STREAM INVENTORY REPORT

NORTH FORK GUALALA RIVER

*Prepared for**:***
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1.0 INTRODUCTION

A stream inventory was conducted during the fall of 1994 on the North Fork Gualala River to assess habitat conditions for anadromous salmonids. The objective of this habitat inventory was to document the habitat available to anadromous salmonids in the North Fork Gualala River. This report serves to document the current habitat conditions as well as recommend options for the potential enhancement of habitat for coho salmon and steelhead trout. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

2.0 WATERSHED OVERVIEW

The North Fork Gualala River is tributary to the Gualala River and is located in Mendocino County, California. The legal description at the confluence with the Gualala River is T11N R15W S26. Its location is 38°46'42" N. latitude and 123°29'52" W. longitude. The North Fork Gualala River is a fourth order stream with a length of approximately 14.1 miles between its confluence with the Gualala River and its upstream end at the confluence of Billings and Bear Creeks, according to the USGS Gualala and McGuire Ridge 7.5 minute quadrangles. The North Fork Gualala River and its tributaries have a total of 35.7 miles of perennial stream. Elevations range from about 30 feet at the mouth of the North Fork to approximately 2,000 feet in the headwaters of the drainage. Redwood and Douglas fir forest dominates the watershed. The watershed is privately owned is managed primarily for timber production. Year round vehicle access exists via private logging roads.

3.0 METHODS

The habitat inventory conducted in the North Fork Gualala River follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds 1991). The ENTRIX fisheries biologist that conducted the inventory has extensive experience conducting habitat inventories utilizing the methodologies of the California Department of Fish and Game (CDFG) and Region 5 of the U.S. Forest Service (USFS). This inventory was conducted by a two person team.

3.1 HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the California Salmonid Stream Habitat Restoration Manual. This form was used in the North Fork Gualala River to record measurements and observations. There are nine components to the inventory form:

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows also are measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing was conducted according to the classification system developed by David Rosgen (1985). This methodology is described in the California Salmonid Stream Habitat Restoration Manual. Channel typing follows a standard form to record measurements and observations. There are four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.

3. Temperatures:

Both water and air temperatures were taken and recorded at each tenth unit typed. The time of the measurement was also recorded. Temperatures were taken in Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain et al. (1988). Habitat units were numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types (See Appendix B). Dewatered units are labeled "dry". The North Fork Gualala River habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. Unit measurements included mean length, mean width, mean depth, and maximum depth. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken in feet to the nearest tenth. Additionally, every tenth

habitat unit was marked in the field using survey flagging in order to facilitate relocation of any unit(s) in the future.

5. Embeddedness:

The depth of substrate embeddedness in pool tail-outs was measured by the percent of the cobble that is surrounded or buried by fine sediment. In the North Fork Gualala River, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4).

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In the North Fork Gualala River, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300, and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes.

8. Canopy:

Stream canopy is a measure of the water surface shaded during periods of high sun. In the North Fork Gualala River, an estimate of the percentage of the habitat unit covered by canopy was made both ocularly and using a handheld spherical densiometer from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

9. Bank Composition:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In the North Fork Gualala River, the dominant composition type in both the right and left banks was selected from a list of eight options on the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

3.2 DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the California Department of Fish and Game (CDFG). This program processes and summarizes the data, and produces the following tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics were produced from the data using Quattro Pro. Graphics developed for the North Fork Gualala River include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths
- Embeddedness

- Pool cover by cover type
- Dominant substrate in low gradient riffles
- Percent canopy
- Bank composition by composition type

4.0 HABITAT INVENTORY RESULTS

The habitat inventory on the North Fork Gualala River was performed between September 29 and October 5, 1994, with the final portion surveyed on October 15, 1994. The survey was conducted by Dan Gale and Dan Lipman of ENTRIX. The survey began at the confluence with the South Fork Gualala River and extended up the North Fork Gualala River to the Gualala Redwoods property boundary, located in T11N, R14W, NW ¼ of NW ¼ Sec. 9. The total length of the stream surveyed was 57,430 feet, with an additional 2,070 feet of side channel and backwater habitat.

Flows in the North Fork Gualala River were estimated to range between 0-30 cubic feet per second (cfs.), depending on the location within the survey reaches. Four sections of dry channel were encountered in reach 1, totaling 197 feet (Table 1). The average flow observed throughout the survey was estimated to be 10 cfs.

This section of the North Fork Gualala River has two channel types: Reach 1 extends from the mouth of the North Fork to the "Boulders", a distance of 51,400 feet, and is a C3 channel type; and Reach 2 extends from the "Boulders" to the Gualala Redwoods property boundary, a distance of 6,030 feet, and is a B1 channel type. C3 streams have low gradient (0.5-1.0%), meandering gravel bed channels. B1 channels are moderate gradient (2.5-4.0%), moderately confined boulder/large cobble channels.

Water temperatures in the North Fork Gualala River during the survey ranged from 55.0 to 69.5 degrees Fahrenheit. Air temperatures ranged from 58.0 to 84.5 degrees Fahrenheit.

The Level II riffle, flatwater, and pool habitat types are summarized in Table 1. By percent occurrence, pools made up 50%, flatwater types 34%, riffles 15%, and dry channel 1% (Figure 1). Pools made up 64% of the total survey length, flatwater habitat types 32%, riffles 4% and dry channel <0.5% (Figure 2).

Twenty-one Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent occurrence were mid-channel pools, 26%; runs, 21%; low gradient riffles, 12%; and step-runs, 10% (Figure 3). By percent total length, mid-channel pools made up 39%, step-runs 16%, runs 13%, and lateral scour pools formed by rootwads made up 8%.
A total of 304 pools were identified (Table 3). Main channel pools were most often encountered at 53%, and comprised 62% of the total length of pools (Figure 4). Scour pools accounted for 40% of the pools encountered and comprised 36% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Out of the 304 pools encountered, 130 (43%) had a depth of three feet or greater (Figure 5).

The substrate embeddedness was estimated at main and scour pool tail-outs. Of the 285 pool tail-outs measured, 33 had a value of 1 (11.6%); 214 had a value of 2 (75.1%); 38 had a value of 3 (13.3%); and none of the tailouts had an embeddedness value of 4 (Figure 6). On this scale, a value of one is best for fisheries.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Pool types had the highest shelter rating at 59 (Table 1). Flatwater habitat types had a rating of 25, and riffle types had the lowest rating with 21. Of the pool types, the backwater pools had the highest mean shelter rating at 77, scour pools rated 65, and main channel pools 53 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation is the dominant cover type in the North Fork Gualala River, with boulders, large and small woody debris, undercut banks, and root masses comprising the subdominant cover types. Figure 7 describes the pool cover in the North Fork Gualala River in more detail.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 38 of the 71 low gradient riffles (53.5%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 42.3% of the low gradient riffles (Figure 8).
The mean percent of open canopy for the entire portion of the North Fork Gualala River surveyed was 40.5%. Of the 59.5% of the stream that was covered with canopy, 44% was composed of deciduous trees and 56% was composed of coniferous trees. Figure 9 describes the canopy composition in the North Fork Gualala River.

North Fork Gualala River

Drainage: Gualala River

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES

Survey Dates: September 29-October 14, 1994

Confluence: QUAD: McGuire LEGAL DESCRIPTION: T11NR15WS23 LATITUDE: 38°46'30" LONGITUDE: 123°30'0"

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA (sq.ft.)	MEAN VOLUME (cu. ft.)	TOTAL VOLUME (cu. ft)	MEAN RESIDUAL POOL VOL (cu. ft.)	MEAN SHELTER RATING
94	RIFFLE	15	28	2605	4	13.1	0.3	248	23321	83	7823	0	21
207	FLATWATER	34	91	18865	32	15.5	0.4	1409	291734	599	123910	7	25
304	POOL	50	124	37833	64	22.1	1.2	3054	928506	3678	******	2685	59
4	DRY	1	49	197	0	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
609	59500	1243561	1249973

North Fork Gualala River

Drainage: Gualala River

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS

Survey Dates: September 29-October 14, 1994

Confluence: QUAD: McGuire LEGAL DESCRIPTION: T11NR15WS23 LATITUDE: 38°46'30" LONGITUDE: 123°30'0"

