STREAM INVENTORY REPORT

EAST BRANCH WADDELL CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1997 on East Branch Waddell Creek and it's tributary Last Chance Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in East Branch Waddell Creek.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for 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

East Branch Waddell Creek is a tributary to Waddell Creek, located in Santa Cruz County, California (Map 1). East Branch Waddell Creek's legal description at the confluence with the main stem of Waddell Creek is T09S R04W. Its location is 37°08’02” north latitude and 122°15'59" west longitude. East Branch Waddell Creek is a fourth order stream and has approximately 17.8 miles of blue line stream according to the USGS Big Basin 7.5 minute quadrangle. East Branch Waddell Creek drains a watershed of approximately 11.1 square miles. Elevations range from about 40 feet at the mouth of the creek to 1800 feet in the headwater areas. Redwood/Douglas fir mixed coniferous forest dominates the watershed. The watershed is primarily in state park ownership and is managed for recreation. Vehicle access exists via State Route One to the Waddell Creek entrance of Big Basin State Park.

METHODS

The habitat inventory conducted in East Branch Waddell Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The California Conservation Corps (CCC) Technical Advisors and the AmeriCorps Watershed Stewards Project (WSP\AmeriCorps) Members who 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 (Hopelain, 1995). 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 in East Branch Waddell 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". East Branch Waddell 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 East Branch Waddell 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 East Branch Waddell 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 East Branch Waddell 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 East Branch Waddell 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.

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 East Branch Waddell 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 June 17, 18 and July 13, 1997, was conducted by Kevin McKernan, Gina Capser and Deborah Crockett (WSP\AmeriCorps). The total length of the stream surveyed was 6,699 feet with an additional 143 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.5 cfs on June 17, 1997.

East Branch Waddell Creek is an F2 channel type for the first 3,147 feet and a B2 channel type for the remaining 3,552 feet of stream reach surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and boulder dominated substrates. B2 channel types are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools; a very stable plan and profile; stable banks and a boulder channel.

Water temperatures taken during the survey period ranged from 59 to 65 degrees Fahrenheit. Air temperatures ranged from 65 to 78 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 11% riffle units, 36% flatwater units, and 53% pool units (Graph 1). Based on total **length** of Level II habitat types there were 5% riffle units, 61% flatwater units, and 34% pool units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were mid-channel pools, 35%, and step runs, 30% (Graph 3). Based on percent total **length**, step runs made up 56% and mid-channel pools made up 24%.

A total of fifty-one pools were identified (Table 3). Main channel pools were most frequently encountered at 69% and comprised 72% 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. Twenty-two of the 51 pools (43%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 51 pool tail-outs measured, three had a value of 1 (5.9%); 17 had a value of 2 (33.3%); 24 had a value of 3 (47.1%); none had a value of 4 and seven had a value of 5 (13.7%) (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 East Branch Waddell Creek, all of the pool tail-outs which were valued at 5 had boulder tail-outs unsuitable for spawning and existed in the last 459 feet of the survey reach.

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 20, flatwater habitat types had a mean shelter rating of 13, and pool habitats had a mean shelter rating of 29 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 48. Main channel pools had a mean shelter rating of 24 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in East Branch Waddell Creek and are extensive. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in East Branch Waddell Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate in the one low gradient riffle fully measured. Boulders were the dominant substrate observed in 33 of the 51 pool tail-outs measured (64.7%). Small cobble was the next most frequently observed dominant substrate type and occurred in 17.6% of the pool tail-outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 82%. The mean percentages of deciduous and coniferous trees were 61% and 39%, respectively. Graph 9 describes the canopy in East Branch Waddell Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 62.9%. The mean percent left bank vegetated was 73.6%. The dominant elements composing the structure of the stream banks consisted of 17.86% bedrock, 51.79% boulder, 26.79% cobble/gravel, and 3.57% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 48.21% of the units surveyed. Additionally, 17.86% of the units had coniferous trees as the dominant vegetation, including down trees, logs, and root wads; and 16.07% had no vegetation (Graph 11).

DISCUSSION

East Branch Waddell Creek is an F2 channel type for the first 3,147 feet of stream surveyed and a B2 for the remaining 3,552 feet. The suitability of these channel types for fish habitat improvement structures is as follows: F2 channel types are: fair for weirs, single and opposing wing deflectors, and log cover. B2 channel types are: excellent for weirs, single and opposing wing deflectors, and bank cover.

