STREAM INVENTORY REPORT

"Clark Creek"

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on an unnamed tributary to Bear River locally known as, and herein after referred to as, Clark 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 Clark 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 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

Clark Creek is a tributary to the Bear River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Figure 1). Clark Creek's legal description at the confluence with Bear River is T01N R02S S22. Its location is 40.4611 degrees north latitude and 124.2869 degrees west longitude. Clark Creek is a first order stream and has approximately 2.8 miles of blue line stream according to the USGS Capetown 7.5 minute quadrangle. Clark Creek drains a watershed of approximately 4.3 square miles. Elevations range from about 195 feet at the mouth of the creek to 1,200 feet in the headwater areas. Deciduous trees dominate the watershed. The watershed is entirely privately owned and is managed for rangeland.

METHODS

The habitat inventory conducted in Clark Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The California Conservation Corps (CCC) Technical Advisors and the AmeriCorps Watershed Stewards Project (AmeriCorps WSP) Members who conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 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 Clark 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". Clark 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 (Hopelain, 1995). 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 Clark 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 not suitable 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 Clark 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 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 Clark Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the end of approximately every third unit in addition to every fully-described unit, giving approximately a 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 Clark 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 Clark Creek fish presence was observed from the stream banks, and one site was 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 Clark 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 August 2 through August 14, 1996 was conducted by Bill Malinowski and Andrew McMillan (WSP\AmeriCorps) and Craig Mesman and David Jones (CCC). The total length of the stream surveyed was 10,446 feet.

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Flow was not measured on Clark Creek.

Clark Creek is a B4 channel type for the entire 10,446 feet of stream reach surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channels, with infrequently placed pools, very stable plan and profile, stable banks and a gravel channel.

Water temperatures taken during the survey period ranged from 56 to 80 degrees Fahrenheit. Air temperatures ranged from 56 to 74 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 43% pool units, 40% flatwater units, 9% riffle units, and 8% dry units (Graph 1). Based on total length of Level II habitat types there were 56% flatwater units, 29% dry units, 12% pool units, and 3% riffle units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were main channel pools, 40%; step runs, 38%; and low gradient riffles, 5% (Graph 3). Based on percent total length, step runs made up 55% and main channel pools 11%.

A total of sixty-one pools were identified (Table 3). Main channel pools were most frequently encountered at 95% and comprised 95% 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. Nine of the 61 pools (15%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 61 pool tail-outs measured, 19 had a value of 1 (31%); 11 had a value of 2 (18%); eight had a value of 3 (13%); 16 had a value of 4 (26%); and seven had a value of 5 (12%); (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. Riffle habitat types had a mean shelter rating of 60, flatwater habitats had a mean shelter rating of 26, and pools had a mean shelter rating of 19 (Table 1). Of the pool types, the scour pools had a mean shelter rating of 25. Main channel pools had a mean shelter rating of 18 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Large cobble was the dominant substrate observed in the one low gradient riffle measured. Of the seven step runs measured, three had gravel or small cobble as the dominant substrate (Graph 8).

The mean percent canopy density for the stream reach surveyed was 61%. The mean percentages of deciduous and coniferous trees were 78% and 22%, respectively. Graph 9 describes the canopy in Clark Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 53%. The mean percent left bank vegetated was 61%. The dominant elements composing the structure of the stream banks consisted of 52% cobble/gravel, 24% bedrock, 12% boulders, and 12% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 45% of the units surveyed. There was no vegetation on 21% of the units surveyed (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on August 20, 1996 in Clark Creek. The site was sampled by Bill Malinowski and Craig Mesman.

The site sampled was Habitat Unit #011, a mid-channel pool approximately 2,687 feet from the confluence with Bear River. This site had an area of 396 square feet and a volume of 554 cubic feet. The site yielded forty steelhead/rainbow trout, one stickleback, five yellow-legged frogs and one tadpole.

DISCUSSION

Clark Creek is a B4 channel type for the entire 10,446 feet of stream surveyed. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, bolder clusters, bank placed boulders, single and opposing wing deflectors and log cover; and good for medium-stage plunge weirs.

The water temperatures recorded on the survey days August 2 through 14, 1996 ranged from 56 to 80 degrees Fahrenheit. Air temperatures ranged from 55 to 72 degrees Fahrenheit. This is a poor water temperature range for salmonids. Sixty-nine degrees Fahrenheit, if sustained, is near the threshold stress level for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 56% of the total length of this survey, riffles 3%, and pools 12%. The pools are relatively shallow with only nine of the 61 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.

Thirty-one of the 61 pool tail-outs measured had embeddedness ratings of 3, 4 or 5. Nineteen had an embeddedness rating of 1. 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 Clark 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 19. The shelter rating in the flatwater habitats was slightly higher at 26. 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. Log and root wad cover structure 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 divide territorial units to reduce density related competition.

The low gradient riffle measured had large cobble (5" to 10") as the dominant substrate. Of the seven step runs measured one had gravel (0.08" to 2.5") as the dominant substrate, two had small cobble (2.5" to 5"), two had large cobble, one had boulder (>10") and one had silt/clay as the dominant substrate. Gravel and small cobble are the preferred substrate for spawning for steelhead and coho salmon. Suitable spawning substrate is limited in Clark Creek.

The mean percent canopy density for the stream was 61%. This is a moderate percent of canopy. 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 53% and 61%, 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) Clark Creek should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures are above 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) 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.

5) 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.

6) Increase the canopy on Clark Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy 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.

7) There are sections where the stream is being impacted from cattle trampling the riparian zone. Alternatives should be explored with the grazier and developed if possible.

8) Suitable spawning substrate on Clark 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.

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.

Position (ft):	Comments:
0'	Start of survey at confluence with Bear River. Channel type is B4.
1,050'	Flatcar bridge measures 7’ high x 31' wide x 10' long. Livestock have free run of stream.
2,871'	Right bank erosion site ("blue goo") measures 170' long x 60' high.
3,318'	Left bank erosion site ("blue goo") measures 60' long x 45' high.
3,704'	Right bank erosion site ("blue goo") measures 100' long x 20' high.
3,936'	Right bank erosion site ("blue goo") measures 200' long x 50' high.
4,253'	Dry left bank tributary, fence across channel.
5,834'	Right bank erosion site measures 60' long x 30' high.
6,362'	Left bank erosion site measures 40' long x 30' high.
6,787'	Left bank erosion site measures 40' high x 40 long.
9,494'	Right bank erosion site measures 30' high x 20' long.
10,417'	End of survey at fourteen foot high bedrock cascade. Walked 400' upstream and observed no fish.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

LEVEL III and LEVEL IV HABITAT TYPE KEY

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