STREAM INVENTORY REPORT

Flynn Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Flynn 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 Flynn 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

Flynn Creek is tributary to the North Fork Navarro River, tributary to the Navarro River, located in Mendocino County, California (Map 1). Flynn Creek's legal description at the confluence with North Fork Navarro River is T15N R15W S13. Its location is 39°09′24″ north latitude and 123°27′59″ west longitude. Flynn Creek is a second order stream and has approximately 4.6 miles of blue line stream according to the USGS Baily Ridge 7.5 minute quadrangle. Flynn Creek drains a watershed of approximately 6.07 square miles. Elevations range from about 70 feet at the mouth of the creek to 400 feet in the headwater areas. Redwood/Douglas conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 128 to Flynn Creek Road.

METHODS

The habitat inventory conducted in Flynn 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 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 (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 Flynn 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". Flynn 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, 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 Flynn 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 Flynn 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 Flynn 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 Flynn 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.

Flynn Creek

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Flynn Creek fish presence was observed from the stream banks, and three 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 Flynn 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 June 5, 6, 7, 11, 12, 1996, was conducted by Craig Mesman (CCC), and Andrew MacMillan and Amber Sigler (WSP/AmeriCorps). The total length of the stream surveyed was 18,626 feet with an additional 351 feet of side channel.

Flow was measured 256 feet from the confluence with a Marsh-McBirney Model 2000 flowmeter at 1.9 cfs on June 5, 1996.

Flynn Creek

Flynn Creek is an F4 channel type for the first 11,000 feet surveyed, a F1 channel type for the next 3,261 feet then changes back to an F4 channel for the remaining 4,365 feet. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F1 channels are entrenched meandering riffle/pool channels on low gradients with a high width/depth ratio, and are very stable bedrock controlled channels.

Water temperatures taken during the survey period ranged from 53 to 59 degrees Fahrenheit. Air temperatures ranged from 58 to 82 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 20% riffle units, 31% flatwater units, 48% pool units, and 1% was dry (Graph 1). Based on total **length** of Level II habitat types there were 10% riffle units, 39% flatwater units, and 50% pool units (Graph 2).

Seventeen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were mid-channel pools, 38%; low gradient riffles, 18%; and runs, 12% (Graph 3). Based on percent total **length**, mid-channel pools made up 41%, step runs 17%, and glides 13%.

A total of 186 pools were identified (Table 3). Main channel pools were most frequently encountered at 81% and comprised 85% 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. One hundred and eight of the 186 pools (58%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 186 pool tail-outs measured, 11 had a value of 1 (6%); 91 had a value of 2 (49%); 36 had a value of 3 (19%); none had a value of 4; and 26 had a value of 5 (26%) (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. Flatwater habitat types had a mean shelter rating of 17, and pool habitats had a mean shelter rating of 39 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 65. Main channel pools had a mean shelter rating of 41 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Undercut banks, small woody debris and terrestrial vegetation are the dominant cover types in Flynn Creek. Large woody debris is lacking in nearly all habitat types. Graph 7 describes the pool cover in Flynn Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 5 of the 8 low gradient riffles measured (63%). One unit each of silt/clay, sand, and bedrock were the dominant substrate type observed in the other three low gradient riffles (Graph 8).

Flynn Creek

The mean percent canopy density for the stream reach surveyed was 88%. The mean percentages of deciduous and coniferous trees were 26% and 74%, respectively. Graph 9 describes the canopy in Flynn Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 66.3%. The mean percent left bank vegetated was 60.0%. The dominant elements composing the structure of the stream banks consisted of 10.78% bedrock, 0.98% boulder, 31.37% cobble/gravel, and 56.86% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type, observed in 56.86% of the units surveyed, including down trees, logs, and root wads. Additionally, 21.57% of the units surveyed had coniferous trees as the dominant vegetation type, and 19.61% had brush as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on July 3 and 12, 1996, in Flynn Creek. The sites were sampled by Craig Messman, Chris Coyle and David Jones (CCC), and Andrew MacMillan (WSP/AmeriCorps).

The first site sampled included habitat units 53 through 57, a mid-channel pool, run, low gradient riffle, mid-channel pool, lateral scour pool - root wad enhanced, approximately 3,041 feet from the confluence with North Fork Navarro River. The site yielded five steelhead, two coho, three roach, one sculpin and one stickleback.

