STREAM INVENTORY REPORT
East Fork Mill Creek 2006
LLID# 1240987417345

INTRODUCTION

A stream inventory was conducted from June 27, 2006 to July 6, 2006 on East Fork Mill Creek. The survey began at the confluence with Mill Creek and extended upstream 4.1 miles. Stream inventories and reports or subsections to this report were also completed for two, tributaries to East Fork Mill Creek.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in East Fork Mill 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

East Fork Mill Creek is a tributary to Mill Creek, tributary to Smith River, tributary to the Pacific Ocean, located in Del Norte County, California (Map 1). East Fork Mill Creek's legal description at the confluence with Mill Creek is T15N R01E S03. Its location is 41°44'04N" north latitude and 124°05'55W" west longitude, LLID number 1240987417345. East Fork Mill Creek is a 4th order stream and has approximately 34.7 miles of blue line stream according to the USGS Childs Hill 7.5 minute quadrangle. East Fork Mill Creek drains a watershed of approximately 16.6 square miles. Elevations range from about 241 feet at the mouth of the creek to 1,600 feet in the headwater areas. Mixed hardwood and conifer forest dominates the watershed. The watershed is entirely state park and is managed for recreation. Vehicle access exists via Highway 101 to Hamilton road east.

METHODS

The habitat inventory conducted in East Fork Mill 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. All pools except step-pools are fully sampled.

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 East Fork Mill Creek 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". East Fork Mill 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. 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 East Fork Mill 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) 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 East Fork Mill 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. 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 East Fork Mill 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 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 East Fork Mill Creek, 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.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, 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 East Fork Mill Creek 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 of June 27, 2006 to July 6, 2006, was conducted by H. Sgalitzer and E. Degenstein (WSP). The total length of the stream surveyed was 21,804 feet with an additional 3,253 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 2.48 cfs on July 13, 2006.

East Fork Mill Creek is an F4 channel type for 20,070 feet of the stream surveyed (Reach 1), and an F2 channel type for 1,734 feet of the stream surveyed (Reach 2).

F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F2 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and boulder-dominant substrates.

Water temperatures taken during the survey period ranged from 56 to 60 degrees Fahrenheit. Air temperatures ranged from 54 to 66 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 39% riffle units, 29% pool units, 26% flatwater units, and 5% dry units (Graph 1). Based on total length of Level II habitat types there were 42% riffle units, 29% flatwater units, 20% pool units, and 9% dry units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units (35%), run units (25%), and mid-channel pool units (23%) (Graph 3). Based on percent total length the dominant habitat types were low gradient riffle units (40%), run units (28%), and mid-channel pool units (14%).

A total of 65 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 78%, and comprised 72% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Thirty-six of the 63 pools (57%) had a residual depth of three

feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 64 pool tail-outs measured, 23 had a value of 1 (35.9%); 28 had a value of 2 (43.8%); 12 had a value of 3 (18.8%); 1 had a value of 5 (1.6%); (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 12, flatwater habitat types had a mean shelter rating of 26, and pool habitats had a mean shelter rating of 34 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 37, scour pools had a mean shelter rating of 26, and backwater pools had a mean shelter rating of 10 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover types in East Fork Mill Creek. Graph 7 describes the pool cover in East Fork Mill Creek. Large woody debris is the dominant pool cover type followed by terrestrial vegetation.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Small cobble was observed in 38% of pool tail-outs and gravel was observed in 37% of pool tail-outs.

The mean percent canopy density for the surveyed length of East Fork Mill Creek was 91%. Nine percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 95% and 5%, respectively. Graph 9 describes the mean percent canopy in East Fork Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 97%. The mean percent left bank vegetated was 97%. The dominant elements composing the structure of the stream banks consisted of 13% bedrock, 14% boulder, 51% cobble/gravel, and 23% sand/silt/clay (Graph 10). Hardwood trees were the dominant vegetation type observed in 91.8% of the units surveyed. Additionally, 7.1% of the units surveyed had coniferous trees as the dominant vegetation type, and 1.2% had brush as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No biological inventories were conducted during this survey.

DISCUSSION

East Fork Mill Creek is a F4 channel type for the first 20,070 feet of stream surveyed and a F2 channel type for the remaining 1,734 feet. The suitability of F2 and F4 channel types for fish

habitat improvement structures is as follows: F2 channel types are fair for plunge weirs, single and opposing wing-deflectors and log cover. F4 channel types are good for bank-placed boulders, fair for plunge weirs, single and opposing wing deflectors, channel constrictors and log cover.

