STREAM INVENTORY REPORT

Bridges Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1994 on Bridges 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 Bridges Creek. The objective of the biological inventory was to document the salmonid species present and their distribution. From 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 Bridges 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

Bridges 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 Mendocino County, California. Bridges Creek's legal description at the confluence with South Fork Eel River is T24N R17W S21. Its location is 39.7897 degrees north latitude and 123.7522 degrees west longitude. Bridges Creek is a first order stream and has approximately 2.3 miles of blue line stream, according to the USGS Noble Butte 7.5 minute quadrangle. Bridges Creek drains a watershed of approximately 3.1 square miles. Elevations range from about 600 feet at the mouth of the creek to 2,300 feet in the headwater areas. Douglas fir forest dominates the watershed. The watershed is privately owned and is managed for timber harvest and private residence. Vehicle access exists via U.S. Highway 101, approximately five miles north of Leggett. Foot access is available from a vehicle pull-out immediately north of the Highway 101 bridge that spans Bridges creek. The mouth of the creek is approximately 400 feet downstream from the Highway 101 bridge.

METHODS

The habitat inventory conducted in Bridges Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) Technical Advisors that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Bridges Creek personnel were trained in May, 1994, by Gary Flosi and Scott Downie. This inventory was conducted by a two person team.

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 Bridges 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". Bridges 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 Bridges 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 Bridges 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 Bridges 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 Bridges 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 Bridges Creek to document the fish species composition and distribution. Three sites were electrofished in Bridges 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 Bridges 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 August 4 through August 31, 1994 was conducted by Ruth Goodfield, Will Abel, and Craig Mesman (CCC). The total length of the stream surveyed was 16,472 feet, with an additional 191 feet of side channel.

Flow was measured at Habitat Unit #048, approximately 3,854 feet from the stream's confluence with the South Fork Eel River, with a Marsh-McBirney Model 2000 flowmeter at 0.32 cfs on August 16, 1994.

Bridges Creek is a B4 channel type for the entire 16,472 feet of stream reach surveyed. B4 channels are moderate gradient (2-4%), moderately entrenched streams, with stable stream banks and predominantly gravel substrate.

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Water temperatures ranged from 56 to 72 degrees Fahrenheit. Air temperatures ranged from 64 to 82 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, riffles made up 40%, flatwater types 36%, and pools 22% (Graph 1). Flatwater habitat types made up 42% of the total survey length, riffles 33%, and pools 12% (Graph 2).

Seventeen 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, 25%; and mid-channel pools, 16% (Graph 3). By percent total length, step runs made up 36%, low gradient riffles 25%, and mid-channel pools 9%.

Ninety-seven pools were identified (Table 3). Main-channel pools were most often encountered at 75%, and comprised 79% 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. Forty of the 97 pools (41%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 97 pool tail-outs measured, 23 had a value of 2 (24%); 66 had a value of 3 (68%); and eight had a value of 4 (8%). 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 habitats had the highest shelter rating at 51. Flatwater habitat types followed with a rating of 43 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 51. Scour pools had a mean shelter rating of 50 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Small cobble was the dominant substrate observed in 50 of the 122 low gradient riffles (41%). Gravel was the next most frequently observed dominant substrate type, and occurred in 27% of the low gradient riffles (Graph 8).

Eighteen percent of the survey reach lacked shade canopy. Of the 82% of the stream covered with canopy, 77% was composed of deciduous trees, and 6% was composed of coniferous trees. Graph 9 describes the canopy in Bridges 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 52%. The mean percent left bank vegetated was 56%. The dominant elements composing the structure of the stream banks consisted of 51% boulders, 33% cobble/gravel, 16% bedrock, and 1% bare soil. Additionally, 98% of the banks were covered with 60% deciduous trees, 29%

brush, 8% grass, and 1% with coniferous trees, including downed trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on August 16, and September 1, 1994 in Bridges Creek. The units were sampled by Ruth Goodfield and Will Abel (CCC). All measurements are fork lengths unless otherwise noted.

