STREAM INVENTORY REPORT

GREENLAW CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1991 on Greenlaw 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 Greenlaw 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.

There is no known record of adult spawning surveys having been conducted on Greenlaw 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

Greenlaw Creek is tributary to the Eel River located in Humboldt County, California. Greenlaw Creek's legal description at the confluence with the Eel River is T1N R1E S26. Its location is 40°26'43" N. latitude and 124°01'45" W. longitude. Greenlaw Creek is a first order stream and has approximately 2.8 miles of blue line stream, according to the USGS Scotia 7.5 minute quadrangle. Greenlaw Creek drains a watershed of approximately 1.8 square miles. Elevations range from about 120 feet at the mouth of the creek to 2,000 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is owned by the Pacific Lumber Company and is managed for timber production. Vehicle access exists from U.S. Highway 101, six miles southeast of Scotia, via the Pepperwood exit.

METHODS

The habitat inventory conducted in Greenlaw 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). Greenlaw 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 Greenlaw Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured at the beginning of the stream survey reach using standard flow measuring equipment. The flow is recorded in cubic feet per second of discharge.

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 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". Greenlaw 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 Greenlaw 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 Greenlaw 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 Greenlaw 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 Greenlaw 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 Greenlaw Creek to document the salmonid species composition and distribution. Two sites were electrofished in Greenlaw Creek 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 is entered into Habtype, a dBASE 3+ data entry program developed by the Department and Fish and Game. 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 Greenlaw 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 19, 20, and 21, 1991, was conducted by Erick Elliot and Steve Liebhardt (CCC). The total length of the stream surveyed was 6,118 feet, with an additional 126 feet of side channel.

Greenlaw Creek is a B3 channel type for the entire stream reach surveyed. B3 channels are moderate gradient, well confined streams, with cobble/gravel streambeds and unstable stream banks.

Water temperatures ranged from 51 to 53 degrees fahrenheit. Air temperatures ranged from 54 to 62 degrees fahrenheit.

Table 1 summarizes the riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles make up 44.3%, flatwater types make up 17.9%, and pools make up 35.7% (Graph 1). Riffles make up 61.7% of the total **length**, flatwater habitats make up 13.3%, and pools make up 12.1% (Graph 2).
Eleven habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffles, 43.6%, mid-channel pools, 17.9%, and log enhanced lateral scour pools, 11.4% (Graph 3). By percent total **length**, low gradient riffles made up 61.3%, step runs made up 9.1%, and mid-channel pools made up 5.6%.

Table 3 summarizes the pool habitat types. Of these pools, 54.0% were main channel pools, and 44.0% were scour pools. Main channel pools and scour pools comprised 53.5% and 45.5%,

respectively, 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 43 of the 50 pools (86%) was less than two feet. This level indicates a poor quality of pool habitat in Greenlaw Creek.

The depth of cobble embeddedness was estimated at the pool tail-outs. Of the 48 pool tail-outs measured, zero had a value of 1, 15 (31.3%) had a value of 2, 33 (68.8%) had a value of 3, and zero 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 within the survey using a scale of 0-300. Pool types had the highest shelter rating at 77.3 (Table 1). For the pool types, the scour pools had the highest mean shelter rating at 87.5, main channel pools had a mean shelter rating of 70.2, and backwater pools had a rating of 45.0 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large and small woody debris are the dominant cover types in Greenlaw Creek and are extensive. Graph 7 describes the pool cover in Greenlaw Creek.

Table 6 (Graph 8) describes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 60.7% of the low gradient riffles. Small cobble was the next most frequently observed dominant substrate type, and occurred in 37.7% of the 61 low gradient riffles.

