STREAM INVENTORY REPORT

Daugherty Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1993 on Daugherty 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 Daugherty 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 Daugherty Creek. Electrofishing conducted by the Department of Fish and Game in October 1988 found juvenile coho salmon and steelhead. 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

Daugherty Creek is tributary to the South Fork Big River, located in Mendocino County, California (Figure 1). The legal description at the confluence with the South Fork Big River is T16N R14W S19. Its location is 39°13'46" N. latitude and 123°27'46" W. longitude. Daugherty Creek is a third order stream and has approximately 7.4 miles of blue line stream, according to the USGS Baily Ridge and Orrs Springs 7.5 minute quadrangles. Daugherty Creek and its tributaries drain a basin of approximately 16.6 square miles, and the system has a total of 15.2 miles of blue line stream. Elevations range from about 470 feet at the mouth of the creek to 2200 feet in the headwater areas. Redwood and douglas fir forest dominates the watershed. The watershed is owned primarily by the Louisiana-Pacific Corporation and is managed for timber production. Vehicle access exists from the Masonite Road.

METHODS

The habitat inventory conducted in Daugherty 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). Daugherty Creek personnel were trained in May, 1993, by Gary Flosi and Scott Downie. This inventory was conducted by two person teams.

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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 Daugherty 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. 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". Daugherty 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 Daugherty 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 Daugherty 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 Daugherty 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 Daugherty 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.

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 Daugherty Creek to document the fish species composition and distribution. Three sites were electrofished in Daugherty 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 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 Daugherty 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 July 12 through 28, 1993, was conducted by Brian Humphrey, Charles Patton, and Chris Coyle (CCC). The survey began at the confluence with the South Fork Big River. The total length of the stream surveyed was 41,490 feet, with an additional 612 feet of side channel.

Flows were not measured on Daugherty Creek.

This section of Daugherty Creek has two channel types: from the mouth to 37,250 a B1; the remainder of the stream is a A3. B1 channels are moderate gradient (2.5-4.0%), moderately confined boulder/large cobble channels. A3 channels are steep, erodible, coarse grained channels.

Water temperatures ranged from 55 to 73 degrees fahrenheit. Air temperatures ranged from 52 to 85 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 37.0%, flatwater types 31.3%, and pools 31.5% (Graph 1). Flatwater habitat types made up 40.3% of the total survey **length**, riffles 34.3%, and pools 25.1% (Graph 2).

Eighteen 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, 36.2%; runs, 16.9%; mid-channel pools, 12.5%; and step runs, 11.0% (Graph 3). By percent total **length**, low gradient riffles made up 33.9%, and step runs 23.1%.

Three-hundred-eleven pools were identified (Table 3). Scour pools were most often encountered at 57.9%, and comprised 61.2% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Fifty-seven of the 311 pools (18%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 311 pool tail-outs measured, 40 had a value of 1 (12.8%); 94 had a value of 2 (30.1%); 99 had a value of 3 (32.0%); and 78 had a value of 4 (25.2%). On this scale, a value of one is 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. Pools had the highest shelter rating at 40.4. Riffles had the lowest rating with 15.2 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 55.0, main channel pools rated 42.0 and scour pools 39.0 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders and bedrock ledges are the dominant cover type in Daugherty Creek. Graph 7 describes the pool cover in Daugherty Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 276 of the 357 low gradient riffles (77.3%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 14.0% of the low gradient riffles (Graph 8).

Nearly 32% of Daugherty Creek lacked shade canopy. Of the 68% of the stream that was covered with canopy, 51% was composed of deciduous trees, and 49% was composed of coniferous trees. Graph 9 describes the canopy in Daugherty 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 54.1%. The mean percent left bank vegetated was 57.6%. The dominant elements composing the structure of the stream banks consisted of 13.0% bedrock, 0.1% boulder, 7.8% cobble/gravel, 6.5% bare soil, 18.6% grass, 5.4% brush. Additionally, 29.2% of the banks were covered with deciduous trees, and 19.4% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on August 26, 1993 in Daugherty Creek. The units were sampled by Craig Mesman and Charles Patton (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was habitat unit 40, a lateral scour pool bedrock, approximately 2,026 feet from the confluence with the South Fork Big River. The site had an area of 826 sq ft, and a volume of 1322 cu ft. The sample included 26 steelhead, ranging from 52 to 128mm; 8 stickleback and 6 Pacific lamprey ammocetes.

The second sample site was habitat units 719, 720 and 721, a run, low gradient riffle, and mid-channel pool, approximately 32,856' above the confluence with the South Fork Big River. This site had an area of 524 sq ft, and a volume of 555 cu ft. The sample included 22 steelhead, ranging from 41 to 155mm; 2 sculpin, and 4 stickleback.

The third site was approximately 50' above the end of the survey, a low gradient riffle and plunge pool, approximately 41,490 feet from the confluence with the South Fork Big River. No fish were sampled.

DISCUSSION

Daugherty Creek has two channel types: an A3 and a B1. The high energy and steep gradient of the A3 channel type is generally not suitable for instream enhancement structures. The B1 channel type is excellent for many types of low and medium stage instream enhancement structures. There are 37,250 feet of this type of channel in Daugherty Creek. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and pool cover.

The water temperatures recorded on the survey days July 12-28, 1993 ranged from 55° F to 73° F. Air temperatures ranged from 52° F to 85° F. These warm water temperatures, if sustained, are above the stress threshold level for salmonids. It is unknown if this thermal regime is typical. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 40.3% of the total **length** of this survey, riffles 34.4%, and pools 25.1%. The pools are relatively shallow with only 57 of the 311 pools having a maximum depth greater than 3 feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total 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. Therefore, installing structures that will increase pool habitat is recommended for locations where their installation will not jeopardize unstable stream banks, or subject the structures to high stream energy.

