STREAM INVENTORY REPORT

BULL CREEK (UPPER REACH)

INTRODUCTION

A stream inventory was conducted during the summer of 1991 on Bull 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 Bull Creek. The objective of the biological inventory was to document the salmonid species present and their distribution in the stream. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

Adult spawning surveys conducted in December 1987, January 1988, December 1988, and January 1990, documented chinook salmon, coho salmon, and steelhead trout in Bull Creek. 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

Bull Creek is tributary to the South Fork Eel River, tributary to the Eel River, located in Humboldt County, California (Figure 1). The legal description at the confluence with the South Fork Eel River is T1S R2E S34. Bull Creek is a fourth order stream. The total length of blue line stream, according to the USGS Bull Creek and Weott 7.5 minute quadrangles is 21.2 miles. Bull Creek drains a watershed of approximately 38.1 square miles. Summer base flow is approximately 2-3 cfs at the mouth, but over 5,000 cfs is not unusual during winter storms. Elevations range from about 160 feet at the mouth of the creek to 3,000 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is owned by the State of California and is managed as a state park. Vehicle access exists from U.S. Highway 101, via the Bull Creek Road exit. This road accesses the mouth of Bull Creek and parallels the stream channel, crossing the creek four times.

METHODS

The habitat inventory conducted in Bull Creek follows the methodology presented in the California Salmonid Stream Habitat

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

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 the upper reach of Bull 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 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. 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". Bull 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:

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 Bull 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 Bull 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 Bull Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The percentage 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 Bull 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 Bull Creek to document the salmonid species composition and distribution. Three sites were electrofished in Bull 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 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 Habtabs, a dBASE 4.1 program in development by DFG.

The Habtabs 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 the upper reach of Bull 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 July 11, 12, 15, 17, 18, 19, 22, and 23, 1991, was conducted by Craig Mesman and Tony Sartori (CCC). The total length of the main stream surveyed was 19,447 feet, with an additional 868 feet of side channel. The survey began 9.8 miles above the mouth of Bull Creek.

Flows were not measured on this reach of Bull Creek.

The upper section of Bull Creek has four channel types: for the lower 3,924 feet of the survey reach it is a B1; the next 991' a B2; next 631' a C2; next 7,268, a B2; next 3,721' a C3; next 349' a B2; and the upper 2,563 feet a B1. B1 channels are moderate gradient (2.5-4.0%), moderately confined boulder/large cobble channels. B2 channels are moderate gradient (1.0-2.5%), moderately confined, large cobble/boulder channels. C2 channels are low gradient (< 1%), moderately confined streams, with stable stream banks. C3 channels are low gradient (< 1%), meandering gravel bed channels.

Water temperatures ranged from 57 to 71 degrees fahrenheit. Air temperatures ranged from 66 to 85 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, flatwater types made up 40.7%; riffles made up 38.9%; and pools 20.5% (Graph 1). Flatwater habitat types made up 48.0% of the total survey **length**, riffles were 38.3%, and pools 13.8% (Graph 2).

Nineteen 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, 29.5%, step runs, 17.4%, and runs, 16.8% (Graph 3). By percent total **length**, low gradient riffles made up 32.2%, step runs 28.8%, and runs 13.6% (Table 2).

Seventy-nine pools were identified (Table 3). Scour pools were most often encountered at 53.2%, and comprised 54.9% 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. Fifty-four of the 79 pools (68.4%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 78 pool tail-outs measured, one had a value of 1 (1.3%); H26 had a value of 2 (33.8%); 30 had a value of 3 (39.0%); and 21 had a value of 4 (26.0%). 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. Riffles had the highest shelter rating at 58.4. Flatwater habitats followed with a rating of 45.8 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 60.0, scour pools had a rating of 37.0, and main channel pools rated 35.6 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in the upper reach of Bull Creek and are extensive. Root mass is the next most commonly occurring cover type. Graph 7 describes the pool cover in Bull Creek.

Table 6 summarizes the dominant substrate by habitat type. Boulder was the dominant substrate observed in 39 of the 114 low gradient riffles (34.2%). Gravel was the next most frequently observed dominant substrate type, and occurred in 27.2% of the low gradient riffles (Graph 8).

Fifty-three percent of the survey reach lacked shade canopy. Of the 47% of the stream covered with canopy, 90% was composed of deciduous trees, and 10% was composed of coniferous trees. Graph 9 describes the canopy in Bull 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 66.9%. The mean percent left bank vegetated was 59.5%. The dominant elements composing the structure of the stream banks consisted of 3.4% bedrock, 3.9% boulder, 3.4% cobble/gravel, 8.1% bare soil, 8.9% grass, 1.8% brush. Additionally, 66.7% of the banks were covered with deciduous trees, and 3.9% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three electrofishing sites were sampled on Bull Creek. The objective was to identify fish species and distribution. The

units were sampled on July 24 and 25, 1991, by Toni Sartori and Craig Mesman (CCC). Each unit was end-blocked with nets to contain the fish within the sample reach. The fork lengths (FL) were measured and recorded, and the fish returned to the stream.

