STREAM INVENTORY REPORT

Bell Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1991 on Bell 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 Bell 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 Bell Creek. The objective of this report is to document the current habitat conditions, and recommend options for the enhancement of habitat for coho salmon and steelhead trout.

WATERSHED OVERVIEW

Bell Creek is a tributary to Lawrence Creek, a tributary to Yager Creek, a tributary to the Van Duzen River, a tributary to the Eel River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Figure 1). Bell Creek's legal description at the confluence with Lawrence Creek is T03N R02E S04. Its location is 40.6733 degrees north latitude and 123.9564 degrees west longitude. Bell Creek is a second order stream. The total length of blue line stream, according to the USGS Iaqua Buttes quadrangle is 4.2 miles. Bell Creek drains a watershed of approximately 4.7 square miles. Elevations range from about 1,120 feet at the mouth of the creek to 2,500 feet in the headwater areas. Redwood forest, Douglas fir forest and mixed hardwood forest dominate the watershed. The watershed is owned by the Pacific Lumber Company and other private interests, and is managed for timber production. Year round vehicle access exists from State Highway 36 near Carlotta, via Fisher Road, to Pacific Lumber Company's Yager Camp. The main Yager-Lawrence Haul Road leads to Road Nine and Bell Creek, 14 miles from Yager Camp.

METHODS

The habitat inventory conducted in Bell Creek follows the methodology as presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds). 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). Bell Creek personnel were trained in May and June, 1991, by Gary Flosi and Scott Downie. This inventory was conducted by a two person team.

Bell Creek

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 Bell 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". Bell 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 Bell 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 Bell 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 Bell 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 Bell 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.

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*.

Bell Creek

Biological inventory was conducted in Bell Creek to document the salmonid species composition and distribution. Two sites were electrofished in Bell Creek using one Smith Root Model 12 electrofisher. 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 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 Bell 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 September 9 through September 10, 1991 was conducted by Shea Monroe and Jerry Suissa (CCC). The total length of the stream surveyed was 4,171 feet.

Flow was not measured on Bell Creek.

Bell Creek is an A3 channel type for the entire stream reach surveyed. A3 channels are steep (4-10% gradient), very well confined, coarse-grained streams, with erodible stream banks.

Water temperatures ranged from 56 to 59 degrees Fahrenheit. Air temperatures ranged from 63 to 72 degrees Fahrenheit.

Table 1 summarizes the riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 41%, flatwater 40%, and riffles 15% (Graph 1). Flatwater made up 57% of the total length of the survey, pools 27%, and riffles 15% (Graph 2).

Ten habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent occurrence were mid-channel pools, 31%; step runs, 27%; and low gradient riffles, 16% (Graph 3). By percent total length, step runs made up 47%, mid-channel pools 21%, and low gradient riffles 15%.

Table 3 summarizes the pool habitat types. Of these pools, 76% were main channel pools. These main channel pool types comprised 79% 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 27 of the 29 pools (93%) was two feet or deeper. This level indicates a good quality of pool habitat in Bell Creek.

The depth of cobble embeddedness was estimated at the pool tail-outs. Of the 27 pool tail-outs measured, one had a value of 1 (4%); seven had a value of 2 (26%); 16 had a value of 3 (59%); and three had a value of 4 (11%). 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 46 (Table 1). For the pool types, the backwater pools had the highest mean shelter rating at 53. Main channel pools had a mean shelter rating of 50. Scour pools had a mean shelter rating of 30 (Table 3).

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

Table 6 (Graph 8) describes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 46% of the low gradient riffles. Large cobble was the next most frequently observed dominant substrate type, and occurred in 27% of the 11 low gradient riffles.

Approximately 31% of Bell Creek lacked shade canopy. Of the 69% of the stream that was covered with canopy, 66% was composed of deciduous trees, and 34% was composed of coniferous trees. Graph 9 describes the canopy in Bell 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 70%. The mean percent left bank vegetated was 76%. The elements composing the structure of the stream banks consisted of 21% bedrock, 21% brush, 9% grass, and 1% boulders.

Additionally, 37% of the banks were composed of deciduous trees, and 10% of coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on Bell Creek on September 16 and 19, 1991 by Shea Monroe, Erick Elliot, and Brian Humphrey (CCC). A total of sixty steelhead/rainbow trout were sampled at the three sites.

The first site sampled was Habitat Unit #002, a glide, approximately 63 feet above the confluence with Lawrence Creek and just below an 8 to 10 foot high plunge. The unit had an area of 150 square feet and a volume of 105 cubic feet. Forty-five steelhead/rainbow trout were collected. They ranged from 35 mm to 78 mm long.