UNITS MEASURED	HABITAT TYPE	HABITAT OCCURRENCE	MEAN LENGTH	TOTAL LENGTH	TOTAL LENGTH	MEAN WIDTH	MEAN DEPTH	MAXIMUM DEPTH	MEAN AREA	TOTAL AREA	MEAN VOLUME	TOTAL VOLUME	MEAN RESIDUAL POOL VOL	MEAN SHELTER RATING	MEAN RT. BANK VEGETATED	MEAN LT. BANK VEGETATED	MEAN CANOPY
#		%	ft.	ft.	%	ft.	ft.	ft.	sq.ft.	sq.ft.	cu. ft.	cu. ft.	cu. ft.		%	%	%
71	LGR	12	26	1834	3	12	0.2	1.0	233	16572	55	3905	0	7	36	38	55
22	HGR	4	34	748	1	15	0.5	1.8	298	6554	175	3859	0	67	42	40	55
1	BRS	0	23	23	0	13	0.3	0.6	194	194	58	58	0	0	45	25	60
6	ROW	1	62	369	1	15	0.7	1.7	545	3272	335	2013	0	87	47	39	48
11	GLD	2	106	1161	2	21	0.5	2.2	2375	26124	1093	12023	0	10	55	51	55
129	RUN	21	61	7861	13	15	0.4	3.7	962	124158	351	45231	11	17	47	44	60
61	SRN	10	155	9474	16	15	0.5	2.2	2265	138180	1060	64643	0	41	48	50	59
158	MCP	26	145	22985	39	24	1.0	5.1	3837	606309	4022	635514	2870	51	49	51	59
1	CCP	0	167	167	0	24	2.5	4.6	4008	4008	10020	10020	7615	150	90	85	85
3	STP	0	73	219	0	23	0.9	3.2	897	2692	800	2399	487	140	35	37	52
7	CRP	1	144	1009	2	22	1.5	4.7	3362	23532	4375	30622	3536	47	47	43	6p
33	LSI	5	104	3424	6	22	1.2	5.5	2462	81235	3152	104008	2419	74	46	51	65
39	LSR	6	118	4621	8	21	1.5	7.1	2753	107369	4415	172202	3367	71	51	58	70
21	LSBk	3	122	2570	4	19	1.8	10.0	2444	51333	4752	99790	3829	41	27	31	58
19	LSBo	3	99	1889	3	19	1.4	6.2	1924	36563	2334	44346	1699	68	47	41	60
4	PLP	1	48	190	0	26	1.7	4.0	1169	4675	1462	5849	992	65	39	33	51
7	SCP	1	50	352	1	12	1.1	3.7	634	4439	755	5282	0	69	24	59	65
2	BPB	0	21	42	0	22	1.3	3.2	260	520	327	654	0	80	25	35	43
7	BPR	1	34	241	0	14	1.4	5.2	484	3386	690	4829	157	91	29	49	66
3	BPL	0	41	124	0	19	1.2	3.7	815	2446	909	2726	0	60	50	35	78
4	DRY	1	49	197	0	0	0.0	0.0	0	0	0	0	0	0	26	23	63

TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu. ft)
609	59500	1243561	1249973

North Fork Gualala River

Drainage: Gualala River

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: September 29-October 14, 1994

Confluence: QUAD: McGuire LEGAL DESCRIPTION: T11NR15WS23 LATITUDE: 38°46'30" LONGITUDE: 123°30'0"

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA (sq.ft.)	MEAN VOLUME (cu. ft.)	TOTAL VOLUME (cu. ft)	MEAN RESIDUAL POOL VOL. (cu. ft.)	MEAN SHELTER RATING
162	MAIN	53	144	23371	62	24.0	1.1	3784	613009	4000	647933	2855	53
123	SCOUR	40	111	13703	36	20.7	1.4	2477	304707	3714	456817	2866	65
19	BACKWATER	6	40	759	2	14.9	1.3	568	10791	710	13491	58	77

TOTAL MEASURED	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu. ft.)
304	37833	928506	1118241

North Fork Gualala River Drainage: Gualala River

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES Survey Dates: September 29-October 14, 1994

Confluence: QUAD: McGuire LEGAL DESCRIPTION: T11NR15WS23 LATITUDE: 38°46'30" LONGITUDE: 123°30'0"

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
158	MCP	52	6	4	38	24	62	39	29	18	23	15
1	CCP	0	0	0	0	0	0	0	0	0	1	100
3	STP	1	0	0	0	0	2	67	1	33	0	0
7	CRP	2	0	0	0	0	0	0	4	57	3	43
33	LSL	11	1	3	5	15	9	27	9	27	9	27
39	LSR	13	0	0	2	5	17	44	7	18	13	33
21	LSBk	7	0	0	1	5	4	19	7	33	9	43
19	LSBo	6	0	0	4	21	8	42	4	21	3	16
4	PLP	1	0	0	0	0	1	25	1	25	2	50
7	SCP	2	1	14	2	29	3	43	1	14	0	0
2	BPB	1	0	0	0	0	1	50	1	50	0	0
7	BPR	2	0	0	3	43	2	29	0	0	2	29
3	BPL	1	0	0	0	0	2	67	1	33	0	0

TOTAL UNITS

304

North Fork Gualala River

Drainage: Gualala River

Table 5 - SUMMARY OF MEAN PERCENT COVER BY HABITAT TYPE

Survey Dates: September 29-October 14, 1994

Confluence: QUAD: McGuire LEGAL DESCRIPTION: T11NR15WS23 LATITUDE: 38°46'30" LONGITUDE: 123°30'0"

UNITS MEASURED	HABITAT TYPE	MEAN % UNDERCUT BANKS	MEAN % SWD	MEAN % LWD	MEAN % ROOT MASS	MEAN % TERR. VEGETATION	MEAN % AQUATIC VEGETATION	MEAN % WHITE WATER	MEAN % BOULDERS	MEAN % BEDROCK LEDGES
71	LGR	1	5	4	2	22	0	0	0	0
22	HGR	0	1	0	0	31	0	0	65	3
1	BRS	0	0	0	0	0	0	0	0	0
6	ROW	0	5	14	0	11	4	0	54	13
11	GLD	15	0	3	0	50	0	0	5	0
129	RUN	6	7	3	3	42	1	0	5	1
61	SRN	7	6	S	1	51	0	0	19	0
158	MCP	9	13	12	6	42	2	0	12	2
1	CCP	0	30	45	0	25	0	0	0	0
3	STP	0	0	10	0	15	0	0	75	0
7	CRP	28	15	6	13	26	0	0	10	1
33	LSL	12	19	34	5	25	0	0	1	0
39	LSR	14	12	10	43	20	1	0	0	1
21	LSBk	4	3	3	5	31	5	1	13	34
19	LSBo	4	8	6	1	26	0	1	53	3
4	PLP	0	3	15	0	20	0	0	63	0
7	SCP	6	23	6	11	34	16	0	0	5
2	BPB	0	0	15	0	5	0	0	80	0
7	BPR	6	12	7	55	20	0	0	0	0
3	BPL	28	0	15	25	28	3	0	0	0
4	DRY	0	0	0	0	0	0	0	0	0

North Fork Gualala River

Drainage: Gualala River

Table 6 - SUMMARY *Of* DOMINANT SUBSTRATES BY HABITAT TYPE

Survey Dates: September 29-October 14, 1994

Confluence: QUAD: McGuire LEGAL DESCRIPTION: T11NR15US23 LATITUDE: 38°46'30" LONGITUDE: 123°30'0"

