**CALIFORNIA DEPARTMENT OF FISH AND GAME**

**STREAM INVENTORY REPORT**

**Warden Creek**

## INTRODUCTION

A stream inventory was conducted during the summer of 1992 on Warden 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 Warden 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 Warden 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

Warden Creek is a tributary to Sproul Creek, tributary to the South Fork Eel, tributary to the Eel River, which drains to the Pacific Ocean. It is located in Humboldt County, California. Warden Creek's legal description at the confluence with Sproul Creek is T05S R03E S05. Its location is 40.7217 degrees north latitude and 123.8514 degrees west longitude. Warden Creek is a first order stream and has approximately 1.9 miles of blue line stream, according to the USGS Garberville 7.5 minute quadrangle. Warden Creek drains a watershed of approximately 1.2 square miles. Elevations range from about 480 feet at the mouth of the creek to 1600 feet in the headwater areas. Grass, oak and Douglas fir forest dominate the watershed. The watershed is privately owned and is managed for timber production.

## METHODS

The habitat inventory conducted in Warden Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991). 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). Warden Creek personnel were trained in May, 1992 by G. Flosi and S. 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 Warden Creek to record measurements and observations. There are nine components to the inventory form. For specific information on the methods used see the Sproul Creek report.

## 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 Warden Creek to document the fish species composition and distribution. Two sites were electrofished in Warden 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 Habitat Runtime, a dBASE 4.1 data entry program developed by the 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 Lotus 1,2,3. Graphics developed for Warden 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 October 6, 1992 was conducted by C. Coyle and J. Crittenden (CCC and contract seasonal). The total length of the stream surveyed was 2,017 feet.

Flows were not measured on Warden Creek.

Warden Creek is a B3 channel type for 1,441 feet (Reach 1) and an A2 for the remaining 576 feet of stream reach surveyed (Reach 2). B3 channels are moderate gradients, moderately entrenched, with stable banks. A2 channels are steep (4-10% gradient), very well confined streams, with stable stream banks.

Water temperatures ranged from 51 to 56 degrees Fahrenheit. Air temperatures ranged from 57 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent occurrence, pools made up 36%, riffles 34%, and flatwater types 18% (Graph 1). Riffle habitat types made up 42% of the total survey length, pools 19%, and flatwater 13% (Graph 2).

Eight 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, 26%; high gradient riffles, 20%; and low gradient riffles, 14% (Graph 3). By percent total length, high gradient riffles made up 22%, low gradient riffles 21%, and mid-channel pools 14%.

Eighteen pools were identified (Table 3). Main-channel pools were most often encountered at 78%, and comprised 81% 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. One of the 18 pools (6%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 17 pool tail-outs measured, four had a value of 2 (24%); 10 had a value of 3 (59%); and three had a value of 4 (18%). 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 79. Pool habitats followed with a rating of 39 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 49. Main-channel pools had a mean shelter rating of 36 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Warden Creek and are extensive. Graph 7 describes the pool cover in Warden Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in six of the seven low gradient riffles (86%). Large cobble was the next most frequently observed dominant substrate type, and occurred in 14% of the low gradient riffles (Graph 8).

Twenty-one percent of the survey reach lacked shade canopy. Of the 79% of the stream covered with canopy, 63% was composed of hardwood trees, and 37% was composed of coniferous trees. Graph 9 describes the canopy in Warden 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 68%. The mean percent left bank vegetated was 74%. The dominant elements composing the structure of the stream banks consisted of 3% bedrock, 17% boulder, 2% cobble/gravel, 14% bare soil, 19% grass, and 11% brush. Additionally, 16% of the banks were covered with hardwood trees, and 18% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

## BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on October 7, 1992 in Warden Creek. The units were sampled by C. Coyle and J. Crittenden (CCC and contract seasonal). All measurements are fork lengths unless noted otherwise.

The first site sampled was Habitat Units #002 through #006, a mid-channel pool, low gradient riffle, run, low gradient riffle and a second mid-channel pool, located approximately 237 feet above the creek mouth and interrupted by a culvert: Habitat Unit #003. This site had an area of 835 square feet, and a volume of 464 cubic feet. Two steelhead were sampled, measuring 56 and 49mm.

The second site sampled was Habitat Unit #035, a mid-channel pool, approximately 1,553 feet from the confluence with Sproul Creek. This site had an area of 238 square feet, and a volume of 214 cubic feet. The unit yielded 13 steelhead, ranging from 47 to 153mm.

## DISCUSSION

The B3 channel types are excellent for low stage weirs, boulder clusters and bank-placed boulders, and log cover. It is also good for medium stage plunge weirs. 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 Warden 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 October 6, 1992 ranged from 51 to 56 degrees Fahrenheit. Air temperatures ranged from 57 to 70 degrees Fahrenheit. This is a suitable water temperature regime for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 13% of the total length of this survey, riffles 42%, and pools 19%. One of the 18 pools had 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. 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.

Thirteen of the 17 pool tail-outs measured had embeddedness ratings of 3 or 4. None had a 1 rating. On this scale, a value of one is the best for fisheries. In Warden 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 low with a rating of 39. The shelter rating in the flatwater habitats was lower at 14. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulders in all habitat types. Log and root was cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

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

The mean percent canopy for the stream was 79%. Eighty percent canopy cover is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

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

2) 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.

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) Due to the high gradient of the stream, access for migrating salmonids is an ongoing potential problem. Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish. Fish passage should be monitored, and improved where possible.

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 boulders. Adding high quality complexity with woody cover is desirable and in some areas the material is at hand.

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 confluence with Sproul Creek. |
| 237' | Flow estimated 1-2 gallons per/minute. Culvert measures 7' diameter x 42' long and has no baffles. |
| 279' | Left bank erosion site measures 4' high x 100'long. |
| 546' | Right bank erosion site measures 12' high x 30' long and is contributing fines and gravel to the channel. |
| 572' | Right bank erosion site measures 8' high x 75' long and is contributing fines to the channel. |
| 738' | Left bank erosion site measures 7' high x 25' long and is contributing fines to the channel. |
| 1238' | Tributary enters from right bank. |
| 1441' | Left bank erosion site measures 20' high x 40' long and is contributing fines to the channel. |
| 1519' | Right bank erosion site measures 7' high x 35' long and is contributing fines to the channel. Right bank overflow channel. |
| 1601' | Left and right bank erosion sites measure 6' high and are contributing fines to the channel. |
| 1629' | Right bank erosion site measures 10' high x 40' long and is contributing fines to the channel. |
| 1648' | Left bank erosion site measures 20' high x 50' long and is contributing fines to the channel. |
| 1749' | Left bank slide measures 30' high x 40' long and is contributing gravel to the channel. |
| 1814' | Left bank erosion site measures 20' high x 20' long and is contributing fines to the channel. |
| 2017' | Begin very steep boulder, cascade reach. Gradient increases to 45%. End of survey. |

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 |