STREAM INVENTORY REPORT

Soldier Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Soldier Creek. 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 Soldier Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species. There is no known record of adult spawning surveys having been conducted on Soldier 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. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Soldier Creek is tributary to the North Fork Eel River, tributary to the Eel River, located in Trinity County, California. Soldier Creek's legal description at the confluence with the North Fork Eel River is T03S R08E S15. Its location is 40°12'12" North latitude and 123°22'23" West longitude. Soldier Creek is a first order stream, and has approximately 5.0 miles of blue line stream according to the USGS Shannon Butte, Zenia, and Pickett Peak 7.5 minute quadrangles. Soldier Creek drains a watershed of approximately 6.1 square miles. Elevations range from about 2,000 feet at the mouth of the creek to 3,000 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is primarily National Forest and is managed for timber production and diverse recreation. Vehicle access exists via the Zenia road south toward Double Gate Ridge and Atkinson Spring. Follow USFS road 3S15 north towards the Gilman Ranch. The road crosses the mouth of Soldier Creek.

METHODS

The habitat inventory conducted in Soldier Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). The Pacific Coast Fisheries, Wildlife, and Wetlands Restoration Association (PCFWWRA) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Soldier Creek personnel were trained in May, 1996, by Scott Downie and Ruth Goodfield. This inventory was conducted by a two-person team.

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SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 1994). All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth. Habitat unit types encountered for the first time are further measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

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 Soldier 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.

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 every tenth habitat unit. 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. Additionally, a recording thermograph was deployed in Soldier Creek from July 23, 1996 to September 18, 1996 to record temperatures on a 24 hour basis during warm summer months.

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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". Soldier 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. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form (Hopelain, 1995). 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 Soldier 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). Additionally, a rating of "not suitable" (NS) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

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 fully-described 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 Soldier 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 fully-described 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 density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*, 1994. Canopy density relates to the amount of stream shaded from the sun. In Soldier Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or deciduous trees.

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 Soldier Creek, the dominant composition type (options 1-4) and the dominant vegetation type (options 5-9) of both the right and left banks for each fully-described unit 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. In Soldier Creek fish presence was observed from the stream banks. This sampling technique is discussed in the *California Salmonid Stream Habitat Restoration Manual*.

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 0.85 mm (Valentine, 1995).

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

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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 Soldier 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

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

The habitat inventory of July 23, 1996, was conducted by Greg Mullins and Frank Humphrey (PCFFWA). The total length of the stream surveyed was 4,470 feet with an additional 324 feet of side channel.

Flows were not measured on Soldier Creek.

Soldier Creek is a B3 channel type for the first 3,545 feet, and an A3 for the remaining 925 feet of stream reach surveyed. B3 channels are moderately entrenched, moderate gradient, riffle dominated channels with stable banks and cobble-dominant substrates. A3 channels are steep, cascading streams with high energy/debris transport and have cobble-dominant substrates.

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Water temperatures taken during the survey period ranged from 58 to 70 degrees Fahrenheit. Air temperatures ranged from 75 to 77 degrees F. Water temperatures taken with a recording thermograph deployed from July 23 to September 18, 1996, ranged from 50° to 85° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 37% flatwater units, 35% riffle units, 13% pool units, and 1% dry units (Graph 1). Based on total **length** of Level II habitat types there were 46% flatwater units, 27% pool units, 24% riffle units, and 3% dry units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffles, 27%; mid-channel pools, 24%; and runs, 14% (Graph 3). Based on percent total **length**, step runs made up 26%, mid-channel pools 21%, and low gradient riffles 19%.

A total of forty-five pools were identified (Table 3). Main channel pools were most frequently encountered at 87% and comprised 86% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-three of the 45 pools (51%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 45 pool tail-outs measured, 11 had a value of 1 (24%); 18 had a value of 2 (40%); 16 had a value of 3 (36%); and none had a value of 4 (0%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

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. Flatwater habitat types had a mean shelter rating of 25, and pool habitats had a mean shelter rating of 24 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 33. Main channel pools had a mean shelter rating of 22 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Soldier Creek and are extensive. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in Soldier Creek.

Table 6 summarizes the dominant substrate by habitat type. Boulder was the dominant substrate observed in five of the seven low gradient riffles measured (71%). Small cobble was the next most frequently observed dominant substrate type and occurred in 14% of the low gradient riffles (Graph 8).

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The mean percent canopy density for the stream reach surveyed was 54%. The mean percentages of deciduous and coniferous trees were 99% and 1%, respectively. Graph 9 describes the canopy in Soldier Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 36%. The mean percent left bank vegetated was 28%. The dominant elements composing the structure of the stream banks consisted of 2.5% bedrock, 90.0% boulder, 6.3% cobble/gravel, and 1.3% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 56% of the units surveyed. Additionally, 43.8% of the units surveyed had deciduous trees as the dominant vegetation type, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Young-of-the-year (YOY) steelhead rainbow trout were observed from the streambanks by Frank Humphrey and Greg Mullins (PCFWWRA) during the 1996 stream habitat survey.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Soldier Creek.

DISCUSSION

Soldier Creek is a B3 channel type for the first 3,545 feet of stream surveyed and an A3 for the remaining 925 feet. The suitability of B3 channel types for fish habitat improvement structures is described as excellent for low-stage plunge weirs, boulder clusters, and bank-placed boulders; and good for medium-stage plunge-weirs. Because of steep gradient and high energy, A3 channels are generally not considered suitable for fish habitat improvement structures.

The water temperatures recorded on the survey day July 23, 1996, ranged from 58 to 70 degrees Fahrenheit. Air temperatures ranged from 65 to 77 degrees Fahrenheit. Further samples from a recording thermograph deployed during the summer of 1996 measured water temperatures that ranged from 50° to 85° Fahrenheit. This is a warm temperature range for salmonids. Sustained temperatures above 70° F, exceed threshold stress levels for salmonids. Although this seems to be the case here, and Soldier Creek is supporting juvenile steelhead.

Flatwater habitat types comprised 46% of the total **length** of this survey, riffles 24%, dry units

3%, and pools 27%. The pools are relatively deep, with 23 of the 45 (51%) pools having a maximum depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream 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 mean shelter rating for pools was low with a rating of 24. The shelter rating in the flatwater habitats was slightly better at 25. 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, white water 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 structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Five of the seven low gradient riffles had boulders as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean percent canopy density for the stream was 54%. This is a relatively moderate percentage of canopy. In general, re-vegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 36% and 28%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

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

2)The limited water temperature data available suggest that maximum temperatures are above the optimum range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be conducted for 3 to 5 years.

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3)Increase the canopy on Soldier 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) 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.

5)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 locally available.

6)Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 3187', should then be treated to reduce the amount of fine sediments entering the stream.

PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and measured from the beginning of the survey reach.

0'Begin survey at confluence with the North Fork Eel River. Channel type is a B3 for the first 3545' of stream surveyed.

185'Thermograph placed in unit on July 23, 1996.

1001'Slide on right bank (RB); approximately 20' long x 100' wide. Contributing materials directly to the stream channel.

3187'Slide on left bank (LB); approximately 40' long x 250' wide. Material is backed-up in channel for 100' upstream of failure.

3546'Channel type changes from a B3 to an A3 for the remaining 925' of stream surveyed.

4095'Slide on RB; 25' long x 50' wide. Contributing material directly to the stream.

4217'Small tributary enters from LB; temperature is 57°F.

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4470' Stream gradient is steepening; large boulders in channel. Flow is intermittent. End of anadromy. End of survey.

References

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, California.

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