STREAM INVENTORY REPORT

ROOT CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1991 on Root Creek to assess habitat conditions for anadromous salmonids. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Root Creek. The objective of the biological inventory was to document the salmonid species present and their distribution. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

Adult carcass surveys were conducted on Root Creek by the California Department of Fish and Game (DFG) from 1987 through 1992. The table below describes the results of those surveys:

Root Creek Carcass Surveys 1987 - 92

	Chinook Salmon					Other	
Year	# of Surveys	Live Fish	# of Carcass	Adipose ClipCWT	Redds seen	Coho seen	SH/RT seen
1987-88	2	59	117	2	24	0	1
1988-89	5	198	112	2	120	0	0
1989-90	1	0	0	0	4	0	0
1990-91	2	0	3	0	3	0	0
1991-92	4	1	0	0	37	0	6

Two carcasses found on the survey of 12-24-87 had adipose fin clips, but no coded wire tags (CWT) were found in the snouts. Two more adipose clipped carcasses were found on the survey of 12-9-88; both of those fish bore CWT # 06-05-23 and were from the Marshall Creek ponds on the South Fork Eel, brood year 1985. The drought related low flows during prime migration periods from 1989 through 1992 made Root Creek, typical of many Van Duzen tributaries, inaccessible to most chinook salmon. In fact, the single redd observed 12-9-92 was at the confluence of Root Creek and the Van Duzen River. The objective of this report

is to document the current habitat conditions in Root Creek, and recommend options for the enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Root Creek is a tributary to the Van Duzen River, a tributary to the Eel River, located in Humboldt County, California (Figure 1). Root Creek's legal description at the confluence with the Van Duzen River is T01N R02E S16. Its location is 40°28'33" N. latitude and 123°56'58" W. longitude. Root Creek is a third order stream and has approximately 4.5 miles of blue line stream according to the USGS Bridgeville and Redcrest 7.5 minute quadrangles.

Root Creek and its tributaries drain a basin of approximately 6.5 square miles. Elevations range from about 320 feet at the mouth of the creek to 1,600 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed, but there are zones of grassland and oak-woodland in the upper watershed. The watershed is owned primarily by the Pacific Lumber Company and is managed for timber production. Year round vehicle access exists by going east approximately 15 miles on Highway 36 from Alton and Highway 101. From there, access is on foot by fording the Van Duzen River to the mouth of Root Creek. During summmer PALCO often installs a temporary bridge to their Root Creek Road.

METHODS

The habitat inventory conducted in Root Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) Technical Advisors that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Root Creek personnel were trained in May and June, 1991, by Gary Flosi and Scott Downie. This inventory was conducted by two person teams.

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 Root Creek 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 should also be 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 is conducted during habitat typing operations and 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 are taken and recorded at each tenth unit typed. The time of the measurement is also recorded. Temperatures are taken in Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing used the 24 habitat classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". Root Creek 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 measurements were accomplished using hip chains, range finders, tape measures, and stadia rods. Unit measurements included mean length, mean width, mean depth, and maximum depth. Depth of the pool tail crest at each pool habitat unit was measured at the thalweg. All measurements were taken in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Root Creek, 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 Root Creek, 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 estimated using handheld spherical densiometers and is a measure of the water surface shaded during periods of high sun. In Root Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The percentages of the total canopy area was then further analyzed and recorded according to whether it was composed of either coniferous or deciduous trees.

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 Root Creek, 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.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, 3) electrofishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual.

Biological inventory was conducted in Root Creek to document the fish species composition and distribution. Three sites were

electrofished using one Smith Root Model 12 electrofisher. Each site was end-blocked with nets to contain the fish within the sample reach. Fish from each site were counted by species, measured, and returned to the stream.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85mm).

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. This program also processes and summarizes the data.

The Habitat Runtime program 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 are produced from the tables using Lotus 1,2,3. Graphics developed for Root Creek 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
- Fish species by fork length

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of June 14, and 17-21, 1991, was conducted by Jay Miller, John Crittenden, and Jerry Suissa (CCC). The survey began at the confluence with the Van Duzen River. The total length of the stream surveyed was 13,824 feet, with an additional 229 feet of side channel.

Flows were not measured on Root Creek.

Root Creek has two channel types: from the mouth to 4,811 a C4; and the remaining 9,013 feet a B2. C4 streams have low gradient (0.1-0.5%), meandering, sand bed channels with unstable banks. B2 channels are moderate gradient (1.0-2.5%), moderately confined, large cobble/boulder channels.

