SECTION F
SALMONID HABITAT CONDITION

INTRODUCTION

The anadromous fish species inhabiting the Greenwood WAU is steelhead trout (*Oncorhynchus mykiss)* and there is much debate as to whether or not coho salmon (*Oncorhynchus kisutch*) once existed in this watershed. Coho salmon do not currently reside in the Greenwood WAU. Other species include three-spine stickleback *(Gasterosteus aculeatus),* prickly sculpin *(Cottus asper),* coastrange sculpin *(C. aleuticus),* California roach *(Lavinia symmetricus),* crayfish *(Pacifastacus spp.),* red-legged frog *(Rana aurora spp.),* foothill yellow legged frog *(Rana boylii),* Pacific giant salamander *(Dicamptodon tenebrosus),* tailed frog *(Ascaphus truei),* Southern torrent salamander *(Rhyacotriton variengatus),* and California newt *(Taricha torosa)*. A fish habitat assessment was conducted in the Greenwood WAU to identify the current habitat conditions and areas of special concern regarding spawning and summer rearing habitat.

Field surveys conducted to evaluate the quality and quantity of fish habitat in the Greenwood WAU included fish habitat typing and assessment, aquatic species distribution surveys, stream gravel permeability measurements and bulk gravel samples. The fish habitat assessment evaluated spawning and summer rearing habitats based on targets derived from scientific literature (Bilby and Ward, 1989; Bisson et al., 1987; Bjornn and Reiser, 1991; CDFG, 2002; Montgomery et al., 1995; Washington Forest Practices Board, 1997) and professional judgment. The habitat data are used to rate the quality of the habitat for the life history stages discussed above.

Aquatic species distribution surveys were conducted by the previous landowners (Louisiana-Pacific Corp.) from 1994-1996, and were repeated by MRC from 2000-2002 (MRC 2002). The study consisted of single pass electrofishing or snorkeling surveys in the summer months to assess aquatic species distribution and composition in the Greenwood WAU. All organisms observed were identified to the lowest possible taxonomic level.

Permeability and bulk gravel samples were taken in one long term channel monitoring segment in the Greenwood WAU to determine an index of spawning gravel quality. Permeability and gravel particle size distributions are stream substrate parameters, which affect survival of incubating salmonid embryos. Salmonid eggs buried under as much as a foot of gravel depend on sufficient intragravel water flow for their survival and development. Fine sediment within spawning gravel can impede intragravel water flow, reducing the delivery of dissolved oxygen to eggs, which can increase mortality in the egg to emergence stage. Forest management practices may increase the delivery of fine sediment to the stream channel, potentially impacting spawning gravel. The assessment of substrate permeability and composition are useful in monitoring the effects of increased sediment delivery on salmonid spawning and incubation conditions.

METHODS

Salmonid Habitat Assessment

The habitat inventory used to evaluate the habitat condition of the Greenwood WAU was conducted during low flow conditions using methods modified from the California Salmonid Stream Habitat Restoration Manual (CDFG, 2002). Surveys described 100% of the stream channel's wetted width, including side channel habitats. Stream segments were created based on stream gradient and channel confinement (see section E "Stream Channel Conditon"). A representation of the fish bearing segments was surveyed in each of the 2 planning watersheds. Each of the selected stream segments within the planning watersheds was fully sampled. Fish

habitat conditions were determined by habitat typing the majority of fish bearing stream segments throughout the watershed. High gradient streams are likely to be non-fish bearing, thus survey efforts were concentrated on low gradient reaches of the stream network.

Data collected during the fish habitat and stream channel surveys provided information on habitat type occurrence (Table F-2); pool, riffle, and flatwater frequency; pool spacing; spawning gravel quantity and quality; shelter complexity and availability (shelter rating); residual pool depths; substrate embeddedness; substrate composition; frequency of key pieces of large woody debris; overwintering substrate (Table F-5) (see section D "Riparian Function" for definition of 'Key LWD') and dominant cover type (Table F-3).

