STREAM INVENTORY REPORT

North Branch North Fork Navarro River

INTRODUCTION

A stream inventory was conducted during the summer of 1994 on North Branch North Fork Navarro River 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 North Branch North Fork Navarro River. 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.

There is no known record of spawning surveys having been conducted on North Branch North Fork Navarro River. 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.

WATERSHED OVERVIEW

North Branch North Fork Navarro River is tributary to the North Fork Navarro River, tributary to the Navarro River, located in Mendocino County, California (Figure 1). North Branch North Fork Navarro River's legal description at the confluence with the North Fork Navarro River is T15N R15W S07. Its location is 39°10'17" North latitude and 123°33'35" West longitude. North Branch North Fork Navarro River is a third order stream and has approximately 4.6 miles of blue line stream according to the USGS Navarro and Bailey Ridge 7.5 minute quadrangles. North Branch North Fork Navarro River and its tributaries drain a basin of approximately 27.3 square miles, and the system has a total of 30.5 miles of blue line stream. Summer base flow is intermittent. Elevations range from about 110 feet at the mouth of the creek to 1600 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed. The watershed is privately owned and is managed for timber production. Year round vehicle access exists via Masonite Road.

METHODS

The habitat inventory conducted in North Branch North Fork Navarro River 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 that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). North Branch North Fork Navarro River personnel were trained in June, 1994, by Gary Flosi and Scott Downie. This inventory was conducted by a two-person team.

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 North Branch North Fork Navarro River 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 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 taken and recorded at each tenth unit typed. The time of the measurement is also recorded. 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". North Branch North Fork Navarro River 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 North Branch North Fork Navarro River, 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 North Branch North Fork Navarro River, 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 and recorded as a one and two respectively.

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 North Branch North Fork Navarro River, 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 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 North Branch North Fork Navarro River, the dominant composition type and the dominant vegetation type of both the right and left banks 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. 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.

North Branch North Fork Navarro River

Biological inventory was conducted in North Branch North Fork Navarro River to document the fish species composition and distribution. One site was electrofished in North Branch North Fork Navarro River 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, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game (DFG). This program also processes and summarizes the data.

The Habitat program produces the following 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 North Branch North Fork Navarro River 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 4, 8, 9, 10, 11, and 15, 1994, was conducted by Chris Bysshe and Jeff Strayer (CCC). The survey began at the impoundment at Camp Navarro and extended up North Branch North Fork Navarro River to the confluence with John Smith Creek. The total length of the stream surveyed was 26,621 feet with an additional 396 feet of side channel.

North Branch North Fork Navarro River

Flow was intermittent during the survey period, and approximately 35% of the surveyed reach was dry.

North Branch North Fork Navarro River is a C4 channel type for the first 19203 feet surveyed then it changes to a F4 channel for the remainder of the survey. C4 channels are low gradient, meandering, point-bar riffle/pool, alluvial channels with broad, well defined floodplains with gravel channel. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios. F4 channels have gravel-dominant substrates.

Water temperatures ranged from 62 to 78 degrees Fahrenheit. Air temperatures ranged from 64 to 82 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, flatwater habitats made up 39%, pool types 29%, and riffles 19% (Graph 1). Flatwater habitat types made up 36% of the total survey **length**, pools 22%, and riffles 7% (Graph 2). Additionally, 35% of the reach surveyed was dry.

Nine Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were mid-channel pools, 28%; step runs, 20%; low gradient riffles, 19%; and runs, 18% (Graph 3). By percent total **length**, step runs made up 26%, mid-channel pools 20%, runs 9%, and low gradient riffles 6%.

Ninety pools were identified (Table 3). Main channel pools were most often encountered at 96% and comprised 93% 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. Twenty-eight of the 90 pools (31%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 87 pool tail-outs measured, 44 had a value of 1 (50.6%); 39 had a value of 2 (44.8%); 4 had a value of 3 (4.6%); and none had a value of 4 (0%). On this scale, a value of one is 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 types had the highest shelter rating at 84. Riffle types had the lowest rating with 60 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 97, main channel pools rated 84, and backwater pools 20 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Aquatic vegetation is the dominant cover type in North Branch North Fork Navarro River. Boulders are the next most common cover type. Graph 7 describes the pool cover in North Branch North Fork Navarro River.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 30 of the 59 low gradient riffles (51%). Small cobble was the next most frequently observed dominant substrate type and occurred in 46% of the low gradient riffles (Graph 8).