Water temperatures ranged from 49 to 59 degrees fahrenheit. Air temperatures ranged from 55 to 70 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, pools made up 39.4%, flatwater types were 37.5%, and riffles 23.0% (Graph 1). Flatwater habitat types made up 53.9% of the total survey **length**, pools were 25.2%, and riffles 20.8% (Graph 2).

Twelve 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, 29.8%; low gradient riffles, 23.1%; and step runs, 19.3% (Graph 3). By percent total **length**, step runs made up 30.1%, low gradient riffles 20.8%, and mid-channel pools 19.1%.

One hundred and six pools were identified (Table 3). Main channel pools were most often encountered at 82.1%, and comprised 84.0% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Twenty-three of

the 106 pools (21.7%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 105 pool tail-outs measured, three had a value of 1 (2.9%); 35 had a value of 2 (33.3%); 41 had a value of 3 (39.0%); and 26 had a value of 4 (24.8%). On this scale, a value of one is best for fisheries (Graph 6).

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 31.6. Riffles had the lowest rating with 15.5 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 32.2, backwater pools rated 28.8, and scour pools 28.7 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Root Creek. Boulders are the next most common cover type. Graph 7 describes the pool cover in Root Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 41 of the 62 low gradient riffles (66.1%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 19.4% of the low gradient riffles (Graph 8).

Approximately 22% of Root Creek lacked shade canopy. Of the 78% of the stream that was covered with canopy, 87% was composed of deciduous trees, and 13% was composed of coniferous trees. Graph 9 describes the canopy in Root Creek.

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 70.9%. The mean percent left bank vegetated was 75.5%. The dominant elements composing the structure of the stream banks consisted of 5.2% bedrock, 1.9% boulder, 3.4% cobble/gravel, 6.4% bare soil, 1.1% grass, 0.0% brush. Additionally, 65.5% of the banks were covered with deciduous trees, and 16.5% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three electrofishing sites were sampled on Root Creek. The objective was to identify fish species and distribution within Root basin. The units were sampled on October 30, 1991 by Erick

Elliot and Brian Humphrey (CCC). Each unit was end-blocked with nets to contain the fish within the sample reach. Two passes were conducted at each site, fork lengths measured and recorded, and the fish returned to the stream. All measurements are fork lengths unless noted otherwise.

The first site sampled was habitat unit 011, a mid-channel pool, approximately 961 feet from the confluence with the Van Duzen River. The site had an area of 190 sq ft, and a volume of 114 cubic feet. The sample included 12 steelhead, ranging from 53 to 135mm, two Pacific lamprey ammocetes, 90 and 120mm total length, and one stickleback, 40mm.

The second sample site was habitat unit 174, a plunge pool, approximately 10,048 above the confluence with the Van Duzen River. This site had an area of 351 sq ft, and a volume of 491 cubic feet. The sample included 32 steelhead, ranging from 43 to 138mm.

The third site was habitat unit 235, a mid-channel pool, approximately 12,858 feet from the confluence with the Van Duzen River. This site had an area of 330 sq ft, and a volume of 264 cubic feet. The sample included 16 steelhead, ranging from 54 to 150mm.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Root Creek.

DISCUSSION

Root Creek has two channel types: C4 and B2. The B2 channel type is excellent for many types of low and medium stage instream enhancement structures. There are 9,013 feet of this type of channel in Root Creek. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and pool cover.

The lower 4,811' of the survey reach is a C4 channel. C4 channels are meandering stream types on noncohesive sand 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 recorded on the survey days June 14-21, 1991, ranged from 49° F to 59° F. Air temperatures ranged from 55° F to 70° F. This is an excellent water temperature regime for salmonids. However, to make any further conclusions, temperatures need to be monitored for a longer period during the summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 53.9% of the total **length** of this survey, pools 25.2%, and riffle 20.8%. The pools are relatively shallow with only 23 of the 106 pools (21.7%) having a maximum depth of three feet or greater. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. Therefore, installing structures that will increase pool habitat is recommended for locations where their installation will not jeopardize the unstable C4 stream banks, or subject the structures to high stream energy.
Forty-seven of the 105 pool tail-outs measured had embeddedness ratings of 3 or 4. Only three had a 1 rating. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In Root Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for riffles was very low with a rating of 15.5. The shelter rating in the flatwater habitats was slightly better at 23.4. Pools rated highest at 31.6. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by large woody debris in most habitat types. Additionally, boulders and small woody debris contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Fifty-three of the 62 low gradient riffles had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the survey reach was 77.8%. This is a high percentage of canopy, since 80 percent is generally considered desirable.

