Stream Inventory Report

Caspar Creek

September 1999

Jackson Demonstration State Forest
Mendocino County

California Department of Fish and Game

Northern California and North Coast Region
Fortuna, California

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INTRODUCTION

Habitat inventories conducted by the California Department of Fish and Game (DFG) of the west end streams in Jackson Demonstration State Forest (JSDF) have repeatedly revealed them to possess a high percentage of canopy cover and generally well-vegetated stream banks. However, their pools are often shallow and there is generally very little large woody debris (LWD) in the channel. It is believed that the addition of large woody material to stream channels could produce higher habitat quality in these streams for anadromous fish. Enhanced juvenile rearing and over-winter holding areas should improve the survival of juvenile anadromous fish to their smolt stage. However, little information currently exists regarding the physical response of the stream channel and the biological response of juvenile anadromous fish to the addition of LWD to California streams. Because LWD placement projects offer the possibility to increase salmon and steelhead productivity in California streams, and thereby aid in the recovery effort for these species, the California Department of Forestry and Fire Protection (CDF) and DFG have agreed that sections in two streams in the Jackson Demonstration State Forest, Caspar Creek and Hare Creek, Mendocino County, should be treated with a LWD placement project in conjunction with a pre- and post-project monitoring project to assess the physical and biological response to these projects. Habitat inventories and field inspections suggested that Caspar Creek, from the western boundary of Jackson Demonstration State Forest to the confluence of North Fork Caspar Creek, and Hare Creek, from Covington Gulch to Bunker Gulch, would benefit from the addition of LWD to their channels.

This report describes the findings of the a stream inventory conducted in Caspar Creek on September 1 and 2, 1999. The objectives of the inventory were to: 1) document the current habitat conditions in order to provide data for a comparison of habitat conditions in the LWD Project reach before and after the addition of the woody material to the stream channel, and 2) recommend options for the potential enhancement or maintenance of habitat for coho salmon and steelhead. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

Annual biological inventories are also conducted in Caspar Creek by the California Department of Fish and Game (DFG). The objectives of these inventories are to: 1) to document the relative abundance of juvenile salmonids in four index reaches during the late summer-early fall period, and 2) to obtain a measure of relative juvenile salmonid outmigrant during the spring. This information will also be used to help assess the response to the LWD placement project.

WATERSHED OVERVIEW

Caspar Creek is a tributary to the Pacific Ocean located in Mendocino County, California (Map 1). Caspar Creek's legal description at the confluence with the Pacific Ocean is T17N R18W S01. Its location is 39E21N430 north latitude and 123E31N250 west longitude. Caspar Creek is a first order stream and has approximately 8.0 miles of blue line stream according to the USGS Mendocino, Mathison Peak, and Noyo Hill 7.5 minute quadrangles. Caspar Creek drains a watershed of approximately 8.2 square miles. Elevations range from about 0 feet at the Pacific Ocean to 1,000 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely state owned and is managed for timber production. Vehicle access exists via Highway 20 to Fern Creek Road to Caspar Orchard Road to Caspar Logging Road to road marked with post #600 to a locked gate.

METHODS

The habitat inventory conducted in Caspar Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The stream inventory was conducted in a continuous reach of Caspar Creek which included a section of stream downstream of the proposed LWD Placement Project reach (control section) and the section through the LWD Placement Project reach (treatment section). The survey began at road marker #24 (N 39º 21.252', W 123º 46.911) and extended upstream for 2.3 miles. This reach is an F4 channel type with an average bankfull width of 26.5 ft. Results contained in this report pertain to the entire stream reach surveyed. Results for the control and treatment section will be dealt with in subsequent reports.

The Watershed Stewards Project/AmeriCorps (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.

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 (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are 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 in Caspar Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Stream flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter. 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*. 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. Channel characteristics are measured using a clinometer, hand level, hip chain, and a stadia rod.

