STREAM INVENTORY REPORT

CHADD CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Chadd Creek to assess habitat conditions for anadromous salmonids. 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 Chadd Creek. The objective of the biological inventory was to document the salmonid species present and their distribution. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

Adult carcass surveys were conducted in Chadd Creek from 1987 through 1990. In December 1987, three live chinook salmon, 15 chinook carcasses, and 1 coho carcass were recovered. In January 1988, seven chinook carcasses and seven steelhead carcasses were observed. A survey in December 1988 revealed no fish. In January 1989, one live chinook was observed. In 1990, the last year a carcass survey was conducted, two surveys were completed. On January 17, one chinook and two coho skeletons were found. On January 23, no fish were observed. 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.

WATERSHED OVERVIEW

Chadd Creek is tributary to the Eel River, located in Humboldt County, California (Figure 1). Chadd Creek's legal description at the confluence with the Eel River is T1N R2E S32. Its location is 40°25'16" N. latitude and 123°58'32" W. longitude. Chadd Creek is a second order stream and has approximately 5.8 miles of blue line stream, according to the USGS Redcrest 7.5 minute quadrangle. Chadd Creek drains a watershed of approximately 4.9 square miles. Elevations range from about 100 feet at the mouth of the creek to 1,800 feet in the headwater areas. Redwood and Douglas fir dominate the watershed. The lower section of the watershed, and a portion of the upper watershed, is under the jurisdiction of Humboldt Redwoods State Park. The Pacific Lumber Company and other private landowners own the remainder. The basin is managed for recreation and timber production. The town of Redcrest diverts Chadd Creek for

its domestic water supply. Vehicle access exists via Highway 101 to Redcrest.

METHODS

The habitat inventory conducted in Chadd Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) and contract seasonal Technical Advisors that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Chadd Creek personnel were trained in May, 1992, by Gary Flosi and Scott Downie. 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 Chadd 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. Flows should also be measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed by David Rosgen (1985). 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 four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.

3. Temperatures:

Both water and air temperatures are taken and recorded at each tenth unit typed. The time of the measurement is also recorded. Both temperatures are taken in 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". Chadd 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. Unit measurements included mean length, mean width, mean depth, and maximum depth. 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 Chadd 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).

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 Chadd 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.

8. Canopy:

Stream canopy is estimated using handheld spherical densiometers and is a measure of the water surface shaded during periods of high sun. In Chadd Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

9. Bank Composition:

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 Chadd Creek, the dominant composition type in both the right and left banks was selected from a list of eight options on 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. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, 3) electrofishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual.

Biological inventory was conducted in Chadd Creek to document the fish species composition and distribution. Three sites were electrofished in Chadd Creek using one Smith Root Model 12 electrofisher. Each site was end-blocked with nets to contain the fish within the sample reach. Fish from each site were counted by species, measured, and returned to the stream.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the California Department of Fish and Game (DFG). This program also processes and summarizes the data.

The Habitat Runtime program produces the following 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 Lotus 1,2,3. Graphics developed for Chadd 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

HABITAT INVENTORY RESULTS

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

The habitat inventory of June 8-11, 15, 17, 18, and 25, 1992, was conducted by Tony Sartori and Erick Elliot (CCC). The total length of the stream surveyed was 19,392 feet, with an additional 265 feet of side channel. Chadd Creek forks approximately 12,500 feet from the confluence. This tributary, identified as tributary 1 was also inventoried. The data for tributary 1 will be summarized separately in this report.

Flow was measured three times on Chadd Creek with a Marsh-McBirney Model 2000 flowmeter. On June 8th, 2600 feet from the confluence the flow was 0.19 cfs; on June 12th, 12,360 feet from the confluence the flow was 1.3 cfs; on June 19th, 12,600 feet from the confluence, and above tributary 1, the flow was measured at 0.6 cfs. From the confluence of the Eel River upstream approximately one mile the flow in Chadd Creek goes subterranean every summer.

Chadd Creek has three channel types: from the confluence with the Eel River to 9,179 feet a C3; next 8,303 feet a B3; and the upper 2,175 feet an A3 channel type. C3 channels are low gradient (0.5 to 1.0%), moderately confined streams, with a gravel, small cobble and sand bed. B3 channels are moderate gradient (1.5-4.0%), well confined, unstable cobble/gravel channels. A3 types have steep, erodible, coarse-grained, unstable gravel/sand channels.

