2	0	0	0	2(1.7)	0	0	0	0
Vallejo Gulch	0.2	0.0	0.4	0	2	0	1(2.5)	0	0	0	0	0	0
Bald Hills Cr.	1.9	1.9	0.0	1	0	0	0	0	0	0	0	0	0
		Clark Fork Tributaries											
SF Bearhaven	0.4	1.1	1.2	3	2	1(0.9)	0	1(2.5)	6(15)	0	0	0	0
Bearhaven***	2.9	10.8	16.1	4	7*	8(0.7)	2(0.1)	17(5.9)	26(9.0)	0	4	1	0
L. Bearhaven	1.3	1.3	2.1	1	2	0	0	0	5(3.8)	0	0	0	0
Minor Clark Tribs	0.25		0.5	0	2		0		1(4.0)	0	0	0	0
		Clark Fork											
Booth up	1.6	3.2	1.6	2	1	0	0	0	7(4.4)	0	0	0	0
Booth-LBear	3.15	7.2	7.2	2	2*	3(0.3)	1(0.1)	6(1.9)	lO(3.2)	0	0	0	0
LBear-Bearhaven	3.75	11.3	9.0	3	3*	9(0.8)	2(0.2)	6(1.6)	7(1.9)	1	1	0	(1)
Bearh to Mouth	3.4	10.2	14.2	3	5*	11(1.1)	1(0.07)	4(1.2)	9(2.6)	1	1	0	1
Clark Fk Summary	11.9	31.8	31.95	10	11	23(0.7)	3(0.09)	16(1.3)	33(2.8)	2	2	0	1(1)
Smith Creek***	2.8	7.7	12.2	3	5*	9(1.2)	6(0.5)	13(4.6)	11(3.9)	0	4	0	0
Campbell Creek	2.1	8.0	10.3	5	4	6(0.7)	10(1.0)	3(1.4)	15(7.1)	0	7	0	
Churchman Cr.	1.3	1.6	3.4	2*	3*	0	0	3(2.3)	2(1.5)	0	2	0	0
Gulch 11	0.72	0.7	0.7	1	1	0	0	0	5(6.9)	0	0	0	0
		South Fork											
Redwood up	1.5	3.0	2.5	2	2	0	4(1.6)	0	8(5.3)	0	0	0	0
Camp28-Church	5.4	15.0	8.9	3	2	12(0.8)	3(0.3)	21(3.9)	6(1.1)	0	1	0	0
Church-Campbel	5.8	17.3	10.5	5**	3*	11(0.6)	0	8(1.4)	5(0.9)	0	5(9)	1	1
South Fk Summary	12.7	35.3	21.9	10	7	23(0.7)	7(0.3)	29(2.3)	1911.5)	0	6(9)	1	1
SUMMARY		Ten Mile River Basin											
Tributaries	18.4	45.4	66.8	24	38	40(0.9)	21(0.3)	62(3.3)	94(5.0)	0	27	2	1
Main Forks	24.6	67.1	53.9	21	18	46(0.7)	11(0.2)	45(1.8)	52(2.1)	2	8(12)	1	2(3)
		Caspar Creek											
Mainstem	2	10	4	5	2	14(1.4)	3(0.8)	54(27.0)	4(2.0)	0	17(19)	0	
North Fork***	1.9	9.5	5.7	5	3	15(1.6)	2(0.4)	38(20.0)	12(6.3)	0	21(28)	2(3)	0
South Fork***	0.5	3	1.5	6	3	7(2.3)	0	9(18.0)	4(8.0)	0	5	0	0
		Garcia River Tributaries											
Signal Creel	3.5	3.5	7	1	2*	3(0.9)	3(0.4)	1(0.3)	29(8.3)	0	0	0	0
Inman Creek***	1.5	1.5	4.5	1	2	0	0	0	3(2)	0	0	0	0
Mill Creek	3.6	3.6	10.8	1	3	2(0.6)	19(1.7)	8(2.5)	66(18.3)	0	0	2	0
Pardaloe Creek***	1.5	1	4.5	1	3	0	29(6.4)	8(5.3)	25(16.6)	0	0	2	0

* Incomplete survey of reach where fish utilization considered likely in at least one survey

** Somewhat larger survey area covered than nnormal reach in at least one survey

*** Reach limited by physical or other constraints and additional spawning likely in other stream areas

survey per reach mile. The redd counts in the early period were 62 in the tributaries and 45 in the main forks. The highest number and density was in the LNF where redd counts were 7.6/ mile. Bearhaven had the second highest density a 5.9 redds/ miles. This was followed by 4.6 redds/mile in Smith and 3.9 in the mid-portion of the South Fork. These densities are by reach mile and not total survey miles.

