STREAM INVENTORY REPORT

Lake Creek

INTRODUCTION

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

Lake Creek is tributary to North Fork Elk River, a tributary to the Elk River, a tributary to Humboldt Bay, which drains to the Pacific Ocean. It is located in Humboldt County, California. Lake Creek's legal description at the confluence with North Fork Elk River is T04N R01E S32. Its location is 40.6919 degrees north latitude and 124.0911 degrees west longitude. Lake Creek is a first order stream and has approximately 2.1 miles of blue line stream according to the USGS McWhinney 7.5 minute quadrangle. Lake Creek drains a watershed of approximately 2.2 square miles. Elevations range from about 120 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 Elk River Timber Company's Ridge Road at the Lake Creek spur.

METHODS

The habitat inventory conducted in Lake 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). Lake 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 Lake 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". Lake 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 Lake 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 Lake 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 Lake 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 Lake Creek, the dominant bank 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 Lake Creek to document the fish species composition and distribution. Three sites were electrofished in Lake 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 Lake 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 21, 1994 was conducted by Craig Mesman and Chris Coyle (CCC). The total length of the stream surveyed was 825 feet.

Flow was estimated to be less than 0.2 cfs during the survey period.

Lake Creek is an F3 channel type for the entire 825 feet of stream reach surveyed. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

Water temperature remained constant at 55 degrees Fahrenheit during the survey period. Air temperatures ranged from 59 to 60 degrees Fahrenheit.

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Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 43%, riffles 29%, and flatwater 21% (Graph 1). Pool habitat types made up 42% of the total survey length, dry units 28%, and flatwater 17% (Graph 2).

Nine 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 29%; low gradient riffles 25%; and runs 14% (Graph 3). By percent total length, mid-channel pools made up 32%, dry units 28%, and low-gradient riffles 11%.

Twelve pools were identified (Table 3). Main channel pools were most often encountered at 67% and comprised 76% 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. Seven of the 12 pools (58%) 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 1 (17%); seven had a value of 2 (58%); one had a value of 3 (8%); and two had a value of 4 (17%). 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 37. Riffle habitats followed with a rating of 26 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 50. Main channel pools had a shelter rating of 34 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Lake Creek. Graph 7 describes the pool cover in Lake Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in four of the seven low gradient riffles (57%). Small cobble was the next most frequently observed dominant substrate type and occurred in 29% 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, 64% was composed of deciduous trees, and 36% was composed of coniferous trees. Graph 9 describes the canopy in Lake 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 89%. The mean percent left bank vegetated was 88%. The dominant elements composing the structure of the stream banks consisted of 84% sand/silt/clay, 13% bedrock, and 4% cobble/gravel (Graph 10). Brush was the dominant vegetation type observed in 61% of the units surveyed. Additionally, 4% of the units surveyed had deciduous trees as the dominant vegetation type, and 11% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on June 27 and June 28, 1994 in Lake Creek. The units were sampled by Chris Coyle and Craig Mesman (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was Habitat Unit #005, a mid-channel pool approximately 79 feet from the confluence with North Fork Elk River. This site had an area of 308 square feet and a volume of 308 cubic feet. The unit yielded one 100 mm steelhead, 31 coho between 45 and 70 mm, three coastal cutthroat trout between 77 and 85 mm, one 50 mm three-spine stickleback, and one Pacific giant salamander.

The second site was Habitat Units #007 and #008, a run/mid-channel pool combination located approximately 140 feet above the creek mouth and just upstream from a suspected low-flow barrier. This site had an area of 339 square feet and a volume of 303 cubic feet. The site yielded six coastal cutthroat trout between 43 and 97 mm.

The third site sampled was a series of mid-channel pools located approximately 6,100 feet above the creek mouth and approximately one mile upstream from the 1994 end of survey. The site yielded 13 coastal cutthroat trout between 38 and 111 mm.

DISCUSSION

Lake Creek is an F3 channel type for the entire 825 feet surveyed. The F3 channel type is considered good for bank-placed boulders and single and opposing wing deflectors; fair for low-stage weirs, random boulder placement, channel constrictors, bank cover, and log cover structures; and poor for medium-stage weirs.

The water temperature recorded on the survey day June 21, 1994 was 55 degrees Fahrenheit. Air temperatures ranged from 59 to 60 degrees Fahrenheit. This is a very good water temperature range 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 17%, and riffles 13%. The pools are relatively deep, with seven of the 12 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 numerous 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.

Three of the 12 pool tail-outs measured had embeddedness ratings of 3 or 4. Only two 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 Lake 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 37. The shelter rating in the flatwater habitats was lower at 18. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by large woody debris in all habitat types. Additionally, small woody debris contributes 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.

Six of the seven 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.

The percentage of right and left bank covered with vegetation was high at 89% and 88%, respectively. In areas of stream bank erosion or where bank vegetation is at unacceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

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

2) Increase woody cover in the pools and flatwater habitat units. 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) There are several log debris accumulations present on Lake 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.

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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 North Fork Elk River. Channel type is F3.
336'	Small, vegetated log and debris accumulation (LDA).
450'	LDA measures 7' high x 25' wide x 15' long. It is comprised of well-consolidated logs and silt and it is well-vegetated.
505'	LDA measures 5' high x 12' wide x 18' long.
586'	LDA measures 7' high x 15' wide x 12' long. It is comprised of well-consolidated logs and silt. The Channel is continuously clogged with logs, debris, silt, and vegetation upstream at least 225' and beyond.
825'	End of survey. Previously mentioned log/debris/silt matrix continues upstream for an undetermined distance.

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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