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". Caspar 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. All measurements are in

feet to the nearest tenth. Habitat characteristics were measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Caspar 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, 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 Caspar 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 Caspar 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 Caspar 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 (including downed trees, logs, and rootwads) was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Caspar Creek. In addition, two sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

LARGE WOODY DEBRIS (LWD) STREAM AND RIPARIAN INVENTORY

In Caspar Creek, a large woody debris (LWD) stream and riparian inventory was conducted using the methodology as described in the *California Salmonid Stream Habitat Restoration Manual*. Data from the LWD Inventory Form are entered into a dBASE 4.2 data entry program developed by Inland Fisheries Division, California Department of Fish and Game. The Caspar Creek LWD Inventory Report is included in this report as Appendix A.

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 Caspar 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
- Mean 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 September 1 and 2, 1999, was conducted by Barry Collins (DFG), Chris Ramsey, and Toni Beaumont (WSP\AmeriCorps). The total length of the stream surveyed was 12,030 feet.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.7 cfs on September 1, 1999.

Caspar Creek is an F4 channel type for the entire 12,030 feet of stream reach surveyed. F4 channels are entrenched, meandering, riffle/pool channels with low gradients, high width/depth ratios, and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 56 to 58 degrees Fahrenheit. Air temperatures ranged from 54 to 66 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 12% riffle units, 26% flatwater units, and 62% pool units (Graph 1). Based on total length of Level II habitat types there were 6% riffle units, 23% flatwater units, and 71% pool units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pools, 25%; runs, 23%; lateral scour pools - log enhanced, 22%; lateral

scour pools - rootwad enhanced, 14%; and low gradient riffles, 12% (Graph 3). Based on percent total length, mid-channel pools made up 35%, lateral scour pools - log enhanced, 21%, runs 19%, lateral scour pools - rootwad enhanced 15%, and low gradient riffles 6%.

A total of 120 pools were identified (Table 3). Scour pools were the most frequently encountered, at 59% and comprised 51% of the total length of all pools. Main channel pools accounted for 40% of the pools encountered, and comprised 49% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. In general pool quality for salmonids increases with depth. Eighty-four of the 120 pools (70%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 120 pool tail-outs measured, 1 had a value of 2 (0.8%); 12 had a value of 3 (10%); 8 had a value of 4 (6.7%); and 99 had a value of 5 (82.5%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. The breakdown of dominant substrate composition for the 99 pool tail-outs that had a embeddedness value of 5 were as follows: 78.6% gravel, 3.1% silt/clay, and 17.3% sand.

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 5, flatwater habitat types had a mean shelter rating of 25, and pool habitats had a mean shelter rating of 57 (Table 1). Of the pool types, the scour pools and backwater pools had the highest mean shelter ratings at 60. Main channel pools had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Root mass is the dominant cover type in Caspar Creek followed by small woody debris. Graph 7 describes the pool cover in Caspar Creek. Root masses are the dominant pools cover type followed by large woody debris, small woody debris, undercut banks.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 82% of pool tail-outs while sand was the next most frequently observed substrate type, at 14%.

The mean percent canopy density for the stream reach surveyed was 88% (Table 7). The mean percentages of deciduous and coniferous trees were 76% and 24%, respectively. Graph 9 describes the canopy in Caspar Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 94.2%. The mean percent left bank vegetated was 94.0%. The dominant elements composing the structure of the stream banks consisted of 90.4% sand/silt/clay and 9.6% cobble/gravel (Table 9, Graph 10). Deciduous trees were the dominant vegetation type observed in 50.0% of the units surveyed. Additionally, 34.6% of the units

surveyed had coniferous trees as the dominant vegetation type, and 15.4% had brush as the dominant vegetation type (Table 9, Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on September 20, 1999, in Caspar Creek. The sites were sampled by Barry Collins (DFG), Paul Ferns (WSP/AmeriCorps), and Don Rehberg (WSP/AmeriCorps).

The first site sampled is approximately 13,887 feet from the confluence with the Pacific Ocean. This site had an area of 2,307.6 sq ft and a volume of 1,846 cu ft. The total catch for four passes was 96 steelhead, 21 coho, 7 stickleback, 3 sculpin, and 5 salamanders.

The second site is located approximately 14,793 feet above the creek mouth. This site had an area of 6,280.6 sq ft and a volume of 7,955.4 cu ft. The total catch for two passes was 104 steelhead, 20 coho, 3 stickleback, 3 sculpin, and 5 salamanders.