The second site included habitat units 249 through 252, a mid-channel pool, mid-channel pool, run located approximately 14,058 feet above the creek mouth. The site yielded two steelhead, 13 coho, two sculpin, one stickleback, and two Pacific giant salamanders.

The third site sampled included habitat units 279 through 286, a plunge pool, mid-channel pool, mid-channel pool, step run, mid-channel pool, run, mid-channel pool, low gradient riffle located approximately 15,625 feet above the creek mouth. The site yielded seven steelhead, 11 coho, 17 sculpin and one stickleback.

DISCUSSION

Flynn Creek is a F4 channel type for the first 11,000 feet of stream surveyed, a F1 channel type for the next 3,261 feet and a F4 for the remaining 4,365 feet. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank placed boulders, fair for low staged weirs, single and opposing wing deflectors, channel constrictors and log cover and poor for medium staged weirs and boulder clusters. The suitability of F1 channel types are good for bank placed boulders, fair for single wing deflectors and log cover and poor for low and medium stage weirs, boulder clusters, and opposing wing deflectors.

The water temperatures recorded on the survey days June 5 through 12, 1996, ranged from 53 to 59 degrees Fahrenheit. Air temperatures ranged from 58 to 82 degrees Fahrenheit. This is a

good water temperature range for salmonids. 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 39% of the total **length** of this survey, riffles 10%, and pools 50%. The pools are relatively deep, with 108 of the 186 (58%) 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.

Forty-five of the 186 pool tail-outs measured had embeddedness ratings of 3, 4 or 5. Only 11 had a 1 rating. 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 Flynn 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 39. The shelter rating in the flatwater habitats was slightly lower at 17. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by undercut banks, small woody debris and terrestrial vegetation in all habitat types. 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.

Five of the 8 low gradient riffles measured had gravel as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 88%. 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 66.3% and 60.0%, 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) Flynn Creek should be managed as an anadromous, natural production stream.

2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from undercut banks, small woody debris and terrestrial vegetation. Adding high quality complexity with woody cover is desirable.

3) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish a more complete and meaningful temperature regime, Louisiana-Pacific Corp has conducted 24-hour monitoring during the July and August temperature extreme period. This should be continued for a continuous 3 to 5 year period.

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'	Begin survey at confluence with North Fork Navarro River. Channel type is F4.
256'	Highway 256 bridge.
2,040'	Tributary enters from the right bank, dry.
2,245'	Old railroad trestle causing constriction.
3,563'	Log debris accumulation (LDA), 27' long x 15' wide x 4' high. Not a barrier to anadromous fish.
5,598'	Tributary enters from the right bank, dry.
6,622'	LDA, 15' long x 30' wide x 4' high. Not a barrier a anadromous fish.
7,839'	Tributary enters from the right bank.
9,605'	Tributary enters from the left bank.
10,005'	Tributary enters from the right bank.
11,000'	Channel type changes to an F1.
11,634’	Tributary enters from the right bank. Flow estimated at 0.2 cfs. There is a five foot high bedrock cascade at the confluence. No fish observed.
12,227'	LDA, 15' long x 22' wide x 4' high. Not a barrier to anadromous fish.
12,743'	Tributary enters from the left bank, Onion Patch Gulch. The confluence is a high gradient bedrock cascade. Trickle of a flow.

Flynn Creek

13,649' Tributary enters from the right bank, Camp 16 Gulch.

13,958' Old railroad bridge timbers on both banks.

14,090' LDA, 8' long x 20' wide x 5' high, retaining sediment 2 feet high.

14,261' Channel type changes to an F4.

14,777' LDA, 12' long x 14' wide x6' high. Not a barrier to anadromous fish.

15,423' LDA, 20' long x 14' wide x 4' high. Not a barrier to anadromous fish.

15,939' LDA, 14' long x 20' wide x 4' high. Not a barrier to anadromous fish.

16,650' LDA, 25' long x 15' wide x 3' high. Not a barrier to anadromous fish.

16,805' LDA, 35' long x 30' wide x 5' high. Not a barrier to anadromous fish.

18,626' End of Survey due to lack of access through a small landowners property. Not the end of the anadromous reach. Tank 4 Gulch enters from the right bank.

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

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