SALMON AND STEELHEAD RESTORATION AND ENHANCEMENT PROGRAM

NORTH COAST

BASIN PLANNING PROJECT

STREAM INVENTORY REPORT

Sequoia Creek, Eel River, 1998

CALIFORNIA DEPARTMENT OF FISH AND GAME

SPORT FISH RESTORATION ACT

1998

Scott Downie,
Fish Habitat Supervisor II

NORTH COAST BASIN PLANNING PROJECT

The North Coast Basin Planning Project (BPP) was begun in 1991 to develop salmon and steelhead restoration and enhancement programs in North Coast watersheds for the Department of Fish and Game (DFG). The objectives of the project conform with the goals of California's Salmon and Steelhead Restoration and Enhancement Program of 1988. The Restoration Program strives to enhance the status of anadromous salmonid populations and improve the fishing experience for Californians. The Program's goal has been to achieve a doubling of the population of salmon and steelhead by the year 2000. The BPP is supported by the Sport Fish Restoration Act, which uses sport fishermen's funds to improve sport fisheries.

The project conducts stream and habitat inventories according to the standard methodologies discussed in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et al., 1998). Biological sampling is conducted using electrofishing and direct observation to determine species presence and distribution, and some selected streams are electrofished for population estimates. A few streams are also sampled for substrate composition. Collected information is used for base-line data, public cooperation development, restoration program planning, specific project design and implementation, and for project evaluation.

The Eel River system was identified as the initial basin for project planning activities. Most anadromous tributaries to the Van Duzen, South Fork Eel, Mainstem Eel, Middle Fork Eel, and North Fork Eel rivers have been inventoried since 1991. BPP personnel have also completed inventories of most Mattole River tributaries, and a few Mendocino County coastal streams, and tributaries to Humboldt Bay.

STREAM INVENTORY REPORT

Sequoia Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1997 on Sequoia 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 Sequoia 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

Sequoia Creek is tributary to Sonoma Creek, tributary to the Eel River, located in Humboldt County, California (Map 1). Sequoia Creek's legal description at the confluence with Sonoma Creek is T2S R3E S13. Its location is 40°17′58″ north latitude and 123°47′48″ west longitude. Sequoia Creek is a 1st order stream and has approximately 1.1 miles of blue line stream according to the USGS Myers Flat 7.5 minute quadrangle. Sequoia Creek drains a watershed of approximately 1.2 square miles. Elevations range from about 260 feet at the mouth of the creek to 1,100 feet in the headwater areas. Redwood and Douglas fir forest dominate the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists via Highway 101 to Dyerville exit. Follow Dyerville Loop Road past McCann Road to junction with Whitlow Road. Sequoia Creek joins Sonoma Creek behind building.

METHODS

The habitat inventory conducted in Sequoia Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al., 1998). The California Conservation Corps (CCC) Technical Advisors and AmeriCorps Watershed Stewards Project

(AmeriCorps/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

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 1995). 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 has 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 Sequoia 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.

Sequoia Creek

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". Sequoia 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 Sequoia 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 Sequoia 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.

Sequoia Creek

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 Sequoia 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 Sequoia 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 Sequoia Creek fish presence was observed from the stream banks. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

SUBSTRATE SAMPLING

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

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:

Sequoia Creek

- 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 Sequoia 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 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 July16, 1998, was conducted by John Wooster and Caroline Jezierski (AmeriCorps/WSP). The total length of the stream surveyed was 2,095 feet with no additional feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh. McBirney Model 2000 flowmeter at 0.18 cfs on July 13, 1998.

Sequoia Creek is a B4 channel type for the entire 2,095 feet of stream reach surveyed. B4 types are moderately entrenched, moderate gradient riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks and gravel channels.

Water temperatures taken during the survey period ranged from 57° to 60° F. Air temperatures ranged from 70° to 73° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% riffle units, 22% flatwater units, and 34% pool units (Graph 1). Based on total length of Level II habitat types there were 49% riffle units, 29% flatwater units, and 19% pool units (Graph 2).

Six Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 42%; mid-channel pools, 33%; and runs, 13% (Graph 3). Based on percent total length, low gradient riffles made up 49%, mid-channel pools, 18%, and runs and step runs, 14% (Table 2).

