STREAM INVENTORY REPORT

Anderson Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1993 on Anderson 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 Anderson 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 Anderson Creek by the California Department of Fish and Game (DFG) from 1987 through 1990. The table below describes the results of those surveys:

Anderson Creek Carcass Surveys 1987 to 1990

		Chinook Salmon				Other	
Year	# of Surveys	Live Fish	# of Carcasses	AdiposeClip CWT	Redds obs.	Coho obs.	SH/RT obs.
1987-1988	1	3	50	0	11	1	0
1988-1989	2	8	1	0	7	0	0
1989-1990	1	0	0	0	5	0	0

Adult carcasses surveys were conducted on Anderson Creek from 1988 through 1990. In January of 1988, three live chinook salmon were observed, and fifty chinook carcasses were found. One coho salmon carcasses was also found. Eleven redds were seen during this survey. Two surveys were conducted during the winter months of 1988-1989. Eight live chinook salmon were observed, as well as one chinook carcass and seven redds. The drought related low flows during prime migration periods of 1989-1990 made Anderson Creek, typical of many South Fork Eel River tributaries, inaccessible to most salmonids. In fact, only five redds were observed on January 24, 1990. No live fish or carcasses were found. The objective of this report is to document the current habitat conditions in Anderson Creek, and recommend options for the enhancement of habitat for coho salmon and steelhead trout.

WATERSHED OVERVIEW

Anderson Creek is a tributary to Indian Creek, a tributary to the South Fork Eel River, a tributary to the Eel River, which drains to the Pacific Ocean. It is located in Mendocino County, California. Anderson Creek's legal description at the confluence with Indian Creek is T24N R18W S07. Its location is 39.9467 degrees north latitude and 123.8981 degrees west longitude.

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Anderson Creek is an intermittent stream according to the USGS Bear Harbor 7.5 minute quadrangle. Anderson Creek drains a watershed of approximately 4.3 square miles. Summer base runoff is approximately 2.3 cfs at the mouth. Elevations range from about 820 feet at the mouth of the creek and 1,600 feet in the headwater areas. Second growth redwood forest dominates the watershed. The watershed is privately owned by the Georgia Pacific Corporation and is managed for timber production. Vehicle access exists from Highway 1 via Georgia Pacific's controlled access WRP Road. The mouth of Anderson Creek is located approximately nine miles northwest on the WRP Road.

METHODS

The habitat inventory conducted in Anderson Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) Technical Advisors and the contract seasonals that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Anderson Creek personnel were trained in June, 1993, by Gary Flosi and Scott Downie. This inventory was conducted by a two person teams.

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 Anderson 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 by David Rosgen (1985). 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 four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.

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 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". Anderson 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. Unit measurements included mean length, mean width, mean depth, and maximum depth. 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 Anderson 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).

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 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 Anderson 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 habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes.

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 Anderson Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

9. Bank Composition:

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 Anderson Creek, the dominant composition type in both the right and left banks was selected from a list of eight options on 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, 3) electrofishing. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

Biological inventory was conducted in Anderson Creek to document the fish species composition and distribution. One site was electrofished in Anderson Creek using one Smith Root Model 12 electrofisher. The site was end-blocked with nets to contain the fish within the sample reach. Fish from the site were counted by species, measured, and returned to the stream.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the 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 Lotus 1,2,3. Graphics developed for Anderson 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

HABITAT INVENTORY RESULTS

The inventory of July 22 through September 9, 1993 was conducted by Erick Elliot, Brian Michaels, Chris Coyle, and Craig Mesman (CCC and contract seasonals). The total length of the stream surveyed was 26,548 feet, with an additional 1,159 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 2.3 cfs on July 26, 1993.

Anderson Creek is a B1 channel type for 6,501 feet of stream surveyed (Reach 1), a C2 channel type for 343 feet of stream surveyed (Reach 2), a B3 channel type for 1,196 feet of stream surveyed (Reach 3), an F3 channel type for 1,755 feet of stream surveyed (Reach 4), a C2 channel type for 6,955 feet of stream surveyed (Reach 5), an F3 channel type for 3,247 feet of stream surveyed (Reach 6), and a C2 channel type for 6,551 feet of stream surveyed (Reach 7). B1 channels are moderate gradient (1.5-4.0%), moderately confined, bedrock controlled streams. B3 types are moderate gradient (1.5-4.0%), well confined channels, with unstable rejuvenating slopes, and cobble/ gravel substrate. F3 channels are flat gradient, totally confined (<1.5), highly meandering, cobble/ gravel streams, with high sediment supply. C2 types are low gradient (0.3-1.0%), moderately confined channels, with over-fit cobble beds; a channel within a channel.

Water temperatures ranged from 53 to 60 degrees Fahrenheit. Air temperatures ranged from 55 to 73 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 37%, riffle types 31%, and flatwater 31% (Graph 1). Flatwater habitat types made up 43% of the total survey length, pools 29%, and riffles 27% (Graph 2).