Ten Mile Late Period Observations

In the later period, peak counts of live coho were 8, 3, and 3 in Campbell, Smith and LNF, respectively. Highest live fish densities were 1.6/ mile (steelhead) in the upper South Fork and 1 .0/mile in Campbell Creek (coho). Redd count densities in the later period were highest in Bearhaven and its SF although this was partly due to an extra survey in April which was not conducted in other areas. Eliminating this late survey, redd densities were highest in the SF Bearhaven, LNF followed by Bearhaven Creek.

Ten Mile Carcass Observations

The total number of jaw tagged coho carcasses were 27 in the tributaries and 8 in the main forks. Another 4 were tagged in the South Fork where only the tails were found. Including these 4, the highest number of coho carcass were 10 in the LNF and 9 in the South Fork and 7 in Campbell Creek. Two chinook carcasses were found in the Clark Fork and 3 steelhead carcasses were observed, one in Bearhaven, LNF and in the South Fork.

Caspar Creek Early Period Observations

Caspar Creek had higher densities than anywhere in the Ten Mile River. The early period density of live fish observations were 2.3 per mile in its South Fork followed by 1.6 per mile in the North Fork. The mainstem matched the highest area in Ten Mile, the LNF, at 1.4 per mile. Peak daily live fish counts were 23 on the mainstem, 8 in the North Fork and 6 in the South Fork. Caspar redd counts were also higher in the early period. Counts of 27 to 18 per mile were typically 3 to 12 times that found in Ten Mile.

Caspar Creek Late Period Observations

In the later period, Caspar live fish observations (0.8/mile) were higher than most Ten Mile River areas. Redd densities of 2 to 8 redds/mile were quite similar to other areas.

Table 2. Number of Carcasses, Live Fish and Redds Observed by Week in the Ten Mile River, Caspar Creek and Garcia River During 199596 Spawning Surveys.

Area	December		January			February				March				April	
	3rd	4th	1st	2nd	4th	1 st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd
COHO CARCASSES															
LNF	0	2	4	1		1	2	0			0	0	0		
Bearhaven Cr	0	0	1	3		0	0	0			0	0	0	0	
Clark Fork	0	0	1	1		0	0	0						0	
South Fork	0	0	3	6			0				0	0	0		
ChurchmanCr		0		2			0			0					
Campbell Cr	0	0	2	2		1	2			0	0		0		
Smith Creek		1	0	1		1	1			0		0	0		
SF Caspar Cr	0	3	1	0	1	0	0		0		0	0			
NF Caspar Cr	9	0	6	11		0	0	2			0				
Caspar Cr	3	5	0	11	0		0	0							
LIVE COHO															
LNF	0	0	7*	9		3	1	0			0	0	0		
Bearhaven Cr	1	1	4*	2		0	0	0			0	1	0	0	
Clark Fork	6*	2	0	6		0	0	0						0	
South Fork	7*	0	8	7			0				0	0	0		
ChurchmanCr		0		0			0			0					
Campbell Cr	0	0	6	0		8	3*			0	0		0		
Smith Creek		1	5	3*		3	1			0		0	0		
SF Caspar Cr	2	6	0	0	0	0	0		0		0	0			
NF Caspar Cr	1	0	9	5		0	0	0			0				
Caspar Cr	36	15	11	6	0		0	0							
REDDS															
LNF	0	1	6	18		10	2	2			3	1	3		
Bearhaven Cr	1	6	9	1		1	5	0			5	5	1	9	
Clark Fork		10	1	5			12	1					18	2	
South Fork	4		15	10			7					3	9		
ChurchmanCr	0			3			0			0				2	
Campbell Cr	0	0	3	0		6	5			1		1	2		
Smith Cr		7	6	0		1	5			0		3	2		
SF Caspar Cr	4	1	0	1	3	0	3		1		0	0			
NF Caspar	16	2	17	3		6	4	1			1				
Caspar Cr	28	23	1	2	0		2	2							
Signal Cr				1			10					19			
Mill Cr				8			7					10			17
Pardaloe Cr				8			5					16			4
LIVE STEELHEAD															
Bearhaven Cr	0	0	0	0		1	0	0			0	1'	0	0	
Clark Fork				3		0	1	0						1	
South Fork	0	0	7	0	0		0				0	2	4		
NF Caspar Cr	0	0	0	0		0	2	0			0				
Caspar Cr	0	0	0	1	0		0	0							
Signal Cr				3			0					3			
Inman Cr				0			0					0			
Mill Cr				2			8					10			2
Pardaloe Cr				0			7					22			0
STEELHEADCARCASSES															
LNF	0	0	0	0		1	0	0			0	1'	0		
Bearhaven Cr	0	0	0	0			0	0			1	0	0	0	
NF Caspar	0	0	1	1		0	1	0			0				
Caspar Cr	0	0	0	1	0		1	0							
Signal Cr				0			0					0			
Inman Cr				0			0					0			
Mill Cr				0								0			1
Pardaloe Cr				1			0					0			1

