STREAM INVENTORY REPORT

TWIN CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1999 on Twin Creek, a tributary to the mainstem Eel River. 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 Twin 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

Twin Creek is tributary to the mainstem Eel River, located in Humboldt County, California (Map 1). Twin Creek's legal description at the confluence with Eel River is T1N R1E S21. Its location is 40°27′14.8″ North latitude and 124°04′10.6″ West longitude. Twin Creek is a first order stream and has approximately 2.35 miles of blue line stream according to the USGS Scotia 7.5 minute quadrangle. Twin Creek drains a watershed of approximately 4.2 square miles. Elevations range from about 40 feet at the mouth of the creek to 1,840 feet in the headwater areas. Redwood forest dominates the watershed. The entire watershed is in private ownership and is managed for timber production. Vehicle access exists via US 101; heading southbound, take the Stafford Exit and turn right at the stop sign. Head south and turn right where this road dead-ends in a T. Proceed west to the end of this road segment. Walk down to the mainstem Eel River and proceed downstream on the left bank, the first tributary is Twin Creek.

METHODS

The habitat inventory conducted in Twin Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al., 1998). The AmeriCorps 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

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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 methodology and data sheet have been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This protocol was used in Twin Creek to record measurements and observations. There are nine components to the inventory data sheet.

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:

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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". Twin 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 Twin 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 Twin 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 Twin 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 Twin 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 Twin 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 Twin Creek include:

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- 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 June 9-10, 1999, was conducted by Greg Larson and Donn Rehburg (WSP). The total length of the stream surveyed was 6,010 feet.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.74 cfs on June 9, 1999.

Twin Creek is an B4 channel type for the first 1,803 feet and a B2 channel type for the next 4,207 feet of the stream reach surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; gravel channel. B2 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; boulder channel.

Water temperatures taken during the survey period ranged from 49° to 54° F. Air temperatures ranged from 52° to 66° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 47% riffle units, 24% flatwater units, and 29% pool units (Graph 1). Based on total length of Level II habitat types there were 67% riffle units, 23% flatwater units, and 10% pool units (Graph 2).
Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were high gradient riffles, 24%; mid-channel pools, 23%; and low gradient riffles, 18% (Graph 3). Based on percent total length, high gradient riffles made up 32%, low gradient

riffles 31%, and step runs 16% (Table 2) of the stream length surveyed.

A total of 29 pools were identified (Table 3). Main channel pools were most frequently encountered at 83% (Graph 4) and comprised 87% of the total length of all pools (Table 3).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Fifteen of the 29 pools (52%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 28 pool tail-outs measured, 0 had a value of 1, 3 had a value of 2 (10.7%), 16 had a value of 3 (57.1%), 3 had a value of 4 (10.7%), and 6 had a value of 5 (21.4%) (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 36, flatwater habitat types had a mean shelter rating of 21, and pool habitats had a mean shelter rating of 46 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 52, while main channel pools had a mean shelter rating of 42 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Twin Creek and are extensive. Large and small woody debris are absent from most habitat types and not abundant in the remainder. Graph 7 describes the pool cover in Twin Creek.

Table 6 summarizes the dominant substrate in pool habitat types. Gravel was the dominant substrate observed in 18 of the 27 (67%) pool tail-outs measured. Small cobble, large cobble, and boulders were equal proportionally with each occurring in 11% of the pool tail-outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 57%. The mean percentages of conifer and deciduous trees were 41% and 59%, respectively. Graph 9 describes the canopy in Twin Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 76.8%. The mean percent left bank vegetated was 76.6%. The dominant elements composing the structure of the stream banks consisted of 0% bedrock, 6% boulder, 78% cobble/gravel, and 16% sand/silt/clay (Graph 10). Deciduous trees were the dominant bank vegetation type observed in 64% of the units surveyed. Sixty-four percent of the units surveyed had deciduous trees as the dominant bank vegetation and 28% had coniferous trees as the dominant bank vegetation, including down trees, logs, and root wads (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Two reaches on Twin Creek were electrofished on October 13, 1999 to determine presence/absence of fish species. The sites were sampled by Glenn Yoshioka (DFG) and Jason Hadley (CCC).

