NORTH COAST WATERSHED PLANNING and COORDINATION PROJECT

The North Coast Watershed Planning and Coordination Project (NCWPCP), formerly the 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 intends to achieve a doubling of the population of salmon and steelhead by the year 2000. The project is supported by the Sport Fish Restoraion Act, which uses sport fishermen's funds to improve sport fisheries.

The NCWPCP conducts stream and habitat inventories according to the standart methodologies discussed in the *California Salmonid stream Habitat Restoration Manual,* (Flosi et.al., 1998). Biological sampling is conducted using electrofishbing and direct observation to determine species presence and distribution; selected streams are electrofished for population estimates. Some streams are also sampled for sediment composition. Collected information is used for base-line data, public cooperation development, restoraion 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 the North Fork Eel rivers have been inventoried since 1991. Initial field inventory of the Eel River system should be essentially complete in 1996. NCWPCP personnel have also worked in cooperation with the DFG Salmon Restoration Project's staff to inventory streams on the Mattole River, Mendocino Coast, and Humboldt Bay.

STREAM INVENTORY REPORT

Harrow Creek, **Mattole River**

INTRODUCTION

A stream inventory was conducted during the summer of 1998 on Harrow 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 Harrow 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

Harrow Creek is tributary to the Mattole River, located in Humboldt County, California (Map 1). Harrow Creek's legal description at the confluence with Mattole River is T3S R1E S25. Its location is 40°10′35″ north latitude and 124°01′15″ west longitude. Harrow Creek is a first order stream and has approximately 2.8 miles of intermittent stream according to the USGS Honeydew 7.5 minute quadrangle. Harrow Creek drains a watershed of approximately 1.0 square miles. Elevations range from about 520 feet at the mouth of the creek to 1140 feet in the headwater areas. Douglas fir, oak, and mixed hardwood forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production and rangeland. Vehicle access exists from Etterburg via Wilder Ridge Road.

METHODS

The habitat inventory conducted in Harrow 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

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 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 Harrow 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:

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". Harrow 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 Harrow 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 Harrow 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 Harrow 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 Harrow 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 Harrow Creek fish presence was observed from the stream banks, and sites were electrofished using a Smith-Root Model 12 electrofisher. 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:

- 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 Harrow 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 September 2, 1998, was conducted by Paul Retherford and Jaret Lester (AmeriCorps/WSP). The total length of the stream surveyed was 1,222 feet with an additional 0 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.02 cfs on September 2, 1998.

Harrow Creek is an B3 channel type for the entire 1,222 feet of stream reach surveyed. B3 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools; very stable plan and profile; stable banks; cobble channel.

Water temperatures taken during the survey period ranged from 60°- 64° F. Air temperatures ranged from 68°- 76° F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 23% riffle units, 33% flatwater units, and 38% pool units (Graph 1). Based on total length of Level II habitat types there were 14% riffle units, 48% flatwater units, and 30% pool units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 20%; step runs, 20%; and mid-channel pools, 18% (Graph 3). Based on percent total length, step runs made up 39%, lateral scour pools (bedrock formed), 14%, and low gradient riffles, 13%.

A total of 15 pools were identified (Table 3). Scour pools were most frequently encountered at 53% and comprised 55% 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. 8 of the 15 pools (53%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 15 pool tail-outs measured, two had a value of 1 (13.3%); one had a value of 2 (6.7%); four had a value of 3 (26.7%); four had a value of 4 (26.7%) and four had a value of 5 (26.7%) (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 5, flatwater habitat types had a mean shelter rating of 18, and pool habitats had a mean shelter rating of 35 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 39. Main channel pools had a mean shelter rating of 15 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Harrow Creek and are extensive. Large and small woody debris are absent all habitat types. Graph 7 describes the pool cover in Harrow Creek.

