STREAM INVENTORY REPORT

China Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on China Creek. The survey began at the confluence with Redwood Creek and extended upstream 2.9 miles. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in China Creek.

Adult spawner surveys were conducted on China Creek by the California Department of Fish and Game (DFG) from December 1995 through January 1998. The table below describes the results of those surveys:

China Creek Spawner Surveys December 95 to January 98

		Chinook Salmon				Other	
Year	# of Surveys	Live Fish	# of Carcasses	AdClip CWT	Redds seen	Coho seen	SH/RT seen
1995-1996	3	7	10	0	30	4	0
1996-1997	2	3	3	0	6	0	0
1997-1998	2	0	3	0	4	0	0

Adult spawner surveys were conducted on China Creek by the DFG beginning in 1987 as part of an Eel River index survey reach in the Redwood Creek system. Chinook and coho salmon, as well as steelhead spawners have been documented in China Creek. 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

China Creek is a tributary to Redwood Creek, a tributary to the South Fork Eel River, located in Humboldt County, California (Map 1). China Creek's legal description at the confluence with Redwood Creek is T04S R02E S24. Its location is 40°05′51″ north latitude and 123°54′33″ west

longitude. China Creek is a second order stream and has approximately 2.7 miles of blue line stream according to the USGS Briceland 7.5 minute quadrangle. China Creek drains a watershed of approximately 3.8 square miles. Elevations range from about 600 feet at the mouth of the creek to 1,400 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for rural subdivision. Vehicle access exists via Briceland Road from the town of Redway to a private access road. Continue down the access road on foot approximately 600 feet to the mouth of China Creek.

METHODS

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

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are 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 China 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 a Marsh-McBirney Model 2000 flow meter.

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. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

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. Additionally, a recording thermograph was deployed in China Creek during the summer months of 1998 to record temperatures on a 24 hour basis during warm summer months.

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". China 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. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In China 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, bedrock, 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 China 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 China 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 China 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 (including downed trees, logs, and rootwads) was estimated and recorded.

BIOLOGICAL INVENTORY

Fish presence was observed from the stream banks in China Creek.

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 China 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
- Mean 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 16, 17, 25 and 26, 1998, was conducted by John Wooster and Caroline Jezierski (WSP/AmeriCorps). The total length of the stream surveyed was 15,747 feet with an additional 166 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.7 cfs on June 17, 1998.

China Creek is an F4 channel type for the first 11,957 feet of stream reach surveyed, and an E4 channel type for the remaining 3,790 feet of stream surveyed. F4 channel types are entrenched meandering riffle/pool channel on low gradients with high width/depth ratio and gravel dominant substrates. E4 channel types are low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition; very efficient and stable; high meander width ratio and gravel dominant channel.

Water temperatures taken during the survey period ranged from 52° to 59° Fahrenheit. Air temperatures ranged from 57° to 83° Fahrenheit. Water temperatures taken with a recording thermograph deployed from July 15 to September 25, 1996, ranged from 53° to 73° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 26% riffle units, 31% flatwater units, and 43% pool units (Graph 1). Based on total length of Level II habitat types there were 21% riffle units, 45% flatwater units, and 35% pool units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pools, 38%; low gradient riffles, 26%; and runs, 19%

(Graph 3). Based on percent total length, mid-channel pools made up 32%, step runs 23%, and runs 22%.

A total of 164 pools were identified (Table 3). Main channel pools were most frequently encountered at 90%, and comprised 93% 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. Ninety-seven of the 164 pools (59%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 163 pool tail-outs measured, one had a value of 1 (1%); thirty-four had a value of 2 (21%); 103 had a value of 3 (63%); eighteen had a value of 4 (11); and seven had a value of 5 (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 12, flatwater habitat types had a mean shelter rating of 16, and pool habitats had a mean shelter rating of 32 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 40. Main channel pools had a mean shelter rating of 31 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in China Creek. Graph 7 describes the pool cover in China Creek. Small woody debris is the dominant pool cover type followed by large woody debris.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 119 of the 160 pool tail outs measured (74%). Small cobble was the next most frequently observed dominant substrate type and occurred in 7% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 88%. The mean percentages of deciduous and coniferous trees were 76% and 12%, respectively. Graph 9 describes the mean percent canopy in China Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 82%. The mean percent left bank vegetated was 87%. The dominant elements composing the structure of the stream banks consisted of 5.5% bedrock, 0.0% boulder, 59.1% cobble/gravel, and 35.5% sand/silt/clay (Graph 10). Deciduous trees are the dominant vegetation type observed in 65.5% of the units surveyed. Additionally, 25.5% of the units surveyed had brush as the dominant vegetation type, and 4.5% had coniferous trees as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No sites were electrofished in China Creek. Juvenile salmonids were observed from the

streambanks by the surveyors throughout the entire length of the 1998 stream survey.