The first site sampled was Habitat Unit #021, a mid-channel pool, approximately 1,380 feet from the confluence with the South Fork Eel River. This site had an area of 98 square feet, and a volume of 69 cubic feet. The unit yielded 199 steelhead/rainbow trout, ranging from 49 mm to 145 mm long.

The second site was Habitat Unit #213, a step-run, located approximately 9,726 feet above the creek mouth. This site had an area of 1,408 square feet, and a volume of 364 cubic feet. Sixty-one steelhead/rainbow trout were sampled. They ranged from 44 mm to 144 mm long.

The third site sampled was a mid-channel pool, located approximately 100 feet above the end of survey. The site had an area of 105 square feet, and a volume of 95 cubic feet. Two steelhead/rainbow trout were sampled, ranging from 114 mm to 172 mm long.

DISCUSSION

B4 channel types are generally quite suitable for fish habitat improvement structures. B4 channels are found in moderately entrenched, moderate gradient stream reaches. They have a gravel substrate, and have stable stream banks. B4 channel types are excellent for low-stage plunge weirs, boulder clusters, and bank placed boulders. They are also good for wing deflectors and log cover structures. This seems to be the case in Bridges Creek, but any structure sites must be selected with care because of the predominantly gravel and cobble bank composition, which can create problems with stream bank erosion and structure stability.

The water temperatures recorded on the survey days August 8 through August 31, 1994 ranged from 56 to 72 degrees Fahrenheit. Air temperatures ranged from 64 to 82 degrees Fahrenheit. This is a fair water temperature regime for salmonids. However, warmer temperatures, if sustained, are near the threshold stress level for salmonids. This does not seem to be the case here, and Bridges Creek seems to have temperatures favorable to 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 42% of the total length of this survey, riffles 33%, and pools 12%. The pools are moderately deep with 40 of the 97 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 be threatened by high stream energy, cause streambank erosion, or conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. The LDA's in the system are retaining needed gravels. Any modifications to them should be done with the intent of metering the gravels out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Seventy-four of the 97 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 Bridges 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 fair with a rating of 51. The shelter rating in the flatwater habitats was slightly lower at 43. However, 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 and small 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 structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

Eighty-three of the 122 low gradient riffles had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 82%. 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) Bridges 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, like the site at 5,950', 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.

4) There are several log debris accumulations present on Bridges 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.

5) 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 and in some areas the material is at hand.

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 the canopy on Bridges Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is at unacceptable 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.

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. Mouth of stream highly aggraded. Dry channel for first 200 feet of survey. Channel type is a B4 for entire length of survey.
1380'	Bioinventory site #1.
1531'	Log debris accumulation (LDA) is retaining gravel. The channel is dry above the LDA.
1642'	Spring on right bank.
3854'	Flow measured at 0.32 cfs.
4566'	Spring on right bank.
4580'	Spring on right bank.
4651'	LDA is retaining gravel and measures approximately 3' high.

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5095'	Spring on left bank. Left bank slope failure measures approximately 75' in length.
5426'	Spring on left bank.
5645'	Unstable left bank measures approximately 800' in length. It is contributing fine sediment directly into stream.
6447'	Spring on left bank.
6633'	Spring on left bank.
7272'	Tributary enters on the left bank. The water temperature was 58 degrees Fahrenheit.
7954'	Spring on left bank.
9726'	Spring on left bank.
9761'	Bioinventory site #2.
10350'	Spring on right bank.
10949'	Spring on left bank.
13727'	Bridge crosses stream. Appears to have been recently used, but access and ownership are unclear.
13912'	Dry tributary on left bank.
15425'	Running tributary on left bank. The water temperature was 59 degrees Fahreneit.
15950'	LDA measures four feet high.
16291'	Five-foot step.
16472'	Tributary on right bank. Flow in main stem is less than 0.10 cfs. Rapidly running out of water and habitat. Fish seen throughout survey. 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