Additional biological sampling was conducted in Caspar Creek by Scott Harris (DFG). Information regarding that sampling may be obtained from DFG's California Central Coast Region.

DISCUSSION

Caspar Creek is an F4 channel type for the entire 12,030 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: F4 channels are good for bank placed boulders, single and opposing wing deflectors, channel constrictors, and log cover.

The water temperatures recorded on the survey days of September 1 and 2, 1999, ranged from 56 to 58 degrees Fahrenheit. This is a good water temperature range for salmonids. Air temperatures ranged from 54 to 66 degrees Fahrenheit. 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 23% of the total length of this survey, riffles 6%, and pools 71%. Eighty-four of the 120 (70%) pools had 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 120 pool tail-outs measured only one had an embeddedness rating of 2. Twenty of the pool tail-outs had embeddedness ratings of 3 or 4. Ninety-nine of the pool tail-outs had a rating of 5 and were considered unsuitable for spawning because the dominant substrate consisted of either silt/sand/clay or small gravel. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Caspar Creek should be mapped and rated according to their potential sediment yields and control measures should be taken.

Eighty-two percent of the 120 pool tail-outs measured had gravel as the dominant substrate; however, the gravel in many of these units were too small to be considered suitable for spawning salmonids.

The mean shelter rating in the flatwater habitats was 25. The mean shelter rating for pools was 57. A pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by root mass and small woody debris in all habitat types. Log and root wad complex cover structure in the pool and flatwater habitats would enhance 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.

The mean percent canopy density for the stream was 88%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left banks covered with vegetation was high, at 94.2% and 94.0%, 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) Caspar 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) Increase the large wood component in the pool and flatwater habitat units. Most of the existing cover is from root mass. Adding high quality complexity with woody cover is desirable.

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.

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 road marker 24, north latitude 39° 21.252', west longitude 123° 46.911'. Channel type is F4.
178'	Log debris accumulation, 5' high x 5' long x 20' wide, with three pieces of large wood.
236'	Three trees with root wads in channel.
631'	Left bank tributary, 58 degrees Fahrenheit water temperature, mud substrate.
1,278'	Three logs in pool creating scour.
1,885'	Log debris accumulation, 5' high x 5' long x 20' wide, five pieces of large wood.
2,024'	Log debris accumulation, 5' high x 70' long x 19' wide, consisting of approximately 10 pieces of large wood.
2,505'	Log debris accumulation, 7' high x 15' wide x 20' long, consisting of 3 pieces of large wood.
2,595'	One large redwood log and one small tree in channel.
2,633'	Log debris accumulation, 6' high x 15' wide x 19' long, consisting of 10 pieces of large wood.
3,024'	Right bank spring, 54 degrees Fahrenheit water temperature.
3,314'	Log debris accumulation, 3' high x 15' wide x 5' long, consisting of 5 pieces of large wood, retaining less than 1' of sediment. Young-of-the-year and one-plus age class salmonids observed upstream.
3,449'	Six large logs in channel.
3,611'	Log debris accumulation, 5' high x 15' wide x 6' long, consisting of 6 pieces of large wood.
4,018'	Log debris accumulation, 4' high x 19' wide x 40' long, consisting of 3 pieces of large wood. Young-of-the-year and one-plus age class salmonids observed.
4,151'	First electrofishing site
5,057'	Second electrofishing site
5,113'	Left bank tributary, 58 degrees Fahrenheit water temperature.
6,752'	Right bank spring, 55 degrees Fahrenheit water temperature.
7,242'	Old bridge in channel, 3' wide x 20' long x 2' high. Young-of-year, one-plus, and two-plus age class salmonids observed upstream of old bridge.

9,306' Log debris accumulation, 3' high x 15' wide x 15' long. Young-of-the-year salmonids observed upstream.

9,635' Left bank tributary, 1.5' wide and 0.5' deep, 54 degrees Fahrenheit water temperature.

10,573' Left bank tributary, 3' wide and 0.1' deep, 56 degrees Fahrenheit water temperature.