The second sample site was Habitat Unit #004, a corner pool, approximately 105 feet above the confluence with Lawrence Creek, and just above an 8 to 10 foot high plunge. The unit had an area of 480 square feet and a volume of 672 cubic feet. Two steelhead/rainbow trout were collected. They ranged from 43 mm to 62 mm long.

The third site sampled was a mid-channel pool, approximately 13,000 feet upstream from the confluence with Lawrence Creek, and 8,800 feet above the survey reach. This is also above numerous quite large debris accumulations surveyed. Thirteen steelhead/rainbow trout were collected. They ranged from 73 mm to 144 mm long.

DISCUSSION

A3 channel types are generally not suitable for fish habitat improvement structures. A3 channels are found in high energy, steep gradient stream reaches. These channels are dominated by coarse-grained materials, do not retain gravels very well, and have unstable stream banks. Usually within the A3 channel there are zones of lower gradient where structures designed to trap gravels, if needed, can be constructed. This seems to be the case in Bell Creek, but any structure sites must be selected with care because of the high stream energy which can create problems with stream bank erosion and structure stability.

The water temperatures recorded on the survey days September 9 through September 10, 1991 ranged from 56 to 59 degrees Fahrenheit. Air temperatures ranged from 63 to 72 degrees Fahrenheit. This is a very good water temperature regime for salmonids. However, to make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 57% of the total length of this survey, riffles 15%, and pools 27%. The pools are relatively deep with 27 of the 29 pools having a maximum depth greater than two 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 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.

Nineteen of the 27 pool tail-outs measured had embeddedness ratings of 3 or 4. Only one had an embeddedness rating of 1. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In Bell Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for flatwater habitats was relatively low with a rating of 39. The shelter rating in the pools was slightly better at 46. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, large and small woody debris contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

Six of the 11 low gradient riffles had gravel or small cobble as the dominant substrate. This is acceptable to spawning salmonids.

The mean percent canopy for the stream was 69%. This is a relatively high percentage of canopy, since 80% is generally considered desirable. In areas of stream bank erosion the planting of endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Bell Creek should be managed as an anadromous, natural production stream.

2) Due to the high gradient and many LDA in the stream, access for migrating salmonids is an ongoing potential problem. The cascade 115' above the mouth is probably at least a selective barrier for adults, and it can be modified relatively easily. Since good water temperature and flow regimes exist in the stream, and it offers good conditions for rearing fish, fish passage should be monitored and improved where possible.

3) 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.

4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable and in some areas the material is at hand.

5) There are several log debris accumulations present on Bell Creek that are retaining large quantities of fine sediment. They also are creating selective barriers to migrating adult salmonids. The modification of these debris accumulations is desirable, but must be done over time and in a manner that will not release an overabundance of fine sediment into the system.

6) 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.

7) 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.

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.

Position (ft):	Comments:
0'	Start of survey at the confluence with Lawrence Creek. Channel type is A3 for the entire stream reach surveyed.
115'	8-10' high plunge over bedrock.
299'	Log debris accumulation (LDA) measures 15' high x 40' wide x 20' long. It is retaining gravel.
462'	LDA measures 5' high x 30' wide x 5' long. It is retaining gravel.
830'	2.5’ high plunge over bedrock with right bank overflow channel.
1095'	Channel is braided, with 60% exposed boulders.
1202'	LDA measures 15' high x 50' wide x 15' long and is retaining gravel.
1573'	Left bank slump measures 70' long x 30' high and is contributing fir and alder trees into the channel.
1916'	LDA measures 7' high x 40' wide x 15' long.

Bell Creek

2044'	LDA along the left bank measures 12' high x 15' long x 35' wide and is retaining gravel.
2804'	LDA measures 15' high x 40' wide x 15' long and is retaining gravel.
2864'	LDA measures 15' high x 40' wide x 15' long.
3079'	LDA measures 15' high x 70' wide x 15' long and is retaining gravel. Channel is dry for 50'.
3094'	LDA measures 15' high x 50' wide x 20' long and is retaining gravel. Channel is dry for 30'.
3383'	LDA measures 10' high x 10' wide x 40' long and is retaining gravel.
3442'	LDA meaures 6' high x 40' wide x 10' long and is retaining gravel.
3536'	Tributary enters from the right bank.
3665'	LDA measures 10' high x 40' wide x 10' long and is retaining gravel.
3937'	LDA measures 15' high x 30' wide x 12' long and is retaining gravel.
4171'	Only two fish have been observed since 1,100'. End of survey.