THE 1996-97

SALMONID SPAWNNG SURVEY

FOR PORTIONS OF THE TEN MILE RIVER

GARCIA RIVER AND CASPAR CREEK

Prepared for

Humboldt County Resource Conservation District

By

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ABSTRACT

Spawning surveys were conducted for the second consecutive year within three watersheds along the Mendocino County coast of northern California. These watersheds are the Ten Mile River, Garcia River and Caspar Creek, all tributaries to the Pacific Ocean. Coho spawning populations are estimates for surveyed areas by four separate estimating techniques utilizing; 1) carcass mark and recapture, 2) area-under-the-curve live fish counts, 3) number of redds, and 4) area of constructed redds. Indices of steelhead population are also developed.

Within the Ten Mile River, two tributaries to the South Fork were surveyed, Campbell and Smith Creek. Coho populations were low in each. In Campbell. no coho were estimated with either the live or carcass methods but redd information suggested between 3 and 12 coho spawned. In Smith, 1 to 3 were estimated from carcass and live fish counts while between 4 to 16 were estimated utilizing redd information. These estimates are generally 20 to 40 percent of the populations found in these tributaries in 1995-96. Late season redd counts and steelhead live fish and carcass counts were up this year compared to 1995-96.

In Caspar Creek, coho populations were down this year as well. Carcass and live fish based estimates were 24 to 16, respectively, while redd based methodologies estimated between 16 and 64 coho spawners. These estimates are generally about 20 percent of those found in 1995-96 but a significant improvement over the 1990-91 year class which was its parent year two generations back. Steelhead indices were also up in Caspar Creek, the highest of any of the four years surveyed.

In the Garcia River, five major tributaries were surveyed. Coho were found in three tributaries, Signal and Inman Creek and the South Fork. This is the first time surveys in these areas have found coho but populations estimates were very low; in the range of 2 to 5 coho salmon each. The possibility of coho were not ruled out in two other headwater tributaries, with unidentified carcasses or live fish in Mill and Pardaloe Creeks. Steelhead spawning activity was also up in Garcia River tributaries this year with high densities of redds (24-37 redds/mile) and live fish (4-9 live fish/mile) in Mill and Pardaloe Creeks.

Spawning surveys also were conducted in conjunction with three salmonid restoration/enhancement activities. Coho population estimates are related to a brood stock collection program in Campbell Creek. Project ended without capturing brood stock. Habitat structures were installed in Garcia River tributaries. In two areas number of structures were severely impacted by recent flood events. Remaining structures were not found to be utilized by salmon or steelhead during surveys nor were redds found to be associated with structures.

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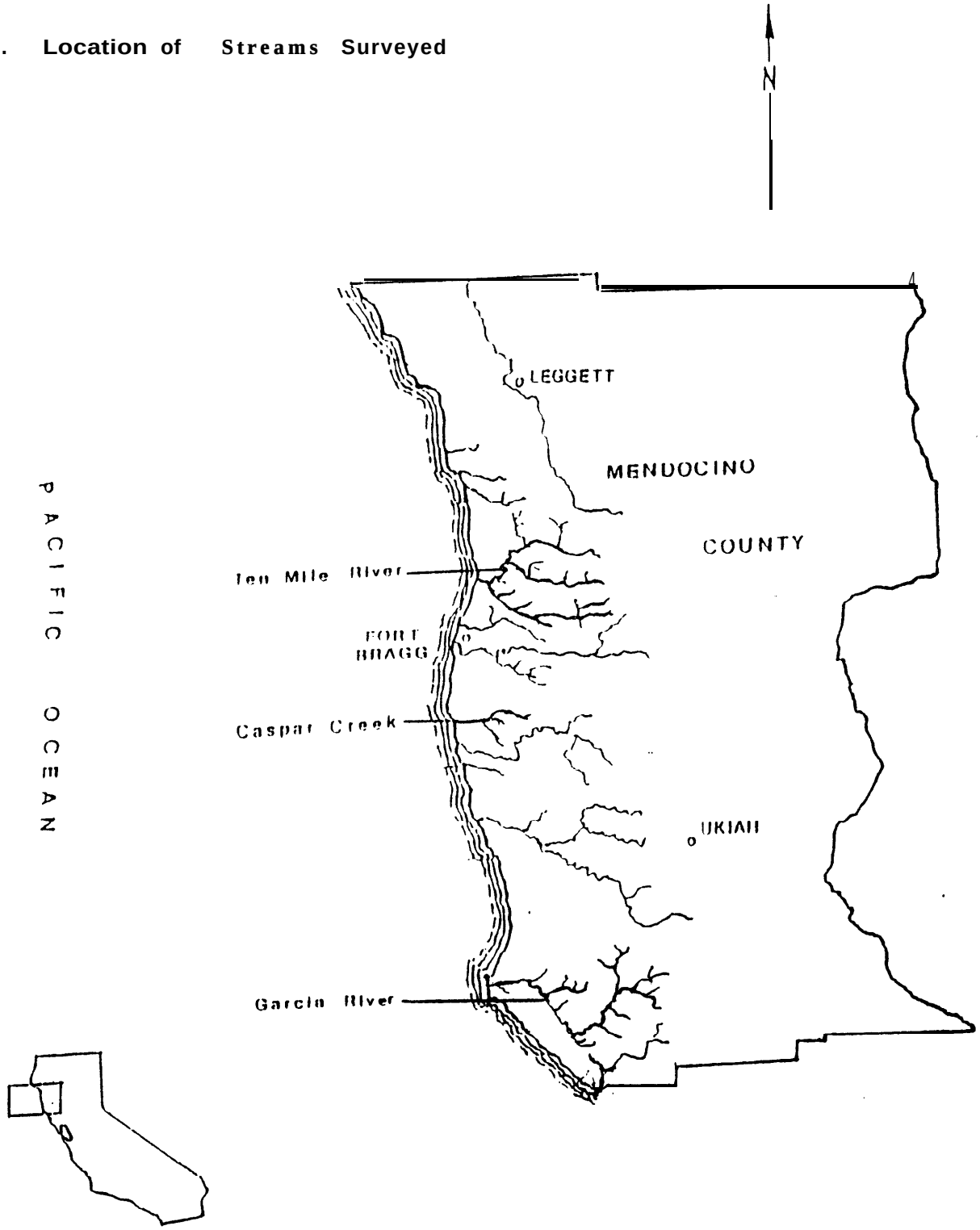
INTRODUCTION

Salmon Trollers Marketing Association (STMA), through the National Emergency Assistance Program (NEAP), was funded to conduct 1996-97 spawning surveys on portions of three streams in Mendocino County, CA. These surveys were conducted on tributaries to the Ten Mile and Garcia Rivers as well as Caspar Creek and its tributaries (Figure 1). The purpose of these surveys varied by area. On the Ten Mile River surveys were conducted to monitor population status of coho *(Oncorhynchus kisutch)* and steelhead trout *(Oncorhynchus mykiss)* in conjuction with a coho and steelhead trapping and rearing project conducted by the Salmon Restoration Association. inc. The Garcia River has been the target of an extensive habitat restoration effort guided by the Garcia River Watershed Enhancement Plan (MCRCD 1992). The Garcia River spawning surveys were to document salmon and steelhead utilization of streams where habitat enhancement projects had been conducted as well as collect baseline fishery data for the basin. One stream, Mill Creek, was surveyed as a control stream in the Garcia River since no restoration work has been done or is expected due to the general quality of the habitat present.

