STREAM INVENTORY REPORT

ELK CREEK

INTRODUCTION

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

Elk Creek is tributary to the Middle Fork Eel River, tributary to the Eel River, located in Mendocino County, California (Figure 1). The legal description at the confluence with the Middle Fork Eel River is T21N R11W S18. Its location is 39° 40'37" N. latitude and 123°07'58" W. longitude. Elk Creek is a third order stream and has approximately 14 miles of blue line stream, according to the USGS Jamison Ridge, Potter Valley, and Brushy Mountain 7.5 minute quadrangles. Elk Creek and its tributaries drain a basin of approximately 105 square miles, and the system has a total of 29 miles of blue line stream. Elevations range from about 1,150 feet at the mouth of the creek to 5,100 feet in the headwater areas. Oak grasslands and Douglas fir forests dominate the watershed. The Diamond H Ranch, Eden Valley Ranch, Louisiana Pacific, and US Forest Service own major portions of the watershed and it is managed for timber production, grazing, and as a wildlife hunting reserve. Year round vehicle access exists from State Highway 162 near Covelo via a Diamond H Ranch road, or through the Willits-Hearst road.

METHODS

The habitat inventory conducted in Elk Creek followed 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). Elk Creek personnel were trained in May, 1993, by Gary Flosi and Scott Downie. Two people conducted this inventory.

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 Elk 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". Elk 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 Elk 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 Elk 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 Elk 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 Elk 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 Elk Creek to document the fish species composition and distribution. Two sites were electrofished in Elk 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.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85mm).

During field analysis, fine sediment suspended in the liquid portion of the sample is settled in Imhoff cones for one hour, measured, and recorded on a standard field form. The remainder of the sample is sealed in plastic bags with an identification and information ribbon, then taken to the laboratory for final processing.

In the laboratory the samples are wet sieved using standard Tyler screens. All particles greater than 0.85 mm diameter are measured by displacement in graduated cylinders. The volume of

fine sediment less than 0.85 mm is measured following one hour of settling in graduated cylinders or Imhoff cones. The fines measured in the field are added to these results.

Gravel sampling is conducted to determine the percentage of fine sediment present in probable fish spawning areas. These areas are generally found in low gradient riffles at the tail-outs of pools. The higher the percent of fine sediment, the lower the probability for eggs to survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and preventing fry emergence.

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 SAMPLE 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

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of Sept. 14 through Oct. 6, 1994, was

conducted by Ruth Goodfield, Jason MacDonnell, and Craig Mesman (CCC). The survey began at the confluence with the Middle Fork Eel River and extended up Elk Creek to approximately 1/4 mile below the confluence with Deep Hole Creek. The total length of the stream surveyed was 27,944 feet, with an additional 4,254 feet of side channel.

A flow of 0.42 cfs was measured 9-15-94 at habitat unit 4, a run, 155' above the start with a Marsh-McBirney Model 2000 flowmeter.

This section of Elk Creek has two channel types: from the mouth to 13,262 an F3; and the next 10,428 feet an F4. F-type streams are entrenched, meandering riffle/pool channels with low gradients and high width/depth ratios. The substrate in these types is primarily cobble and gravel.

Water temperatures ranged from 52 to 81 degrees fahrenheit. Air temperatures ranged from 41 to 99 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 23%, flatwater types 36%, and pools 38% (Graph 1). Flatwater habitat types made up 42% of the total survey **length**, riffles 17%, and pools 35% (Graph 2).

Thirteen Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were runs, 32%; low gradient riffles, 23%; and mid-channel pools, 18% (Graph 3). By percent total **length**, runs made up 35%, low gradient riffles 17%, and mid-channel pools 24%.

One-hundred-forty-one pools were identified (Table 3). Main-channel pools were most often encountered at 48%, and comprised 68% 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. Eighty-seven of the 141 pools (62%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 141 pool tail-outs measured, twenty-seven had a value of 1 (18.9%); 79 had a value of 2 (56.2%); 32 had a value of 3 (22.9%); and 3 had a value of 4 (2.0%). 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. Pool types had the highest shelter rating at 60. Except for the dry units, riffle types had the lowest rating with 17 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 79, main-channel pools rated 57, and scour pools 45 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Elk Creek. Aquatic vegetation is the next most common cover type. Graph 7 describes the pool cover in Elk Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 60 of the 85 low gradient riffles (71%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 27% of the low gradient riffles (Graph 8).

