SALMON AND STEELHEAD RESTORATION AND ENHANCEMENT PROGRAM

NORTH COAST

WATERSHED PLANNING and COORDINATION PROJECT

STREAM INVENTORY REPORT

CHADD CREEK, EEL RIVER, 1998

CALIFORNIA DEPARTMENT OF FISH AND GAME

SPORT FISH RESTORATION ACT

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NORTH COAST WATERSHED PLANNING and COORDINATION PROJECT

The North Coast Watershed Planning and Coordination Project (NCWPCP), formerly the North Coast Basin Planning Project (BPP) was begun in 1991 to develop salmon and steelhead restoration and enhancement programs in North Coast watersheds for the Department of Fish and Game (DFG). The objectives of the project conform with the goals of California's Salmon and Steelhead Restoration and Enhancement Program of 1988. The Restoration Program strives to enhance the status of anadromous salmonid populations and improve the fishing experience for Californians. The program's goal is to achieve a doubling of the population of salmon and steelhead by the year 2000. The project is supported by the Sport Fish Restoration Act, which uses sport fishermen's funds to improve sport fisheries.

The NCWPCP conducts stream and habitat inventories according to the standard methodologies discussed in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). Biological sampling is conducted using electrofishing and direct observation to determine species presence and distribution; selected streams are sampled for population estimates. Some streams are also sampled for substrate composition. Collected information is used for base-line data, public cooperation development, restoration program planning, specific project design and implementation, and for project evaluation.

The Eel River system was identified as the initial basin for project planning activities. Most anadromous tributaries to the Van Duzen, South Fork Eel, Mainstem Eel, Middle Fork Eel, and North Fork Eel rivers have been inventoried since 1991. NCWPCP personnel have also worked in cooperation with the DFG Salmon Restoration Project's staff to inventory Mattole River tributaries, Mendocino County coastal streams, and tributaries to Humboldt Bay. Project staff includes DFG personnel, AmeriCorps/Watershed Stewards Project members, California Conservation Corps Technical Assistants, and fishermen from the Northwest Economic Assistance Program.

STREAM INVENTORY REPORT

Chadd Creek, 1998, Eel River

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Chadd Creek. 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 presence and distribution of juvenile salmonid species.

Adult carcass surveys were conducted in Chadd Creek from 1987 through 1990. In December 1987, three live chinook salmon, 15 chinook carcasses, and one coho carcass were recovered. In 1990, the last year a carcass survey was conducted, two surveys were completed. On January 17, one chinook and two coho skeletons were recovered. 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 (Map 1). Chadd Creek's legal description at the confluence with the Eel River is T01N R02E S32. Its location is 40°25′16″ North latitude and 123°58′32″ West 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. Mixed conifer forest dominates the watershed. The lower section and a small portion of the upper watershed is under the jurisdiction of Humboldt Redwoods State Parks. The Pacific Lumber Company and other private landowners own the remainder. The basin is managed for rural residence, recreation, and timber production. The town of Redcrest uses Chadd Creek for its 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 et.al., 1998). The California Conservation Corps (CCC) Technical Advisors and AmeriCorps Watershed Stewards Project (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.

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.

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". 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. 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 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) 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 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 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 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 Chadd Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every unit, giving a 100% 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 Chadd 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 was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Chadd Creek fish presence was observed from the stream banks. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85 mm)(Valentine, 1995).

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 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 the pool tail outs
- 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 May 26 to June 23, 1998, was conducted by Stewart McMorrow, John Wooster, Kelley Turner, and Dana McKracken (WSP). The total length of the stream surveyed was 16,194 feet with an additional 272 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 2.8 cfs on May 27, 1998.

Chadd Creek is a C4 channel type for the entire 16,194 feet of stream reach surveyed. C4 channels are low gradient, meandering, point bar, riffle/pool, alluvial channels with broad, well-defined floodplains and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 50° to 61° F. Air temperatures ranged from 52° to 82° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 22% riffle units, 28% flatwater units, 49% pool units, and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 19% riffle units, 48% flatwater units, 30% pool units, and 3% dry units (Graph 2).

Seventeen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pools, 37%; low gradient riffles, 22%; and runs, 19% (Graph 3). Based on percent total length, runs made up 27%, mid-channel pools 25%, and step runs 21%.

A total of one hundred fifty-one pools were identified (Table 3). Main channel pools were most frequently encountered at 75% and comprised 86% 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. Eighty-nine of the 151 pools (59%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 148 pool tail-outs measured, none had a value of 1 (0%); 50 had a value of 2 (34%); 78 had a value of 3 (53%); 11 had a value of 4 (7%) and nine had a value of 5 (6%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate and a value of 5 indicates the tail-out is not suitable for spawning. In Chadd Creek, eight of the nine pool tail-outs which were valued at 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate. The other tail-out was unsuitable for spawning due to the tail-out being comprised of large cobble, boulder, bedrock or wood.
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 8, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 39 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 50. Main channel pools had a mean shelter rating of 39 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Chadd Creek. 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 124 of the 148 pool tail outs measured (84%). Small cobble was the next most frequently observed dominant substrate type and occurred in 9% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 83%. The mean percentages of deciduous and coniferous trees were 54% and 46%, respectively. Graph 9 describes the canopy in Chadd Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 84%. The mean percent left bank vegetated was 84%. The dominant elements composing the structure of the stream banks consisted of 1.6% bedrock, 0.2% boulder, 53.7% cobble/gravel, and 44.5% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 20% of the units surveyed. Additionally, 48.4% of the units surveyed had deciduous trees as the dominant vegetation type, and 23.6% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No sites were electrofished during the 1998 summer stream inventory of Chadd Creek.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Chadd Creek.

