STREAM INVENTORY REPORT

LAWRENCE CREEK (Upper Reach)

INTRODUCTION

A stream inventory was conducted during the summer of 1991 on 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 upper reach of Lawrence Creek follows the methodology as presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds). The inventory was conducted by a two person team. The California Conservation Corps (CCC) Technical Advisors conducting 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.

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 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, 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 simultaneously with 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". 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 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 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 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 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 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 salmonid species composition and distribution. Three sites were electrofished using one Smith Root Model 12 electrofisher. 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-out of a pool, in the thalweg. 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 be percolated through the gravel, or because of the fine sediment capping the redd and preventing fry from emerging from the gravel.

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 (DFG). 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 upper reach 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 August 16, 19 thru 23, and 26, 1991, was conducted by Chris Coyle and Erick Elliot (CCC). The total length of the stream surveyed was 21,514 feet, with an additional 828 feet of side channel.

This section of Lawrence Creek has six channel types: from the confluence with Booths Run Creek to 3,969 feet a C2; next 6,423 feet a B3; next 892 feet an A3; next 3,739 feet a B4; next 1,252 feet a B1; and the upper 5,239 feet a C1. C2 channels are low gradient (0.3-1.0%), moderately confined streams, with cobble beds. B3 channels have moderate gradient (1.5-4.0%), well confined, unstable cobble/gravel channels. A3 streams have steep, erodible, coarse-grained channels. B4 types have moderate gradient, well confined, unstable gravel/sand channels. B1 streams have moderate gradient, moderately confined, stable channels. C1 types have low gradient, slightly confined, meandering channels.

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

Water temperatures ranged from 57 to 63 degrees fahrenheit. Air temperatures ranged from 57 to 74 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 28.6%, flatwater types 29.1%, and pools 42.3% (Graph 1). Riffles made up 26.6% of the total **length**, flatwater habitats 35.7%, and pools 37.7% (Graph 2).

Eighteen 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, 26.3%; low gradient riffles, 23.7%; and step runs, 12.4% (Graph 3). By percent total **length**, mid-channel pools made up 23.7%, low gradient riffles 21.2%, and step runs 20.1%.

Table 3 summarizes the pool habitat types. Of these pools, 70.9% were main channel pools. These main channel pool types comprised 74.6% of the total length for all pools (Graph 4).

Table 4 (Graph 5) is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. The maximum depth for 116 of the 148 pools (78.4%) was two feet or deeper. This level indicates a good quality of pool habitat in the upper reach of Lawrence Creek.

The depth of cobble embeddedness was estimated at the pool tail-outs. Of the 139 pool tail-outs, 23 (16.5%) had a value of 1;

56 (40.3%) had a value of 2; 58 (41.7%) had a value of 3; and 2 (1.4%) had a value of 4. Graph 6 describes embeddedness.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type using a scale of 0-300. Pool types had the highest shelter rating at 35.2 (Table 1). For the pool types, the backwater pools had the highest mean shelter rating at 40.5, main channel pools had a rating of 36.8, and scour pools had a rating of 28.6 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in the upper reach of Lawrence Creek. Bedrock ledges are the next most common cover type. Graph 7 describes the pool cover in the upper reach of Lawrence Creek.

Table 6 (Graph 8) describes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 65.5% of the low gradient riffles. Small cobble was the next most frequently observed dominant substrate type, and occurred in 23.8% of the 84 low gradient riffles.

Nearly 41% of the upper reaches of Lawrence Creek lacked shade canopy. Of the 59.4% of the stream that was covered with canopy, 50.1% was composed of deciduous trees, and 9.3% was composed of coniferous trees. Graph 9 describes the canopy in the upper reach of Lawrence Creek.

Table 2 summarizes the mean percent of the right and left stream banks covered with vegetation by habitat unit type. For the stream reach surveyed, the mean percent right bank vegetated was 74.6%. The mean percent left bank vegetated was 71.5%. The elements composing the structure of the stream banks consisted of 8.0% bedrock, 11.7% boulder, 2.9% cobble/gravel, 2.0% bare soil 5.4% grass and 34.1% brush. Additionally, 32.1% of the banks were composed of deciduous trees, and 3.7% of 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 site was habitat unit 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

No gravel samples were conducted on the upper reach of Lawrence Creek. Refer to Lower Lawrence Creek report for gravel samples.

DISCUSSION

The upper reach of Lawrence Creek has six channel types: A3, B1, B3, B4, C1, and C2. The high energy and erodible stream banks of the A2 channel type is generally not suitable for instream enhancement structures. Both the B3 and B4 channels are also unsuitable for instream enhancement structures due to their unstable stream banks.

The B1 channel type is excellent for many types of low and medium stage instream enhancement structures. There are 1,252 feet of this type of channel in the upper reach of Lawrence Creek. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and pool cover.

The lower 3,969 feet of the survey reach is a C2 channel type. There is also a 5,239 foot reach of C1 channel in the upper section of Lawrence Creek. Both C1 and C2 channels have suitable gradients and the stable stream banks 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 are usually appropriate and have a good chance of success in these channel types.

The water temperatures recorded on the survey days of Aug. 16-26 1991, ranged from 57° F to 64° F. Air temperatures ranged from 57° F to 74° F. This is a very good water temperature regime for salmonids. However, 64° F, if sustained, is near the threshold stress level for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 35.7% of the total **length** of this survey, riffles 26.6%, and pools 37.7%. The pools are relatively deep with 114 of the 148 pools having a maximum depth or two feet or greater. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat.

