STREAM INVENTORY REPORT

Bear Pen Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Bear Pen Creek to assess habitat conditions for anadromous salmonids. 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 Bear Pen Creek. The objective of the biological inventory was to document the salmonid species present and their distribution. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

Adult carcass surveys were conducted in Bear Pen Creek in 1988 and 1990. In February 1988, two unidentified skeletons and one live steelhead smolt were found in the stream. In January 1990, one redd was observed during the survey. 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.

WATERSHED OVERVIEW

Bear Pen 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 Mendocino County, California. Bear Pen Creek's legal description at the confluence with the South Fork Eel River is T24N R17W S07. Its location is 39.9358 degrees north latitude and 123.7764 degrees west longitude. Bear Pen Creek is a second order stream and has approximately 2.7 miles of blue line stream, according to the USGS Piercy 7.5 minute quadrangle. Bear Pen Creek drains a watershed of approximately 5.0 square miles. Elevations range from about 560 feet at the mouth of the creek to 1,600 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is owned by the Georgia-Pacific Corporation and is managed for timber production. Vehicle access exists from U.S. Highway 101 to Highway 171. Proceed south to the first large pullout on the right. Follow the dirt road to the gate. Cross the South Fork Eel River on foot, and walk downstream 1/4 mile to the mouth of Bear Pen Creek on the left bank.

METHODS

The habitat inventory conducted in Bear Pen Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) Technical Advisors and contract seasonals that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Bear Pen Creek personnel were trained in May, 1992, by Gary Flosi and Scott Downie. This inventory was conducted by two person teams.

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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 Bear Pen 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. Flows should also be measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed by David Rosgen (1985). 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 four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.

3. Temperatures:

Both water and air temperatures are taken and recorded at each tenth unit typed. The time of the measurement is also recorded. Both temperatures are taken in 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". Bear Pen 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. Unit measurements included mean length, mean width, mean depth, and maximum depth. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken 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 Bear Pen 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).

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 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 Bear Pen 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 habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes.

8. Canopy:

Stream canopy is estimated using handheld spherical densiometers and is a measure of the water surface shaded during periods of high sun. In Bear Pen Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

9. Bank Composition:

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 Bear Pen Creek, the dominant composition type in both the right and left banks was selected from a list of eight options on 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. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, 3) electrofishing. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

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Biological inventory was conducted in Bear Pen Creek to document the fish species composition and distribution. One site was electrofished in Bear Pen Creek using one Smith Root Model 12 electrofisher. The site was end-blocked with nets to contain the fish within the sample reach. Fish from the site were counted by species, measured, and returned to the stream.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the California Department of Fish and Game (DFG). This program also processes and summarizes the data.

The Habitat Runtime program produces the following 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 Bear Pen 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

HABITAT INVENTORY RESULTS

The habitat inventory of July 28 through August 10, 1992 was conducted by Brian Humphrey, Aaron Nadig and Jason Cleckler (CCC and contract seasonals). The total length of the stream surveyed was 17,851 feet, with an additional 172 feet of side channel.

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Flow was not measured on Bear Pen Creek.

Bear Pen Creek is a B3 channel type for the entire 17,851 feet of stream reach surveyed. B3 channels are moderate gradient (1.5-4.0%), well confined streams, with unstable stream banks.

Water temperatures ranged from 61 to 71 degrees Fahrenheit. Air temperatures ranged from 62 to 85 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 37%, riffles 35%, and flatwater 28% (Graph 1). Riffle habitat types made up 39% of the total survey length, flatwater 38%, and pools 21% (Graph 2).

Thirteen Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent occurrence were low gradient riffles, 31%; step runs, 15%; mid-channel pools, 15%; and runs, 12% (Graph 3). By percent total length, low gradient riffles made up 37%, step runs 28%, runs 9%, and mid-channel pools 9%.

One hundred-twenty pools were identified (Table 3). Scour pools were most often encountered at 56%, and comprised 54% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Seventy-eight of the 120 pools (65%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 115 pool tail-outs measured, two had a value of 1 (2%); 29 had a value of 2 (25%); 61 had a value of 3 (53%); and 23 had a value of 4 (20%). On this scale, a value of one is the best for fisheries (Graph 6).

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. Pool habitat types had the highest shelter rating at 33. Flatwater habitats followed with a rating of 21 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 37. Main channel pools had a mean shelter rating of 28 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Bear Pen Creek and are extensive. Large and small woody debris are the next most common cover types. Graph 7 describes the pool cover in Bear Pen Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 73 of the 100 low gradient riffles (73%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 22% of the low gradient riffles (Graph 8).

Thirty-three percent of the survey reach lacked shade canopy. Of the 67% of the stream covered with canopy, 65% was composed of deciduous trees, and 35% was composed of coniferous trees. Graph 9 describes the canopy in Bear Pen Creek.

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Table 2 summarizes the mean percentage of the right and left stream banks covered with vegetation by habitat type. For the stream reach surveyed, the mean percent right bank vegetated was 26%. The mean percent left bank vegetated was 24%. The dominant elements composing the structure of the stream banks consisted of 49% cobble/gravel, 12% grass, 9% bedrock, 9% boulders, 4% bare soil, and 2% brush. Additionally, 7% of the banks were covered with deciduous trees, and 8% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on August 7, 1992 in Bear Pen Creek. The unit was sampled by Erick Elliot and Shea Monroe (CCC). All measurements are fork lengths unless noted otherwise.