DISCUSSION

Chadd Creek is a C4 channel type for the entire 16,194 feet of stream surveyed The suitability of C4 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.

The water temperatures recorded on the survey days May 27 to June 23, 1998, ranged from 50° to 61° F. Air temperatures ranged from 52° to 82° F. This is an acceptable water temperature range for salmonids. However, 65° F, if sustained, is near the threshold stress level for salmonids. This does not seem to be the case here, and Chadd 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 48% of the total length of this survey, riffles 19%, pools 30%, and dry units 3%. The pools are relatively deep, with 89 of the 151 (58.9%) pools having a maximum depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second

order streams, a primary pool is defined to have a maximum depth of at least two 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. 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.

None of the 148 pool tail-outs measured had an embeddedness rating of 1. Eighty-nine of the pool tail-outs had embeddedness ratings of 3 or 4. Nine of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. Eight of the nine were unsuitable for spawning due to the dominant substrate being silt/sand/clay or gravel being too small to be suitable. 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 Chadd 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 39. 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 small woody debris in all habitat types. Additionally, undercut banks 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 thirty-eight of the 148 pool tail outs 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 83%. 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 84% and 84%, 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) Chadd 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) 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.

4) 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.

5) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from undercut banks. Adding high quality complexity with woody cover is desirable.

6) 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.

7) There are several log debris accumulations present on Chadd 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.

8) Culverts under county roads and state highways should be assessed for fish passage.

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 Eel River. Channel type is a C4 for the entire 16,192' of stream survey.

405' Large debris accumulation (LDA) in stream channel; 30'L x 25'W x 4'H. Not a barrier to fish migration.

639' Telephone pole appears to be slumping down the bank.

832' Dry tributary enters from left bank (LB).

857' LDA in stream channel; 20'L x 40'W x 4'H. Not a barrier.

1925' Tributary enters from LB; water temperature is 50° F.

2000' Tributary enters from LB.

2566' Tributary enters from LB.

2621' Juvenile salmonids observed from the streambanks by surveyors.

3613' Avenue of the Giants on LB, near mile marker 41.59. Good access for electrofishing.

3814' Leaving the Avenue. Good electrofishing site.

3943' Tributary enters from LB.

4084' LDA in stream channel; 10'L x 40'W x 4'H. Not a barrier.

4402' Livestock exclusionary fence on right bank (RB).

4434' Wooden vehicle bridge crosses stream.

4801' Burl shop on LB, off the Avenue of the Giants. Good stream access. Cattle tracks in the creek.

4921' Small mill operation on RB. Road fords stream.

5054' Sliding livestock exclusionary fence across stream.

5694' Rip-rap on RB. Evidence of cattle in stream continues.

5764' Dirt road parallels RB.

6422' Instream structure; single wing-deflector on RB.

6767' Holmes Flat Road crosses stream. Two square concrete culverts at 60'L x 5'W x 3'H.

6934' Spring on RB.

7062' Instream structure; sill log.

7195' LDA in stream channel; 8'L x 20'W x 6'H. Consists of two 3' diameter redwood spanners.

7613' Instream structure; upstream weir.

7924' Instream structure; sill log creating step run.

7935' Instream structure; sill log forming pool.

8056' LDA in stream channel; 15'L x 40'W x 4'H. Not a barrier.

8281' Corrugated metal pipe (CMP) in channel; 9' diameter, rustline at 3'.

8402' Instream structure; upstream weir.

8443' Instream structure; upstream weir forming pool. Rock armor on RB beneath road.

8525' Scouring against RB has cut away the bank; telephone pole appears ready to fall into stream.

11284' Major tributary enters from the LB, contributing 1/3 to ½ of the flow. Water temperature is 56° F. A Humboldt crossing 150' upstream of the tributary and a possible fish barrier at 350'. Survey continues up the mainstem of Chadd Creek.

11315' LDA in stream channel; 6'L x 20'W x 5'H. Not a barrier.

12046' LDA in stream channel; 15'L x 20'W x 5'H. Not a barrier.

12315' Juvenile salmonids observed from the streambanks by surveyors.

12545' LDA in stream channel; 8'L x 10'W x 4'H. Not a barrier.

12658' Tributary enters from RB.

12805' Culvert under Highway 101 begins. Concrete ledge at outfall could be a fish barrier.

13255' Concrete apron at inflow of culvert; weir/baffle combination. Needs repair.

13516' Tributary enters from RB.

13998' Tributary enters from LB.

14371' Tributary enters from RB.

15388' Failure on RB; 60'L x 80'H. Contributing fines to the stream channel.

15440' Failure on LB; 100'L x 300'H.

15441' LDA in stream channel; 40'L x 20'W x 10'H.

16183' LDA in stream channel; 25'L x 30'W x 6'H. Retaining gravel, potential fish barrier.

16194' End of survey.

REFERENCES

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. California salmonid stream habitat restoration manual, 3rd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, 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