Sixty of the 139 pool tail-outs measured had embeddedness ratings of 3 or 4. Twenty-three had a 1 rating. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In the upper 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 pools was moderate with a rating of 35.2. The shelter rating in the flatwater habitats was slightly lower at 26.6. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders and bedrock ledges in all habitat types. 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.

Seventy-five of the 84 low gradient riffles had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 59%. This is a relatively high percentage of canopy, since 80 percent is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) The upper reach of Lawrence Creek should be managed as an anadromous, natural production stream.

2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulders and bedrock ledges. Adding high quality complexity with woody cover is desirable.

3) 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.

4) 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.

5) 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 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.

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 upper reach of Lawrence Creek at the confluence with Booths Run Creek. Reach #1 is a C2 channel type.

199' Right bank erosion 60' high x 50' long; toe is

vegetated.

621' Bridge crossing 19' wide x 45' long x 14' high. Exposed soil areas along bridge supports, contributing fines into the channel.

783' Approximately 12 logs in the channel with 1-3' diameters; no barrier.

974' Old skid trail crosses the channel.

3064' Good spawning gravel being retained by boulders and bedrock protrusions.

3969' Channel type changes to a B3 (reach #2).

4687' Beginning of a narrow, bedrock canyon.

5896' Tributary enters from the left bank.

6273' Bell Creek enters from the right bank. Flatcar bridge crossing 14' wide x 40' long x 20' high.

6782' Log and debris accumulation (LDA) 45' wide x 20' long x 8' high, retaining gravel 3' high; possible barrier in the future if further debris accumulation occurs.

6838' LDA created by nine large logs; no barrier. YOY observed.

8598' LDA 30' wide x 10' long x 7' high'; no barrier.

8810' RB slide 20' x 20' contributing gravel.

9781' Large woody debris (LWD) accumulation on left bank (LB).

10392' Channel type changes to an A3 (reach #3).

10424' Three foot plunge over large boulders.

11107' Approximately 22 steps interspersed with high gradient riffles and cascades with drops up to 6'. Top of unit contains log debris accumulation (LDA) 8' high x 15' long x 100' wide. Gravel retention estimated at 4' deep x 50' wide x 80' long.

11187' Mid-channel bar. YOY observed.

11284' Channel type changes to a B4 (reach #4).

12196' LDA at top of unit, water percolates through retained gravel approximately 3' high.

12226' Mid-channel bar. LB with dry overflow channel.

12366' RB erosion 10' x 6' contributing fines.

12421' RB erosion 15' x 10' contributing fines.

12785' RB rangeland under-going large scale slump process, estimated 150 x 300 yards. Toe cut by channel 8' highexposed clay for 100 yards.

12833' LB erosion contributing silt and gravel.

12984' Four steps. LB erosion 7' high x 150' long contributing fines and overflow channel.

13029' Large boulders creating numerous scours.

13177' Approximately 200' long LB overflow channel.

13342' Large boulder deflects channel to right, overflow channel to left of boulder.

13590' Two small and one large steps.

13636' Tributary enters LB.

13758' LB erosion 4' x 20' contributing fines.

14000' Wetted LB overflow channel (120' long x 6' wide), dry above and below, contains some fish.

14560' Cattle tracks causing erosion to RB, contributing fines.

14871' LB overflow channel.

15005' Barbed wire fence along RB.

15023' Channel type changes to a B1 (reach #5).

15311' Numerous large boulders, 2 large mid-channel bars at bottom of unit.

15383' Two foot plunge over boulders.

15578' RB intermittent overflow channel. 3' plunge. 2' diameter culvert at top of unit (not functional).

15737' LB rangeland hillside contributing fines.

15834' Debris jam 8' high x 12' long x 40' wide creating 8' cascade and gravel retention 7' high and 50' upstream.

15851' Rangeland hillside 300' long x 40' high contributing clay. YOY observed.

16110' Ten steps with up to a 2' drop between steps.

16227' Channel splits around 10' diameter boulder.

16275' Channel type changes to a C1 (reach #6).

16385' RB terraces 5' x 30' contributing sand.

16587' Many YOY and 1+ observed from this point upstream.

16854' LB erosion 4' x 30' contributing fines.

16930' RB cattle track 7' x 25' contributing fines.

16997' LB erosion 3' x 25' contributing fines.

17041' LB erosion 3' x 10' contributing gravel.

17326' RB erosion 5' x 10' contributing fines. Broad riffle with small runs cutting either bank.

17533' LB erosion, 15' x 15' contributing fines and sand.

17672' LB erosion 4' x 30 contributing gravel.

17761' Large boulder in channel causing upstream scour into RB eroding gravel and undercutting standing alder.

18009' Narrowing channel undercutting alders on RB.

18265' Cabled log across channel 2' above stream. Mid-channel scour caused by debris caught on upstream side.

19000' Mid-channel bar. Dry overflow channel from 7 units upstream ends here.

19501' RB partially vegetated, cut terrace 5' x 60' contributing fines and gravel.

19814' LB erosion 4' x 10' contributing fines and gravel.

20321' LB erosion 6' x 10' over bedrock contributing fines and gravel.

20825' Kneeland Road Bridge. RB overflow channel.

21262' RB erosion 15' x 40', with alders fallen into channel contributing fines.

21386' LB erosion 4' x 20' over bedrock contributing fines.

21476' LB erosion 4' x 20' contributing fines. Fallen log in right channel associated with small backwater.

21546' LB erosion 7' x 20' contributing fines. 4 steps. End of survey.