Coho salmon as well as steelhead trout populations have been extensively studied in Caspar Creek over the last decade. Caspar Creek has maintained itself as one of the more productive coho and steelhead streams along the Mendocino coast. It also has received very little to no restoration work and serves as a good control stream to compare other coast coho and steelhead runs. It was included in this survey so that this fishery data could continue to be collected

Estimates of coho salmon spawning populations are made in this report as well as indices for steelhead abundance. These estimates are only for the specific reaches of the streams surveyed and are in most cases not estimates for entire basins. Coho salmon estimates are made with the knowledge that stream flow conditions were very high for extended periods of time and that these long periods of high flows cast doubt on the reliability of estimates obtained. The major high flow period occurred during the first week of January. A second significant run-off period occurred in late January. Flows were fairly low starting in early February and stayed that way through the end of the spawner survey in late March and early April. This condition resulted in washing out carcasses, reducing

Figure 1. Location of Streams Surveyed



opportunity to observe live fish, and obliterating redds constructed between spawning survey intervals.. High flows also likely resulted in fish spawning higher into the smaller tributaries and headwater areas which not surveyed in the early December - January period.

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 adult salmonids observed and tagged and measured any carcasses encountered. They also took scale samples for aging fish. Jaws were tagged with an aluminum numbered tag by attaching it with a plastic tie around the jaw. 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 the Appendix. The caudal fin was also punched with a hole punch if tail was present. 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 hatchery fin clips.

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 spawning surveys (Maahs and Gilleard 94; Maahs, 1996).

The carcass method, called here the Carcass Retention or CR. (Maahs and Gilleard 94) 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. This year there was little tag recovery data due to very few carcasses being tagged. This made it necessary to determine carcass recovery rates from very limited data. Tag and recovery data for different survey intervals were lumped together. For example, where 1 carcass was tagged on two separate surveys and one was recovered on a survey 7 days after tagging while the other was not recovered when there was a survey 5 days after tagging, the average survey period would be 6 days for which there was a recovery rate of 50%. The CR. rate of 0.89 would be estimated (0.89^6=.50). Where only a single carcass was tagged and there was no recovery a CR. rate of .85/day was used which is a typical recovery rate based on past survey data (Maahs & Gilleard 1994). In one case, the recovery rate on a near by stream was used. In cases where there were only one or two carcass, the selection of a CR. rate was inconsequential with regard to the population estimated.

An example of how the CR. model calculates the spawner population is as given below:

> If the daily retention rate of carcasses was found to be 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:
>
> $$\text{Carcass Population} = \frac{\text{Carcass x Days}}{\text{Sum of Daily Retentions}} = \frac{10 \times 4}{\text{sum}(.8 + 64 + .512 + .41)} = 17 \text{ carcasses.}$$
>
> The total population would be the sum of the carcass population from each survey interval

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 above capture sites which allowed a comparison between the number of female spawners and the number of redds observed (only the female coho are known to dig redds). Results indicated that the number of redds constructed per female varied between different areas from 1 redd 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:

Number of Redds x 2= Upper Range
1 redd per female

Number of Redds x 2=Lower Range
4 redds per female

This range is beiieved to encompass the possible range in the number of spawners which have spawned but could underestimate a spawning population if redds have been underestimated due to flows impacting ability to observe redd presence.

The second method described in Maahs (1996) utilizes redd size to better estimate the amount of spawning activity. Each redd encountered in this survey was measured and grouped into three size group categories. 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 1/4 of the total area made by a female coho.

All redds in December and January were assumed to be coho redds except Mill Creek where no coho were observed or known to exist. Also, for streams other than Mill and Pardaloe Creek, redds found in the first survey in February were counted as January redds due to there being a two week period in late January where no surveys were conducted. It is expected that some steelhead spawned in the January period but these are assumed to be offset by some coho spawning into February.

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.

RESULTS

In 1996-97, two tributaries of the South Fork Ten Mile River (see Figure 2) were surveyed, Smith and Campbell Creek. Smith Creek was surveyed from its mouth up to the North Fork (about 3.1 mile) in most urveyss but occasionally stopped short or extended farther upstream. Surveys above the NF are reported as upper Smith Creek. Two surveys continued up a short distance into the North Fork of Smith. Campbell Creek surveys typically extended up from the mouth about 1.9 miles. One survey continued up to the West Branch of Campbell Creek (about 2.4 miles).

This season Fish & Game crews, under the direction of Weldon Jones, surveyed Caspar Creek during the month of December and STMA surveyed January through March. In the North and South Forks of Caspar Creek (see Figure 3), surveys were conducted from the weirs to the mouths of each tributary. In two surveys, a short distance of the SF was surveyed above the Weir. For the mainstem of Caspar Creek, Fish and Game crews surveyed from the forks to the mouth while STMA surveyed from the forks downstream a distance of about 2 miles.

In the Garcia River basin, five tributaries were surveyed; Inman, Signal, Mill and Pardaloe Creeks, and the South Fork. The first four tributaries were survey from the mouth up a distance of about 2.1, 3.5, 3.6 and 1.5 miles respectively. The South Fork was surveyed from the mouth to Flemming Creek, about 2 miles. Also, sporadic surveys were extended into three of its tributaries. One survey was conducted in lower Graphite Creek for about 3/10ths of a mile above the logging road culvert.

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. Flow estimates by survey week are shown in Appendix II and Observable depths are given in Appendix III. One Table 2 are given the number of carcasses, live fish observations and redd counts by survey week for coho, steelhead and those unidentified to species. Zeros indicate a survey was conducted but no observations were made. A blank space indicates that no survey was conducted. For all categories except redds, a stream was listed only if there was an observation for that category. In the redd category, all surveyed streams are listed whether or not redds were observed as a means of documenting survey coverage.