Evaluations on the quality of habitat available for spawning life stages, summer rearing, and overwintering were made based upon scientific literature and professional judgment. The criteria used to determine whether a specific variable was 'good', 'fair', or 'poor' is defined within Table F-1. Spawning habitat conditions are evaluated on the basis of gravel availability and quality (gravel size and embeddedness), and were evaluated within preferred salmonid spawning areas located at the tail-outs of pools. The percent of tailout area providing spawnable habitat was calculated by measuring the dimensions of the area available. Summer rearing habitat was evaluated using methods developed by CDFG (2002). Summer rearing habitat conditions for salmonids are evaluated on the size, depth, and availability of pools; and the complexity and quantity of cover (particularly large woody debris). Overwintering habitat is evaluated on the size, depth and availability of pools, the proportion of habitat units with cobble or boulder-dominated substrate (overwintering substrate) and the quantity of cover. The overwintering scores reflect parameters measured during summer flows and may not be an accurate representation of actual overwintering habitat conditions.

The habitat data are combined into indices of habitat quality for the different salmonid life stages. Measured fish habitat parameters were weighted and given a numeric scale to develop a quality rating for individual life history stages. Parameters were divided into subsets that correspond with individual life history stages (spawning, summer rearing, and over-wintering habitat). Parameters were scored as follows: 1 (poor), 2 (fair), and 3 (good). Parameter weights were applied to the total score calculated as shown below. The parameter codes (see Table F-1) are in bold and the weights in parentheses.

Spawning Habitat

E (0.30) + **F** (0.35) + **G** (0.35)

Summer Rearing Habitat

A (0.20) + **B** (0.15) + **C** (0.15) + **D** (0.15) + **F** (0.15) + **H** (0.20)

Over-wintering Habitat

A (0.20) + **B** (0.15) + **C** (0.15) + **D** (0.10) + **H** (0.20) + **I** (0.20)

The overall score is rated as follows:
1.00 - 1.66 = Poor
1.67 - 2.33 = Fair
2.34 - 3.00 = Good

Table F-1. Fish Habitat Quality Criteria for Measured Parameters.

		Fish Habitat Quality		
Fish Habitat Parameter	**Feature**	**Poor**	**Fair**	**Good**
Percent Riffle (By length) **(A)**	Anadromous Salmonid Streams	<25%	25-50%	>50%
Pool Spacing (Reach length/Bankfull/#pools) **(B)**	Anadromous Salmonid Streams	≥ 6.0	3.0 - 5.9	≤ 2.9
Shelter Rating (Shelter value x % of habitat covered) **(C)**	Pools	<60	60-120	>120
% Of Pools that are ≥3 ft. residual depth **(D)**	Pools	<25%	25-50%	>50%
Spawning Gravel Quantity (% of Surface Area) **(E)**	Pool Tail-outs	<25%	25-50%	>50%
Percent Embeddedness **(F)**	Pool Tail-outs	>50%	25-50%	<25%
Gravel Quality Rating (L-P watershed analysis manual) **(G)**	Pool Tail-outs	2.31-3.0	1.61-2.3	1.0-1.6
Key LWD +root wads / 328 ft of stream. **(H)**	Streams < 40 ft. BFW	<4.0	4.0-6.5	>6.6
	Streams ≥ 40 ft. BFW	<3.0	3.0-3.8	>3.9
Substrate for Over-wintering **(I)**	All Habitat Types	<20% of Units Cobble or Boulder Dominated	20-40% of Units Cobble or Boulder Dominated	>40% of Units Cobble or Boulder Dominated

Table F-2. Habitat types as described in the California Salmonid Stream Habitat Restoration Manual (CDFG, 2002).

