STREAM INVENTORY REPORT

DARNELL CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Darnell 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 Darnell 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.

There is no known record of adult spawning surveys having been conducted on Darnell Creek. The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Darnell Creek is tributary to the Eel River, located in Humboldt County, California. Darnell Creek's legal description at the confluence with the Eel River is T1N R2E S19. Its location is 40 °27'09" N. latitude and 123°59'13" W. longitude. Darnell Creek is a first order stream and has approximately 0.8 miles of blue line stream, according to the USGS Redcrest 7.5 minute quadrangle. Darnell Creek drains a watershed of approximately 0.9 square miles. Elevations range from about 80 feet at the mouth of the creek to 1,400 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is owned by the Pacific Lumber Company and is managed for timber production. Vehicle access exists from U.S. Highway 101 just south of Scotia, via Shively Road.

METHODS

The habitat inventory conducted in Darnell 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). Darnell 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 Darnell 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 measured 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". Darnell 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 Darnell 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 Darnell 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 Darnell 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 Darnell 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 Darnell Creek to document the fish species composition and distribution. Three sites were electrofished in Darnell 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 Darnell 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 10, 1992, was conducted by Craig Mesman and Jason Cleckler (CCC and contract seasonal). The total length of the stream surveyed was 1,361 feet.

Flows were not measured on Darnell Creek.

Darnell Creek is a B5 channel type for the entire 1,361 feet of stream reach surveyed. B5 channels are moderate gradient (1.5-4.0%), well confined streams, with silt stream beds.

Water temperatures ranged from 56 to 58 degrees fahrenheit. Air temperatures ranged from 61 to 66 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 44.0%, pools 40.0%, and flatwater 16.0% (Graph 1). Riffle habitat types made up 53.3% of the total survey **length**, pools 25.6%, and flatwater 21.1% (Graph 2).

Eight 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, 40.0%; and plunge pools, 28.0% (Graph 3). By percent total **length**, low gradient riffles made up 51.1%, and plunge pools 19.5%.

Twenty pools were identified (Table 3). Scour pools were most often encountered at 75.0%, and comprised 82.2% 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. Thirteen of the 20 pools (65%) had a depth of less than two feet (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 20 pool tail-outs measured, zero had a value of 1; zero had a value of 2; 2 had a value of 3 (10%); and 18 had a value of 4 (90%). 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. Riffle habitat types had the highest shelter rating at 53.0. Pool habitats followed with a rating of 48.7, and flatwater rated 25.0 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 53.0, and main channel pools rated 36.0 (Table 3).
Table 5 summarizes mean percent cover by habitat type. Large and small woody debris are the dominant cover types in Darnell Creek and are extensive. Graph 7 describes the pool cover in Darnell Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 18 of the 20 low gradient riffles (90%). Graph 8 describes the dominant substrate in Darnell Creek.

Twenty-one percent of the survey reach lacked shade canopy. Of the 79% of the stream covered with canopy, 62% was composed of deciduous trees, and 38% was composed of coniferous trees. Graph 9 describes the canopy in Darnell 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 43.7%. The mean percent left bank vegetated was 45.1%. The dominant elements composing the structure of the stream banks consisted of 4.1% cobble/gravel, 39.8% bare soil, 14.3% grass, 23.5% brush. Additionally, 5.1% of the banks were covered with deciduous trees, and 13.3% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on July 1, 1992 in Darnell Creek. The units were sampled by Chris Coyle and Craig Mesman (CCC). All measurements are fork lengths unless noted otherwise.

The first site sampled included habitat units 005-007, a scour pool/low gradient riffle/run sequence, approximately 92 feet from the confluence with the Eel River. This site had an area of 368 sq ft, and a volume of 145 cu ft. The site yielded 5 steelhead, ranging from 88 to 95 mm FL.

The second site was habitat unit 025, a plunge pool, located approximately 50' downstream from a small culvert, and 760 feet from the mouth. This site had an area of 189 sq ft, and a volume of 265 cu ft. No fish were sampled; however, one 1+ salmonid was observed.

The third site sampled was habitat unit 050, a mid-channel pool, located approximately 1,346 feet above the creek mouth. The site had an area of 105 sq ft, and a volume of 84 cu ft. No fish were found.

DISCUSSION

The B5 channel type is generally not suitable for fish habitat improvement structures. B5 channels are found in moderate gradient stream reaches, have channels dominated by silt, and have unstable stream banks.

The water temperatures recorded on the survey day June 10, 1992 ranged from 56° F to 58° F. Air temperatures ranged from 61° F to 66° F. This is a very good water temperature regime for salmonids. However, to make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling conducted.

Riffle habitat types comprised 53.3% of the total **length** of this survey, pools 25.6%, and flatwater 21.1%. The pools are relatively shallow with only 7 of the 20 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. 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. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not interfere with the unstable stream banks of the B5 channel type.

All 20 of the pool tail-outs measured had embeddedness ratings of 3 or 4. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Darnell 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 moderate with a rating of 48.7. The shelter rating in the flatwater habitats was lower at 25.0. However, a pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by large and small woody debris all habitat types. 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.

Eighteen of the 20 low gradient riffles had gravel as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 79%. This is a relatively 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) Darnell Creek should be managed as an anadromous, natural production stream.

2) The log debris accumulation at 345' and the plunges at 760' and 799' should be modified to provide fish passage.

3) The 5' culvert under the Shively Road at 1173' should be replaced with a culvert below grade level to provide fish passage. If the culvert is not replaced, the 5' plunge into the entrance of the culvert should be modified to provide fish passage into the culvert. Baffles should be installed provide fish passage through the culvert.

4) 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 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.

6) 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.

7) 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.

0'	Begin survey at confluence with the Eel River. Mouth is a pool 35' wide x 140' long x 1' deep, approximately 100 yards from the Eel River. Channel type is a B5 for the entire survey reach.
227'	Railroad trestle 30' high x 100' long crosses the channel.
345'	Log and debris accumulation (LDA) 18' wide x 6' long x 6' high.
438'	Left bank erosion 55' high x 50' long, contributing logs and debris into the channel.
541'	Left bank cut 35' high x 40' long.
760'	Two plunges, 4.5' and 6' high.
799'	Plunge 5.5' high.
1173'	Culvert under Shively Road. Culvert is 60' long x 5' diameter, with a 5' high plunge onto boulders.
1361'	End of survey. Culvert under Shively Road creates a barrier for anadromous fish.

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**