North Branch North Fork Navarro River

Thirty percent of North Branch North Fork Navarro River lacked shade canopy. Of the 70% of the stream that was covered with canopy, 42% was composed of deciduous trees, and 58% was composed of coniferous trees. Graph 9 describes the canopy in North Branch North Fork Navarro River.

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 63%. The mean percent left bank vegetated was 64%. The dominant elements composing the structure of the stream banks consisted of 4.5% bedrock, 0.3% boulder, 56.4% cobble/gravel, and 38.8% sand/silt/clay (Graph 10). Coniferous trees, including downed trees, logs, and root wads, were the dominant vegetation type observed in 50% of the units surveyed. Additionally, 40% of the units had deciduous trees as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on August 2, 1994, in North Branch North Fork Navarro River. The unit was sampled by Weldon Jones (DFG), Chris Bysshe and Jeff Strayer (CCC). All measurements are fork lengths unless noted otherwise.

The site sampled was habitat unit 13, a run, approximately 1000 feet from the impoundment at Camp Navarro. The site had an area of 2,310 sq ft, and a volume of 2,310 cu ft. The sample included 14 steelhead between 57 and 134 mm, four coho between 63 and 70 mm, eleven roach between 51 and 80 mm, and two prickly sculpin, 92 and 100 mm.

DISCUSSION

North Branch North Fork Navarro River is a C4 channel type for the first 19,213 feet surveyed then it changes to a F4 channel for the remainder of the survey. The C4 channel type is good for bank-placed boulders and log cover structures; and fair for low-stage weirs, single and opposing wing deflectors, and channel constrictors. The F4 channel type is considered good for bank-placed boulders; fair for low-stage weirs, single and opposing wing deflectors, channel constrictors, bank cover, and log cover structures; and poor for medium-stage weirs and random boulder placement.

The water temperatures recorded on the survey days August 4 through 15, 1994, ranged from 62 to 78° Fahrenheit. Air temperatures ranged from 64 to 82° Fahrenheit. If sustained, these warmer water temperatures are above the threshold stress level for salmonids. It is unknown if this thermal regime is typical. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 36% of the total **length** of this survey, riffles 7%, and pools 22%. The pools are relatively shallow with only 28 of the 90 pools having a maximum depth greater than 3 feet. In coastal coho and steelhead streams, it is generally desirable to have

primary pools comprise approximately 50% of total habitat. In third and fourth order streams a primary pool is defined to have a maximum depth of at least three 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 pool habitat is recommended for locations where their installation will not jeopardize unstable stream banks or subject the structures to high stream energy.

Forty-four of the 87 pool tail-outs measured had an embeddedness rating of 1. Only four had a 3 or 4 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead.

The mean shelter rating for pools was relatively high with a rating of 84. The shelter rating in the flatwater habitats was lower at 64. Riffles rated 60. A pool shelter rating of approximately 100 is desirable. The existing cover is being provided primarily by aquatic vegetation 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.

Fifty-seven of the 59 low gradient riffles had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the survey reach was 70%. This is a relatively high percentage of canopy, since 80 percent is generally considered desirable. However, elevated water temperatures could be reduced by increasing stream canopy. Cooler water temperatures are desirable in North Branch North Fork Navarro River. The large trees required to contribute shade to the wide channel typical of this reach would also eventually provide a long term source of large woody debris needed for instream structure.

The percentage of right and left bank covered with vegetation was moderate at 63% and 64%, 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) North Branch North Fork Navarro River should be managed as an anadromous, natural production stream.

2) Temperatures in this section of North Branch North Fork Navarro River, as well as upstream, should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

3) Increase the canopy on North Branch North Fork Navarro River 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.

4) Where feasible, increase woody cover in the pool and flatwater habitat units. Most of the existing cover is from aquatic vegetation. Adding high quality complexity with woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations. In some areas the material is at hand.

5) Where feasible, design and engineer pool enhancement structures to increase the number of pools and deepen the existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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'	Begin survey at upstream end of impoundment at Camp Navarro. Channel type is C4.
1012'	Steel bridge 20' x 50' x 25'.
9126'	Deer Creek enters left bank.
17252'	Dutch Henry Creek enters right bank.
19203'	Channel Changes to an F4.
20756'	Left bank bedrock cliff calving boulders into channel.
23250'	Left bank tributary. Only 50 feet of tributary is wetted.
25862'	Steel bridge 15' x 40' x 15'.
26621'	John Smith Creek enters right bank. End of survey. Remainder of stream is known as Little North Fork Navarro River and a report is available.

North Branch North Fork Navarro River

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