STREAM INVENTORY REPORT
West Fork Sproul Creek Unnamed Right Bank Tributary

INTRODUCTION

A stream inventory was conducted on 8/24/2004 for an unnamed right bank tributary to West Fork Sproul Creek. The survey began at the confluence with West Fork Sproul Creek and extended upstream 0.6 miles.

The unnamed right bank tributary 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 the unnamed right bank tributary. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

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

Unnamed right bank tributary is a tributary to West Fork Sproul Creek, a tributary to Sproul Creek, a tributary to South Fork Eel River, a tributary to Eel River, a tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Unnamed right bank tributary's legal description at the confluence with West Fork Sproul Creek is T5S R2E S00. Its location is 40°02'19.0" north latitude and 123°54'00.0" west longitude, LLID number 1239001400387. Unnamed right bank tributary is a first order stream and has approximately 0.86 miles of blue line stream according to the USGS Briceland 7.5 minute quadrangle. Unnamed right bank tributary drains a watershed of approximately 1.26 square miles. Elevations range from about 711 feet at the mouth of the creek to 1,610 feet in the headwater areas. Redwood and mixed hardwood forest types dominate the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 101 out of Garberville to Sprowel Creek road behind a locked gate.

METHODS

The habitat inventory conducted in unnamed right bank tributary Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors and Watershed Stewards Project/AmeriCorps (WSP) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. 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, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are 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 unnamed right bank tributary to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (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. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

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.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1990). 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". Unnamed right bank tributary 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. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In unnamed right bank tributary, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile 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 for prey. 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 unnamed right bank tributary, 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. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In unnamed right bank tributary, 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 hardwood 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 unnamed right bank tributary, the dominant composition type and the

dominant vegetation type 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 (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in unnamed right bank tributary. In addition, underwater observations were made at 11 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual.*

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.9, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)

- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

Graphics are produced from the tables using Microsoft Excel. Graphics developed for unnamed right bank tributary include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

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

The habitat inventory on 8/24/2004 was conducted by Lindsey Selvaggio and Corby Hines (CCC). The total length of the stream surveyed was 2,928 feet.

Stream flow was not measured on unnamed right bank tributary.

Unnamed right bank tributary is a B3 channel type for 2,928 feet of the stream surveyed (Reach 1). B3 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and cobble dominant substrates.

Water temperatures taken during the survey period ranged from 60 to 61 degrees Fahrenheit. Air temperatures ranged from 64 to 71 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 41% flatwater units, 31% pool units, 17% riffle units and 12% dry units (Graph 1). Based on total length of Level II habitat types there were 64% flatwater units, 9% pool units, 8% riffle units and 19% dry units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 34% step run units, 25% mid-channel pool units, and 12% dry units (Graph 3). Based on percent total length there were 60% step run units, 8% mid-channel pool units and 19% dry units.

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A total of 18 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 83%, and comprised 88% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Five of the 18 pools (28%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 18 pool tail-outs measured, 6 had a value of 2 (33.3%); 4 had a value of 3 (22.2%); 1 had a value of 4 (5.6%); 7 had a value of 5 (38.9%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

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. Riffle habitat types had a mean shelter rating of 32, flatwater habitat types had a mean shelter rating of 38, and pool habitats had a mean shelter rating of 63 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 68, scour pools had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in unnamed right bank tributary. Graph 7 describes the pool cover in unnamed right bank tributary. Boulders are the dominant pool cover type followed by large woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 56% of pool tail-outs and boulders were observed in 28% of pool tail-outs.

The mean percent canopy density for the surveyed length of unnamed right bank tributary was 99%. One percent of the canopy was open (Graph 9). Of the mean percent canopy density the mean percentages of hardwood and coniferous trees were 78% and 22%, respectively (Table 7).

For the stream reach surveyed, the mean percent right bank vegetated was 83%. The mean percent left bank vegetated was also 83% (Table 7). The dominant elements composing the structure of the stream banks consisted of 15% bedrock, 8% boulder, 33% cobble/gravel and 44% sand/silt/clay (Graph 10). Hardwood trees were the dominant vegetation type observed in 71.2% of the units surveyed. Additionally, 28.8% of the units surveyed had Coniferous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Eleven sites were electrofished for species composition and distribution in unnamed right bank tributary on September 22, 2004. Water temperatures taken during the electrofishing period from 1045 to 1435 ranged from 52 to 57 degrees Fahrenheit. Air temperatures ranged from 54 to 65 degrees Fahrenheit. The sites were sampled by Allan Renger (DFG).

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In reach 1, which comprised 2,928 feet of stream, eleven sites were sampled. Combined the reach yielded 55 young-of-the-year steelhead/rainbow trout (SH/RT), 2 age 1+ SH/RT and 53 young-of-the-year coho salmon.

