STREAM INVENTORY REPORT

Bell Springs Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Bell Springs Creek. 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 Bell Springs Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species. There is no known record of adult spawning surveys having been conducted on Bell Springs 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 Springs Creek is a tributary to the Eel River, which drains to the Pacific Ocean. It is located in Mendocino County, California. Bell Springs Creek's legal description at the confluence with the Eel River is T24N R14W S18. Its location is 39.9339 degrees north latitude and 123.6453 degrees west longitude. Bell Springs Creek is a second order stream and has approximately 7.3 miles of blue line stream according to the USGS Updegraff Ridge 7.5 minute quadrangle. Bell Springs Creek drains a watershed of approximately 19.5 square miles. Summer base flow is approximately 0.4 cubic feet per second (cfs) at the mouth, but over 20 cfs is not unusual during winter storms. Elevations range from about 600 feet at the mouth of the creek to 2,400 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is privately owned and is managed for timber production, rangeland, and dispersed recreation. Vehicle access exists via Bell Springs Road to a private, unimproved road that leads to the mouth of Bell Springs Creek. The landowner must be contacted for access permission and more explicit road directions.

METHODS

The habitat inventory conducted in Bell Springs Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The Pacific Coast Fisheries, Wetlands, and Wildlife Restoration Association (PCFWWRA) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Bell Springs Creek personnel were trained in May, 1996, by Scott Downie and Ruth Goodfield. 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, 1994). 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. 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 Springs 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 Springs 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 Bell Springs 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). Additionally, a rating of "not suitable" (value 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 Springs 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.

8. Canopy:

Stream canopy density was estimated using modified hand-held spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*, 1994. Canopy density relates to the amount of stream shaded from the sun. In Bell Springs 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 Springs Creek, the dominant composition type (options 1-4) and

the dominant vegetation type (options 5-9) 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 Bell Springs Creek fish presence was observed from the stream banks, and one site was sampled with 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 Lotus 1,2,3. Graphics developed for Bell Springs 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
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

The habitat inventory of September 9 through September 12, 1996 was conducted by Greg Mullins and Frank Humphrey (PCFWWRA). The total length of the stream surveyed was 17,778

feet with an additional 1,778 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.4 cfs on September 19, 1996.

Bell Springs Creek is a B2 channel type for the first 5,114 feet of stream reach surveyed (Reach 1), a C2 for the next 11,382 feet (Reach 2), and a B1 channel type for the remaining 1,282 feet of stream surveyed (Reach 3). C2 channels are meandering, riffle/pool channels on low gradients with broad, well-defined floodplains and boulder-dominant substrates. B2 channels are moderately entrenched, moderate gradient, riffle dominated channels, with stable banks and boulder-dominant substrates. B1 channels are similar to the B2 types, but with bedrock as the dominant substrate.

Water temperatures taken during the survey period ranged from 57 to 82 degrees Fahrenheit. Air temperatures ranged from 58 to 100 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% flatwater units, 30% pool units, 25% riffle units, and 3% dry units (Graph 1). Based on total length of Level II habitat types there were 61% flatwater units, 22% pool units, 16% riffle units, and 2% dry units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step runs, 28%; mid-channel pools, 19%; and low gradient riffles, 19% (Graph 3). Based on percent total length, step runs made up 45%, mid-channel pools 13%, and pocket water 11%.

A total of ninety pools were identified (Table 3). Main channel pools were most frequently encountered at 72% and comprised 77% 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. Seventy-eight of the 90 pools (87%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 90 pool tail-outs measured, 37 had a value of 1 (41%); 25 had a value of 2 (28%); and 28 had a value of 3 (31%); (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning 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. Flatwater habitat types had a mean shelter rating of 32, and pool habitats had a mean shelter rating of 22 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 36. Backwater pools had a mean shelter rating of 30 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in the stream and are extensive. Large and small woody debris are lacking in nearly all habitat types (Graph 7).

Table 6 summarizes the dominant substrate by habitat type. Bedrock was the dominant substrate observed in three of the eight low gradient riffles measured (38%). Gravel was the next most frequently observed dominant substrate type and occurred in 25% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 14%. The mean percentages of deciduous and coniferous trees were 78% and 23%, respectively (Graph 9). For the stream reach surveyed, the mean percent right bank vegetated was 12%. The mean percent left bank vegetated was 8%. The dominant elements composing the structure of the stream banks consisted of 44% bedrock, 43% boulders, 13% cobble/gravel, and 1% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 39% of the units surveyed. Additionally, 18% of the units surveyed had deciduous trees as the dominant vegetation type, and 1% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on September 9, 1996 in Bell Springs Creek. The site was sampled by Ruth Goodfield (DFG) and Dale Melton (WSP/AmeriCorps).

