# STREAM INVENTORY REPORT

## BEAR CREEK

### INTRODUCTION

A stream inventory was conducted during the summer of 1991 on Bear 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 Bear 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 Bear Creek by the California Department of Fish and Game (DFG) from 1987 through 1992. The table below describes the results of those surveys:

Bear Creek Carcass Surveys 1987 - 92

| | Chinook Salmon | | | | Other | | |
|---|---|---|---|---|---|---|---|
| Year | # of Surveys | Live Fish | # of Carcass | Adipose ClipCWT | Redds seen | Coho seen | Unkn seen |
| 1987-88 | 3 | 37 | 13 | 0 | 2 | 1 | 1 |
| 1988-89 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989-90 | 3 | 14 | 7 | 0 | 16 | 0 | 4 |
| 1990-91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991-92 | 2 | 0 | 2 | 0 | 52 | 3 | 6 |

The drought related low flows during prime migration periods from 1989 through 1992 made Bear Creek, like many Eel River tributaries, inaccessible to most chinook salmon. The objective of this report is to document the current habitat conditions in Bear Creek, and recommend options for the enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

### WATERSHED OVERVIEW

Bear Creek is a tributary to the Eel River, located in Humboldt County, California. Bear Creek's legal description at the confluence with the Eel River is T1N R2E S32. Its location is

40°25'53" N. latitude and 123°58'50" W. longitude. Bear Creek is a third order stream. The total length of blue line stream, according to the USGS Scotia, Weott, Bull Creek, and Redcrest quadrangles is 3.9 miles.

Bear Creek drains a watershed of approximately 8.5 square miles. Redwood forest dominates the watershed. The watershed is owned by the Pacific Lumber Company and the State of California and is managed for timber production and as a state park. Vehicle access exists from U.S. Highway 101, via the Holmes/Redcrest exit. Approximately 0.75 miles west of Highway 101 on the Bear Creek road is a locked gate with access controlled by the Pacific Lumber Company.

## METHODS

The habitat inventory conducted in Bear Creek follows the methodology as presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds). The inventory was conducted by two person teams. 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). Bear 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 Bear 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". Bear 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 Bear 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 Bear 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 Bear 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 Bear 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 Bear Creek to document the salmonid species composition and distribution. Three sites were electrofished in Bear 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 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.

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 Bear 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 REPORT *

The habitat inventory of June 24-28, and July 1-3, 9, and 11, 1991, was conducted by Jay Miller, John Crittenden, and Steve Liebhardt (CCC). The total length of the stream surveyed was 18,024 feet, with an additional 1,471 feet of side channel.

Bear Creek is a B2 channel type for the first 15,349 feet from the confluence with the Eel River, then it changes to a B1 channel type for the remaining 2,675 of stream reach surveyed. B2 channels are moderate gradient (1.5-2.5%), moderately confined, with cobble/gravel streambeds. B1 channels have moderate gradients (2.5-4.0%), are moderately confined, and have boulder/cobble streambeds.

Water temperatures ranged from 52 to 57 degrees fahrenheit. Air temperatures ranged from 55 to 85 degrees fahrenheit.

Table 1 summarizes the riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 38.0%, flatwater types were 26.4%, and pools 35.4% (Graph 1). Riffles made up 48.9% of the total **length**, flatwater habitats were 30.3%, and pools 20.4% (Graph 2).

Sixteen habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffles, 34.1%; step runs, 14.5%; mid-channel pools, 14.2%; and runs, 11.1% (Graph 3). By percent total **length**, low gradient riffles made up 45.1%, step runs 21.3%, mid-channel pools 8.7%, and runs 8.2%.

Table 3 summarizes the pool habitat types. Main channel pools were the most commonly encountered pool type at 51.8%, followed by scour pools at 37.2%. Main channel pools and scour pools accounted for 57.1% and 36.1%, respectively, of the total pool length (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 100 of the 137 pools (73%) was two feet or deeper. This level indicates a good quality of pool habitat in Bear Creek.

