STREAM INVENTORY REPORT

Panther Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2001 on Panther Creek. The survey began at the confluence with Redwood Creek and extended upstream 2.7 miles.

The Panther Creek 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 Panther 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

Panther Creek is a tributary to Redwood Creek, a tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Panther Creek's legal description at the confluence with Redwood Creek is T08N R02E S14. Its location is 41°05′19.6″ north latitude and 123°54′25.72″ west longitude. Panther Creek is a second order stream and has approximately 5.27 miles of blue line stream according to the USGS Panther Creek 7.5 minute quadrangle. Panther Creek drains a watershed of approximately 5.98 square miles. Elevations range from about 610 feet at the mouth of the creek to 2,400 feet in the headwater areas. Redwood/Douglas fir and mixed hardwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists from Korbel, through a locked gate, and via the K&K Road to the mouth of Panther Creek.

METHODS

The habitat inventory conducted in Panther Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Department of Fish and Game Scientific Aides 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. 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 (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are 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 Panther 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 a Marsh-McBirney Model 2000 flow meter.

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. Channel characteristics are measured using a hand level, hip chain, tape measure, and a stadia rod.

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". Panther 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. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Panther 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, bedrock, 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 Panther 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 Panther 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 Panther 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 (including downed trees, logs, and rootwads) was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Panther Creek. In addition, thirty-nine 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 Panther 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
- Mean 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 June 13 through July 18, 2001, was conducted by Jennifer Aspittle and Janet Lester (DFG). The total length of the stream surveyed was 14,504 feet with an additional 997 feet of side channel.

Stream flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 2.05 cfs on July 2, 2001.

Panther Creek is an F4 channel type for the first 2,516 feet of the stream surveyed, an F2 channel type for the next 2,812 feet, a B4 for 7,319 feet and an F2 for the remaining 1,857 feet surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F2 channels are entrenched meandering riffle/pool channel on low gradients with high width/depth ratio and boulder dominant substrates. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel dominate substrates.

Water temperatures taken during the survey period ranged from 52 to 57 degrees Fahrenheit. Air temperatures ranged from 57 to 67 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 35% riffle units, 17% flatwater units, and 46% pool units (Graph 1). Based on total **length** of Level II habitat types there were 37% riffle units, 28% flatwater units, and 33% pool units (Graph 2).

Sixteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffles, 27%; mid-channel pools, 25%; and plunge pool, 10% (Graph 3). Based on percent total **length**, low gradient riffles made up 29%, step run, 15%, and mid-channel pool at 14%.

A total of 142 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 65% , and comprised 77% 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. Seventy-one of the 142 pools (50%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 142 pool tail-outs measured, 20 had a value of 1 (14.0%); 38 had a value of 2 (27.0%); 27 had a value of 3 (19.0%); 28 had a value of 4 (20.0%); and 29 had a value of 5 (20.0%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. The breakdown of dominant substrate composition for the 29 pool tail-outs that had a embeddedness value of 5 were as follows: 72%

boulder, 17% silt/clay/sand, and 3% bedrock.

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 63, flatwater habitat types had a mean shelter rating of 17, and pool habitats had a mean shelter rating of 52 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 119. Scour pools had a mean shelter rating of 62 and main channel pools had a mean shelter rating of 43. (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Panther Creek. Graph 7 describes the pool cover in Panther Creek. Boulders are the dominant pool cover type followed by large woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 67% of pool tail-outs while boulders were the next most frequently observed substrate type, at 15%.

