STREAM INVENTORY REPORT

SOUTH FORK HARE CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on South Fork Hare Creek. In addition one unnamed tributary to South Fork Hare Creek was inventoried. 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 Hare 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 South Fork Hare 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

South Fork Hare Creek is tributary to Hare Creek, tributary to the Pacific Ocean, located in Mendocino County, California (Figure 1). South Fork Hare Creek's legal description at the confluence with Hare Creek is T18N R17W S27. Its location is 39E23'20" north latitude and 123E44'07" west longitude. South Fork Hare Creek is a first order stream and has approximately 0.9 miles of blue line stream according to the USGS Noyo Hill 7.5 minute quadrangle. South Fork Hare Creek drains a watershed of approximately 1.3 square miles. Summer base runoff is approximately 0.20 cubic feet per second (cfs) at the mouth. Elevations range from about 200 feet at the mouth of the creek to 900 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed. The watershed is located within Jackson Demonstration State Forest and is managed for timber production. Vehicle access exists via California Department of Forestry and Fire Protection (CDF) Road 400.

METHODS

The habitat inventory conducted in South Fork Hare Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 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). South Fork Hare Creek personnel were trained in May, 1995, by Gary Flosi. 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 South Fork Hare 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 Hare 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 (*Sampling Levels*

for Fish Habitat Inventory, Hopelain, 1995). 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 South Fork Hare 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 South Fork Hare 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 South Fork Hare 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 Hare 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 and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In South Fork Hare Creek fish presence was observed from the stream banks, and six sites were electrofished using one Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

SUBSTRATE SAMPLING

In South Fork Hare Creek gravel samples were taken using the methodology as described in *Stream Substrate Quality for Salmonids: Guidelines for Sampling, Processing, and Analysis*, Valentine, 1995. Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. 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).

LARGE WOODY DEBRIS (LWD) STREAM AND RIPARIAN INVENTORY

In South Fork Hare Creek a large woody debris (LWD) stream and riparian inventory was conducted using the methodology as described in the *California Salmonid Stream Habitat Restoration Manual*. Data from the LWD Inventory Form are entered into a dBASE 4.2 data entry program developed by Inland Fisheries Division, California Department of Fish and Game. The South Fork Hare Creek LWD Inventory Report is included in the Hare Creek Stream Inventory Report as Appendix B.

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

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- Mean percent shelter by habitat types

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for South Fork Hare 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

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of September 7 and 12, 1995, was conducted by Shelly Dunn and Bettina Chimarios (WSP/AmeriCorps). The total length of the stream surveyed was 5,413 feet with an additional 14 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.18 cfs on September 18, 1995.

South Fork Hare Creek is an F4 channel type for the first 1,925 feet of stream reach surveyed, a B2 for the next 863 feet, and an F4 for the remaining 2,625 feet. F4 channels are entrenched, meandering riffle/pool channels on low gradients with high width/depth ratios and gravel substrates. B2 channels are moderately entrenched, moderate gradient, riffle-dominant channels with infrequently spaced pools, stable banks, and boulder substrates.

Water temperatures ranged from 53 to 63 degrees Fahrenheit. Air temperatures ranged from 50 to 66 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% pool units, 35% flatwater units, 21% riffle units (Graph 1). Based on total length of Level II habitat types there were 54% flatwater units, 29% pool units, and 14% riffle units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent

occurrence were mid-channel pools 38%, step runs 25%, and low-gradient riffles 21% (Graph 3). Based on percent total length, step runs made up 45%, mid-channel pools 28%, and low-gradient riffles 14%.

A total of 82 pools were identified (Table 3). Main channel pools were 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. Depth is an indicator of pool quality. Twenty-one of the 82 pools (26%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 82 pool tail-outs measured, 4 had a value of 1 (4.9%); 18 had a value of 2 (22.0%); 30 had a value of 3 (36.6%); and 30 had a value of 4 (36.6%) (Graph 6). On this scale, a value of 1 indicates the highest quality 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 a mean shelter rating of 60, flatwater habitat had a mean shelter rating of 12 (Table 1). Scour pools had a mean shelter rating of 83, and main channel pools had a mean shelter rating of 48 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 2 of the 4 low gradient riffles measured (50%)(Graph 8).

The mean percent canopy density for the stream reach surveyed was 98%. The mean percentages of deciduous and coniferous trees were 27% and 73%, respectively. Graph 9 describes the canopy in South Fork Hare Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 85%. The mean percent left bank vegetated was 87%. The dominant elements composing the structure of the stream banks consisted of 7.4% bedrock, 0% boulder, 66.7% cobble/gravel, and 25.9% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 52% of the units surveyed. Additionally, 11% of the units surveyed had deciduous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Six sites were electrofished on September 14 and 18, 1995, in South Fork Hare Creek. The units were sampled by Shelly Dunn and Bettina Chimarios (WSP/AmeriCorps). The second site was located within the B2 channel type reach. All other sites were located within the F4 channel type reaches.

