STREAM INVENTORY REPORT

FOURMILE CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Fourmile 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 Fourmile Creek. 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

Fourmile Creek is tributary to the Mattole River, tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Fourmile Creek's legal description at the confluence with Mattole River is T3S R1E S0. Its location is 40°11′52″ north latitude and 124°03′22″ west longitude. Fourmile Creek is a third order stream and has approximately 7.3 miles of blue line stream according to the USGS Honeydew 7.5 minute quadrangle. Fourmile Creek drains a watershed of approximately 5. 5 square miles. Elevations range from about 480 feet at the mouth of the creek to 1400 feet in the headwater areas. Douglas fir forest and mixed hardwood forest dominate the watershed. The watershed is privately owned and is managed for timber production and rangeland. Vehicle access exists via Mattole Road to Honeydew. From Honeydew take the Wilder Ridge Road approximately 3.5 miles, then turn left onto Pringle Ridge Road. Continue along Pringle Ridge Road for approximately 3.5 miles and then turns into a jeep trail that continues down to the Mattole River. Hike upstream along the Mattole River approximatley 0.5 miles, Fourmile Creek is the first tributary that you will come to on the left bank (facing downstream).

METHODS

The habitat inventory conducted in Fourmile Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et.al., 1998). The AmeriCorps 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 (Hopelain, 1995). 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, dominant substrate composing the pool tail crest, and embeddedness. 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 methodology and data sheet have been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This protocol was used in Fourmile Creek to record measurements and observations. There are nine components to the inventory data sheet.

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.

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". Fourmile 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 Fourmile 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 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 Fourmile 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 Fourmile 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 Fourmile 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 was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Fourmile Creek fish presence was observed from the stream banks, and 3 sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are 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 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. Graphics developed for Fourmile

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 the pool tail outs
- 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 August 25-26 and September 2, 1998, was conducted by C. Jezierski, P. Retherford, and J. Wooster (AmeriCorps/WSP). The total length of the stream surveyed was 15,566 feet with an additional 62 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.6 cfs on September 3, 1998.

Fourmile Creek is a C4 channel type for the first 6,948 feet, and a F4 channel type for last 8,618 feet of the stream reach surveyed. C4 channel types are low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplain; gravel channel. F4 channel types are entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; gravel channel.

Water temperatures taken during the survey period ranged from 59°- 73° F. Air temperatures ranged from 58°- 94° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 22% riffle units, 45% flatwater units, and 31% pool units (Graph 1). Based on total length of Level II habitat types there were 17% riffle units, 61% flatwater units, and 14% pool units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step run, 27%; mid-channel pool, 26%; low gradient riffle, 18%; and run, 17% (Graph 3). Based on percent total length, step run made up 47%, run 15%, and low

gradient riffle 14%.
A total of seventy-two pools were identified (Table 3). Main pools were most frequently encountered at 85% and comprised 84% 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-six of the seventy-two pools (64%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the seventy-two pool tail-outs measured, one had a value of 1 (1.4%); seventeen had a value of 2 (23.6%); thirty-eight had a value of 3 (52.8%); eleven had a value of 4 (15.3%) and five had a value of 5 (6.9%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate and a value of 5 indicates the tail-out is not suitable for spawning.

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 16, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 28 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 75. Scour pools had a mean shelter rating of 41 (Table 3).

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

Table 6 summarizes the dominant substrate in pool habitat types. Gravel was the dominant substrate observed in forty-three of the seventy pool tail outs measured (61.4%). Small cobble was the next most frequently observed dominant substrate type and occurred in 21.4% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 53%. The mean percentages of conifer and deciduous trees were 15% and 85%, respectively. Graph 9 describes the canopy in Fourmile Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 77.7%. The mean percent left bank vegetated was 72.4%. The dominant elements composing the structure of the stream banks consisted of 18.2% bedrock, 6.1% boulder, 50% cobble/gravel, and 25.8% sand/silt/clay (Graph 10). Deciduous trees were the dominant bank vegetation type observed in 80.3% of the units surveyed, and 4.5% had coniferous trees as the dominant bank vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on September 3, 1998 in Fourmile Creek. The sites were sampled by Janet Lester and Paul Retherford (AmeriCorps/WSP).

The first site sampled included habitat units 07- 09, approximately 500 feet from the confluence with the Mattole River. This site had an area of approximately 520 sq ft and a volume of 256 cu ft. The site yielded twenty-three young of the year steelhead trout, and one steelhead trout age 2+.

The second site included habitat units 45- 46, located approximately 3,185 feet above the creek mouth. This site had an area of approximately 790 sq ft and a volume of 966 cu ft. The site yielded seven young of the year steelhead.