UNITS MEASURED	HABITAT TYPE	# UNITS SILT/CLAY DOMINANT	% TOTAL SILT/CLAY DOMINANT	# UNITS SAND DOMINANT	% TOTAL SAND DOMINANT	# UNITS GRAVEL DOMINANT	% TOTAL GRAVEL DOMINANT	# UNITS SM COBBLE DOMINANT	% TOTAL SM COBBLE DOMINANT	# UNITS LG COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	# UNITS BOULDER DOMINANT	% TOTAL BOULDER DOMINANT	# UNITS BEDROCK DOMINANT	% TOTAL BEDROCK DOMINANT
71	LGR	0	0	0	0	38	54	30	42	3	4	0	0	0	0
22	HGR	0	0	0	0	1	5	0	0	0	0	16	73	5	23
1	BRS	0	0	0	0	0	0	0	0	0	0	0	0	1	100
6	POW	0	0	0	0	1	17	0	0	0	0	5	83	0	0
11	GLO	0	0	1	9	9	82	1	9	0	0	0	0	0	0
129	RUN	1	1	6	5	88	68	25	19	2	2	6	5	0	0
61	SRN	0	0	1	2	37	61	7	11	1	2	12	20	3	5
158	MCP	11	7	34	22	88	56	14	9	0	0	8	5	3	2
1	CCP	0	0	0	0	1	100	0	0	0	0	0	0	0	0
3	STP	0	0	0	0	0	0	0	0	0	0	3	100	0	0
7	CRP	1	14	1	14	5	71	0	0	0	0	0	0	>,o	0
33	LSI	5	15	11	33	17	52	0	0	0	0	0	0	0	0
39	LSR	3	8	10	26	23	59	3	8	0	0	0	0	0	0
21	LSBk	1	5	3	14	16	76	0	0	0	0	0	0	1	5
19	LSBo	1	5	4	21	10	53	0	0	0	0	4	21	0	0
4	PLP	1	25	0	0	1	25	0	0	0	0	2	50	0	0
7	SCP	2	29	1	14	4	57	0	0	0	0	0	0	0	0
2	BPB	0	0	1	50	1	50	0	0	0	0	0	0	0	0
7	BPR	2	29	2	29	3	43	0	0	0	0	0	0	0	0
3	BPL	2	67	1	33	0	0	0	0	0	0	0	0	0	0
4	DRY	0	0	0	0	4	100	0	0	0	0	0	0	0	0

