STREAM INVENTORY REPORT

Bridge Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Bridge Creek, a tributary to the Eel River. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bridge Creek.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for anadromous salmonids. 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 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 Eel River is T01N R02E S34. Its location is 40.4253 degrees north latitude and 123.9361 degrees west longitude. Bridge Creek is a second order stream and has approximately 3.4 miles of blue line stream according to the USGS Redcrest 7.5 minute quadrangle. Bridge Creek drains a watershed of approximately 2.2 square miles. Elevations range from about 400 feet at the mouth of the creek to 1,500 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via US Highway 101 to Shively Road. Turn left on to Shively Road and follow for approximately 12.5 miles to the Larabee Haul Road controlled by PALCO. Follow this road for approximately 2 miles to where the road crosses Bridge Creek near its confluence with Byron Creek. Also, the Eureka Southern Railroad crosses Bridge Creek approximately 450' above its mouth.

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 (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. 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. 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 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 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.

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

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of June 30, 1998 was conducted by John Wooster and Kelley Turner (WSP). The total length of the stream surveyed was 3,563 feet with an additional seven feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.8 cfs on June 30, 1998.

Bridge Creek is a B6 channel type for the entire 3,563 feet of stream reach surveyed. B6 channels are moderately entrenched, meandering, riffle/pool channels on 2 to 4% gradients with moderate width/depth ratios with sand-dominated substrate.

Water temperatures taken during the survey period ranged from 59 to 61 degrees Fahrenheit. Air temperatures ranged from 57 to 58 degrees Fahrenheit.

Bridge Creek

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% flatwater units, 37% pool units, 22% riffle units, and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 60% flatwater units, 20% riffle units, 18% pool units, and 2% dry units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pools, 26%; runs, 23%; and low gradient riffles, 22% (Graph 3). Based on percent total length, step runs made up 35%, runs 25%, and low gradient riffles 20%.

A total of 29 pools were identified (Table 3). Main channel pools were most frequently encountered at 72% (Graph 4) and comprised 80% 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. Seventeen of the 29 pools (59%) 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, twelve had a value of 4 (43%) and sixteen had a value of 5 (57%); (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 Bridge Creek, all of the 16 pool tail-outs that had embeddedness values of 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate.

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 13, flatwater habitat types had a mean shelter rating of 76, and pool habitats had a mean shelter rating of 36 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 48. Backwater pools had a mean shelter rating of 28 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Bridge Creek. Most types of cover 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. Sand was the dominant substrate observed in 12 of the 28 pool tail outs measured (43%). Silt was the next most frequently observed dominant substrate type and occurred in 56% of the pool tail-outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 81%. The mean percentages of deciduous and coniferous trees were 52% and 48%, respectively. Graph 9 describes the canopy in Bridge Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 84%. The mean percent left bank vegetated was 87%. The dominant elements composing the structure of the stream banks consisted of 97% sand/silt/clay and 3% cobble/gravel (Graph 10). Brush was the dominant vegetation type observed in 23% of the units surveyed. Additionally, 60% of the

units surveyed had deciduous trees as the dominant vegetation type, and 7% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

DISCUSSION

Bridge Creek is a B6 channel type for the entire 3,563 feet of stream surveyed. The suitability of B6 channel types for fish habitat improvement structures is excellent for bank-placed boulders and log cover; good for plunge weirs, single and opposing wing-deflectors, and channel constrictors; and fair for boulder clusters.

The water temperatures recorded on the survey day June 30, 1998 ranged from 59 to 61 degrees Fahrenheit. Air temperatures ranged from 57 to 58 degrees Fahrenheit. This is a good water temperature range for salmonids. However, 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 60% of the total length of this survey, riffles 20%, and pools 18%. The pools are relatively deep, with 17 of the 29 (59%) 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 only comprised 11% of the total stream length surveyed.

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) in the stream. The LDAs 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 without exacerbating siltation problems in the creek. Therefore, gravel retention features may need to be developed prior to any LDA modification.

None of the pool tail-outs measured had an embeddedness rating of 1 or 2. Twelve of the 28 (43%) pool tail-outs had embeddedness ratings of 3 or 4. Sixteen of the 28 (57%) pool tail-outs had a rating of 5, which is considered not suitable for spawning. All of the pool tail-outs with embeddedness ratings of 5 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 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 36. The shelter rating in the flatwater habitats was 76. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by small woody debris in all habitat types. Additionally, large woody debris contributes 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.

All 28 of the pool tail-outs measured had silt or sand as the dominant substrate. This is generally considered not suitable for spawning salmonids.

The mean percent canopy density for the stream was 81%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 84% and 87%, respectively. However, the bank composition is 97% sand or smaller particles. Therefore, 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) 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) The surveyors did not see any fish in the relatively short portion of the creek surveyed. There are culverts and LDAs on this stream that should be evaluated to determine if they are barriers or impediments to fish passage. It appears that good water temperatures exist for fish in the stream. Fish passage should be monitored and improved where possible.

4) 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.

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

6) Primary pools comprise only 11% 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.

7) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from small woody debris. Adding high quality complexity with woody cover is desirable.

8) There are several log debris accumulations present on Bridge Creek that are retaining fine sediment. The modification of these debris accumulations may be desirable in order to meter gravel downstream to spawning sites, but must be balanced against the risk of

mobilizing stored fine sediments and thereby exacerbating downstream siltation problems.

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 the Eel River. Channel type is a B6 for the entire 3,563 feet of stream surveyed.
273'	Dry tributary enters creek from left bank.
289'	Railroad culvert, 10' x 6', enters stream.
309'	8' diameter culvert, under railroad, is retaining large amount of sediment.
520'	Dry tributary enters from right bank.
720'	Log debris accumulation (LDA) measures 30' long x 24' wide x 8' high.
1,436'	Logging landing on right bank.
1,469'	Tributary enters from left bank. LDA measures 10' long x 15' wide x 4' high.
2,313'	LDA measures 20' long x 25' wide x 7' high.
2,323'	LDA measures 10' wide x 15' long x 16' high and is retaining fine sediment.
2,438'	Left bank erosion site measures 12' long x 30' high.
2,631'	Confluence with Byron Creek.
2,787'	Culvert enters creek. Rust line at 40% of culvert diameter. Water plunges 3' into pool.
3,346'	LDA measures 10' long x 20' wide x 15' high and is retaining fine sediment.
3,563'	No fish observed in the stream during survey. Flow is decreasing rapidly. End of survey.

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.

Bridge Creek

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		
Cscade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pockt Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trech 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