STREAM INVENTORY REPORT

BULL CREEK (LOWER 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 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). Bull Creek personnel were trained in May and June, 1991, by Gary Flosi and Scott Downie. This inventory was conducted by two person teams.

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 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. Flows should also be measured 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. 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

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 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 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 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.

SUBSTRATE SAMPLING

Gravel sampling is conducted using either a 6 or 9 inch diameter standard McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream.

Gravel samples are separated and measured to determine respective percent volume using five sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85 mm). During field analysis, fine sediment suspended in the liquid portion of the sample is settled in Imhoff cones for one hour, measured, and recorded on a standard field form. The remainder of the sample is sealed in plastic bags with an identification and information ribbon, then taken to the laboratory for final processing.

In the laboratory the samples are wet sieved using standard Tyler screens. All particles greater than 0.85 mm diameter are measured by displacement in graduated cylinders. The volume of fine sediment less than 0.85 mm is measured following one hour of settling in graduated cylinders or Imhoff cones. The fines measured in the field are added to these results.

Gravel sampling is conducted to determine the percentage of fine

sediment present in probable fish spawning areas. These areas are generally found in low gradient riffles, at the tail-out of a pool, in the thalweg. The higher the percent of fine sediment, the lower the probability for eggs to survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and preventing fry emergence.

DATA ANALYSIS

Data from the habitat inventory form is entered into Habtype, a DBASE 3+ data entry program developed by the Department and Fish and Game. From Habtype, the data is summarized by Habtab, a dBASE 4.1 program in development by DFG.

The Habtab program produces the following summary tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for the lower 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 June 21, 24-28, and July 1-3, 1991, was conducted by Shea Monroe, Jerry Suissa, Chris Coyle, and Craig Mesman, (CCC). The length of the lower Bull Creek survey was 45,583 feet, with an additional 2,416 feet of side channel.

Flow was estimated to be 2-3 cfs during the survey period.

This lower section of Bull Creek has three channel types: from the mouth to 30,472 a C1; next 14,699 feet a D1; and the upper 412 feet a C2. C1 channels are low gradient, meandering streams, with cobble beds and developed flood plains. D1 channels are moderate gradient (> 1.0%), braided, coarse grained channels. C2 channels are low gradient (0.3-1.0%), moderately confined, with cobble streambeds.

Water temperatures ranged from 54 to 72 degrees fahrenheit. Air temperatures ranged from 55 to 84 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles make up 40.3%, flatwater types make up 47.1%, and pools make up 12.6% (Graph 1). Riffles make up 54.3% of the total survey **length**, flatwater habitats make up 39.9%, and pools make up 5.8% (Graph 2).

Twelve 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, 39.4%, glides, 27.1%, and runs, 15.5% (Graph 3). By percent total **length**, low gradient riffles made up 54.0%, glides made up 27.2%, and runs made up 7.8%.

Only thirty-nine pools were identified (Table 3). Main channel pools were the most commonly encountered pool type at 69.2%, followed by scour pools at 30.8%. Main channel pools and scour pools accounted for 72.3% and 27.7%, respectively, of the total pool length (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Twenty-eight of the 39 pools (72%) had a depth of three feet or greater. The remaining 11 pools had depths between 2 and 3 feet (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 38 pool tail-outs measured, one had a value of 1 (2.6%); 20 had a value of 2 (52.6%); 17 had a value of 3 (44.7%). There were no value four units. 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 38.9 (Table 1). For the pool types, the scour pools had the highest mean shelter rating at 43.8, and main channel pools had a mean shelter rating of 36.7 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in the lower reach of Bull Creek.

Large woody debris is the next most common cover type. Graph 7 describes the pool cover in the lower reach of Bull Creek.

Table 6 describes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 54.1% of the low gradient riffles. Small cobble was the next most frequently observed dominant substrate type, and occurred in 30.3% of the 122 low gradient riffles (Graph 8).

Nearly 76% of lower Bull Creek lacked shade canopy. Of the 24% of the stream that was covered with canopy, 85% was composed of deciduous trees, and 15% was composed of coniferous trees. Graph 9 describes the canopy in the survey reach.

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 75.0%. The mean percent left bank vegetated was 77.6%. The dominant elements composing the stream banks consisted of 1.6% bedrock, 28.9% boulder, 6.4% cobble/gravel, 2.3% bare soil, 6.1% grass, 1.6% brush. Additionally, 29.9% of the banks were covered with deciduous trees, and 23.2% 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 Tony Sartori and Craig Mesman (CCC). Each unit was end-blocked with nets to contain the fish within the sample reach, fork lengths (FL) of the salmonids were measured and recorded, and all 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 total 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

The lower reach of Bull Creek has three channel types: C1, D1, and C2. There are 30,884 feet of C1 and C2 channel types in lower Bull Creek. Both C1 and C2 channels have suitable gradients and the stable stream banks 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.

There is also 14,699' of D1 channel in the survey reach. D1 channels have moderate gradients and braided channels that are generally not suitable for instream structures. In these stream reaches, establishing stable vegetated banks that will serve to confine the channel are a first step to restoration and must be very carefully engineered to succeed.

The water temperatures recorded on the survey days ranged from 54° F to 72° F. Air temperatures ranged from 55° F to 84° F. The warmer water and air temperatures were recorded in the upper half of the survey reach. These water temperatures, if sustained, are above the threshold stress level for salmonids. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 39.9% of the total **length** of this survey, riffles 54.3%, and pools only 5.8%. The pools are relatively deep with 28 of the 39 pools having a maximum depth

greater than 3 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 pool habitat is recommended for locations where their installation will not jeopardize any unstable stream banks, or subject the structures to high stream energy.