Nearly 66% of Elk Creek lacked shade canopy. Of the 33% of the stream that was covered with canopy, 89% was composed of deciduous trees, and 11% was composed of coniferous trees. Graph 9 describes the canopy in Elk 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 29.3%. The mean percent left bank vegetated was 29.8%. The dominant elements composing the structure of the stream banks consisted of 6.5% bedrock, 17.7% boulder, 67.5% cobble/gravel, 8.2% bare soil. Additionally, 55.4% of the banks were covered with deciduous trees, and 0.3% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on Oct. 4, 1994 in Elk Creek. The units were sampled by Ruth Goodfield and Jason MacDonnell (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was habitat unit 41, a step run, approximately 2,987 feet from the confluence with the Middle Fork Eel River. The site had an area of 3,936 sq ft, and a volume of 995 cu ft. The sample included zero steelhead, 1 roach, 66mm; 45 squawfish, ranging from 49 to 75mm; 3 Green Sunfish, ranging from 47 to 58mm; and 1 Pacific lamprey ammocete 106mm total length.

The second sample site was habitat unit 202, a run, approximately 17,891 feet above the confluence with the Middle Fork Eel River, and 8,681 feet upstream from the confluence with

Eden Creek. This site had an area of 792 sq ft, and a volume of 475 cu ft. The sample included 3 steelhead, ranging from 69 to 110mm; 38 squawfish, ranging from 37 to 100mm; and 168 roach, which were not measured.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Elk Creek.

DISCUSSION

Elk Creek has two channel types: F4 and F3. The lower 13,262 feet of Elk Creek is an F3 channel type. There is also a 10,428' reach of F4 channel in the middle section of Elk Creek. Both F3 and F4 channels have suitable gradients and the stable stream banks that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective cover for fish. Well placed and engineered structures that constrict the channel to form pool habitat or cover structures are usually appropriate and have a good chance of success in these channel types.

The water temperatures recorded on the survey days September, 14-October,06, 1994 ranged from 52° F to 81° F. Air temperatures ranged from 41° F to 99° F. The warmer water and air temperatures were recorded thoughout the survey reach. These warmer temperatures, if sustained, are above the threshold stress level for salmonids. It is unknown if this thermal regime is typical, but our electrofishing samples found steelhead more frequently in the upper, cooler sample sites. 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 42% of the total **length** of this survey, pools 38%, and riffles 17%. The pools are relatively deep with 87 of the 141 pools having a maximum depth greater than 3 feet. 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.

Thirty-five of the 141 pool tail-outs measured had embeddedness ratings of 3 or 4. Twenty-seven 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 Elk 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 fair with a rating of 60. The shelter rating in the flatwater habitats was lower at 27. Riffles rated lowest at 17. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by aquatic vegetation in all habitat types. Additionally, boulders 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.

Eighty-three of the 85 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 only 33%. This is a very low percentage of canopy, since 80 percent is generally considered desirable. Elevated water temperatures could be reduced by increasing stream canopy. Cooler water temperatures are desirable in Elk Creek. The large trees required to contribute shade to the wide channel typical of the survey reach would also eventually provide a long term source of large woody debris needed for instream structure.

RECOMMENDATIONS

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

2) Temperatures in this section of Elk 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) Increase the canopy on Elk Creek by planting willow, alder, 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.

4) 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.

5) 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.

6) 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.

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.

0'	Begin survey at confluence with Middle Fork Eel River. Channel type is F3 for first 13,262 feet of survey.
155'	Flow measured in habitat unit #4, a run, at 0.42 cfs.
2987'	Bioinventory site #1.
3191'	Road fords creek; road is in use.
9210'	Confluence with Eden Creek. Water temperature in Eden Creek approximately 79° F.
12203'	DFG recording thermograph station. Period of record 9-14-94 to 10-06-94.
12325'	Stream gage located on right bank; not in use.
12822'	First steelhead fry seen during survey!
13262'	Channel type changes to F4 for remainder of survey.
17891'	Bioinventory site #2.

23690' Field season terminated because of weather concerns. End of survey. Resume in the 1995 field season.

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