# STREAM INVENTORY REPORT
Hollow Tree Creek

## INTRODUCTION

A stream inventory was conducted during in June and July 2003 on Hollow Tree Creek. The survey began at the confluence with Redwood Creek and extended upstream 3.6 miles to Waldron Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in this section of Hollow Tree 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

Hollow Tree Creek is a tributary to South Fork Eel River, a tributary to the Eel River, a tributary to the Pacific Ocean, located in Mendocino County, California (Map 1). Hollow Tree Creek's legal description at the confluence with Redwood Creek is T23N R17W S9. Its location is 39°46'43.07" north latitude and 123°45'7.89" west longitude. Hollow Tree Creek is a third order stream and has approximately 19.5 miles of blue line stream according to the USGS Hales Grove 7.5 minute quadrangle. Hollow Tree Creek drains a watershed of approximately 42 square miles. Elevations range from about 760 feet at the mouth of the creek to 1,900 feet in the headwater areas. Mixed hardwood/mixed conifer forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production. Vehicle access exists via a locked gate on Hales Grove Road off Highway 1.

## METHODS

The habitat inventory conducted in Hollow Tree Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Watershed Stewards Project/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 Hollow Tree Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near 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 (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 (1990). 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". Hollow Tree 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 Hollow Tree 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 like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile 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 for prey. 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 Hollow Tree 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 Hollow Tree 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 hardwood 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 Hollow Tree 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.

10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

## 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 Hollow Tree Creek.

## DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 1.0.35, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Hollow Tree Creek include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools

- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

## HABITAT INVENTORY RESULTS

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

The habitat inventory of 6/25/2003 to 7/14/2003, was conducted by Lesley Merrick and Sarah Ganas (WSP). The total length of the stream surveyed was 18,849 feet with an additional 296 feet of side channel.

Stream flow was measured near the bottom (30 feet from the confluence with Redwood Creek) of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 7.49 cfs on 6/26/03.

Hollow Tree Creek is a F4 channel type for 18,849 feet of the stream surveyed (Reach 1). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 51 to 61 degrees Fahrenheit. Air temperatures ranged from 52 to 76 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% riffle units, 32% flatwater units, 28% pool units (Graph 1). Based on total length of Level II habitat types there were 38% riffle units, 38% flatwater units, 24% pool units (Graph 2).

Seven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 37% low gradient riffle units, 31% run units, and 27% mid-channel pool units (Graph 3). Based on percent total length, 37% were run units, 36% low gradient riffle units, and 23% mid-channel pool units.

A total of 54 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 96%, and comprised 97% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-three of the 54 pools (43%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 55 pool tail-outs measured, 14 had a value of 1 (25.9%); 28 had a value of 2 (50.0%); 4 had a value of 3 (7.4%); 1 had a value of 4 (1.9%); 8 had a value of 5 (14.8%) (Graph 6). On this scale, a value of 1

indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders, etc.

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 20, flatwater habitat types had a mean shelter rating of 20, and pool habitats had a mean shelter rating of 38 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 38 and scour pools had a mean shelter rating of 52 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover types in Hollow Tree Creek. Graph 7 describes the pool cover in Hollow Tree Creek. Large woody debris is the dominant pool cover type followed by bedrock ledges.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 53% of pool tail-outs and large cobble in 16% of pool tail-outs.

The mean percent canopy density for the surveyed length of Hollow Tree Creek was 92%. The mean percentages of hardwood and coniferous trees were 93% and 7%, respectively. Eight percent of the canopy was open. Graph 9 describes the mean percent canopy in Hollow Tree Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 55%. The mean percent left bank vegetated was 56%. The dominant elements composing the structure of the stream banks consisted of 50% sand/silt/clay, 29% bedrock, 21% cobble/gravel, and 1% boulder (Graph 10). Eighty-one percent of the units surveyed had hardwood trees as the dominant vegetation type, and 8% had coniferous trees as the dominant vegetation (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

Juvenile salmonids were observed throughout the survey reach.

## DISCUSSION

Hollow Tree Creek is a F4 channel type for the entire 18,185 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, log cover; and poor for boulder clusters.

The water temperatures recorded on the survey days 6/25/2003 to 7/14/2003, ranged from 51° to 61° Fahrenheit. Air temperatures ranged from 52° to 76° Fahrenheit. This is a good water temperature for juvenile 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 38% of the total length of this survey, riffles 38%, and pools 24%. The pools are relatively deep, with 23 of the 54 (43%) pools having a maximum residual 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 order streams, a primary pool is defined to have a maximum residual 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.

Forty-two of the 55 pool tail-outs measured had embeddedness ratings of 1 or 2. Five of the pool tail-outs had embeddedness ratings of 3 or 4. Eight 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.

