STREAM INVENTORY REPORT

Upper Redwood Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2001 on upper Redwood Creek. The survey began at the confluence with Minon Creek and extended upstream 2.7 miles to the confluence with Pardee Creek.

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

Redwood Creek is a tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Redwood Creek's legal description at the confluence with Pacific Ocean is T11N R01E S32. Its location is 41.2925 degrees north latitude and 1234.0906 degrees west longitude. Redwood Creek is a fourth order stream and has approximately 66 miles of blue line stream according to the USGS Orick 7.5 minute quadrangle. Redwood Creek drains a watershed of approximately 281 square miles. Elevations range from sea level at the mouth of the creek to 3,100 feet in the headwater areas. Redwood forest, Douglas fir forest and grassland dominate the watershed. The lower portion of the watershed is Redwood National Park while the middle and upper portions of the watershed are privately owned. The upper watershed is managed for timber production, rangeland, and recreation. Vehicle access to upper Redwood Creek exists via Highway 299 to Bald Mountain Road to Snow Camp Mountain Road.

METHODS

The habitat inventory conducted in upper Redwood Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the

parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in upper Redwood 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 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". Upper Redwood 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 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 upper Redwood 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 not suitable 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 upper Redwood 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 upper Redwood 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 upper Redwood 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.

Upper Redwood Creek

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 upper Redwood 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

The habitat inventory of September 6 through October 15, 2001 was conducted by T. Hollingsworth and D. Resnik (WSP/AmeriCorps). The total length of the stream surveyed, from the confluence with Minon Creek to the confluence with Pardee Creek, was 13,996 feet with an additional 872 feet of side channel.

Stream flow was measured with a Marsh-McBirney 2000 model flow meter to be 0.94 cfs. Stream flow was measured approximately 120 feet upstream of the confluence of Minon Creek with Redwood Creek.

Upper Redwood Creek is an F3 channel type for the entire 13,996 feet of the stream surveyed. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 64 degrees Fahrenheit. Air temperatures ranged from 56 to 77 degrees Fahrenheit.

Upper Redwood Creek

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 37% pool units, 36% flatwater units, and 26% riffle units (Graph 1). Based on total length of Level II habitat types there were 52% flatwater units, 26% pool units, and 21% riffle units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were runs, 30%; low gradient riffles, 26%; and mid channel pools, 14% (Graph 3). Based on percent total length, runs made up 41%, low gradient riffles 21%, and step runs 11%.

A total of 60 pools were identified (Table 3). Scour pools were the most frequently encountered, at 52%, and comprised 57% 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. Twenty-seven of the 60 pools (45%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 60 pool tail-outs measured, five had a value of 1 (8%); 29 had a value of 2 (48%); nine had a value of 3 (15%); 17 had a value of 5 (28%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. The breakdown of dominant substrate composition for the 17 pool tail-outs that had an embeddedness value of 5 were as follows: 71% boulders, 24% bedrock and 6% silt/clay.

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 24, flatwater habitat types had a mean shelter rating of 15, and pool habitats had a mean shelter rating of 35 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 90. Scour pools had a mean shelter rating of 35 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in upper Redwood Creek. Small woody debris is lacking in nearly all habitat types. Graph 7 describes the pool cover in upper Redwood Creek. Boulders are the dominant pool cover type followed by large woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders were the dominant substrate observed in 32% of pool tail-outs while small cobble was the next most frequently observed substrate type, at 23%.

The mean percent canopy density for the surveyed length of upper Redwood Creek was 59%. The mean percentages of deciduous and coniferous trees were 85% and 16%, respectively. Graph 9 describes the mean percent canopy in upper Redwood Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 75%. The mean percent left bank vegetated was 74%. The dominant elements composing the structure of the

stream banks consisted of 56% cobble/gravel, 20% bedrock, 16% boulders, and 9% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type in 93% of the units surveyed and 7% had coniferous trees as the dominant vegetation (Graph 11).

DISCUSSION

Upper Redwood Creek is an F3 channel type for the entire 13,996 feet of stream surveyed. The suitability of F3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders, single and opposing wing-deflectors; fair for plunge weirs, boulder clusters, channel constrictors, and log cover.

The water temperatures recorded on the survey days September 6 through October 15, 2001 ranged from 53 to 64 degrees Fahrenheit. Air temperatures ranged from 56 to 77 degrees Fahrenheit. This is a suitable water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 52% of the total length of this survey, riffles 21%, and pools 26%. The pools are shallow, with only 27 of the 60 (45%) pools having a maximum depth greater than three 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.

Thirty-four of the 60 pool tail-outs measured had embeddedness ratings of 1 or 2. Nine of the pool tail-outs had embeddedness ratings of 3 or 4. Seventeen of the pool tail-outs had a rating of 5, which is considered not suitable for spawning. Twelve of the 17 tail-outs were not suitable for spawning due to the dominant substrate being boulders. The remainder of pool tail-outs with an embeddedness value of 5 were dominated by bedrock or silt/clay. 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-six of the 60 pool tail-outs had gravel, small cobble or large cobble as the dominant substrate. This is generally considered suitable for spawning salmonids.

The mean shelter rating for pools was 35. The shelter rating in the flatwater habitats was 15. 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, large 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 structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 59%. In general, revegetation projects are considered when canopy density is less than 80% or the canopy composition is dominated by

deciduous trees.

The percentage of right and left bank covered with vegetation was high at 75% and 74%, respectively. In areas of stream bank erosion or where bank vegetation is not at an acceptable level, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Upper Redwood 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 boulders. Adding high quality complexity with woody cover is desirable.

4) Increase the canopy on Upper Redwood 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 effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

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.

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'	Start of survey at confluence with Minon Creek. The channel type is an F3. Instream log structure on right bank.
641'	Road crosses through creek.
1,166'	Instream log structure constructed of four logs.

Upper Redwood Creek

1,599' Left bank erosion site measures approximately 115' long x 80' high.

1,947' Log cabled to bedrock on right bank. Two logs cabled to bedrock on left bank.

2,223' Right bank erosion site measures approximately 50' long x 80' high and is contributing large woody debris to channel.

2,678' Lake Prairie Creek enters on left bank.

2,810' Right bank erosion site measures approximately 160' long x 25' high.

2,971' Right bank erosion site measures approximately 60' long x 170' high.

3,505' Instream log structure on right bank with three logs cabled to bedrock.

6,603' Right bank erosion site, 60% vegetated with alders, measures approximately 50' long x 150' high.

9,955' Right bank erosion site measures approximately 170' long x 60' high.

10,388' Bradford Creek enters on right bank. The water temperature was 56 degrees Fahrenheit.

12,169' Tributary enters on left bank; was dry at the time of survey.

13,996' End of survey due to lack of access upstream. Pardee Creek enters on left bank.

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]	