The mean percent canopy density for the surveyed length of Panther Creek was 98%. The mean percentages of deciduous and coniferous trees were 65% and 35%, respectively. Graph 9 describes the mean percent canopy in Panther Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 94.7%. The mean percent left bank vegetated was 95.3%. The dominant elements composing the structure of the stream banks consisted of 35.2% boulder, 31.4% cobble/gravel, 19.3% sand/silt/clay, and 14.1% bedrock (Graph 10). Deciduous trees were the dominant vegetation type observed in 58.6% of the units surveyed. Additionally, 40.0% of the units surveyed had coniferous trees as the dominant vegetation type, and 0.69% had brush as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Thirty-nine habitat units were electrofished for species composition and distribution in Panther Creek on August 8 - 22, 2001. Water temperatures taken during the electrofishing period ranged from 57 to 61 degrees Fahrenheit. Air temperatures ranged from 59 to 64 degrees Fahrenheit. The sites were sampled by Trevor Tollefson (DFG), Devin Best and Justin Martin (WSP/AmeriCorps).

The first site sampled was habitat unit 010, a plunge pool located approximately 482 feet from the confluence with Redwood Creek. The site yielded 20 young-of-the-year steelhead, 2 age one-plus steelhead and 1 age two-plus steelhead.

The second site was habitat unit 011, a mid-channel pool located approximately 521 feet above the creek mouth. The site yielded 12 young-of-the-year steelhead, 4 age one-plus steelhead, and 1 age three-plus steelhead.

The third site sampled was habitat unit 015, a mid-channel pool located approximately 740 feet above the creek mouth. The site yielded 6 young-of-the-year steelhead and 5 age one-plus steelhead.

The fourth site sampled was habitat unit 022, a mid-channel pool located approximately 1,273 feet above the creek mouth. The site yielded 9 young-of-the-year steelhead, 6 age one-plus steelhead and 1 age two-plus steelhead.

The fifth site sampled was habitat unit 026, a mid-channel pool located approximately 1,427 feet above the creek mouth. The site yielded 11 young-of-the-year steelhead, 1 age one-plus steelhead and 1 age two-plus steelhead.

The sixth site sampled was habitat unit 037, a mid-channel pool located approximately 1,756 feet above the creek mouth. The site yielded 4 young-of-the-year steelhead and 5 age one-plus steelhead.

The seventh site sampled was habitat unit 038, a plunge pool located approximately 1,785 feet above the creek mouth. The site yielded 2 young-of-the-year steelhead and 2 age one-plus steelhead.

The eighth site sampled was habitat unit 040, a plunge pool located approximately 1,918 feet above the creek mouth. The site yielded 7 young-of-the-year steelhead and 3 age one-plus steelhead.

The ninth site sampled was habitat unit 043, a plunge pool located approximately 2,163 feet above the creek mouth. The site yielded 12 young-of-the-year steelhead and 3 age one-plus steelhead.

The tenth site sampled was habitat unit 047, a plunge pool located approximately 2,470 feet above the creek mouth. The site yielded 8 young-of-the-year steelhead and 4 age one-plus steelhead.

The eleventh site sampled was habitat unit 054, a lateral scour pool - boulder formed located approximately 2,709 feet above the creek mouth. The site yielded 4 young-of-the-year steelhead and 3 age one-plus steelhead.

The twelfth site sampled was habitat unit 059, a mid-channel pool located approximately 2,971 feet above the creek mouth. The site yielded 16 young-of-the-year steelhead, 4 age one-plus steelhead, 1 age two-plus steelhead and 1 age three-plus steelhead.

The thirteenth site sampled was habitat unit 064, a plunge pool located approximately 3,209 feet above the creek mouth. The site yielded 2 young-of-the-year steelhead and 1 age one-plus steelhead.

The fourteenth site sampled was habitat unit 073, a plunge pool located approximately 3,647 feet

above the creek mouth. The site did not yield fish.

The fifteenth site sampled was habitat unit 074, a mid-channel pool located approximately 3,686 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead and 1 age one-plus steelhead.

The sixteenth site sampled was habitat unit 089, a mid-channel pool located approximately 4,203 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead and 1 age one-plus steelhead.

The seventeenth site sampled was habitat unit 095, a mid-channel pool located approximately 4,375 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead, 2 age one-plus steelhead and 1 age two-plus steelhead.