The depth of cobble embeddedness was estimated at the pool tail-outs. Of the 133 pool tail-outs measured, 9 (6.8%) had a value of 1; 69 (50.8%) had a value of 2; 47 (36.4%) had a value of 3; and 8 (6.1%) 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 69.4 (Table 1). For the pool types, the backwater pools had the highest mean shelter rating at 89.7, main channel pools had a mean shelter rating of 69.9, and scour pools had a rating of 62.7 (Table 3).

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

Table 6 (Graph 8) describes the dominant substrate by habitat type. Small cobble was the dominant substrate observed in 54.5% of the low gradient riffles. Large cobble was the next most frequently observed dominant substrate type, and occurred in 34.9% of the 132 low gradient riffles.

Approximately 35% of Bear Creek lacked shade canopy. Of the 65% of the stream that was covered with canopy, 84% was composed of deciduous trees, and 16% was composed of coniferous trees. Graph 9 describes the canopy in Bear 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 68.4%. The mean percent left bank vegetated was 72.1%. The stream bank composition consisted of 2.5% bedrock, 3.5% boulder, 3.8% cobble/gravel, 1.0% bare soil, 0.5% grass, 0.3% brush, 68.0% deciduous trees, and 20.4% coniferous trees (Graph 10).

## BIOLOGICAL INVENTORY RESULTS

Three electrofishing sites were sampled on Bear Creek, on August 23, 1991 by Craig Mesman, Jay Miller, and Brian Humphrey (CCC). A total of 105 steelhead were sampled for all sites.

The first site sampled was habitat unit 46, a mid-channel pool, approximately 2,620' upstream from the confluence with the Eel River. The unit had an area of 300 sq ft and a volume of 480 cubic feet. Twenty-two steelhead were sampled, ranging from 47

to 136 mm fork length. One sculpin was also observed but not measured.

The second site was habitat unit 105, a mid-channel pool, approximately 5,698' from the confluence with the Eel River. The unit had an area of 672 sq ft and a volume of 1,478.4 cubic feet. Forty-six steelhead were sampled. They ranged from 45 to 160 mm fork length.

The third site was habitat unit 172, a log enhanced lateral scour pool, approximately 9,613' from the confluence with the Eel River. Habitat unit 172 had an area of 1,044 sq ft and a volume of 1,879.2 cubic feet. Thirty-seven steelhead were sampled. They ranged from 36 to 198 mm fork length.

## GRAVEL SAMPLING RESULTS

No gravel samples were taken on Bear Creek.

## DISCUSSION

Bear Creek has two channel types: B1 and B2. Both the B1 and B2 channel types are excellent for many types of low and medium stage instream enhancement structures. Many site specific projects can be designed within these channel types, especially to increase pool frequency, volume and pool cover.

The water temperatures recorded on the survey days ranged from 52 F to 57 F. Air temperatures ranged from 55 F to 85 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 30.3% of the total **length** of this survey, riffles 48.9%, and pools 20.4%. The pools are relatively deep with 100 of the 137 pools having a maximum depth of two feet or greater. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, 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.

Fifty-five of the 133 pool tail-outs measured had embeddedness ratings of 3 or 4. Nine had a 1 rating. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In Bear 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 moderate with a rating of 36.1. The shelter rating in pools was better at 69.4. 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 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.

Eighty-one of the 132 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 65%. This is a relatively 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) Bear 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. Most of the existing cover is from large woody debris. Adding high quality complexity with additional woody cover is desirable, and in many reaches the material is nearby.

4) There are several log debris accumulations present on Bear Creek that are retaining fine sediment. The modification

of many of these debris accumulations is desirable.

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.

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' | Survey begins at the confluence with the Eel River. Reach #1 is a B2 channel type. |
| 249' | Concrete bridge on the Avenue of the Giants is 30' wide x 52' long x 55' high crosses the channel. |
| 273' | Highway 101 bridge 50' wide x 77' long x 55' high crosses the channel. |
| 994' | Left bank undercut 30' long x 20 high, depositing fines and gravel into the channel. |
| 1368' | CCC flag site #1, 3/8/88. |
| 1579' | Left bank erosion 6' high x 20' long, contributing fines and gravel into the channel. |
| 1658' | Left bank erosion 6' high x 20' long, contributing fines and gravel into the channel. |
| 1698' | Log and debris accumulation (LDA) 15' wide x 40' long x 6' high. CCC flag site #2, 3/8/88. |
| 2229' | YOY observed. |
| 2715' | Left bank erosion 4' high x 20' long, contributing cobble and gravel into the channel. |
| 2790' | LDA 50' wide x 20' long x 10' high. |
| 3164' | Right bank bare soil area 20' high x 40' long. |

