STREAM INVENTORY REPORT

Baechtel Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on Baechtel Creek to assess habitat conditions for anadromous salmonids. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Baechtel Creek. The objective of the biological inventory was to document the salmonid species present and their distribution. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

Adult carcass surveys were conducted on Baechtel Creek by the California Department of Fish and Game (DFG) from 1987 through 1988. The table below describes the results of those surveys:

Baechtel Creek Carcass Surveys 1987 1988

	Chinook Salmon				Other		
Year	# of Surveys	Live Fish	# of Carcass	Adipose ClipCWT	Redds seen	Coho seen	SH/RT seen
1987	1	45	87	0	0	3	0
1988	3	77	80	4	18	4	0

Four carcasses found during surveys of December 1988 had adipose fin clips; of these, three had a coded wire tag (CWT) # H-60701 in their snouts. This CWT brood lot originated in Outlet Creek in 1985, were reared at the Silverado facility near Yountville, and released into Outlet Creek as smolts. The objective of this report is to document the current habitat conditions in Baechtel Creek, and recommend options for the enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Baechtel Creek is tributary to Outlet Creek, tributary to the Mainstem Eel River, located in Mendocino County, California. Baechtel Creek's legal description at the confluence with Outlet and Haehl Creeks is T18N R13W S18. Its location is

39°24'42" N. latitude and 123°20'20" W. longitude. Baechtel Creek is a second order stream and has approximately 3.24 miles of blue line stream according to the USGS Willits, Laughlin Range, Greenough Ridge, and Burbeck 7.5 minute quadrangles. Baechtel Creek drains a watershed of approximately 9.17 square miles. Summer base runoff is approximately 0.80 cubic feet per second (cfs) at the mouth. Elevations range from about 1350 feet at the mouth of the creek to 2200 feet in the headwater areas. Oak grassland dominates the watershed. The watershed is mostly in private ownership and approximately one third of the watershed lies within the Willits city limits. Vehicle access exists via East Valley Rd, Highway 101, and Muir Mill Rd.

METHODS

The habitat inventory conducted in Baechtel 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 Watershed Stewards Project/AmeriCorps members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Baechtel Creek personnel were trained in May, 1995, by Ruth Goodfield. This inventory was conducted by a two-person team.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Baechtel Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows should also be measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed 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 each tenth unit typed. 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". Baechtel 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 measured for mean width, mean depth, and maximum depth (*Sampling Levels for Fish Habitat Inventory*, Hopelain, 1995). Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Baechtel 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" (NS) 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 Baechtel 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.

8. Canopy:

Stream canopy is estimated using handheld spherical densiometers and is a measure of the water surface shaded during periods of high sun. In Baechtel 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. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results were recorded.

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 Baechtel 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.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, or 3) electrofishing. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

Streamside observation was conducted in Baechtel Creek to document the fish species composition and distribution. No sites were electrofished in Baechtel Creek due to extreme temperatures.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes: 25.4, 12.5, 4.7, 2.37, and 0.85mm (*Stream Substrate Quality for Salmonids: Guidelines for Sampling, Processing, and Analysis*, Valentine, 1995).

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat7.3, 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 4. Graphics developed for Baechtel 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

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

The habitat inventory of July 26, August 7, 9, 10, 14, 15, 16, 17, 21, 22, and 23, 1995, was conducted by Jennifer Terwilliger (AmeriCorps/WSP) and Brie Darr (CCC). The total length of the stream surveyed was 36,925 feet with an additional 1,116 feet of side channel.
Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.80 cfs on July 20, 1995.

Baechtel Creek is an F3 channel type for the first 11,268 feet, an E3 for 6,104 feet, a C3 for the next 3,534 feet, and an F3 for the remaining 16,019 feet of stream reach surveyed. F3 channels have a gradual gradient (less than 2%), with very well confined streams. E3 channel types also have a low gradient (less than 2%), stable banks, and is very well confined. C3 channel types have a low gradient (less than 2%), are slightly entrenched, and have a well defined floodplain.