Figure 1. North Fork Gualala River
Habitat Types by Percent Occurence

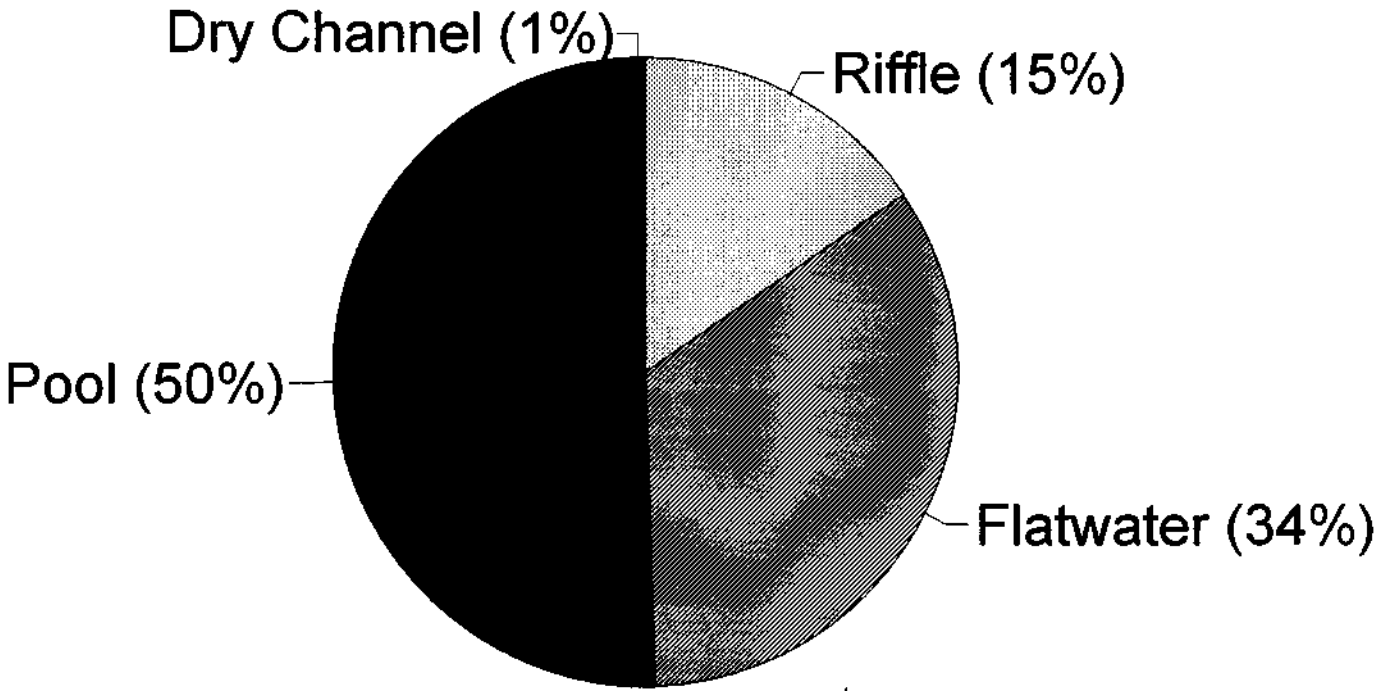

Figure 2. North Fork Gualala River
Habitat Types by Percent Total Length

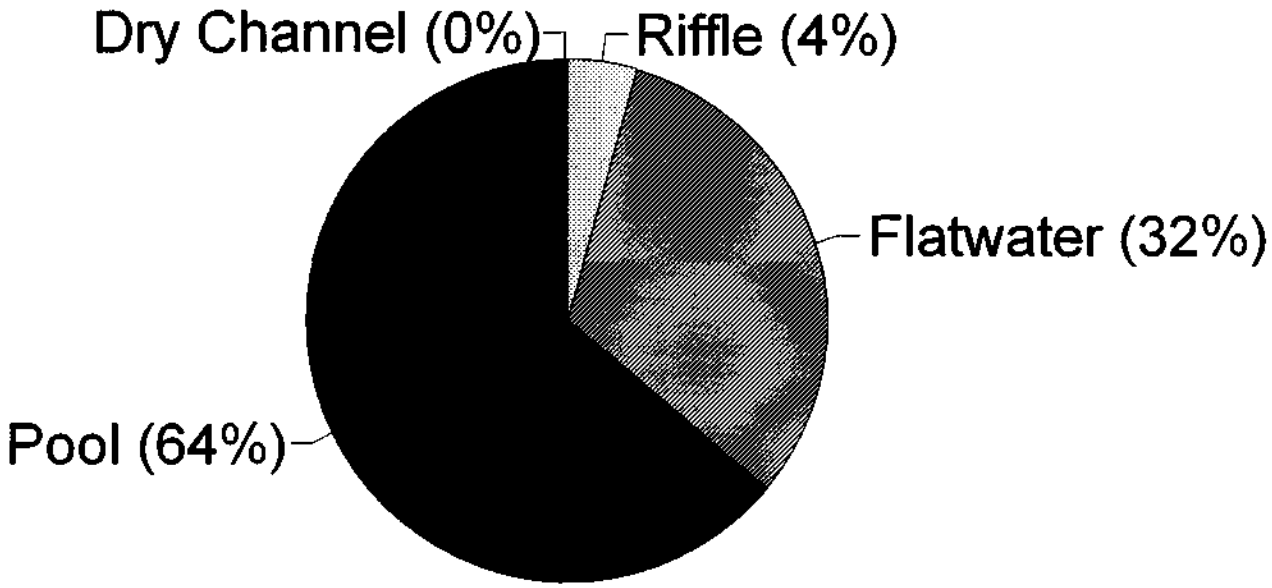

Figure 3. North Fork Gualala River
Level IV Habitat Types by Percent Occurence

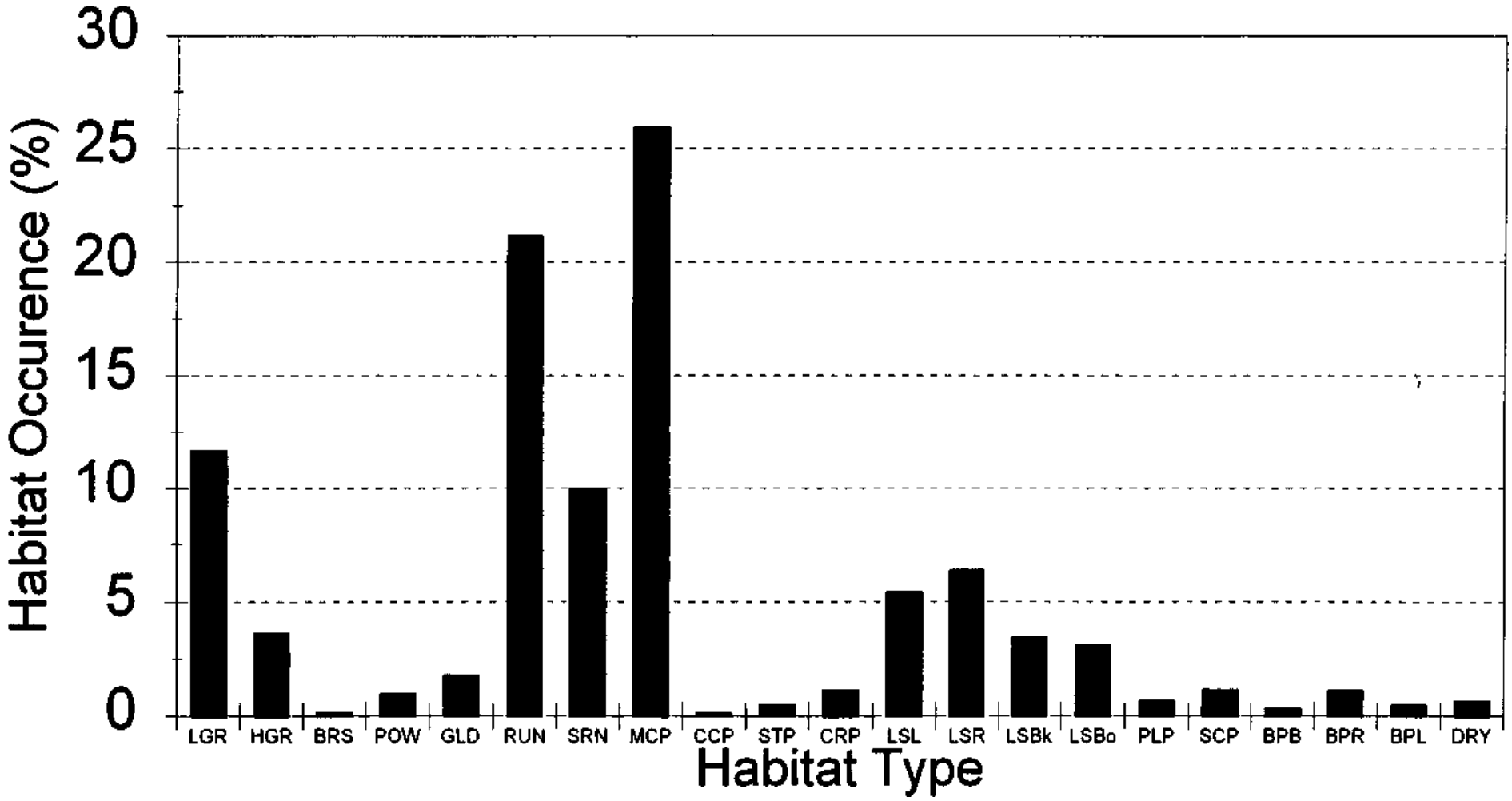

Figure 4. North Fork Gualala River
Pool Types by Percent Occurence

