STREAM INVENTORY REPORT

String Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on String 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 String 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 String 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

String Creek is tributary to Rocktree Creek, tributary to Tomki Creek, tributary to the Mainstem Eel River, located in Mendocino County, California. String Creek's legal description at the confluence with Rocktree Creek is T19N R13W S35. Its location is 39°27'51" north latitude and 123°16'18" west longitude. String Creek is a first order stream and has approximately 3.0 miles of blue line stream according to the USGS Willits 7.5 minute quadrangle. String Creek drains a watershed of approximately 5.5 square miles. Elevations range from about 1,760 feet at the mouth of the creek to 2,400 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is privately owned. Vehicle access exists via Commercial St in Willits, to the Hearst-Willits Rd to the mouth.

METHODS

The habitat inventory conducted in String Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). String Creek personnel were trained in May, 1995, by 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 String 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 String Creek from July 31 to August 22 to record temperatures on a 24 hour basis during warm summer months.

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". String 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 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 String 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 String 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.

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 String 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 String 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 String Creek fish presence was observed from the stream banks.

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

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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 Quattro Pro 4. Graphics developed for String 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 27, 31, August 1, 8, 9, and 21, 1995, was conducted by Jeffrey Jahn and Kyra Short (WSP/AmeriCorps). The total length of the stream surveyed was 21,612 feet with an additional 179 feet of side channel.

Flows were not measured on String Creek.

String Creek is an F4 channel type for the entire 21,612 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.

Water temperatures taken during the survey period ranged from 56 to 82 degrees Fahrenheit. Air temperatures ranged from 61 to 95 degrees Fahrenheit. Water temperatures taken with a recording thermograph deployed from July 31 to August 22, 1995, ranged from 54° to 83° Fahrenheit.

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Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 41% flatwater units, 38% riffle units, 19% pool units, and 2% dewatered units (Graph 1). Based on total **length** of Level II habitat types there were 47% flatwater units, 38% riffle units, 19% pool units, and 6% dewatered units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were runs, 41%; low gradient riffles, 37%; and mid-channel pools, 15% (Graph 3). Based on percent total **length**, runs made up 47%, low gradient riffles 28%, and mid-channel pools 16%.

A total of 31 pools were identified (Table 3). Main channel pools were most frequently encountered at 89% and comprised 83% 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. Forty-four of the 165 pools (27%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 107 pool tail-outs measured, 15 had a value of 1 (14%); 45 had a value of 2 (42%); 32 had a value of 3 (30%); and 15 had a value of 4 (14%) (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. Pool habitat types had a mean shelter rating of 42, and flatwater habitats had a mean shelter rating of 14 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 46. Scour pools had a mean shelter rating of 35 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 31 of the 34 low gradient riffles measured (91%). Small cobble was the next most frequently observed dominant substrate type and occurred in 9% of the low gradient riffles (Graph 8).

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The mean percent canopy density for the stream reach surveyed was 73%. The mean percentages of deciduous and coniferous trees were 53% and 20%, respectively (Graph 9).

For the stream reach surveyed, the mean percent right bank vegetated was 57%. The mean percent left bank vegetated was 54%. The dominant elements composing the structure of the stream banks consisted of 3.4% bedrock, 0.5% boulder, 15.7% cobble/gravel, and 80.4% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 51.5% of the units surveyed. Additionally, 3.4% of the units surveyed had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

In String Creek, fish presence was observed throughout the survey from the streambank.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on String Creek.

DISCUSSION

String Creek is an F4 channel type for the entire 21,612 feet of stream surveyed. F4 channel types are generally suitable for fish habitat improvement structures of bank-placed boulders; fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors, and log cover; and poor for medium-stage weirs, and boulder clusters.

The water temperatures recorded on the survey days July 27, 31, August 1,8,9, and 21, 1995, ranged from 56 to 82 degrees Fahrenheit. Air temperatures ranged from 61 to 95 degrees Fahrenheit. Further samples from a recording thermograph deployed during the summer of **1995** measured water temperatures ranged from 54° to 83° Fahrenheit. This is a poor water temperature range for salmonids. These higher water temperatures, if sustained, are above the threshold stress level for salmonids.

Flatwater habitat types comprised 47% of the total **length** of this survey, riffles 38%, and pools 19%. The pools are relatively shallow, with only 44 of the 165 (27%) 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 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.

Forty-seven of the 107 pool tail-outs measured had embeddedness ratings of 3 or 4. Only 15 had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In String 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 low with a rating of 42. The shelter rating in the flatwater habitats was lower at 14. 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, 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.

All of the 34 low gradient riffles measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 73%. 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 moderate at 57% and 54%, 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) String Creek should be managed as an anadromous, natural production stream.
2) The limited water temperature data available suggest that maximum temperatures are above the acceptable 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 performed for 3 to 5 years.

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) 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.

5) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 5281', 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 String 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.

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

0'	Begin survey at confluence with Rocktree Creek. Channel type is F4. Map Site 1.
132'	Bridge. Map Site 2.
1048'	Dry tributary enters from the right bank (RB).
1869'	Dry tributary enters from the RB.
1917'	Possible structure, log cabled to the bank.
2396'	Rip-rap on the RB for the next 140'.
2762'	Possible structure.
3446'	Stock exclusion fence, riparian vegetation enhancement, continues for approximately 420'.
3868'	One foot diameter road culvert.
3914'	Old railroad car bridge.
4271'	Possible structure on the left bank (LB).
5281'	Erosion on the RB, contributing fines.
6566'	Stock exclusion fencing.
6871'	Dry tributary enters from the RB.
8569'	Dry tributary enters from the LB.
10806'	Road bridge.
11228'	Footbridge.
11646'	Spring enters from the RB. Stream ford.
12851'	Rip-rap on the RB.

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12964' Rip-rap on both banks and instream.

13211' Dry tributary enters from the LB.

13369' Large debris accumulation, 8'L x 20'W x 4'H, retaining gravel.

13423' Large debris accumulation, 20'L x 25'W x 6'H

14215' Old bridge.

14594' Willow and boulder rip-rap on the RB.

14780' Boulder rip-rap on the LB for the next 75'.

15020' Boulder rip-rap on the RB.

15121' Boulder rip-rap on the LB.

15285' Large debris accumulation, 10'L x 30'W x 4'H.

15686' Rip-rap on the RB.

15859' Boulder rip-rap on the RB.

16761' Dry tributary enters from the RB. Site 3 on the map.

16888' Large debris accumulation, 5'L x 20'W x 3'H.

17045' Large debris accumulation on the LB, 70'L x 20'W x 5'H.

17105' Dry tributary enters from the RB.

18096' Large debris accumulation, 7'L x 9'W x 5'H.

18238' Large debris accumulation, 10'L x 20'W x 8'H.

18301' Dry tributary enters from the RB.

18756' Car bridge. Map Site 4.

18776' Large debris accumulation, 3'L x 9'W x 3'H. Retaining gravel.

19029' Small debris accumulation with one piece of large wood, retaining gravel.

20203' Dry tributary enters from the LB.

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20527' Large debris accumulation, 39'L x 20'W x 5'H.

20614' Erosion on the RB.

20892' Footbridge.

21445' Dry tributary enters from the RB, site 5 on the map.

21468' A tributary enters from the RB.

21612' End of survey, stream is dry.

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: guide

lines 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