

STREAM INVENTORY REPORT

Bear Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on Bear 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 Bear 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 Bear Creek.

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

Bear Creek is tributary to the South Branch North Fork Navarro River, tributary to the North Fork Navarro River, located in Mendocino County, California (Figure 1). Bear Creek's legal description at the confluence with South Branch North Fork Navarro River is T15N R14W S19. Its location is 39°08'56" north latitude and 123°26'56" west longitude. Bear Creek is a first order stream and has approximately 1.2 miles of blue line stream according to the USGS Bailey Ridge 7.5 minute quadrangle. Bear Creek drains a watershed of approximately 1.9 square miles. Elevations range from about 490 feet at the mouth of the creek to 2000 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists via private road.

METHODS

The habitat inventory conducted in Bear Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). 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). Bear Creek personnel were trained in May, 1995, by Gary Flosi. 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

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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 Bear 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". Bear 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 (*Sampling Levels for Fish Habitat Inventory*, Hopelain, 1995). Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were in feet to the nearest tenth.

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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 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" (NS) was assigned to tail-outs deemed unsuited 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 Bear 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 handheld spherical densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*, 1994. Canopy density relates to the amount of stream shaded from the sun. In Bear 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 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.

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BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Bear Creek fish presence was observed from the stream banks, and one site was electrofished using one 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 Bear 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 July 13-31, 1995, was conducted by Bettina Chimarios and Shelly Dunn (WSP/AmeriCorps). The total length of the stream surveyed was 5,115 feet with an additional 167 feet of side channel.

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Flows were not measured on Bear Creek.

Bear Creek is an F3 channel type for the entire 5,115 feet of stream reach surveyed. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

Water temperatures ranged from 52 to 69 degrees Fahrenheit. Air temperatures ranged from 60 to 95 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 39% pool units, 36% riffle units, and 25% flatwater units (Graph 1). Based on total **length** of Level II habitat types there were 34% flatwater units, 34% riffle units, and 32% pool units (Graph 2).

Six Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were mid-channel pools, 36%; low-gradient riffles, 35%; and runs, 15% (Graph 3). Based on percent total **length**, low-gradient riffles made up 34%, mid-channel pools 30%, and step runs 17%.

A total of 76 pools were identified (Table 3). Main channel pools were most frequently encountered at 93% and comprised 95% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Eighteen of the 76 pools (24%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 76 pool tail-outs measured, none had a value of 1 (0%); 45 had a value of 2 (59%); 31 had a value of 3 (41%); and none had a value of 4 (0%) (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. Pool habitat types had a mean shelter rating of 24, and flatwater habitats had a mean shelter rating of 20 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 45. Main channel pools had a mean shelter rating of 21 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation is the dominant cover type in Bear Creek. Graph 7 describes the pool cover in Bear Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 5 of the 9 low gradient riffles measured (56%). Small cobble was the next most frequently observed dominant substrate type and occurred in 44% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 85%. The mean percentages of deciduous and coniferous trees were 69% and 31%, respectively. Graph 9

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describes the canopy in Bear Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 84%. The mean percent left bank vegetated was 86%. The dominant elements composing the structure of the stream banks consisted of 6.5% bedrock, 0% boulder, 47.8% cobble/gravel, and 45.7% sand/silt/clay (Graph 10). Grass was the dominant vegetation type observed in 58.7% of the units surveyed. Additionally, 23.9% of the units surveyed had deciduous trees as the dominant vegetation type, and 6.5% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on July 20, 1995, in Bear Creek. The site was sampled by Gary Flosi (DFG) and Bettina Chimarios and Shelley Dunn (WSP/AmeriCorps).

The site sampled included habitat units 11 and 12, a mid-channel pool and scour pool approximately 309 feet from the confluence with South Branch North Fork Navarro River. This site had an area of 195 sq ft and a volume of 156 cu ft. The site yielded two 0+ steelhead, two crayfish, two Pacific giant salamanders, and one yellow-legged frog.

DISCUSSION

Bear Creek is an F3 channel type for the entire 5,115 feet of stream surveyed. The suitability of F3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders and single and opposing wing deflectors; fair for low-stage weirs, boulder clusters, channel constrictors, and log cover; and poor for medium-stage weirs.

The water temperatures recorded on the survey days July 13-31, 1995, ranged from 52 to 69 degrees Fahrenheit. Air temperatures ranged from 60 to 95 degrees Fahrenheit. This is a fair water temperature range for salmonids. However, 69 degrees Fahrenheit, if sustained, is above the threshold stress level for coho salmon. 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 34% of the total **length** of this survey, riffles 34%, and pools 32%. The pools are relatively shallow, with only 18 of the 76 (24%) 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. 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. The LDA's in the system are retaining needed gravel. Any necessary modifications to them

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should be done with the intent of metering the gravel out to downstream reaches that will trap the gravel for future spawning use.

Thirty-one of the 76 pool tail-outs measured had embeddedness ratings of 3. None had a 1 rating. 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 Bear Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for pools was low with a rating of 24. The shelter rating in the flatwater habitats was slightly lower at 20. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by terrestrial vegetation in all habitat types. Log and root wad cover structures in the pool and flatwater habitats are needed to improve 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 9 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 85%. This is a relatively high percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 84% and 86%, 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) Bear Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are 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) 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 terrestrial vegetation. Adding high quality complexity with woody cover is desirable and in some areas the material is locally available.

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- 5) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 1,319', should then be treated to reduce the amount of fine sediments entering the stream.
- 6) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.
- 7) There are several log debris accumulations present on Bear 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 distances are approximate and taken from the beginning of the survey reach.

Position

(ft): Comments:

0'	Begin survey at confluence with South Branch North Fork Navarro River. Channel type is F3.
197'	Bridge 12' long x 28' wide x 9' clearance.
1075'	Dry left bank tributary.
1183'	LDA 5' high x 20' wide x 21' long. Not a barrier.
1302'	LDA 5' high x 11' wide x 14' long retaining gravel and silt. Not a barrier.
1319'	Left bank erosion 9' high x 15' long.
1522'	LDA 7' high x 9' wide x 9' long retaining gravel. Possible barrier. Left bank erosion.
1874'	Right bank erosion 10' high x 30' long.
2056'	LDA 8' high x 25' wide x 37' long retaining gravel. Right bank erosion 50' high x 30' long.
2772'	Left bank erosion 15' high x 10' long contributing silt and clay.
2845'	LDA 4' high x 5' wide x 8' long.

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- 2941' LDA 7' high x 11' wide x 68' long retaining silt. Possible barrier.
- 3554' LDA 3' high x 8' wide x 4' long. Right bank erosion 13' high x 30' long contributing silt.
- 4074' Last noted observation of fish presence.
- 4295' LDA 4' high x 10' wide x 8' long. Possible barrier.
- 4852' Right bank tributary.
- 5115' End of survey at road crossing due to diminished habitat.

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.

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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