Water temperatures ranged from 54 to 62 degrees fahrenheit. Air

temperatures ranged from 60 to 72 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 37.2%, flatwater types 29.9%, and pools 32.5% (Graph 1). Riffle habitat types made up 35.2% of the total survey **length**, pools 28.8%, and flatwater 27.5% (Graph 2).

Twenty-one Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffles, 33.1%; runs, 18.5%; and mid-channel pools, 9.2% (Graph 3). By percent total **length**, low gradient riffles made up 32%, runs 13.4%, and step-runs 9.3%.

One-hundred-seventy-four pools were identified (Table 3). Scour pools were most often encountered at 61.5%, and comprised 52.6% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Sixty-four of the 174 pools (37%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 162 pool tail-outs measured, twenty had a value of 1 (12.3%); 59 had a value of 2 (36.4%); 55 had a value of 3 (34.0%); and 28 had a value of 4 (17.3%). On this scale, a value of one is the best for fisheries (Graph 6).

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 had the highest shelter rating at 55.5. Riffle habitats followed with a rating of 46.5 (Table 1). Of the pool types, the main-channel had the highest mean shelter rating at 56.5, and scour pools rated 56.1 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Chadd Creek and are extensive. Large and small woody debris also contribute some cover in nearly all habitat types. Graph 7 describes the pool cover in Chadd Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 98 of the 177 low gradient riffles (55.3%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 27.7% of the low gradient riffles (Graph 8).

Seventeen percent of the survey reach lacked shade canopy. Of

the 83% of the stream covered with canopy, 27% was composed of deciduous trees, and 57% was composed of coniferous trees. Graph 9 describes the canopy in Chadd Creek.

Table 2 summarizes the mean percentage of the right and left stream banks covered with vegetation by habitat type. For the stream reach surveyed, the mean percent right bank vegetated was 87.2%. The mean percent left bank vegetated was 85.3%. The dominant elements composing the structure of the stream banks consisted of 0.9% bedrock, 3.7% boulder, 0.5% cobble/gravel, 5.3% bare soil, 11.1% grass, 50.3% brush. Additionally, 17.3% of the banks were covered with deciduous trees, and 10.9% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on July 13, 1992 in Chadd Creek. The units were sampled by Tony Sartori, Russ Irvin, and John Crittenden (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled was habitat unit 273, a lateral scour pool - log enhanced, approximately 12,416 feet from the confluence with the Eel River. This site had an area of 507 sq ft, and a volume of 507 cu ft. The unit yielded 17 steelhead, ranging from 46 to 136mm and four coho ranging from 71 to 75mm.

The second site was habitat unit 284, a mid-channel pool, located approximately 12,753 feet above the confluence. This site had an area of 117 sq ft, and a volume of 23.4 cu ft. Twenty-three steelhead were sampled. They ranged from 43 to 79mm.

The third site sampled was habitat units 354, 355, and 356, a mid-channel pool, a low gradient riffle, and a step run located approximately 15,449 feet above the creek mouth. This site is directly above the Highway 101 culvert. The site had an area of 432.6 sq ft, and a volume of 916 cu ft. Twenty-two steelhead were sampled, ranging from 40 to 123mm.

DISCUSSION

The surveyed reach of Chadd Creek has three channel types: A3, B3, and C3. The A3 channel type is generally not suited for instream enhancement structures due to the high energy stream and steep erodible stream banks. The B3 channel has unstable rejuvenating stream banks and is generally not suitable for

instream enhancement structures, although site specific projects can be designed in areas where the banks are stable or in conjunction with bank armoring to prevent erosion.

C3 channels are meandering stream types on noncohesive gravel beds with poorly consolidated stream banks. They are generally not suitable for instream enhancement structures. However, bank placed boulders, bank cover, overhead log cover and shelter structures in straight reaches are often appropriate. Any work considered will require careful design, placement, and construction that must include protection for the unstable banks.

The water temperatures recorded on the survey days June 8-11, 15, 17, 18, and 25, 1992 ranged from 54° F to 62° F. Air temperatures ranged from 60° F to 72° F. This is a very good water temperature regime for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 27.5% of the total **length** of this survey, riffles 35.2%, and pools 28.8%. The pools are relatively shallow with only 64 of the 174 pools having a maximum depth greater than 2 feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. Therefore, 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 create bank erosion.