The site sampled was Habitat Unit #003, a mid-channel pool, approximately 158 feet from the confluence with the South Fork Eel River. This site had an area of 154 square feet, and a volume of 231 cubic feet. The unit yielded 14 steelhead/rainbow trout, ranging from 62 mm to 92 mm long, four coho salmon, ranging from 50 mm to 70 mm long, and one squawfish, 57 mm long.

DISCUSSION

The B3 channel type is generally not suitable for fish habitat improvement structures. B3 channels are found in moderate gradient, well confined stream reaches. They have channels dominated by cobble/gravel, and have unstable stream banks.

The water temperatures recorded on the survey days July 28 through August 10, 1992 ranged from 61 to 71 degrees Fahrenheit. Air temperatures ranged from 62 to 85 degrees Fahrenheit. The warmer water temperatures, if sustained, are above the threshold stress level 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.

Riffle habitat types comprised 39% of the total length of this survey, flatwater 38%, and pools 21%. The pools are relatively deep with 78 of the 120 pools having a maximum depth greater than two feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not conflict with the unstable stream banks of the B3 channel type.

Eighty-four of the 115 pool tail-outs measured had embeddedness ratings of 3 or 4. Only two had embeddedness rating of 1. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In Bear Pen Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was low with a rating of 33. The shelter rating in the flatwater habitats was lower at 21. However, 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, large and small woody debris contribute 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.

Ninety-five of the 100 low gradient riffles had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 67%. This is a relatively high percentage of canopy, since 80% is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Bear Pen Creek should be managed as an anadromous, natural production stream.

2) Temperatures in this section of Bear Pen Creek, as well as upstream, should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

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 existing cover is from boulders. Adding high quality complexity with woody cover is desirable and in some areas the material is available.

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) Increase the canopy on Bear Pen 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.

7) There are several log debris accumulations present on Bear Pen Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time to avoid excessive sediment loading in downstream reaches.

PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. All the distances are approximate and taken from the beginning of the survey reach.

Position (ft):	Comments:
0'	Start of survey at confluence with the South Fork Eel River. Channel type is B3 for the entire survey reach.
232'	Left bank erosion site measures 10' high x 228' long.
766'	Left bank erosion site measures 10' high x 172' long.
1253'	Left bank erosion site measures 10' high x 106' long.
1640'	Log debris accumulation (LDA) measures 38' wide x 11' long x 6' high.
1736'	Young-of-the-year salmonids (YOY) observed.
1827'	LDA measures 50' wide x 10' long x 6' high.
2547'	LDA measures 10' wide x 4' long x 6' high.
2655'	LDA measures 50' wide x 6' long x 5' high and is retaining gravel measuring 3' high.
3441'	Bank erosion site measures 12' high x 77' long.
4332'	Left bank erosion site measures 12' high x 85' long and is partially revegetated.
5325'	Cub Creek enters from the right bank.
5778'	Left bank erosion site measures 20' high x 106' long.
6207'	Bank erosion site measures 30' high x 27' long.
6661'	LDA measures 45' wide x 5' long x 3' high and is retaining gravel measuring 2' high.
6716'	LDA measures 25' wide x 6' long x 2.5' high and is retaining gravel measuring 3' high.
7028'	Tributary enters from the left bank.
7627'	LDA measures 40' wide x 9' long x 7' high and is retaining gravel measuring 5' high.

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8565'	Left and right bank erosion sites measure 65'-100' high x 166' long.
8691'	LDA measures 37' wide x 25' long x 7' high and is retaining gravel measuring 3' high.
9409'	Right bank erosion site measures 15' high x 31' long.
9508'	Age 1+ salmonids observed.
9881'	Right bank erosion site measures 100' high x 162' long.
9939'	LDA measures 30' wide x 100' long x 5' high.
10090'	Right bank erosion site measures 10' high x 82' long.
10581'	Tributary enters from the right bank.
11144'	Tributary enters from the left bank.
11356'	LDA measures 35' wide x 5' long x 3' high.
11512'	LDA measures 70' wide x 30' long x 9' high and is retaining gravel measuring 6' high.
11568'	Numerous YOY observed.
12364'	Left bank erosion site measures 6' high x 214' long.
13718'	Right bank erosion site measures 6' high x 50' long. Tributary enters from the left bank.
13881'	LDA measures 30' wide x 6' long x 4' high.
14452'	LDA measures 45' wide x 10' long x 6' high.
15619'	LDA measures 45' wide x 25' long x 8' high.
15866'	YOY observed.
15990'	Right bank erosion site measures 9' high x 87' long.
16363'	Tributary enters from the left bank.
16473'	Right bank erosion site measures 25' high x 76' long.
16610'	LDA measures 50' wide x 70' long x 8' high and is retaining gravel measuring 4' high.

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17800' LDA measures 35' wide x 25' long x 11' high and is retaining gravel measuring 7' high. 4' high plunge over the LDA.

17851' End of survey due to numerous LDAs.

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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