STREAM INVENTORY REPORT

SALMON AND STEELHEAD RESTORATION AND ENHANCEMENT PROGRAM

NORTH COAST

WATERSHED PLANNING and COORDINATION PROJECT

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STRAWBERRY CREEK (100%),EEL RIVER, 1998

CALIFORNIA DEPARTMENT OF FISH AND GAME

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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.

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INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Strawberry. 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 Strawberry Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

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

Strawberry Creek is tributary to Yager Creek, tributary to the Van Duzen River, located in Humboldt County, California (Map 1). Strawberry Creek's legal description at the confluence with Yager Creek is T02N R02E S05. Its location is 40°34′37″ north latitude and 123°58′29″ west longitude. Strawberry Creek is a first order stream and has approximately 1.0 miles of blue line stream according to the USGS Owl Creek 7.5 minute quadrangle. Strawberry Creek drains a watershed of approximately 1.8 square miles. Elevations range from about 540 feet at the mouth of the creek to 1,700 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed. The watershed is owned by the Pacific Lumber Company and is managed for timber production. Year round vehicle access exists via Fisher Road to Pacific Lumber Company's Yager Camp. The main Yager Haul Road leads to Strawberry Creek, approximately eight miles from Yager Camp.

METHODS

The habitat inventory conducted in Strawberry 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.

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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 Strawberry 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". Strawberry 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. All units were measured for mean length. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were in feet to the nearest tenth.

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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 Strawberry 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 Strawberry 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 Strawberry Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of 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 Strawberry 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 Strawberry Creek fish presence was observed from the stream banks, and no sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

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 Strawberry 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

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HABITAT INVENTORY RESULTS

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

The habitat inventory of May 26-27 and June 25, 1998, was conducted by Carolyn Jezierski and Kelley Turner(WSP). The total length of the stream surveyed was 3,128 feet with an additional 31 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.9 cfs on May 27, 1998.

Strawberry Creek is a G4 channel type for the entire 3,128 feet of stream reach surveyed. G4 channels are entrenched, gully, Step-pool channels with moderate gradients and low width/depth ratios with gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 49 to 55 degrees Fahrenheit. Air temperatures ranged from 50 to 59 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% riffle units, 25% flatwater units, 41% pool units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 40% riffle units, 31% flatwater units, 28% pool units, and 2% culvert units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 34%; mid-channel pools, 28%; and step runs, 12% (Graph 3). Based on percent total length, low gradient riffles made up 40%, step runs 21%, and mid-channel pools 20%.

A total of forty-six pools were identified (Table 3). Main channel pools were most frequently encountered at 72% and comprised 76% 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. Seventeen of the 46 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 forty-six pool tail-outs measured, one had a value of 1 (2%); eight had a value of 2 (17%); 32 had a value of 3 (72%); none had a value of 4 (0%) and five had a value of 5 (9%) (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 Strawberry Creek, one of the five 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-outs were unsuitable for spawning due to the tail-outs 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 16, flatwater habitat types had a mean shelter rating of 25, and pool habitats had a mean shelter rating of 62 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 67. Scour pools had a mean shelter rating of 52 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Unndercut bank is the dominant cover type in Strawberry Creek. Large and small woody debris are found in nearly all habitat types. Graph 7 describes the pool cover in Strawberry Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 36 of the 46 pool tail outs measured (79%). Small cobble was the next most frequently observed dominant substrate type and occurred in 15% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 91%. The mean percentages of deciduous and coniferous trees were 52% and 39%, respectively. Graph 9 describes the canopy in Strawberry Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 84%. The mean percent left bank vegetated was 83%. The dominant elements composing the structure of the stream banks consisted of 1.0% bedrock, 1.0% boulder, 50.0% cobble/gravel, and 48% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 16% of the units surveyed. Additionally, 46% of the units surveyed had deciduous trees as the dominant vegetation type, and 34% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No sites were electrofished on Strawberry Creek.

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DISCUSSION

Strawberry Creek is a G4 channel type for the entire 3,128 feet of stream surveyed. The suitability of G4 channel types for fish habitat improvement structures is good for bank-placed boulders; fair for plunge weirs, opposing wing-deflectors, and log cover; and poor for boulder clusters and single wing-deflectors.

The water temperatures recorded on the survey days May 26-27, June 25, 1998, ranged from 49° to 55° F. Air temperatures ranged from 50° to 59° F. This is an acceptable water temperature range for salmonids. However, 63° F, if sustained, is near the threshold stress level for salmonids. This does not seem to be the case here, and Strawberry 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 31% of the total length of this survey, riffles 40%, and pools 28%. The pools are relatively shallow, with only 17 of the 46 (37%) 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.

One of the 46 pool tail-outs measured had an embeddedness rating of 1. Eight of the pool-tail outs had embeddedness ratings of 2. Thirty-two of the pool tail-outs had embeddedness ratings of 3. None of the pool-tail outs had embeddedness of 4. Five of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. One of the tail-outs 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 Strawberry Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

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The mean shelter rating for pools was low with a rating of 62. The shelter rating in the flatwater habitats was slightly lower at 25. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by undercut banks in all habitat types. Additionally, rootmass contributes 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.

Forty-three of the 46 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 91%. 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 83%, 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) Strawberry 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) There are several log debris accumulations present on Strawberry 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.

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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 Yager Creek. Channel type is a G4 for the entire 3128' of stream surveyed.

479' Old road crossing.

921' Channel type measured.

1189' Old log bridge crossing; both banks armored with redwood logs.

1422' Large debris accumulation (LDA) in stream channel; 5'L x 38'W x 5'H. No clear jump pool below. Possible fish migration barrier.

1735' Corrugated metal pipe (CMP) in stream channel; 6' diameter; rustline at 1.6'. Baffles have been installed and culvert is in good condition. CMP 1.6' above water surface.

2421' LDA in stream channel; 60'L x 25'W x 3'H. Possible fish barrier.

2422' Failure on right bank (RB); 25'L x 20'H.

2561' LDA in channel; 8'L x 15'W x 3'H.

2629' Tributary enters from RB.

2651' Failure on left bank (LB); 35'L x 25'H.

2652' LDA in channel; 10'L x 15'W x 5'H.

2813' LDA in channel; 20'L x 20'W x 3'H.

2814' Failure on right bank (RB); 90'L x 50'H.

2851' LDA in channel; 15'L x 20'W x 3'H.

3128' End of survey due to apparent fish barrier caused by upstream gravel accumulation from LDA.

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