RECOMMENDATIONS

1) Root Creek should be managed as an anadromous, natural

production stream.

2) 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.

3) Where feasible, increase woody cover in the pool and flatwater habitat units. Most of the existing cover is from large and small woody debris and boulders. 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.

4) 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.

5) 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.

PROBLEM SITES AND LANDMARKS

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

0'	Begin survey at confluence with Van Duzen River. The first 4,811' surveyed is a C4 channel type. Left bank (LB) exposed 200' x 100' contributing fines.
758'	Tributary enters from LB.
1022'	Tributary enters from LB.
1125'	CCC flag site # 1.
1837'	Log debris accumulation (LDA), 7' long x 15' wide.
2766'	LDA, 25' long x 8' wide.
3799'	Exposed LB, 5' high x 30' long, contributing fines and gravel.
3845'	Exposed right bank (RB), 3' high x 75' long,

contributing fines and gravel.

4420' Steep exposed RB, 35' long x 8' high, contributing fines and gravel.

4527' Steep, partially exposed RB, 70' long x 15' high, contributing fines and gravel.

4462' Tributary enters from LB.

4811' Channel type changes to a B2 channel type (reach #2).

4989' CCC flag site # 2. Fallen tree retaining silt and sand.

5285' Exposed RB, 7' x 50', contributing fines.

5377' Overflow channel on left bank around large boulder.

5663' CCC flag site # 3.

5818' Steep exposed RB, 8' x 30', contributing fines.

6344' CCC flag site # 4.

6668' Large 30' long x 15' high boulder on RB.

7177' LDA, 12' wide x 3' long x 3' high, retaining fines and debris.

7331' Fallen log, 37' long x 4' wide, providing undercut on LB.

7396' Overflow channel on LB.

7530' Exposed LB, 11' x 15', contributing fines.

8107' CCC flag site # 5. LDA with large gravel bar for last 70' of unit.

8212' Exposed LB, 25' x 7', contributing fines.

8268' Continuation of exposed LB, contributing fines.

8330' CCC flag site # 6. Log structure retaining fines on LB.

8714' Fallen log, 40' x 4', on LB.

8753' Vertical siltstone RB, 20' high x 40' long.

9014' Fallen log across stream, 30' long x 6' diameter.

9085' Overflow channel on LB 35' long.

9409' CCC flag site # 7.

9754' Steep bedrock LB, 40' high x 60' long.
9847' LDA on both banks, 4' diameter log spanning stream.

9949' CCC flag site # 9. Coniferous debris on both banks.

10021' Exposed LB, 20' long x 7' high, contributing fines.

10219' CCC flag site # 10.

10425' Inverted stump, 20' wide x 10' high, in middle of pool. Water cascades 4' into pool. Log barrier causing sand and gravel retention.

10480' CCC flag site # 11. Two fallen logs and debris.

10598' CCC flag site # 12.

10760' Exposed LB, 20' high x 30' long, contributing fines.

10806' LDA along both banks.

10913' Exposed LB, 10' high x 25' long, contributing fines. Over flow channels on both sides. YOY observed.

11048' CCC flag site # 13. LDA 80' wide x 30' long, not restricting water flow.

11184' CCC flag site # 14.

11345' LDA up to 15' high along both banks.

11377' CCC flag site # 15. Fallen log catching debris.

11405' CCC flag site # 16. LDA of 6-7' diameter redwood logs, not restricting water flow. YOY observed.

11539' CCC flag site # 17. Fallen log. YOY observed.

11723' CCC flag site # 18. 3' plunge over log in main channel.

11739' CCC flag site # 19. Stumps and logs comprise RB, water percolates through debris.

11859' CCC flag site # 20.

11998' LDA, 15' long x 5' high x 25' wide, not restricting water flow.

12181' Tributary enters RB.

12319' CCC flag site # 21. LDA, 15' long x 4' high x 20' wide, water percolates through.

12517' CCC flag site # 22. LDA restricting flow.

12771' CCC flag site # 23. Debris accumulation restricting flow.

12902' CCC flag site # 25. Debris accumulation restricting flow. Coniferous debris along both banks.

13307' Small tributary enters LB.

13514' LDA, 100' long x 15' wide x 7' high. Exposed RB contributing fines and debris.

13604' Silt build-up, 60' wide x 5' deep x 220' long.

13750' Small tributary enters LB. 4" fish and YOY observed.

13824' LDA, 200' long x 80' wide x 15' high, water percolates through and under. Second LDA of undetermined size upstream of this one. No fish observed beyond this point. End of survey.