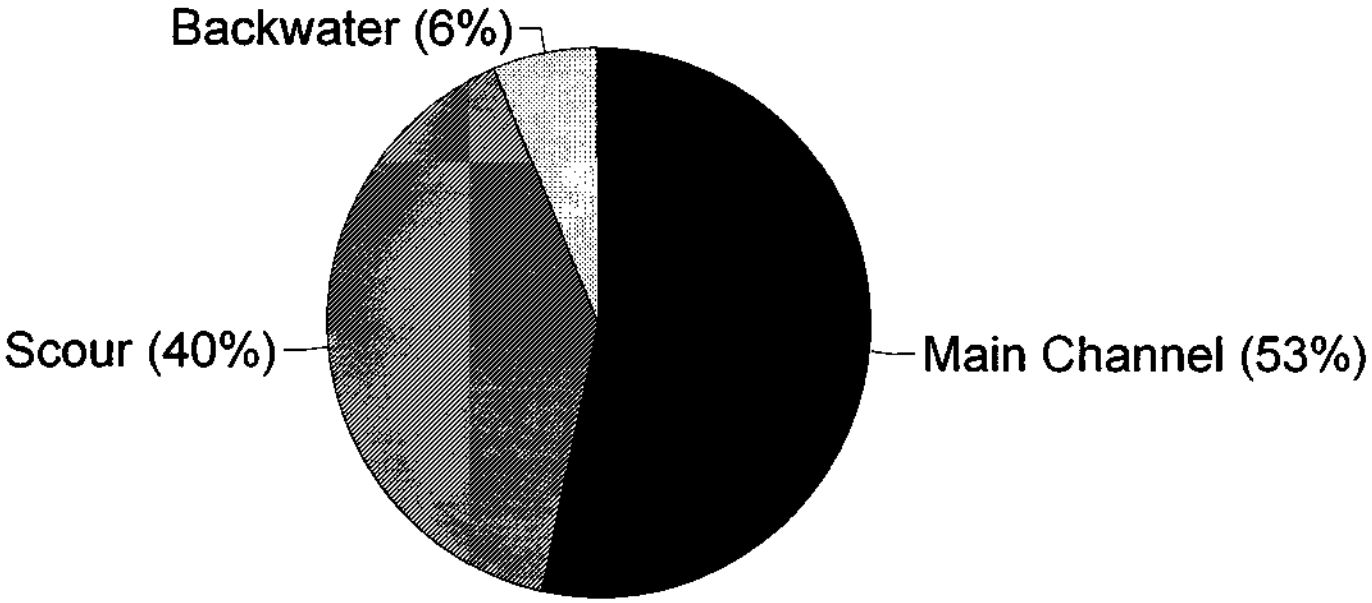

Figure 5. North Fork Gualala River
Total Pools by Maximum Depth

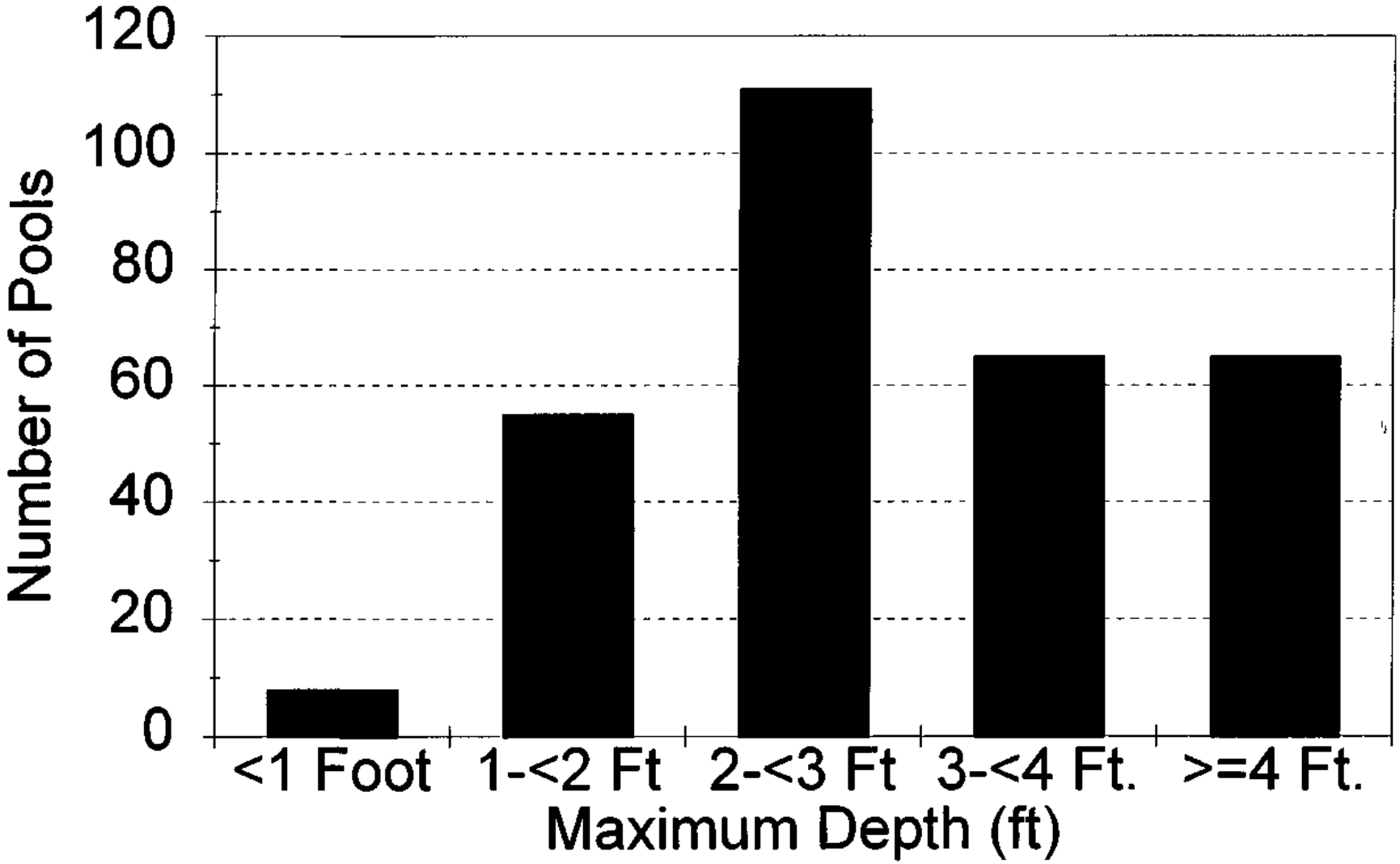

Figure 6. North Fork Gualala River
Pool Tail-out Embeddedness

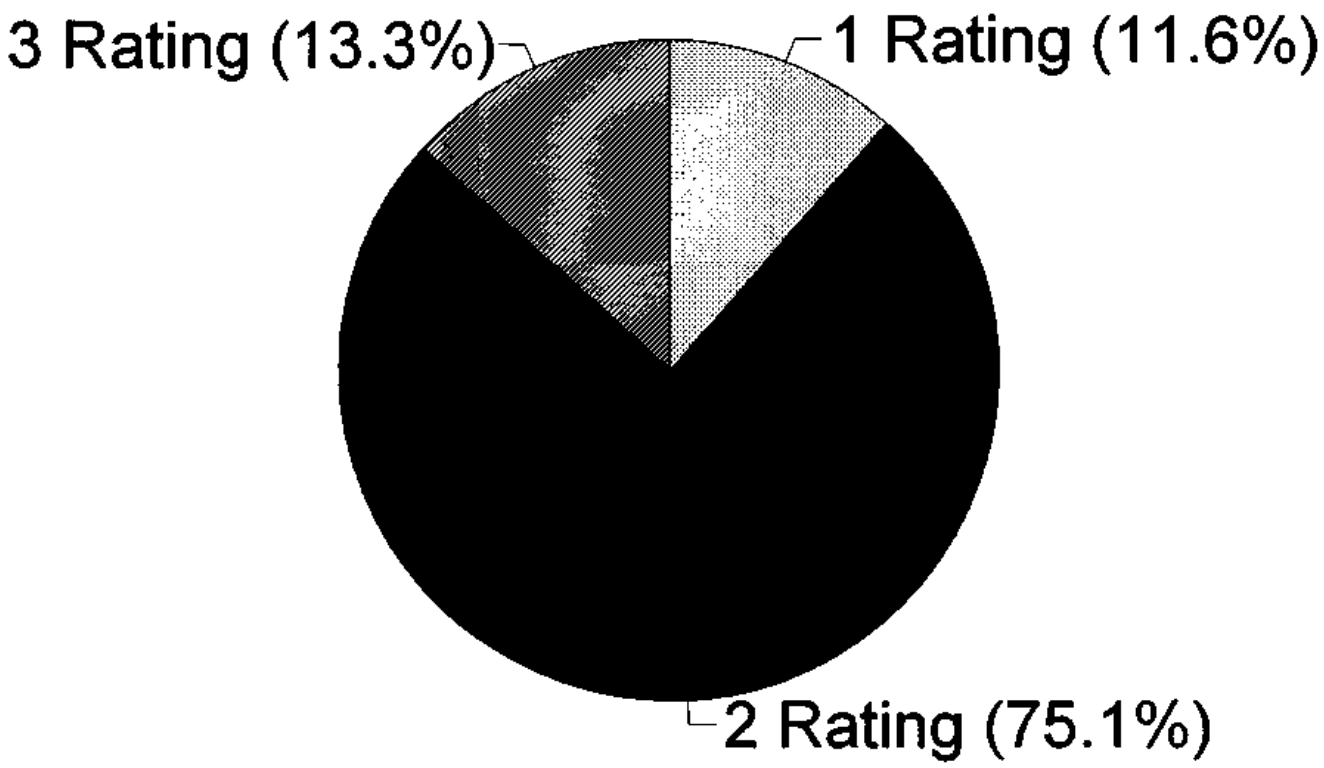

Figure 7. North Fork Gualala River
Pool Cover by Cover Type

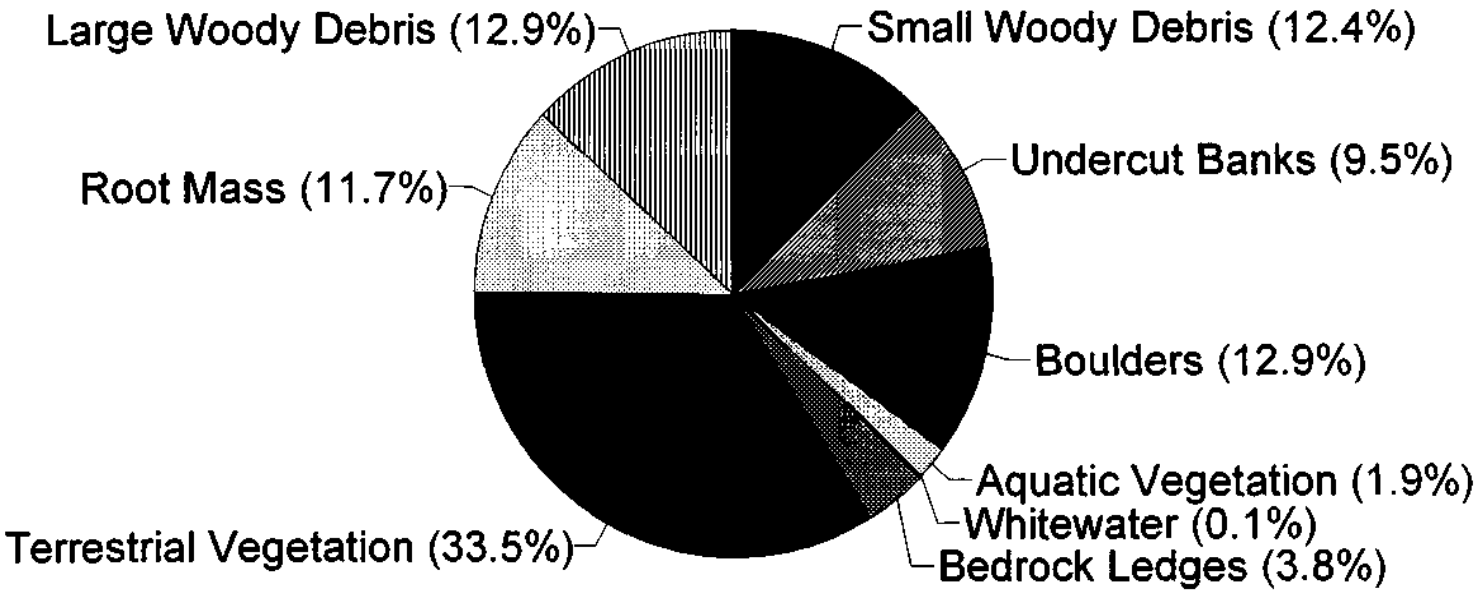

Figure 8. North Fork Gualala River
Dominant Substrate Type in Low Gradient Riffles