The site sampled included Habitat Units #020 through #023, a run/riffle/pool sequence approximately 2,037 feet from the confluence with the Eel River. This site had an area of 930 square feet and a volume of 690 cubic feet. The site yielded six young-of-the-year (YOY) steelhead/rainbow trout, two age 1+ steelhead/rainbow trout, 60 California roach, 15 suckers, and 50 Sacramento pikeminnow.

DISCUSSION

Bell Springs Creek is a B2 channel type for the first 5,114 feet of stream surveyed, a C2 for the next 11,382 feet, and a B1 for the remaining 1,282 feet. The suitability of B2 channel types for fish habitat improvement structures is described as excellent for low and medium-stage weirs, wing deflectors, and bank cover. The suitability of B1 channel types for fish habitat improvement structures is excellent for bank-placed boulders and bank cover; good for log cover; and poor for low-stage weirs, wing-deflectors, and boulder clusters. The suitability of C2 channel types for fish habitat improvement structures is good for low-stage weirs, wing-deflectors, channel constrictors, and log cover; and fair for medium-stage weirs.

The water temperatures recorded on the survey days September 9 to September 12, 1996 ranged from 57 to 82 degrees Fahrenheit. Air temperatures ranged from 58 to 100 degrees Fahrenheit. This is a warm water temperature range for salmonids. Temperatures above 70 degrees Fahrenheit, if sustained, are considered above the threshold stress level for salmonids. This may be the case here, and Bell Springs Creek seems to have marginal summer temperatures 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.

Flatwater habitat types comprised 61% of the total length of this survey, riffles 16%, dry units 2%, and pools 22%. The pools are relatively deep, with 78 of the 90 (87%) 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. 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 the modification of the numerous log debris accumulations (LDA's) in the stream.

Twenty-eight of the 90 pool tail-outs measured had embeddedness ratings of 3 or 4. Thirty seven had embeddedness ratings of 1. 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 Bell Springs Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken where appropriate.

The mean shelter rating for pools was low with a rating of 22. The shelter rating in the flatwater habitats was slightly better at 32. 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, white water 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.

Four of the eight low gradient riffles 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 14%. This is a relatively low percentage of canopy. In general, re-vegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 12% and 8%, 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 Springs Creek should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures are within/above 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) Increase the canopy on Bell Springs Creek by planting willow, alder, 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 here is effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

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 and in some areas the material is locally available.

5) 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.

6) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 7116', should then be treated to reduce the amount of fine sediments entering the stream.

PROBLEM SITES 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 the confluence with the Eel River. Channel type is a B2 for the first 5114' of stream surveyed (Reach 1).
536'	Surveyors observed adult Sacramento pikeminnow from the streambanks.
2037'	Bioinventory site for Bell Springs Creek, 1996.
2495'	Spring on right bank. Young-of-the-year (YOY) salmonids observed from the streambanks.
3619'	Large spring on right bank.
4053'	Tributary enters from the right bank. The water temperature was 57 degrees Fahrenheit.
4648'	Large school of YOY salmonids observed from the streambanks.

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5114'	Channel type changes from a B2 to a C2 (Reach 2).
5505'	Vertical drop of 4.6' in stream elevation.
5817'	Vertical drop of 4.6' in stream elevation.
7116'	Failure on the right bank measures approximately 500' long x 150' high. The slide is active; the channel is full of sediment and loose woody debris.
8146'	Tributary enters from right bank; the water temperature was 60 degrees Fahrenheit.
8370'	Spring on left bank.
9760'	Spring on left bank.
10368'	Spring on right bank.
10870'	Large spring on right bank; the water temperature was 59 degrees Fahrenheit.
12679'	Active failure on right bank measures 300' long x 100' high.
14218'	Spring on the right bank.
14543'	Large, steep tributary enters from the left bank; the water temperature was 67 degrees Fahrenheit.
16496'	Channel type changes to a B1 for the remaining 1282' of stream surveyed (Reach 3).
17565'	Active failure on the right bank measures 150' long x 150' high. It is contributing boulders and blue clay directly into the stream.
17778'	Stream channel gets very steep. A series of waterfalls higher than 8' were observed for the next several hundred feet. End of survey.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd 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