STREAM INVENTORY REPORT

Line Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1994 on Line 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 Line 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 Line 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

Line Creek is tributary to the South Fork Elk River, a tributary to Elk River, a tributary to Humboldt Bay, which drains to the Pacific Ocean. It is located in Humboldt County, California. Line Creek's legal description at the confluence with South Fork Elk River is T03N R01E S03. Its location is 40.6631 degrees north latitude and 124.0603 degrees west longitude. Line Creek is an intermittent stream according to the USGS McWhinney Creek 7.5 minute quadrangle. Line Creek drains a watershed of approximately 1.2 square miles. Elevations range from about 400 feet at the mouth of the creek to 1,500 feet in the headwater areas. Redwood forest and Douglas fir forest dominate the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists via U.S. Highway 101 at the Elk River Road exit, thence approximately 5.4 miles east on Elk River Road, thence approximately 6.5 miles east on Elk River Timber Company's Ridge Road to Line Creek.

METHODS

The habitat inventory conducted in Line 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). Line Creek personnel were trained in June, 1994, by Gary Flosi and Scott Downie. This inventory was conducted by a two person team.

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 Line 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, 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 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". Line 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 Line 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 Line 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 Line 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 Line 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 Line Creek to document the fish species composition and distribution. Three sites were electrofished in Line Creek using a 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 Line 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 29 and June 30, 1994 was conducted by Chris Coyle and Charles Bartolotta (CCC). The total length of the stream surveyed was 2,779 feet with an additional 120 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.3 cfs on June 29, 1994.

Line Creek is an F4 channel type for the entire 2,779 feet of stream reach surveyed. F4 channels are entrenched, meandering riffle-pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

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The water temperature remained 54 degrees Fahrenheit throughout the survey. Air temperatures ranged from 58 to 63 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 43%, riffles 31%, and flatwater 26% (Graph 1). Pool habitat types made up 42% of the total survey length, flatwater 29%, and riffles 28% (Graph 2).

Sixteen 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, 28%; mid-channel pools, 25%; and runs, 12% (Graph 3). By percent total length, low gradient riffles made up 26%, mid-channel pools 26%, and step runs 17%.

Fifty-one pools were identified (Table 3). Main channel pools were most often encountered at 61% and comprised 63% 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. Nineteen of the 51 pools (37%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 48 pool tail-outs measured, 31 had a value of 2 (65%); six had a value of 3 (13%); and 11 had a value of 4 (23%). 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 56. Riffle habitats followed with a rating of 39 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 59. Main channel pools had a shelter rating of 55 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 13 of the 33 low gradient riffles (39%). Boulders were the next most frequently observed dominant substrate type and occurred in 33% of the low gradient riffles (Graph 8).

Five percent of the survey reach lacked shade canopy. Of the 95% of the stream covered with canopy, 57% was composed of deciduous trees, and 43% was composed of coniferous trees. Graph 9 describes the canopy in Line 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 84%. The mean percent left bank vegetated was 84%. The dominant elements composing the structure of the stream banks consisted of 46% sand/silt/clay, 38% cobble/gravel, 15% boulders, and 1% bedrock (Graph 10). Deciduous trees were the dominant vegetation type observed in 35% of the units surveyed. Additionally, 23% of the units surveyed had grass (including ferns) as the dominant vegetation type, 21% had brush, and 19% had coniferous trees

as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on July 5, 1994 in Line Creek. The units were sampled by Craig Mesman and Chris Coyle (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was Habitat Units #019 and #020, a low gradient riffle and a log enhanced lateral scour pool approximately 442 feet from the confluence with the South Fork Elk River. This site had an area of 280 square feet and a volume of 159 cubic feet. The unit yielded two steelhead of 84 and 196 mm, eight coho between 48 and 70 mm, four Pacific giant salamanders, and one tailed frog.