12,030' End of survey at confluence with North Fork Caspar Creek. Arch culvert, 12' high x 50' long.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. California Salmonid Stream Habitat Restoration Manual, 3rd edition. California Department of Fish and Game, Sacramento, California.

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE					
Low Gradient Riffle	(LGR)	[1.1]		{ 1}	
High Gradient Riffle	(HGR)	[1.2]		{ 2}	
CASCADE					
Cascade	(CAS)	[2.1]		{ 3}	
Bedrock Sheet	(BRS)	[2.2]		{24}	
FLATWATER					
Pocket Water	(POW)		[3.1]		{21}
Glide	(GLD)	[3.2]		{14}	
Run	(RUN)	[3.3]		{15}	
Step Run	(SRN)	[3.4]		{16}	
Edgewater	(EDW)		[3.5]		{18}
MAIN CHANNEL POOLS					
Trench Pool	(TRP)	[4.1]		{ 8}	
Mid-Channel Pool	(MCP)		[4.2]		{17}
Channel Confluence Pool	(CCP)	[4.3]		{19}	
Step Pool	(STP)	[4.4]		{23}	
SCOUR POOLS					
Corner Pool	(CRP)	[5.1]		{22}	
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]		{10}	
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]		{11}	
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]		{12}	
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]		{20}	
Plunge Pool	(PLP)	[5.6]		{ 9}	
BACKWATER POOLS					
Secondary Channel Pool	(SCP)	[6.1]		{ 4}	
Backwater Pool - Boulder Formed	(BPB)	[6.2]		{ 5}	
Backwater Pool - Root Wad Formed	(BPR)	[6.3]		{ 6}	
Backwater Pool - Log Formed	(BPL)	[6.4]		{ 7}	
Dammed Pool	(DPL)	[6.5]		{13}	
ADDITIONAL UNIT DESIGNATIONS					
Dry	(DRY)	[7.0]			
Culvert	(CUL)	[8.0]			
Not Surveyed	(NS)	[9.0]			

Not Surveyed due to a marsh	(MAR)	[9.1]

Appendix A

California Department of Fish and Game
Northern California and North Coast Region

Large Woody Debris (LWD) Riparian Inventory

Caspar Creek Drainage
Jackson Demonstration State Forest
Mendocino County
September 1999

BACKGROUND

The importance of large woody debris (LWD) in the development of a stream's morphological and biological productivity has been well documented over the last 20 years. It strongly influences stream habitat characteristics and biotic composition. LWD is often the structural element associated with pool formation. LWD is considered one of the major elements that creates complex fish habitat vital to juvenile salmonid survival. Habitat complexity is particularly important for coho salmon and steelhead trout juveniles which remain in the stream for at least one year before migrating to the ocean.

LWD inventories describe the present relative abundance of LWD elements providing, or with the potential to provide, fish habitat within the stream channel. LWD inventories also describe the relative abundance of recruitable LWD existing out of the stream channel but having a high potential of entering the stream channel sometime in the future.

METHODS

Prior to conducting the LWD inventory the LWD Placement Project reach (Project Reach) was habitat typed and stream channel typed employing the method described by Flosi et al (1998). In the habitat inventory database stream reaches were numbered sequentially beginning at the downstream end of the LWD Placement Project reach with the reach number increased by 1 each time the channel type changed. For example, Reach 01 begins at the confluence in a C4-type channel; upstream 4,710 feet the channel type changes to a B3 and the reach number changes to Reach 02; upstream another 3,470 feet the channel type changes back to C4 and the reach number becomes Reach 03.

LWD inventory methods, data recording forms, and database structure used for this inventory are described by Flosi et al (1998). LWD minimum size was 12 inches in diameter and 6 feet in length.

