STREAM INVENTORY REPORT

Bear Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1996 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 Mattole River, located in Humboldt County, California. Bear Creek's legal description at the confluence with the Mattole River is T04S R02E S06. Its location is 40°08'07" North latitude and 123°59'43" West longitude. Bear Creek is a third order stream and has approximately 21.9 miles of blue line stream according to the USGS Ettersburg, Shelter Cove, and Honeydew 7.5 minute quadrangles. Bear Creek drains a watershed of approximately 21.7 square miles. Summer base flow is approximately 8 cubic feet per second (cfs) at the mouth, but over 50 cfs is not unusual during winter storms. Elevations range from about 600 feet at the mouth of the creek to 2,200 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is primarily owned by the Bureau of Land Management and is managed for dispersed recreation. Vehicle access exists via the Shelter Cove Road west from Redway to Honeydew Road. Go north on Wilder Ridge Road to Ettersburg. Turn left on the unsurfaced road at paddle marker 679 to the mouth of Bear Creek.

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 Pacific Coast Fisheries, Wildlife, and Wetlands Restoration Association (PCFWWRA) 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, 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 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 Fahrenheit at the middle of the habitat unit 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 (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 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 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 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.

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*.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter McNeil gravel sampler. Sample sites are identified numerically

beginning at the most upstream site in the stream. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85 mm)(Valentine, 1995).

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

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of September 3 - 6, 1996, was conducted by Greg Mullins and Frank Humphrey (PCFWWRA). The total length of the stream surveyed was 38,174 feet with an additional 1,931 feet of side channel.

Flow was estimated to be 8 cfs during the survey period.

Bear Creek is an F3 channel type for the first 15,114 feet of stream reach surveyed, an F2 for the next 9,017 feet of stream,

a B2 for the next 8,437 feet, and an F2 again for the final 5,606 feet of stream surveyed. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates. F2 channels are similar to F3 types, but with boulder-dominant substrates. B2 channels

are moderately entrenched, moderate gradient, riffle dominated channels with stable banks and boulder-dominant substrates.

Water temperatures taken during the survey period ranged from 55 to 69 degrees Fahrenheit. Air temperatures ranged from 49 to 79 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 42% flatwater units, 31% pool units, and 27% riffle units (Graph 1). Based on total **length** of Level II habitat types there were 53% flatwater units, 30% pool units, and 17% riffle units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were lateral scour bedrock-formed pools, 18%; runs, 16%; and low gradient riffles, 14% (Graph 3). Based on percent total **length**, step runs made up 25%, lateral scour bedrock-formed pools 17%, and runs 15%.

A total of one hundred and eighteen pools were identified (Table 3). Scour pools were most frequently encountered at 75% and comprised 69% 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. One hundred and sixteen of the 118 pools (98%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 117 pool tail-outs measured, 59 had a value of 1 (50%); 28 had a value of 2 (24%); 30 had a value of 3 (26%); and none had a value of 4 (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. Riffle habitat types had a mean shelter rating of 119, and pool habitats had a mean shelter rating of 84 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 85. Main channel pools had a mean shelter rating of 82 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Boulder was the dominant substrate observed in six of the ten low gradient riffles measured (60%). Large cobble was the next most frequently observed dominant substrate type and occurred in 20% of the low gradient riffles (Graph 8).

The mean percent canopy density for the survey reach was 46%. The mean percentages of deciduous and coniferous trees were 81% and 19%, respectively (Graph 9).

For the stream reach surveyed, the mean percent right bank vegetated was 30%. The mean percent left bank vegetated was 27%. The dominant elements composing the stream banks consisted of 44.2% bedrock, 39.6% boulder, 11.7% cobble/gravel, and 4.6% sand/silt/clay (Graph 10). Grass was the dominant vegetation type observed in 42% of the units surveyed. Additionally, 56% of the units surveyed had deciduous trees as the dominant vegetation type, and none 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 4, 1996, in Bear Creek. The site was sampled by Todd Kraemer (WSP/AmeriCorps) and Ray Bevitori (PCFWWRA).

The site sampled included habitat unit 025, a step run approximately 3,282 feet from the confluence with the Mattole River. This site had an area of 3,400 sq ft and a volume of 3,060 cu ft. The site yielded 20 young-of-the-year (YOY) steelhead rainbow trout, six 1+ steelhead rainbow trout, and three coho YOY.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Bear Creek.

DISCUSSION

Bear Creek is an F3 channel type for the first 15,114 feet of stream surveyed, an F2 for the next 9,017 feet, a B2 for the next 8,437 feet, and an F2 for the remaining 5,606 feet. The

suitability of F2 and F3 channel types for fish habitat improvement structures is fair for low-stage weirs, wing deflectors, and log cover structures; and poor for medium-stage weirs. The suitability of B2 channel types for fish habitat improvement structures is excellent for low and medium-stage plunge weirs, single and opposing wing deflectors, and bank cover.
The water temperatures recorded on the survey days September 3 - 6, 1996, ranged from 55 to 69 degrees Fahrenheit. Air temperatures ranged from 49 to 79 degrees Fahrenheit. This is a relatively warm water temperature range for salmonids. Temperatures over 68° F, if sustained, are near the threshold stress level 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 53% of the total **length** of this survey, riffles 17%, and pools 30%. The pools are relatively deep, with 116 of the 118 (98%) pools having a maximum depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum depth of at least three 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.

Thirty of the 117 pool tail-outs measured had embeddedness ratings of 3 or 4. Fifty-nine 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.

The mean shelter rating for pools was high with a rating of 84. The shelter rating in the flatwater habitats was slightly lower at 77. A pool shelter rating of approximately 100 is desirable. The relatively large amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, bedrock ledges 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 structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Eight of the ten fully measured low gradient riffles had large cobble or boulders as the dominant substrate. This is generally

considered poor for spawning salmonids.

The mean percent canopy density for the stream was 46%. 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 both the right and left banks covered with vegetation was low at 30% and 27%, 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 near the upper range suitable for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August extreme temperature period should be performed for 3 to 5 years.

3) Increase the canopy on Bear 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.

4) 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.

5) 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.

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.

0'	Begin survey at confluence with the Mattole River. Channel type is an F3 for the first 15,114' of stream surveyed.
408'	Rip-rap on right bank (RB).
1444'	Flat-car bridge crosses over stream. Tributary enters from left bank (LB). Large numbers of salmonids of different age classes observed from streambank.
2147'	Mattole Restoration Association hatchbox on RB.
3044'	Rip-rap on RB - approximately 750' long.
3282'	Bioinventory site #1.
6714'	Springs on LB - 66°F.
6818'	Small failure and spring on right bank (RB).
11848'	Jewett Creek enters from LB.
15114'	Channel type changes to an F2 for the next 9,017' of stream surveyed.
19303'	Small tributary enters from RB - 59°F.
24131'	Channel type changes to a B2 for the next 8,437' of stream surveyed.
25946'	Small, steep tributary enters from RB - 55°F.
26611'	Spring on RB.
27420'	Spring on LB.
27521'	Spring on LB.
28440'	Spring on LB.
29240'	Spring on LB.
29693'	Small tributary on LB - 59°F. No fish observed in tributary.

30015' Large slide on RB.

32568' Channel type changes to an F2 for the remaining 5,606' of stream surveyed.

32904' Small tributary enters from RB - 55°F. No fish observed in tributary.

34796' Small tributary on LB - 100' waterfall.

35870' Small, steep tributary on RB - 54°F.

36007' Small, steep tributary on RB - 53°F.

38174' Confluence of North Fork and South Fork of Bear Creek. End of Bear Creek 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