Water temperatures ranged from 60 to 85° Fahrenheit. Air temperatures ranged from 62 to 94° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, pools made up 38%, riffle types 34%, and flatwater 28% (Graph 1). Pool habitat types made up 47% of the total survey **length**, flatwater 30%, and riffles 23% (Graph 2).

One thousand fourteen Level IV habitat types were identified. These data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were mid-channel pools, 33%; low gradient riffles, 30%; and runs, 25% (Graph 3). By percent total **length**, mid-channel pools made up 40%, runs 25%, and riffles 21%.

Four hundred and sixty-three pools were identified (Table 3). Main pools were most often encountered at 86% and comprised 85% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. One hundred and seventy-four of the 463 pools (38%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 436 pool tail-outs measured, 14 had a value of 1 (3%); 75 had a value of 2 (17%); 57 had a value of 3 (13%); and 290 had a value of 4 (67%). On this scale, a value of 1 is

the best for fisheries (Graph 6).

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle and pool habitat types had the highest shelter rating at 6. Flatwater habitats followed with a rating of 5 (Table 1). Of the pool types, main and scour pools had the highest mean shelter rating at 6, and backwater pools rated 5 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 28 of the 51 low gradient riffles measured (55%). Small cobble was the next most frequently observed dominant substrate type and occurred in 22% of the low gradient riffles (Graph 8).

The mean percent canopy for the stream reach surveyed was 85%. The mean percentages of deciduous and coniferous trees were 61.5% and 23.5%, respectively. Graph 9 describes the canopy in Baechtel Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 63%. The mean percent left bank vegetated was 68%. The dominant elements composing the structure of the stream banks consisted of 8.3% bedrock, 2.0% boulder, 35.6% cobble/gravel, and 54.1% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation types observed in 62% of the units surveyed. Ten percent had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No electrofishing was conducted on Baechtel Creek due to extreme water temperatures. Steelhead juveniles were observed during the course of the survey.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Baechtel Creek.

DISCUSSION

Baechtel Creek is an F3 channel type for the first 11,268 feet of stream surveyed, an E3 for 6,104 feet, a C3 for the next 3,534 feet, and an F3 for the remaining 16,109 feet. The suitability of these channel types for fish habitat improvement structures is as follows: F3 channel types are good for bank placed boulders, single and opposing wing-deflectors, fair for low-stage weir, boulder clusters, channel constrictors, and log cover, and poor for medium stage weirs. E3 channel types are good for bank placed boulders, fair for opposing wing-deflectors, and poor for medium stage weirs, boulder clusters, and single wing-deflectors. C3 channel types are excellent for bank-placed boulders, good for low-stage weirs, boulder clusters, single and opposing wing deflectors, and log cover, and fair for medium-stage weirs.

The water temperatures recorded on the survey days July 26, August 7, 9, 10, 14-17, and 21-23, 1995, ranged from 60 to 85° Fahrenheit. Air temperatures ranged from 62 to 94° Fahrenheit. This is a poor water temperature range for salmonids. Baechtel Creek does not seem to have temperatures favorable to 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 28% of the total **length** of this survey, riffles 34%, and pools 38%. The pools are relatively shallow, with only 174 of the 463 pools having a maximum depth greater than 2 feet. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. In first and second order streams, a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. 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.

Three hundred and forty-seven of the 436 pool tail-outs measured had embeddedness ratings of 3 or 4. Only 14 had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1,

is considered best for the needs of salmon and steelhead. In Baechtel 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 low with a rating of 6. The shelter rating in the flatwater habitats was slightly lower at 5. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by terrestrial vegetation in all habitat types. Additionally, boulders 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 structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Twenty-eight of the 53 low gradient riffles measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 85%. This is a relatively high percentage of canopy, since 80 percent is generally considered optimum in these north coast streams.

