STREAM INVENTORY REPORT

South Fork Hardy Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1997 on South Fork Hardy Creek beginning at the confluence with Hardy 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 South Fork Hardy 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 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

South Fork Hardy Creek is tributary to Hardy Creek, a tributary to the Pacific Ocean, located in Mendocino County, California (Map 1). South Fork Hardy Creek's legal description at the confluence with Hardy Creek is T22N R17W S32. Its location is 39°43′20″ north latitude and 123°46′52″ west longitude. South Fork Hardy Creek is a 1st order stream and has approximately 1.78 miles of blue line stream according to the USGS Westport 7.5 minute quadrangle. South Fork Hardy Creek drains a watershed of approximately 0.73 square miles. Elevations range from about 240 feet at the mouth of the creek to 1280 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists via Highway 1.

METHODS

The habitat inventory conducted in South Fork Hardy Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). The California Conservation Corps (CCC) Technical Advisors and 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 (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, 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 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 South Fork Hardy 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.

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". South Fork Hardy 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. 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 South Fork Hardy 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 South Fork Hardy 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 South Fork Hardy 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 South Fork Hardy 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 South Fork Hardy Creek fish presence was observed from the stream banks, and one site was 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 South Fork Hardy 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

The habitat inventory of September 23, October 8, 10 and 14, 1997, was conducted by Tara Cooper and Craig Mesman (CCC). The total length of the stream surveyed was 5,752 feet with an additional 190 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.37 cfs on September 19, 1997.

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South Fork Hardy Creek is a B4 channel type for the entire 5,752 feet of stream reach surveyed. Characteristics of B4 channels include: moderate entrenching; riffle-dominated channels with infrequently spaced pools; moderate gradients; stable banks, plans, and profiles; and gravel-dominated substrate.

Water temperatures taken during the survey period ranged from 54 to 56 degrees Fahrenheit. Air temperatures ranged from 49 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 32% riffle units, 23% flatwater units, 43% pool units, and 2% dry units (Graph 1). Based on total **length** of Level II habitat types there were 36% riffle units, 37% flatwater units, and 27% pool units, and dry units made up 1% (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffles, 31%; plunge pools, 21%; and step runs, 19% (Graph 3). Based on percent total **length**, low gradient riffles made up 35%, step runs 33%, and plunge pools 12%.

A total of 108 pools were identified (Table 3). Scour pools were most frequently encountered at 60% and comprised 56% 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. Nineteen of the 108 pools (17.6%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 108 pool tail-outs measured, 3 had a value of 1 (2.7%); 53 had a value of 2 (49.1%); 39 had a value of 3 (36.1%); 2 had a value of 4 (1.9%) and 11 had a value of 5 (10.2%) (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. In South Fork Hardy Creek, 2 of the 11 pool tail-outs which were valued at 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate. The other tail-outs were unsuitable for spawning due to the tail-outs being comprised of large cobble, boulder, bedrock or wood.

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 10, flatwater habitat types had a mean shelter rating of 13, and pool habitats had a mean shelter rating of 45 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 51. Main channel pools and backwater pools both had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in South Fork Hardy Creek. Graph 7 describes the pool cover in South Fork Hardy Creek.

Table 6 summarizes the dominant substrate by habitat type. Of the five low gradient riffles fully measured all had gravel or small cobble as the dominant substrate. In pool tail-outs, where substrate

is also sampled, gravel was the dominant substrate observed in 82 of the 108 pool tail outs measured (75.2%). Small cobble was the next most frequently observed dominant substrate type and occurred in 14.7% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 83%. The mean percentages of deciduous and coniferous trees were 23% and 77%, respectively. Graph 9 describes the canopy in South Fork Hardy Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 93%. The mean percent left bank vegetated was 96.5%. The dominant elements composing the structure of the stream banks consisted of 3% bedrock, 51.5% cobble/gravel, and 45.5% sand/silt/clay (Graph 10). Coniferous trees were the dominant vegetation type observed in 43.9% of the units surveyed. Additionally, 16.7% of the units surveyed had deciduous trees as the dominant vegetation type, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on October 7, 1997, in South Fork Hardy Creek. The site was sampled by Tara Cooper and Craig Mesman (CCC).

The site sampled included habitat units 39 through 46, a run, low gradient riffle, pool combination approximately 896 feet from the confluence with Hardy Creek. The site yielded 14 steelhead and 8 salamanders.

DISCUSSION

South Fork Hardy Creek is a B4 channel type for the entire 5,752 feet of stream surveyed. The suitability of B4 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 September 23, October 8, 10, and 14, 1997, ranged from 54 to 56 degrees Fahrenheit. Air temperatures ranged from 49 to 75 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 more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 37% of the total **length** of this survey, riffles 36%, and pools 27%. The pools are relatively shallow, with only 19 of the 108 (17.6%) 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. Installing structures that will increase or deepen pool habitat is recommended.

Three of the 108 pool tail-outs measured had an embeddedness rating of 1. Ninety-four of the pool tail-outs had embeddedness ratings of 2, 3 or 4. Eleven of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. Two of the 11 were unsuitable for spawning due to the dominant substrate being silt/sand/clay or gravel being too small to be suitable. 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 South Fork Hardy 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 45. The shelter rating in the flatwater habitats was lower at 13. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by large woody debris in all habitat types. Additional log and root wad cover structure 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.

Ninety-eight of the 108 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 83%. The percentage of right and left bank covered with vegetation was high at 93% and 96.5%, respectively. In general, revegetation projects are considered when canopy density is less than 80%.

RECOMMENDATIONS

1) South Fork Hardy 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) 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. Adding high quality complexity with woody cover is desirable.

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.

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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):	Comments:
0'	Begin survey at confluence with Hardy Creek. Channel type is an B4.
292'	Left bank tributary, dry and steep.
295'	Log debris accumulation (LDA), 4.5' high x 4' wide, retaining sediment, not a barrier.
896'	Electrofishing site.
936'	Left bank tributary. Silty bottom, steep slope, no fish observed.
986'	Railroad flat car bridge set on log cribbing, 16' long x 17' high.
1,339'	Left bank tributary, dry.
1,747'	LDA, not a barrier.
2,026'	LDA, 2' long x 3.5' high x 12' wide.
2,186'	LDA, not a barrier.
2,225'	Right bank erosion, 15' long x 45' high.
2,315'	LDA, 10' long x 20' wide x 3.5' high, retaining 6' of gravel, possible barrier.
2,627'	LDA, 38' long x 20' wide. Several logs cabled in-place.
3,017'	Left bank tributary, gradual slope, channel is 2' wide.
3,096'	LDA, with 3' high jump.
3,401'	Left bank erosion, 10' wide x 20' high.
4,282'	LDA, 14' long x 25' wide x 5' high, retaining 5' of sediment, overgrown, possible barrier.
4,345'	Right bank erosion, 30' long x 11' high adding debris to the channel.

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4,730' Left bank erosion, 50' long x 15' high.

5,752' Left bank tributary, narrow channel. End of survey. Substrate becomes large with channel narrowing.

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.

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