STREAM INVENTORY REPORT

Bradburn Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Bradburn Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bradburn Creek. There is no known record of adult spawning surveys having been conducted on Bradburn 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

Bradburn Creek is a tributary to West Fork North Fork Eel River, a tributary to the North Fork Eel River, a tributary to the Eel River, which drains to the Pacific Ocean. It is located in Trinity County, California. Bradburn Creek's legal description at the confluence with West Fork North Fork Eel River is T03S R07E S09. Its location is 40.2117 degrees north latitude and 123.3947 degrees west longitude. Bradburn Creek is a second order stream and has approximately 3.6 miles of blue line stream according to the USGS Zenia 7.5 minute quadrangle. Bradburn Creek drains a watershed of approximately 4.4 square miles. Summer base flow is approximately 0.2 cubic feet per second (cfs) at the mouth, but over ten cfs is not unusual during winter storms. Elevations range from about 2,150 feet at the mouth of the creek to 3,500 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely National Forest and is managed for timber production, rangeland, and dispersed recreation. Vehicle access exists via the Alderpoint Road from the town of Alderpoint to Zenia. Take the jeep trail from the Zenia Guard Station toward Double Gate ridge to the mouth of Bradburn Creek. Contact Six Rivers National Forest personnel for road conditions and detailed directions.

METHODS

The habitat inventory conducted in Bradburn Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). 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). Bradburn Creek personnel were trained in May, 1996, by Scott Downie and Ruth Goodfield. This inventory was conducted by a two-person team.

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SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 1994). 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. 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 Bradburn 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. Additionally, a recording thermograph was deployed in Bradburn Creek from July 23, 1996 to September 18, 1996 to record temperatures on a 24 hour basis during warm summer months.

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". Bradburn Creek to 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 (Hopelain, 1995). Pool tail crest depth at each pool unit was measured at the thalweg in feet and tenths.

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 Bradburn 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). Additionally, a rating of "not suitable" (value 5) was assigned to tail-outs with unusable sites due to poor 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 Bradburn 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 type.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant (1) and sub-dominant (2) substrate elements were ocularly estimated from a list of seven size classes.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*, 1994. Canopy density relates to the amount of stream shaded from the sun. In Bradburn 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 Bradburn Creek, the dominant composition type (options 1-4) and the

dominant vegetation type (options 5-9) 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 DFG. 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 Lotus 1,2,3. Graphics developed for Bradburn 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
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

The habitat inventory of July 23 to August 6, 1996 was conducted by Dale Melton and Paul Ouradnik (WSP/AmeriCorps). The total length of the stream surveyed was 14,976 feet with an additional 135 feet of side channel.

Flow was estimated to be 0.2 cfs during the survey period.

Bradburn Creek is a B4 channel type for the entire 14,976 feet of stream reach surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channels with stable banks and gravel-dominant substrates.

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Water temperatures during the survey period ranged from 62 to 67 degrees Fahrenheit. Air temperatures ranged from 68 to 84 degrees Fahrenheit. Water temperatures taken with a recording thermograph deployed from July 23 to September 18, 1996 ranged from 51 to 69 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% riffle units, 33% flatwater units, and 25% pool units (Graph 1). Based on total length of Level II habitat types there were 40% flatwater units, 39% riffle units, and 21% pool units (Graph 2).

Seventeen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were high gradient riffles, 36%; mid-channel pools, 19%; and step runs, 19% (Graph 3). Based on percent total length, high gradient riffles made up 33%, step runs 28%, and mid-channel pools 15%.

A total of one hundred-twenty-six pools were identified (Table 3). Main channel pools were most frequently encountered at 89% and comprised 91% 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. Sixty-three of the 126 pools (50%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 126 pool tail-outs measured, 11 had a value of 1 (9%); 33 had a value of 2 (26%); nine had a value of 3 (7%); and 73 had a value of 5 (58%); (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

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. Pool habitat types had a mean shelter rating of 59, and flatwater habitats had a mean shelter rating of 20 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 72. Main channel pools had a mean shelter rating of 56 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Large and small cobble were the dominant substrates observed in all of the low gradient riffles measured (100%); (Graph 8).