* Includes additional live fish where fish were not vusually identified to species but are believed to be species listed

Caspar Creek Carcass Observations

There were 43 coho carcasses jaw tagged in Caspar with an additional 9 tail punched only, for a total of 52 coho carcasses tagged. A total of 3 steelhead were tagged in Caspar Creek.

Garcia River Tributaries Observations

No salmon were observed as live fish or carcasses in these surveys. In the early period, a single survey in mid-January, found a single redd in Signal and none in Inman Creek. Eight redds were observed in both Mill and Pardaloe Creek Three steelhead were observed in Signal, one adult and two smaller fish assumed to be half-pounders as one was found with the adult steelhead. Two adult steelhead were observed in Mill Creek. Four steelhead carcasses were tagged altogether, two in Mill and two in Pardaloe Creek. One from each stream was tagged on the first survey and the others on the last survey in April. Very dense populations of newts (primarily red-bellied, *Taricha rivularis)* were observed in Mill Creek during March survey. About 1 newt per foot or stream was observed throughout the entire stream reach. Pardaloe Creek had quite high populations of newts as well. Spawning lamprey (Entosphenus tridentata) and nests were noted during April survey in Mill and Pardaloe Creek.

Timing of Spawning

The timing of spawning can be compared on Table 2 where live fish, carcass observations and redd counts are shown by week. There were two periods with very few or no surveys. These were the last two weeks of January and February. There was a longer period of coho spawning in the tributaries such as the LNF, Campbell and Smith Creeks compared to the main forks. No live coho or carcasses were found in either the South Fork or Clark fork in February surveys while coho spawning continued into mid-February in the tributaries. One live coho was reported in the third week of March in Bearhaven. Following surveys did not observe this fish as either a live fish or carcass. All chinook were observed in January, primarily late January. In Caspar, the coho run was earlier than in Ten Mile.

Steelhead were observed as early as the first week of January in Ten Mile. All January observations were in the main forks. The peak live steelhead count was in the second week of January. Only three steelhead carcasses were tagged. One in each month

January through March. The upper Garcia River clearly had relatively high numbers of steelhead late in the season.

Age and Lengths of Coho Carcasses

In Table 3 are given the ages and lengths of coho carcasses observed, The number, average length and range in length of carcasses is given for both male and female coho. Only two coho were aged as grilse, both on Caspar Creek. There was one very small (42cm) female found on Caspar Creek. This fish was initially thought to be miss-identified as a female but scales indicated it was a 3 year old fish.

Table 3. 'The Number (%), Average Length and Range (fork length cm.) of coho salmon carcasses found in 1995-96 surveys by age and sex

		Males			Females		
Stream	Age	Number	Ave Len.	Range	Number	Ave. Len.	Range
LNF	3	5	66	60-72	0		
Smith Cr	3	2	66.5	66-67	2	64	63-65
Campbell Cr	3	3	65.3	60-71	2	69	68-70
Churchman	3	0			1	60	60
Clark Fork	3	1	63	63	0		
South Fork	3	1	65	65	2	62.5	60-65
Bearhaven	3	1	61	61	0		
Summary		13	65.2	60-72	7	64.4	60-70
SF Casper	3	1	65	65			
NF Casper	3	1	69.5	65-72	6	60.2	42-70
Caspar Cr.	3	1	69	65-74	4	63.5	55-70
Summary		3	67.8	65-74	10	61.5	42-70
Caspar Cr.	2	1	44	44			
NF Casper	2	1	41	41			
Summary		2	42.5	41-44			

POPULATION ESTIMATES

On Table 4 is given the population estimates for coho and chinook salmon in Caspar Creek and portions of the Ten Mile River. On the whole, there is a surprising closeness between the live fish and carcass estimates for the combined tributary areas of the Ten Mile and Caspar Creek, differing by only 1 to 2 fish. . There are differences when looking at individual streams in each basin between live fish and carcass estimates.

