STREAM INVENTORY REPORT

Brushy Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1997 on Brushy Creek starting at the confluence with Bear River. 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 Brushy 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 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

Brushy Creek is a tributary to Bear River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Brushy Creek's legal description at the confluence with Bear River is T01S R01E S08. Its location is 40.3919 degrees north latitude and 124.0992 degrees west longitude. Brushy Creek is a 1st order stream and has approximately 1.8 miles of blue line stream according to the USGS Scotia 7.5 minute quadrangle. Brushy Creek drains a watershed of approximately 2.5 square miles. Elevations range from 1,200 feet at the mouth of the creek to 1,600 feet in the headwater areas. Douglas fir forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Monument Ridge Road.

METHODS

The habitat inventory conducted in Brushy Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). 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 (Hopelain, 1994). 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, dominant substrate composing the pool tail crest, and embeddedness.

Habitat unit types encountered for the first time are further 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 Brushy 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.

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.

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". Brushy 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. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were 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 Brushy 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 not suitable for spawning due to inappropriate substrate particle size, having a bedrock tail-out, 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 Brushy 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 Brushy 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 Brushy 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 was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Brushy Creek fish presence was observed from the stream banks, and one site was electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

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 Brushy 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 the pool tail-outs
- Percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

The habitat inventory of July 14 through July 16, 1997 was conducted by David Jones and Bill Malinowski (WSP/AmeriCorps). The total length of the stream surveyed was 5,705 feet with an additional 548 feet of side channel.

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Flow was measured with a Marsh-McBirney Model 2000 flowmeter at 1.00 cfs on July 22, 1997.

Brushy Creek is a B2 channel type for the entire 5,705 feet of stream reach surveyed. B2 channels are moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools; very stable plan and profile; stable banks; boulder channel.

Water temperatures taken during the survey period ranged from 59 to 60 degrees Fahrenheit. Air temperatures ranged from 62 to 71 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 44% pool units, 39% flatwater units, and 14% riffle units (Graph 1). Based on total length of Level II habitat types there were 77% flatwater units, 14% riffle units, and 8% pool units (Graph 2).

Seven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step runs, 39%; plunge pools, 22%; and mid-channel pools, 16% (Graph 3). Based on percent total length, step runs made up 77%, and low gradient riffles, 13%.

A total of 28 pools were identified (Table 3). Scour pools were most frequently encountered at 50% and comprised 36% 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. Seven of the 28 pools (25%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 28 pool tail-outs measured, five had a value of 1 (18%); five had a value of 2 (18%); three had a value of 3 (11%); five had a value of 4 (18%) and 10 had a value of 5 (36%); (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 Brushy Creek, six of the 10 pool tail-outs which had embeddedness ratings of 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate. The other tail-outs were not suitable 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 15, flatwater habitat types had a mean shelter rating of 38, and pool habitats had a mean shelter rating of 80 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 100. Scour pools had a mean shelter rating of 80 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Small cobble was the dominant substrate in the one low gradient riffle fully measured. Gravel was the dominant substrate observed in 11 of the 28 pool tail-outs measured (39%). Silt/clay was the next most frequently

observed dominant substrate type and occurred in 21% of the pool tail-outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 46%. The mean percentages of deciduous and coniferous trees were 55% and 45%, respectively. Graph 9 describes the canopy in Brushy Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 58%. The mean percent left bank vegetated was 40%. The dominant elements composing the structure of the stream banks consisted of 54% cobble/gravel, 25% boulders, 13% sand/silt/clay, and 8% bedrock (Graph 10). Deciduous tree was the dominant vegetation type observed in 54% of the units surveyed. Additionally, 21% of the units surveyed had brush as the dominant vegetation type, and 13% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on July 22, 1997 in Brushy Creek. The site was sampled by David Jones and Bill Malinowski (WSP/AmeriCorps).

The site sampled had a length of 150 feet and was located approximately 100 feet from the confluence with Bear River. The site yielded 33 steelhead/rainbow trout.

DISCUSSION

Brushy Creek is a B2 channel type for the entire 5,705 feet of stream surveyed. The suitability of B2 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, single and opposing wing deflectors, and log cover.

The water temperatures recorded on the survey days July 14 through July 16, 1997 ranged from 59 to 60 degrees Fahrenheit. Air temperatures ranged from 62 to 71 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 77% of the total length of this survey, riffles 14%, and pools 8%. The pools are relatively shallow, with only seven of the 28 (25%) pools having a maximum depth greater than two feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second 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.

Five of the 28 pool tail-outs measured had an embeddedness rating of 1. Thirteen of the pool tail-outs had embeddedness ratings of 2, 3 or 4. Ten of the pool tail-outs had a rating of 5, which

is considered not suitable for spawning. Six of the 10 were not suitable for spawning due to the dominant substrate being silt/sand/clay or gravel being too small to be suitable. 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 Brushy 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 80. The shelter rating in the flatwater habitats was 38. A pool shelter rating of approximately 100 is desirable. The 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 are needed to improve both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

Fifteen of the 28 pool tail-outs measured had gravel or small cobble as the dominant substrate. Suitable size spawning substrate is lacking in Brushy Creek.

The mean percent canopy density for the stream was 46%. This is a relatively 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 low at 58% and 40%, respectively. In areas of stream bank erosion or where bank vegetation is at unacceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Brushy 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) 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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6) Increase the canopy on Brushy 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.

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

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.

Position (ft):	Comments:
0'	Start of survey at confluence with Bear River. Channel type is B2.
636'	Right bank erosion site measures 96' long x 50' high. Left bank erosion site measures 96' long x 75' high.
895'	Left bank erosion site measures 78' long x 75' high.
1,243'	Left bank erosion site measures 302' long x 100' high.
1,576'	Log debris accumulation (LDA) measures 33' long x 27' wide x 8' high.
1,719'	Salmonid observed.
2,214'	Left bank tributary, barely flowing with high gradient. The water temperature was 58 degrees Fahrenheit.
2,425'	LDA measures 85' long x 58' wide x 10' high and is retaining 2' of sediment.
2,885'	Right bank seepage.
3,768'	LDA measures 31' long x 17' wide.
3,870'	4.7' high plunge.
3,949'	Salmonid observed.
4,259'	LDA measures 58' long x 21' wide and is not retaining sediment.

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4,386' Left bank tributary (see subsection report).

5,705' End of survey. LDA measures 400' long and ends at a 25 foot boulder cascade. No fish observed above the LDA.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

LEVEL III and LEVEL IV HABITAT TYPE KEY

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