Figure 2 Ten Mile River

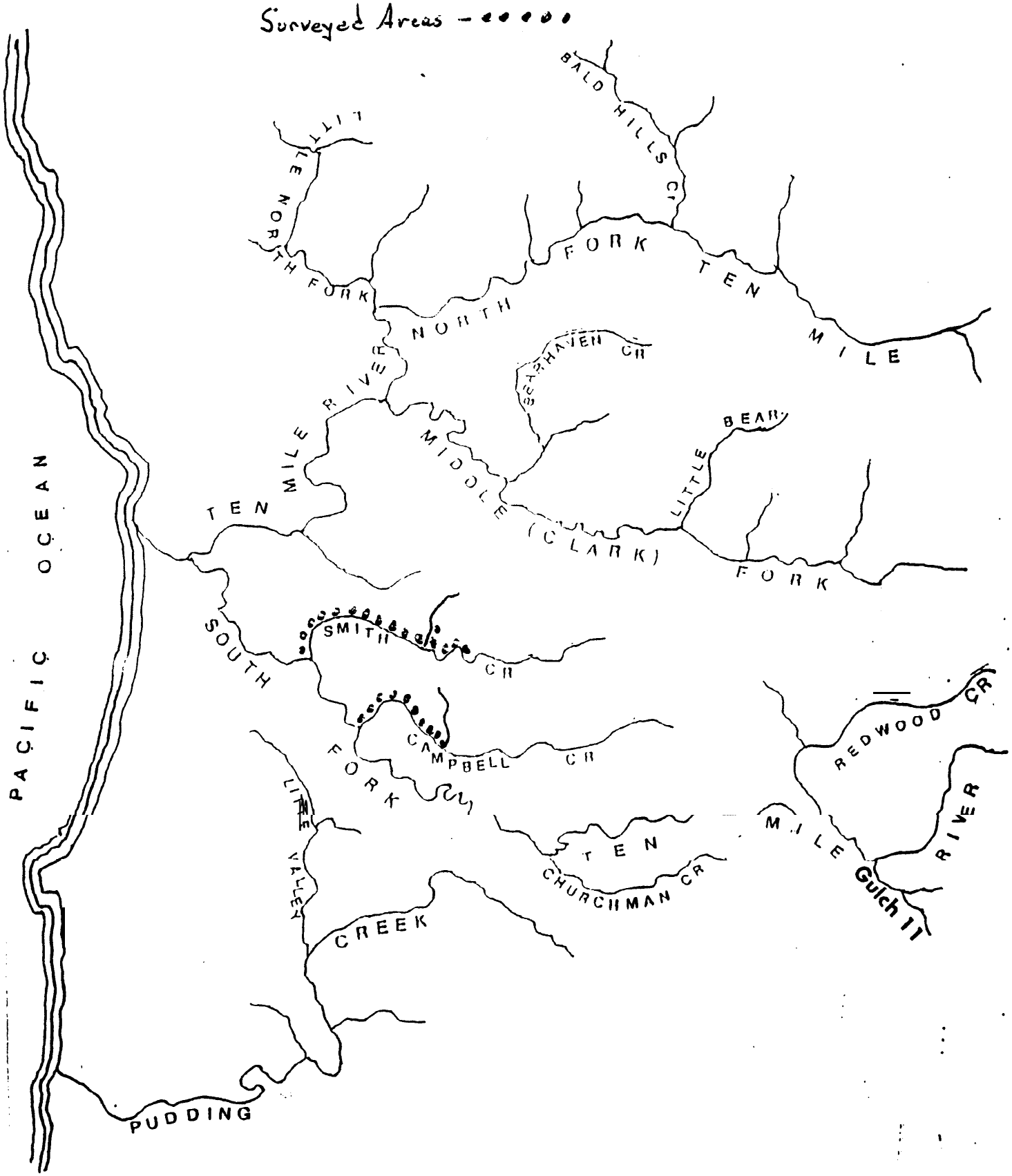


Figure 3 **Caspar Cr**

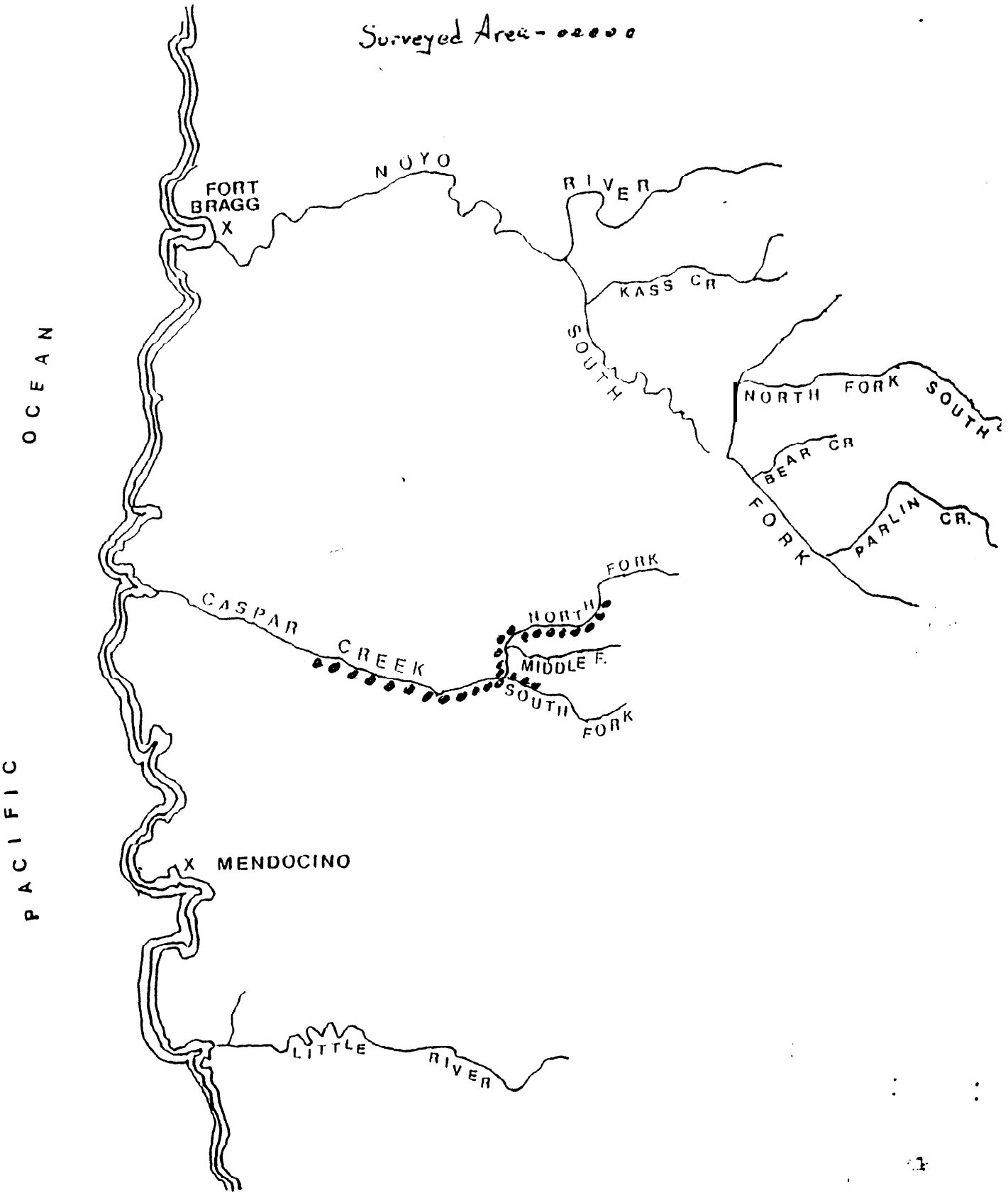


Figure 4

GARCIA RIVER WATERSHED.