Table 4. Estimated Run Size by Four Different Population Estimation Procedures for Salmon in Ten Mile and Caspar Creek 1995-96

		Population Model			
Stream	Species	Car. Reten	AUC Live	Redd Area	Redd #
Smith Cr	Coho	11	12	14	10-40
Campbell Cr	Coho	25	18	13	6-26
Churchman Cr	Coho	13	0	7	2-9
South Fork	Coho	12	27	52	21-83
L. N. Fork	Coho	31	21	47	25-101
Bearhaven Cr	Coho	9	7	35	14-55
Clark Fork	Coho	5	19	22	9-37
Total	Coho	106	104	190	78-351
Clark Fork	Chinook	5	7	5	3-6
Caspar SF	Coho	8	4	5	5-19
Caspar NF	Coho	37	13	46	24-96
Caspar Main	Coho	27	54	76	29-117
Caspar Total	Coho	72	71	127	58-323

The larger streams such as the South Fork and Clark Fork produced relatively small carcass estimates compared to live fish estimates. Some of this is likely due to using the basin average for Carcass Retention. Too few carcasses, only a single tail hole punch, were recovered to make a Carcass Retention estimate on either Clark Fork or the South Fork so the basin average was used. This could have resulted in an under estimate if actual retention rate were lower which could be true since no jaw tags were recovered out of 12 jaw tagged carcasses. It is also possible some live fish observed in forks may have been destined to spawn in tributaries. A similar difference is found in Caspar Creek where the carcass estimates are lower than live fish estimate for the lower river area compared to North and South Forks.

Estimates based on redd area were higher than live or carcass estimates. Both live fish and carcass estimates were found to dramatically underestimate spawning populations where known numbers of fish were released (Maahs and Gilleard 1994). In that study, carcass based estimates resulted in numbers only 8-15 percent of the actual number of spawners released, Live fish estimates were from 21 to 42 percent of actual numbers. It does not appear reasonable that carcass estimates would be that much in error in this study since applying the same magnitude of error as previous studies found produces estimates (700 and 1300) well beyond the upper limit of the redd-based population range (78 and 351). It does seem reasonable that the live and carcass methods produce

estimates that are between 30 to 42 percent of the actual populations. At 42 percent, the closest either of these methods got in the control streams in previous studies, would estimate a coho population of 250 in Ten Mile and 170 in Caspar Creek. The redd-area methodology suggest somewhat lower estimates, around 25% less. Estimates for Ten Mile between 190 and 250 and for Caspar, between 127 and 170 appear to present a reasonable range for spawning coho this year.It should be pointed out that all estimates given are for the areas sampled only. It is expected that fair numbers of fish spawned in upper North and South Fork Caspar as well as other areas in the Ten Mile River. The number derived from carcass and live fish estimates should be considered the absolute minimum number that spawned.

The number and size of redds observed in various areas of Ten Mile and other areas surveyed are shown on Tables 5 & 6. Redd numbers by size are separated by dotted lines. The upper portion, the smallest redds, were considered to each represent one-fourth of the redd area dug by one female coho (in the months of December and January).
The middle area redds were considered to represent l/2 area dug by a female. Each redd in the lower portion was assumed to be the entire redd area of a single female spawner.

No estimates for steelhead spawning are given here. There is no estimate of the time that steelhead spend on the spawning grounds nor can carcass estimates be used since many if not most steelhead do not die after spawning. The best opportunity lies in utilizing the number of redds in the later period. Because there are no available estimates for the number of redds produced per female steelhead or information on the ratio of males to females there is little information to base an estimate. The numbers of live fish and redds can be used to compare one year to another where such information is available.

Comparison To Past Run Estimates

Ten Mile River

Yearly comparisons between results of spawning surveys and coho population estimates are shown in Tables 7 for coho. The population estimates are higher in 1995-96 than in other years. Carcass counts themselves are also up. The summed peak live coho counts are down from 1989-90 but a substantial portion of that estimate was from the North Fork Ten Mile which was not surveyed in 1995-96.

The chinook run was much lower in 1995-96 than previous years. This years estimate of less than 10 compares to an estimates ranging from 51 to 154 in 1991-92 and from 34 to 54 in 1989-90. Whatever the cause, these low numbers of chinook being found in a year of coastwide high chinook abundance does make it appear that the chinook introductions in the Ten Mile River, while occasionally productive, may experience river conditions that are unfavorable to continued natural production . Chinook were only observed in Clark Fork in 1995-96. It is quite possible that additional chinook spawned in the North Fork which was not surveyed this year.