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The first site sampled included habitat units 40-42, a low-gradient riffle/mid-channel pool/step run combination approximately 1,060 feet from the confluence with Hare Creek and within the F4 channel type reach. This site had an area of 1,834 sq ft. The unit yielded two 0+ steelhead, four 1+ steelhead, and four Pacific giant salamanders.

The second site included habitat units 69-79, a series of riffles, runs, and pools located approximately 2,094 feet above the creek mouth and within the B2 channel type reach. This site had an area of 1,540 sq ft. The site yielded five 0+ steelhead, two 1+ steelhead, one 2+ steelhead, and eight Pacific giant salamanders.

The third site sampled included habitat units 100-109, a series of riffles, runs, and pools located approximately 2,827 feet above the creek mouth. This and the remaining sites are within the second F4 channel type reach. The site had an area of 3,980 sq ft. The site yielded four 0+ steelhead, two 1+ steelhead, and six Pacific giant salamanders.

The fourth site sampled included habitat units 155-160, a series of riffles, runs, and pools located approximately 4,228 feet above the creek mouth. The site had a length of 205 ft. The site yielded nineteen Pacific giant salamanders.

The fifth site sampled included habitat units 193-201, a series of runs and pools located approximately 5,184 feet above the creek mouth. The site had a length of 211 ft. The site yielded sixteen Pacific giant salamanders.

The sixth site sampled was above the end of the surveyed reach, a series of high-gradient riffles and step runs located approximately 5,413 feet above the creek mouth. The site had a length 123 ft. No fish were sampled.

GRAVEL SAMPLING RESULTS

McNeil sediment samples in Hare Creek, as well as in South Fork Hare Creek, Bunker Gulch, and Walton Gulch, were taken by Craig Mesman and Heidi Hickethier (CCC) at 30 sites on September 20 through October 2, 1995. The methods used to collect and analyze these samples and the results obtained are discussed in Appendix A of the Hare Creek Stream Inventory Report.

LARGE WOODY DEBRIS (LWD) STREAM AND RIPARIAN INVENTORY RESULTS

The results of the LWD stream and riparian inventory are discussed in Appendix B of the Hare Creek Stream Inventory Report.

DISCUSSION

South Fork Hare Creek is an F4 channel type for the first 1,925 feet of stream surveyed, a B2 for the next 863 feet, and an F4 for the remaining 2,625 feet. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for low-stage weirs, single and opposing wing deflectors, channel constrictors, and log cover; and poor for medium-stage weirs and boulder clusters. B2 channels are considered excellent for low- and medium-stage plunge weirs, single and opposing wing deflectors, and bank cover.

The water temperatures recorded on the survey days September 7-12, 1995, ranged from 53 to 63 degrees Fahrenheit. Air temperatures ranged from 50 to 66 degrees Fahrenheit. This is a fair 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 54% of the total length of this survey, riffles 14%, and pools 29%. The pools are relatively shallow, with 21 of the 82 (25.6%) 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.

Sixty of the 82 pool tail-outs measured had embeddedness ratings of 3 or 4. Only four 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 South Fork Hare 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 moderate with a rating of 60. The shelter rating in the flatwater habitats was 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, undercut banks 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 four low gradient riffles 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 98%. This is a relatively high percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

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No coho were sampled in South Fork Hare Creek. Steelhead were observed through unit 153, approximately 4,220' above the confluence with Hare Creek, where an LDA retaining 5' of sediment appears to impede further passage.

RECOMMENDATIONS

1) South Fork Hare Creek should be managed as an anadromous, natural production stream.

2) 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.

3) 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.

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 and in some areas the material locally available. In particular, large wood should be placed in a manner to increase backwater areas to produce winter holdover habitat.

5) 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.

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.

0'	Begin survey at confluence with Hare Creek. Channel type is F4.
336'	LDA 5' high x 10' wide x 12' long.
448'	LDA 3' high x 18' wide x 10' long.
475'	LDA 5' high x 12' wide x 16' long.
1721'	Unnamed South Fork Hare Creek Tributary enters left bank (see subsection).
1925'	Channel type changes to B2.

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2076' Old bridge 10' long x 20' wide x 5' clearance.

2311' LDA 4' high x 20' wide x 8' long.

2480' LDA 10' wide x 5' long x 1' clearance.

2788' Channel type changes to F4.

3368' LDA 1' high x 4' wide x 10' long.

3913' LDA 8' wide x 10' long x 1' clearance.

4220' LDA 3' high x 6' wide x 15' long retaining gravel 5' deep at base. Probable barrier. No fish observed or sampled above this point.

4351' Dry right bank tributary.

5370' LDA 5' high x 4' wide x 10' long.

5395' Seven foot jump.

5413' End of survey due to increased gradient, lack of habitat, lack of suitable flow, and absence of fish.

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.

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.