STREAM INVENTORY REPORT

Brock Creek, Mainstem Eel River

INTRODUCTION

A stream inventory was conducted during the summer of 2000 on Brock Creek. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Brock Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for chinook salmon, coho salmon and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Brock Creek is tributary to the mainstem Eel River, located in Humboldt County, California (Map 1). Brock Creek's legal description at the confluence with mainstem Eel River is T02S R04E S34. Its location is 40°14′56.2″ North latitude and 123°43′7.6″ West longitude. Brock Creek is a second order stream and has approximately 8.64 miles of blue line stream according to the USGS Fort Seward, Blockburg, Myers Flat, and Miranda 7.5 minute quadrangles. Brock Creek drains a watershed of approximately 7.07 square miles. Elevations range from about 200 feet at the mouth of the creek to 2,000 feet in the headwater areas. Douglas fir, oak, and mixed hardwood forests dominate the watershed. The watershed is entirely privately owned and is managed for timber production and rangeland. Vehicle access exists from Garberville via Alderpoint Road. Travel east on Alderpoint Road until you come to Dyerville Loop. Turn left on Dyerville Loop and follow until Fort Seward Road. Turn right onto Fort Seward Road and follow until you reach Fort Seward. The Fort Seward Ranch Road will take you directly to Brock Creek, this is a locked and controlled road.

METHODS

The habitat inventory conducted in Brock Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et. al., 1998). The Watershed Stewards Project (WSP) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest, dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are further measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Brock 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". Brock 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 Brock 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 Brock 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 Brock 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 Brock Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

BIOLOGICAL INVENTORY

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

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Quattro Pro. Graphics developed for Brock 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

HABITAT INVENTORY RESULTS

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

The habitat inventory of July 6, 7, 10, 11, 2000, was conducted by Gordon Johnson and Chris Glenney (WSP). The total length of the stream surveyed was 12,301 feet with an additional 498 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.87 cfs on July 12, 2000.

Brock Creek is a B4 channel type for the first 4,777 feet, and a B2 channel type for the remaining 7,524 feet of the stream reach surveyed. B4 channel types are moderately entrenched, moderate gradient, riffle-dominated gravel channels with infrequently spaced pools, very stable plan and profile, and stable banks. B2 channel types are moderately entrenched, moderate gradient, riffle-dominated boulder channels with infrequently spaced pools, very stable plan and profile, and stable banks.

Water temperatures taken during the survey period ranged from 55° to 76 ° F. Air temperatures ranged from 60° to 85 ° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 29% riffle units, 38% flatwater units, and 33% pool units (Graph 1). Based on total length of Level II habitat types there were 28% riffle units, 60% flatwater units, and 9% pool units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle, 28%; step run, 24%; and mid-channel pools, 17% (Graph 3). Based on percent total length, step runs made up 53%; low gradient riffles, 25%; and runs, 8%.

A total of fifty-nine pools were identified (Table 3). Main channel pools were most frequently encountered at 53% and comprised 60% 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. Thirty-nine of the fifty-nine pools (66%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the fifty-eight pool tail-outs measured, eight had a value of 1 (13.8%); fourteen had a value of 2 (24.1%); seventeen had a value of 3 (29.3%); seven had a value of 4 (12.1%) and twelve had a value of 5 (20.7%) (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.

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 6, flatwater habitat types had a mean shelter rating of 10, and pool habitats had a mean shelter rating of 19 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 24. Main channel pools had a mean shelter rating of 13 (Table 3).

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

Table 6 summarizes the dominant substrate in pool habitat types. Gravel was the dominant substrate observed in twenty of the fifty-eight pool tail outs measured (34.5%). Small cobble was the next most frequently observed dominant substrate type and occurred in 24.1% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 65%. The mean percentages of conifer and deciduous trees were 48.75% and 16.25 %, respectively. Graph 9 describes the canopy in Brock Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 58.4%. The mean percent left bank vegetated was 53.4%. The dominant elements composing the structure of the stream banks consisted of 45.2% bedrock, 29% boulder, 22.6% cobble/gravel, and 3.2% sand/silt/clay (Graph 10). Deciduous trees were the dominant bank vegetation type observed in 54.8% of the units surveyed. Additionally, 14.5% had grass as the dominant bank vegetation, and 8.1% had coniferous trees as the dominant bank vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on October 27, 2000 in Brock Creek. The sites were sampled by Glenn Yoshioka (CDFG), Gordon Johnson, Ben Beaver, and Kirsten Williams (WSP).

The first site sampled included habitat units 60 to 64, approximately 4,400 feet from the confluence with Eel River. Habitat units included a channel confluence pool, a boulder enhanced later scour pool, a low gradient riffle, and a mid-channel pool. The site yielded 20 juvenile steelhead rainbow trout. Based upon visually estimated lengths, all of these trout were young-of-the-year (age 0+).

The second site included habitat units 111 to 114, located approximately 7,600 feet above the creek mouth. Habitat units included in this site were a low gradient riffle, a step run, a plunge pool, and two mid-channel pools. The site yielded fifteen juvenile steelhead rainbow trout. Based on visually estimated lengths, the probable distribution of juvenile steelhead age classes was 11 age 0+, 3 age 1+, and 1 age 2+ individuals.