Root wads had the 12-inch minimum diameter criteria but had no minimum length requirement. Diameter and length categories consisted of the following:

Diameter Category	Length Category
1. 1-2 feet	1. 6 to 20 feet
2. 2-3 feet	2. Over 20 feet
3. 3-4 feet	
4. Over 4 feet	

Condition or status categories included:

a) dead and down
b) dead and standing
c) perched for imminent delivery to the stream channel
d) live coniferous trees
e) live broadleaf trees (a.k.a. deciduous)

The sampling strategy consisted of selecting a random starting point near the stream confluence and systematically sampling 200-foot sections every 1,000 feet of stream length. The first 1,200 feet of stream was segmented into 200-foot sections and consecutively numbered 1 through 6 , beginning at the confluence. One of these six 200-foot sections was randomly selected as the beginning of the first sample section. After conducting the inventory survey in the initial 200-foot section surveyors proceeded upstream 800 feet and began surveying the next 200-foot as the second sample section. The third sample section began 800 feet upstream of the end of the second sample section, and so on. Systematic sampling continued upstream until the end of anadromous fish access. This method produced a sampling level of approximately 20 percent. Streams less than 1,000 feet in length were inventoried throughout the entire length.

Inventory data of 200-foot sample sections were segregated by reach number. A LWD abundance index expressed as "number of pieces per 100 feet" was calculated for each reach.

RESULTS

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

The Caspar Creek section surveyed consisted of one F4 channel type and was divided into 2 reaches. The reaches were divided in order to evaluate three different management schemes; no added wood in lowest reach (Reach 1), added wood in the upper (Reach 2).

Reach 1 (no added wood treatment) begins about 11,115 feet upstream from Caspar Creek's confluence with the Pacific Ocean and extended 5,530 feet upstream. This reach contained 18.6

pieces of LWD on both the right and left banks per 100 linear feet of stream (TABLE 1). In descending proportions, the condition of the pieces were 72% live broadleaf, 20% live coniferous, 5% dead and down, 4% dead and standing, and 0% perched. Within the bankfull channel, Reach 1 contained 4.3 pieces of LWD per 100 linear feet of stream. The conditions of the pieces were 91% dead and down and 9% live broadleaf. The total number of pieces per 100 linear feet for both the banks and the bankfull channel were 22.9, of which 60% were live broadleaf, 21% dead and down, 16% live coniferous, 3% dead and standing, and 0% perched. Of the pieces in Reach 1, 82.5% were in the LWD size category of 1 - 2 foot in diameter, 13.5% were in the 2 - 3 foot category, 2.6% were in the 3 - 4 foot category and, 1.3 % were in the > 4 foot category (FIGURE 1).

Reach 2 (wood added treatment) and extended 6.500 feet upstream of the end of Reach 1. This reach contained 16.6 pieces of LWD on both the right and left banks per 100 linear feet of stream (TABLE 1). In descending proportions, the condition of the pieces were 52% live coniferous,31% live broadleaf, 11% dead and down, 6% dead and standing, and 0% perched. Within the bankfull channel, Reach 2 contained 4.43 pieces of LWD per 100 linear feet of stream. The conditions of the pieces were 95% dead and down, 3% live broadleaf, and 2% dead and standing. The total number of pieces for both the banks and the bankfull channel were 21.1, of which 41% were live coniferous, 29% dead and down, 25% live broadleaf, 5% dead and standing, and 0% perched. Of the pieces in Reach 2, 64.7% were in the LWD size category of 1 - 2 foot in diameter, 23.7% were in the 2 - 3 foot category, 6.8% were in the 3 - 4 foot category, and 4.7% were in the > 4 foot category (FIGURE 1).

For both reaches combined, there was a total of 21.8 pieces of LWD per 100 linear feet of stream. The reaches were dominated by live broadleaf trees (40.3%), followed by live coniferous trees (30.2%), dead and down (25.4%), dead and standing (4.0%), and perched trees (0.2%).

DISCUSSION

In Reach 1 LWD on the banks was dominated by live broadleaf trees, while Reach 2 had more live coniferous trees. Dead and down LWD dominated in the stream channel of both reaches. The 1 - 2 foot diameter size category was the most common for all LWD pieces in both the stream channel and bank zones.

The number of pieces of LWD per 100 linear feet on the banks of Reaches 1 and 2 were very similar at 18.6 and 16.8, respectively. The number of pieces of LWD per 100 linear feet in the stream channel of Reaches 1 and 2 were also very similar at 4.3 and 4.4, respectively.

