STREAM INVENTORY REPORT

Mill Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on Mill Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Mill Creek.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for 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

Mill Creek is tributary to Redwood Creek, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Mill Creek's legal description at the confluence with Redwood Creek is T07N R03E S08. Its location is 41.0019 degrees north latitude and 123.8578 degrees west longitude. Mill Creek is a second order stream and has approximately 1.4 miles of blue line stream according to the USGS Hupa Mountain 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 1.3 square miles. Elevations range from about 640 feet at the mouth of the creek to 2,800 feet in the headwater areas. Redwood forest and Douglas fir forest dominate the watershed. The watershed is primarily owned by private landowners, and is managed for timber production and grazing in the prairies. Vehicle access exists via Highway 299 to Redwood Valley Road.

METHODS

The habitat inventory conducted in Mill Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). The NEAP fisherpersons 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.

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 Mill Creek to record measurements and observations. There are nine components to the inventory form.

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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". 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. Channel dimensions were measured using hip chains, tape measures, and stadia rods. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In 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 not suitable 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 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 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*. Canopy density relates to the amount of stream shaded from the sun. In Mill Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of every unit. 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 Mill Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

DATA ANALYSIS

Data from the habitat inventory forms 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

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Graphics are produced from the tables using Quattro Pro. Graphics developed for Mill 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

The habitat inventory of July 17 through July 20, 1996 was conducted by Mike Devlin (PCFWWRA), Dick Estes and Dave Allen. The total length of the stream surveyed was 2,468 feet with an additional 295 feet of side channel.

Flow was measured at 0.2 cfs with a Marsh-McBirney Model 2000 flowmeter on September 21, 1996.

Mill Creek is a B4 channel type for the first 1,225 feet (Reach 1) and an A2 channel type for the remaining 1,243 feet of stream reach surveyed (Reach 2). B4 channel types are moderately entrenched, and have moderate gradient, riffle dominated channels, with infrequently spaced pools, very stable plan and profile, stable banks and a gravel channel. A2 channel types are steep, narrow, cascading, step-pool streams, with high energy/debris transport associated with depositional soils; and a boulder channel.

Water temperatures taken during the survey period ranged from 58 to 62 degrees Fahrenheit. Air temperatures ranged from 62 to 88 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 45% pool units, 35% flatwater units, and 20% riffle units (Graph 1). Based on total length of Level II habitat types there were 47% flatwater units, 38% pool units, and 15% riffle units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step runs and step pools, 25% each; high gradient riffles, 10%; and cascades and boulder formed lateral scour pools, 8% (Graph 3). Based on percent total length, step runs made up 38%, step pools 29%, and high gradient riffles 9%.

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A total of forty-seven pools were identified (Table 3). Main channel pools were most frequently encountered at 62% and comprised 80% 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. Two of the forty-seven pools (4%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 47 pool tail-outs measured, seven had a value of 1 (15%); 12 had a value of 2 (26%); 12 had a value of 3 (26%); and 16 had a value of 5 (34%); (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 41, and riffle habitats had a mean shelter rating of 25 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 70. Scour pools had a mean shelter rating of 51 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Mill Creek. Graph 7 describes the pool cover in Mill Creek.

Table 6 summarizes the dominant substrate by habitat type. Sand was the dominant substrate observed in 67% of the low gradient riffles measured. Small cobble was the next most frequently observed dominant substrate type and occurred in 33% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 86%. The mean percentages of deciduous and coniferous trees were 97% and 3%, respectively. Graph 9 describes the canopy in Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 56%. The mean percent left bank vegetated was 63%. The dominant elements composing the structure of the stream banks consisted of 43% sand/silt/clay, 41% cobble/gravel, 15% boulders, and 1% bedrock (Graph 10). Deciduous trees were the dominant vegetation type observed in 49% of the units surveyed. Additionally, 36% of the units surveyed had brush as the dominant vegetation type, and 14% had grass as the dominant vegetation (Graph 11).

DISCUSSION

Mill Creek is a B4 channel type for the first 1,225 feet of stream surveyed and an A2 for the remaining 1,243 feet. The suitability of B4 and A2 channel types for fish habitat improvement structures is as follows: B4 channels are excellent for low-stage plunge weirs, boulder clusters and bank placed boulders, single and opposing wing deflectors and log cover, and good for medium-stage plunge weirs. A2 channels are generally not suitable, since they are characterized by high energy streams with stable stream banks, and poor gravel retention capabilities.

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The water temperatures recorded on the survey days July 17 through July 20, 1996 ranged from 58 to 62 degrees Fahrenheit. Air temperatures ranged from 63 to 88 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 47% of the total length of this survey, riffles 15%, and pools 38%. The pools are relatively shallow, with only two of the 47 (5%) pools having a maximum depth greater than two 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.

Twenty-eight of the forty-seven (60%) pool tail-outs measured had embeddedness ratings of 3, 4 or 5. Only seven (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 Mill 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 41. The shelter rating in the flatwater habitats was slightly lower at 23. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, white water contributes a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Two of the three low gradient riffles had sand as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean percent canopy density for the stream was 86%. This is a relatively high percentage of canopy, although conifers are lacking in the riparian zone. In general, re-vegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 56% and 63%, respectively. In areas of stream bank erosion or where bank vegetation is at unacceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

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RECOMMENDATIONS

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

2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from white water. Adding high quality complexity with woody cover is desirable.

3) 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.

4) 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.

5) In the B4 channel type, design and engineer pool enhancement structures to increase the number of pools or deepen existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

6) Spawning gravel on Mill Creek are limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

7) Plant conifers to improve the canopy in the riparian zone.

COMMENTS AND LANDMARKS

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

Position (ft):	Comments:
0'	Start of survey 14' above confluence with Redwood Creek. The channel type is a B4.
27'	Culvert.
569'	Right bank erosion.
779'	Small spring coming in left bank.
1159'	Right bank erosion resulting in small slide.
1261'	Channel type changes to A2.

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1784' Right bank slide.

1866' Age 1+ fish observed.

1889' Steep, unstable left bank.

1955' Plunge pool, with 2.5’ high plunge.

1967' Silt deposition from right bank below road.

2468' Gradient increases to waterfall. Possible fish barrier. End of survey.

REFERENCES

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

LEVEL III and LEVEL IV HABITAT TYPE KEY

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