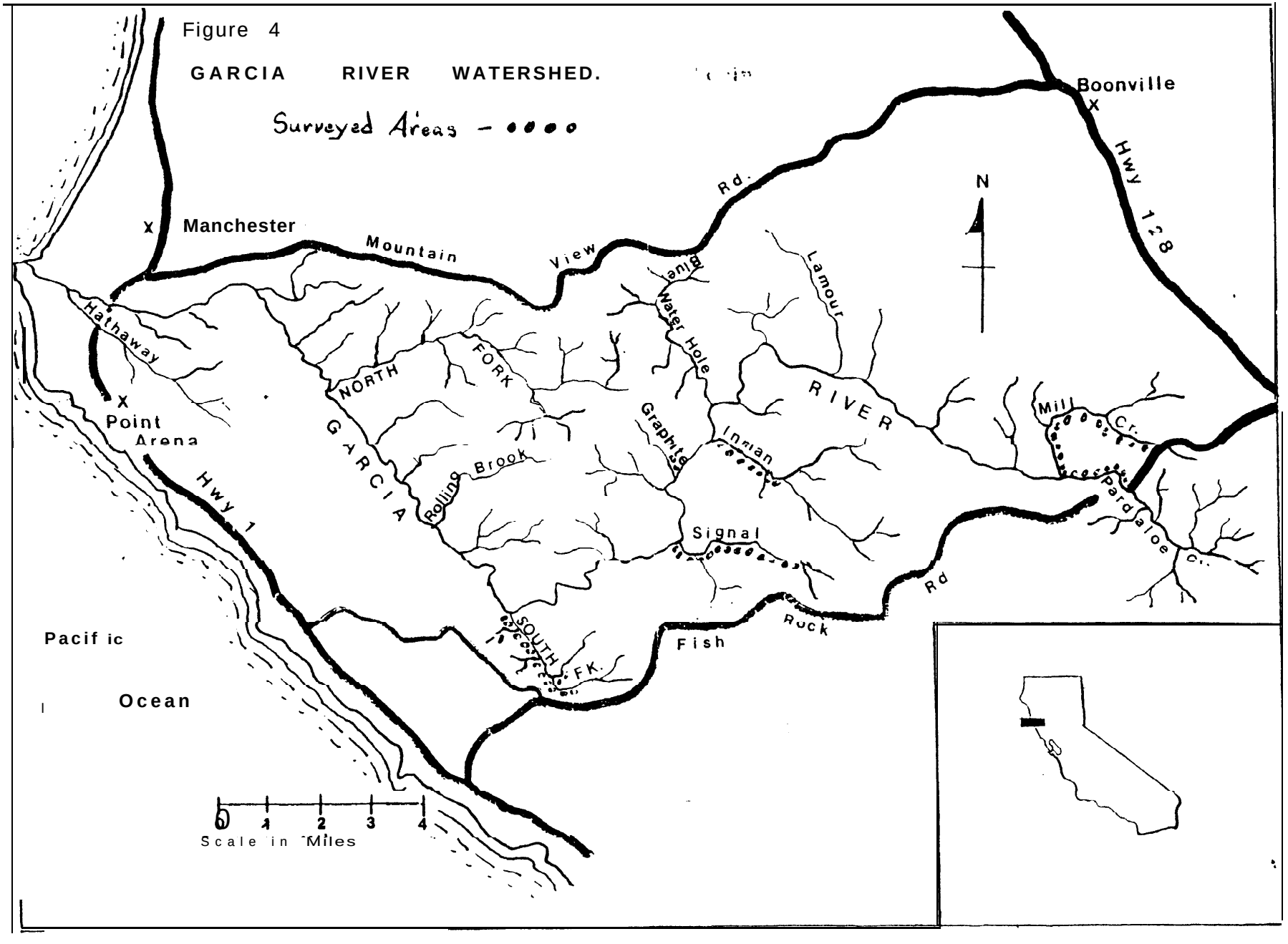


Table 1. Length of survey reach, total number of miles surveyed, number of surveys,number of live fish, number redds, and number of carcasses jaw tagged during 1996-97 survey. Number in ()'s are live fish per survey mile, redds per reach mile and number of carcasses found including jaw and tail punched fish. Data is separated into early (December-January) and late (February-April) periods.

	Reach	Survey Miles		Number of Surveys		Number Live Fish		Number Redds		Number Tagged Carcasses by Species			
Stream	Len (mi)	Dec-Jan	Feb-Apr	Dec-Jan	Feb-Apr	Dec-Jan	Feb-Apr	Dec-Jan	Feb-Apr	Chinook	Coho		Unknown
South Fork Ten Mile Tributaries													
Smith Creek	2.8	9.8	16.8	4	6	3(0.3)	3(0.2)	8(2.8)	42(15.0)	0	1	2	0
Upper Smith'	1	0	1.7	0	2		3(1.8)		10(10.0)	0	0	0	0
NF Smith	0.3	0	0.5	0	3	0	0		1(3.3)	0	0	0	0
Campbell Creek	2.1	6.4	8.5	3	5	0	2(1)	6(2.9)	17(8.1)	0	0	0	(2)
Caspar Creek													
Mainstem**	2	8	12	3	6	4(0.5)	4(0.3)	19(9.5)	53(26)	0	5(6)	0	1
North Fork*	1.9	5.7	9.5	3	5	5(0.9)	1(0.1)	13(6.8)	58(30.5)	0	1(1)	1(3)	2
South Fork	0.5	1.5	2.5	3	5	0	0	0		0	0	0(1)	0
Upper SF*	0.3	0.3	0.3	1	1	1(3.3)	0	2(6.6)	0	0	0	0	0
Garcia River Tributaries													
Signal Creek^	3.5	3.5	3.5	1	1	4(1.1)	2(0.6)	1(0.3)	11(3.1)	0	0	0	0
Inman Creek*^	2	2	2.3	1	1	0	0	1(0.5)	4(2.0)	0	1	0	0
Mill Creek	3.6	7.2	21.6	2	6	0	93(4.3)	6(1.7)	87(24.2)	0	0	0	1
Pardaloe Creek*	1.5	3	10.2	2	6	0	88(8.6)	0	56(37.3)	0	0	0	0
South Fork	2	6	12	3	6	2(0.3)	6(0.5)	3(1.5)	24(12)	0	0	1	0
SF Trib I	0.2	0.2	0.4	1	2	0	0	1(5)	0	0	0	0	0
SF Trib 2	0.2	0	0.2	0	1		0		0	0	0	0	0
Flemming Cr	0.3	0	0.9	0	3		0			0	0	0	0
Graphite Cr.	0.3	1	0.3	1	0	0		0		0	0	0	0

**F&G 2 Dec. surveys covered three miles. Considered same as STMA's 2 mile section. First mile normally has little activity.