| | |
|---|---|
| 3224' | Right bank erosion 3' high x 20' long, contributing cobble and gravel into the channel. |
| 3264' | Left bank erosion 6' high x 40' long, contributing cobble, gravel, and fines into the channel. |
| 3966' | CCC flag site #8, 3/8/88. Log weir with water flowing under it. |
| 4166' | Installed log weir is in need of repair. |
| 4264' | LDA 10' wide x 10' long x 3' high. |
| 4760' | CCC flag site #11, 3/9/88. |
| 4965' | An old bridge is in the channel and has created pool habitat. |
| 5334' | Installed log weir in need of repair. |
| 5948' | LDA 20' wide x 10' long x 15' high on the left bank. |
| 7565' | Dysfunctional log weir. |
| 7740' | Dysfunctional log weir. |
| 7826' | LDA 10' wide x 25' long x 10' high, on the left bank. |
| 8013' | Bank erosion 5' high x 20' long, contributing fines, cobble, and gravel into the channel. |
| 8041' | Tributary enters from the left bank. |
| 8188' | LDA 20' wide x 10' long x 4' high. |
| 8584' | LDA 55' wide x 40' long x 6' high. |
| 8584' | LDA 30' wide x 10' long x 5' high. |
| 9142' | LDA 20' wide x 24' long x 5' high. |
| 9743' | YOY and four 1+ steelhead observed. |
| 9820' | Tributary enters the channel. |
| 10295' | LDA 40' wide x 15' long x 10' high. |
| 10426' | LDA 7' wide x 25' long x 6' high. |

10535' LDA 20' wide x 40' long x 5' high.

10681' LDA 50' wide x 80' long x 5' high.

10906' LDA 30' wide x 20' long x 4' high.

10958' Right bank erosion 4' high x 25' long.

11228' Tributary enters from the left bank.
11383' LDA 35' wide x 10' long x 15' high.

11537' LDA 20' wide x 20' long x 4' high.

11600' LDA 40' wide x 10' long x 6' high.

11635' LDA 20' wide x 15' long x 5' high.

12539' LDA 30' wide x 20' long x 15' high.

13328' Horizontal metal culvert on the right bank.

13413' LDA 30' wide x 130' long x 5' high, causing side channels and pools.

13499' LDA 30' wide x 15' long x 6' high.

13795' Left bank erosion 20' high x 20' long, depositing fines and gravel into the channel.

13990' Tributary enters from the right bank.

14461' Left bank erosion 5' high x 5' long, contributing cobble and boulder into the channel.

14528' LDA 30' wide x 15' long x 11' high.

14790' LDA 20' wide x 10' long x 5' high.

14992' 2' high plunge.

15125' LDA 20' wide x 15' long x 6' high.

15349' Channel changes from a B2 to a B1 channel type (reach #2).

15387' LDA 20' wide x 15' long x 5' high.

15459' LDA 20' wide x 40' long x 6' high.

15876' Tributary (fork) enters from the right bank.

16325' LDA 100' wide x 80' long x 7' high, retaining gravel 16' wide x 20' long x 1' high. 4' high plunge.

16581' LDA 20' wide x 40' long x 6' high.

16895' Tributary enters from the left bank.

17319' 5' high plunge onto large woody debris; possible barrier.

17332' LDA 10' wide x 30' long x 7' high.

17380' LDA 30' wide x 60' long x 15' high; 12' high plunge.

17570' Left bank erosion 40' high x 70' long, contributing boulders, cobble, and gravel into the channel.

17730' Right bank bare soil area 10' high x 10' long, contributing gravel and silt into the channel.

17751' LDA 10' wide x 25' long x 4' high.

17791' Steelhead/rainbow trout (SHRB) YOY observed.

17902' LDA 90' wide x 35' long x 10' high.

17979' Log jam covered with cobble and gravel. Flow is beneath this log jam.

18024' Stream flow is intermittent; end of survey.