The first site sampled included habitat units 18 to 24. One low gradient riffle, one step run, and five mid-channel pools were sampled in this B4 reach. This site yielded 163 juvenile steelhead rainbow trout. Based on visually estimated lengths, the probable breakdown of steelhead age classes was 121 age 0+, 39 age 1+, and 3 age 2+ juveniles.

The second site sampled began at habitat unit 29 and extended beyond habitat unit 36. One low gradient riffle, one run, one lateral scour pool-bedrock formed, and four mid-channel pools were sampled in this B2 reach. This site yielded 79 juvenile steelhead rainbow trout. Based on visually estimated length, the probable breakdown of steelhead age classes was 64 age 0+, 11 age 1+, and 4 age 2+ juveniles.

These data can be summarized as follows:

	SHRT Age 0+	SHRT Age 1+	SHRT Age 2+	SHRT Age 3+
Site 1	121	39	3	0
Site 2	64	11	4	0

DISCUSSION

Twin Creek is a B4 channel type for the first 1,803 feet of stream surveyed and a B2 for the next 4,207 feet. The suitability of B4 and B2 channel types for fish habitat improvement structures is as follows: B4 channels are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover. B2 channels are excellent for plunge weirs, single and opposing wing-deflectors, and log cover.

Water temperatures taken during the survey period ranged from 49° to 54° F. Air temperatures ranged from 52° to 66° F. This is a good water temperature range for salmonids. 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 23% of the total length of this survey, riffles 67%, and pools 10%. The pools are relatively deep with 52% of 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 only 5% of the total length of stream habitat surveyed in Twin Creek. 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.

None of the pool tail-outs measured had an embeddedness rating of 1, 11% had a rating of 2, 68% had ratings of 3 or 4, and 21% had a rating of 5 and were considered unsuitable for spawning due to the dominate substrate being boulders or cobble too large to be used. 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 Twin 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 46. The shelter rating in the flatwater habitats was 21. 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 many habitat types. Additionally, white water contributes some cover. There is a paucity of small and large woody debris. Log and root wad cover structures in the pool and flatwater habitats would 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-one of the twenty-seven (78%) of 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 57%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 77% and 77%, 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) Twin Creek should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that 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) 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.

4) 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.

5) Increase the canopy on Twin 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.

6) Primary pools comprise only 5% of the total stream length surveyed on Twin Creek. 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 confluence with the mainstem Eel River. Channel type is a B4.

419' Juvenile salmonids observed.

790' Log debris accumulation (LDA), 5' high x 30' wide x 12' long, retaining sediment.

813' Out of the hydrologic influence of the Eel River and its flood prone zone. Begin 100% sampling of habitat types by first occurrence.

903' LDA, 5' high x 45' wide x 17' long, retaining 3' of sediment.

1,880' Channel Type changes to a B2.

2,156' LDA, with a 6' high cascade, retaining sediment.

2,633' Right bank erosion, 90' long x 15' high.

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2,904' Left bank erosion, 50' long x10' high.

3,214' Left bank erosion, 40' long x 5' high.

3,845' Right bank slope failure.

3,917' Right bank, trees fallen over creek from slope failure.

4,118' Right bank slope failure ends.

4,970' Right bank slope failure, 76' long x 50' high.

5,699' LDA, retaining sediment.

5,744' Juvenile salmonids observed.

6,010' End of survey. LDA with two jumps, both over 6 feet high. Very shallow pools at bottom of jumps. LDA retaining sediment. No fish seen for 0.25 miles above LDA.

REFERENCES

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd 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
Dammed Pool [DPL]
6.5