As an indicator of steelhead abundance both redds and live steelhead observations can be used Some indication can also be ascertained from steelhead carcass counts as well. In 1989-90 a total of 4 steelhead carcasses were tagged In 1991-92 and 1995-96 there were a total of three. Late season redds densities were similar between these two latest survey years in three areas with comparable data, Clark Fork, LNF and Bearhaven Creek. Comparable redd information for 1989-90 is not available. From this information it appears the steelhead runs have been at a similar level in each of these three survey years.

Caspar Creek

Data Table 7 shows a comparisons between coho for four different survey years for Caspar Creek. It is clear coho runs are up in 1995-96 compared to past years. The steelhead run would appear to be down compared to 1990-91 and 1989-90 but better than 1991-92.

Garcia River Tributaries

There are no previous surveys in the tributaries surveyed to make comparison. Surveys were conducted in the South Fork Garcia in 1989-90 and 1990-91. No coho were observed in the South Fork in either those two years. Late season redds in the South Fork were 1.0 per mile in 1990-91 but no live fish were observed. Live fish densities of .58 per mile were found in 1989 which compares to this years results in Signal of 0.4 per mile this last year but were much lower than in the upper Garcia tributaries where 1.7 and 6.4 live per mile were observed in Mill and Pardaloe Creek, respectively.

Table 5 Number of redds by Size (Sq.Meters) in the Caspar Creek and Garcia River Tributaries by Month found During in 1995-96 Surveys

Redd Area	North Fork Caspar				South Fork Caspar					Caspar Mainstem					
(Sq M)	December	Janaury	February	March	December	Janauty	February	March	April	December	Janaury	February	March	April	Sum
0-1	1	5	2			1					1	1			11
1.1-2	5	4	3		2	2	1			12					29
2.1-3	2	5	3	1	2					9	2	1	2		27
3.1-5	5	5	1		1	1				8					21
5.1-7	2	1	1							8					
7.1-9	1		1							4					6
9.1-l 1	1									1					2
11.1-15										6					6
15.1-20	1									2					3
20.1-26										1					1
Average	4.46	2.05	3.14	2.1	2.4	1.97	1.2			6.7	2.04	1.53	3.13		
Total	18	20	11	1	5	4	1	0		51	3	2	2		118

Redd Area	Signal Creek				Mill Creek					Pardaloe Creek					
(Sq. M)	December	Janaury	February	March	December	Janaury	February	March	April	December	Janaury	February	March	April	Sum
0-1		2				3		IO	0		1				16
1.1-2		4	11			2	3	15	2		3	1	3		44
2.1-3		2	5			1	2	8	5		1		8	1	32
3.1-5		2	2			1	2	6	5		2	1	4	2	25
5.1-7			1					3	4		1	1	2		12
7.1-9									1			2		1	3
9.1-11															0
11.1-15															0
15.1-20						1									1
20.1-26															0
Average		2.19	2.42			3.94	1.69	2.29	4.1		2.88	5.44	3.13	5	
total	0	IO	19	0		8	7	42	17		8	5	17,	4	133

Table 6 Number of Redds Listed by Size (Sq. Meters) in the Ten Mile River Tributary Areas by Month in 199596

Redd Area	LNF Ten Mile					Smith Creek				Campbell Creek					
(Sq. M)	December	January	February	March	April	December	January	February	March	December	January	February	March	April	Sum
0-l		3	3	1		3	1						1		12
1.1-2		9	2	2		3	1	4	2		2	1			26
2.1-3		3	1	1			3	2	2			2			14
3.1-5		3	3	2		1	1		1		1	5	'3		20
			4	1								2			I0
7.1-9		2										1			3
9.1-I 1		2													2
11.1-15			1												1
15.1-20															0
20.1-25															0
Average	6.8	3.4	3.5	3.0		1.4	2.4	1.8	2.3		2.3	4.1	3.1		
total	1	24	14	7		7	6	6	5		3	11	4		88

Redd Area	Clark Fork Ten Mile					SF Ten Mile				Bearhaven Creek					
(Sq. M)	December	January	February	March	April	December	January	February	March	December	January	February	March	April	Sum
0-l	2	1						1		1					5
1.1-2	1		2	1		3	4	1	3	4	2	1	2		
2.1-3	1		1	6	2	1	4	2	4	2		2	4	5	34
3.1-5	4	1	5	6			3		3		2	2	3	2	31
5.1-7	1	1	2	4			2	1	1		1	1	2	1	17
7.1-9							1	2							3
9.1-11		2	1				3		1		1				8
11.1-15	1	1	1	1			6								10
15.1-20							1				3				4
20.1-25							1				1				2
Average	3.8	8.4	4.9	4.6	2.5	1.8	6.6	4.3	3.2	1.8	9.9	3.6	3.3	3.1	
total	I0	6	12	18	2	4	25	7	12	7	10	6	11	9	139