Table 6 summarizes the dominant substrate in pool habitat types. Small cobble was the dominant substrate observed in 5 of the 15 pool tail outs measured (33.3%). Gravel was the next most frequently observed dominant substrate type and occurred in 20 % of the pool tail outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 99%. The mean percentages of conifer and deciduous trees were 3% and 97%, respectively. Graph 9 describes the canopy in Harrow Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 42.5%. The mean percent left bank vegetated was 47.5%. The dominant elements composing the structure of the stream banks consisted of 40% bedrock, 0% boulder, 45% cobble/gravel, and 15% sand/silt/clay (Graph 10). Deciduous trees are the dominant bank vegetation type observed in 40% of the units surveyed. Additionally, 40% of the units surveyed had deciduous trees as the dominant bank vegetation, and 0% had coniferous trees as the dominant bank vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished on September 2, 1998 in Harrow Creek. The sites were sampled by Jaret Lester and Paul Retheford (CDFG and AmeriCorps).

The site sampled included habitat units 003 - 005, approximately 41 feet from the confluence with the Mattole River. This site had an area of 780 sq ft and a volume of 266.5 cu ft. The site yielded 10 young of the year steelhead.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Harrow Creek.

DISCUSSION

Harrow Creek is a B3 channel type for the entire 1,222 feet of stream surveyed. The suitability of B3 channel types for fish habitat improvement structures is excellent for plunge weirs; boulder clusters and bank placed boulder; single and opposing wing-deflectors; log cover.

The water temperatures recorded on the survey day September 2, 1998, ranged from 60°- 64° F. Air temperatures ranged from 68°- 76° F. This is a good water temperature range for salmonids. Although Harrow Creek seems to have temperatures favorable to salmonids, 64° F, if sustained, is near the threshold stress level 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 33% of the total length of this survey, riffles 23%, and pools 38%. The pools are relatively deep, with eight of the 15 (53%) 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. 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 any needed modification of the log debris accumulations (LDA's) in the stream. Some of the LDA's in the system are 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.

Two of the 15 pool tail-outs measured had an embeddedness rating of 1. Eight of the pool tail-outs had embeddedness ratings of 3 or 4. Four of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. All four of these pool tail-outs were unsuitable for spawning due to the dominant substrate being too large 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 Harrow 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 35. The shelter rating in the flatwater habitats was slightly lower at 18. A pool shelter rating of approximately 100 is desirable. The poor amount of cover that now exists is being provided primarily by boulders in all habitat types. Log and root wad cover structures in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Instream cover created by small and large woody debris provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Eight of the 15 pool tail outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. However the other seven pool tail-outs measured all had dominant substrates that were too large to be suitable for spawning salmonids.

The mean percent canopy density for the stream was 99%. This is a very high percentage of canopy. In general, revegetation projects are considered in reaches where canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 42.5% and 47.5%, 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)   Harrow Creek should be managed as an anadromous, natural production stream.

2)   Suitable size spawning substrate on Harrow Creek is limited to relatively few reaches.
        Projects should be designed at suitable sites to trap and sort spawning gravel.

3)   There are two log debris accumulations present on Harrow Creek that are retaining
        gravel. The modification of these debris accumulations may be desirable, but must be
        done carefully, over time, to meter gravel to downstream spawning sites.

4)   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.

5)   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.

6)   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.

7)   Primary pools comprise only 20% of the total stream length. 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.

8)   Increase the bank vegetation on Harrow Creek by planting willow, alder, redwood, and
        Douglas fir along the stream where bank vegetation 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'   This survey begins at the confluence of Harrow Creek and the Mattole River. The channel type is a B3.

41'   Young of the year salmonids observed in this unit.

352'   A tributary enters from the right bank.

486'   A dry steep tributary enters from the right bank.

606'   Erosion on the right bank is 25' long, 30' wide, and 50' high.

811'   A log debris accumulation 5' long, 45' wide, and 6' high is retaining gravel.

836'   Water flows subsurface.

857'   There is a 3' jump at the top of this pool. Young of the year salmonids observed in this unit.

1144'   Young of the year were observed in this unit.

1176'   A log debris accumulation 6' long, 12' wide, and 6' high is retaining gravel 4' deep.

1222'   End of survey. The survey was ended at a 20' bedrock waterfall with a 4' deep jump pool. There is no end of survey flag.

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