STREAM INVENTORY REPORT

BERRY CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Berry 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 Berry 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.

WATERSHED OVERVIEW

Berry Creek is tributary to the Navarro River, located in Mendocino County, California (Map 1). Berry Creek's legal description at the confluence with the Navarro River is T15N R15W S31. Its location is 39°06'46" north latitude and 123°33'38" west longitude. Berry Creek is a first order stream and has approximately 1.2 miles of blue line stream according to the USGS Cold Spring 7.5 minute quadrangle. Berry Creek drains a watershed of approximately 0.98 square miles. Elevations range from about 80 feet at the mouth of the creek to 600 feet in the headwater areas. Redwood/Douglas fir mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via various gated logging roads off of State Route 128 near Boonville.

METHODS

The habitat inventory conducted in Berry 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 the AmeriCorps Watershed Stewards Project (WSP\AmeriCorps) Members who 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 (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 Berry 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". Berry 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 Berry 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, 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 Berry 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*. Canopy density relates to the amount of stream shaded from the sun. In Berry Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the end of approximately every third unit in addition to every fully-described unit, giving approximately a 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 Berry 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 was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their

distribution in the stream. In Berry Creek fish presence was observed from the stream banks, and two 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 Berry 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 July 18, 23, and 24, 1996, was conducted by Andrew MacMillan (WSP\AmeriCorps) and David Jones (CCC). The total length of the stream surveyed was 2,052 feet with an additional 50 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.13 cfs on July 19, 1996.

Berry Creek is a B3 channel type for the entire 2,052 feet of stream reach surveyed. B3 channels are moderately entrenched, moderate gradient channels with stable plan and profile, and cobble dominated substrates.

Water temperatures taken during the survey period ranged from 60 to 63 degrees Fahrenheit. Air temperatures ranged from 69 to 80 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 34% riffle units, 34% flatwater units, and 30% pool units (Graph 1). Based on total **length** of Level II habitat types there were 22% riffle units, 50% flatwater units, 15% pool units, and 12% was dry (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were step runs, 25%; low gradient riffles, 21%; and mid-channel pools, 15% (Graph 3). Based on percent total **length**, step runs made up 46%, low gradient riffles 12%, and mid-channel pools 7%.

A total of 21 pools were identified (Table 3). Main channel pools were most frequently encountered at 81% and comprised 85% 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. Five of the 21 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 21 pool tail-outs measured, 1 had a value of 1 (5%); 5 had a value of 2 (24%); 6 had a value of 3 (29%); 4 had a value of 4 (19%); and 5 had a value of 5 (24%) (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 10, flatwater habitats had a mean shelter rating of 65, and pool habitats had a mean shelter rating of 72 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 78. Scour pools had a mean shelter rating of 62 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Of the two low gradient riffles measured one had gravel and one had small cobble as the dominant substrate (Graph 8).

The mean percent canopy density for the stream reach surveyed was 62%. The mean percentages of deciduous and coniferous trees were 19% and 81%, respectively. Graph 9 describes the canopy in Berry Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 55.6%. The mean percent left bank vegetated was 54%. The dominant elements composing the structure of the stream banks consisted of 3.13% bedrock, 3.13% boulder, 93.8% cobble/gravel, and 0% sand/silt/clay (Graph 10). Coniferous trees were the dominant vegetation type observed in 50% of the units surveyed, including downed trees, logs, and root wads. Additionally, 21.9% of the

units surveyed had deciduous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on July 24, 1996, in Berry Creek. The sites were sampled by Andrew MacMillan (WSP\AmeriCorps) and David Jones (CCC).

The first site sampled included habitat units 3 through 11, a run, low gradient riffle, run, mid-channel pool, step run, low gradient riffle, step run, low gradient riffle and mid-channel pool approximately 111 feet from the confluence with the Navarro River. The site yielded 18 steelhead and 2 sculpin.

The second site included habitat units 17 through 22, a glide, low gradient riffle, mid-channel pool, plunge pool and trench pool sequence located approximately 535 feet from the confluence with the Navarro River. The site yielded 11 Pacific Giant salamanders and 3 other unidentified salamanders.

DISCUSSION

Berry Creek is a B3 channel type for the entire 2,052 feet of stream surveyed. The suitability of B3 channel types for fish habitat improvement structures is as follows: B3 channel types are excellent for low stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing deflectors and log cover, and good for medium stage plunge weirs.

The water temperatures recorded on the survey days July 18 and 23, 1996, ranged from 60 to 63 degrees Fahrenheit. Air temperatures ranged from 69 to 80 degrees Fahrenheit. This is a good water temperature range for salmonids. Berry Creek seems to have temperatures favorable to 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 50% of the total **length** of this survey, riffles 22%, and pools 15%. The pools are relatively shallow, with only 5 of the 21 (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.

Fifteen of the 21 pool tail-outs measured had embeddedness ratings of 3, 4 or 5. Only 1 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 Berry 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 relatively high with a rating of 72. The shelter rating in the flatwater habitats was 65. 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. 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 divides territorial units to reduce density related competition.

The two 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 62%. This is a relatively moderate 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 moderate at 55.6% and 54.1%, 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) Berry 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. 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) 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) 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) Increase the canopy on Berry Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

8) There are several log debris accumulations present on Berry 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.

0' Begin survey at confluence with Navarro River. Channel type is an B3.

111' First electrofishing site.

300' Log debris accumulation (LDA), 15' long x 15' wide x 10' high.

333' LDA over entire unit and extending into the next, a dry unit. Retains 20' sediment over 150' of stream. Probable barrier.

535' Second electrofishing site.

559' Very flat topography. Stream choked with sedges.

968' Streambed entirely choked with sedges.

1,119' Braided channel, choked with sedges.

1,482' LDA, 15' long x 10' wide x 10' high, in a bedrock constriction.

1,574' Erosion, 20' long x 40' high.

1,658' LDA, 12' long x 20' wide x 8' high, retaining 5' of sediment.

1,759' Right bank tributary, dry. Accessible to fish.

1,985' Boulder cascade, 20' rise in 60' of stream.

2,052' End of survey. Sixty foot long boulder cascade with a gradient of 33%. At top of the cascade is a small plunge pool (0.7' deep) with a 10.5 waterfall. It is just downstream from a high gradient riffle 30' long. All of these components combined create the end of anadromy.

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.

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