STREAM INVENTORY REPORT

LAWRENCE CREEK (MIDDLE REACH)

INTRODUCTION

A stream inventory was conducted during the summer of 1991 on the middle reach of Lawrence 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 Lawrence 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.

Spawning surveys were conducted in January 1988, December 1988, January 1989, January 1990, December 1990, January 1991, December 1991, and January 1992. These surveys documented the presence of steelhead and chinook salmon in Lawrence Creek. The objective of this report is to document the current habitat conditions, and recommend options for the enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Lawrence Creek is tributary to Yager Creek, tributary to the Van Duzen River, tributary to the Eel River, located in Humboldt County, California (Figure 1). Lawrence Creek's legal description at the confluence with Yager Creek is T2N R2E S06. Its location is 40°34'37" N. latitude and 123°59'28" W. longitude. Lawrence Creek is a third order stream, and has approximately 14.6 miles of blue line stream according to the USGS Iaqua Buttes, Owl Creek, and McWhinney Creek 7.5 minute quadrangles. Lawrence Creek and its tributaries drain a basin of approximately 38.8 square miles. Elevations range from about 450 feet at the mouth of the creek to nearly 3,000 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is owned primarily by the Pacific Lumber Company and is managed for timber production and grazing. Year round vehicle access exists from State Highway 36 near Carlotta, via Fisher Road, to Pacific Lumber Company's Yager Camp. The main Yager Creek Haul Road leads to Lawrence Creek, 7 miles northeast of Yager Camp.

METHODS

The habitat inventory conducted in the middle reach of Lawrence 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). Lawrence Creek personnel were trained in May and June, 1991, by Gary Flosi and Scott Downie. This inventory was conducted by a two person team.

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 middle reach of Lawrence 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. Flows should also be measured 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 simultaneously with habitat typing 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". Lawrence 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 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. 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 the middle reach of Lawrence 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 the middle reach of Lawrence 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 the middle reach of Lawrence 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 the middle reach of Lawrence 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 Lawrence Creek to document the fish species composition and distribution. Four sites were electrofished in Lawrence Creek 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 either a 6 or 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 0.85 mm). During field analysis, fine sediment suspended in the liquid portion of the sample is settled in Imhoff cones for one hour, measured, and recorded on a standard field form. The remainder of the sample is sealed in plastic bags with an identification and information ribbon, then taken to the laboratory for final processing.

In the laboratory the samples are wet sieved using standard Tyler screens. All particles greater than 0.85 mm diameter are measured by displacement in graduated cylinders. The volume of

fine sediment less than 0.85 mm is measured following one hour of settling in graduated cylinders or Imhoff cones. The fines measured in the field are added to these results.

Gravel sampling is conducted to determine the percentage of fine sediment present in probable fish spawning areas. These areas are generally found in low gradient riffles at the tail-outs of pools. The higher the percent of fine sediment, the lower the probability for eggs to survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and preventing fry from emerging from the gravel.

DATA ANALYSIS

Data from the habitat inventory form is entered into Habtype, a dBASE 3+ data entry program developed by the California Department of Fish and Game (DFG). From Habtype, the data is summarized by Habtab, a dBASE 4.1 program in development by DFG.

The Habtab program produces the following summary 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 the middle of Lawrence 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

HABITAT INVENTORY RESULTS

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

The habitat inventory of June 18 and 19, 1991, was conducted by

Tony Sartori, and Brian Humphrey (CCC). The survey began approximately 32,880 feet from the confluence with Yager Creek where the channel changed from a B1 to an A2 channel type and extended up Lawrence to the confluence of Booths Run. The total length of the stream reach surveyed was 10,195 feet, with an additional 363 feet of side channel.

A flow of 2.1 cfs was measured 10-23-91 below bridge 8 (habitat unit 88 at 9,718') with a Marsh-McBirney Model 2000 flowmeter.