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

^ Surveys limited due to property access problems. Redd data not comparable to other streams.

Early Period Observations

Ten Mile Tributaries

In Smith Creek, few redds were observed, only 8 through the first week of February. Three live coho were observed, two of which were reported as grilse (two year old mature coho). In Campbeil, only six redds were observed through the first survey in Februarv. No coho carcasses or live fish were seen.

Caspar Creek

In Caspar Creek. Fish & Game crews in December observed five live coho on the NF and 4 in the mainstem. They also found 1 male coho carcass in the NF and a male and female coho carcass in the mainstem. No live fish or carcass were observed in the SF Caspar STMA crews in the single January survey found 3 coho carcass in the mainstem Caspar but no live coho. One coho was observed swimming in the pond behind the SF weir in early February.

Garcia River Tributaries

In December, live coho were observed in both the South Fork Garcia and Signal Creek. A pair of coho were observed in the South Fork on December 21 on the lower end of the stream and were thought to be have be fresh fish, having just entered the SF. Two redds were observed. It is possible that coho entered the SF as early as November as flagging was found noting live fish observations in November 1997 on both the SF and Flemming Creek. Four live coho were observed in Signal Creek. Two were identified as grilse. Only a single redd was observed. No live fish but a single female coho carcass was found in Inman Creek along with a single redd. No coho were observed in the two headwater tributaries, Mill and Pardaloe Creek. One carcass was found in Mill Creek on December 20 which may have been a coho carcass but surveyors were not able to identify to species due to its deteriorated condition. A single redd was also found. There was also a lamprey (Entosphenus tridentatus) carcass in the December survey. It is unusual for there to be a lamprey in a stream this early in the season..

Late Period Observations

February through April, all carcasses except of one on lower Caspar, and all live fish observations were either steelhead or unidentified to species. Late season redd densities were relatively high in Caspar and the upper Garcia River compared to other areas. There were two fish originally reported as coho in Pardaloe Creek on February 7th. These fish were described as small, less than 45 cm, and both being bright red on the lower half and darker on top. No carcasses were found on following surveys. These fish are listed as species unknown being somewhat unusual. In four seasons of spawning surveys there has only been one other instance of fish in this size range being characterized as bright red. This was reported in March 1996 in a tributary to the Ten Mile River. Again, no carcass was recovered to determine species. In this case the fish was assumed to be a coho due to the lack of any alternative species to explain occurrence and since tributary had 10 coho carcasses recovered and many live coho observations in earlier surveys.

Peak live steelhead counts have been quite high in the upper Garcia River compared to other areas. Caspar Creek, which has had redd densities similar to the upper Garcia, has had much fewer live fish observed. A likely explanation would be that the duration of time which steelhead spend on the spawning grounds in Caspar Creek is much shorter than in the upper Garcia. The distance of steeihead must travel, 30+ miles, to reach the upper Garcia compares to only 2-5 miles in Caspar Creek. This may effect the time it takes to construct redds and complete the spawning process. Reduced water clarity and the relatively higher amount of cover in Caspar Creek may also inhibit surveyors ability to observe fish in Caspar Creek compared to the upper Garcia River

Timing of Spawning

The timing of spawning can be inferred from information on Table 2 which gives, by week, the numbers of carcasses, live fish and redds observed during surveys. Coho spawning in most areas occurred in the third week of December based on carcass, redd and live fish observations. Coho spawning was later in the Ten Mile River tributaries compared to Caspar Creek. This is typical of that has been found in past spawning surveys.

Table 2. Number of Carcasses, Live Fish and Redds Observed by Week in the Ten Mile River, Caspar Creek and Garcia River During 1996-97 Spawning Surveys.

Area	December			January				February				March				April	
	1st	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd
COHO CARCASSES																	
Smith Creek		0	0	0	1			0	0	0		0	0		0		
Inman Creek		1							0								
NF Caspar	0	1			0			0	0		0	0		0			
Caspar Creek	0	2			3			1	0		0	0		0	0		
LIVE COHO																	
Smith Creek		0	0	2	1			0	0	0		0	0		0		
Signal Creek		4							0								
SF Garcia		2			0	0		0	0	0		0					
Upper SF Caspar								1	0								
NF Caspar	0	5			0			0	0		0	0		0			
Caspar Creek	0	4			0			0	0		0	0		0	0		
REDDS																	
Campbell Cr		0			2	0		4	6		8	3		0			
Smith Cr		0	0	2	3			3	19	10		2	6		5		
Upper Smith										8		2					
Inman Cr.		1							2								
Signal Cr.		1							11								
Mill Cr		1			5			13	15		7		15	15		22	
Pardaloe		0			0			8	8		8		5	13		15	
SF Garcia		2			0	0		1	4	12		3	2	2			
SF trib #1						0		1					0				
SF trib #2													0				
Flemming Cr												6	0	0			
SF Caspar CR	0	0			0			0	0		0	0		0			
Upper SF								2	0								
NF Caspar	0	6			9			11	9		24	4		10			
Caspar	0	11			8			18	4		14	7		5	5		
LIVE STEELHEAD																	
Campbell Cr		0			0	0		0	0		0	1		1			
Smith Cr		0	0	0	0			0	0	2		0	0		1		
Upper Smith									1	0					2		
Signal Cr		0							2								
Mill Cr		0			0			5	3		1		22	40		18	
Pardaloe Cr		0			0			5	0		3		18	33		26	
SF Garcia		0			0	0		0	1	4		0	0	1			
NF Caspar	0	0			0			0	1		1	0		0			
Caspar Cr.	0	0			0			0	0		0	0		3	1		
STEELHEAD CARCASSES																	
Smith Cr.		0	0	1	0			0	0	0		0			1		
Pardaloe Cr.		0			0			0	0		0		0	0		0	
Mill Cr		0			0			0	0		2		0	0		1	
SF Garcia					0	0		0	0	0		0	1	0			
NF Caspar	0	0			0			0	0		1	0					
LIVE FISH UNKNOWN SPECIES																	
Pardaloe Cr.		0			0			3	0		0		0	0		0	
Mill Cr		0			0			6	0		0		0	0		0	
CARCASSES UNKNOWN SPECIES																	
Campbell Cr.		0			0	0		1	1		0	0		0			
Mill Cr.		1			0			0	0		0		0	0		0	
Caspar Cr.					0			1	0		0	0		0	0		