HABITAT TYPES	CODES	DESCRIPTIONS
Riffle		
Low Gradient Riffle	LGR	Shallow reach with swift flowing, turbulent water; partially exposed substrate; and <4% gradient.
High Gradient Riffle	HGR	Steep reach with swift flowing, very turbulent water; high exposed substrate; and >4% gradient.
Cascade		
Cascade	CAS	Steepest riffle habitat; consisting of alternating small waterfalls and shallow pools.
Bedrock Sheet	BRS	Thin sheet of water flowing over a smooth bedrock surface.
Flatwater		
Pocket Water	POW	Swift flowing stream around boulders and obstructions creating eddies or scour holes (pockets).
Glide	GLD	Wide uniform channel bottom; low to moderate flow.
Run	RUN	Swift flowing reaches with little surface agitation and no major flow obstructions; flooded riffle.
Step Run	SRN	Sequence of runs seperated by short riffle steps.
Edgewater	EDW	Quiet, shallow area along stream margins, typically associated with riffles; low water velocities
Main Channel Pool		
Trench Pool	TRP	U-shaped cross section typically flanked by bedrock walls; water velocities are swift.
Mid-Channel Pool	MCP	Large pools formed by mid-channel scours; water velocities are slow.
Channel Confluence Pool	CCP	Large pools formed at the confluence of two or more channels; higher water velocities and turbulence.
Step Pool	STP	Series of pools seperated by short riffles or cascades; generally high gradient, confined streams.
Scour Pool		
Corner Pool	CRP	Lateral scour pools formed at a bend in the channel.
Lateral Scour Pool - Log Formed	LSL	Formed by flow impinging against partial channel obstruction consisting of large woody debris.
Lateral Scour Pool - Rootwad Formed	LSR	Formed by flow impinging against partial channel obstruction consisting of a rootwad.
Lateral Scour Pool - Bedrock Formed	LSBk	Formed by flow impinging against a bedrock stream bank.
Lateral Scour Pool - Boulder Formed	LSBo	Formed by flow impinging against a partial channel obstruction consisting of a boulder.
Plunge Pool	PLP	Stream passes over channel obstruction and drops steeply into stream bed below; scouring depression.
Backwater Pools		
Secondary Channel Pool	SCP	Formed outside the average wetted channel width; mainly associated with gravel bars.
Backwater Pool - Boulder Formed	BPB	Shallow pool found along channel margins; caused by eddies around a boulder obstruction.
Backwater Pool - Rootwad Formed	BPR	Shallow pool found along channel margins; caused by eddies around a rootwad obstruction.
Backwater Pool - Log Formed	BPL	Shallow pool found along channel margins; caused by eddies around a woody debris obstruction.
Damned Pool	DPL	Water impounded from complete or nearly complete channel blockage (debris jams & rockslides).
Additional Unit Designations		
Dry	DRY	Dry stream beds.
Culvert	CUL	Culvert.
Not Surveyed	NS	Not surveyed.
Not Surveyed due to marsh	MAR	Not surveyed due to marsh.

Aquatic Species Distribution

A hierarchical framework was used to select the initial locations of survey sites in each stream. Major streams were broken into lower, middle and upper reaches. Smaller streams were divided into lower and upper reaches. One site is surveyed in each reach, resulting in 3 sites in larger streams, and 2 sites in smaller streams. Additional sites are added directly downstream and upstream of potential migration barriers to determine which salmonid species these barriers are impacting.

A survey site contains a minimum of two consecutive habitat sequences (pool-riffle sequences) and has a minimum length of ninety feet. The survey method used to determine the aquatic species present is single pass electrofishing or snorkeling. The effort put forth at each survey site is not sufficient to delineate the absence of a species. If future fishery research develops reasonable methods to determine the probability that a species is absent, these methods will be incorporated into future distribution surveys.

Prior to initiating surveys water quality is measured using a Horiba™ U-10 Water Quality Checker. Measurements taken are water temperature (°C), conductivity (microS/cc), dissolved oxygen (mg/L), and pH. Air temperature is measured with a pocket thermometer and water visibility is estimated. Stream discharge is estimated or measured with a Swoffer™ Model 2100 flow meter. The actual physical parameters measured at each site vary depending on equipment availability. Horiba™ U-10 Water Quality Checkers were not used prior to the surveys in 2000.

Diving (snorkeling) is used to assess species presence when stream conditions are considered adequate or when elevated stream temperatures have the potential to adversely impact the health of the animals being electrofished. The basic survey unit for diving consists of a minimum of two pools, however if riffles are deep enough to allow underwater observation these units are sampled.

Permeability and Stream Bulk Gravel Samples

Steam gravel permeability and bulk gravel samples were collected on one stream monitoring segment in the Greenwood WAU in 2001 and 2003. The stream gravel permeability was measured using a 1-inch diameter standpipe similar to the standpipe discussed in Terhune (1958) and Barnard and McBain (1994) with the exception that our standpipe is smaller in diameter. We used the smaller diameter standpipe because we hypothesize that it creates fewer disturbances to the stream gravel when inserted. Bulk stream gravel samples were taken with a 12-inch diameter sampler as described in Platts, Megahan and Minshall (1983).