Thirty-seven of the 55 pool tail-outs 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 38. The shelter rating in the flatwater habitats was 20. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in Hollow Tree Creek. Large woody debris is the dominant cover type in pools followed by bedrock ledges. 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 reach was 92%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 55% and 56%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

## RECOMMENDATIONS

1) Hollow Tree 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) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from large woody debris. Adding high quality complexity with woody cover is desirable.

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

5) Evaluate the log structures installed by the California Conservation Corps (CCC) to determine if modification, maintenance or additional logs would increase their effectiveness.

## 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.) | Habitat Unit # | Comments: |
|---|---|---|
| 0 | 0001.00 | Start of survey at Redwood Creek confluence |
| 30 | 0002.00 | Flow recorded at 7.49 cfs |
| 87 | 0003.00 | CCC log structure |
| 117 | 0004.00 | CCC log structure |
| 261 | 0006.00 | CCC log structure |
| 348 | 0007.00 | CCC log structure |
| 456 | 0008.00 | Two CCC log structures |
| 593 | 0010.00 | CCC log weir, log and root wad structures |
| 735 | 0012.00 | Juvenile salmonids observed |
| 1,289 | 0019.00 | CCC log structure |
| 1,614 | 0022.01 | CCC log structure |
| 1,614 | 0023.00 | CCC log weir |
| 2,020 | 0026.00 | CCC log structure |
| 2,203 | 0027.00 | CCC log structure |
| 2,486 | 0030.00 | Right bank erosion 70’ long x 25’ high |

| | | |
|---|---|---|
| 2,556 | 0031.00 | CCC log structure |
| 2,642 | 0032.00 | CCC log structures both banks |
| 3,114 | 0037.00 | CCC log structures both banks |
| 3,637 | 0039.00 | CCC log structure |
| 3,879 | 0040.00 | CCC log structure |
| 4,132 | 0044.00 | CCC log weir |
| 4,836 | 0053.00 | CCC log weir |
| 4,978 | 0055.00 | CCC log on right bank |
| 5,288 | 0060.00 | CCC one log on left bank |
| 5,692 | 0064.00 | CCC log structure |
| 6,139 | 0070.00 | Left bank tributary |
| 6,272 | 0071.00 | Steel bridge crossing, 20’ wide x 55’ high x 75’ long. |
| 6,635 | 0074.00 | CCC log structure |
| 6,700 | 0075.00 | Two CCC log structures |
| 6,842 | 0077.00 | Two CCC log structures |
| 7,221 | 0079.00 | Right bank tributary |
| 7,326 | 0081.00 | CCC log structure |
| 7,510 | 0083.00 | CCC log and root wad structure |
| 7,998 | 0086.00 | Left bank landslide 30’ long x 75’ high |
| 8,170 | 0088.00 | Two CCC log structures |
| 9,195 | 0098.00 | CCC log structures both banks |
| 9,494 | 0101.00 | CCC log structure |
| 9,572 | 0102.00 | Two CCC log structures |

Hollow Tree Creek (Redwood Creek to Waldron Creek)

| | | |
|---|---|---|
| 10,126 | 0108.00 | Two CCC log structures |
| 10,368 | 0110.00 | Left bank landslide 20’ long x 70’ long |
| 11,113 | 0114.00 | Multiple cover logs |
| 11,362 | 0116.00 | Two CCC log structures |
| 11,552 | 0117.00 | Two CCC log structures |
| 11,710 | 0119.00 | Two CCC log structures |
| 12,165 | 0124.00 | CCC log structure |
| 12,380 | 0126.00 | Two CCC log structures |
| 12,617 | 0128.00 | Two CCC log structures |
| 13,130 | 0135.00 | Two CCC log structures, one on each bank |
| 14,102 | 0146.00 | Right bank tributary |
| 14,310 | 0148.00 | CCC log structure |
| 14,355 | 0149.00 | CCC log structure |
| 14,651 | 0151.00 | CCC log structure |
| 14,820 | 0153.00 | CCC log structure |
| 15,205 | 0159.00 | CCC log structure |
| 15,288 | 0159.01 | Right bank landslide 150’ long x 100’ high |
| 15,600 | 0162.00 | CCC log structure |
| 15,788 | 0164.00 | CCC log structure |
| 16,051 | 0166.00 | CCC log structure needing maintenance |
| 16,956 | 0171.01 | CCC log structure |
| 17,551 | 0178.00 | CCC root wad |
| 17,708 | 0182.00 | CCC log structure |

Hollow Tree Creek (Redwood Creek to Waldron Creek)

| | | |
|---|---|---|
| 17,847 | 0185.00 | CCC multiple log structure |
| 18,185 | 0186.00 | End of survey at confluence with Waldron Creek. |

## 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] | |