STREAM INVENTORY REPORT

Bell Creek

INTRODUCTION

A habitat inventory was conducted during the summer of 1998 on Bell Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bell 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. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Bell Creek is a tributary to the Eel River, which drains to the Pacific Ocean. It is located in Humboldt County, California. Bell Creek's legal description at the confluence with the Eel River is T01S R03E S33. Its location is 40.3342 degrees north latitude and 123.8494 degrees west longitude. Bell Creek is an intermittent stream according to the USGS Myers Flat 7.5 minute quadrangle. Bell Creek drains a watershed of approximately 0.5 square miles. Elevations range from about 200 feet at the mouth of the creek to 2,080 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists from U.S. Highway 101 via Dyerville Road. Follow the Dyerville Loop Road for about 6.4 miles to the mouth of Bell Creek.

METHODS

The habitat inventory conducted in Bell Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et.al., 1998). The surveyors who 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 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 Bell 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.

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". Bell 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 Bell 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 Bell 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 Bell 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 Bell 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 Bell 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 July 15 1998 was conducted by Ruth Goodfield (DFG) and Curtis Ihle (HCRCD). The total length of the stream surveyed was 1,038 feet.

Flow was estimated at 0.5 cfs during the July 15, 1998 survey on Bell Creek.

Bell Creek is a B4 channel type for the entire length of the survey. B4 channels are moderately entrenched, moderate gradient, riffle-dominated gravel channels with infrequently spaced pools, very stable plan and profile, and stable banks.

Water temperatures taken during the survey period ranged from 58 to 59 degrees Fahrenheit. Air temperatures ranged from 67 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 50% riffle units, 31% pool units, and 19% flatwater units (Graph 1). Based on total length of Level II habitat types there were 59% riffle units, 27% pool units, and 14% flatwater units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 44%; runs, 19%; and mid-channel pools, 19% (Graph 3). Based on percent total length, low gradient riffles made up 55%, step pools 18%, and

runs 14% (Table 2).

A total of ten pools were identified (Table 3). Main channel pools were most frequently encountered at 80% and comprised 93% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. One of the ten pools (10%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the nine pool tail-outs measured, seven had a value of 2 (78%); one had a value of 3 (11%); and one had a value of 5 (11%); (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 9, flatwater habitat types had a mean shelter rating of 20, and pool habitats had a mean shelter rating of 44 (Table 1). Of the pool types, the main pools had the highest mean shelter rating at 47. Scour pools had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Bell Creek. Graph 7 describes the pool cover in Bell Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel and small cobble were the two dominant substrates observed at 50% each (Graph 8).

The mean percent canopy density for the stream reach surveyed was 84%. The mean percentages of deciduous and coniferous trees were 49% and 51%, respectively. Graph 9 describes the canopy in Bell Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 71%. The mean percent left bank vegetated was 73%. The dominant elements composing the structure of the stream banks consisted of 86% sand/silt/clay, 9% boulders, and 5% cobble/gravel (Graph 10). Coniferous trees were the dominant vegetation type observed in 55% of the units surveyed. Additionally, 36% of the units surveyed had deciduous trees as the dominant vegetation type (Graph 11).

DISCUSSION

Bell Creek is a B4 channel type for the entire 1,038 feet of stream surveyed. The suitability of B4 channel types for fish habitat improvement structures is excellent for low-stage plunge weirs, bank-placed boulders, single and opposing wing-deflectors, boulder clusters, and log cover.

The water temperatures recorded on the survey days July 15, 1998 ranged from 58 to 59 degrees Fahrenheit. Air temperatures ranged from 67 to 75 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.

Flatwater habitat types comprised 14% of the total length of this survey, riffles 59%, and pools 27%. The pools are relatively shallow, with only one of the ten (10%) pools having a maximum depth greater than two feet. 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 comprised less than 3% of the entire habitat surveyed on Bell Creek. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. Installing structures that will increase or deepen pool habitat is recommended.

None of the nine pool tail-outs measured had an embeddedness rating of 1, 78% had a rating of 2, 11% had ratings of 3 or 4, and 11% had a rating of 5 and was considered not suitable for spawning. The one pool tail-out with the rating of 5 was not suitable for spawning due to the composition being wood. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

The mean shelter rating for pools was 44. The shelter rating in the flatwater habitats was 20. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by large woody debris in all habitat types. Additionally, small 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 nine of the 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 84%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 71% and 73%, respectively. 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) Bell Creek should be managed as an anadromous, natural production stream.

2) Due to the high gradient of the stream and some problem culverts, access for migrating salmonids is an ongoing potential problem. Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish. Bioinventory sampling to determine fish species presence should be conducted. Potential fish passage problems should be evaluated and improved if necessary.

3) 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 relatively low amount of existing cover is from woody debris. Adding high quality complexity with woody cover is desirable.

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. The channel type is a B4 for the entire survey length.
477'	Railroad trestle crosses Bell Creek. Right bank is partially eroded, but pilings appear to be intact. Water is diverted around and under an old, non-functioning culvert that is located directly upstream of trestle.
563'	Stream drops 4.5' over old, non-functioning culvert. This is a barrier for both adult and juvenile migration,
1,038'	Arch culvert in channel measures 40' long x 8' wide x 5' high, with a gradient of approximately 15%. Stream gradient climbs to about 50% upstream of culvert. End of survey.

REFERENCES

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins.1998. *California Salmonid Stream Habitat Restoration Manual*, 3nd edition. California Department of Fish and Game, Sacramento, 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