STREAM INVENTORY REPORT

Barnwell Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Barnwell Creek to assess habitat conditions for anadromous salmonids. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Barnwell Creek. 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 Barnwell Creek. 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.

WATERSHED OVERVIEW

Barnwell 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 Mendocino County, California (Figure 1). Barnwell Creek's legal description at the confluence with the South Fork Eel River is T22N R16W S20. Its location is 39.7592 degrees north latitude and 123.7464 degrees west longitude. Barnwell Creek is a first order stream and has approximately 0.5 miles of blue line stream, according to the USGS Lincoln Ridge 7.5 minute quadrangle. Barnwell Creek drains a watershed of approximately 0.7 square miles. Elevations range from about 1,200 feet at the mouth of the creek to 2,400 feet in the headwater areas. Douglas fir forest and oak forest dominate the watershed. The watershed is privately owned and is managed for timber production and rangeland. Vehicle access exists from Highway 101 at Laytonville, then west past Branscomb on Highway 271 to Sanctuary Road. Follow Sanctuary Road to a point one mile past Wilderness Lodge and wade the South Fork Eel to Barnwell Creek. Access is controlled by Wilderness Lodge.

METHODS

The habitat inventory conducted in Barnwell Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) and contract seasonal Technical Advisors that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG) in May, 1992.

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 Barnwell 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 by David Rosgen (1985). 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 four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.

3. Temperatures:

Both water and air temperatures are taken and recorded at each tenth unit typed. The time of the measurement is also recorded. Both temperatures are taken in 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". Barnwell 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 Barnwell 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 Barnwell 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.

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 Barnwell 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:

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 Barnwell Creek, the dominant composition type in both the right and left banks was selected from a list of eight options on the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the California Department of Fish and Game (DFG). This program also processes and summarizes the data.

The Habitat Runtime program produces the following 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 Barnwell 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

HABITAT INVENTORY RESULTS

The habitat inventory of June 8, 1992 was conducted by Warren Mitchell and Judah Sanders (contract seasonals). The total length of the stream surveyed was 2,640 feet.

Flow was not measured on Barnwell Creek.

Barnwell Creek is an A5 channel type for the entire 1,213 feet of stream reach surveyed. A5 channels are steep (4-10% gradient), very well confined streams with unstable stream banks.

Water temperatures ranged from 59 to 64 degrees Fahrenheit. Air temperatures ranged from 66 to 76 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, riffles made up 47%, pools 34%, and flatwater 2% (Graph 1). Riffle habitat types made up 62% of the total survey length, flatwater 19%, and pools 17% (Graph 2).

Eleven Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent occurrence were low gradient riffles, 26%; high gradient riffles, 21%; and mid-channel pools, 16% (Graph 3). By percent total length, low gradient riffles made up 40%, high gradient riffles 22%, and mid-channel pools 8%.

Thirteen pools were identified (Table 3). Main-channel pools were most often encountered at 53.9%, and comprised 65.1% of the total length of pools (Graph 4).

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Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Four of the 13 pools (31%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 12 pool tail-outs measured, two had a value of 2 (17%); five had a value of 3 (42%); and five had a value of 4 (42%). 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. Pool habitat types had the highest shelter rating at 63. Riffle habitats followed with a rating of 33 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 158. Scour pools had a shelter rating of 56, and main channel pools had a shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Barnwell Creek and are extensive. Root mass and terrestrial vegetation are lacking in nearly all habitat types. Graph 7 describes the pool cover.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in six of the 10 low gradient riffles (60%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 30% of the low gradient riffles (Graph 8).

Twenty-nine percent of the survey reach lacked shade canopy. Of the 71% of the stream covered with canopy, 42% was composed of deciduous trees, and 30% was composed of coniferous trees. Graph 9 describes the canopy in Barnwell 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 31%. The mean percent left bank vegetated was 32%. The dominant elements composing the structure of the stream banks consisted of 38% bare soil, 20% cobble/gravel, 13% boulders, 13% grass, and 12% brush. Additionally, 1% of the banks were covered with deciduous trees, and 3% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

DISCUSSION

A5 channel types are generally not suitable for fish habitat improvement structures. A5 channels are found in high energy, steep gradient stream reaches. They have channels dominated by silt and clay, do not retain gravels very well, and have unstable banks.

The water temperatures recorded on the survey day June 8, 1992 ranged from 59 to 64 degrees Fahrenheit. Air temperatures ranged from 66 to 76 degrees Fahrenheit. This is a fair water temperature regime for salmonids. However, 64 degrees Fahrenheit, if sustained, is near the threshold stress level 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.

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Flatwater habitat types comprised 19% of the total length of this survey, riffles 62%, and pools 17%. The pools are relatively shallow with only three of the 13 pools having a maximum depth greater than two feet. However, 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. Therefore, 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 gravels. Any necessary modifications to them should be done with the intent of metering the gravels 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.

Ten of the 12 pool tail-outs measured had embeddedness ratings of 3 or 4. None had an embeddedness rating of 1. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Barnwell Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was moderate with a rating of 63. The shelter rating in the flatwater habitats was lower at 20. However, 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 all habitat types. Additionally, large and small woody debris 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 structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

Nine of the 10 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% is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Barnwell Creek should be managed as an anadromous, natural production stream.

2) Temperatures in this section of Barnwell Creek, as well as upstream, should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

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 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 at hand.

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) There are several log debris accumulations present on Barnwell 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.

7) Due to the high gradient of the stream, access for migrating salmonids is an ongoing potential problem. Fish passage should be monitored, and improved where possible.

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'	Start of survey at confluence with South Fork Eel River. Channel is braided at mouth with fine sediments.
533'	Small pocket of water adjacent to right bank, very embedded. Many young-of-the-year (YOY) salmonids observed.
660'	Log jam measures 20' wide x 9' high and is retaining silt and some gravel. It is also causing stream to flow sub-surface for 17'.
753'	Log jam measures 6' high x 7' long x 15' wide. Pool located under log-jam. YOY observed.
1213'	Log jam measures 8' high x 21' wide x 20' long and is retaining 10-12' of gravel. End of survey. There are five to six log jams in the quarter mile upstream of this point.

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