Table 8. Comparisons between Miles of Survey, Population Estimates, Carcass Counts, Live Fish Observations for the Ten Mile River and Caspar Creek by Survey Year

Survey Year	Miles of Survey	Carcass Based Estimates	Redd Based Range	AUC Live Estimate	Carcass Counts	Peak Live Counts*
	Ten Miie River Basin					
1989-90	409	32-55	**n/a**	86	16	35**
1991-92	97	n/a	14-42	n/a	3	1
1995-96	116	106	78-351	104	39	28
	Caspar Creek Basin					
1989-90	49.2	33	n/a	52	1	4
1990-91	33	0	8-28	2	0	1
1991-92	41.3	55-80	49-196	15	20	10
1995-96	33 . 7	72	58-323	71	53	22

* Greatest number of live fish counts during any survey week for fish indentified as coho

** 14 of the live coho were counts from the North Fork which was not surveyed in 1995-95

Table 9. Number of Steelhead Carcasses, Late Season Redd Densities and Peak Live Counts of Steelhead in Caspar Creek and Ten Mile for Three Years of Survey

Survey Year	Steelhead Carcass Count	Late Season Redd Densities	Peak Live Counts
		Caspar Creek	
1989-90	4	n/a	4
1990-91	2	10.2	10
1991-92	1	1.5	1
1995-96	3	4.3	2
		Ten Mile River*	
1989-90	4	n/a	6
1991-92	3	1.4	7
199596	3	1.5	8

Data limited to survey areas covered each survey year.

PART II

ANALYSIS OF PROPAGATION AS A RESTORATION ACTION AND HABITAT RESTORATION EVALUATION

Analysis of Hatchery Supplementation Program

Returning Hatchery Produced Coho

A primary reason for conducting this survey was to determine how many spawners and what portion of all spawners had originated from coho yearlings planted in 1992 and to determine where these fish were returning to spawn. These fish were marked with Maxillary clips before release, Several of these fish were observed in 1994-95 during adult trapping operations (Ed Moore, Salmon Restoration Association, personnel communication).

During the 1995-96 spawning surveys no marked fish were observed. Twenty complete or nearly complete coho carcasses were examined with an additional 10 heads examined. It is possible that a marked head would not have been observed if the head had been scavenged upon but in any event returning marked fish did not make up a substantial portion of returning adults. What was reported as a relatively high proportion of the grilse population having marks in 1994-95 may be the result of an advanced maturity schedule due to the feeding and rearing regime. While there may have been some benefit from the artificial production of the native Ten Mile River coho salmon, those benefits could not be measured in this study. What may be the greatest benefit from future artificial rearing is the ability to alter the maturity schedule through feeding regimes, An artificial rearing strategy where a deliberate attempt is made to speed up of the maturity schedule may be an appropriate method to help recovery of a very weak brood. Such a brood may be due to return in 1996-97. This is two generations from a very low escapement year (1990-91) experienced all along the Mendocino Coast (Maahs and Gilleard 1994).

Impacts to Escapement From Trapping Operations

Two adult traps were operated by the Salmon Restoration Association, Inc. in the Ten Mile River this season. During this operation, 7 females and 5 males were collected from a trap on the lower SF Ten Mile and 3 males and 3 females were released

upstream. In Bearhaven Creek, a tributary to Clark Fork, 9 females and 11 males were collected and 5 females and 7 males released upstream. Fish were collected for a native coho rearing program. One of the purposes of this spawning survey was to document where and to what extent coho and chinook salmon were spawning in the Ten Mile River in relation to the numbers taken for propagation purposes. From information collected in this survey (discussed below) it does not appear that the egg taking program had a significant impact on the numbers of naturally spawning coho salmon. Release of hatchery reared progeny should compensate for any reduction in the number of spawners. Progeny from the egg taking program should be released back into Bearhaven Creek and the South Fork. Two specific recommendations, based on spawning survey results, are discussed below (see following sections under SF Bearhaven and South Fork Ten Mile),

