# STREAM INVENTORY REPORT

## Mud Creek

## INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Mud Creek. The survey began at the confluence with the South Fork Eel River and extended upstream 3.9 miles. 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 a tributary to the South Fork Eel River, tributary to the Eel River, tributary to the Pacific Ocean, located in Mendocino County, California (Map 1). Mud Creek's legal description at the confluence with the South Fork Eel River is T21N R16W S26. Its location is 39°38′41″ north latitude and 123°38′47″ west longitude. Mud Creek is a second order stream and has approximately 4.2 miles of blue line stream according to the USGS Cahto Peak 7.5 minute quadrangle. Mud Creek drains a watershed of approximately 5.1 square miles. Elevations range from about 1,580 feet at the mouth of the creek to 3,200 feet in the headwater areas. Mixed conifer and hardwood forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production, grazing and rural residence. Vehicle access exists via Branscomb Road from the town of Laytonville. Drive west from Laytonville approximately 13 miles to Admiral Standley State Recreation Area. Park at the Mud Creek bridge and walk downstream to 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 et al, 1998). The Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) 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 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 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 (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. 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 (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. 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 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) 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, bedrock, 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. 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 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 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.

## 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 Mud Creek. In addition, two sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

## 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 Mud 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
- Mean 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 6 to September 5, 1996, was conducted by Kelly Garrett and Todd Kraemer (WSP/AmeriCorps). The total length of the stream surveyed was 20,332 feet with an additional 382 feet of side channel.

Stream flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.5 cfs on August 13, 1996.

Mud Creek is a B3 channel type for the entire 20,332 feet of the stream surveyed. B3 channels are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools; very stable plan and profile; stable banks and cobble dominant.

Water temperatures taken during the survey period ranged from 55° to 69° Fahrenheit. Air temperatures ranged from 57° to 94° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 42% pool units, 41% flatwater units, and 14% riffle units (Graph 1). Based on total **length** of Level II habitat types there were 71% flatwater units, 19% pool units, and 9% riffle units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were mid-channel pools, 40%; step runs, 25%; and runs, 16% (Graph 3). Based on percent total **length**, step runs made up 59%, mid-channel pools 18%, and runs 12%.

A total of 110 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 95%, and comprised 95% 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. Fifty-five of the 110 pools (50%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 110 pool tail-outs measured, 2 had a value of 1 (2%); 12 had a value of 2 (11%); 13 had a value of 3 (12%); 2 had a value of 4 (2%); and 81 had a value of 5 (73%) (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. Flatwater habitat types had a mean shelter rating of 35, and pool habitat types had a mean shelter rating of 32 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 38. Main channel pools had a mean shelter rating of 33 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Mud Creek. Graph 7 describes the pool cover in Mud Creek. Boulders are the dominant pool cover type followed by terrestrial vegetation.

Table 6 summarizes the dominant substrate by habitat type. Small cobble was the dominant substrate observed in 2 of the 3 low gradient riffles measured (67%) while gravel was the next most frequently observed dominant substrate type and occurred in 33% of the low gradient riffles.

The mean percent canopy density for the surveyed length of Mud Creek was 86%. The mean percentages of deciduous and coniferous trees were 81% and 19%, respectively. Graph 9 describes the mean percent canopy in Mud Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 86%. The mean percent left bank vegetated was 87%. The dominant elements composing the structure of the stream banks consisted of 96.1% cobble/gravel, 2.6% bedrock, and 1.3% boulder (Graph 10). Deciduous trees were the dominant vegetation type observed in 60.5% of the units surveyed. Additionally, 39.5% of the units surveyed had coniferous trees as the dominant vegetation type (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on August 13, 1996, in Mud Creek. The sites were sampled by Ruth Goodfield (DFG) and Todd Kraemer (WSP/AmeriCorps).

The first site sampled included habitat units 005-006, a riffle/run sequence approximately 187 feet from the confluence with the South Fork Eel River. The site had an area of 240 sq. ft. and a volume of 192 cu. ft. The site yielded five young-of-the-year (YOY) steelhead rainbow trout.

The second site included habitat unit 154, a step run located approximately 14,144 feet above the creek mouth. This site had an area of 980 sq. ft. and a volume of 740 cu. ft. The site yielded five YOY steelhead rainbow trout.

## DISCUSSION

Mud Creek is a B3 channel type for the entire 20,332 feet of stream surveyed. The suitability of channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters, bank placed boulders, single and opposing wing deflectors and log cover.

The water temperatures recorded on the survey days August 6 to September 5, 1996, ranged from 55° to 69° Fahrenheit. Air temperatures ranged from 57° to 94° Fahrenheit. This is nearing the threshold stress level temperature range for 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 71% of the total **length** of this survey, riffles 9%, and pools 19%. The pools are relatively deep, with 55 of the 110 (50%) pools having a maximum 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 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.

Two of the 110 pool tail-outs measured had embeddedness ratings of 1 or 2. Fifteen of the pool tail-outs had embeddedness ratings of 3 or 4. Due to the natural levels of silt present in Mud Creek, eighty-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.

All of the low gradient riffles 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 32. The shelter rating in the flatwater habitats was 35. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, terrestrial vegetation contributes a small amount. 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 86%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 86% and 87%, 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) The limited water temperature data available suggest that maximum temperatures are nearing the threshold stress level 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. 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 is from boulders. Adding high quality complexity with woody cover is desirable.

5) There are sections where the stream is being impacted from cattle entering the riparian zone. Alternatives should be explored with the grazier and developed if possible.

## 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 the South Fork Eel River. Channel type is B3. |
| 187' | Electrofishing site #1. |
| 325' | Branscomb Road bridge crosses stream. |
| 2,812' | Footbridge crosses stream. |
| 5,540' | Tributary enters from right bank and was dry at the time of survey. |
| 5,662' | Dirt road fords channel. |
| 5,937' | Dirt road fords channel. |
| 6,728' | Footbridge crosses stream. |
| 7,197' | Small tributary enters from right bank. Water temperature at the time of survey was 59° F. |
| 10,897' | Grapevine Creek enters from right bank. Water temperature at the time of survey was 57° F. |
| 13,335' | Mud spring enters on right bank. Water temperature at the time of survey was 67° F. |
| 14,124' | Dirt road fords channel. |
| 14,144' | Electrofishing site #2. |
| 16,411' | Tributary enters from left bank. Water temperature at the time of survey was 61° |

F.

17,628' Cement road fords stream, approximately 10' long x 20' wide.

19,246' Plunge of 6'. Not a barrier.

20,332' Stream gradient increases to greater than 5% and flow becomes intermittent. End of survey.

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] | |