STREAM INVENTORY REPORT

Bull Creek (Upper Reach)

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Bull Creek . 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 presence and distribution of juvenile salmonid species.

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. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Bull Creek is tributary to the South Fork Eel River, tributary to the Eel River, tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Bull Creek 's legal description at the confluence with South Fork Eel River is T1S R2E S34. Its location is 40°20′22″ north latitude and 123°56′16″ west longitude. Bull Creek is a fourth order stream and has approximately 21.2 miles of blue line stream according to the USGS Weott and Bull Creek 7.5 minute quadrangle. 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 entirely owned by the State of California and is managed as a state park. Vehicle access exists from U.S. Highway 101, via 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 et al, 1998). The California Conservation Corps (CCC) Technical Advisors and Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

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SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

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 a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

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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. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas 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) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, bedrock, or other considerations.

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 fully-described 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 fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers

as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Bull Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or deciduous trees.

9. Bank Composition and Vegetation:

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 and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Bull Creek. No biological survey was conducted at this time.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following six 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 Quattro Pro. Graphics developed for Bull Creek include:

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- 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
- Mean percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

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

The habitat inventory of October 28, 29, November 2, and 5, 1998, was conducted by Caroline Jezierski, Greg Larson, and Michelle Anderson (AmeriCorps). The total length of the stream surveyed was 16,867 feet with an additional 120 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.54 cfs on October 16,1998.

Bull Creek is a B2 channel type for the first 4,103 feet, a B4 channel type for the next 6,950 feet, a B1 channel type for the next 1,549 feet, and a F4 channel type for the next 3,612 feet, a B2 channel type for the next 653 feet of the stream reach surveyed. B2 channels are moderately entrenched, moderate gradient, riffle dominated boulder channel with infrequently spaced pools; very stable plan and profile; and stable banks. B4 channels are moderately entrenched, moderate gradient, riffle dominated gravel channel with infrequently spaced pools; very stable plan and profile; and stable banks. B1 channels are moderately entrenched, moderate gradient, riffle dominated bedrock channel with infrequently spaced pools; very stable plan and profile; and stable banks. F4 channels are entrenched meandering riffle/pool gravel channels on low gradients with high width/depth ratio.

Water temperatures taken during the survey period ranged from 48° to 56° F. Air temperatures ranged from 49° to 59° F. Water temperatures taken with a recording thermograph deployed from June 1, to October 31, 1998, ranged from 44° to 68° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 42% riffle units, 39% flatwater units, and 19% pool units (Graph 1).

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Based on total **length** of Level II habitat types there were 41% riffle units, 47% flatwater units, and 12% pool units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffles, 41%; runs, 32%; and mid channel pools, 13% (Graph 3). Based on percent total **length**, low gradient riffles made up 39%, runs, 37%, and step runs, 10%.

A total of fifty pools were identified (Table 3). Main channel pools were most frequently encountered at 70% and comprised 65% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Sixteen of the fifty pools (32%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 50 pool tail-outs measured, zero had a value of 1 (0%); ten had a value of 2 (20%); twenty-five had a value of 3 (50%); eight had a value of 4 (16%) and seven had a value of 5 (14%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate and a value of 5 indicates the tail-out is not suitable for spawning.

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. Riffle habitat types had a mean shelter rating of 34, flatwater habitat types had a mean shelter rating of 15, and pool habitats had a mean shelter rating of 24 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 32. Backwater pools had a mean shelter rating of 20 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Bull Creek and are extensive. Large woody debris is lacking in nearly all habitat types. Graph 7 describes the pool cover in Bull Creek .

Table 6 summarizes the dominant substrate in pool habitat types. Gravel was the dominant substrate observed in twenty-two of the fifty pool tail outs measured (44%). Small cobble was the next most frequently observed dominant substrate type and occurred in 28% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 37%. The mean percentages of conifer and deciduous trees were 38% and 62%, respectively. Graph 9 describes the canopy in Bull Creek .

For the stream reach surveyed, the mean percent right bank vegetated was 74.8%. The mean percent left bank vegetated was 61.6%. The dominant elements composing the structure of the

stream banks consisted of 17.9% bedrock, 5.7% boulder, 56.6% cobble/gravel, and 19.8% sand/silt/clay (Graph 10). Deciduous trees the dominant bank vegetation type observed in 49.1% of the units surveyed. Additionally, 17.9% had coniferous trees as the dominant bank vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No biological sampling was conducted on the upper reach of Bull Creek.

