STREAM INVENTORY REPORT

Bear Canyon Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1999 on Bear Canyon Creek, a tributary to the South Fork Eel River. 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 Canyon 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 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.

A salmon spawner survey was conducted on January 4, 1996. The surveyors did not see any live adult salmon or steelhead, carcasses, skeletons, or redds.

WATERSHED OVERVIEW

Bear Canyon 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 Humboldt County, California (Map 1). Bear Canyon Creek's legal description at the confluence with the South Fork Eel River is T04S R03E S24. Its location is 40.1067 degrees north latitude and 123.7964 degrees west longitude. Bear Canyon Creek is a second order stream and has approximately 3.3 miles of blue line stream according to the USGS Garberville 7.5 minute quadrangle. Bear Canyon Creek drains a watershed of approximately 3.4 square miles. Elevations range from about 300 feet at the mouth of the creek to 2,000 feet in the headwater areas. Grassland, oak woodland, and Douglas fir forest dominate the watershed. The watershed is privately owned and is subdivided for residential use and ranching. Vehicle access exists from U.S. Highway 101 at Garberville via Redwood Drive, to Bear Canyon Road.

METHODS

The habitat inventory conducted in Bear Canyon Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors and 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 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 (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 Bear Canyon 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". Bear Canyon 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 clinometer, 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 Bear Canyon 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, 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 Bear Canyon 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 Bear Canyon 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 Bear Canyon 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 Bear Canyon Creek. In addition, four 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 Bear Canyon 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

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HABITAT INVENTORY RESULTS

The habitat inventory of June 10 through June 17, 1999 was conducted by Michelle Anderson and Paul Ferns (AmeriCorps/WSP). The total length of the stream surveyed was 7,472 feet with an additional 128 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.05 cfs on June 14, 1999.

Bear Canyon Creek is a B4 channel type for the first 3,900 feet (Reach 1) and an F4 channel type for the remaining 3,572 feet of stream surveyed (Reach 2). B4 channels are moderately entrenched, moderate gradient, riffle dominated gravel channels with infrequently spaced pools, with very stable plan and profile and stable banks. F4 channels are entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; gravel channel.

Water temperatures taken during the survey period ranged from 59 to 65 degrees Fahrenheit. Air temperatures ranged from 65 to 78 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% pool units, 33% flatwater units, 31% riffle units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 53% flatwater units, 27% riffle units, 11% pool units and 8% culvert units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 30%; runs, 30%; and mid-channel pools, 23% (Graph 3). Based on percent total length, runs made up 49%, low gradient riffles, 26%, and culvert, 8%.

A total of 35 pools were identified (Table 3). Main channel pools were most frequently encountered at 66% (Graph 4) and comprised 59% 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. Fourteen of the 35 pools (40%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 35 pool tail-outs measured, seven had a value of 1 (20%); 24 had a value of 2 (69%); and four had a value of 3 (11%); (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. Riffle habitat types had a mean shelter rating of 44, flatwater habitat types had a mean shelter rating of 13, and pool habitats had a mean shelter rating of 48 (Table 1). Of the Level III pool types, the scour pools had the highest mean shelter rating at 58. Backwater pools had a mean shelter rating of 50 (Table 3).

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Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Bear Canyon Creek. Small woody debris provides some cover in most habitat types. Graph 7 describes the pool cover in Bear Canyon Creek.

Table 6 summarizes the dominant substrate in pool habitat types. Gravel was the dominant substrate observed in 32 of the 34 pool tail outs measured (94%). Small cobble was the next most frequently observed dominant substrate type and occurred in 6% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 85%. The mean percentages of conifer and deciduous trees were 8% and 92%, respectively. Graph 9 describes the canopy in Bear Canyon Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 76%. The mean percent left bank vegetated was 87%. The dominant elements composing the structure of the stream banks consisted of 52% sand/silt/clay, 22% cobble/gravel, 17% bedrock, and 9% boulders (Graph 10). Deciduous trees were the dominant bank vegetation type observed in 54% of the units surveyed (Graph 11).