The following chart displays the information yielded from these sites:

2004 unnamed right bank tributary dive observations.

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
Reach 1 B3 Channel Type									
09/22/04	1	0003	4.2	186	15	0	15	0	0
09/22/04	2	0006	5.6	225	10	0	20	0	0
09/22/04	3	0015	4.2	744	19	0	2	1	0
09/22/04	4	0019	4.2	875	6	0	6	0	0
09/22/04	5	0027	4.2	1126	3	0	4	0	0
09/22/04	6	0033	5.6	1220	0	0	1	0	0
09/22/04	7	0034	4.2	1242	0	0	0	1	0
09/22/04	8	0043	4.2	1834	0	0	3	0	0
09/22/04	9	0046	4.2	1969	0	0	2	0	0
09/22/04	10	0050	3.4	2205	0	0	2	0	0
09/22/04	11	0055	4.2	2361	0	0	0	0	0

DISCUSSION

Unnamed right bank tributary is a B3 channel type for the entire 2,928 feet of stream surveyed. The suitability of B3 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters, bank placed boulder, single and opposing wing deflectors and log covers.

The water temperatures recorded on the survey day 8/24/2004, ranged from 60 to 61 degrees Fahrenheit. Air temperatures ranged from 64 to 71 degrees Fahrenheit. This is a good water

temperature for juvenile salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 64% of the total length of this survey, riffles 8%, and pools 9% and 19% dry units. The pools are relatively shallow, with only 5 of the 18 (28%) pools having a maximum residual 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 residual 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.

Six of the 18 pool tail-outs measured had embeddedness ratings of 1 or 2. Five of the pool tail-outs had embeddedness ratings of 3 or 4. Seven of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

Eleven of the 18 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered suitable for spawning salmonids.

The mean shelter rating for pools was 63. The shelter rating in the flatwater habitats was 38. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in unnamed right bank tributary. Boulders are the dominant cover type in pools followed by large woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance 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.

The mean percent canopy density for the stream was 99%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was at 83% each. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Unnamed right bank tributary should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures are within 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 or deepen the existing 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 in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.

5) The log debris accumulations (LDA's) at 1141' and 1394' on unnamed right bank tributary are retaining fine sediment and appear to be barriers to coho salmon. Modifying these LDA's to improve fish passage and provide a source of large wood for cover is desirable. The modification of these LDA's must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

COMMENTS AND LANDMARKS

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

Position (Feet)	Habitat Unit #	Comments:
0	0001.00	Start of survey at confluence with West Fork Sproul Creek.
24	0002.00	Gradient of the channel is 12-15% for habitat unit.
186	0003.00	Electrofishing site #1.
186	0004.00	Right bank tributary contributes 5% of flow. Downstream of the tributary the temperature was 61° F, the tributary temperature was 60° F, and upstream the temperature was 61° F. Not accessible to fish, with a 35% slope.
236	0005.00	Two foot plunge.
225	0006.00	Electrofishing site #2.

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Position (Feet)	Habitat Unit #	Comments:
248	0006.00	Falls with a 7.5 foot plunge and a 55% slope.
744	0015.00	Electrofishing site #3.
841	0019.00	Cable running throughout unit.
875	0019.00	Electrofishing site #4.
1126	0027.00	Electrofishing site #5.
1141	0029.00	Log debris accumulation (LDA) 8’ high x 15’ wide x 13’ long, Composed of 7 pieces of wood. Some sediment retention.
1220	0033.00	Electrofishing site #6.
1242	0034.00	Electrofishing site #7.
1242	0034.00	Left bank tributary with approximately 10% of downstream flow. Temperature of water downstream is 61° F, tributary is 60° F and upstream is 61° F. No fish observed, but is accessible to fish with 6% slope.
1394	0037.00	LDA 5’ high x 22’ wide x 12’ long, composed of five pieces of wood. Some sediment retention.
1834	0043.00	Electrofishing site #8.
1969	0046.00	Electrofishing site #9.
1969	0047.00	Left bank tributary contributes 40% of downstream flow. Temperature downstream is 61° F, tributary is 61° F, and upstream is 60° F. Accessible to fish, but no fish were observed. The tributary is very overgrown with vegetation.
2205	0050.00	Electrofishing site #10.
2361	0055.00	Electrofishing site #11.

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Position (Feet)	Habitat Unit #	Comments:
2361	0056.00	Right bank erosion 95 feet into unit, 40’ long x 11’ high x 3’ deep.
2522	0058.00	LDA 23’ high x 55’ wide x 60’ long, composed of ~35 pieces of wood. Extensive sand to gravel sediment retention and vegetation growing in the debris accumulation. Probable barrier.
2928	0059.00	Survey ended due to LDA completely blocking channel with 250 feet of subsurface unit upstream of accumulation.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

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LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	