The percentage of right and left bank covered with vegetation was moderate at 63% and 68%, 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) Baechtel Creek should be managed as an anadromous, natural production stream.

2) Temperatures in this section of Baechtel Creek, as well as upstream, should be monitored to determine if they are having a deleterious effect upon juvenile salmonids.

3) 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.

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 and in some areas the material is at hand.

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) There are at least two sections where the stream is being impacted from cattle trampling the riparian zone and defecating in the water. Alternatives should be explored with the grazier and developed if possible.

PROBLEM SITES 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 Outlet and Haehl Creeks.
770'	A three foot culvert enters from the right bank (RB).
945'	East Valley Road bridge.
2352'	Remnants of an old bridge are present in the stream.
2384'	A private, gated bridge provides access to the mill.
2711'	Bank stabilization on the left bank (LB).
3301'	Skunk Train Railroad bridge.
3367'	Railroad bridge.
4361'	Rip rap is present on the LB.
4425'	Twenty-four inch culvert enters from the LB.
4518'	Railroad bridge. A culvert 3' wide enters from the LB.
4858'	Old bridge crossing.
6223'	Trail to the stream from the Burger King parking lot. Twelve inch culvert enters from the LB.
6634'	Main Street bridge (Highway 101).
7192'	Woven willow bank stabilization structure is on the LB.

8116'	Dry tributary on the LB.
9039'	Log fence structure on the LB, holding back fines.
9117'	Plank fence structure on the RB.
9269'	Remnants of alder planting on the LB. Plank fence structure on the RB.
11313'	Cattle have access to the stream.
11268'	Channel type changes from an F3 to an E3 (reach 2).
13181'	Rip rap on the RB.
13331'	Rip rap on the RB.
14871'	Cattle have access to the stream.
16744'	Possible dry tributary enters from the LB.
16967'	A private driveway crosses the stream.
17039'	Car bridge crossing.
17372'	Channel type changes from an E3 to a C3 (reach 3).
19794'	Rip rap on the LB.
20239'	Private bridge.
20674'	A 12 inch culvert enters from the RB.
21002'	Muir Mill Road bridge crosses the creek. The channel type changes from a C3 to an F3 (reach 4).
22531'	A dry tributary enters the RB.
22733'	A 24 inch culvert enters from the LB.
22834'	Access from Muir Mill Rd.
24904' rap	A 12 inch culvert enters the LB. There is also rip on the LB.
25064'	Access from Muir Mill Rd.
25211'	Car access to the stream from Muir Mill Rd.
25506'	A 12 inch culvert on the LB.

25726' A 36 inch culvert enters from the LB.

26537' A tributary enters from the RB. A bridge crosses the creek, the road is not named.

26584' A thermograph was placed in this unit on 8/16/95.

27901' A 24 inch culvert enters from the LB.

28556' A tributary enters from the LB.

28937' Private bridge crossing.

29344' Car access from the RB. There is also a concrete retaining wall on the RB.

29404' Footbridge. An 18 inch culvert and rip rap are on the LB.

30109' Private bridge crossing.

31118' Erosion on the RB.

31181' Private bridge crossing.

31258' Private bridge crossing.

31701' Footbridge.

31881' Private bridge crossing.

32228' Denied access to approximately 600' of stream. Survey continues on the other side of the property.

32277' Private bridge crossing.

32761' A dry tributary enters from the LB.

33333' A 12 inch culvert enters from the LB.

33683' Private bridge crossing.

33990' Dry tributary enters from the RB.

34587' Remnants of an old Humboldt crossing. There is also a dry tributary entering the RB.

34684' Log jam, 20'W 15'L x 12'H, it is not obstructing flow.

35931' Log/cable structure on the RB.

36326' Streambed drops 5' in 5'. Three boulders are trapping fines. Possible fish barrier.

36585' Streambed drops 10 - 12' in 64'.

36925' End of survey. Ran out of fish and water. A tributary enters the LB, but runs out of water in approximately 500'.

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