STREAM INVENTORY REPORT

Redwood Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on Redwood Creek, beginning at Joe Massei's cabin. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Redwood 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

Redwood Creek is tributary to the Pacific Ocean in Humboldt County, California (Map 1). Redwood Creek's legal description at the confluence with the Pacific Ocean is T11N R01E S32. Its location is 41°17′03″ north latitude and 124°05′25″ west longitude. Redwood Creek is a sixth order stream and has approximately 2,368 miles of blue line stream according to the USGS Orick (et al) 7.5 minute quadrangle. Redwood Creek drains a watershed of approximately 278 square miles. Elevations range from sea level at the mouth of the creek to 5,300 feet in the headwater areas. Mixed conifer forest and oak woodland dominate the watershed in the reaches surveyed. The section of Redwood Creek surveyed is privately owned and is managed for timber production. Vehicle access to the Redwood Creek survey reach exists via Highway 299 to High Prairie Road.

METHODS

The habitat inventory conducted in Redwood Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The Northwest Emergency Assistance Program (NEAP) 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.

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 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 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". 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. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. 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 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 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 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 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 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*. Canopy density relates to the amount of stream shaded from the sun. In Redwood Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of every unit. 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 Redwood Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation 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 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
- 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 was conducted on August 1, 2, and 5, 1996. The total length of the stream surveyed was 6,428 feet with an additional 582 feet of side channel.

Flows were not measured on Lower Redwood Creek.

Redwood Creek is an F3 channel type for the entire 6,428 feet of stream reach 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 60 to 66 degrees Fahrenheit. Air temperatures ranged from 51 to 73 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 7% riffle units, 54% flatwater units, 36% pool units, and 3% dry units (Graph 1). Based on total **length** of Level II habitat types there were 3% riffle units, 57% flatwater units, and 29% pool units (Graph 2).

Fifteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were step runs, 20%; pocket water, 17%; and runs, 16% (Graph 3). Based on percent total **length**, step runs made up 23%, runs 22%, and pocket water and dry 11% each.

A total of 32 pools were identified (Table 3). Scour pools were most frequently encountered at 41% and comprised 51% 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. Twelve of the thirty-two pools (37.5%) had a depth of three feet or greater

(Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the thirty-two pool tail-outs measured, 1 had a value of 1 (3%); 19 had a value of 2 (59%); 7 had a value of 3 (22%); 5 had a value of 4 (16%) and none had a value of 5 (Graph 6). On this scale, a value of 1 indicates the highest quality of 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. Riffle habitat types had a mean shelter rating of 29, flatwater habitat types had a mean shelter rating of 28, and pool habitats had a mean shelter rating of 22 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 32. Main channel pools had a mean shelter rating of 17 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Lower Redwood Creek. Graph 7 describes the pool cover in Lower Redwood 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%). Small and large cobble were the next most frequently observed dominant substrate types and both occurred in 25% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 46%. The mean percentages of deciduous and coniferous trees were 37% and 63%, respectively. Graph 9 describes the canopy in Redwood Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 42.4%. The mean percent left bank vegetated was 47.9%. The dominant elements composing the structure of the stream banks consisted of 16.7% bedrock, 16.1% boulder, 49.4% cobble/gravel, and 17.8% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 79.9% of the units surveyed. Additionally, 1.7% of the units surveyed had deciduous trees as the dominant vegetation type, and 1.2% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

DISCUSSION

Redwood Creek is an F3 channel type for the entire 6,428 feet of stream surveyed. The suitability of F3 channel types for fish habitat improvement structures is as follows: Good for bank placed boulders, and single and opposing wing deflectors; fair for low stage weirs, boulder clusters, channel constrictors, and log cover; and poor for medium stage weirs.

The water temperatures recorded on the survey days August 1, 2, and 5, 1996, ranged from 60 to 66 degrees Fahrenheit. Air temperatures ranged from 51 to 73 degrees Fahrenheit. This is an acceptable 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 57% of the total **length** of this survey, riffles 3%, and pools 29%. The pools are relatively shallow with 12 of the 32 (37.5%) 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.

Twelve of the 32 pool tail-outs measured had embeddedness ratings of 3, 4 or 5. Only one 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 Redwood 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 low with a rating of 22. The shelter rating in the flatwater habitats was slightly better at 28. 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, bedrock ledges 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 46%. This is a relatively low 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 moderate at 42.4% and 47.9%, 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) Lower 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) 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) 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.

6) Increase the canopy on 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.

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 Joe Massei's cabin, 40°50'00" north latitude and 123°46'03" west longitude.
403'	Root wad enhancement.
1,111'	Large left bank slide.
1,443'	Small left bank tributary (6' x 2').
1,520'	Boulder enhancement.
1,563'	Left bank slide.
2,196'	Old slide begins here.
2,254'	Young-of-the-year salmonids observed.
2,333'	Slide ends.
2,815'	Log enhancement intact.
3,128'	Old slide on right bank.
3,999'	Log enhancement structure.

4,214' Slide is contributing sediment.

4,628' Right bank slide is delivering sediment and some woody debris.

4,809' Slide ends here.

5,056' Boulder enhancement.

5,236' Bedrock and boulder enhancement is missing wood.

5,311' Right bank slide.

5,444' Right bank slope is unstable.

5,546' Unstable right bank.

5,594' Right bank slope is more stable.

5,746' Small left bank slide. Boulder enhancement.

6,147' Right bank slide.

6,254' Slide ends.

6,428' Flagged stop. End of survey.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, 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