

SALMON AND STEELHEAD RESTORATION AND ENHANCEMENT PROGRAM

NORTH COAST

WATERSHED PLANNING and COORDINATION PROJECT

STREAM INVENTORY REPORT

BULL CREEK (LOWER REACH), SOUTH FORK EEL RIVER, 1998

CALIFORNIA DEPARTMENT OF FISH AND GAME

SPORT FISH RESTORATION ACT

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North Coast Watershed Planning and Coordination Project

NORTH COAST WATERSHED PLANNING and COORDINATION PROJECT

The North Coast Watershed Planning and Coordination Project (NCWPCP), formerly the Basin Planning Project (BPP), was begun in 1991 to develop salmon and steelhead restoration and enhancement programs in North Coast watersheds for the Department of Fish and Game (DFG). The objectives of the project conform with the goals of California's Salmon and Steelhead Restoration and Enhancement Program of 1988. The Restoration Program strives to enhance the status of anadromous salmonid populations and improve the fishing experience for Californians. The program intends to achieve a doubling of the population of salmon and steelhead by the year 2000. The project is supported by the Sport Fish Restoration Act, which uses sport fishermen's funds to improve sport fisheries.

The NCWPCP conducts stream and habitat inventories according to the standard methodologies discussed in the *California Salmonid stream Habitat Restoration Manual*, (Flossi et.al., 1998). Biological sampling is conducted using electrofishing and direct observation to determine species presence and distribution; selected streams are electrofished for population estimates. Some streams are also sampled for sediment composition. Collected information is used for base-line data, public cooperation development, restoration program planning, specific project design and implementation, and for project evaluation.

The Eel River system was identified as the initial basin for project planning activities. Most anadromous tributaries to the Van Duzen, South Fork Eel, Mainstem Eel, Middle Fork Eel, and the North Fork Eel rivers have been inventoried since 1991. Initial field inventory of the Eel River system should be essentially complete in 1996. NCWPCP personnel have also worked in cooperation with the DFG Salmon Restoration Project's staff to inventory streams on the Mattole River, Mendocino Coast, and Humboldt Bay.

STREAM INVENTORY REPORT

Bull Creek (Lower Reach), South Fork Eel River

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Lower Bull Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Lower 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. 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 T01S R02E S34. Its location is 40°20'22.5" 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 Bull Creek and Weott 7.5 minute quadrangle. Bull Creek drains a watershed of approximately 38.1 square miles. Elevations range from about 160 feet at the mouth of the creek to 3,000 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely owned by the state park and is managed for recreation. Vehicle access exists west of Highway 101 at the Dyerville exit, via Bull Creek Road.

METHODS

The habitat inventory conducted in Lower 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.

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 Lower 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:

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". Lower 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 Lower 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 Lower 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Lower 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 Lower 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 Lower Bull Creek. No biological sampling was conducted on Lower Bull Creek.

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 Lower 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
- 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 15, 16, 19, 20, 21, 26, and 27, 1998, was conducted by Michelle Anderson, Greg Larson, and Caroline Jerzierski (WSP). The total length of the stream surveyed was 47,688 feet.

Flow was estimated to be 1.54 cfs during the survey period.

Lower Bull Creek is an F4 channel type for the first 45,468 feet of stream reach surveyed and a B2 for the remaining 2,220 feet surveyed. F4 channels are entrenched, meandering, riffle/pool gravel dominant channels on low gradients with high width/depth ratios. B2 channel types are moderately entrenched, moderate gradient, riffle dominated boulder channel with infrequently spaced pools; very stable plan and profile; and stable banks.

Water temperatures taken during the survey period ranged from 48 °F to 64 °F. Air temperatures ranged from 48 °F to 68 °F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 38% riffle units, 32% flatwater units, and 30% pool units (Graph 1). Based on total **length** of Level II habitat types there were 42% riffle units, 38% flatwater units, and 20% pool units (Graph 2).

Eighteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffle, 34%; run, 28%; and mid-channel pool, 23% (Graph 3). Based on percent total **length**, low gradient riffle made up 40%, run 32%, and mid-channel pool 17% (Table 2).