These data can be summarized as follows:

	SHRT Age 0+	SHRT Age 1+	SHRT Age 2+	SHRT Age 3+
Site 1	20	0	0	0

Site 2	11	3	1	0

DISCUSSION

Brock Creek is a B4 channel type for the first 4,777 feet of stream surveyed, and a B2 for the remaining 7,524 feet. The suitability of B4 channel types for fish habitat improvement structures is excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover. The suitability of B2 channel types for fish habitat improvement structures is excellent for plunge weirs, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days July 6 to11, 2000, ranged from 55° to 76° F. Air temperatures ranged from 60° to 85° F. The highest water temperatures were taken in the lower 2,476 feet of the creek that lacked riparian canopy. The upper end of this temperature range is very poor for salmonids. Further upstream, Brock Creek is shaded by valley walls and riparian canopy and the water temperatures ranged from 55° to 66° F. This is a suitable water temperature range for steelhead but the upper end of the temperature range is very poor for salmon. Furthermore, 66° F for salmon (chinook and coho) if sustained, is above the threshold stress level. Brock Creek seems to have temperatures favorable to steelhead but not for salmon. However, 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 60% of the total length of this survey, riffles 28%, and pools 9%. The pools are relatively deep, with thirty-nine of the fifty-nine (66%) pools having a maximum depth greater than 2 feet. In first and second order streams, a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Primary pools comprise 5% of the total length of the habitat inventoried. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. Installing structures that will increase or deepen pool habitat is recommended.

Eight of the fifty-eight (13.8%) pool tail-outs measured had an embeddedness rating of 1; 24.1% had a rating of 2; 32.7% had ratings of 3 or 4; and 20.7% had a rating of 5 and were considered unsuitable for spawning. Eleven of the twelve (91%) with the rating of 5 were unsuitable for spawning due to the dominant substrate consisting of wood, bedrock, or boulders or substrate too large to be suitable. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Brock Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for pools was 19. The shelter rating in the flatwater habitats was 10. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, bedrock

ledges contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Thirty-four of the fifty-eight (58.6%) pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 65%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left bank covered with vegetation was moderate at 58.4% and 53.4%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting native species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Brock 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 canopy and bank vegetation on Brock Creek by planting willow, alder, and Douglas fir along the stream where shade canopy or bank vegetation is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

4) 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.

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) Primary pools comprise 5% of the total length of the habitat surveyed. Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

7) 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.

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 the confluence with the mainstem Eel River. Eel River water temperature was 71° F. Channel type is a B4.
309'	Cattle crossing across creek.
798'	Railroad trestle crosses creek, 20' wide x 130' long x 80' high.
895'	Right bank dry tributary. Young-of-the-year (YOY) steelhead rainbow trout seen.
1,787'	Out of the hydrologic influence of the Eel River and its flood prone zone. Begin 100% sampling of habitat types by first occurrence.
1,882'	Entering bedrock gorge. Shade provided by gorge walls.
2,130'	All canopy provided by bedrock ledges.
2,236'	Gorge walls narrow down to 9' wide.
2,278'	Log debris accumulation (LDA) 30' long x 14' wide x 8' high. LDA caught in the bottle neck of the gorge walls.
2,394'	Entire unit covered by LDA.
2,992'	Gorge walls narrow down to 6' apart.
3,854'	Out of the bedrock gorge.
4,168'	Stream forks. Flows seem to be about equal. Followed right fork.
4,400	Electrofishing site #1.
4,777	Channel type changes to a B2.
4,863'	Right bank slide, 90' long x 80' high.
5,010'	Left bank slide, 215' long x 120' high.
5,212'	Right bank slide, 61' long x 50' high.
5,497'	Three foot plunge.

5,543'	Right bank slide, 230' long x 80' high.
5,879'	Right bank slide, 80'L x 30' H.
6,036'	Left bank tributary, water temperature was 57° F. Gradient appears too steep to allow anadromous salmonids to enter.
6,058'	Right bank slide, 150' long x 100' high.
6,170'	LDA, 20' long x 30' wide x 10' high.
6,230'	Left bank tributary, dry.
6,956'	Four foot plunge.
6,976'	Two foot plunge.
7,185'	Cattle crossing. Access point from ranch road.
7,445'	Two large boulders are creating a bottleneck that has trapped wood and sediment in the creek to form a 5' plunge.
7,600	Electrofishing site #2.
8,090'	Left bank tributary, dry.
8,453'	Right bank slide, 60' long x 30' high.
8,671'	Right bank tributary, dry.
8,785'	Left bank tributary, dry.
8,864'	Substrate becomes bedrock
9,197'	Four foot plunge.
10,412'	Left bank tributary, water temperature 56° F. Walked up first 100' of tributary no fish seen. Gradient between 30% and 40%.
11,544'	LDA, 5' long x 35' wide x 4' high, retaining a sediment wedge 3' deep.
11,612'	LDA, 5' long x 25' wide x 4' high, sediment wedge is 3' deep.
12,437'	Left bank tributary. Water temperature 53° F. Tributary is cascading off of a

bedrock wall.

12,670' Large boulder plugs channel. Flows are forced into a bedrock sheet, 5' high x 3' wide. During high flow event water back up to about 8' deep on the upstream side of the boulder.

12,800' Twelve foot waterfall from bedrock ledge. Probable end of anadromy. End of survey.

REFERENCES

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

LEVEL III and LEVEL IV HABITAT TYPE KEY

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