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The water temperatures recorded on the survey days June 17, 18 and July 13, 1997, ranged from 59 to 65 degrees Fahrenheit. Air temperatures ranged from 65 to 78 degrees Fahrenheit. This is near the threshold stress level 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 61% of the total **length** of this survey, riffles 5%, and pools 34%. The pools are relatively shallow, with only 22 of the 51 (43.1%) pools having a maximum depth greater than three feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

Three of the 51 pool tail-outs measured had an embeddedness rating of 1. Forty-one of the pool tail-outs had embeddedness ratings of 2 or 3. Seven of the pool tail-outs had a rating of 5 and were considered unsuitable for spawning. All of these were unsuitable for spawning due to a dominant substrate of boulder. 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 East Branch Waddell 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 29. The shelter rating in the flatwater habitats was 13. A pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by boulders in all habitat types. Additionally, undercut banks contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and divides territorial units to reduce density related competition.

Thirty-three of the 51 pool tail-outs had boulders as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean percent canopy density for the stream was 82%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 62.9% and 73.6%, 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.

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RECOMMENDATIONS

1)East Branch Waddell Creek should be managed as an anadromous, natural production stream.

2)The limited water temperature data available suggest that maximum temperatures are nearing the threshold stress level 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)Where feasible, design and engineer pool enhancement structures to increase the number of pools or deepen existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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

5)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.

6)Suitable size spawning substrate on East Branch Waddell Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

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 West Branch Waddell Creek. Channel type is F2.

314'Footbridge, 4' long X 75' wide X 20' high.

538'Right bank log debris accumulation (LDA) with a large bay tree root wad.

1,908Left bank erosion, 60' long X 50' high on bedrock.

2,935Salmonids observed.

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3,147Channel changes to a B2 type.

3,386Last Chance Creek enters from the left bank (See sub-section report).

5,386Old road on left bank.

5,731Five foot jump through boulder jam, no clear passage, potential barrier.

6,699'End of survey at a 30' high waterfall.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd 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.

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

STREAM INVENTORY REPORT

LAST CHANCE CREEK

WATERSHED OVERVIEW

Last Chance Creek is a tributary to East Branch Waddell Creek, a tributary to Waddell Creek, located in Santa Cruz County, California (Map 1). Last Chance Creek's legal description at the confluence with East Branch Waddell Creek is T09S R04W S24. Its location is 37°08'18" north latitude and 122°15'29" west longitude. Last Chance Creek is a first order stream with 1.5 miles of blue line stream according to the USGS Big Basin 7.5 minute quadrangle. Last Chance Creek drains a watershed of approximately 0.83 square miles. Elevations range from about 120 feet at the mouth of the creek to 2,000 feet in the headwater areas. Redwood/Douglas fir mixed coniferous forest dominates the watershed. The watershed is primarily state park and is managed for recreation. Foot access is available approximately 0.75 miles upstream from the mouth of East Branch Waddell Creek.

HABITAT INVENTORY RESULTS AND DISCUSSION

The habitat inventory of June 19, 1997, was conducted by Kevin McKernan and Gina Capser (WSP\AmeriCorps). The total length of the stream surveyed was 345 feet.

Last Chance Creek is an A2 channel type for the entire 345 feet of stream surveyed. A2 channel types are generally considered unsuitable for fish habitat improvement structures.

The water temperature recorded on the survey day June 19, 1997 was 56 degrees Fahrenheit and the air temperature was 60 degrees Fahrenheit. This is an acceptable water temperature range for salmonids, but water temperature data during the warm summer months are lacking. For a more complete and accurate water temperature profile, 24-hour temperatures would need to be monitored throughout the warm summer months.

Based on the total **length** of this survey, Level II habitat units consisted of 45% pool units, 30% riffle units, and 25% flatwater units. The pools are relatively shallow, with only one of the nine pools having a maximum depth greater than 2 feet.

Three of the nine pool tail-outs measured had an embeddedness rating of 2, two had a rating of 3, and two had a rating of 5. Two pool tail-outs had a 1 rating. Cobble embeddedness of 25% or less, a rating of 1, is considered best for the spawning needs of salmon and steelhead.

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.

Six of the nine pool tail-outs measured had gravel or small cobble as the dominant substrate. Three of the nine pool tail-outs had large cobble or boulders as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 89%. The percentage of right and left bank covered with vegetation was moderate at 89.4% and 86.1%, respectively.

RECOMMENDATIONS

1) Last Chance Creek should be managed as an anadromous, natural production stream.

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 East Branch Waddell Creek. Channel type is an A2.

150' Two foot jump at the top of bedrock sheet with woody debris blocking passage.

345' End of survey at pinched bedrock chute, no clear jump, no fish observed above.