A total of 23 pools were identified (Table 3). Main pools were most frequently encountered at 100% (Graph 4) and comprised 100% of the total length of all pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-two of the 23 pools (96%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the twenty-three pool tail-outs measured, none had a value of 1 (0.0%); six had a value of 2 (26.0%); seventeen had a value of 3 (74.0%); none had a value of 4 (0.0%) and none had a value of 5 (0.0%) (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 seventeen, flatwater habitat types had a mean shelter rating of fifteen, and pool habitats had a mean shelter rating of 47 (Table 1). Of the pool types, the main pools had the highest mean shelter rating at 47. Twenty-three pools had a mean shelter rating of 47 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Sequoia Creek and is extensive. Large woody debris is lacking in nearly all habitat types. Graph 7 describes the pool cover in Sequoia Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 22 of the 23 pool tail outs measured (96%). Small cobble was the next most frequently observed dominant substrate type and occurred in 4% of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 90%. The mean percentages of deciduous and coniferous trees were 65% and 35%, respectively. Graph 9 describes the canopy in Sequoia Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 88.8%. The mean percent left bank vegetated was 84.2%. The dominant elements composing the structure of the stream banks consisted of 4.20% bedrock, 0.0% boulder, 83.3% cobble/gravel, and 12.5% sand/silt/clay (Graph 10). Deciduous trees was the dominant vegetation type observed in 50% of the units surveyed. Additionally, 41.7% of the units had brush as the dominant vegetation type, and 8.3% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No sites were electrofished on Sequoia Creek in 1998, in Sequoia Creek. Surveyors observed unidentified young-of-the-year (YOY) salmonids from streambank.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Sequoia Creek.

DISCUSSION

Sequoia Creek is a B4 channel type for the entire 2,095 feet of stream surveyed. The suitability of B4 channel types for fish habitat improvement structures is excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey day July 16, 1998, ranged from 57° to 60° F. Air temperatures ranged from 70° to 73° F. This is a good water temperature range for salmonids. Sequoia Creek seems to have temperatures favorable to 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 29% of the total length of this survey, riffles 49%, and pools 19%. The pools are relatively shallow, with only five of the 23 (21.7%) 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. Primary pools only comprise 4% of the total length of stream surveyed. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. The LDA's in the system may be 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.

None of the 23 (0.0%) pool tail-outs measured had an embeddedness rating of 1. 26.1% had a rating of two, 73.9% had a rating of 3 or 4. None of the pool tail-outs had a rating of 5 (0.0%) which is considered unsuitable for spawning. 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 Sequoia 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 47. The shelter rating in the flatwater habitats was lower at 15. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by small woody debris in all habitat types. Additionally, boulders contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Twenty-three of the 23 (100%) 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 90%. This is a relatively high percentage 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 88.8% and 84.2%, 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) Sequoia Creek should be managed as an anadromous, natural production stream.

2) A rusted out culvert should be evaluated to determine if it is a barrier or impediment to fish migration.

3) 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.

4) The limited water temperature data available suggest that maximum 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.

5) 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.

6) 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.

7) 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.

8) There are several log debris accumulations present on Sequoia Creek that are retaining fine sediment. The modification of these debris accumulations may be desirable, but must be done carefully over time to meter gravel to downstream spawning sites, yet avoid mobilization of fine sediment that could cause downstream siltatation.

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 Sonoma Creek. Channel type is B4.
295'	Log Debris Accumulation (LDA) 10'L x 22'W x 8'H, not a fish barrier.
400'	LDA 10'L x 25'W x 5'H.
425'	Unidentified young-of-the-year (YOY) observed in the unit.
691'	LDA 20'L x 30'W x 8'H.
711'	First 60' of the unit is under log debris from LDA of previous unit.
1253'	LDA 8'L x 20'W x 6'H is retaining fines. Flow is subsurface.
1321'	Unidentified YOY observed in the unit.
1400'	LDA 10'W x 20'L x 5'H is retaining fines. Flow is subsurface.
1427'	LDA 10'W x 15'L x 5'H.

1462' LDA 5'W x 20'L x 5'H.

1485' LDA 10'W x 30'L x 15'H.

1511' LDA is retaining fines and gravel with subsurface intermittent flow.

1895' 6' diameter culvert 50' into unit. Bottom and half of side walls are rusted out.

1964' Unidentified YOY observed in the unit. Last culvert.

2095' End of survey. Inaccessable due to brush.

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.

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

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, 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