BIOLOGICAL INVENTORY RESULTS

The surveyors reported seeing juvenile salmonids and juvenile pikeminnow in Bear Canyon Creek based on streambank observations. Electrofishing was not conducted in 1998. However, four sites were electrofished on July 17, 1992. Those sites were sampled by Chris Coyle and Craig Mesman (CCC) and their results are summarized below. All measurements are fork lengths unless noted otherwise.

The first site sampled was a bedrock formed lateral scour pool, approximately 617 feet from the confluence with the South Fork Eel River. This site had an area of 448 square feet, and a volume of 269 cubic feet. This unit yielded three steelhead/rainbow trout, ranging from 58 mm to 76mm long, and six coho salmon, ranging from 59 mm to 70mm long.

The second site sampled included a mid-channel pool and a step run, located immediately above the Highway 101 culvert, 1,222 upstream from the creek mouth. This site had an area of 3,491 square feet, and a volume of 1,746 cubic feet. Seven steelhead/rainbow trout were caught, ranging from 63mm to 143mm long.

The third site sampled was a mid-channel pool, located approximately 4,892 feet above the creek mouth. The site had an area of 406 square feet and a volume of 5,287 cubic feet. One steelhead/rainbow trout 150mm long, and eight coho salmon ranging from 64mm to 72mm long were caught.

The fourth site sampled included a low gradient riffle, run, and mid-channel pool. Located approximately 206 feet from the survey's end, this site had an area of 306 square feet and a volume of 68 cubic feet. No fish were found.

DISCUSSION

Bear Canyon Creek is a B4 channel type for the first 3,900 feet and a F4 channel type for the last 3,572 feet of stream surveyed. The suitability of B4 and F4 channel types for fish habitat improvement structures is: B4 channels are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover. F4 channel types are good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover; and poor for boulder clusters.

The water temperatures recorded on the survey days June through June 17, 1999 ranged from 59 to 65 degrees Fahrenheit. Air temperatures ranged from 65 to 78 degrees Fahrenheit. This is a suitable water temperature range 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 53% of the total length of this survey, riffles 27%, and pools 11%. Fourteen of the 35 (40%) pools had 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.

Seven of the 35 (20%) pool tail-outs measured had an embeddedness rating of 1, 66% had an embeddedness rating of 2, and 14% had an embeddedness rating of 3. 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 48. The shelter rating in the flatwater habitats was 13. 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 most habitat types. Additionally, small woody debris and terrestrial vegetation contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

All thirty-four 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 85%. However, the conifer component of the canopy is lacking. The percentage of right and left bank covered with vegetation was 76% and 87%, respectively. Planting coniferous trees within the riparian zone is recommended.

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RECOMMENDATIONS

1) Bear Canyon 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) Where feasible, design and engineer pool enhancement structures to increase the number of pools or the depth of existing 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.

5) Increase the conifer component of the canopy on Bear Canyon Creek by planting Douglas fir along the stream where appropriate. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is effected from upstream.

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 survey at confluence with South Fork Eel River. Channel type is B4. A railroad bridge passes over the creek.
678'	Highway 101 concrete culvert. Culvert measures approximately 627' long x 14' wide x 11' high. Gravel and boulders are accumulating toward the lower end of the culvert and may be filling in the baffles.
2,345'	Small debris accumulation in side channel is retaining silt, sand, clay, and small woody debris.
2,521'	Erosion site on right bank measures approximately 60' long.
2,862'	Tributary enters on right bank and was dry at time of survey. Active erosion site on left bank measures approximately 34' long and 10' high.
3,382'	Left bank tributary enters.

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3,608' Erosion site on right bank measures approximately 5' long x 10' high.

3,693' Erosion site on right bank measures approximately 50' long x 30' wide.

3,900' Creek forks. Survey followed the north fork. Channel type changes to an F4.

4,309' Log debris accumulation measures approximately 50' long x 20' wide x 5' high. Right bank erosion site measures approximately 25' long x 10' high.

5,530' Active erosion site on right bank measures approximately 40' high x 80' long.

6,121' Gully on left bank measures approximately 125' long x 40' high x 100' wide.

6,134' Erosion site on left bank is contributing fine sediment to the channel.

7,347' Gradient of stream increases.

7,372' Stream continues at high gradient, end of 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.

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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