The eighteenth site sampled was habitat unit 105, a mid-channel pool located approximately 4,735 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead and 1 age two-plus steelhead.

The nineteenth site sampled was habitat unit 116, a mid-channel pool approximately 5,133 feet above the creek mouth. The site did not yield fish.

The twentieth site sampled was habitat unit 117, a mid-channel pool located approximately 5,180 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead, 1 age one-plus steelhead, 1 age two-plus steelhead, and 1 age two-plus cutthroat.

The twenty-first site sampled was habitat unit 133, a step pool located approximately 6,072 feet above the creek mouth. The site yielded 1 age two-plus cutthroat.

The twenty-second site sampled was habitat unit 140, a mid-channel pool located approximately 6,870 feet above the creek mouth. The site yielded 3 young-of-the-year steelhead, 1 age one-plus cutthroat and 1 age two-plus cutthroat.

The twenty-third site sample was habitat unit 164, a mid-channel pool located approximately 8,141 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead, 3 age one-plus steelhead, and 2 age one-plus cutthroat.

The twenty-fourth site sample was habitat unit 194, a plunge pool located approximately 9,716 feet above the creek mouth. The site did not yield fish.

The twenty-fifth site sampled was habitat unit 197, a step pool approximately located 9,931 feet above the creek mouth. The site yielded 1 age one-plus steelhead.

The twenty-sixth site sampled was habitat unit 213, a plunge pool located approximately 11,011 feet above the creek mouth. The site yielded 1 age one-plus cutthroat.

The twenty-seventh site sampled was habitat unit 217, a plunge pool located approximately 11,459 feet above the creek mouth. The site yielded 1 age three-plus steelhead.

The twenty-eighth site sampled was habitat unit 227, a mid-channel pool located approximately 12,112 feet above the creek mouth. The site did not yield fish.

The twenty-ninth site sampled was habitat unit 234, a plunge pool located approximately 12,320 feet above the creek mouth. The site yielded 1 age two-plus steelhead.

The thirtieth site sampled was habitat unit 236, a step pool located approximately 12,388 feet above the creek mouth. The site yielded four young-of-the-year steelhead and 1 age one-plus steelhead.

The thirty-first site sampled was habitat unit 242, a mid-channel pool located approximately 12,719 feet above the creek mouth. The site did not yield fish.

The thirty-second site sampled was habitat unit 243, a step pool located approximately 12,646 feet above the creek mouth. The site yielded 2 young-of-the-year steelhead.
The thirty-third site sampled was habitat unit 245, a step pool approximately 12,875 feet above the creek mouth. The site did not yield fish.

The thirty-fourth site sampled was habitat unit 247, a mid-channel pool approximately 13,029 feet above the creek mouth. The site yielded 1 age two-plus steelhead and 1 age three-plus cutthroat.

The thirty-fifth site sampled was habitat unit 256, a plunge pool approximately 13,359 feet above the creek mouth. The site did not yield fish.

The thirty-sixth site sampled was habitat unit 261, a mid-channel pool located approximately 13,516 feet above the creek mouth. The site yielded 1 young-of-the-year steelhead, 2 age one-plus cutthroat and 1 age two-plus cutthroat.

The thirty-seventh site sampled was habitat unit 271, a mid-channel pool located approximately 13,885 feet above the creek mouth. The site did not yield fish.

The thirty-eighth site sampled was habitat unit 279, a boulder lateral scour pool located approximately 14,272 feet above the creek mouth. The site did not yield fish.

The thirty-ninth site sampled was habitat unit 283, a mid-channel pool located approximately 14,390 feet above the creek mouth. The site did not yield fish.