The water temperatures recorded on the survey days June 27, 2006 to July 6, 2006, ranged from 56 to 60 degrees Fahrenheit. Air temperatures ranged from 54 to 66 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and biological sampling would need to be conducted.

Flatwater habitat types comprised 20% of the total length of this survey, riffles 42%, and pools 20%. The pools are relatively deep, with 36 of the 63 (57%) pools having a maximum residual depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual 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. Installing large wood structure that will increase or deepen pool habitat is recommended.

Fifty-one of the 64 pool tail-outs measured had embeddedness ratings of 1 or 2. Twelve of the pool tail-outs had embeddedness ratings of 3 or 4. One 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.

Forty-nine of the 65 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 34. The shelter rating in the flatwater habitats was 26. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in East Fork Mill Creek. Large woody debris is the dominant cover type in pools followed by terrestrial vegetation. 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 91%. Reach 1 had a canopy density of 90.6%, and Reach 2 had a canopy density of 94.9%. The percentage of right and left bank covered with vegetation was 97% and 97%, respectively. In general, revegetation projects are considered when canopy density is less than 80%.

RECOMMENDATIONS

1) East Fork Mill Creek 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) 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.

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 (ft):	Habitat Unit #:	Comments:
0	0001.00	Start survey at confluence with Mill Creek
1360	0013.00	Fish trap/weir
1719	0015.00	Bridge, 75' long x 30' high x 25' wide; concrete
3095	0026.00	Tributary #1 enters from the left bank; high gradient at the confluence; no fish observed; water temperature was 44º F
3297	0028.00	Left bank erosion
3764	0034.00	Left bank erosion; 80' long x 20' high
4125	0036.00	Tributary #2 enters from the right bank; fish observed in the tributary; water temperature was 58º F
4411	0039.00	Right bank erosion
5554	0046.00	Minor left bank erosion
5885	0049.00	Tributary #3 enters from right bank; not accessible to fish; water temperature was 52º F
7211	0062.00	Left bank erosion
8318	0068.02	Tributary #4 enters from right bank; accessible to fish but no fish observed; water temperature was 58º F
8318	0068.02	Right bank erosion

East Fork Mill Creek

8318	0068.02	Culvert, 3' height
9053	0073.00	Tributary #5 enters from the left bank; fish observed within the first 50’; water temperature 58º F
9940	0077.00	Instream structure
10220	0081.00	Tributary #6 enters from the left bank; a LB; accessible to fish but no fish observed; water temperature was 57º F
10905	0088.00	Bridge; 75' long x 15' wide x 15' high, metal
11224	0091.00	Scour log
11319	0092.00	Scour log
12393	0101.00	Tributary #7 enters from the left bank; accessible to fish but no fish observed; water temperature was 54º F
12883	0106.00	Tributary #8 enters from the right bank; not accessible to fish; water temperature was 56º F
13113	0107.00	Tributary #9 enters from the right bank; accessible to fish but no fish observed; water temperature was 57º F
13671	0113.00	Tributary #10 enters from the left bank; Bummer Lake Creek; water temperature was 55º F
13904	0115.00	Start of instream structure projects
16050	0142.00	Left bank waterfall
16196	0144.00	Tributary #11 enters from the left bank; accessible to fish but no fish observed; water temperature was 54º F
16196	0144.00	Left bank erosion, 80' long x 20' high
17342	0153.00	Tributary #14 enters from the right bank; accessible to fish but no fish observed; water temperature was 53º F
17342	0153.00	Culvert; height from culvert bottom to water's surface was 2'
18006	0157.00	Tributary #12 enters from the left bank; accessible to fish but no fish observed; water temperature was 52º F
18296	0158.00	Right bank drainage pipe

East Fork Mill Creek

19124	0169.00	Tributary #13 enters left bank; flowing; accessible to fish but no fish observed; water temperature was 56º F
19451	0172.00	Railroad car bridge, 45' long x 12' wide x 15' high
21649	0197.00	Left bank erosion, 15' long x 20' high
21677	0198.00	Log debris accumulation (LDA), 12' high x 34' wide x 11' long; composed of 8 pieces of large wood
21822	0202.00	End of survey due to high plunge into a pool and narrow passage; the stream gradient is 5% before the plunge; high gradient riffle after plunge approximately 80' in length; no young of the year salmonids observed.

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

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]	