STREAM INVENTORY REPORT

Bridge Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1993 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 approximately two miles on 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, 1993, 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 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 June 15 to June 18, 1993 was conducted by Chris Coyle, Brian Michaels, and Charles Patton (CCC and contract seasonals). The total length of the stream surveyed was 5,183 feet, with an additional 169 feet of side channel.

Flow was measured 300 feet above the confluence with a Marsh-McBirney Model 2000 flowmeter at 1.2 cfs on June 29, 1993.

Bridge Creek is a B3 channel type for the first 4,300 feet of stream reach surveyed (Reach 1), and a B4 channel type for the remaining 883 feet of the survey (Reach 2). B3 and channels are moderate gradient (1.5-4.0%), well confined streams, with unstable stream banks.

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Water temperatures ranged from 51 to 64 degrees Fahrenheit. Air temperatures ranged from 58 to 83 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 37%, riffle types 36%, and flatwater 27% (Graph 1). Riffle habitat types made up 45% of the total survey length, flatwater 32%, and pools 23% (Graph 2).

Fifteen 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, 30%; runs, 20%; mid-channel pools, 18%, and step runs, 7% (Graph 3). By percent total length, low gradient riffles made up 38%, runs 20%, step runs 12%, and mid-channel pools 11%.

Fifty-three pools were identified (Table 3). Main channel pools were most often encountered at 53%, and comprised 52% 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. Thirty-one of the 53 pools (58%) had a depth of less than two feet (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 48 pool tail-outs measured, two had a value of 1 (4%); 13 had a value of 2 (28%); 30 had a value of 3 (64%); and two had a value of 4 (4%). 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 52. Riffle habitats followed with a rating of 27 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 77. Scour pools had a mean shelter rating of 65. Main channel pools had a mean shelter rating of 39 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Bridge Creek and are extensive. Other cover types are lacking in nearly all habitat types. Graph 7 describes the pool cover in Bridge Creek.

Table 6 summarizes the dominant substrate by habitat type. Small cobble was the dominant substrate observed in 29 of the 43 low gradient riffles (67%). Gravel was the next most frequently observed dominant substrate type, and occurred in 19% of the low gradient riffles (Graph 8).

Thirty-eight percent of the survey reach lacked shade canopy. Of the 62% of the stream covered with canopy, 37% was composed of deciduous trees, and 63% 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 44%. The mean percent left bank vegetated was 37%. The dominant elements composing the structure of the stream banks consisted of 19% brush, 15% cobble/gravel, 12% bare soil, 9% grass, and 7% boulders. Additionally, 12% of the banks were covered with deciduous trees, and

26% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on June 29, 1993 in Bridge Creek. The units were sampled by Warren Mitchell and Ruth Goodfield (contract seasonal and CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was Habitat Unit #031, a plunge pool, approximately 1,193 feet from the confluence with the South Fork Eel River. This site had an area of 242 square feet, and a volume of 290 cubic feet. The unit yielded four steelhead/rainbow trout in three passes, ranging from 50 mm to 62 mm long. The total effort was 272 seconds.

The second site sampled included a run and root wad enhanced lateral scour pool, located approximately 200 feet above the Avenue of the Giants bridge. This site had an area of 421 square feet, and a volume of 368 cubic feet. The site yielded two steelhead/rainbow trout, 79 mm and 87 mm long, and one California roach, 54 mm long. Three passes were performed, for a total effort of 495 seconds.

DISCUSSION

The B3 and B4 channel types are generally considered excellent for fish habitat improvement structures. B3 and B4 channels are found in moderate energy, moderate gradient stream reaches. They have channels dominated by cobble/gravel, and have stable stream banks. These channel types are excellent for instream structures such as low-stage plunge weirs and boulder or log cover structures. This seems to be the case in Bridge Creek, but any structure sites must be selected with care because of the unstable stream banks which can create problems with erosion and structure stability.

The water temperatures recorded on the survey days June 15 to June 18, 1993 ranged from 51 to 64 degrees Fahrenheit. Air temperatures ranged from 58 to 83 degrees Fahrenheit. This is a fair water temperature regime for salmonids. However, 64 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 45% of the total length of this survey, flatwater 32%, and pools 23%. The pools are relatively shallow with only 22 of the 53 pools having a maximum depth greater than two feet. 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 interfere with any unstable stream banks.

Thirty-two of the 47 pool tail-outs measured had embeddedness ratings of 3 or 4. Only two had embeddedness ratings 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 52. The shelter rating in the flatwater habitats was lower at 19. 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 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.

Thirty-seven of the 43 low gradient riffles had small cobble or gravel as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 62%. 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 in areas where 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, like the site at 2786', 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.

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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. Channel type is a B3 for the first 4,300 feet of stream surveyed.
519'	Avenue of the Giants bridge 35' above stream.
762'	Right bank erosion site measures 20' high x 100' long and is contributing fine sediment to the channel.
1296'	Left bank erosion site measures 20' high x 50' long and is contributing fine sediment to the channel.
1477'	Left bank erosion site measures 20' high x 50' long and is contributing fine sediment and gravel into the channel.
1580'	Right bank erosion site measures 20' high x 50' long and is contributing fine sediment to the channel.
1866'	Flatcar bridge measures 12' high x 40' long. Left bank erosion site under the bridge is contributing fine sediment to the channel.
1901'	Small tributary enters from the left bank, with flow of approximately 0.5 cfs.
2471'	Log debris accumulation (LDA) measures 4' high x 4' long x 30' wide. It is not retaining gravel.
2513'	Left bank erosion site measures 30' high x 40' long and is contributing fine sediment to the channel.
2728'	Left bank erosion site measures 30' high x 50' long and is contributing fine sediment and gravel to the channel.
2786'	Significant right bank erosion measures 20' high x 180' long and is contributing fine sediment and gravel to the channel.
3629'	Tributary enters from the right bank; approximate flow is 0.5 cfs.
4115'	LDA measures 4' high x 30' long x 20' wide and is retaining gravel.

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4145' Right bank erosion site measures 40' high x 20' long and is contributing fine sediment and gravel into the channel.

4783' Tributary enters from the right bank and comprises 30% of the stream flow, which is approximately 1.5 cfs.

5183' Gradient increases to 20%. 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