The following chart displays the information yielded from these sites:

Date	Site #	Approx. Dist. from mouth (ft.)	Hab. Unit #	Hab. Type	Reach #	Channel type	Steelhead/Cutthroat0+	1+	2+	3+	CT
08/08/01	1	482	0010	5.6	1	F4	20	2	1	0	0
08/08/01	2	521	0011	4.2	1	F4	12	4	0	1	0
08/08/01	3	740	0015	4.2	1	F4	6	5	0	0	0
08/08/01	4	1,273	0022	4.2	1	F4	9	6	1	0	0
08/08/01	5	1,427	0026	4.2	1	F4	11	1	1	0	0
08/08/01	6	1,756	0037	4.2	1	F4	4	5	0	0	0
08/08/01	7	1,785	0038	5.6	1	F4	2	2	0	0	0
08/08/01	8	1,918	0040	5.6	1	F4	7	3	0	0	0
08/09/01	9	2,163	0043	5.6	1	F4	12	3	0	0	0
08/09/01	10	2,470	0047	5.6	1	F4	8	4	0	0	0
08/09/01	11	2,709	0054	5.5	2	F2	4	3	0	0	0
08/09/01	12	2,971	0059	4.2	2	F2	16	4	1	1	0
08/09/01	13	3,209	0064	5.6	2	F2	2	1	0	0	0
08/09/01	14	3,647	0073	5.6	2	F2	0	0	0	0	0
08/09/01	15	3,686	0074	4.2	2	F2	1	1	0	0	0
08/09/01	16	4,203	0089	4.2	2	F2	1	1	0	0	0
08/09/01	17	4,375	0095	4.2	2	F2	1	2	1	0	0
08/09/01	18	4,735	0105	4.2	2	F2	0	1	1	0	0
08/09/01	19	5,133	0116	4.2	2	F2	0	0	0	0	0
08/09/01	20	5,180	0117	4.4	2	F2	1	1	1	0	1
08/13/01	21	6,072	0133	4.4	3	B4	0	0	0	0	2
08/13/01	22	6,870	0140	4.2	3	B4	3	0	0	0	2
08/13/01	23	8,141	0164	4.2	3	B4	1	3	0	0	2

Date	Site #	Approx. Dist. from mouth (ft.)	Hab. Unit #	Hab. Type	Reach #	Channel type	Steelhead/Cutthroat0+	1+	2+	3+	CT
08/13/01	24	9,716	0194	5.6	3	B4	0	0	0	0	0
08/13/01	25	9,931	0197	4.4	3	B4	0	1	0	0	0
08/13/01	26	11,011	0213	5.6	3	B4	0	0	0	0	1
08/13/01	27	11,459	0217	5.6	3	B4	0	0	0	1	0
08/22/01	28	12,112	0227	4.2	3	B4	0	0	0	0	0
08/22/01	29	12,320	0234	5.6	3	B4	0	0	1	0	0
08/22/01	30	12,388	0236	4.4	3	B4	4	1	0	0	0
08/22/01	31	12,719	0242	4.2	4	F2	0	0	0	0	0
08/22/01	32	12,742	0243	4.4	4	F2	2	0	0	0	0
08/22/01	**33**	**12,875**	**0245**	**4.4**	4	F2	0	0	0	0	0
08/22/01	**34**	**13,029**	**0247**	**4.2**	4	F2	0	0	1	0	1
08/22/01	**35**	**13,359**	**0256**	**5.6**	4	F2	0	0	0	0	0
08/22/01	**36**	**13,516**	**0261**	**4.2**	4	F2	1	0	0	0	3
08/22/01	**37**	**13,885**	**0271**	**4.2**	4	F2	0	0	0	0	0
08/22/01	**38**	**14,272**	**0279**	**5.5**	4	F2	0	0	0	0	0
08/22/01	39	**14,390**	**0283**	**4.2**	4	F2	0	0	0	0	0

DISCUSSION

Panther Creek is an F4 channel type for the first 2,516 feet of stream surveyed, an F2 channel type for 4,669 feet of stream surveyed and a B4 for 7,319 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters. The suitability of F2 channel types for fish habitat improvement structures is as follows: fair for plunge weirs, single and opposing wing deflectors and log cover. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover.

