STREAM INVENTORY REPORT

Bridge Creek

INTRODUCTION

A stream inventory was conducted during the fall of 1992 on Bridge 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 Bridge Creek. The objective of the biological inventory was to document the salmonid species present and their distribution. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

There is no known record of adult spawning surveys having been conducted on Bridge Creek. 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.

WATERSHED OVERVIEW

Bridge Creek is a tributary to the South Fork Eel River, a tributary to the Eel River, which drains to the Pacific Ocean. It is located in Humboldt County, California. Bridge Creek's legal description at the confluence with the South Fork Eel River is T02S R03E S20. Its location is 40.2825 degrees north latitude and 123.8561 degrees west longitude. Bridge Creek is a second order stream and has approximately 2.1 miles of blue line stream, according to the USGS Myers Flat 7.5 minute quadrangle. Bridge Creek drains a watershed of approximately 2.5 square miles. Summer base runoff is approximately 1.2 cfs at the mouth. Elevations range from about 220 feet at the mouth of the creek to 2,200 feet in the headwater areas. Redwood forest dominates the watershed. The lower quarter mile of the creek is owned by the State of California and is managed by Humboldt Redwoods State Parks. The remainder of the watershed is privately owned and is managed for timber production. Vehicle access exists from U.S. Highway 101 at Myers Flat south for approximately two miles via the Avenue of the Giants.

METHODS

The habitat inventory conducted in Bridge Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) Technical Advisors and the contract seasonals that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Bridge Creek personnel were trained in May, 1992, by Gary Flosi and Scott Downie. This inventory was conducted by two and three 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 Bridge Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows should also be measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed by David Rosgen (1985). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing 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 measured and recorded at each tenth unit typed. The time of the measurement is also recorded. Both temperatures are taken in Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". Bridge Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. Unit measurements included mean length, mean width, mean depth, and maximum depth. Pool tail crest depth at each pool unit was measured in 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 Bridge 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 Bridge 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 Bridge Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

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 Bridge 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 Bridge Creek to document the fish species composition and distribution. Two sites were electrofished in Bridge Creek using one Smith Root Model 12

electrofisher. Each site was end-blocked with nets to contain the fish within the sample reach. Fish from each site were counted by species, measured, and returned to the stream.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the 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 Lotus 1,2,3. Graphics developed for Bridge 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

The habitat inventory of October 1, 1992 was conducted by Erick Elliot and Brian Humphrey (CCC). The total length of the stream surveyed was 5,293 feet.

Flow was not measured on Bridge Creek.

Bridge Creek is a B3 channel type for the first 2,190 feet of the survey (Reach 1), then it changes to an A2 channel type for the remaining 3,103 feet of stream reach surveyed (Reach 2). B3 channels are moderate gradient (2.5-4.0%), moderately confined streams, with stable stream banks. A2 channels are high gradient (4-10%), very well confined streams, with unstable stream banks.

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Water temperatures ranged from 58 to 63 degrees Fahrenheit. Air temperatures ranged from 59 to 67 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, riffles made up 38%, flatwater 30%, and pools 24% (Graph 1). Riffle habitat types made up 52% of the total survey length, flatwater 30%, and pools 10% (Graph 2).

Eleven 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, 28%; step runs, 17%; and runs, 13% (Graph 3). By percent total length, low gradient riffles made up 34%, step runs 25%, and high gradient riffles 12%.

Twenty-four pools were identified (Table 3). Main channel pools were most often encountered at 54%, and comprised 59% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Twenty of the 24 pools (83%) had a depth of less than two feet (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 23 pool tail-outs measured, two had a value of 2 (9%); 10 had a value of 3 (44%); and 11 had a value of 4 (48%). On this scale, a value of one is the best for fisheries (Graph 6).

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Pool habitat types had the highest shelter rating at 48. Flatwater habitats followed with a rating of 33 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 60. 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 Bridge Creek and are extensive. Large woody debris is the next most common cover type. Graph 7 describes the pool cover in Bridge Creek.

Table 6 summarizes the dominant substrate by habitat type. Boulders were the dominant substrate observed in 21 of the 28 low gradient riffles (75%). Large cobble was the next most frequently observed dominant substrate type, and occurred in 21% of the low gradient riffles (Graph 8).