This section of Lawrence Creek has two channel types: from the beginning of the survey 32,880 feet from the mouth for the first 2,532 feet, an A2; and the upper 7,663 feet a C2. A2 streams have steep gradient (4-10%), very well confined, boulder channels. C2 channels are low gradient (< 1%), moderately confined streams, with stable stream banks.

Water temperatures ranged from 50 to 56 degrees Fahrenheit. Air temperatures ranged from 53 to 66 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 40.2%, flatwater types were 34.7%, and pools 24% (Graph 1). Riffles made up 43.2% of the total survey **length**, flatwater habitat types were 37.5%, and pools 18% (Graph 2).

Sixteen Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffles 28.4%; runs, 16.5%; mid-channel pools, 12.6%; and step runs, 9.5% (Graph 3). By percent total **length**, low gradient riffles made up 36.5%, runs 17%, step runs 12.0%, and mid-channel pools 9.1%.

Thirty-one pools were identified (Table 3). Main channel pools were most often encountered at 58%, and comprised 55% 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. All 32 of the pools had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 29 pool tail-outs measured, zero had a value of 1 (0.0%); 8 had a value of 2 (27.6%); 18 had a value of 3 (62.1%); and 3 had a value of 4 (10.3%). 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. Riffle types had the highest

shelter rating at 53.1, followed by pools, with a rating of 39.1 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 60.0, scour pools rated 39.2, and main channel pools 37.9 (Table 3).
Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in the middle reach of Lawrence Creek. Bedrock ledges are the next most common cover type. Graph 7 describes the pool cover in the middle reach of Lawrence Creek.

Table 6 summarizes the dominant substrate by habitat type. Large cobble was the dominant substrate observed in 15 of the 36 low gradient riffles (41.7%). Small cobble and gravel were the next most frequently observed dominant substrate types, and each occurred in 25.0% of the low gradient riffles (Graph 8).

Approximately 59% of the middle reach of Lawrence Creek lacked shade canopy. Of the 41% of the stream that was covered with canopy, 83% was composed of deciduous trees, and 18% was composed of coniferous trees. Graph 9 describes the canopy in the middle reach of Lawrence 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 60.3%. The mean percent left bank vegetated was 59.9%. The dominant elements composing the structure of the stream banks consisted of 12.9% bedrock, 17.4% boulder, 7.6% cobble/gravel, 1.5% bare soil, 3.0% grass, 4.5% brush. Additionally, 50.0% of the banks were covered with deciduous trees, and 3.0% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Four electrofishing sites were sampled on Lawrence Creek. The objective was to identify fish species and distribution within Lawrence basin. The units were sampled on September 16 and 18, 1991 by Brian Humphrey, Erick Elliot, and Shea Monroe (CCC). Each unit was end-blocked with nets to contain the fish within the sample reach. Fork lengths were 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 431, a mid-channel pool, approximately 43,174 feet (8.2 miles) from the confluence with Yager Creek. This unit was located directly under the bridge 621' upstream from the confluence with Booth's Run Creek. The site had an area of 1,000 sq ft, and a volume of 1,900 cubic

feet. The sample included 49 steelhead, ranging from 49 to 148 mm, and 12 Pacific lamprey ammocetes, which were not measured.

The second sample site was habitat unit 492, a channel confluence pool, approximately 48,826 feet above the confluence with Yager Creek, and directly under the Bell Creek bridge. This site had an area of 441 sq ft, and a volume of 396.9 cubic feet. The sample included 54 steelhead, ranging from 44 to 143 mm.

The third sites habitat units 705/706, a mid-channel pool, approximately 61,141 feet (11.6 miles) from the confluence with Yager Creek. This site had an area of 660 sq ft, and a volume of 726 cubic feet. The sample included 47 steelhead, ranging from 44 to 135 mm, and 1 Pacific lamprey ammocete 115 mm total length.

The fourth site was habitat unit 741, a mid-channel pool, approximately 63,265 feet from the confluence with Yager Creek, and under the bridge crossing on Kneeland Road. This site had an area of 700 sq ft, and a volume of 630 cubic feet. The sample included 124 steelhead, ranging from 45 to 192 mm, and four Pacific lamprey ammocetes, which were not measured.

