STREAM INVENTORY REPORT

HOLLOW TREE CREEK (WALDRON CREEK TO HEADWATERS)

INTRODUCTION

A stream inventory was conducted during the summer of 2002 on Hollow Tree Creek, from the confluence with Waldron Creek to the headwaters. The survey began at the confluence with Waldron Creek and extended upstream 2.6 miles. Subsections to this report were also completed for eight tributaries to Hollow Tree Creek.

The objective of the habitat inventory on Hollow Tree Creek was to document the habitat available to anadromous salmonids in 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 the South Fork Eel River, a tributary to the Eel River, located in Mendocino County, California (Map 1). Hollow Tree Creek's legal description at the confluence with Waldron Creek is T22 R17 S14. Its location is 39E45N22.67O north latitude and 123E43N26.9O west longitude. Hollow Tree Creek is a third order stream and has approximately 3.48 miles of blue line stream, from Waldron Creek to the headwaters, according to the USGS Leggett 7.5 minute quadrangle. Hollow Tree Creek drains a watershed of approximately 8.77 square miles. Elevations range from about 1388 feet at the mouth of the creek to 1597 feet in the headwater areas. Deciduous forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production/rangeland. Vehicle access exists via Highway 101 to Highway 20 West, then turn onto the Mendocino Redwood Company road at Hales Grove.

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 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. 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 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". 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 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 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 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 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.

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 Hollow Tree 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 October 16-24, 2002, was conducted by Janelle Breton and Dan Resnik (CCC). The total length of the stream surveyed was 13,584 feet.

Stream flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.06 cfs on October 16, 2002.

Hollow Tree Creek is an F3 channel type for the first 9,409 feet of the stream surveyed, an F2 channel type for the next 1,093 feet, and an F4 channel type for the remaining 3,082 feet surveyed. F3, F2, and F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant, boulder-dominant, and cobble-dominant substrates, respectively.

Water temperatures taken during the survey period ranged from 48 to 50 degrees Fahrenheit. Air temperatures ranged from 48 to 59 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 31% riffle units, 31% flatwater units, and 37% pool units (Graph 1). Based on total length of Level II habitat types there were 20% riffle units, 27% flatwater units, and 53% pool units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool, 34%; low-grade riffle, 29%; and run, 29% (Graph 3). Based on percent total length, mid-channel pool made up 49%, run 25%, and low-grade riffle 19%.

A total of 93 pools were identified (Table 3). Mid-channel pools were the most frequently encountered, at 96%, and comprised 98% 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. 18 of the 93 pools (19.4%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 91 pool tail-outs measured, 25 had a value of 1 (27.5%); 38 had a value of 2 (41.8%); 6 had a value of 3 (7%); 0 had a value of 4 (0%); and 22 had a value of 5 (24.2%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. The breakdown of dominant substrate composition for the 22 pool tail-outs that had an embeddedness value of 5 were as follows: 40.9% boulder, 31.8% large cobble, and 27.3% bedrock.

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 12, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 34 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 42. Main channel pools had a mean shelter rating of 34 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Hollow Tree Creek. Large woody debris is lacking in nearly all habitat types. Graph 7 describes the pool cover in Hollow Tree Creek. Large woody debris is the dominant pool cover type followed by boulders.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Small cobble was the dominant substrate observed in 36.3 % of pool tail-outs while gravel was the next most frequently observed substrate type, at 35.2%.

The mean percent canopy density for the surveyed length of Hollow Tree Creek was 88%. The mean percentages of deciduous and coniferous trees were 73% and 15%, respectively. Graph 9 describes the mean percent canopy in Hollow Tree Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 88.2%. The mean percent left bank vegetated was 85.5%. The dominant elements composing the structure of the stream banks consisted of 33.19% bedrock, 32.35% cobble/gravel, 19.33% boulder, and 15.13% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 74.79% of the units surveyed. Additionally, 20.59% of the units surveyed had coniferous trees as the dominant vegetation type (Graph 11).

DISCUSSION

Hollow Tree Creek is an F3 channel type for the first 9,409 feet of stream surveyed, an F2 channel type for the next 1,093 feet, and an F4 channel type for the remaining 3,082 feet. The suitability of F3 channel types for fish habitat improvement structures is good for bank-placed boulders, and single and opposing wing-deflectors; fair for plunge weirs, boulder clusters, channel constrictors, and log cover. The suitability of F2 channel types for fish habitat improvement structures is fair for plunge weirs, single and opposing wing-deflectors, and log cover. The suitability of F4 channel types for fish habitat improvement structures is good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover; poor for boulder clusters.