Nearly 28% of Greenlaw Creek lacked shade canopy. Of the 72% of the stream that was covered with canopy, 94% was composed of deciduous trees, and 6% was composed of coniferous trees. Graph 9 describes the canopy in Greenlaw 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 77.8%. The mean percent left bank vegetated was 75.9%. The

stream bank composition consisted of 0.7% boulder, 1.4% cobble/gravel, 0.7% bare soil, 1.4% grass, 21.4% brush, 65.0% deciduous trees, and 9.3% coniferous trees (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Two electrofishing sites were sampled on Greenlaw Creek, on September 23, 1991, by Erick Elliot and Brian Humphrey (CCC). A total of seven steelhead were sampled for the two sites. Graph 11 summarizes the fork lengths of all fish sampled.

The first unit sampled was habitat unit 19, a mid-channel pool, approximately 1,989' upstream from the confluence with the Eel River and just above the Avenue of the Giants bridge. The unit had an area of 119 sq ft and a volume of 71 cubic feet. Five steelhead were sampled. They measured 130, 138, 146, 152, and 168 mm fork length.

The second unit was habitat unit 48, a mid-channel pool, approximately 3,038' from the confluence with the Eel River and just above the new Pacific Lumber Company bridge. The unit had an area of 200 sq ft and a volume of 100 cubic feet. Two steelhead were sampled, 53 and 134 mm fork length.

GRAVEL SAMPLING RESULTS

No gravel sampling was conducted on Greenlaw Creek.

DISCUSSION

The B3 channel type is generally not suitable for fish habitat improvement structures. B3 channels are dominated by cobble and gravel and have unstable stream banks.

The water temperatures recorded on the survey days ranged from 51° F to 53° F. Air temperatures ranged from 54° F to 62° 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 13.3% of the total **length** of this survey, riffles 61.7%, and pools 12.1%. The pools are relatively shallow with only seven of the 50 pools having a maximum depth greater than 2 feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. In first and second order streams a primary pool is defined to have a maximum depth of at least two 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 or deepen pool habitat is recommended for locations where their installation will not interfere with the unstable stream banks, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. The LDA's in the system are retaining needed gravels. Any necessary modifications to them should be done with the intent of metering the gravels out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Thirty-three of the 48 pool tail-outs measured had embeddedness ratings of 3. None had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Greenlaw Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating in the flatwater habitats was low with a rating of 16.3. The shelter rating for the pools was better at 77.3. 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 and small woody debris in all habitat types. Log and root wad cover structures in the 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.

Sixty of the 61 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 72%. This is a high 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) Greenlaw 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) Increase woody cover in flatwater habitat units. Although the majority of the cover is composed of large and small woody debris, increasing the complexity and amount of woody cover would be desirable.

4) There are several log debris accumulations present on Greenlaw Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done in a manner that will not release an overabundance of fine sediment into the system.

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.

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' Dry channel for the first 752' from the confluence with

the Eel River. Entire stream reach surveyed is a B3 channel type.

1942' Avenue of the Giants bridge, 49' long x 27' wide x 20' high.

2141' Left bank erosion 2' high x 20' long, depositing gravel and fines into the channel.

2618' Highway 101 bridge, 80' long.

2856' Cat tracks crossing the channel, 15' wide.

2917' Right bank erosion 15' high x 30' long, depositing gravel and fines into the channel.

3021' New Pacific Lumber Company bridge, 28' wide x 17' long x 12' high.

3320' Log and debris accumulation (LDA).
4486' LDA 5' wide x 20' long x 1.5' high, retaining gravel.

4528' Plunge over a conifer log, 7.5' high.

5518' LDA 45' wide x 85' long, retaining gravel.

5685' Gravel retention 7' wide x 40' long x 1' high, caused by LDA.

5779' Left bank erosion 20' wide x 20' long.

5799' Gravel retention 15' wide x 10' long x 4' high, caused by LDA.

5855' 4' high plunge, retaining gravel 3' wide x 3' long x 1' high.

6073' LDA 61' wide, retaining gravel.

6118' Succession of LDAs for approximately 300', retaining gravel. Each LDA is approximately 20' wide x 25' long x 15' high. End of survey.

Greenlaw Creek

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	[BRS]	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