STREAM INVENTORY REPORT

Bridge Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1999 on Bridge Creek, a stream in the South Fork Eel River basin. 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 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

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 (Map 1). 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. Elevations range from about 220 feet at the mouth of the creek to 2,200 feet in the headwater areas. Summer base runoff is approximately 1.2 cfs at the mouth (1992). Redwood forest dominates the watershed. The lower quarter mile of the creek is owned by the State of California and is managed by Humboldt Redwood State Park. 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, approximately two miles south via 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 et al., 1998). The AmeriCorps Watershed Stewards Project (AmeriCorps/WSP) 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, 1995). 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 methodology and data sheet have been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This protocol was used in Bridge Creek to record measurements and observations. There are nine components to the inventory data sheet.

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". 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. 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 (Hopelain, 1995). 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 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) 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, 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 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 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 Bridge 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 Bridge 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 Bridge Creek fish presence was observed from the stream banks, and two sites were 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 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 the pool tail outs
- Percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

The habitat inventory of June 7 and June 8, 1999 was conducted by Greg Larson and Donn Rehberg (AmeriCorps/WSP). The total length of the stream surveyed was 4,844 feet with an additional 32 feet of side channel.

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Flow was measured in Reach 2 with a Marsh-McBirney Model 2000 flowmeter at 0.6 cfs on June 8, 1999.

Bridge Creek is an F3 channel type for the first 924 feet (Reach 1), a B3 channel type for the next 2,764 feet (Reach 2), and a B2 channel type for the last 1,141 feet of stream surveyed (Reach 3). F3 channels are entrenched meandering cobble dominated riffle/pool channels on low gradients with high width/depth ratio. B3 channel are moderately entrenched, moderate gradient, cobble substrate riffle dominated channel with infrequently spaced pools; very stable plan and profile; and stable banks. B2 channels are moderately entrenched, moderate gradient, boulder substrate riffle dominated channel with infrequently spaced pools; very stable plan and profile; and stable banks.

Water temperatures taken during the survey period ranged from 49 to 56 degrees Fahrenheit. Air temperatures ranged from 51 to 63 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% riffle units, 33% flatwater units, and 25% pool units (Graph 1). Based on total length of Level II habitat types there were 56% riffle units, 32% flatwater units, and 12% pool units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 28%; runs, 26%; and mid-channel pools, 17% (Graph 3). Based on percent total length, low gradient riffles made up 33%, high gradient riffles, 22%, and runs, 21%.

A total of 26 pools were identified (Table 3). Main channel pools were most frequently encountered Level III pool type at 77% (Graph 4) and comprised 79% of the total length of all pools (Table 3).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Fourteen the 26 pools (54%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 24 pool tail-outs measured, one had a value of 1 (4%); seven had a value of 2 (29%); six had a value of 3 (25%); one had a value of 4 (4%) and nine had a value of 5 (38%); (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.

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 8, flatwater habitat types had a mean shelter rating of 16, and pool habitats had a mean shelter rating of 30 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 53. Main channel pools had a mean shelter rating of 32 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Bridge Creek and are extensive. Large and small woody debris are lacking in many habitat types.

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Graph 7 describes the pool cover in Bridge Creek.

Table 6 summarizes the dominant substrate in pool habitat types. Large cobble was the dominant substrate observed in six of the 22 pool tail outs measured (27%). Gravel, small cobble and boulders were the next most frequently observed dominant substrate types and each occurred in 23% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 77%. The mean percentages of conifer and deciduous trees were 54% and 46%, respectively. Graph 9 describes the canopy in Bridge Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 92%. The mean percent left bank vegetated was 92%. The dominant elements composing the structure of the stream banks consisted of 52% sand/silt/clay, 36% cobble/gravel, 9% boulders, and 3% bedrock (Graph 10). Deciduous was the dominant bank vegetation type observed in 55% of the units surveyed. Additionally, 55% of the units surveyed had deciduous trees as the dominant bank vegetation, and 31% had coniferous trees as the dominant bank vegetation, including down trees, logs, and root wads (Graph 11).

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 juveniles were captured, 63 mm and 89 mm long.

DISCUSSION

Bridge Creek is an F3 channel type for the first 924 feet of stream surveyed, a B3 channel type for the next 2,764 feet, and a B2 for the remaining 1,141 feet of stream surveyed. The suitability of F3, B3, and B2 channel types for fish habitat improvement structures is: F3 channels are good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors, and log cover. B3 channels are excellent for plunge weirs, boulder clusters and bank placed boulder, single and opposing wing-deflectors, and log cover. B2 channels are excellent for plunge weirs, single and opposing wing-deflectors, and log cover.

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The water temperatures recorded on the survey days June 7 and June 8, 1999 ranged from 49 to 56 degrees Fahrenheit. Air temperatures ranged from 51 to 63 degrees Fahrenheit. This is an excellent water temperature range for salmonids. Bridge 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 32% of the total length of this survey, riffles 56%, and pools 12%. The pools are relatively shallow, with 14 of the 26 (54%) 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. Primary pools comprise only 6% of the total stream length. 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 where their installation will not conflict with any needed modification of log debris accumulations (LDA's) in the stream. The LDA's in the system may be retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the gravel 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.

One of the 24 (4%) pool tail-outs measured had an embeddedness rating of 1**,** 29% had a rating of 2, 29% had ratings of 3 or 4, and 38% had a rating of 5, which is considered not suitable 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 Bridge 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 low with a rating of 30. The shelter rating in the flatwater habitats was lower at 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 most habitat types. Additionally, undercut banks and root masses contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Ten of the 22 (45%) 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 77%. This is a relatively moderate percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

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The percentage of right and left bank covered with vegetation was high at 92% and 92%, respectively. In areas of stream bank erosion or where bank vegetation is at unacceptable levels, planting native 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) 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) Primary pools only comprise 6% of the total stream length. 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 Bridge 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.

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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):	Habitat unit #:	Comments:
0'		Start of survey at confluence with South Fork Eel River. Channel type is F3.
193'		Avenue of the Giants bridge at 22' into unit.
407'		Out of hydrologic influence of the receiving stream and its flood prone zone; begin 100% occurrence.
902'		Channel type change has occurred. Begin Reach 2, which is a B3 channel type.
1085'		No fish seen yet.
1451'		Concrete in stream. Many pieces contain rebar.
1568'		Bridge crosses at 62' into unit. Rip rap on both banks.
1689'		CCC flag. Electrofishing site from 1992.
2317'		Possible channel change, start 100% occurrence.
2391'		YOY observed.
2457'		1993, CCC Habitat Unit #071 at top of unit.
2524'		Right bank erosion 60' long.
2608'		Left bank erosion for 20'.
2638'		LDA not retaining gravel. Stream passes underneath.
2670'		Same LDA, unsurveyed because stream flow is under the LDA. Much less clearence than the previous unit.
2703'		Channel type taken at this unit.
2927'		Right bank erosion extending 30' in length.
3180'		CCC flag. 3215' chop and drop. February 7, 1996

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3303' Right bank tributary enters at the top of the unit.

3703' Channel type change; begin Reach 3, a B2 channel type.

4365' CCC Habitat Unit #129 June 10, 1993. Channel type location.

4490' Right bank tributary enters at 89 feet into unit.

4520' Start 100% occurrence.

4844' End of survey. Gradient increases to cascade-like conditions. Appears to be an A type channel. Appears to be the end of access for anadromous salmonids.

REFERENCES

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. California salmonid stream habitat restoration manual, 3rd 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.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, 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