An electric pump was used to create the water suction in the standpipe for the permeability measurements. The permeability measurements were taken at a depth of 25 centimeters, near the maximum depth of coho and steelhead spawning. From a power analysis it was determined that 26 measurements per segment are needed to predict within 20 percent accuracy the survival of emerging fry. The measurements were evenly distributed among all pool tail-outs in the segments, with any additional measurements taken in tail-outs behind the deepest pools. The measurement location in each tail-out was randomly selected from an evenly selected 12-point grid in the tail-out. At each measurement location permeability repetitions were taken until the permeability readings no longer were increasing.

The median permeability measurement for each permeability site in the monitoring segment was used as representative of the site. To characterize the entire monitoring segment the natural log of the geometric mean of the median permeability measurements was determined. The natural

log of the permeability is used because of a relationship developed from data from Tagart (1976) and McCuddin (1977) (Stillwater Sciences, 2000) to estimate survival to emergence from permeability data. This relationship equates the natural log of permeability to fry survival (r^2 = 0.85, $p<10^{-7}$). This index needs further improvements, but is currently all we have for interpreting permeability information and biological implications. This relationship is:

Survival = -0.82530 + 0.14882 * ln permeability

It is important to understand that the use of this survival relationship is only an index of spawning gravel quality in the segment. The permeability measurements were taken in randomly selected pool tail-outs and are not indicative of where a salmon may select to spawn. Furthermore, spawning salmon have been shown to improve permeability in gravel where redds are developed (MRC, 2000). Therefore the survival percentage developed is only indicative of the quality of potential spawning habitat and not as an absolute number.

Bulk gravel samples were taken in 4 randomly selected pool tail-outs. The gravel sample was taken directly over the permeability site that is closest to the thalweg of the channel. After the bulk gravel samples were collected the gravel was dried and sieved through 7 different size-class screens (50.8, 25.4, 12.5, 6.3, 4.75, 2.36, 0.85 mm). The weight of each gravel size class was determined for each of the bulk gravel samples using a commercial quality scale.

From the sieved bulk gravel samples the percent fine particles less than 0.85 mm sieve size class was determined. The survival index for steelhead trout was calculated from the bulk gravel samples using the method described in Tappel and Bjorn (1983).

RESULTS AND DISCUSSION

Salmonid Habitat Condition

The Greenwood WAU is comprised of two planning watersheds of which both were surveyed for fish habitat and aquatic species distribution. The results are discussed by segment. Tables F-4 and F-5 summarize the 2003 fish habitat assessment data. A total of 11 segments were evaluated. The habitat parameters used to evaluate individual stream segments can be found in Table F-5. The 'rating' is the quality value for calculation of weighted habitat indices (see Table F-1). The ratings were used to calculate habitat quality for each life history stage. A summary of the habitat ratings corresponding to each life history stage can be found in Table F-4. Table F-3 summarizes the percent of dominant cover types found in pool, riffle, and flatwater habitats.

Table F-3. Percent of dominant cover types found in pool, riffle, and flatwater habitats of the Greenwood WAU, 2003.

Segment	Pool		Riffle		Flatwater	
	Dom. Cover	Percent	Dom. Cover	Percent	Dom. Cover	Percent
CGO1	Bedrock Ledges	46	Boulder	45	Boulder	65
CG04	Boulder	41	Boulder	73	Boulder	61
CG16	LWD	58	Boulder	75	Boulder	67
CG25	Boulder	29	Boulder	89	Boulder	56
CG26	Boulder	100	Boulder	83	Boulder	100
CG30	Rootwad	33	Boulder	46	LWD	100
CU02	Boulder	43	Boulder	88	Boulder	75
CU04	Boulder	29	Boulder	29	Boulder	44
CU06	LWD	55	Boulder	52	Boulder	47
CU09	Boulder	50	Boulder	100	Boulder	100
CU10	LWD	74	LWD	44	Boulder	50

Table F-4. Summary of Fish Habitat Ratings for Three Life History Stages of the Greenwood WAU, 2003.