The water temperatures recorded on the survey days October 16-24, 2002, ranged from 48 to 50 degrees Fahrenheit. Air temperatures ranged from 48 to 59 degrees Fahrenheit. This is an acceptable water temperature range for salmonids. However, 68N F, if sustained, is near the threshold stress level for salmonids. This does not seem to be the case here, and Hollow Tree Creek seems to have temperatures favorable to 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 27% of the total length of this survey, riffles 20%, and pools 53%. The pools are relatively shallow, with only 18 of the 93 (19.4%) 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, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. The LDA's in the system are retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the gravel out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

63 of the 91 pool tail-outs measured had embeddedness ratings of 1 or 2. 6 of the pool tail-outs had embeddedness ratings of 3 or 4. 22 of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. 0 of the 22 were unsuitable for spawning due to the dominant substrate being silt/sand/clay or small gravel. The remainder of pool tails valued at 5 were dominated by boulders, large cobble, or bedrock. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Hollow Tree Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

65 of the 91 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 low with a rating of 34. The shelter rating in the flatwater habitats was slightly lower at 14. 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 almost all habitat types. Additionally, small woody debris 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 88%. Reach 1 had a canopy density of 89% while Reaches 2 and 3 had canopy densities of 88% and 88%, respectively. This is a relatively high percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 88.2% and 85.5%, 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) **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/above 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. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable.**

5) **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.**

6) **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.**

7) **Increase the canopy on Hollow Tree Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.**

8) **Suitable size spawning substrate on Hollow Tree Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.**

9) **There are several log debris accumulations present on Hollow Tree Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.**

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

11) 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.

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 Waldron Creek, which enters at beginning of survey; Waldron Creek is flowing at 0.5 cfs and is accessible to fish. Channel type is F3.
1095' Left bank erosion, 30' high X 60' wide X 25' deep.
1216' Channel type taken, F3.
2112' Juvenile salmonids present.
2328' Right bank erosion, 40' high x 15' wide X 20' deep.
2548' Right bank erosion, 15' high X 25' wide X 5' deep.
3434' Log debris accumulation of 4 pieces: 9' high X 30' wide X 15' long. Stored sand to gravel sediment 30' wide X 50' long X 2' deep. There are visible gaps and water flows through. Left bank landslide contributing sediment, 40' high X 20' wide X 25' deep.
3725' Right bank erosion, 20' high X 10' wide X 10' deep.
6204' Unidentified juvenile salmonids present.
6665' Left bank tributary #6 – Bear Pen Creek. Flowing at 0.1 cfs, accessible to fish. Flagged.
7777' Right bank landslide contributing sediment, 40' high X 40' wide X 20' deep.
8341' Right bank landslide contributing sediment, 30' high X 20' wide X 25' deep.
8658' Right bank erosion, 25' high X 40' wide X 7' deep.
9209' Left bank tributary #7 – Huckleberry Creek. Flowing at 0.1 cfs, accessible to fish. Vehicle bridge, 12' wide X 17' high X 40' long. Made of wood and steel.
9448' Left bank cutting erosion, 19' high X 19' wide X 5' deep. Channel type change, F3 to F2.
10423' Left bank landslide contributing sediment, 40' high X 50' wide X 20' deep.
10502' Channel type change, F2 to F4.
10688' Unidentified juvenile salmonids present.
11280' Right bank tributary, not flowing; flagged.
11392' Left bank erosion, 10' high X 26' wide X 5' deep.
12307' Log debris accumulation of 11 pieces: 10' high X 60' wide X 20' long. Stored gravel to cobble sediment 20' wide X 40' long X 3' deep. There are visible gaps and water flows through. Right bank erosion contributing sediment, caused by old bridge, 17' high X 25' wide X 7' deep.
12355' Left bank erosion contributing sediment, 18' high X 20' wide X 10' deep.
12602' Left bank erosion, 15' high X 32' wide X 6' deep.
13317' Right bank tributary #12, flagged.
13584' Left bank erosion, 10' high X 15' wide x 5' deep. Right bank tributary # 13 – Butler Creek. End of survey due to dry streambed.

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]**