A total of 124 pools were identified (Table 3). Main channel pools were most frequently encountered at 80% and comprised 88% 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. Forty-six of the 124 pools (37%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 124 pool tail-outs measured, three had a value of 1 (2%); 39 had a value of 2 (32%); 67 had a value of 3 (54%); six had a value of 4 (5%) and nine had a value of 5 (7%) (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. In Lower Bull Creek, all of the nine pool tail-outs which were valued at 5 were unsuitable for spawning due to the tail-outs being comprised of large cobble, boulder, bedrock or wood.

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 33, flatwater habitat types had a mean shelter rating of 16, and pool habitats had a mean shelter rating of 35 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 42. Main channel pools had a mean shelter rating of 38 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Lower Bull Creek and are extensive. Graph 7 describes the pool cover in Lower Bull Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 95 of the 119 pool tail outs measured (80%). Small cobble was the next most frequently observed dominant substrate type and occurred in 8% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 31%. The mean percentages of deciduous and coniferous trees were 45% and 55%, respectively. Graph 9 describes the canopy in Lower Bull Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 63.3%. The mean percent left bank vegetated was 65.8%. The dominant elements composing the structure of the stream banks consisted of 0.8% bedrock, 23.5% boulder, 43.9% cobble/gravel, and 31.8% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 40.9% of the units surveyed. Additionally, 24.2% of the units surveyed had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

DISCUSSION

Lower Bull Creek is a F4 channel type for the first 45,468 feet of stream surveyed and a B2 for the remaining 2,220 feet. The suitability of F4 and B2 channel types for fish habitat improvement structures is as follows: F4 channels are good for bank-placed boulders. Fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; and log cover. Poor for boulder clusters. B2 channels are excellent for plunge weirs; single and opposing wing-deflectors; and log cover.

The water temperatures recorded on the survey days October 15, to 27, 1998, ranged from 48 °F to 64 °F. Air temperatures ranged from 48 °F to 68 °F. This is a suitable water temperature range for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 38% of the total **length** of this survey, riffles 42%, and pools 20%. The pools are relatively deep, with 46 of the 124 (37%) 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 three 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.

Three of the 124 pool tail-outs measured had an embeddedness rating of 1. Thirty-nine of the pool tail-outs had embeddedness ratings of 2. Seventy-three of the pool tail-outs had embeddedness ratings of 3 or 4. Nine of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. 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 35. The shelter rating in the flatwater habitats was 16. 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 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 structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

One-hundred-five of the 124 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 31%. 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 63.3% and 65.8%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

- 1) Lower Bull Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are within 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.
- 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.
- 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 Lower Bull Creek (above Albee 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.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

- | | |
|--------|---|
| 0' | Begin survey at confluence with South Fork Eel River. Channel type is F4. |
| 593' | Right bank slide approximately 20' long x 10' x 20'. |
| 3,316' | Left bank culvert. |

4,505'	Right bank slide approximately 300' long, some revegetation but still active.
4,957'	Tributary enters from right bank and was dry at time of survey.
8,195'	Log debris accumulation (large redwood crossing creek) approximately 20' x 150' x 12'.
10,557'	Tributary enters from left bank and was dry at time of survey.
15,498'	Tributary enters from right bank and was dry at time of survey.
16,188'	Calf Creek enters from the left bank.
19,784'	Tributary enters left bank, there is vertical erosion at the mouth for 25'.
21,264'	Tributary enters from right bank and was dry at time of survey.
22,716'	Parking lot on left bank.
27,052'	Road crosses creek, bridge is 25' wide.
27,446'	Road on right bank.
34,071'	Bridge crosses creek.
38,922'	Cuneo creek enters from left bank.
42,748'	Tributary enters from left bank and was dry at time of survey.
44,354'	Right bank slide approximately 120' x 50' x 60', seeping water and contributing fines.
44,931'	Tributary enters left bank.
45,468'	Channel type changes from F4 to B2.
47,207'	Right bank slide.
47,688'	End of survey. Active rock slide on right bank.

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
Dammed Pool	[DPL]	6.5