STREAM INVENTORY REPORT
CARSON CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Carson 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 Carson 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 Carson Creek from 1988 through 1990. In January 1988, 4 live chinook salmon, 1 live coho, 1 chinook carcass, and 10 redds were found in the lower 800' of the stream. Two redds were found during the January 1990 survey. No other survey found adults or redds, although steelhead fry were sampled during 1992 summer electrofishing (DFG file data). The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Carson Creek is tributary to Larabee Creek, tributary to the Eel River, located in Humboldt County, California (Figure 1). Carson Creek's legal description at the confluence with Larabee Creek is T1S R2E S01. Its location is 40°24'31" N. latitude and 123°53'34" W. longitude. Carson Creek is a first order stream and has approximately 2.3 miles of blue line stream, according to the USGS Redcrest and Bridgeville 7.5 minute quadrangles. Carson Creek drains a watershed of approximately 2.3 square miles. 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 at Redcrest, via the Avenue of the Giants, to Holmes Road.

METHODS

The habitat inventory conducted in Carson Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) and contract seasonal Technical Advisors that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Carson Creek personnel were trained in May and June, 1992, by Gary Flosi and Scott Downie. This inventory was conducted by a two person team.

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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 Carson 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 is 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. Both 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 uses 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". Carson 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:

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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 Carson 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 Carson 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 Carson Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

9. Bank Composition:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Carson 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

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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 Carson Creek to document the fish species composition and distribution. Three sites were electrofished in Carson 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.

DATA ANALYSIS

Data from the habitat inventory form are entered into Runtime, a DBASE 4.1 data entry program developed by the Department of Fish and Game. This program processes and summarizes the data.

The Runtime 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 Carson 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

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HABITAT INVENTORY RESULTS

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

The habitat inventory of June 15-17, 1992, was conducted by Chris Coyle and Jason Cleckler (CCC and contract seasonal). The total length of the stream surveyed was 4,846 feet, with an additional 87 feet of side channel.

Flow was not measured on Carson Creek.

Carson Creek is a C3 channel type for the first 2,985 feet from the confluence, then it changes to a B2 channel type for the remaining 1,861 feet of stream reach surveyed. C3 channels are low gradient (0.5-1.0%), meandering gravel bed streams. B2 channels are moderate gradient (1.0-2.5%), moderately confined, with stable stream banks.

Water temperatures ranged from 55 to 60 degrees fahrenheit. Air temperatures ranged from 59 to 76 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 39.0%, pools 36.8%, and flatwater 24.2% (Graph 1). Riffle habitat types made up 44.2% of the total survey **length**, flatwater 30.3%, and pools 25.5% (Graph 2).

Thirteen 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, 34.7%; mid-channel pools, 17.4%; and plunge pools, 14.7% (Graph 3). By percent total **length**, low gradient riffles made up 40.3%, step runs 16.4%, and mid-channel pools 13.0% (Table 2).

Seventy pools were identified (Table 3). Main channel pools were most often encountered at 51.4%, and comprised 61.3% 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. Twelve of the 70 pools (17%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 66 pool tail-outs measured, zero had a value of 1; 18 had a value of 2 (27.3%); 43 had a value of 3 (65.1%); and 5 had a value of 4 (7.6%). On this scale, a value of one is the 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 habitats had the highest shelter rating at 42.4. Riffle habitats followed with a rating of 36.3 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 43.2, main channel pools had a rating of 43.1, and backwater pools rated 30.0 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 51 of the 66 low gradient riffles (77.3%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 15.2% of the low gradient riffles (Graph 8).

Sixteen percent of the survey reach lacked shade canopy. Of the 84% of the stream covered with canopy, 43% was composed of deciduous trees, and 57% was composed of coniferous trees. Graph 9 describes the canopy in Carson 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 63.1%. The mean percent left bank vegetated was 58.5%. The dominant elements composing the structure of the stream banks consisted of 1.1% bedrock, 1.3% boulder, 1.1% cobble/gravel, 17.1% bare soil, 11.8% grass, 42.4% brush. Additionally, 5.5% of the banks were covered with deciduous trees, and 19.7% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three electrofishing sites were sampled on Carson Creek. The objective was to identify fish species and distribution. The units were sampled on June 30, 1992, by Chris Coyle and Craig Mesman (CCC). Each unit was end-blocked with nets to contain the fish within the sample reach. Three passes were conducted at each site, fork lengths (FL) measured and recorded, and the fish returned to the stream.

The first site sampled was habitat units 021-023, a pool/riffle/pool sequence, located approximately 696 feet above the creek mouth. The site had an area of 512.8 sq ft, and a volume of 230.8 cu ft. Nineteen steelhead were sampled, ranging from 34 to 60 mm FL.

The second site was habitat units 048-054, a riffle/run/pool sequence, located approximately 1,329 feet above the creek mouth. One steelhead was sampled, 45 mm FL.

The third site sampled was habitat units 080-082, a combination low gradient riffle, run, plunge pool, located approximately 2,205 feet from the confluence with Larabee Creek. This site had an area of 520.6 sq ft, and a volume of 303.1 cu ft. No fish were found.