Seventeen of the 38 pool tail-outs measured had an embeddedness rating of 3; none had a rating of 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 lower reach of Bull Creek, and its tributaries, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken where feasible.

The mean shelter rating for pools was low with a rating of 38.9. The shelter rating in the flatwater habitats was even lower at 21.4, and riffles rated only 11.4. However, a 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 divides territorial units to reduce density related competition.

One hundred three of the 122 low gradient riffles had either 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 the survey reach was only 24%. This is a very low percentage of canopy, since 80 percent is generally considered desirable. The elevated water temperatures in lower Bull Creek could be reduced by increasing stream canopy. The large trees required to contribute shade to the wide channels typical of this reach would also eventually provide a long term source of large woody debris needed for instream structure.

RECOMMENDATIONS

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

2) Temperatures in this section of Bull Creek, as well as upstream, should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

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) Where feasible, increase woody cover in the pool and flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations. In some areas the material is at hand.

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.

7) Increase the canopy on Bull Creek by planting native willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this inventory section must be treated as well, since the water being delivered here is being warmed above. In many cases, planting will need to coordinated to follow bank stabilization or upslope erosion control projects.

8) Beginning in the upper reaches and tributaries, sections like the D1 reach in this lower part of Bull Creek, should have channel confinement projects designed and constructed. These must include scour designs that will increase the extremely low amount of pool habitat, provide woody cover for pool and flatwater habitat, and establish riparian vegetation to create long term stability and cover supply.

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'	Confluence of Bull Creek and South Fork Eel River. Begin inventory. C1 channel type (reach 1).
575'	Young of the year (YOY) steelhead observed.
2326'	Man-made boulder barrier on the right bank; needs maintenance and anchoring.
2516'	4' diameter boulders lying in the channel from man-made barrier on the right bank.
3208'	Tributary enters from the left bank.
5099'	C1 channel typed at habitat unit 43.
6445'	Right bank erosion 8' high x 20' long; young redwoods sliding into the channel.
6749'	Man-made boulder banks.
6849'	Spawning redds observed in this area.
7738'	Redd observed.
8458'	YOY and one redd observed.
8808'	Tan oak is sliding into the channel from the right bank.
9035'	Very small steelhead YOY observed.
9985'	Cow Creek enters from the left bank. Above the confluence, alders are sliding into Bull Creek from the left bank.
11420'	Stagnant pools 25' long x 15' wide.
12772'	Redd observed.
14646'	Miller Creek (dry) enters from the right bank.
15948'	Unidentified fish approximately 5" long observed.
16918'	YOY observed.
17109'	Large woody debris (LWD) in stream.
17700'	Log armament on the left bank..
18674'	Harper Creek enters from the left bank; steelhead YOY present.

20425' Squaw Creek enters from the right bank.

20450' Right bank failure of man-made boulder barrier 8' high x 40' long. Sixty percent of the boulders are in the channel, retaining debris 100' wide x 8' long x 2' high.

21296' First 1+ size fish observed in over 1.5 miles.

21916' Park trail bridge crossing to the Big Trees area, 80' long x 2' wide x 12' high.

23726' Left bank cobble floodplain 200' long x 100' wide.

23999' Flood plain 250' long x 80' wide behind row of alders on the right bank.

24101' Right bank very unstable due to cobble/gravel composition; alders are slumping into the channel.

24350' Hardware cloth on the right bank, 25' long.

24518' Bank erosion with vegetation slumping into the channel, 12' high x 50' long.

24593' Left bank bare soil slump, 3' high x 20' long.

24707' Right bank erosion 12' high x 15' long.

26099' Man-made cobble/boulder dam spanning the channel causing a one foot step plunge. Three 1+ size fish observed.

26346' Old concrete bridge 60' long x 14' wide x 2' high lying in the channel, 180' below the new bridge; no barrier.

26697' Concrete highway bridge crossing 35' wide x 88' long x 15' high.

27428' Albee Creek enters from the left bank.

29093' Mill Creek enters from the left bank; 90% algae.

29143' Highway bridge crossing 90' long x 33' wide x 12' high.

30472' Channel changes to a D1 channel type (reach 2).

34190' Man-made boulder step pool, 3' high step, retaining

gravels 20' long x 25' wide x 1.5' high; possible barrier.

34904' Man-made horse-crossing in the channel.

35166' No YOY observed for over 1.5 miles.

35880' Cuneo Creek enters from the left bank.

37429' Large concrete block in this pool.

37775' Large cobble/boulder flood plain 250' wide x 400' long.

37951' Alluvial terrace 10' high x 300' long on the left bank.

39738' Burns Creek enters from the left bank; YOY observed 100' up the creek.

42105' Left bank bare shale area 20' high x 20' long.

42606' Very good spawning gravel in this glide. YOY and 1+ size fish observed.

43069' Redds observed in this very silty lateral scour pool.

44922' Right bank bare soil area 30' high x 70' long.

45019' Alder slump on the right bank.

45171' Channel changes to a C2 channel type. Right bank erosion 45' high x 100' long.

45583' End survey of lower reach. Channel changes to an A2 channel type.

LEVEL III and LEVEL IV HABITAT TYPE KEY:

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1

Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6

BACKWATER POOLS

Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5