Thirty-nine percent of the survey reach lacked shade canopy. Of the 61% of the stream covered with canopy, 41% was composed of deciduous trees, and 59% was composed of coniferous trees. Graph 9 describes the canopy in Bridge Creek.

Table 2 summarizes the mean percentage of the right and left stream banks covered with vegetation by habitat type. For the stream reach surveyed, the mean percent right bank vegetated was 73%. The mean percent left bank vegetated was 68%. The dominant elements composing the structure of the stream banks consisted of 19% grass, 18% bare soil, 5% boulders, 4% brush, and 1% bedrock. Additionally, 36% of the banks were covered with deciduous trees, and 19%

with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on October 6, 1993 in Bridge Creek. The units were sampled by Erick Elliot and Brian Humphrey (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was Habitat Unit #041, a log enhanced lateral scour pool, located 140 feet upstream from a bridge crossing, and approximately 1,727 feet from the confluence with the South Fork Eel River. This site had an area of 256 square feet, and a volume of 308 cubic feet. The unit yielded two steelhead/rainbow trout, 84 mm and 108 mm long.

The second site sampled was Habitat Unit #081, a mid-channel pool, located 80 feet upstream from the forks, and approximately 3,580 feet from the creek mouth. This site had an area of 225 square feet, and a volume of 202 cubic feet. Two steelhead/rainbow trout were sampled, 63 mm and 89 mm long.

DISCUSSION

The surveyed reach of Bridge Creek has two channel types: A2 and B3. The high energy and steep gradient of the A2 channel type is generally not suitable for instream enhancement structures. The B3 channel type is excellent for many types of low and medium stage instream enhancement structures. There are 2,190 feet of this type of channel in Bridge Creek, along with a plenitude of large woody debris either in or nearby the stream. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and pool cover.

The water temperatures recorded on the survey day October 1, 1992 ranged from 58 to 63 degrees Fahrenheit. Air temperatures ranged from 59 to 67 degrees Fahrenheit. This is a fair water temperature regime for salmonids. However, 63 degrees Fahrenheit, if sustained, is near the threshold stress level 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.

Riffle habitat types comprised 52% of the total length of this survey, flatwater 30%, and pools 10%. The pools are relatively shallow with only four of the 24 pools having a maximum depth greater than two feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total 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. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or cause streambank erosion.

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Twenty-one of the 23 pool tail-outs measured had embeddedness ratings of 3 or 4. None had an embeddedness rating of 1. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Bridge Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was moderate with a rating of 48. The shelter rating in the flatwater habitats was lower at 33. However, a pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by boulders in all habitat types. Additionally, large woody debris contributes a small amount. Log and root wad cover structures in the 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.

Twenty-seven of the 28 low gradient riffles had boulder or large cobble as the dominant substrate. This is generally considered poor for spawning salmonids.

The mean percent canopy for the stream was 61%. This is a relatively high percentage of canopy, since 80% is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

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

2) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

3) Increase woody cover in the flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable and in some areas the material is at hand.

4) 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.

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.

6) Spawning gravels on Bridge Creek are limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravels in order to expand redd site distribution in the stream.

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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.

Position (ft):	Comments:
0'	Start of survey at confluence with the South Fork Eel River. Reach 1 is a B3 channel type for the first 2,190 feet of stream surveyed.
436'	Right bank erosion site measures 35' high x 100' long and is depositing fine sediment into the channel.
1199'	Left bank erosion site measures 35' high x 40' long and is depositing fine sediment to the channel.
1583'	Bridge measures 10' wide x 40' long x 11' high.
2191'	Channel type changes from a B3 to an A2 (Reach 2) for the remaining 3,103 feet of stream surveyed.
2303'	Left bank slide measures 40' high x 35' long and is depositing fine sediment to the channel.
2573'	Braided channel through boulder and woody debris accumulation.
2719'	Right bank slide measures 35' high x 75' long. Young-of-the-year (YOY) salmonids observed.
2833'	Braided channel through large woody debris (LWD) accumulation.
3580'	Dry tributary enters from the right bank.
4061'	Gradient steepens to 8%.
4847'	Dry tributary enters from the right bank.
5293'	Gradient steepens to 10% and greater for the next 500 feet. End of survey.

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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