The mean percent canopy density for the stream reach surveyed was 86%. The mean percentages of deciduous and coniferous trees were 67% and 33%, respectively. Graph 9 describes the canopy in Bradburn Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 77%. The mean percent left bank vegetated was 77%. The dominant elements composing the structure of the

stream banks consisted of 33% cobble/gravel, 25% sand/silt/clay, 24% boulders, and 19% bedrock (Graph 10). Brush was the dominant vegetation type observed in 16% of the units surveyed. Additionally, 58% of the units surveyed had deciduous trees as the dominant vegetation type, and 15% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

DISCUSSION

Bradburn Creek is a B4 channel type for the entire 14,976 feet of stream surveyed. The suitability of B4 channel types for fish habitat improvement structures is excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, and log cover; and good for medium-stage plunge weirs.

The water temperatures recorded on the survey days July 23 to August 6, 1996 ranged from 62 to 67 degrees Fahrenheit. Air temperatures ranged from 68 to 84 degrees Fahrenheit. Further samples from a recording thermograph deployed during the summer of 1996 measured water temperatures ranged from 51 to 69 degrees Fahrenheit. This is an acceptable water temperature range for salmonids. However, 67 degrees Fahrenheit., if sustained, is near the threshold stress level for salmonids. This does not seem to be the case here, and Bradburn Creek seems to have temperatures favorable to salmonids.

Flatwater habitat types comprised 40% of the total length of this survey, riffles 39%, and pools 21%. The pools are relatively deep, with 63 of the 126 (50%) pools having a maximum depth greater than two 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. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

The LDA's in the system are retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the gravel out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Nine of the 126 pool tail-outs measured had a embeddedness rating of 3. Eleven had embeddedness ratings of 1. Cobble embeddedness of 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Bradburn 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 moderate with a rating of 59. The shelter rating in the flatwater habitats was lower at 20. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. 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 also divide territorial units to reduce density related competition.

Half of the low gradient riffles had large cobble or boulders as the dominant substrate. This is generally considered not suitable for spawning salmonids.

The mean percent canopy density for the stream was 86%. This is a relatively high percentage of canopy. In general, re-vegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 76% and 77%, respectively. In areas of stream bank erosion or where bank vegetation is at unacceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

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

2) 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 and in some areas the material is locally available.

3) Spawning gravel on Bradburn Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel in order to expand redd site distribution in the stream.

4) There are several log debris accumulations present on Bradburn Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

5) 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.

6) 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.

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PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and measured from the beginning of the survey reach.

Position (ft):	Comments:
0'	Start of survey at confluence with the West Fork of the North Fork Eel River. Channel type is a B4 for the entire 14976' of stream surveyed.
15'	Young-of-the-year (YOY) salmonids observed from the streambanks by surveyors.
118'	Recording thermograph site; July 23 to September 18, 1996.
2789'	Slope failure on the left bank measures 100' high x 100' long. Slump is contributing fines directly to the stream channel.
3014'	Large debris accumulation (LDA) measures 40' long x 10' wide x 5' high.
3911'	Spring on right bank; the water temperature was 61 degrees Fahrenheit.
5201'	LDA in stream channel measures 15' long x 40' wide x 20' high. The LDA is retaining small woody debris and gravel.
6241'	Dry tributary enters from right bank.
7342'	Tributary enters from left bank; the water temperature was 58 degrees Fahrenheit.
7482'	YOY salmonids observed from the streambanks by surveyors.
7655'	LDA in stream channel measures 10' long x 40' wide x 15' high.
8113'	LDA in stream channel measures 10' long x 40' wide x 10' high. The LDA is retaining small woody debris and gravel.
12084'	Dry tributary enters from right bank.
12157'	Dry tributary enters from left bank.
12651'	LDA in stream channel measures 10' long x 30' wide x 10' high. The LDA is trapping small wood and gravel.
13068'	YOY salmonids observed from the streambanks by surveyors.
14509'	Dry tributary enters from left bank.

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14916' LDA in stream channel measures 15' long x 35' wide x 10' high. The LDA is trapping small wood and gravel.

14976' Boulder roughs in stream channel; steep waterfalls. No fish observed above the waterfalls. End of survey.

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.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, California.

LEVEL III and LEVEL IV HABITAT TYPE KEY

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5