Eighty-three of the 162 pool tail-outs measured had embeddedness ratings of 3 or 4. Twenty had a 1 rating. Embeddedness in excess of 26%, a rating of 2 or more, is considered poor quality for fish habitat. In Chadd Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was relatively low with a rating of 55.5. The shelter rating in the flatwater habitats was slightly lower at 41.6. 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 and small woody debris 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.

One-hundred-forty-seven of the 177 low gradient riffles had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 83%. This is a high percentage of canopy, since 80 percent is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Chadd Creek should be managed as an anadromous, natural production stream.

2) Increase woody cover in the pool 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 is at hand.

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) 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.

PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. All the distances are approximate and taken from the beginning of the survey reach.

675'	Begin survey 675' from confluence of with the Eel River. First 675' dry.
2535'	Tributary enters from left bank. Mouth approximately 4' wide, very well confined.

2593' Flow rate 0.19 cfs. Young-of-the-year (YOY) observed.
2640' Tributary entering from left bank. YOY observed.

3532' Tributary entering from left bank, 8' wide. YOY observed.

3569' Flow rate 0.1 cfs. YOY observed.

5185' 4" x 4" wire fence across unit holding 10' long x 1' diameter redwood log.

5274' Bridge 5' high x 30' wide x 12' long over stream.

5724' Outlet from pond dammed by 1' x 12' x 1" board. Culvert from pond 1' diameter.

5869' Dirt 4 x 4 road crossing channel. Also, 4" x 4" x 5' high fence spanning creek at top of unit 101.

6401' YOY coho, 2+ steelhead, and stickleback observed.

7110' 4" x 4" x 4' high wire fence spanning stream.

7668' Concrete bridge over stream 4' high x 28' wide x 35' long.

9162' YOY, 1+, and 2+ steelhead observed.

9259' Culvert 9' diameter by 97' long creating scour pool at low end.

9679' Small woody debris accumulation 20' wide x 3' high x 4' long.

11045' Braided channel. Also old 1' diameter culvert crossing stream.

12534' Chadd Creek forks at top of unit (tributary 1).

12822' Large woody debris (LDA) accumulation 15' wide x 5' high x 10' long. Not a barrier.

13239' LDA 15' wide x 50' long x 15' high suspended 2' above channel.

13717' Loose matrix of SWD 30' long x 6' wide retaining gravel 3' high x 5' wide x 20' long. Overflow channel to right of accumulation.

14732' 9' diameter x 605' long metal culvert under Highway 101 creating a 2' plunge on downstream side. Wooden baffles in culvert approximately 20 to 25' apart. Each baffle creating a 1/2' to 1' deep plunge while retaining some gravel. YOY observed above.

14932' LDA 10' long x 20' wide x 2' high. Not a barrier.

14999' Braided channel.

15449' LDA 20' wide x 5' long x 3' high. Not a barrier.

16055' LDA 15' long x 5' high x 10' wide. Not a barrier.

17220' 4' diameter redwood log on right bank and a 3' diameter redwood log on left bank creating a "V" shape weir. (V pointing upstream) Narrow opening causing gravel retention 15' wide x 6' high. At wide end of "V" (the downstream side) a 6' plunge flows into a 3.5' deep pool. Also 100' long x 100' high slide composed of small cobble, gravel, and boulders on left bank in this unit (409) and extending into next unit. YOY observed upstream.

17969' LDA 10' long x 10' high x 20' wide causing gravel retention 15' wide x 7' high x 50' long and subsurface flow.

18017' LDA (no measurements) loose matrix. Not a barrier. YOY observed.

18353' 4.5' plunge over roots, downed redwoods and boulders. Possible barrier.

18601' 5' plunge between units 464 and 465 under old splintered redwood. No jump pool.

18921' Slump on right bank causing LDA 60' long x 10' high x 30' wide retaining gravel 30' wide x 3' high x 100' long.

19145' Debris slump from left bank causing gravel retention. 3' high x 10' wide x 30' long.

19295' Side channel of equal flow to left at downstream end of this unit. Could possibly be old main channel.

19530' 45% gradient.

19550' 6' plunge onto boulders. Deepest