The third site sampled included habitat units 100-101, located approximately 6,400 feet above the creek mouth. The site had an area of 482 sq ft and a volume of 357 cu ft. The site yielded fourteen young of the year steelhead, seven steelhead age 1+, one amphibian, and one salamander.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Fourmile Creek.

DISCUSSION

Fourmile Creek is a C4 channel type for the first 6,948 feet of stream surveyed and a F4 for the remaining 8,639 feet. The suitability of C4 channel types for fish habitat improvement structures is: good for bank-placed boulders and fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover. The suitability of F4 channel types is: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, log cover; and poor for boulder clusters.

Water temperatures recorded on the survey days August 25-26 and September 2, 1998, ranged from 59°- 73° F. Air temperatures ranged from 58°- 94° F. This is a fair water temperature range for salmonids. However, 73° F, if sustained, is above the threshold stress level for steelhead and approaches the lethal threshold for coho salmon. Fourmile Creek seems to have high summer temperatures that could be unfavorable to 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 61% of the total length of this survey, riffles 17%, and pools 14%. The pools are relatively deep, with forty-six of the seventy-two (64%) pools having a maximum depth greater than 2 feet. Primary pools comprise only 9% of the total length of

stream habitat. 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 any needed modification of log debris accumulations (LDA's) in the stream. Some of the LDA's in the system may be 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.

One of the 72 (1.4%) pool tail-outs measured had an embeddedness rating of 1, 23.6% had a rating of 2, 68.1% had ratings of 3 or 4, and 6.9% had a rating of 5 and were 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. In Fourmile 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 28. 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 boulder in most habitat types. Additionally, large and small woody debris and root masses contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Fifty-eight of the 70 (83%) pool tail outs 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 53%. This is a relatively moderate percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 78% and 72%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting native species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

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

2) The limited water temperature data available suggest that maximum temperatures are above the optimal 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) Canopy cover only averages 53%. Increase the canopy on Fourmile 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.

4) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.

5) 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.

6) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

7) 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.

8) There are several log debris accumulations present on Fourmile 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 meter gravel to downstream spawning sites.

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.

0' Begin survey at confluence with Mattole River. Channel type is a C4 (Reach #1).

233' YOY observed.

501' Beginning of electrofishing site #1.

1246' Dry tributary enters from the RB 27' into unit.

1376' Dry tributary enters from the RB 48' into unit.

2245' Dry tributary enters from the RB 28' into unit.

2399' Slide 170'l x 150'h x 50'w starts at beginning of this unit.

2551' Tributary enters from the LB 49' into unit. Water temperature is 58 F. Tributary has good habitat but no fish were observed in initial units.

3235' Electrofishing site #2.

4006' Slide on LB 35' x 15' x 35'.

4394' Seep on LB 96' into unit.

4907' Old slide on LB.

6386' Gradient is increasing.

6948' Channel type changes from a C4 to a F4 (Reach #2).

7179' Tributary enters RB 77' into unit, flow is down a steep failing slope.

7700' Tributary enters from the LB 10' into unit.

8115' 10" RT/SH observed.

8151' LDA, not in channel.

8206' Tributary enters LB. Walked up tributary, at 150' log jam occurred, no fish were observed above log jam.

9229' Tributary enters from the LB 264' into unit. Tributary flows down 60' cascade (fish barrier for that tributary).

9784' LDA 44' into unit. RB slide 150' x 30' x 100'.

9834' YOY observed.

10211' LDA at top of unit retaining gravel, jump pool 3' deep. LDA has logs 7'l.

10235' Large LB slide.

11427' Slide on RB 100' x 25' x 100'.

12165' RB slide 20' x 20' x 200', unable to observe top of slide.

12287' LDA in unit.

13122' LB slide 25' x 10' x 125' is 19' into unit.

13223' One 2+ SHRT.

13310' Tributary enters RB 29' into unit. Water temperature is 45-50 F. Mouth of tributary is a bedrock chute.

13692' Tributary enters from the RB 20' into unit, good flow.

13856' Tributary enters from the LB 60' into unit. LDA at top of unit is +20' high retaining gravel and cobble. Above the LDA walked 1000', no water was found.

14900' Right bank slide for the entire length of the unit, 100' high.

15085' Left bank slide 40 x 10 x 30 contributes gravel to the stream.

15165' LDA 5' to waters surface. Gravel impacted.

15223' LDA fills 13' bank walls and 12' off ground. YOY seen.

15273' LDA starts at bottom of the unit and covers the stream for 72'. Possible but not probable fish barrier.

15566' End of survey.

REFERENCES

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. California salmonid stream habitat restoration manual, 3rd 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