The initial period of steelhead spawning appeared to occur primarily around the second week of February. Somewhat out of sync with other areas was spawning in Caspar Creek around the end of February and early March. Caspar appeared to exhibit a monthly cycle of spawning activity. In the Garcia headwater area, extensive spawning occurred starting in mid March and continued at least into early April when spawning surveys ended. Continued steelhead spawning is likely to have occurred after mid April. Fresh steelhead were observed by spawning surveys crew members in the South Fork Ten Mile River in late April just prior to rains and steelhead have been reported spawning in the lower Garcia towards the end of April this year.

Age and Lengths of Carcasses

On Table 3 is given the age and lengths of coho and steelhead carcasses observed. Of interest was a small, 50cm fork length, female coho found on Smith Creek. This fish, based on its scales, estimated to be three years old. Its first and last annulus was typical of other coho but the second was particularly narrow.

Table 3. Age and Fork Length of Coho and Steelhead Carcasses found during 1996-97 surveys by sex

Stream	Age	Lengths Males	Females
COHO			
Caspar Creek	2	45	
'Smith Creek	3		50
Caspar Creek	3	61	
Inman Creek	3		65
STEELHEAD			
Caspar Creek	4		76
Mill Creek	4	73	76
Smith Creek	6 or 7		78

POPULATION ESTIMATES

In Smith Creek, a coho and a steeihead carcass were jaw tagged, one of which was recovered seven days after tagging. This recovery and the non-recovery of a tag at a survey interval of 17 days were combined to produce a 50 % recovery rate at twelve days. The corresponding CR. rate is 0.944. In Campbell Creek. two carcasses, species unknown, were caudal punched in February but were not recovered. Since these were not identified as coho. no coho are estimated from carcass recovery.

On lower Caspar Creek STMA tagged 7 coho carcasses and F&G observed 2 other carcasses. One tagged carcass was recovered. Of the tagged carcasses, 2 had recovery surveys at an interval of 8 days and 1 had a recovery survey at 9 days. Lumping and averaging the data, there is a average recovery survey at 8.3 days and a recovery of 33%. This results in a CR. rate of 0.88. Other tagged carcasses had no recovery surveys until 14 or 22 days after tagging. For the North Fork Caspar, there was only a single tagged carcass and no recovery. The CR. rate for the North Fork is assumed to be the same as for lower Caspar.

The area of each redd encountered during surveys is summarized of Tables 4 through 8. The data show the number of redds within a variety of size groupings and the total average redd size, total number of redds and total redd area, by month.

On Table 9 is given the population estimates for coho salmon this year. The Carcass Retention estimates utilize the CR. rates listed above to estimate populations. For Inman Creek, a “average” CR. rate of. 85 was utilized . Redd Area estimates are not given for Caspar Creek due to redds sizes not being measured during Fish & Game surveys.

DISCUSSION

Comparison to Past Run Estimates

Coho run estimates in Smith and Campbell are much less than in 1995-96. Campbell estimates last year were 25, 18, 13 and 6-26 for Carcass Retention, Live Fish, Redd Area and Redd Number estimates, respectively (Maahs, 1996). For Smith Creek, these

Table 4 Number of redds by Size (Sq. Meters) in the North Fork Caspar Lower **Caspar** and **SF Caspar** Creek in 1996-97

Redd Area	NF Caspar				Lower Caspar				**SF Caspar**			
(Sq. M)	**December**	**January**	**February**	**March**	**December**	**January**	**February**	**March**	**December**	**January**	**February**	**March**
O-l			15	3			6	3			2	
1.1-2		6	11	5		1	7	8				
2.1-3		1	9	4		2	5	3				
3.1-5			8			2	10	3				
5.1-7			1				3					
7.1-9				1			3					
9 l-11				1		1						
11.1-15						2	2					
15.1-20												
20.1-25			1									
Average		1.6	24	28		6.0	3.6	2.0			1.0	
Number		7	45	14	0	8	36	17	0	0	2	0
Area		11	108	39		48	130	34			2	

Table 5 Number of redds by Size (Sq. Meters) in Smith, Campbell and North Fork Smith **Creek** in 1996-97

Redd Area	Smith Creek				Campbell Creek				NF Smith			
(Sq. M)	**December**	**January**	**February**	**March**	**December**	**January**	**February**	**March**	**December**	**January**	**February**	**March**
0-1		2	1	2		1						1
1.1-2		3	14	5		1	3					
2.1-3		2	9	3		1	3					
3.1-5		1	12	3		2	10	3				
5.1-7			2				1					
7.1-9			2									
9.1-11												
11.1-15						1	1					
15.1-20												
20.1-25												
Average		1.8	3.2	2.3		4.1	4.0	4.0				0.7
Number	0	8	37	13	0	6	18	3			0	1
Area		14	118	30		25	72	12				0.7

Table 6 Number of redds by Size (Sq. Meters) in the South Fork Garcia and two of its Tributaries in 1996-97

Redd Area	SF Garcia				Flemming Creek				!st Tributary			
(Sq. M)	December	January		March	December	January	February	March	December	January	February	March
o-1												
1.1-2	1	1	4	3			3			I		
2.1-3		1	7	2			3					
3.1-5			3	2								
5.1-7			2									
7.1-9	I											
9.1-l 1												
11.1-15												
15.1-20												
20. I-25												
Average	4.4	2.0	3	1 2.3			1.9			I.9		
Number	2	2	16	7			6			I		
Area	9	4	50	16			11			2		

Table 7 Number of redds by Size (Sq. Meters) in the Pardaloe and Mill Creek in 1996-97

	Pardaloe Creek					Mill Creek				
(Sq. M)	December	January	February	March	April	December	January	February	March	April
O-I					I	I		3	4	3
1.1-2			5	3	6	I	I	10	10	IO
2.1-3			6	6	2		2	I2	4	2
3.1-5			8	6	5		I	5	9	4
5.1-7			2	3				4	1	2
7.1-9								I		I
9.1-1 I			1				I		I	
11.1-15					I					
15.1-20										
20. I-25			1							
Average			4 6	3.3	3.2	I.4	4.3	2.9	2.3	2.6
Number	0	0	23	I8	I5	2	5	35	35	22
Area			106	59	48	2.8	22	102	80	57

Table 8 Number of redds by Size (Sq. Meters) in the Inman and Signal Creek in 1996-97

Redd Area	Inman Creek				Signal Creek			
(Sq. M)	December	January	February	March	December	January	February	March
O-l							2	
1.1-2			2		1		4	
2.1-3							2	
3.1-5			2				3	
5.1-7	1		1					
7.1-9								
9.1-11								
11.1-15								
15.1-20								
20.1-25								
Average	7.0		2.8		2.0		2.3	
Number	1		4		1		11	
Area	7		11.2		2		25.3	

estimates were 11, 12, 14 and 10-40, respectively. The low population of coho spawning this year was expected. This has been a particularly weak brood since at

Table 9. Estimated Run by Four Diferent Population Estimation Procedures for Coho Salmon in Smith,. Campbell, Caspar Creek and Garcia River Tributaries in 1996-97.

