STREAM INVENTORY REPORT

Beaver Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2001 on Beaver Creek. The survey began at the confluence with Redwood Creek and extended upstream 0.5 miles.

The Beaver Creek 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 Beaver 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 chinook salmon, 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

Beaver Creek is a tributary to Redwood Creek, a tributary to the Pacific Ocean located in Humboldt County, California (Map 1). Beaver Creek's legal description at the confluence with Redwood Creek is T07 R03E S06. Its location is 41°01′9.31″ north latitude and 123°52′12.7″ west longitude. Beaver Creek is a second order stream and has approximately 1.1 miles of blue line stream according to the USGS Hupa Mountain 7.5 minute quadrangle. Beaver Creek drains a watershed of approximately 0.7 square miles. Elevations range from about 600 feet at the mouth of the creek to 2000 feet in the headwater areas. Redwood/Douglas fir and mixed hardwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 299 to Redwood Valley Road.

METHODS

The habitat inventory conducted in Beaver Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) 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 three-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 (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are 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 Beaver 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 a Marsh-McBirney Model 2000 flow meter.

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. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

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". Beaver 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. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Beaver 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, bedrock, 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 Beaver 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 Beaver 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 Beaver 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 (including downed trees, logs, and rootwads) was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Beaver Creek. In addition, five 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 Beaver 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
- Mean 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 11 and 12, 2001 was conducted by Karen Bromley (DFG), Michelle Wallar and Elizabeth Gill (WSP/AmeriCorps). The total length of the stream surveyed was 2,731 feet.

Stream flow was measured at the bottom of the survey reach 1, with a Marsh-McBirney Model

2000 flowmeter at 0.11 cfs on June 19, 2001.

Beaver Creek is a B3 channel type for the first 2,211 feet surveyed and an A2 channel type for the last 520 feet surveyed. B3 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; cobble channels. A2 channels are steep, narrow, cascading, step-pool streams; high energy/debris transport associated with depositional soils; boulder channels.

Water temperatures taken during the survey period ranged from 52° to 54° Fahrenheit. Air temperatures ranged from 56° to 64° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 38% riffle units, 28% flatwater units, and 32% pool units (Graph 1). Based on total **length** of Level II habitat types there were 44% riffle units, 43% flatwater units, and 11% 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, 30%; mid-channel pools, 18%; and step runs, 15% (Graph 3). Based on percent total **length**, low gradient riffles made up 32%, mid-channel pools 6%, and step runs 31%.

A total of nineteen pools were identified (Table 3). Main channel pools were the most frequently encountered, at 68% , 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. Four of the nineteen pools (21%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 19 pool tail-outs measured, 4 had a value of 1 (21%); 5 had a value of 2 (26.5%); 2 had a value of 3 (10.5%); none had a value of 4; and 8 had a value of 5 (42.1%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. The breakdown of dominant substrate composition for the 8 pool tail-outs that had a embeddedness value of 5 were as follows: 5 boulder, one silt/clay/sand, one small gravel, and one bedrock.

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 14, flatwater habitat types had a mean shelter rating of 11, and pool habitats had a mean shelter rating of 17 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 40. Main channel and scour pools had mean shelter ratings of 18 and 3 respectively (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders is the dominant cover type in Beaver Creek. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in Beaver Creek. Boulders were the dominant pool cover type followed by undercut banks.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders were the dominant substrate observed in 58% of pool tail-outs while small cobble was the next most frequently observed substrate type, at 16%.

The mean percent canopy density for the surveyed length of Beaver Creek was 98%. The mean percentages of deciduous and coniferous trees were 100% and 0%, respectively. Graph 9 describes the mean percent canopy in Beaver Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 92.5%. The mean percent left bank vegetated was 85.6 %. The dominant elements composing the structure of the stream banks consisted of 2.27% bedrock, 18.8% boulder, 61.37% cobble/gravel, and 18.18% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 90.91% of the units surveyed. Additionally, 6.82% of the units surveyed had brush as the dominant vegetation type, and 2.27% had coniferous trees as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Five sites were electrofished for species composition and distribution in Beaver Creek on August 2, 2001. Water temperature taken during the electrofishing period was 58° Fahrenheit. Air temperature was 66° Fahrenheit. The sites were sampled by G. Yoshioka (DFG), M. Wallar, E. Gill and L. Ward (WSP/AmeriCorps).