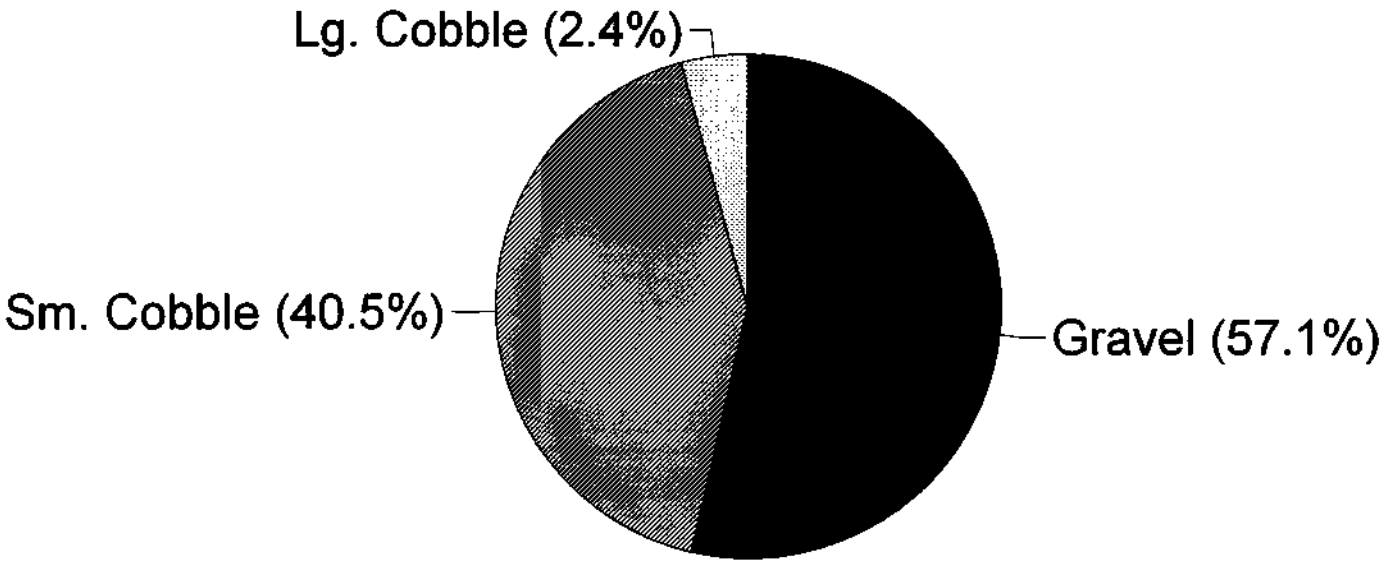

Figure 9. North Fork Gualala River Canopy Composition

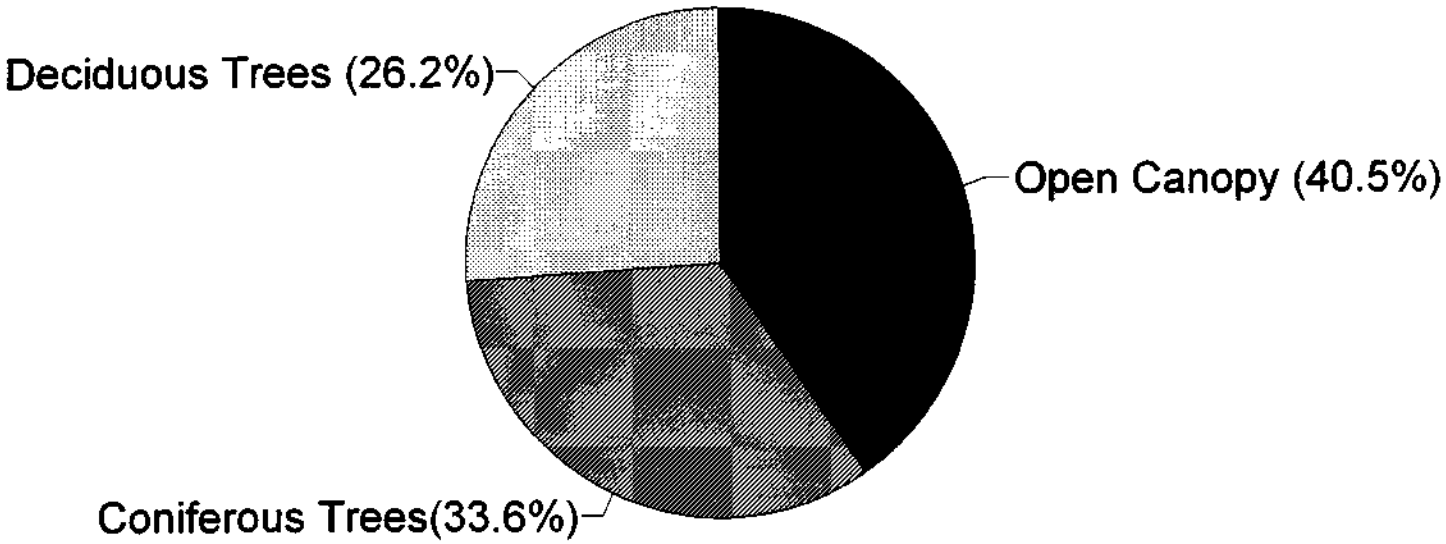

Figure 10. North Fork Gualala River
Bank Composition by Dominant Vegetation Type

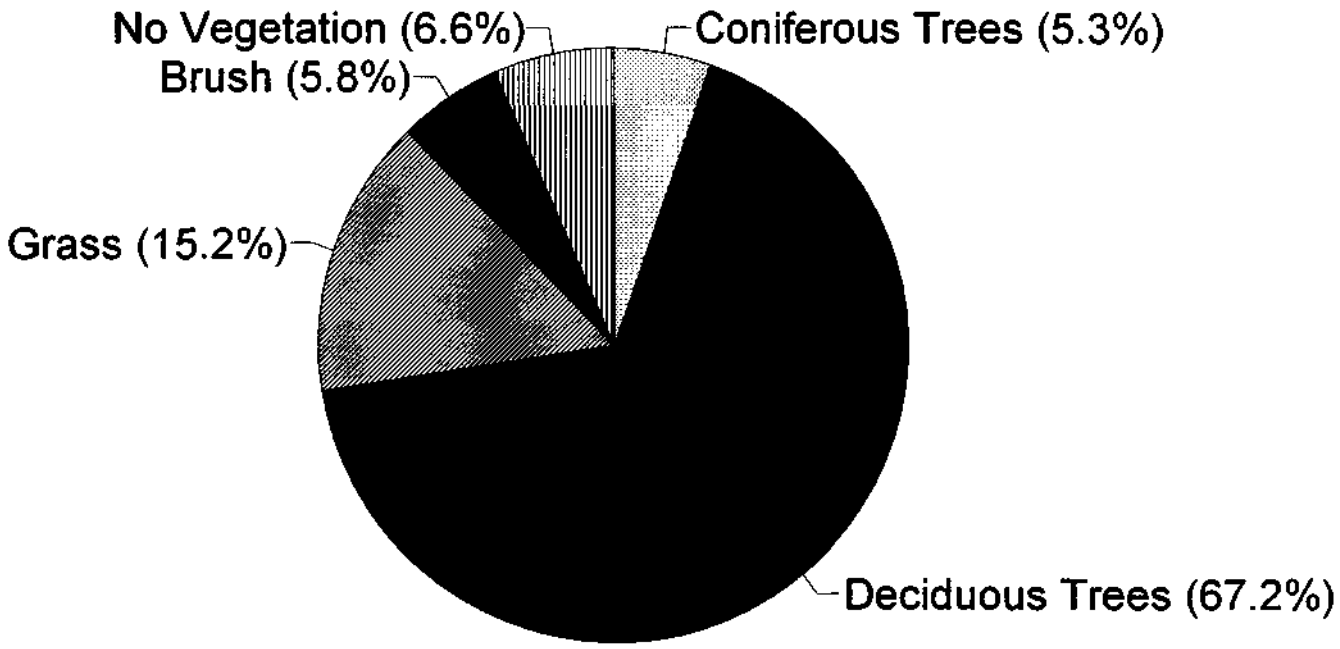

Table 2 summarizes the mean percentage of the right and left stream banks covered with vegetation by habitat type. For the stream reach surveyed, the mean percent right bank vegetated was 45.2%. The mean percent left bank vegetated was 46.4%. The dominant substrate elements composing the structure of the stream banks consisted of 7.8% bedrock, 14.0% boulder, 50.5% cobble/gravel, and 27.6% silt/clay/sand. Additionally, 67.2% of the banks were covered with deciduous trees and 5.3% with coniferous trees, including downed trees, logs, and root wads (Figure 10).

5.0 DISCUSSION

The surveyed portion of the North Fork Gualala River contains two channel types: BI and C3. The B1 channel type is excellent for many types of low and medium stage instream enhancement structures. There are 6,030 feet of this type of channel in reach 2, along with adequate sources of boulders and large organic debris (LOD) either in or nearby the stream. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and pool cover, as well as gravel retention structures to increase available spawning habitat within the reach.

The lower 51,400 feet of the North Fork Gualala River Creek is a C3 channel type. C3 channels are meandering stream types on noncohesive gravel beds which have poorly consolidated and unstable stream banks. They are generally not suitable for instream enhancement structures. However, bank placed boulders, bank cover, overhead log cover and shelter structures in straight reaches are often appropriate. Any work considered will require careful design, placement, and construction that must include protection for the unstable banks.