GRAVEL SAMPLING RESULTS

McNeil sediment samples were taken by Greg Moody, Scott Downie, and Gary Flosi on July 31, August 1, 2, and 5-7, 1991. The 51 samples from the six sites on lower Lawrence Creek had a combined mean of 37.4% for fine sediments <4.7mm. The combined mean of sediments <0.86mm in the samples is 15.7%. These are above threshold levels for optimum salmonid egg and embryo incubation. Table 7 describes the percentage of fines in the McNeil sediment samples by sample and particle size. The last column describes the total percentage of all fines <4.7mm.

DISCUSSION

The middle reach of Lawrence Creek has two channel types: A2 and C2. The high energy and steep gradient of the A2 channel type is generally not suitable for instream enhancement structures. The upper 7,663 feet of the surveyed reach of Lawrence Creek is a C2 channel type. C2 channels have suitable gradients and the stream bank stability that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective cover for fish. Well placed and engineered structures that constrict the channel to form pool habitat or cover structures

are usually appropriate and have a good chance of success in these channel types.

The water temperatures recorded on the survey days ranged from 50° F to 56° F. Air temperatures ranged from 53° F to 66° F. This is a very good water temperature regime for salmonids. However, to make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 37.5% of the total **length** of this survey, riffles 43.2%, and pools 19.3%. The pools are relatively deep with all 32 of the pools having a maximum depth greater than 3 feet. 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 subject the structures to high stream energy.
Twenty-one of the 29 pool tail-outs measured had embeddedness ratings of 3 or 4. None had a 1 rating. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In the middle reach of Lawrence Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for flatwater habitats was relatively low with a rating of 36.1. The shelter rating for the pools was slightly better at 39.1. Riffles rated highest at 53.1. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, bedrock ledges 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.

Eighteen of the 36 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 only 41%. This is a low percentage of canopy, since 80 percent is generally considered desirable. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Lawrence 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 boulders and bedrock ledges. 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.

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.

6) Increase the canopy on Lawrence Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this inventory section must be treated as well, since the water being delivered here is being warmed above. In many cases, planting will need to coordinated to follow bank stabilization or upstream erosion control projects.

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 of the middle reach 32,880 from the confluence with Yager Creek. Channel type changes from a B1 to an A2. Both left and right bank are very steep, with slides behind vegetation bordering them for 815' long.

317' Left bank erosion 100' high X 50' long.

387' Starting from this unit, very large boulders from 10" to 20' and bedrock in channel and on side slopes and banks.

595' LWD accumulation (20' high X 20' long X 20' wide) on the left bank behind a 20' boulder.

721' 3.5' high cascade.

833' 3' high cascade waterfall. No fish were seen from this point on to the next ten units.

1382' Left bank erosion 300' high X 100' long. Unit is a step run with 4 steps that average 50' in length with 2' to 3' high cascades between them.

1761' Bedrock cliff on right bank 300' high X 100' long. A 5' high X 5' long cascade waterfalls at the top of this unit.

2090' Right bank erosion 581' long, contributing boulders, soil into the channel.

2532' Channel type changes from an A2 to a C2.

3600' Tributary enters from the left bank over a 30% gradient, 2' wide at the mouth.

3897' Left bank erosion 50' high X 30' long.

5034' Right bank alluvial terrace 4' high X 100' wide. Left bank cut 10' high exposing bare soil.

5628' Right bank cut 8' high.

6042' Instream road crossing.

6229' Log and debris accumulation 30' long X 30' wide X 10' high with 3' high gravel retention at the base of the accumulation. Not a barrier.

6654' Log and debris accumulation 10' high X 30' wide X 10' long retaining gravels 5' high X 100' long X 50' wide at the base. Associated right bank erosion 3' high X 20' long.

6952' Right bank erosion 200' long X 30' high contributing "blue goo" into the channel.

7673' Tributary enters the channel from the right bank, 4' wide at the mouth.

10195' Booths Run Creek enters from the left bank. End survey of the middle reach.