The water temperatures recorded on the survey days June 13 - July 18, 2001, ranged from 52 to 57 degrees Fahrenheit. Air temperatures ranged from 57 to 67 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 28% of the total **length** of this survey, riffles 37%, and pools 33%. The pools are relatively deep, with 71 of the 142 (50%) 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.

Fifty-eight of the 142 pool tail-outs measured had embeddedness ratings of 1 or 2. Fifty-five of the pool tail-outs had embeddedness ratings of 3 or 4. Twenty-nine of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Twenty-one of the 29 were unsuitable for spawning due to the dominant substrate being boulder. The remainder of pool tails valued at 5 were dominated by sand. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

One-hundred-fourteen of the 143 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 52. The shelter rating in the flatwater habitats was 17. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, large woody debris contributes a small amount. Log and root wad cover structures in the pool and flatwater habitats would enhance 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.

The mean percent canopy density for the stream was 98%. Reach 1 had a canopy density of 96% while Reaches 2, 3, and 4 had canopy densities of 99%, 98% and 97%, respectively. 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 94.7% and 95.3%, respectively.

RECOMMENDATIONS

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

2) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and

meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulder. Adding high quality complexity with woody cover is desirable.

4) In the B4 and F4 channel types design and engineer pool enhancement structures to increase the number of pools or deepen existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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'	Begin survey at confluence with Redwood Creek. Channel type is F4.
114'	Metal foot bridge over Panther Creek, 20 feet long x 1.5 feet wide.
330'	Log debris accumulation, 26 feet long x 20 feet wide x 7 feet high.
482'	Electrofishing site #1.
521'	Electrofishing site #2.
740'	Electrofishing site #3.
982'	Log debris accumulation, 22 feet long x 17 feet wide x 7 feet high.
1,072'	Log debris accumulation, 86 feet long x 80 feet wide x 20 feet high.
1,273'	Log debris accumulation, 10 feet long x 15 feet wide x 4 feet high. Electrofishing site #4.
1,427'	Electrofishing site #5.
1,529'	Log debris accumulation, 8 feet long x 20 feet wide x 5 feet high.
1,756'	Electrofishing site #6.
1,785'	Electrofishing site #7.
1,918'	Electrofishing site #8.

2,054'	Log debris accumulation, 16 feet long x 20 feet wide x 5 feet high.
2,141'	Log debris accumulation, 15 feet long x 30 feet wide x 4 feet high.
2,163'	Electrofishing site #9.
2,470'	Electrofishing site #10.
2,516'	Channel type changes from F4 to F2.
2,709'	Electrofishing site #11.
2,966'	Tributary enters on right bank.
2,971'	Electrofishing site #12.
3,209'	Electrofishing site #13.
3,613'	Log debris accumulation, 30 feet long x 20 feet wide x 6 feet high.
3,647'	Electrofishing site #14.
3,686'	Electrofishing site #15.
3,806'	Tributary enters on left bank.
3,936'	Log debris accumulation, 20 feet long x 40 feet wide x 6 feet high.
4,131'	Log debris accumulation, 30 feet long x 30 feet wide x 4 feet high.
4,203'	Electrofishing site #16.
4,237'	Tributary enters on left bank.
4,375'	Electrofishing site #17.
4,459'	Log debris accumulation, 10 feet long x 50 feet wide x 4 feet high.
4,735'	Electrofishing site #18.
4,745'	Log debris accumulation, 20 feet long x 50 feet wide x 5 feet high.
4,949'	Tributary enters on right bank. Water temperature was 56°F.
5,133'	Electrofishing site #19.