The first unit sampled was habitat unit 157, a glide, approximately 20,450 feet from the confluence with the South Fork Eel River. This site had an area of 8,750 sq ft, and a volume of
7,875 cu ft. The unit yielded six sculpin and two stickleback. One steelhead YOY was also observed but not caught.

The second sample unit was habitat unit 362, a mid-channel pool, located near the State Park shooting range approximately 49,614 feet (9.4 miles) above the creek mouth. This site had an area of 459 sq ft, and a volume of 688.5 cu ft. The unit yielded eleven steelhead, ranging from 40 to 160 mm FL, and four sculpin.

The third unit sampled was habitat unit 644, a plunge pool, located approximately 64,820 feet (12.3 miles) above the creek mouth. The site had an area of 336 sq ft, and a volume of 168 cu ft. The unit yielded 27 steelhead, ranging from 35 to 126 mm FL, and one Pacific lamprey ammocete, 76 mm in length.

GRAVEL SAMPLING RESULTS

McNeil sediment samples were taken December 6, 1991, by Greg Moody, Scott Downie, and Gary Flosi at habitat unit 165, stream mile (SM) 4.2, and just above the Big Trees foot bridge across Bull Creek. The 2 samples from the site had a combined mean of 43% for fine sediments < 4.7 mm. The combined mean of sediments < 0.86 mm in the samples is 29%. These are above threshold levels for optimum salmonid egg and embryo incubation. Table 7 describes the percentage of fines in the McNeil sediment samples by sample and particle size. The last column describes the total percentage of all fines < 4.7 mm.

DISCUSSION

Upper Bull Creek has four channel types: B1, B2, C1 and C2. Both B1 and B2 channel types are excellent for many types of low and medium stage instream enhancement structures. There are 12,532 feet of these channel types in Upper Bull Creek, along with a plenitude of LOD either in or nearby the stream. Many site specific projects can be designed within these channel types, especially to increase pool frequency, volume and cover.

There is also 631' of C2 channel type in the survey reach. C2

channels have suitable gradients and the stream bank stability 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 structures are usually appropriate and have a good chance of success in these channel types.

Additionally, 3,721' of the survey reach is a C3 channel. C3 channels are meandering steam types on uncohesive 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 water temperatures recorded on the survey days ranged from 57 F to 71 F. Air temperatures ranged from 66 F to 85 F. Temperatures of 71 F, if sustained, are above the threshold stress level for salmonids. 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 48.0% of the total **length** of this survey, riffles 38.3%, and pools 13.8%. The pools are relatively deep with 54 of the 79 pools (68.4%) 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 threaten the stream banks with erosion.

Fifty-one of the 78 pool tail-outs measured had embeddedness ratings of 3 or 4. Only one 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 Bull 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 relatively low with a rating of 36.7. The shelter rating in the riffles was better at 58.4. 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, root wads contribute a small amount. Large woody debris 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.

Fifty-one of the 114 low gradient riffles had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. However, there is also a high level of fine sediment < 0.86 mm in the substrate, if our McNeil samples are an accurate measure of the substrate composition.

The mean percent canopy for upper Bull Creek was 47.1%. This is a relatively low 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) Bull 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 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.

4) The log debris accumulation at 16,884' should be maintained to insure access to the unnamed tributary, and to gradually release fine sediments stored behind the LDA.

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.

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 and its tributaries.

8) The culvert in the stream channel at 19,185' should be removed, and the log deflectors at 12,825 maintained.

9) A great deal of alder and willow have been planted in this

section of the stream. Stream temperatures indicate that more are needed. Humboldt Redwoods State Park require that native stocks must be used for stocking. The cooperative effort with the Department of Forestry nursery needs to move forward and include stocks from Bull Creek basin.

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 upper Bull Creek, 51,632 feet (9.8 miles) from the stream's mouth. At this point, just above the third Bull Creek Road bridge, the creek changes from an A2 to a B1 channel type.
542'	Debris flow on the left bank 450' high x 160' long.
950'	Vertical bank erosion on the right bank 60' high x 230' long.
1239'	Bedrock toe on the right bank 100' long, contributing sediment into the channel.
1875'	Left bank consists of a shale bank 40-80' high x 180' long.
2172'	Left bank erosion 15' high x 55' long.
2662'	Bank erosion 30' high x 200' long, composed of a vertical shale bank with a bedrock toe.
2909'	Small tributary enters from the left bank.
3797'	Tributary enters from the right bank.
3924'	Channel changes from a B1 to a B2 channel type.
4389'	Right cutbank 50' high x 40' long.
4915'	Channel changes from a B2 to a C2 channel type.
4984'	Island 20' wide x 283' long with alder growth, creates a side channel.

