STREAM INVENTORY REPORT

Mud Creek

INTRODUCTION

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

Mud Creek is tributary to South Dobbyn Creek, tributary to Dobbyn Creek, tributary to the Eel River, located in Trinity County, California. Mud Creek's legal description at the confluence with South Dobbyn Creek is T03S R06E S20. Its location is 40°11'13" N.latitude and 123°31'40" W. longitude. Mud Creek is a third order stream and has approximately 12.1 miles of blue line stream according to the USGS Alderpoint, Zenia, Black Lassic, and Ruth Lake 7.5 minute quadrangles. Mud Creek drains a watershed of approximately 12 square miles. Summer base runoff is approximately 0.5 cubic feet per second (cfs) at the mouth, but over 1500 cfs is not unusual during winter storms. Elevations range from about 800 feet at the mouth of the creek to 4,000 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is privately owned and is managed for rangeland or is left undeveloped. The Three Forks Hydroelectric Project has been operating in the Mud Creek drainage since 1984. Vehicle access exists from Alderpoint east via Zenia Bluffs Road to a private unsurfaced road on the Burgess Ranch that leads to a point approximately 400' upstream of the mouth of Mud Creek.

METHODS

The habitat inventory conducted in Mud Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The Pacific Coast Fisheries, Wetlands, and Wildlife Restoration Association (PCFWWRA) participants that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Mud Creek personnel were trained in May, 1995, by Scott Downie and Ruth Goodfield. 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, 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 Mud 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 Mud Creek from August 17 to 24, 1995 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". Mud 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 Mud 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 Mud 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.

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 Mud 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 Mud 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.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Mud Creek fish presence was observed from the stream banks, and one site was electrofished using one 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 Lotus 1,2,3. Graphics developed for Mud Creek include:

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- 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 August 22 and 23, 1995, was conducted by Dylan Brown and Ray Bevitori (PCFWWRA). The total length of the stream surveyed was 7,673 feet with no additional feet of side channel.

Flow was estimated to be 0.5 cfs during the survey period.

Mud Creek is a B3 channel type for the entire 7,673 feet of stream reach surveyed. B3 channels are moderately entrenched, moderate gradient (2-4%), riffle dominated channels, with stable banks and predominantly cobble substrate.

Water temperature samples taken during the survey period ranged from 60 to 64 degrees Fahrenheit. Air temperatures ranged from 60 to 75 degrees Fahrenheit. Water temperatures measured with a recording thermograph deployed from August 17-24, 1995, ranged from a low of 55° to a high of 67° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 37% riffle units, 34% pool units, and 29% flatwater units (Graph 1). Based on total **length** of Level II habitat types there were 45% flatwater units, 37% riffle units, and 29% pool units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were cascades, 21%;

plunge pools, 21%; and step runs, 20% (Graph 3). Based on percent total **length**, step runs made up 38%, cascades 22%, and low gradient riffles 13%.

A total of forty-three pools were identified (Table 3). Scour pools were most frequently encountered at 63% and comprised 53% 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 two of the 43 pools (99%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 4 pool tail-outs measured, none had a value of 1 or a value of 2; 3 had a value of 3 (75%); and 1 had a value of 4 (25%) (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 36, and riffle habitats had a mean shelter rating of 20 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 48. Main channel pools had a mean shelter rating of 24 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Boulder was the dominant substrate observed in 3 of the 5 low gradient riffles measured (60%). Gravel was the next most frequently observed dominant substrate type and occurred in 40% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 45%. The mean percentages of deciduous and coniferous trees were 90% and 10%, respectively. Graph 9 describes the canopy in Mud Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 50%. The mean percent left bank vegetated was 53%. The dominant elements composing the structure of the stream banks consisted of 17.2% bedrock, 46.6% boulder, 36.2% cobble/gravel, and 0% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 8.6% of the units surveyed. Additionally, 75.9% of the units surveyed had deciduous trees as the dominant vegetation type, and 6.9% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on August 24, 1995, in Mud Creek. The sites were sampled by Ray Bevitori, Dylan Brown, and Ruth Goodfield (PCFWWRA and DFG).

The site sampled included habitat unit 058, a step run approximately 2,847 feet from the confluence with South Dobbyn Creek. This site had an area of 1,660 sq ft and a volume of 1,328 cu ft. The site yielded fifteen steelhead, ranging from 43mm FL to 159mm FL.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Mud Creek.

DISCUSSION

Mud Creek is a B3 channel type for the entire 7,673 feet of stream surveyed. The suitability of B3 channel types for fish habitat improvement structures is excellent for low-stage plunge weirs, boulder clusters and bank-placed boulders, and log cover structures.

The water temperatures recorded on the survey days August 22 and 23, 1995, ranged from 60 to 64 degrees Fahrenheit. Air temperatures ranged from 60 to 75 degrees Fahrenheit. Further samples from a recording thermograph deployed during the summer

of **1995** measured water temperatures ranging from 56° to 67° Fahrenheit. This is an acceptable water temperature range for salmonids. However, warmer temperatures, if sustained, are near the threshold stress level for salmonids. This does not seem to be the case here, and Mud Creek seems to have temperatures favorable to salmonids.

Flatwater habitat types comprised 45% of the total **length** of this survey, riffles 37%, and pools 18%. The pools are relatively deep, with 42 of the 43 (99%) pools having a maximum 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 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 structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

All of the 4 pool tail-outs measured had embeddedness ratings of 3 or 4. None 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 Mud Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was low with a rating of 36. The shelter rating in the flatwater habitats was slightly lower at 12. 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, bedrock ledges 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.

Three of the five low gradient riffles had silt or sand/large cobble or boulders as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean percent canopy density for the stream was 45%. This is a relatively low 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 50% and 53%, 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) Mud Creek should be managed as an anadromous, natural production stream.
2) 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.

3) 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.

4) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 5146', should then be treated to reduce the amount of fine sediments entering the stream.

5) Due to the high gradient of the stream, access for migrating salmonids is an ongoing potential problem. Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish. Fish passage should be monitored and improved where possible.

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.

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0'	Begin survey at confluence with South Dobbyn Creek. Channel type is a B3 for entire length of stream surveyed.
2988'	Slide on right bank (RB) - approximately 90' high X 60' wide.
3233'	Recording thermograph site - August, 1995.
2847'	Bioinventory site.
4197'	Waterfall - approximately 4' high. Not a fish barrier.
5049'	Spring enters from RB - 62°F.
5146'	Large slide on left bank (LB) - approximately 190' high X 240' wide.
5188'	Hydro-electric plant site.
5522'	Lateral erosion on LB - approximately 40' high X 120' wide.
5690'	Hydro pond wall on RB - 25' high X 400' long.
5768'	Slide on LB - 120' high X 100' long.
6348'	Confluence with Bluford Creek - Bluford Creek temperature is 60°F.
6599'	Slide on LB - 60' high X 80' long.
6987'	Large slide on LB - approximately 170' high X 190' long - blocking stream channel.
7052'	Slide on LB - 50' high X 80' long.
7161'	Lateral erosion on LB - 60' high X 200' long.
7337'	Slide on LB - 70' high X 150' long.

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7493' Slide on LB - 120' high X 150' long.

7623' Waterfall, approximately 20' high - fish barrier.

7653' Zenia Road culvert.

7673' No fish observed since 20' 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.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

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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