Stream	Car. Reten.	AUC Live	Redd Area	Redd#'s
Campbell Cr.	0	0	6	3-12
Smith Cr.	1	3	6	4-16
Lower Caspar	2 2	7	n/a	10-38
NF Caspar	2	9	n/a	6-26
SF Caspar	**0**	**0**	**0**	**0**
Signal Cr.	**0**	**5**	**2**	2
Inman Cr.	1	1	2	2
Mill Cr.	0	0	0	0
Pardaloe Cr.	0	0	0	0
SF Garcia	**0**	3	4	2-4

least the 1990-91 spawning year. Electrofishing surveys of 30 meter sections conducted in the summer of 1991 found no coho in either Smith or Campbell Creek (Maahs , 1991). In the fall of 1994, three years later, no coho were found in Smith Creek but a coho density of 0. 17/m2 reported in Campbell Creek that same year (Georgia Pacific Corp. 1994). These juvenile coho densities compare to 0. 15/m^2 in Smith Creek and 0.35 coho /m^2 in Campbell Creek in 1996 (Georgia Pacific Corp. 1997).

Caspar Creek

The Caspar Creek run of coho this year was also low. The 1995-96 estimate for the three areas, the South Fork, North Fork and lower Caspar totaled 72, 71, 127 and 58-323 for the four methods, respectively. For this year comparable figures are 24, 16, N/A, 16-64, roughly l/4 -l/3 of last years run. On Table 10 is given data for Caspar Creek spawning for 5 different years. It is apparent that this years run was the second lowest of the five but considerable improved from the 1990-91 run.

In Table 11 is a comparison of findings for steelhead carcass counts, February redd densities, and peak live counts for a variety of years. Redd density data was limited to the month of February due to some years surveys ending that month. It is quite clear here that based on redd densities, that the 1996-97 steelhead run was relatively large in comparison to past survey years for all streams surveyed.

Population Estimation

This is the second consecutive year that the same four estimation procedures were used estimate spawning population. With low spawning densities and extreme flow conditions, all three basic methodologies, carcass counts, live counts and redds, are needed to provide information regarding spawning activity. In past surveys (Maahs & Gilleard 1994), it has been shown that both live fish and carcass based methods underestimate spawning population while methods utilizing redd counts produced wide ranging estimates. These last two years of surveys could not validate further any particular method since no known population of spawners was sampled. The need exists to look in greater detail at the amount of area of an individual female coho salmon utilizes to construct a redd. Standardizing redd count methodologies **and** developing better relationships between spawners **and** redds would provide one of the most practical methods of improving population estimation in areas where sparse spawning populations are present. Carcass methods to date have been characterized by poor performance as have live fish counts in estimating populations in this portion of the coast. For this area, no data has been collected regarding the length of time a coho remains alive on the spawning grounds nor are there methodologies to deal with factors such as cover and turbidity which influence live fish observation rates. Since data for all three methods can be collected simultaneousiy while conducting a survey, the continued collection of ail this information is warranted and should be continued.

Table 10. Comparison between Miles of Survey, Population Estimates, Carcass Counts, and Live fish Observations for Caspar Creek by Year.

Survey Year	Miles of Survey	Carcass Based Estimates	Redd Based Estimates	AUC Live Estimate	Carcass Counts	Peak Live Counts
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	58323	71	53	22
1996-97	39.8	24	16-64	16	7	9

Table I I. Number of Steelhead Carcasses, February Redd Densities and Peak Live Counts of Steelhead in Caspar Creek, Smith Creek Campbetl Creek, and Garcia River Tributaries in recent Surveys

Survey Year	Steel head Carcass Count	February Redd Densities/mi	Peak Live Counts
		Caspar Creek	
1989-90	1	n/a	3
1990-91	1	II.7	8
1991-92	0	0	1
1995-96	0	1	0
1996-97	0	I8	3
		North Fork Caspar Creek	
1989-90	0	n/a	2
1990-91	0	10.5	4
1991-92	2	I.6	2
1995-96	5	2.0	2
1996-97	4	23.7	I
		Smith Creek	
1989-90	0	2.8*	0
1995-96	0	3.9	0
1996-97	2	14.3	2
		Campbell Creek	
1989-90	2	6.0"	0
1995-96	0	7.1	0
1996-97	I	10.0	0
		Mill Creek	
1995-96	2	18.3	IO
1996-97	0	24.2	39
		Pardaloe Creek	
1995-96	2	16.6	22
1996-97	0	37.3	33
		South Fork Garcia River	
1989-90	I	n/a	3
1990-91	0	1.0	0
1996-97	I	12.0	4

* Redds were not flagged in 1989-90 to prevent recounting. These estimates assume that redds observed on two surveys 20 days apart were not recounted on second survey.

RESTORATION MONITORING

This spawning survey was conducted in conjunction with three salmonid restoration/ enhancement activities. One of those activities was an adult coho salmon trapping and rearing project in the Ten Mile River. In 1996-97, Salmon Restoration Association operated an adult trap during the month of December on Campbell Creek. No coho were trapped and the operation ended due to high flow conditions in late December. In Campbell Creek, no spawning activity was observed until January. A similar run timing was noted in 1995-96 (Maahs. 1996). A second enhancement activity was a juvenile coho downstream migration trapping and relocation effort. The downstream trapping and relocation effort is being conducted by STMA this year. The downstream trapping effort has documented young of the year coho emigrating form both Campbell and Smith Creeks this year. The numbers have been much reduced from those observed last year (Maahs 1994a). The results of that effort in relation to spawning survey findings will be discussed in more detail in a later document.

It does not appear the trap's existence on Campbell Creek is responsible for the lack of spawning activity in December. The run timing in Smith Creek, another South Fork tributary, located about a l/2 mile downstream of Campbell, has had similarly timed runs in both 1995-96 and 1996-97 as Campbell Creek and it too had no spawning activity this December. The number of coho that did spawn in Campbell was probably in the range of 6 to 10 fish. This low number would likely be too few to warrant taking adults for an artificial spawning and rearing program.