5546' Channel changes from a C2 to a B2 channel type.

5680' Right cutbank 5' high x 200' long, creates a terrace.

6022' Erosion behind rootmass on the left bank 10' high x 30' long.

6616' Left cutbank 10-30' high x 218' long, behind a row of grass and small alders.

7142' Overflow channel 200' long to the left of main channel.

7532' Overflow channel 100' long to the left of main channel.

8088' Overflow channels 300' long on the left and right of main channel. Right overflow is fed by a tributary that crosses Bull Creek Road near Bull Creek Camp.

8324' Pool formed by root wad and debris accumulation. 9" fish observed.

8408' Three to five 2' diameter logs buried in the mid-channel.

8513' Left cutbank 10' high x 167' long, behind root wad and row of alders.

9036' Alluvial terrace composed of cobble and gravel on the right bank, 6' high x 80' wide x 450' long. Needs to be planted with alder.

9096' Exposed area of "blue goo" 15' high x 20' long. YOY and 1+ steelhead observed.

9946' Overflow channel to the left of main channel.

10006' Left bank composed of bedrock/shale with some fines, 30' high x 80' long.

10376' Right bank composed of bedrock/shale 7-10' high x 70' long.

10474' Overflow channel to the left of main channel. Three foot rusted culvert at the end of this unit on the left.

10914' YOY observed.

11151' Road crosses stream, but now blocked by boulders.

11356' Left bank composed of bedrock/shale with some fines

15' high x 118' long. Bedrock toe one foot high.

11513' Panther Gap road crosses creek.

11598' Panther Creek enters from the left bank. YOY observed in both forks of Panther Creek.

11639' Left bank is composed of bedrock toe with fines above it 10' high x 60' long.

11793' Right bank is composed of boulders from previous heavy equipment work. Boulder bank is 130' long.

12089' Sparse canopy for the next 360'.

12192' Preacher Gulch enters from the right bank.

12247' Left bank "blue goo" slide 40' high x 100' long, fifty percent covered with grass.

12348' Pool water temperature was 71 degrees fahrenheit at 1400 hours.

12401' Two 4' high log deflectors on the left bank.

12415' YOY and 1+ steelhead observed.

12449' Left bank slide 300' long, partially revegetated. Top half of right bank is a grass covered slope and terrace 20' high. There is a barn on the flat.

12688' Road access.

12814' Channel changes from a B2 to a C3 channel type.

12829' Log deflectors on the bank; need maintenance.

13390' Boulder riprap on the right bank.

13546' Left cutbank 15' high x 40' long, with no vegetation at the bottom.

13713' Left cutbank 15' high.

14100' Right cutbank 15' high x 30' long, vegetated with grass.

14425' Left cutbank 20' high. Tributary enters from the right bank.

15218' YOY observed.

15824' Left cutbank 15' high x 119' long.

16031' Ephemeral tributary enters from the right bank.

16296' Right cutbank 5' high x 240' long, revegetated with alder at the toe.

16432' Left cutbank 15-20' high x 120' long.

16535' Channel changes from a C3 to a B2 channel type.

16658' Right cutbank 20' high x 124' long, well vegetated with alder and redwood at the toe. YOY observed.

16884' Channel changes from a B2 to a B1 channel type. Unnamed tributary enters from the left bank. Log and debris accumulation (LDA) 50' wide x 30' long x 10' high 300' upstream in the tributary. YOY observed above this LDA.

16964' YOY observed.

17204' Left cutbank 6' high x 70' long.

17303' Left cutbank 20' high x 70' long, composed of shale.

17621' Tributary enters from the right bank. Tributary runs parallel to Bull Creek for 150' on gravel floodplain.

17702' Left cutbank 50' high behind 20' wide strip of grass and alders.

18262' Left cutbank 15' high x 29' long.

18456' Stream channel is very confined for the next 300'. Both banks are composed of a 3-10' wide strip of grass and alders, with bare soil area above the vegetation.

18744' Left cutbank 6' high x 40' long.

19042' Culvert on the right bank 10' high.

19185' Plunge pool with 2' high plunge over culvert lying across the channel. Needs maintenance.

19386' Tanbark Road bridge. Wooden bridge is 15' long x 15' wide x 9' high, with concrete supports 33' long x 15' wide.

19447' End of survey. YOY observed.