South Fork Trap

Based on the "Redd Area" population estimate, which appears to present a good ballpark estimate, about 72 coho spawned above the trap site on the South Fork Ten Mile. This compares to 12 being taken for artificial purposes, about 14 percent. The impact on future natural production due to collection of spawners is difficult to establish. For any of those fish that may have been destined for Campbell Creek, which received about 18 percent of the escapement above the trap site, little benefit would have been expected since large numbers of juvenile young-of-the-year (YOY) coho have been counted outmigrating from of Campbell Creek this spring (Maahs, report in preparation) , This would seem to indicate that the area was fully seeded with coho this year and that additional spawners would not result in increased production from Campbell Creek. Coho typically need to spend a full year in the natal stream to enable them to survive to adulthood and that space and food limitations are what usually initiates YOY coho to outmigrate (Chapman (1962), Mason and Chapman (1965), and LeCren (1965)). Whether such or not increased production would have occurred in the remainder of the South Fork where lower spawning densities occurred can't be certain. The likelihood should be considered in light of habitat conditions such as temperature, large woody debris and percent fines in the river bed Most of the South Fork does not have the ideal temperature regime found in Campbell Creek.

Bearhaven Creek

The twenty adult coho taken from Bearhaven Creek compares to a Redd Area estimate of 35 spawners. The live and carcass estimates indicate much lower numbers but these numbers are less than the known 12 that were released upstream to spawn. The period of operation for the weir extended only until January 7th and was not in operation in key

periods prior due to portions of the weir being washed out during high flows. It is estimated here that about 25 percent of run was taken for spawning purposes. This could be much lower due to spawning surveys being limited to the lower 2.9 miles of the stream. This is only half the area believed accessible to anadromous fish (Georgia Pacific, Habitat Typing Data). The early period redd counts in Bearhaven Creek were relatively high compared to other areas in Ten Mile, being second only to the LNF. These facts indicate that reduced productivity due to trapping would not likely be very significant here as well.

Garcia River Restoration Evaluation

In the summer of 1995, a variety of restoration projects took place in the Garcia River utilizing displaced commercial fisherman. The inclusion of spawning surveys in these areas allow for one; observation of fish utilization of the habitat structures installed; two, evaluation of stability of structures after high flow conditions; and three, establishment of baseline information on spawning populations for future reference in evaluating effectiveness of restoration work performed

During 1996 surveys, no spawners were observed utilizing as cover any of the fish habitat structures installed This is likely influenced by the lack of fish observed in the surveyed streams which was influenced by there being only three to four surveys over the four month period where spawning was possible. Only six steelhead were observed out of three different surveys on Signal Creek. No fish were observed in Inman Creek. On Pardaloe, there were two structures build as part of a bank erosion/protection project. These structures performed only marginally as habitat structures but appeared to protect bank which was the primary purpose and helped prevented any additional erosion. No restoration work was conducted in Mill Creek. This stream was chosen for spawning surveys as a control stream for several reasons. No work was done or planned in Mill Creek. The habitat is in a rather pristine condition and coho have been reported spawning in recent years. It is also uniquely situated so that where the spawning survey began in Mill Creek, the survey could continue down to the mouth and from there continue up Pardaloe Creek. Where the survey ends is in the immediate vicinity-of where the vehicle was parked originally and so a lot of stream can be surveyed without having to double back or use a second vehicle. The point at which two headwater streams join, is considered the beginning of the Garcia River.

Most all habitat structures remained intact throughout the survey period Only two significant changes were noted. One of these was in Signal Creek were a log had not

been fastened securely enough and the upstream end had drifted out towards the opposite bank. It was still functioning well but appeared to be in a somewhat precarious position and would likely continue moving with additional high flows. It should be noted that most (roughly 70%) of redds were above the area where habitat structures were installed There is a limited quantity of spawning gravel in this stream. It was common to see new redds on top of old redds where they had been previously marked

The other habitat structure change was in Inman Creek where a very large root wad had been lowered into stream. This had moved downstream about 100 or so feet. Surveyors thought the new alignment was actually an improvement over the original placement. Overall, the structures remaining intact over the winter in Inman, Signal and Pardaloe Creeks.

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Appendix I	Flow data taken during 1995-96 surveys. Flows are given in cubic feet per second															
										.						
	December		January				February				March				April	
Stream	3rd	4th	1 st	2nd	3rd	4th	1st	2nd	3rd	4th	1 st	2nd	3rd	4th	1 st	2nd
LNF	44		17	19			38	49	38			64	63	30		
Buckhom Cr				3			16									
Vallejo Gulch							4				7					
SF Beanhaven		1	3				6								4	
Bearhaven Cr	28		20				35	30	31			40	37	30	23	
L. Bearhaven	8						12						8			
Smith Cr		3	20	8			30	24			50		18	9		
Campbell Cr	12	3	13	6			28	22			31		34	5		
Churchman Cr	10			18							41					4
Gulch 11		4											16			
Clark Fork		65	72	60			239	194	110					107	102	
South fork	29		70	32				65						43		20
Caspar Main	5	4				14		24	19							
NF Caspar	5	3	5				12	14	5			11				
SF Caspar		1		2		8		6				8	4			
Signal Cr				19				62								
Inman Cr				26				32					41			
Mill Cr				6				19					24			13
Pardaloe Cr				13				36					31			15