The water temperatures in reach 1, recorded on the survey days September 29-October 5, 1994, ranged from 55°- 69.5°F. Air temperatures in reach 1 ranged from 59°- 84.5°F. The water temperatures rarely exceeded 62.5°F, with the exception of some warmer water temperatures which were recorded in a low flow portion of the upper half of the survey reach during the afternoon of October 3, 1994. The water temperatures in reach 2, recorded during the survey on October 15, 1994, ranged from 55°- 57.5°F. Air temperatures in reach 2 ranged from 58°-70.5°F. Bell (1984) identifies the preferred temperature range for steelhead as 45°-58°F with an optimum range of 50°-55°F and an upper lethal limit of 75 °F, while the preferred range for coho salmon is 38°-69°F with an optimum range of 53°-58°F and an upper lethal limit of 78.5°F. The water temperatures encountered in reach 2 fell well within the preferred temperature range for both species as well as within the optimum range for coho salmon, indicating that the temperature regime within this reach is excellent for salmonids. The temperatures encountered in reach 1 fall within the preferred range for coho salmon but exceeded those listed for steelhead much of the time. Despite this, the upper lethal temperature for steelhead was never approached in reach 1

during the survey, and qualitative observations made, of steelhead juveniles during the survey indicate that they were quite active and showed no signs of stress or other negative impacts due to increased water temperatures. To make any further conclusions, water temperature should be monitored for a longer period of time through the critical summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 32% of the total length of this survey, riffles 4%, and pools 64%. The pools are relatively deep with 43% of the pools having a maximum depth greater than 3 feet. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. In third and fourth order streams a primary pool is defined to have a maximum depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Therefore, installing structures that will increase pool habitat is recommended for locations where their installation will not jeopardize the unstable C3 stream banks, or subject the structures to high stream energy.

Out of the 285 pool tail-outs measured, only 38 (13.3%) had a rating of 3 and none had a rating of four. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. The majority of pool tailouts (75.1%) contained a rating of 2, while only 11.6% contained a rating of 1. Drought conditions in Northern California over the last 6-7 years in California have likely resulted in a decreased number of larger "flushing flows" in the North Fork Gualala River. Flushing flows are important in reducing substrate sedimentation and embeddedness problems in salmonid streams, and an increase in these flow events under normal rainfall conditions may result in decreased embeddedness in the North Fork Gualala River. Pool tailout embeddedness should be re-analyzed following the occurrence of flushing flows within the basin such as those that have occurred during the high flows in the winter of 1994/1995.

The mean shelter rating for riffles and flatwater habitat types was low with rating of 21 and 25, respectively. The shelter rating in the pool habitats was better at 59. However, a pool shelter rating of approximately 100 is desirable. The moderate amount of cover that now exists in is being provided primarily by terrestrial vegetation in all habitat types. Additionally, large and small woody debris, boulders, rootwads, and undercut banks are contributing a smaller amount. Log, rootwad, and boulder cover structures in the pool and flatwater habitats could prove effective in providing additional summer and winter salmonid habitat. Cover structures provide rearing fry protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Sixty-eight of the 71 low gradient riffles (95.8%) had either gravel or small cobble as the dominant substrate. This is generally considered excellent for spawning salmonids.

The mean percent canopy for the survey reach was 59,5%. This percentage of canopy closure is somewhat low, since 80 percent is generally considered desirable. Elevated water temperatures in portions of the North Fork Gualala River could be reduced by increasing stream canopy. The large trees required to contribute shade to the wide channel typical of this reach would also eventually provide a long term source of large woody debris needed for instream structure.

6.0 RECOMMENDATIONS

1) The North Fork Gualala River should be managed as an anadromous, natural production stream.

2) Temperatures in this section of The North Fork Gualala River, as well as upstream, should be monitored during summer low flow conditions to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

4) Where feasible, increase woody cover in the pool and flatwater habitat units. Adding high quality complexity with woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations. In some areas the material is at hand.

5) Inventory and map sources of stream bank erosion, and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.

6) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

7) Increase the canopy on the North Fork Gualala River by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

7.0 LITERATURE CITED

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APPENDIX A

PROBLEM SITES AND LANDMARKS

The following observations, comments, landmarks and possible problem sites were noted. All the distances are approximate and taken from the beginning of the survey reach.

Stream Length (ft)	Comment
31	Begin survey at mouth of North Fork Gualala River.
80	RR flatbed bridge over unit.
337	Fish (juv) observed in/around woody debris.
352	" Green Bridge" over unit.
766	Good pool for Coho.
1833	Good Coho Pool.
2257	Good Rootwad cover at head of pool.
2439	Good Coho Pool.
2745	Great woody debris cover.
3353	End of Survey for 9/29/94.
3445	Large redwood and two alders fallen across creek @ downstream (d/s) end of unit - Good cover.
3537	Several juvenile salmonids observed in/around cover - actively feeding.
3537	Terminal SCP off of d/s end of unit #33 - Used to be a side channel.
3839	Excellent Cover.
3859	Backwater pool - See map/diagram on back of data sheet.

4056	Good overwinter habitat.
4163	Unit not flagged in field.
4465	Great coho pool - Large amount of LWD.
4465	SCP @ D/S end of unit #42 - used to be upstream (U/S) portion of a side channel which flowed into unit #40.1.
4757	Excellent cover at top of unit.
4886	Excellent cover - Great fish pool.
5202	Unit not flagged in field.
5475	Active channel wide and shallow along units #52+53.
6244	Overhead lines over unit.
6355	See back of data sheet for map.
6610	See back of data sheet for map. Little North Fork Gualala River enters on right (facing downstream). Water temperatures at 1340 hrs: Little North Fork - 15.5 C North Fork, U/S of confluence - 16 C Unit #60 flagged at upstream end.
6610	See back of datasheet for map.
6610	See back of data sheet for map.
9649	Ford crossing over top of unit. Unit flagged at u/s end.
9748	Crayfish observed in unit.
9783	Numerous juvenile Salmonids observed in/around root wad.
9984	Road from ford adjacent to unit.
10058	Large school of juvenile Salmonids observed @ u/s end of unit.
10515	Excellent fish cover.

11032	Great fish pool.
11093	Great fish cover.
11372	Side channel exits from unit #110.
11372	Logjam over unit. Side channel re-enters main channel @ unit #109.
11820	End of survey for 9/30/94. Unit flagged at u/s end; ford crossing over next unit u/s.
11864	Ford crossing over unit.
12353	Excellent fish cover. Numerous juvenile Salmonids observed in/around root wad @ top.
12381	Excellent fish cover provided by 3' undercut bank. Unit flagged @ u/s end.
12442	Excellent fish cover.
12477	Good fish cover.
12764	Deep hole @ top with excellent cover.
12996	Excellent fish cover. Merganser observed in unit.
13393	Backwater pool near downstream end of unit.
13393	Backwater pool behind 2 LWD; one is appx. 36" in diameter, other is 10 ft.+ in diameter. Larger one includes rootwad.
13962	Small spring enters on left (facing downstream) @ top of unit.
14606	Good fish cover.
14978	Unit flagged at u/s end.
15328	Root wad anchored with cable @ d/s end of unit.
16012	Three rootwads anchored to right bank (facing downstream) with cable.
16097	Unit flagged at u/s end.

17224	Large root wad spans center of unit.
17375	Unit flagged at u/s end.
17687	Numerous 1+ and 2+ sized salmonids observed in/around root wad @ u/s end of unit.
18471	Numerous juvenile salmonids observed in/around cover.
18731	Numerous juvenile salmonids observed in cover near boulder.
19636	2/3 of pool is backwater which used to be side channel. Good overwintering habitat.
19844	One dead Steelhead appx 3.5 in.FL found in tailout of unit. Cricket lodged in mouth/gills (choked to death).
19935	Unit close to road again. Unit is located on topo appx. 1/2" due East of section "13" # on map.
20109	Very large hillslope failure on opposite side of road, deposited material across road and into creek.
20780	Unit flagged @ u/s end.
20872	Numerous juvenile Salmonids observed @ head of unit below riffle.
21428	Numerous juvenile Salmonids observed in/around cover. One stump anchored to left bank. Unit located on 90 degree bend in river.
21567	Unit located on 90 degree bend in river.
21727	Unit located on 90 degree bend in river.
22360	Unit flagged @ u/s end. End of survey for 10/01/94.
23005	Sedge covered scour log at head of pool.
23292	Excellent fish cover.
24021	Several boulders in unit.
24021	SCP located in D/S end of unit #211.