5,180'	Electrofishing site #20.
5,303'	Log debris accumulation, 15 feet long x 60 feet wide x 7 feet high.
5,388'	Channel type changes from F2 to B4.
5,417'	Log debris accumulation, 20 feet long x 15 feet wide x 5 feet high.
5,431'	Tributary enters on left bank.
6,062'	Log debris accumulation, 34 feet long x 40 feet wide x 8 feet high.
6,072'	Electrofishing site #21.
6,192'	Log debris accumulation, 21 feet long x 30 feet wide x 6 feet high.
6,586'	Log debris accumulation, 15 feet long x 20 feet wide x 9 feet high.
6,708'	Log debris accumulation, 40 feet long x 30 feet wide x 6 feet high.
6,870'	Electrofishing site #22.
6,889'	Log debris accumulation, 8 feet long x 25 feet wide x 7 feet high.
6,914'	Tributary enters on right bank, dry at the time of the survey.
6,987'	Log debris accumulation, 11 feet long x 60 feet wide x 4 feet high.
8,141'	Electrofishing site #23.
8,538'	Tributary enters on right bank with low gradient and moderate flow. Water temperature was 56°F.
8,762'	Log debris accumulation, 75 feet long x 60 feet wide x 14 feet high.
9,093'	Tributary enters on left bank with moderate gradient and moderate flow. Water temperature was 56°F.
9,296'	Log debris accumulation, 12 feet long x 20 feet wide x 4 feet high.
9,332'	Log debris accumulation, 18 feet long x 20 feet wide x 4 feet high.
9,358'	Log debris accumulation, 60 feet long x 25 feet wide x 6 feet high.

9,552'	Log debris accumulation, 50 feet long x 20 feet wide x 6 feet high.
9,650'	Log debris accumulation, 45 feet long x 15 feet wide x 5 feet high.
9,716'	Electrofishing site #24.
9,931'	Electrofishing site #25.
10,296'	Log debris accumulation, 15 feet long x 15 feet wide x 4 feet high.
10,433'	Log debris accumulation, 12 feet long x 15 feet wide x 4 feet high.
10,782'	Tributary enters on right bank with low flow and high gradient. Water temperature was 55°F. Log debris accumulation, 20 feet long x 30 feet wide x 6 feet high.
11,011'	Electrofishing site #26.
11,459'	Electrofishing site #27.
11,713'	Tributary enters on right bank with high gradient and moderate flow. Water temperature was 54°F.
11,808'	Log debris accumulation, 12 feet long x 20 feet wide x feet high.
12,112'	Electrofishing site #28.
12,116'	Tributary enters on left bank with high gradient and low flow. Water temperature was 54°F.
12,164'	Log debris accumulation, 10 feet long x 10 feet wide x 6 feet high.
12,320'	Electrofishing site #29.
12,388'	Electrofishing site #30.
12,664'	Channel type changes from B4 to F2.
12,719'	Electrofishing site #31.
12,742'	Electrofishing site #32.
12,746'	Log debris accumulation, 10 feet long x 12 feet wide x 4 feet high.
12,875'	Electrofishing site #33.

13,029'	Electrofishing site #34.
13,292'	Four foot CMP culvert. Culvert rustline at 2 feet and is corroded at outlet. Simpson's O-Line road crosses over culvert. Culvert was replaced with a bridge in September, 2001.
13,359'	Electrofishing site #35.
13,516'	Electrofishing site #36.
13,588'	Log debris accumulation, 9 feet long x 25 feet wide x 5 feet high.
13,870'	Log debris accumulation, 15 feet long x 14 feet wide x 5 feet high.
13,885'	Electrofishing site #37.
13,918'	Log debris accumulation, 15 feet long x 20 feet wide x 3 feet high.
14,272'	Electrofishing site #38.
14,390'	Electrofishing site #39.
14,504'	End of survey due to high gradient of reach. Channel type changes from F2 to an A channel type with cascades and few resting pools. No fish had been observed for approximately ½ mile.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8}
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9}
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4}
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5}
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6}
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7}
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	