STREAM INVENTORY REPORT

ARNOLD CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Arnold Creek 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 Arnold Creek. 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 adult spawning surveys having been conducted on Arnold 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.

WATERSHED OVERVIEW

Arnold Creek is tributary to Larabee Creek, tributary to the Eel River, located in Humboldt County, California (Figure 1). Arnold Creek's legal description at the confluence with Larabee Creek is T1S R3E S05. Its location is 40°24'22" N. latitude and 123°51'39" W. longitude. Arnold Creek is a first order stream and has approximately 1.1 miles of blue line stream, according to the USGS Bridgeville 7.5 minute quadrangle. Arnold Creek drains a watershed of approximately 0.8 square miles. Elevations range from about 320 feet at the mouth of the creek to 2,500 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed. The watershed is owned by the Pacific Lumber Company and is managed for timber production. Year round vehicle access exists from U.S. Highway 101, just south of Scotia, via Shively Road.

METHODS

The habitat inventory conducted in Arnold Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1991). The contract seasonal Technical Advisors that conducted the inventory were

trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Arnold Creek personnel were trained in May and June, 1992, 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 Arnold 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. Flows should also be measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed by David Rosgen (1985). 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 four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.
3. Temperatures:

Both water and air temperatures are taken and recorded at each tenth unit typed. The time of the measurement is also recorded. Both temperatures are taken in 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". Arnold 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. Unit measurements included mean length, mean

width, mean depth, and maximum depth. Depth of the pool tail crest at each pool habitat unit was measured at 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 Arnold 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), 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 Arnold 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 habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes.

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 Arnold Creek, 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:

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 Arnold Creek, the dominant composition type in both the right and left banks was selected from a list of eight options on 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.

Biological inventory was conducted in Arnold Creek to document the fish species composition and distribution. Two sites were electrofished in Arnold Creek using one Smith Root Model 12 electrofisher. Each site was end-blocked with nets to contain the fish within the sample reach. Fish from each site were counted by species, measured, and returned to the stream.

DATA ANALYSIS

Data from the habitat inventory form are entered into Runtime, a dBASE 4.1 data entry program developed by the Department of Fish and Game. This program processes and summarizes the data.

The Runtime program produces the following summary 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 Arnold 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

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of June 26, 1992, was conducted by Aaron Nadig and Russ Irvin (contract seasonals). The total length of the stream surveyed was 1,248 feet, with an additional 28 feet of side channel.

Flow was not measured in Arnold Creek.

Arnold Creek is an A2 channel type for the entire 1,248 feet of stream reach surveyed. A2 channels are steep (4-10% gradient), very well confined streams, with stable stream banks.

Water temperatures ranged from 57 to 59 degrees fahrenheit. Air temperatures ranged from 67 to 69 degrees fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, riffles made up 51.7%, pools 27.6%, and flatwater 20.7% (Graph 1). Riffle habitats made up 64.6% of the total survey **length**, flatwater 21.0%, and pools 14.4% (Graph 2).

Six Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were high gradient riffles, 41.4%; and step pools, 17.2% (Graph 3). By percent total **length**, high gradient riffles made up 50.8%, and low gradient riffles made up 13.8% (Table 2).

Eight pools were identified (Table 3). All 8 of these pools were main channel pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Seven of the 8 pools (87.5%) had a depth of less than two feet (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 8 pool tail-outs measured, zero had a value of 1; 1 had a value of 2 (12.5%); 7 had a value of 3 (87.5%); and zero had a value of 4. On this scale, a value of one is the 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. Riffle habitat types had the

highest shelter rating at 157.0. Pool habitats followed with a rating of 69.4 (Table 1).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Arnold Creek and are extensive. Small woody debris is the next most common cover type. Graph 7 describes the pool cover in Arnold Creek.

Table 6 summarizes the dominant substrate by habitat type. There were only three low gradient riffles in the survey reach. Two of these had boulder, and one had gravel as the dominant substrate (Graph 8).

Ninety-nine percent of the survey reach was covered with canopy. This canopy was composed of 83% deciduous trees, and 17% coniferous trees. Graph 9 describes the canopy in Arnold Creek.

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 41.4%. The mean percent left bank vegetated was 41.2%. The dominant elements composing the structure of the stream banks consisted of 22.8% boulder, 8.7% bare soil, 54.4% grass. Additionally, 14.0% of the banks were covered with deciduous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Two electrofishing sites were sampled on Arnold Creek. The objective was to identify fish species and distribution. The units were sampled on July 1, 1992, by Brian Humphrey and Erick Elliot (CCC). Each unit was end-blocked with nets to contain the fish within the sample reach. Three passes were conducted at each site, fork lengths (FL) measured and recorded, and the fish returned to the stream.

The first site sampled was habitat unit 002, a run, approximately 155 feet from the confluence with the Eel River. This site had an area of 294.0 sq ft, and a volume of 117.6 cu ft. No fish were found.

The second site was habitat unit 020, a step pool, located beneath a log bridge crossing, approximately 870 feet above the creek mouth. This site had an area of 210.9 sq ft, and a volume of 168.7 cu ft. No fish were found.

DISCUSSION

The A2 channel type is generally not suitable for fish habitat improvement structures. A2 channels are found in high energy, steep gradient stream reaches. They have channels dominated by boulders, do not retain gravels very well, but do have stable stream banks. Usually within the A2 channel there are zones of lower gradient where structures designed to trap gravels can be constructed. This seems to be the case in Arnold Creek, but any structure sites must be selected with care because of the high stream energy which can create problems with stream bank erosion and structure stability.

The water temperatures recorded on the survey days June 26, 1992 ranged from 57° F to 59° F. Air temperatures ranged from 67° F to 69° F. This is a very good water temperature regime for salmonids. However, to make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling conducted.

Riffle habitats comprised 64.6% of the total **length** of this survey, flatwater 21.0%, and pools 14.4%. The pools are relatively shallow with only one of the eight pools having a maximum depth greater than two feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total 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. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Seven of the 8 pool tail-outs measured had embeddedness ratings of 3 or 4. Zero had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Arnold Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was relatively high with a rating of 69.4. The shelter rating in the flatwater habitats was lower at 57.5. However, a pool shelter rating of approximately 100 is desirable. The cover that now exists is being provided primarily by boulders in all habitat types. Additionally, small woody debris contributes a small amount.

There were only three low gradient riffles in the survey reach. Two of these had boulder as the dominant substrate. This is generally considered poor for spawning salmonids.

The mean percent canopy for the stream was 99%. This is a very high percentage of canopy, since 80 percent is generally considered optimum in these north coast streams.

RECOMMENDATIONS

1) Arnold Creek should be managed as an anadromous, natural production stream.

2) Due to the high gradient of the stream, access for migrating salmonids is an ongoing potential problem. No fish were found during the electrofishing conducted in July 1992. At the confluence of Arnold Creek and Larabee Creek is a boulder cascade that may impede fish passage during low flow years. Fish passage should be monitored, and improved where possible.

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.

0'	Begin survey at confluence with the Eel River. Channel type is an A2 for the entire survey reach.
242'	Right bank erosion 9' high x 50' long.
775'	Right bank erosion 40' high x 95' long, contributing gravel, fines, and small woody debris into the channel.
870'	Vehicle bridge crosses the stream.
974'	Left bank erosion 16' high x 79' long, contributing fines and gravel into the channel.
1248'	End of survey. Gradient steepens. No fish seen during the entire survey.