DISCUSSION

China Creek is an F4 channel type for the first 11,957 feet of stream surveyed and an E4 for the remaining 3,790 feet. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge-weirs, single and opposing wing-deflectors, channel constrictors, and log cover; poor for boulder clusters. The suitability of E4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for opposing wing-deflectors; poor for plunge-weirs, boulder clusters, and single wing-deflectors.

The water temperatures recorded on the survey days June 16, 17, 25 and 26, 1998, ranged from 52° to 59° F. Air temperatures ranged from 57° to 83° F. Additional samples from a recording thermograph deployed during the summer of 1996 measured water temperatures ranging from 53° to 73° F. Water temperatures above 65°F exceed the desired temperature for coho salmon, and 73°F is near the threshold temperature range for steelhead. 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 45% of the total length of this survey, riffles 21%, and pools 35%. The pools are relatively deep, with 97 of the 163 (59%) pools having a maximum depth greater than 2 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.

One of the 163 pool tail-outs measured one had an embeddedness rating of 1. Thirty-four of the pool tail-outs measured had an embeddedness value of 2. One hundred and three of the pool-tail outs had a rating of 3. Eighteen of the pool-tail outs had a rating of 4. Seven of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. Four of the seven were unsuitable for spawning due to the dominant substrate being silt/sand/clay or gravel being too small to be suitable. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In China Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One hundred thirty-three of the 160 pool-tail outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Four pool-tail outs were not given substrate descriptions.

The mean shelter rating for pools was 32. The shelter rating in the flatwater habitats was 16. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by small woody debris in all habitat types. Additionally, root mass

contributes 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.

The mean percent canopy density for the stream was 88%. In general, revegetation projects are considered when canopy density is less than 80%, or there is a lack of coniferous trees composing the riparian canopy.

The percentage of right and left bank covered with vegetation was high at 82% and 87%, 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) China Creek should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures exceed the threshold stress level for juvenile coho salmon and are nearing the threshold stress level for juvenile steelhead. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from small woody debris. Adding high quality complexity with woody cover is desirable.

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) 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 China Creek by planting redwood and Douglas fir along the stream where the coniferous component of the 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.

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 Redwood Creek. Channel type is an F4 for the first 11,957' of stream surveyed.
530'	Series of instream weir structures for 1,000 feet.
1,973'	Right bank erosion; 20' long x 20' high. Slumping into stream channel.
3,138'	Tributary enters from left bank.
3,267'	Old concrete bridge pilings on right bank.
3,340'	Briceland Road bridge crosses China Creek.
5,370'	Tributary enters from left bank.
5,654'	China Creek Road bridge crosses stream.
6,289'	Right bank erosion; 100' long x 40' high.
6,296'	Log debris accumulation (LDA); 20' long x 15' wide x 6' high, not a barrier.
6,344'	China Creek Road is 15' away and 70' above the left bank. The road is contributing fine sediment into the stream channel.
6,904'	Right bank erosion; 40' long x 35' high. Contributing fines to the stream channel.
6,905'	LDA; 30' long x 20' wide x 8' high, not a barrier.
6,923'	Tributary enters from right bank.
7,322'	Tributary enters from left bank.
8,522'	Twin Creek enters from the right bank.
9,273'	LDA; 15' long x 18' wide x 3' high, not a barrier.
9,274'	Left bank erosion; 25' long x 45' high.
9,337'	LDA; 8' long x 8' wide x 2' high, not a barrier.
9,596'	LDA; 18' long x 6' wide x 3' high, not a barrier.

11,033'	Tributary enters from right bank.
11,343'	Corrugated metal pipe (CMP), 1' diameter, enters stream from left bank.
11,410'	Right bank erosion; 80' long x 40' high.
11,422'	LDA; 30' long x 25' wide x 5' high, not a barrier.
11,749'	China Creek Road bridge crosses stream.
11,765'	Tributary enters from left bank.
11,856'	LDA; 20' long x 8' wide x 5' high, retaining gravel.
11,899'	Channel type changes from F4 to E4 for remaining 3,790' of stream surveyed.
12,409'	Corrugated metal pipe enters stream from right bank; 1' diameter. Shows evidence of over-topping at winter flows.
13,340'	Tributary enters from left bank.
13,372'	Tributary enters from right bank.
13,618'	Juvenile salmonids observed from the streambanks.
14,680'	Dry tributary enters from left bank.
15,233'	Road fords stream.
15,336'	Juvenile salmonids observed from the streambanks.
15,571'	Tributary enters from right bank.
15,610'	Vertical drop of 4' into a shallow run. Possible fish barrier.
15,747'	End of survey.

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.

Friedrichsen, G.L. 1998. *Eel River Water Quality Monitoring Project*. Final report 205(J) Contract # 5-029-250-2 to the California State Water Quality Control Board, May 15, 1998. 70 pp. plus 6 appendices.

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