DISCUSSION

Bull Creek is a B2 channel type for the first 4,103 feet of stream surveyed, a B4 channel type for the next 6,950 feet, a B1 channel type for the next 1,549 feet, a F4 channel type for the next 3,612 feet, and a B2 for the remaining 653 feet. The suitability of B2, B4, B1 and F4 channel types for fish habitat improvement structures is as follows: B2 channels are excellent for plunge weirs; single and opposing wing-deflectors; log cover. B4 channels are excellent for low-stage plung weirs; boulder clusters; bank placed boulders; single and opposing wing-deflectors; log cover. B1 channels are excellent for bank-placed boulders; good for log cover; and poor for plunge weirs; single and opposing wing-deflectors; boulder clusters. F4 channels are good for bank-placed boulders; fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover; and poor for boulder clusters.

The water temperatures recorded on the survey days October 28, 29, November 2, and 5, 1998, ranged from 48° to 56° F. Air temperatures ranged from 49° to 59° F. Additional samples from a recording thermograph deployed during the summer of 1992 measured water temperatures ranging from 44° to 68° F. This is a good water temperature range for salmonids. However, 68° F, if sustained, is near the threshold stress level for salmonids. This does not seem to be the case here, and Bull Creek seems to have temperatures favorable to salmonids. To obtain a more complete temperature profile, temperature monitoring should be performed for several additional years.

Flatwater habitat types comprised 47% of the total **length** of this survey, riffles 41%, and pools 12%. The pools are relatively shallow, with sixteen of the fifty (32%) pools having a maximum depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

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None of the fifty pool tail-outs measured had an embeddedness rating of 1. Ten (20%) of the pool tail-outs measured had an embeddedness rating of 2. Thirty-three (66%) of the pool tail-outs had embeddedness ratings of 3 or 4. Seven of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. All of the pool tail-outs were unsuitable for spawning due to the dominant substrate being boulder and bedrock. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Bull Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for pools was low with a rating of 24. The shelter rating in the flatwater habitats was slightly lower at 15. 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. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Thirty-six of the fifty pool tail outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 37%. This is an extremely low percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 74.8% and 61.6%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting native 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) 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.

3) 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.

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4) Increase the canopy on Bull Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

5) Suitable size spawning substrate on Bull Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

6) 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.

7) 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.

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

9) The limited water temperature data available suggest that maximum temperatures are within/above the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

10) There are sections where the stream is being impacted from cattle trampling the riparian zone. Alternatives should be explored with the grazier and developed if possible.

11) Due to the high gradient of the stream, access for migrating salmonids is an ongoing potential problem. 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.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate

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and taken from the beginning of the survey reach.

0'	Begin survey at top of Bull Creek Gorge. Channel type is a B2.
589'	Left bank tributary enters.
1078'	Tributary enters from left bank and was dry at time of survey.
1706'	Left bank failure, approximately 80' long.
2139'	Left bank failure, approximately 135' x 60' x 75'.
2914'	Left bank failure, approximately 60' long.
2943'	Tributary enters left bank.
3161'	Large debris accumulation (LDA), approximately 12' into unit.
3913'	Right bank tributary enters, culvert has failed and erosion is present.
4103'	Channel type changes from a B2 to a B4.
4799'	Tributary enters from the left bank and was dry at time of survey.
6141'	Large debris accumulation (LDA) retaining small woody debris (SWD) and gravel.
6782'	Tributary enters from right bank and was dry at time of survey.
7611'	Small tributary enters from left bank.
8574'	Tributary enters from right bank and was dry at time of survey.
8966'	Left bank slide, approximately 150' x 15' x 30'.
9863'	Left bank slide, approximately 80' x 15' x 50'.
10928'	Kemp road crossed over creek. Corrugated Plastic Culvert 20' long.
11399'	Panther Creek enters from left bank.
11464'	Left bank slide, approximately 40' x 15' x 25'.
11687'	Right bank failure, approximately 115' x 20' x 30'.
11980'	Tributary enters from right bank
13965'	Small tributary enters from right bank
14669'	Tributary enters from left bank and was dry at time of survey.
14775'	Left bank failure, approximately 50' x 5' x 20'.
15267'	Tributary enters from right bank and was dry at time of survey.

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15818'	Left bank slide, approximately 100' x 15' x 40'.
16167'	Stream forks. Survey follows right fork.
16608'	Large debris accumulation (LDA), not a barrier.
16674'	Tributary enters from right bank.
16867'	End of survey.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

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