STREAM INVENTORY REPORT

Carson Creek, Mainstem Eel River

INTRODUCTION

A stream inventory was conducted during the summer of 2000 on Carson 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 Carson 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

Carson Creek is tributary to Larabee Creek, tributary to the mainstem Eel River, located in Humboldt County, California (Map 1). Carson Creek's legal description at the confluence with Larabee Creek is T1S R2E S1. Its location is 40°24′31.1″ North latitude and 123°53′33.9″ West longitude. Carson Creek is a second order stream and has approximately 3.3 miles of blue line stream according to the USGS Redcrest 7.5 minute quadrangle. Carson Creek drains a watershed of approximately 2.10 square miles. Elevations range from about 217 feet at the mouth of the creek to 2,280 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access is found by traveling south from Fortuna on Highway 101. After Scotia turn left onto Shively Road and travel for about 12.5 miles. Turn left onto a gravel Pacific Lumber Company haul road and travel about 4 miles. At the bottom of the hill take the left road that will have a gate controlled by Pacific Lumber Company. Follow this road about 1.89 miles to the split in the road. Follow to the left for about 0.7 miles all the way to Carson Creek.

METHODS

The habitat inventory conducted in Carson Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et. al.,1998). The AmeriCorps Watershed Stewards Project (WSP) 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, dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are further 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 on Carson 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". Carson 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; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form. 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 Carson 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 Carson 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 Carson 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 Carson 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 Carson Creek fish presence was observed from the stream banks, and one site was 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 Carson 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

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- 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 June 20, 2000, was conducted by Randy Turner and Gordon Johnson (WSP). The total length of the stream surveyed was 2,286 feet with an additional 11 feet of side channel.

Flows were not measured on Carson Creek.

Carson Creek is a F3 channel type for the entire 2,297 feet of stream reach surveyed. F3 channels are entrenched meandering riffle/pool channel on low gradients with high width/depth ratio; cobble channel.

Water temperatures taken during the survey period ranged from 55° to 60°F. Air temperatures ranged from 59° to 74°F .

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 41% riffle units, 29% flatwater units, and 30% pool units (Graph 1). Based on total length of Level II habitat types there were 56% riffle units, 25% flatwater units, and 19% pool units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 40%; runs, 25%; and mid-channel pools, 15% (Graph 3). Based on percent total length, low gradient riffles made up 56%; runs, 20%; and mid-channel pools, 10%.

A total of twenty-four pools were identified (Table 3). Main channel pools were most frequently encountered at 50% and comprised 56% 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. Seven of the twenty-four pools (29%) had a depth of two feet or greater (Graph 5).
The depth of cobble embeddedness was estimated at pool tail-outs. Of the twenty-two pool tail-outs measured, zero had a value of 1 (0%); two had a value of 2 (9%); six had a value of 3

(27%); eleven had a value of 4 (50%) and had a value of 5 (15%) (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.

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 7, flatwater habitat types had a mean shelter rating of 10, and pool habitats had a mean shelter rating of 19 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 38. Scour pools had a mean shelter rating of 16 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Carson Creek. Graph 7 describes the pool cover in Carson Creek.

Table 6 summarizes the dominant substrate in pool habitat types. Gravel was the dominant substrate observed in nine of the twenty-two pool tail outs measured (40%). Large cobble was the next most frequently observed dominant substrate type and occurred in 27% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 93%. The mean percentages of conifer and deciduous trees were 79% and 21%, respectively. Graph 9 describes the canopy in Carson Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 72.3%. The mean percent left bank vegetated was 74.2%. The dominant elements composing the structure of the stream banks consisted of 2.3% cobble/gravel, and 97.7% sand/silt/clay (Graph 10). Coniferous trees, including downed trees, logs, and root wads were the dominant bank vegetation type observed in 59.1% of the units surveyed. Additionally, 29.6% of the units surveyed had brush as the dominant bank vegetation, and 9.1% had deciduous trees as the dominant bank vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on October 31, 2000 in Carson Creek. The site was sampled by Glenn Yoshioka (DFG) and Gordon Johnson, Ben Beaver and Kirsten Williams (WSP).