Twenty-one Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent occurrence were low gradient riffles, 29%; runs, 16%; step runs, 10%; and mid-channel pools, 7% (Graph 3). By percent total length, low gradient riffles made up 25%, step runs 21%, runs 16%, and bedrock formed lateral scour pools 6%.

Two-hundred-six pools were identified (Table 3). Scour pools were most often encountered at 62%, and comprised 61% 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-fifty-five of the 206 pools (75%) had a depth of two feet or greater (Graph 5).

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The depth of cobble embeddedness was estimated at pool tail-outs. Of the 199 pool tail-outs measured, 59 had a value of 1 (30%); 58 had a value of 2 (29%); 50 had a value of 3 (25%); and 32 had a value of 4 (16%). On this scale, a value of one 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. Pool habitat types had the highest shelter rating at 56. Flatwater habitats followed with a rating of 32 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 62. Backwater pools had a mean shelter rating of 59 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Anderson Creek. Large and small woody debris comprise the majority of remaining cover material. Graph 7 describes the pool cover in Anderson Creek.

Table 6 summarizes the dominant substrate by habitat type. Small cobble was the dominant substrate observed in 68 of the 160 low gradient riffles (43%). Gravel was the next most frequently observed dominant substrate type, and occurred in 23% of the low gradient riffles (Graph 8).

Three percent of the survey reach lacked shade canopy. Of the 97% of the stream covered with canopy, 79% was composed of deciduous trees, and 21% was composed of coniferous trees. Graph 9 describes the canopy in Anderson Creek.

Table 2 summarizes the mean percentage of the right and left stream banks covered with vegetation by habitat type. For the stream reach surveyed, the mean percent right bank vegetated was 38%. The mean percent left bank vegetated was 38%. The dominant elements composing the structure of the stream banks consisted of 15% bedrock, 7% cobble/gravel, 4% boulders, 3% brush, 2% grass, and 2% bare soil. Additionally, 49% of the banks were covered with deciduous trees, and 20% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on Sept. 9, 1993 in Anderson Creek. The unit was sampled by Chris Coyle and Craig Mesman (CCC). All measurements are fork lengths unless noted otherwise.

The site sampled included Habitat Units #404 through #409, a glide, mid-channel pool, trench pool, step run, and plunge pool sequence approximately 24,296 feet from the confluence with Indian Creek. This site had an area of 4,039 square feet, and a volume of 2,154 cubic feet. The unit yielded 27 steelhead/rainbow trout ranging from 62 to 203mm fork length, and one coho, 79mm fork length.

DISCUSSION

Anderson Creek has four channel types B1, C2, B3, and F3. The suitability of these four channel types for fish habitat improvement structures is as follows: B1 channel types are excellent for

bank-placed boulders and good for log cover. C2 channel types are good for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. B3 channel types are excellent for plunge weirs, boulder clusters and bank-placed boulders, single and opposing wing-deflectors, and log cover. F3 channel types are good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors and log cover.

The water temperatures recorded on the survey days July 22 through September 9, 1993 ranged from 53 to 60 degree Fahrenheit. Air temperatures ranged from 55 to 73 degrees Fahrenheit. This is a very good water temperature regime for salmonids. To make any further conclusions, temperatures need be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 43% of the total length of this survey, riffles 27%, and pools 29%. The pools are relatively deep with 155 of the 206 pools having a maximum depth greater than two 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. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by unstable stream banks, 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.

Thirty-two of the 199 pool tail-outs measured had embeddedness ratings of 3 or 4. Fifty-nine had embeddedness ratings of 1. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Anderson Creek, sediment sources should be mapped and rated according to their potential sediment yields, and if found to be of significant impact to the existing good gravel, control measures taken.

The mean shelter rating for pools was moderate with a rating of 56. The shelter rating in the flatwater habitats was slightly lower at 32. However, a pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by undercut banks, and large and small woody debris. Additional log and root wad cover structures in the pool and flatwater habitats would be beneficial to 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.

One-hundred-five of the 160 low gradient riffles had small cobble or gravel as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 97%. This is a very high percentage of canopy, as 80% is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank

stabilization, is recommended.

RECOMMENDATIONS

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

2) 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.

3) 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.

4) There are several log debris accumulations present on Anderson 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) Inventory and map sources of stream bank erosion, and rank them according to present and potential sediment yield. Identified sites, like the site at 29,060', should then be treated to reduce the amount of fine sediments entering the stream.

6) 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.

PROBLEM SITES AND LANDMARKS

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

Position (ft):	Comments:
0'	Start of survey at confluence with Indian Creek. Channel type is a B1.
2178'	Young-of-the-year (YOY) coho observed.
3527'	Log debris accumulation (LDA) measures 5' high x 25' long x 25' wide and is retaining gravel measuring 3' high x 60' long x 25' wide.
4282'	Tributary entering from right bank. Estimated was 0.25 cfs. No fish observed.