The first site sampled included habitat units 003-005, a step-run, mid-channel pool, high gradient riffle sequence approximately 144 feet from the confluence with Redwood Creek. The site yielded one young-of-the-year steelhead.

The second site included habitat units 007-009, a mid-channel pool, step run, mid-channel pool sequence located approximately 360 feet above the creek mouth. The site yielded 4 young-of-the-year steelhead, and one age two-plus steelhead.

The third site sampled included habitat unit 027, a mid-channel pool located approximately 1,280 feet above the creek mouth. The site did not yield any fish.

The fourth site sampled included habitat units 029, a run located approximately 1,384 feet above the creek mouth. The site did not yield any fish.

The fifth site sampled included habitat units 031, a step run located approximately 1,046 feet above the creek mouth. The site did not yield any fish.

The following chart displays the information yielded from these sites:

Date	Site #	Approx. Dist. from mouth (ft.)	Hab. Unit #	Hab. Type	Reach #	Channel type	Steelhead YOY	1+	2+
08-02-01	1	144	0003-0005	3.4,4.2, 1.1	1	B3	1	0	0
08-02-01	2	360	0007-0009	4.2,3.4, 4.2	1	B3	4	1	0
08-02-01	3	1,280	0027	4.2	1	B3	0	0	0
08-02-01	4	1,384	0029	3.3	1	B3	0	0	0
08-02-01	5	1,046	0031	3.4	1	B3	0	0	0

DISCUSSION

Beaver Creek is a B3 channel type for the first 2,211 feet of stream surveyed and an A2 channel type for the remaining 520 feet. The suitability of B3 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters and bank placed boulder, single and opposing wing-deflectors, and log cover. Fish habitat improvement structure suitability for A2 channels is as follows: generally not suitable; high energy streams with stable stream banks, and poor gravel retention capabilities.

The water temperatures recorded on the survey days June 11-12, 2001, ranged from 52° to 54° Fahrenheit. Air temperatures ranged from 56° to 64° Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 43% of the total **length** of this survey, riffles 44%, and pools 11%. The pools are relatively shallow, with only 4 of the 19 (21.1%) pools having a maximum depth greater than 2 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.

Nine of the 19 pool tail-outs measured had embeddedness ratings of 1 or 2. Two of the pool tail-outs had embeddedness ratings of 3 or 4. Eight of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. One of the 8 was unsuitable for spawning due to the dominant substrate being silt/clay. The remainder of pool tails valued at 5 were dominated by bedrock or boulders. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

Fourteen of the 19 pool tail-outs had silt or sand, large cobble, boulders, or bedrock as the dominant substrate. Spawning substrate for salmonids is limited.

The mean shelter rating for pools was 17. The shelter rating in the flatwater habitats was 11. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, undercut banks contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 98%. Reach 1 had a canopy density of 98% while Reach 2 had a canopy density of 99%. Revegetation projects are considered when canopy density is less than 80% or the canopy composition is dominated by deciduous trees.

The percentage of right and left bank covered with vegetation was 92.5% and 85.6%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Beaver 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) Conduct a fish passage assessment of the culvert crossing under Redwood Valley Road. The culvert is located approximately 1,209 feet from the mouth of Beaver Creek. If it is determined that the culvert is blocking fish passage, options should be explored to replace the culvert with one that provides unimpeded fish passage.

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) In the B3 channel type, design and engineer pool enhancement structures to increase the number of pools or deepen existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

6) Increase the canopy on Beaver Creek by planting redwood, Douglas fir or other native conifers in the riparian zone. The tributaries to Beaver Creek and the reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected by upstream activities.

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

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.

0'	Begin survey at confluence with Redwood Creek. Channel type is B3.
1,066'	Log debris accumulation (LDA), 3' high x 30' long x 18' wide.
1,209'	Cement culvert crosses under Redwood Valley Road. Culvert measures 6' wide x 55' long with an 8' jump from channel bed to outlet of culvert. Possibly a fish barrier.
1,932'	LDA, 4' high x 7.5' long x 7.5' wide.
2,211'	Channel type changes from B3 to A2.
2731'	End of survey due to a high gradient reach with boulder cascade and the lack of fish sightings throughout the survey.

REFERENCES

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

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8}
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9}
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4}
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5}
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6}
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7}
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	