Three tributaries of the Garcia River, Signal and Inman Creeks and the South Fork Garcia had fish habitat structures installed during the summer and fall of 1995. The purpose of these structures was to increase the carrying capacity of the streams by providing increased amounts of woody debris for cover and logs for scouring pools. Structures were also to provide refuge for adult salmonids during their upstream migration and spawning. These spawning surveys were for the purpose of determining whether the structures were being utilized by adults and to provide baseline data from which future populations could be compared. For both Signal and Inman Creeks, spawning surveys were interrupted by the landowner limiting access to property. Only two surveys were conducted this year. In Inman Creek, of ten structures installed only two remained functional. The others had been taken out by the flood waters over the last two years.

The one coho carcass and December redd was observed well upstream the upper most structure. Similarly, the February redds were found above the areas where structures were installed.

In Signal, the four live coho seen were found above the area where habitat structures were installed. The single December redd was within the area where structures were located but not associated with any of those structures. In February, a single steelhead was also observed above all structures and none of the eleven redds observed were associated with the installed structures. In this stream, the habitat structures remained mostly intact through this winter's storm and flood activity.

In December, the South Fork was surveyed once. Two redds and 2 coho were observed. The redds were located between structures 3 & 4 and between 10 & 11 but not associated with any structure. The adults were located on the lower portion of the stream near a naturally occurring wood structure. During the New Years Day flood, many of the structures were damaged, moved or destroyed, perhaps as many as 40 percent. From January onward there were 24 redds observed in the South Fork. Not all surveyors noted whether redds were located by structures but there was one redd noted as associated with one of the structures. None of the steelhead observed were utilizing any of the structure as cover although these structures would likely have been used as the fish were passing these sites in their migration upstream.

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APPENDIX I Spawning Survey Data Recording Form

DATE VISIBILITY STREAM

TIME IN AIR TEMP WATER TEMP PAGE OF

TIME OUT AIR TEMP WATER TEMP

SURVEYORS	LOCATION / BEGIN	END

NEW CARCASSES SPECIES	CONDIT ION	REACH	FORK LEN	TAG #	HOLE PUNCH	OLD CARCASSES CONDITION	TAG #	HOLE PUNCH
								1

* incl. sex **Incl. stage

LIVE FISH

SPECIES	ADULT	GRILSE	NOTES
COHO			
CHINOOK			
UNKNOWN			

	ADULT	HALF- POUNDER	TROUT (>6")(Optional)
STEELHEAD			

REDDS List approximate area (length X width) in Meters

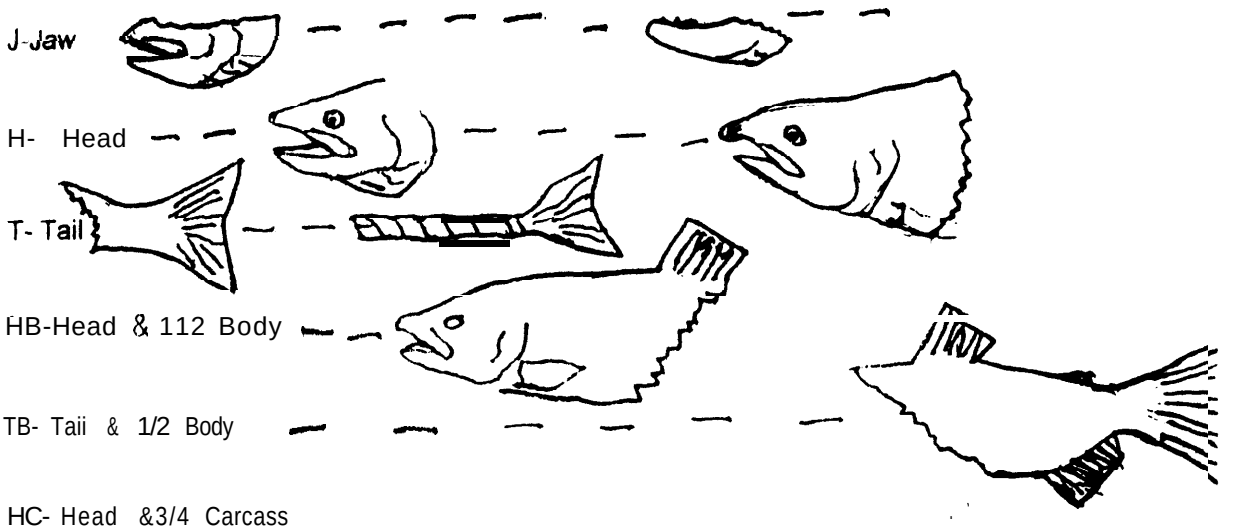
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	x	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X

FLOW DATA

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

LENGTH= (CM)

CONDITION



STAGE

1- Fresh 2- Old 3- Rotten

NOTES

Appendix II Flow data taken during 1996-97 surveys. Flows are given in cubic feet per second

	December		January			February			March					April
Stream	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
Smith Cr	18.3	31.1		24.2	12.7		36.4	20.1	21.8			7.5			
Campbell Cr	12.0			8.9	7.7		19.5	11.3		9.5	8.9		14.6		
Caspar Main				14.9			24.2	15.5		12.2	11.9		16.3	8.1	
NF Caspar				8.5			15.8	13.6		7.5	11.4		14.6		
SF Caspar				2.7			4.1	3.8		3.0	3.0		1.8		
Signal Cr	45.6			36.5											
Graphite Cr.	4.9														
Inman Cr	30.4			31.5											
Mill Cr	12.4			30.4			28.6	18.6		10.1		8.8	17.4		7.4
Pardaloe Cr	22.0			30.4			50.5	32.2		23.2		14.4	24.0		10.5
South Fork Garcia	25.2			23.7	14.0		36.4	14.8	11.8		15.9	10.9	25.0		
West Branch												1.4			
Little SF												3.1			

APPENDIX III

Turbidity data taken during 1996-97 surveys. Depths shown below indicate depth that live fish and carcasses were visible in centimeters

	December		January			February				March				April
Stream	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
Campbell Cr	90				70		45	90			>100				
Smith Cr	30	25	40	80			30	75	65		>100	>100		75	
Inman Cf.	90			100											
Signal Cf	loo			100											
Mill Cf	100			75			90	120		100		>100	>100		>100
Pardaloe Cr	100			70			80	85		100		>100	85		>100
S.F Garcia	90			40	85		90	100	90		75	120	65		
SF Caspar Cr				70			40	45		60	50		40	>100	
NF Caspar				80			35	60		90	60		50		
Caspar Cf				70			35	55		80	60		50		