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DISCUSSION

The surveyed reach of Carson Creek has two channel types: C3 and B2. The lower 2,985' of the survey reach is a C3 channel. C3 channels are meandering steam types on noncohesive gravel beds which have poorly consolidated and unstable stream banks. They are generally not suitable for instream enhancement structures. However, bank placed boulders, bank cover, overhead log cover and shelter structures in straight reaches are often appropriate. Any work considered will require careful design, placement, and construction that must include protection for the unstable banks.

The B2 channel type is excellent for many types of low and medium stage instream enhancement structures. There are 1,861 feet of this type of channel in Carson Creek. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and pool cover.

The water temperatures recorded on the survey days June 15-17, 1992 ranged from 55° F to 60° F. Air temperatures ranged from 59° F to 76° 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.

Riffle habitat types comprised 44.2% of the total **length** of this survey, flatwater 30.3%, and pools 25.5%. The pools are relatively shallow with only 12 of the 70 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. 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.

Forty-eight of the 66 pool tail-outs measured had embeddedness ratings of 3 or 4. Zero had a 1 rating. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In Carson 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 42.4. The shelter rating in the flatwater habitats was lower at 14.7. However, a pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by large woody debris in all habitat types. Additionally, boulders contribute a moderate 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.

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Sixty-one of the 66 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 84%. 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) Carson Creek should be managed as an anadromous, natural production stream.

2) There are log debris accumulations present on Carson Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully over time to avoid excessive sediment loading in downstream reaches.

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 woody cover in the pool and flatwater habitat units. Most of the existing cover is from large woody debris and boulders. Increasing high quality complexity with woody cover is desirable and in some areas the material is at hand.

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

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 Larabee Creek. Reach #1 is a C3 channel type.

219' Canyon 20' wide x 8' high, contributing fines and gravel into the channel. Log bridge 6'

wide x 30' long.

311' 1+ steelhead observed.

388' Right bank erosion 8' high x 15' long, contributing fines into the channel.

448' Left bank erosion 8' high x 20' long.

559' Old bridge site with armored bank and trestle footing.

696' Tributary enters from the right bank. Left bank scoured 5' high x 30' long.

720' Right bank scoured 6' high x 30' long, contributing fines into the channel.

774' Left bank undercut 4' high x 10' long, contributing fines into the channel.

959' Log and debris accumulation (LDA) 3' high x 12' long.

1060' LDA 40' wide x 20' long x 6' high, retaining gravel 15' wide x 50' long x 5' high. Reduced numbers of fish observed above this LDA.

1075' Left bank scoured 5' high x 25' long.

1177' Right bank erosion 40' high x 50' long. LDA 25' wide x 20' long x 5' high, retaining gravel 15' wide x 25' long x 4' high. Probable barrier.

1183' LDA 40' long x 1' high, diverting channel to the left bank.

1249' LDA 30' wide x 10' long x 6' high; no apparent barrier.

1301' LDA 20' wide x 10' long x 3' high, retaining gravel 20' wide x 75' long x 3' high. Possible barrier.

1329' Young-of-the-year steelhead (YOY) observed.

1480' Right bank erosion 7' high x 30' long.

1611' Left bank cut 7' high x 60' long.

1631' Right bank cut 7' high x 25' long.

1866' 1+ steelhead observed.

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2054' LDA with 2' diameter logs blocking the channel; possible barrier.

2065' No fish observed for the remainder of the survey.

2242' 4' high plunge, retaining gravel 10' wide x 75' long x 4' high; low water barrier.

2441' 4' diameter log sill, retaining gravel 15' wide x 75' long x 4' high; low flow barrier.

2688' LDA is diverting channel to the left bank, undercutting standing redwoods.

2837' LDA 30' wide x 10' long x 5' high, retaining gravel 20' wide x 50' long x 5' high; possible barrier.

2911' LDA 30' wide x 15' long x 10' high, retaining gravel 15' wide x 75' long x 4' high. Probable barrier.

2985' Channel type changes from a C3 to a B2 (reach #2).

3222' 3' high plunge, retaining gravel. Low flow barrier.

3375' LDA 25' wide x 15' long x 10' high, retaining some gravel. Probable barrier.

3527' LDA 15' wide x 10' long x 4' high, diverting channel to the left bank.

3582' LDA 25' wide x 10' long x 3' high, retaining gravel 20' wide x 2' high. Probable barrier.

3826' LDA 20' wide x 30' long x 6' high, retaining clean gravel. Channel is diverted to the left bank, causing erosion 20' high x 25' long.

3837' Tributary enters from the left bank.

3894' Beginning of V-shaped canyon. LDA retaining gravel 10' wide x 50' long x 2' high; low flow barrier.

3983' Right bank erosion from vertical canyon wall, contributing abundant clay and sand into the channel.

4169' LDA 25' wide x 68' long x 15' high, retaining gravel 20' wide x 15' high. Probable barrier.

4230' 5' diameter log, retaining gravel 15' wide x 8' high. Possible barrier.

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4499' LDA and boulder constriction, retaining gravel 10' wide x 2' high. Low flow barrier.

4562' Live redwood tree and logs on right bank being undercut. Could collapse and clog the channel.

4757' LDA 40' wide x 25' long x 9' high, retaining gravel 15' wide x 6' high. Probable barrier.

4846' Marginal fish habitat above tributary at 3837'. Poor gravel quality and quantity, and numerous LDAs. End of survey reach.