One goal of conducting LWD inventories is to provide data that, along with fish population and habitat type data, will enable resource managers to characterize the quality of available and potential fish habitat. Although, the relationship between the number, size, and type of LWD pieces per 100 feet, and quality of fish habitat has not been fully established, it is generally accepted that LWD in the stream

channel plays a vital role in contributing to the quality of fish habitat. Large woody debris within the bank zone is the source for future instream LWD and addresses the issue of LWD recruitment to the stream channel. Information in this report will enable resource managers to identify areas lacking in LWD, subsequently leading to planning and prioritizing prescriptions for improvement. This information will also be useful in detecting changes in LWD relative abundance with relation to land use practices or riparian zone restoration programs.

TABLE 1. Summary of Large Woody Debris Inventory for Caspar Creek, Mendocino County, California 1999.

STREAM	REACH	CHANNEL TYPE	TOTAL LENGTH	DEAD DOWN	DEAD STANDING	PERCHED	--LIVE TREES-- CONIFER	BROADLEAF	TOTAL
			Number of pieces per 100 linear feet of stream out of channel on right and left banks						
Caspar Creek	1	F4	5,530	0.9	0.7	0	3.7	13.3	18.6
Caspar Creek	2	F4	6,500	1.9	0.9	0.1	8.6	5.1	16.6
			Number of pieces per 100 linear feet of stream within the bankfull channel						
Caspar Creek	1	F4	5,530	3.9	0		0	0.4	4.3
Caspar Creek	2	F4	6,500	4.2	0.1		0	0.1	4.4
			Number of pieces per 100 linear feet of stream out of channel on right and left banks and within the bankfull channel						
Caspar Creek	1	F4	5,530	4.8	0.7	0	3.7	13.7	22.9
Caspar Creek	2	F4	6,500	6.1	1	0.1	8.6	5.3	21.1
			Percentage of LWD pieces found out of channel on right and left banks						
Caspar Creek	1	F4	5,530	5%	4%	0%	20%	72%	100%
Caspar Creek	2	F4	6,500	11%	6%	0%	52%	31%	100%
			Percentage of LWD pieces found within the bankfull channel						
Caspar Creek	1	F4	5,530	91%	0%	0%	0%	9%	0%
Caspar Creek	2	F4	6,500	95%	2%	0%	0%	3%	100%
			Percentage of LWD pieces found out of channel on right and left banks and within the bankfull channel						
Caspar Creek	1	F4	5,530	21%	3%	0%	16%	60%	100%
Caspar Creek	2	F4	6,500	29%	5%	0%	41%	25%	100%

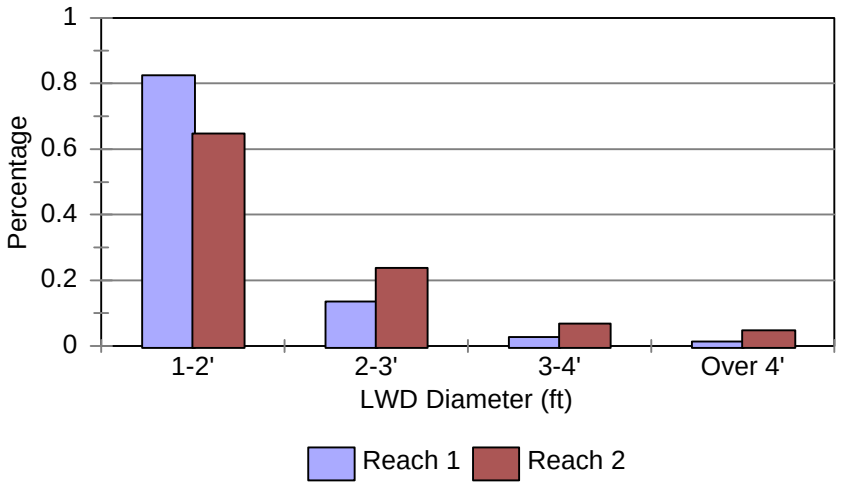

Figure 1. Percentage of LWD in each diameter size category found for each reach surveyed.