STREAM INVENTORY REPORT

Bottom Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1994 on Bottom 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 Bottom 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.

There is no known record of adult spawning surveys having been conducted on Bottom 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.

WATERSHED OVERVIEW

Bottom Creek is tributary to the Little North Fork Navarro River, tributary to the North Branch North Fork Navarro River, located in Mendocino County, California. Bottom Creek's legal description at the confluence with Little North Fork Navarro River is T16N R15W S36. Its location is 39°11'55" North latitude and 123°28'42" West longitude. Bottom Creek is a first order stream and has approximately 1.7 miles of blue line stream according to the USGS Bailey Ridge and Navarro 7.5 minute quadrangles. Bottom Creek drains a watershed of approximately 3.5 square miles. Summer base runoff is approximately 0.03 cubic feet per second (cfs) at the mouth. Elevations range from about 480 feet at the mouth of the creek to 1,300 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 Masonite Road.

METHODS

The habitat inventory conducted in Bottom 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 that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Bottom Creek personnel were trained in June, 1994, by Gary Flosi and Scott Downie. This inventory was conducted by a two-person team.

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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 Bottom 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 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 each tenth unit typed. 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". Bottom 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 Bottom 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 Bottom 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 and recorded as a one and two respectively.

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 Bottom 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 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 Bottom Creek, the dominant composition type and the dominant vegetation type of both the right and left banks 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. 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.

Biological inventory was conducted in Bottom Creek to document the fish species composition and distribution. Two sites were electrofished in Bottom Creek using one Smith-Root Model 12 electrofisher. Each site was end-blocked with nets to contain the fish within the sample reach.

Fish from each site were counted by species, measured, and returned to the stream.

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 Bottom 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 June 27 and 28, 1994, was conducted by Chris Bysshe and Jeff Strayer (CCC). The total length of the stream surveyed was 6,571 feet.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.03 cfs on July 8, 1994.

Bottom Creek is a F4 channel type for the first 4,814 feet of stream reach surveyed and a B4 channel for the remaining 1,757 feet. F-type channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios. F4 channels have gravel-dominant substrates. B-type channels are moderately entrenched, moderate gradient, riffle-dominated channels with infrequently spaced pools, very stable plan and profile, and stable banks. B4 channels have gravel-dominant substrates.

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Water temperatures ranged from 57 to 66 degrees Fahrenheit. Air temperatures ranged from 65 to 89 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, flatwater types made up 36%, pool types 32%, and riffles 31% (Graph 1). Flatwater habitat types made up 56% of the total survey **length**, pools 23%, and riffles 20% (Graph 2).

Four Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were mid-channel pools, 32%; low gradient riffles, 31%; and step runs, 24% (Graph 3). By percent total **length**, step runs made up 49%, mid-channel pools 23%, and low gradient riffles 20%.

Forty-six pools were identified (Table 3). All the pools were classified as main channel pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Fifteen of the 46 pools (33%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 45 pool tail-outs measured, 39 had a value of 1 (87%); 5 had a value of 2 (11%); 1 had a value of 3 (2%); and none had a value of 4 (0%). 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. Riffle habitat types had the highest shelter rating at 104. Pool habitats followed with a rating of 95 (Table 1).

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

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 40 of the 44 low gradient riffles (91%). Small cobble was the next most frequently observed dominant substrate type and occurred in 5% of the low gradient riffles (Graph 8).

Twenty-eight percent of the survey reach lacked shade canopy. Of the 72% of the stream covered with canopy, 34% was composed of deciduous trees, and 66% was composed of coniferous trees. Graph 9 describes the canopy in Bottom Creek.

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 74%. The mean percent left bank vegetated was 77%. The dominant elements composing the structure of the stream banks consisted of 2.8% bedrock, 0% boulder, 43.7% cobble/gravel, and 53.5% sand/silt/clay (Graph 10). Coniferous trees, including down trees, logs, and root wads, were the dominant vegetation type observed in 67% of the units surveyed. Additionally, 27% of the units surveyed had deciduous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on July 8, 1994, in Bottom Creek. The units were sampled by Gary Flosi and Wendell Jones (DFG) and Chris Bysshe and Jeff Strayer (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was habitat units 007-009, a run / low gradient riffle / run combination approximately 233 feet from the confluence with Little North Fork Navarro River. This site had an area of 998 sq ft and a volume of 466 cu ft. The unit yielded 26 steelhead between 39 and 109 mm; 40 California roach between 35 and 100 mm; three, three-spine stickleback between 43 and 51 mm; and one unidentified newt.

The second site was habitat unit 029-031, a step run / mid-channel pool / step run combination located approximately 1,674 feet above the creek mouth. This site had an area of 1,012 sq ft and a volume of 631 cu ft. The site yielded 59 steelhead between 33 and 135 mm; nine California roach between 65 and 83 mm; and three, three-spine stickleback between 45 and 49 mm.

DISCUSSION

Bottom Creek has two channel types: F4 and B4. The F4 channel type is considered good for bank-placed boulders; fair for low-stage weirs, single and opposing wing deflectors, channel constrictors, bank cover, and log cover structures; and poor for medium-stage weirs and random boulder placement. The B4 channel type is considered excellent for low-stage weirs, random boulder placement, bank-placed boulders, single and opposing wing deflectors, channel constrictors, bank cover, and log cover structures; and good for medium-stage weirs.

The water temperatures recorded on the survey days June 27 and 28, 1994, ranged from 57 to 66° Fahrenheit. Air temperatures ranged from 65 to 89° Fahrenheit. This is a good water temperature range 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 56% of the total **length** of this survey, riffles 20%, and pools 23%. The pools are relatively shallow, with only 15 of the 46 pools having a maximum depth greater than 2 feet. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total 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 log debris accumulations (LDA's) in the stream. Any necessary modifications to the LDA's should be done with the intent of metering any gravel out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Thirty-nine of the 45 pool tail-outs measured had an embeddedness rating of 1. Only one had a rating of 3 or 4. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead.

The mean shelter rating for pools was high with a rating of 95. The shelter rating in the flatwater habitats was slightly lower at 81. A pool shelter rating of approximately 100 is desirable. The relatively large amount of cover that now exists is being provided primarily by aquatic vegetation in all habitat types. Additionally, large woody debris, undercut banks, and boulders contribute a small amount. Additional 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.

Forty-two of the 44 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 72%. This is a relatively high percentage of canopy, since 80 percent is generally considered optimum in these north coast streams.

The percentage of right and left bank covered with vegetation was high at 74% and 77%, 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) Bottom Creek should be managed as an anadromous, natural production stream.

2) Where feasible, design and engineer pool enhancement structures to increase the number of pools and deepen the existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from aquatic vegetation. Adding high quality complexity with woody cover is desirable and in some areas the material is at hand.

4) Increase the canopy on Bottom 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 affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

5) There are several log debris accumulations present on Bottom Creek. 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'	Begin survey at confluence with Little North Fork Navarro River. Channel type is F4.
4814'	Channel type changes to B4.
5743'	Log and debris accumulation (LDA) 4' high x 8' wide x 12' long. Possible barrier.
6047'	LDA 6' high x 10' wide x 15' long.
6299'	LDA, unspecified dimensions.
6422'	Right bank tributary.
6571'	End of wetted channel. End of survey.

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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

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