One-hundred-seventy-seven of the pool tail-outs measured had embeddedness ratings of 3 or 4. Forty had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Daugherty 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 low with a rating of 40.4. The shelter rating in the flatwater habitats was 15.2. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders and bedrock ledges 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 structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Three-hundred-twenty-six of the 357 low gradient riffles had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the survey reach was 68%. Eighty percent canopy is generally considered desirable. Elevated water temperatures could be reduced by increasing stream canopy. Cooler water temperatures are desirable in Daugherty Creek. The large trees required to contribute shade to the wide channel typical of this reach would also eventually provide a long term source of large woody debris needed for instream structure.

RECOMMENDATIONS

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

2) Temperatures in this section of Daugherty 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) Where feasible, increase woody cover in the pool and flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is

desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations. 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) 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 Daugherty 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.

COMMENTS 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):	Comment:
0'	Begin survey at confluence with the South Fork Big River. Channel type is B1.
1019'	Left bank erosion, 30' high x 15' wide, contributing fines into the channel.
1705'	Log bridge, 25' high.
2516'	Tributary enters from the right bank.
4652'	Tributary enters from the right bank.
5385'	Right bank erosion, 40' high x 30' wide, contributing fines into the channel.
5710'	Tributary enters from the left bank.
9596'	Soda Creek enters from the right bank.
10305'	Log bridge, 22' long x 15' wide x 8' high.
11242'	Tributary enters from the right bank.

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11966'	Road crossing.
12475'	Railroad car bridge, 20' high.
12928'	Tributary enters from the left bank.
13774'	Gates Creek confluence.
14924'	Bank erosion, 60' high x 30' wide.
15575'	Bank erosion.
15776'	Road crossing.
15875'	Bank erosion.
16086'	Left bank erosion, 50' long x 50' high, contributing fines into the channel.
16622'	Log debris accumulation (LDA), 35' wide x 20' long x 5' high, with associated right bank erosion.
17222'	Left bank erosion, 15' high x 25' wide, contributing fines into the channel.
17246'	Left bank erosion.
17322'	Left bank erosion, 10' high x 10' long.
19128'	LDA, 30' wide x 5' high x 100' long. No barrier.
19306'	LDA, 15' wide x 20' long x 6' high. No barrier.
19370'	Right bank erosion.
19578'	Left bank erosion, 200' high x 200' long, contributing fines into the channel.
19636'	Right bank erosion, 40' high x 100' long, contributing fines into the channel.
20770'	Tributary enters from the right bank.
21066'	LDA, 40' long x 50' wide x 6' high. No barrier.
21388'	Bank erosion 150' high x 150' long; 90% revegetated.
21507'	Bank erosion 25' high.
22030'	LDA, 30' long x 50' wide x 7' high.

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22471' Right bank erosion 50' high x 70' long, contributing fines into the channel.

22495' Remains of a Humboldt crossing deflecting the flow into the right bank creating bank erosion.

23139' Left bank erosion 40' high x 50' long. Horse Thief Creek enters from the right bank.

24064' Tributary enters from the left bank.

24260' Right bank erosion, 10' high x 30' long.

24391' Left bank erosion 15' high x 60' long.

24519' Right bank erosion 100' high x 100' long; 50% revegetated.

25325' Left bank erosion 40' high x 40' long, contributing fines into the channel.

25370' Right bank erosion, 10' high x 50' long, contributing fines into the channel.

25798' LDA, 10' long x 30' wide x 6' high. No barrier.

27918' Tributary enters from the right bank.

28152' Left bank erosion, 30' long x 70' high; 40% revegetated.

28367' Left bank erosion, 60' long x 40' high, contributing fines into the channel; 20% revegetated.

30456' LDA, 50' long x 50' wide x 6' high. No barrier.

31731' eft bank erosion, 40' long x 30' high, contributing fines into the channel.

32887' LDA, 10' long x 16' wide, 6' high. No barrier.

33271' Snuffins Creek enters from the right bank.

33709' Tributary enters from the left bank.

33718' LDA, 30' wide x 7' high x 25' long, retaining gravel. No barrier.

34285' Right bank erosion 40' high x 50' long, contributing fines into the channel.

36864' Left bank erosion, 10' high x 40' long, contributing fines into the channel.

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37250'	Channel type change from B1 to A3.
38191'	Tributary enters from the left bank.
38259'	LDA, 20' long x 15' wide x 7' high. No barrier.
38848'	Left bank erosion, 20' high x 30' long, contributing fines into the channel.
39678'	Left bank erosion, 8' high.
39967'	Log creating a 3.5' plunge and retaining gravel.
40004'	Road crossing.
40271'	LDA, 25' wide x 10' long x 7' high, with associated right bank erosion. No barrier.
40339'	Right bank erosion, 20' high x 25' long.
40392'	Left bank erosion, 10' high x 30' long.
40434'	Right bank erosion, 8' high x 30' long.
40468'	Left bank erosion, 15' high x 25' long, contributing fines into the channel.
40959'	Culvert, 105' long x 9' diameter.
41051'	LDA, retaining gravel 5' high.
41173'	LDA, 8' high x 40' wide x 20' long.
41396'	Left bank erosion 30' high x 40' long.
41410'	LDA, 4' high, retaining gravel.
41443'	LDA, 13' long x 15' wide x 7' high, retaining gravel 6' high, with associated right bank erosion 100' high x 50' long. End of survey due to the steep gradient and numerous log jams.

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