APPENDIX 11 Spawning Survey Data Reocrding Form

DATE VISIBILITY STREAM

TIME IN AIR TEMP WATER TEMP PAGE OF

TIME OUT AIR TEMP WATER TEMP

	BEGIN	END
SURVEYORS	LOCATION	

NEW CARCASSES SPECIES*	CONDITION**	REACH	FORK LEN	TAG #	HOLE PUNCH	OLDCARCASSES CONDITION	TAG #	HOLE PUNCH

* incl. sex ** incl.stage

LIVE FIS

SPECIES	ADULT	GRILSE	NOTES
COHO			
CHINOOK			
UNKNOWN			

	AOULT	HALF-POUNDER	TROUT (M6") (Optional)
STEELHEAD			

REDDS List approximate area (length X width) in Meters

X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X

FLOW DATA

	TIME(SEC.)	DEPTH (CM) 1	2	3	WIDTH(CM)
1					
2					
3					

LENGTH= (CM)

CONDITION

J-Jaw

H- Head

T- Tail

HB-Head & 1/2 Body

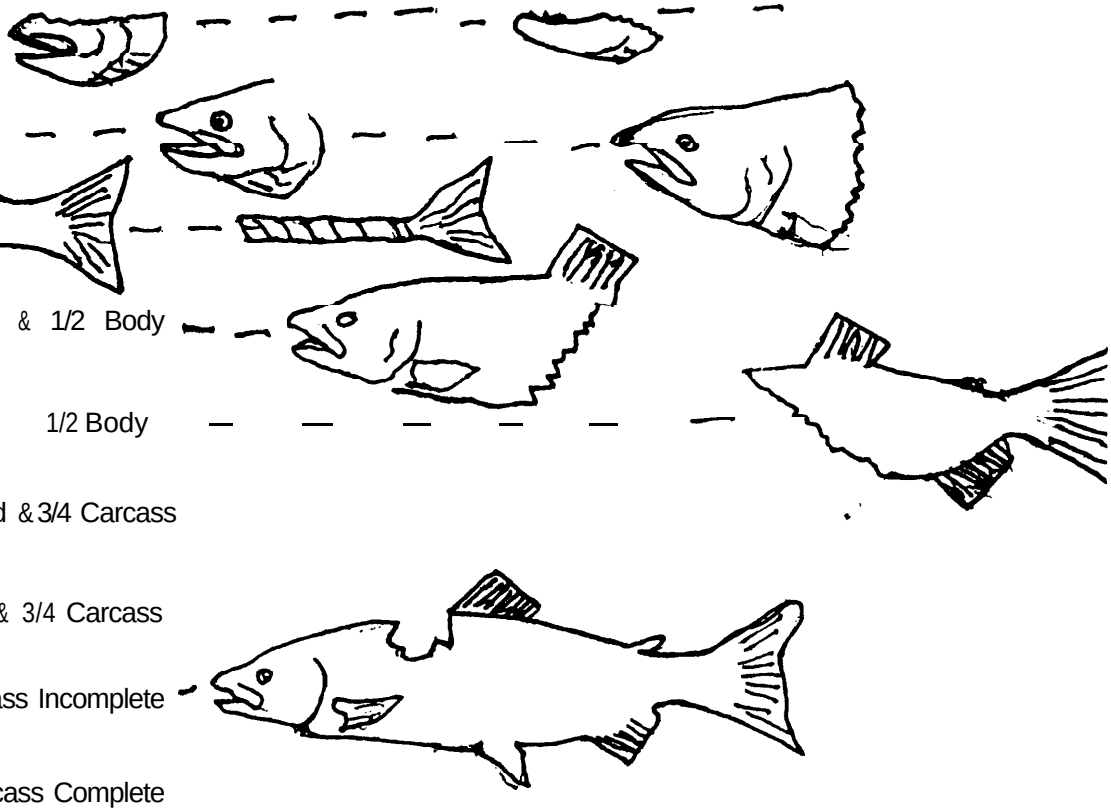
TB-Tail& 1/2 Body

HC- Head &3/4 Carcass

TC- Tail & 3/4 Carcass

Cl- Carcass Incomplete

CC- Carcass Complete



STAGE

I- Fresh 2- Old 3- Rotten

NOTES