The second site was Habitat Unit #095, a log formed backwater pool located 2,209 feet above the creek mouth. This site had an area of 200 square feet and a volume of 200 cubic feet. Four steelhead between 36 and 119 mm and two Pacific giant salamanders were sampled.

The third site sampled was a high gradient riffle / step run series located approximately 3,330 feet above the creek mouth and approximately 550 feet above the 1994 end of survey. This site was upstream from a log debris accumulation suspected of being a complete barrier to fish movement. The site had an area of 350 square feet and a volume of 175 cubic feet. Numerous Pacific giant salamanders were observed, but no fish were sampled.

DISCUSSION

Line Creek is an F4 channel type for the entire distance surveyed. F4 channel types are 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 water temperature recorded on the survey days June 29 and June 30, 1994, was 54 degrees Fahrenheit. Air temperatures ranged from 58 to 63 degrees Fahrenheit. This is a very good water temperature regime 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.

Pool habitat types comprised 42% of the total length of this survey, flatwater 29%, and riffles 28%. The pools are relatively shallow with only 19 of the 51 pools having a maximum depth greater than two 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 the log debris accumulations (LDA's) in the stream. The LDA's in the system are retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the 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.

Seventeen of the 48 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 Line 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 moderate with a rating of 56. The shelter rating in the flatwater habitats was lower at 30. A pool shelter rating of approximately 100 is desirable. The relatively moderate 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.

Seventeen of the 33 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 95%. This is a relatively high percentage of canopy, since 80 percent 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) Line Creek should be managed as an anadromous, natural production stream.

2) 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 at hand.

3) 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.

4) 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.

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5) There are several log debris accumulations present on Line 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 the distances are approximate and taken from the beginning of the survey reach.

Position (ft):	Comments:
0'	Start of survey at the confluence with South Fork Elk River. Channel type is F4.
24'	Log stringer bridge measures 35' long x 20' wide x 7' high.
208'	Log debris accumulation (LDA) measures 4' high x 20' wide x 7' long. It is retaining a volume of gravel measuring 3' high x 10' wide x 30' long.
517'	Unconsolidated LDA with gravel retention 2' deep at base. Braided flow.
533'	LDA measures 3' high x 20' wide x 4' long. It is retaining a volume of gravel measuring 15' wide x 1' deep at base.
839'	Left bank erosion site measures 8' high x 30' long. It is contributing fine sediment to the channel.
947'	Modified LDA. Flow is percolating to right side of notched log.
1137'	Right bank tributary. Flow estimated at 1-2 gallons per minute. Not accessible to anadromous fish.
1395'	LDA measures 3' high x 20' wide x 6' long. It is retaining a volume of gravel measuring 15' wide x 20' long x 2' deep at base.
1487'	LDA measures 3' high x 15' wide 6' long. It is retaining a volume of gravel measuring 10' wide x 10' long x 2' deep at base.
1523'	Three foot high plunge over debris.
1584'	Tiered, braided LDA with considerable silt retention. Total dimensions equal 12' high x 40' wide x 90' long.

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1776' LDA measures 8' high x 50' wide x 20' long. It is retaining a volume of gravel measuring 50' wide x 90' long x 6' deep at base, with slight down-cutting.

2088' Unconsolidated LDA measures 4' high x 20' wide x 10' long. It is not retaining sediment.

2139' Three foot high plunge over debris.

2157' Log stringer bridge measures 40' long x 24' wide x 0' high. Gravel and debris are accumulating on lowermost stringers.

2347' LDA measures 5' high x 15' wide x 10' long. It is retaining a volume of gravel measuring 10' wide x 3' deep at base.

2779' End of survey. Probable end of historically anadromous reach due to boulder-dominant substrate and lack of spawning gravel.

3059' Gradient increases to 4%.

3239' LDA measures 20' high x 40' wide x 90' long.

3539' Gradient increases to 10%.

3679' Gradient increases to 25%.

LEVEL III and LEVEL IV HABITAT TYPE KEY

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