24778	Numerous Cyprinids appx. 3-4 "-FL observed along with one 4-5" FL SH/RBT in/around cover. Unit flagged @ u/s end.
25111	See field map for unit location.
25344	4-5" FL RBT/SH observed in unit.
25475	Numerous logs perpendicular to flow and well anchored naturally creating good pocket cover. Unit flagged at u/s end.
25544	Numerous 3-4" Cyprinids and appx. 30-40 1+ sized steelhead observed in/around cover.
26034	Side channel exits unit #233 @ D/S end.
26034	Side channel on left bank (facing d/s). Channels separated by 15' gravel bar.
26034	Re-enters main channel in upper part of unit #232.
26315	Large woody debris complex at d/s end has excellent cover.
26962	Side channel exits unit #240 @ d/s end on left (facing d/s). Channels separated by 20ft wide gravel bar.
26962	Side channel re-enters main channel in middle of unit #238.
28224	Good fish cover.
28294	Overhead lines cross unit.
28818	Good fish cover. Unit flagged @ u/s end.
28941	Wide shallow riffle has l'-3' wide channel which is 0.3' deep, the rest is 0.1' deep.
29354	Large algae bloom in unit.
29838	Excellent cover. Robinson creek (dry) enters unit on right.
29888	Excellent cover.
30003	Unit flagged at u/s end.

30964	Backwater pool on right in middle of unit.
31167	Unit flagged @ u/s end.
32173	Unit flagged at u/s end.
32527	Spring enters on left; water temp. @ 1500hrs = 13°C.
32969	Hoodoo gulch enters on left. Gulch is dry channel.
33155	U/S end of unit flagged. End of survey for 10/2/94.
33489	Algae bloom in lower 1/2 of unit. Two huge pieces of LWD in top of unit with Alders growing out of them and deep scour around them.
33489	SCP on left side in middle of unit #302.
33576	Photo #2.
33576	SCP on left in middle of unit. Good fish cover. Photo #1.
33779	McGann Gulch enters on left side @ d/s end of unit. Channel is dry.
33801	Photo #3.
33959	Ford crossing over tailout of unit.
34222	One 5" FL RBT/SH and several 3-5" FL RBT/SH observed in/around cover.
34335	Unit flagged @ u/s end.
34374	Photo *#4*.
34973	One dead 3 spine Stickleback found in unit. Dry Creek enters on right @ top of unit - channel is dry for first 75 yds and then there are isolated pools every 50 - 100 ft. All pools observed contained small fish. Water temp in first pool (with lots of LWD) - 15C at 1300hrs. Photo #5.
35048	Flow in this area estimated to be 0.5 - 1.0 cfs. Unit flagged @ U/S end.
35367	Probably a glide/run at higher flows.
35517	Huge school of California Roach in pool.

35915	Excellent fish cover. Photo *#6*.-
36167	Unit is virtually dry.
36752	Stagnant "scum" layer on water. Unit located on 180 degree bend in river.
36865	Unit located on 180 degree bend in river.
37083	Photo #7. Algae bloom in lower 1/2 of unit.
37597	Unit flagged at U/S end.
37937	Large school of 1+ sized salmonids observed in/around cover.
38345	Probably a run at higher flows.
38511	Unit flagged @ U/S end.
38872	Photo #8 looking D/S through unit from top.
38872	Side channel exits on right in middle of unit.
38872	Side channel re-enters unit #354 near D/S end. Channels separated by 15ft gravel bar.
39114	Photo *#9* - view U/s through unit from bottom.
39369	Good fish cover. Photo #10.
39750	Unit flagged at U/S end.
40129	Ford crossing at bottom end of unit (main North Fork Road).
40709	Good fish cover.
40709	Side channel exits unit # 369 @ D/S end.
40709	Side channel re-enters main channel in unit #368. Channel separated by appx. 20 ft wide gravel bar.
40852	Good fish cover. Unit flagged in U/S end. Photo #11.
41315	Good fish cover at top.

41339 Bare slope adjacent to unit on right. Dry channel.

41505 Majority of right bank is bare slope. Dry channel. Photos #12+13.

41697 Unit flagged at U/S end.

41739 Dry channel.

41955 End of survey for 10/3/94.

42262 Stagnant "scum" layer on surface of unit. Photo.

42465 Unit flagged at U/S end.

42543 SCP in D/S portion of side channel which is now mostly dry. Unit located @ U/S end of unit #391.

42844 Rain begins @ 1215 hrs. Steady, medium rain.

42862 Rain turned heavy within minutes and survey is postponed @ 1220 hrs.

43058 Water level in pools up appx. 1/2" - 1" following yesterdays rain. No increase in turbidity noticed. 43528 Three photos. Excellent fish cover. Unit flagged @ U/S end.

43886 Right bank scoured and eroding with large fallen redwoods creating good scour/cover. 2 photos.

43990 BWP located on left side, on inside of bending river. Photo.

44147 Road adjacent to gravel bar on left bank.

44456 Five appx. 4"-5" RBT/SH observed in unit. Two juvenile wild pigs observed @ top of unit rooting in bank.

45018 Ford crossing through middle of unit (main N.F road).

45339 Two photos.

46043 Side channel exits unit #430 @ D/S end. Good fish overwinter cover. Photo.

46043	Side channel re-enters main @ unit #428 U/S end.
46177	Excellent fish cover; DEEP. Gravel island in middle of unit appx. 39'L x 7'W avg. 4" Sculpin found dead in unit. Photo.
46594	Left bank scoured\eroding and top of bench covered with bullrush in units 436 through 440.
46875	Unit flagged @ U/S end.
47157	Side channel exits @ tailout of unit # 443. Units 443.1 through 443.7 Side channel on North side of willow covered cobble island. Channel has almost as much flow as "main" channel.
47157	Side channel re-enters main in middle of unit #435.
47456	Spring enters on right in middle of unit. Water temperature - 16c @ 1615 hrs.
47815	Excellent cover - numerous large logs and good canopy cover.
48147	U/S end of unit flagged.
48937	U/S end of unit flagged.
49567	Spring trickles in on left side in middle of unit.
49834	End of survey for 10/5/94.
50193	Lost creek enters on left @ top of unit. Water temp, at 0920 = 12C.
50617	Ford crossing over middle of unit. Unit flagged @ U/S end.
51234	Deep bedrock scour on bend in river.
51407	Begin channel type B I/Reach 2. Channel has increased gradient (appx. 2-2.5%) and is dominated by boulders.
51595	Gradient levels out to appx. 1-2% at top of unit 475. Both banks well armored with boulders and trees.
51817	Large rusty steel tank embedded in channel @ U/S end.

51925	Unit has several large pockets and almost resembles pocket water at this flow, but gradient is appx. 5%. Unit flagged at U/S end.
52044	BWP adjacent to unit #482 on left side of channel.
52044	Bedrock wall on right bank.
52081	Unit has several large pockets and almost resembles pocket water at this flow, but gradient is appx. 5%.
52156	Small, steep draw enters on right (dry small channel).
52211	Huge boulder on left side with deep scour.
52265	Large bare tallus slope (sparse vegetation) on right bank adjacent to units #485-490.
52362	Dense Alders around/over active channel. Unit flagged @ U/S end.
52405	Channel becomes narrower and noticeably more confined by steep banks.
52737	Confinement back to previous.
53066	Unit flagged at U/S end.
53169	BWP on left, adjacent to unit #502.
53187	Water necks down to appx. 1/2 ft wide @ D/S end and plunges 1.5 ft. into unit #502.
53260	Channel very confined by steep banks in this area, although active channel is only 1/2 of bank full channel.
53487	Unit flagged at U/S end.
53664	0+ SH observed in unit. Majority of unit 1/2 ft. deep with uniform depth bank to bank and lots of gravel. Good spawning potential.
53664	Side channel exits on left @ D/S end of unit #511.
53664	Side channel re-enters main @ top of unit #504.
53759	Gradient lower since unit #511.

53796 Units 513-515: channel braids around small islands with 6-15 ft. Alders.

54499 Bedrock walls on both sides of channel - Unit is long "S" shaped pool. Unit flagged @ U/S end.

55140 Unit flagged at U/S end.

55577 Unit flagged at U/S end.

55748 0+ Steelhead observed in unit.

56388 Unit flagged at U/S end. Three 1+ Steelhead observed in unit. Trib, enters on left, water temp, at 1620= 12C.

56687 Small school of 0+ SH observed in unit.

56860 Small school of 0+ SH observed in unit.

56880 Unit flagged at U/S end.

57334 Unit has features of Pocketwater with gradient of a HGR.

57407 End of survey @ Gualala Redwoods property boundary.

APPENDIX B

LEVEL III and LEVEL IV HABITAT TYPE KEY

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[HRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6

BACKWATER POOLS

Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5