The site sampled included habitat units 005-007, 011, 015, 019, approximately 250 feet from the confluence with Larabee Creek. The habitat types included a run, low gradient riffle, three mid-channel pools, and a rootwad enhanced lateral scour pool. The site yielded eighteen juvenile steelhead rainbow trout. Based on visually estimated lengths, the probable age distribution of juvenile steelhead trout was fifteen age 0+, one age 1+, and two age 2+.

DISCUSSION

Carson Creek

Carson Creek is a F3 channel type for the entire 2,297 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 and fair for plunge weirs; boulder clusters; channel constrictors; log cover.

The water temperatures recorded on the survey day June 20, 2000, ranged from 55° to 60°F. Air temperatures ranged from 59° to 74°F. This is a good 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 25% of the total length of this survey, riffles 56%, and pools 19%. The pools are relatively shallow, with only seven of the twenty-four (29%) pools having a maximum depth greater than 2 feet. 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. In Carson Creek, primary pools comprise less than 6% of the total length of the stream habitat surveyed. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. Installing structures that will increase or deepen pool habitat is recommended.

None of the twenty-two pool tail-outs measured had an embeddedness rating of 1. Two of the 22 pool tail-outs (9%) had a rating of 2; 17 (77%) had ratings of 3 or 4; and 3 (14%) had a rating of 5 or were considered unsuitable for spawning. Two of the three (67%) pool tail-outs which rated a 5 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 Carson 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 19. The shelter rating in the flatwater habitats was 10. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by large woody debris in most pool habitat types. Additionally, boulders contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Thirteen of the twenty-two (59%) 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 93%. 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 72.3% and 74.2%, respectively.

RECOMMENDATIONS

1) Carson 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. However, 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) 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.

4) In Carson Creek, primary pools comprise less than 6% of the total length of stream surveyed. 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.

5) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from large woody debris, but with little complexity. Increasing high quality complex cover by trapping small woody debris is desirable.

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' Began survey at the confluence with Larabee Creek. Channel type is F3. Larabee Creek's water temperature was recorded at 63°F. Young-of-the-year (YOY) steelhead were present.

72' Bridge located 100' into unit. Riprap present on banks.

244' Survey is now out of the hydrologic influence of Larabee Creek and its flood prone zone.

502' Log debris accumulation (LDA) on right bank. Tributary flowed beneath log debris and went subsurface. Water temperature of the tributary was 56°F.

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726' Possible access point. CCC project site 965', 3-9-93 fish passage.

864' Small debris jam retaining gravel; maximum depth of sediment wedge was approximately 1 foot.

913' LDA, retaining gravel; maximum depth of the sediment wedge was about 5'. A 2' plunge was located 7' into unit. A second plunge was located 12' into the unit and measured 3' high.

1,061' YOY steelhead observed.

1,363' LDA, 7' high by 25' wide by 12' long, retaining gravel with a maximum depth of the sediment wedge of about 3'.

1,454' Channel type taken at top of unit.

1,595' CCC project site 2,000' fish passage.

1,735' Five foot plunge.

1,749' CCC structure project site 2,165' bank stabilization.

1,903' CCC project site 2,370' fish passage.

1,917' Salamanders and frogs were observed.

2,134' LDA, 8' high by 20' wide by 15' long, retaining gravel to a maximum depth of 5'. Flows were moving under accumulation , not a fish barrier.

2,286' A very large LDA located upstream. The LDA retained gravel to a maximum depth of about 12'-15'. This barrier was complex without any apparent good jumps, probable barrier. This barrier may prevent passage even at times of high flows. No fish were observed for a distance of 300' upstream from LDA. YOY steelhead were last seen at 1170'. End of Survey.

REFERENCES

Flosi, G., S.Downie, J.Hopelain, M. Bird, R. Coey, ans B. Collins.1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd 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