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6230'	LDA measures 6' high x 10' long x 30' wide and is retaining gravel measuring 5' high x 50' long x 20' wide.
6501'	Channel type change from a B1 to a C2.
6618'	YOY steelhead and coho observed.
6784'	Tributary entering from right bank. Gradient is very steep and mouth of tributary is dry.
6844'	Channel type change from a C2 to a B3.
7143'	Tributary entering from right bank. LDA approximately 10' up tributary acting as a barrier.
8040'	Channel type change from a B3 to an F3. YOY coho and steelhead observed.
8479'	LDA measures 8' high x 40' wide x 30' long and is retaining gravel measuring 20' wide x 30' long.
9294'	LDA measures 6' high x 30' wide x 65' long and is retaining gravel measuring 20' wide x 100' long.
9426'	Tributary entering from right bank. Gradient very steep. No fish observed.
9795'	Channel type change from an F3 to a B3.
9941'	LDA measures 4' high x 30' wide x 15' long and is retaining gravel measuring 3' high x 20' wide x 100' long.
10555'	Collapsed log bridge in channel measures 20' high x 40' long.
10716'	LDA measures 8' high x 25' wide x 50' long.
10802'	LDA measures 6' high x 25' wide x 40' long and is retaining gravel measuring 1' high x 20' wide x 200' long.
10992'	Dry tributary from right bank.
11516'	LDA measures 5' high x 20' wide x 10' long and is retaining gravel measuring 2' high x 15' wide x 100' long.
11605'	Tributary entering from left bank, dry at mouth.
11715'	Channel type change from a B3 to a C2.
11836'	LDA measures 6' high x 20' wide x 150' long and is retaining gravel.

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12845' Tributary entering from left bank, dry at mouth.

13056' LDA measures 5' high x 20' wide x 40' long, YOY observed.

13984' LDA measures 5' high x 30' wide x 50' long and is retaining gravel measuring 3' high x 15' wide x 200' long.

14703' Dry right bank tributary.

14864' LDA measures 6' high x 30' wide x 20' long and is retaining gravel measuring 5' high x 20' wide x 100' long.

15549' LDA measures 5' high x 20' wide x 15' long and is retaining gravel measuring 4' high x 15' wide x 100' long.

16118' Dry left bank tributary.

16691' Tributary entering from right bank.

16751' Channel type changes from a C2 to an F3. YOY salmonids observed.

16751' Tributary entering from left bank.

19541' LDA measures 4' high x 20' wide x 10' long.

19998' Channel type changes from an F3 to a C2.

20721' Tributary entering from right bank, dry at mouth.

20769' LDA measures 4' high x 20' wide x 50' long.

20957' LDA measures 4' high x 30' wide x 50' long and is retaining gravel measuring 2' high x 15' wide x 100' long.

21144' Collapsed bridge in creek, retaining gravel and creating a possible barrier.

21270' LDA measures 6' high x 30' wide x 10' long.

21558' LDA measures 3' high x 15' wide x 8' long and is retaining gravel measuring 2' high x 10' wide x 50' long.

23145' Dry right bank tributary.

23744' Channel type change from an F3 to a C2.

23852' Jeep trail crossing creek.

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23954'	Old LDA measures 3' high x 15' wide x 30' long.
25097'	Dry left bank tributary.
25204'	Two large springs entering creek approximately half way up unit. Water temperature from both springs was 55 degrees Fahrenheit. Tributary entering from left bank.
25326'	Dry left bank tributary.
25358'	Old Humboldt crossing, 100% embedded.
25372'	LDA measures 4' high x 30' wide x 40' long and is retaining silt and fine sediment. YOY observed.
26159'	LDA measures 4' high x 40' wide x 30' long, diverting main channel.
26416'	LDA measures 6' high x 30' wide x 20' long and is retaining gravel.
26572'	Old Humboldt crossing. YOY salmonid observed above.
26833'	LDA measures 7' high x 40' wide x 30' long and is retaining gravel measuring 20' wide.
27348'	Tributary entering from right bank. LDA measures 4' high x 20' wide x 10' long.
27906'	LDA measures 5' high x 30' wide x 20' long. Tributary entering from right bank.
28624'	LDA measures 5' high x 40' wide x 70' long and is retaining silt and fine sediment.
29060'	Right bank erosion site measures 6' high x 100' long.
29236'	Left bank erosion site measures 8' high x 100' long.
29463'	Tributary entering from left bank, gradient steep.
30184'	LDA measures 8' high x 30' wide x 20' long. YOY salmonid observed.
26548'	Channel splits. Flow dramatically decreases. Left fork surveyed for an additional 300'. No fish observed, flow becomes intermittent, dominate substrate gravel/ sand. Right fork walked an additional 150'. Channel is dry, dominate substrate is mud/ silt. End of Survey.

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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