Segment	Spawning Habitat Score	Spawning Habitat Rating	Summer Rearing Habitat Score	Summer Rearing Habitat Rating	Over-wintering Habitat Score	Over-wintering Habitat Rating
CG01	2.39	Good	1.65	Poor	1.60	Poor
CG04	2.74	Good	2.15	Fair	1.95	Fair
CG16	1.71	Fair	1.70	Fair	1.90	Fair
CG25	1.71	Fair	1.45	Poor	1.45	Poor
CG26	2.08	Fair	1.30	Poor	1.35	Poor
CG30	2.04	Fair	1.70	Fair	1.70	Fair
CU02	2.39	Good	1.65	Poor	1.65	Poor
CU04	2.06	Fair	2.10	Fair	1.85	Fair
CU06	1.71	Fair	1.50	Poor	1.50	Poor
CU09	1.03	Poor	1.35	Poor	1.35	Poor
CU10	2.06	Fair	1.85	Fair	1.85	Fair

Table F-5. Summary of Fish Habitat Parameters of the Greenwood WAU, 2003

Segment	Length of surveyed habitat (ft.)	**A.** % Pool:Riffle: Flatwater by stream length	**B.** Pool Spacing	**C.** Mean Pool Shelter Rating	**D.** % of all pools with residual depth ≥3 ft.	**E.** % Spawnable	**F.** % Embeddedness	**G.** Dominant Tailout Substrate	**H.** Key LWD + Rootwads / 328ft.	**I.** % Overwintering Substrate	Mean Residual Pool Depth (ft.)	Woody Debris ≥10" / 328ft.
CG01	7139	18:37:45	2.6	42	43	51	>50	Lg. Gravel	0.3	0	3.3	3.9
CG04	16426	35:23:42	4	70	53	60	25-50	Lg. Gravel	1.1	16	3.2	3.6
CG16	1549	21:72:7	4.6	77	0	37	>50	Sm. Gravel	13.8	28	1.2	21.0
CG25	3044	14:62:24	1.9	66	7	38	>50	Sm. Gravel	1.7	7	1.8	7.4
CG26	739	6:87:7	4.8	37	0	20	25-50	Lg. Gravel	2.0	30	1.7	4.0
CG30	739	15:75:10	4.9	98	0	58	>50	Sm. Gravel	12.2	0	1.5	17.3
CU02	7589	17:42:41	3	108	24	57	>50	Lg. Gravel	0.0	4	2.5	3.9
CU04	6237	21:27:52	2.8	62	67	39	25-50	Sm. Gravel	0	16	3.7	4.2
CU06	2950	19:51:30	5.2	80	5	43	>50	Sm. Gravel	4.2	16	1.8	15.0
CU09	277	7:77:16		40	0	0	>50	Boulder	4.9	17	1.7	17.8
CU10	1680	31:59:10	5.3	128	0	35	>50	Lg. Gravel	31.9	8	1.8	26.4

Lower Greenwood Creek Planning Watershed

Greenwood Creek (Segment CG01)

The segment surveyed was composed of 18% pool, 37% riffle, and 45% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low, although there was a high frequency of flatwater habitat. The majority of pools were lateral scour pools formed by bedrock (43%, Figure F-1). Bedrock ledges (46%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 3.3 feet, with 43% of pools having residual depths ≥3 feet. The shelter rating was low (42), mainly due to a lack of cover availability. There were minimal amounts of key LWD pieces (0.3 pieces per 328 feet) observed in the segment and there were few pools formed by LWD (14%). However, there were 3.9 pieces of woody debris ≥10" diameter per 328 feet surveyed. The dominant tailout substrate was large gravel and the embeddedness rating was high (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be good due to a high percentage of spawnable gravels available to fish in tailouts (51% of tailout area covered with suitable spawning gravels). The dominant tailout substrate size (large gravel) was within the preferred range of salmonids, however the spawning gravels were embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was poor due to the minimal amount of key LWD, low shelter rating, and a low frequency of pools. However, there was a high occurrence of pools with residual depths ≥3 feet.

Overwintering Habitat

Overwintering habitat in the segment was poor due to the minimal amount of key LWD, minimal amount of overwintering substrate, low shelter rating, and a low frequency of pools. However, there was a high occurrence of pools with residual depths ≥3 feet.

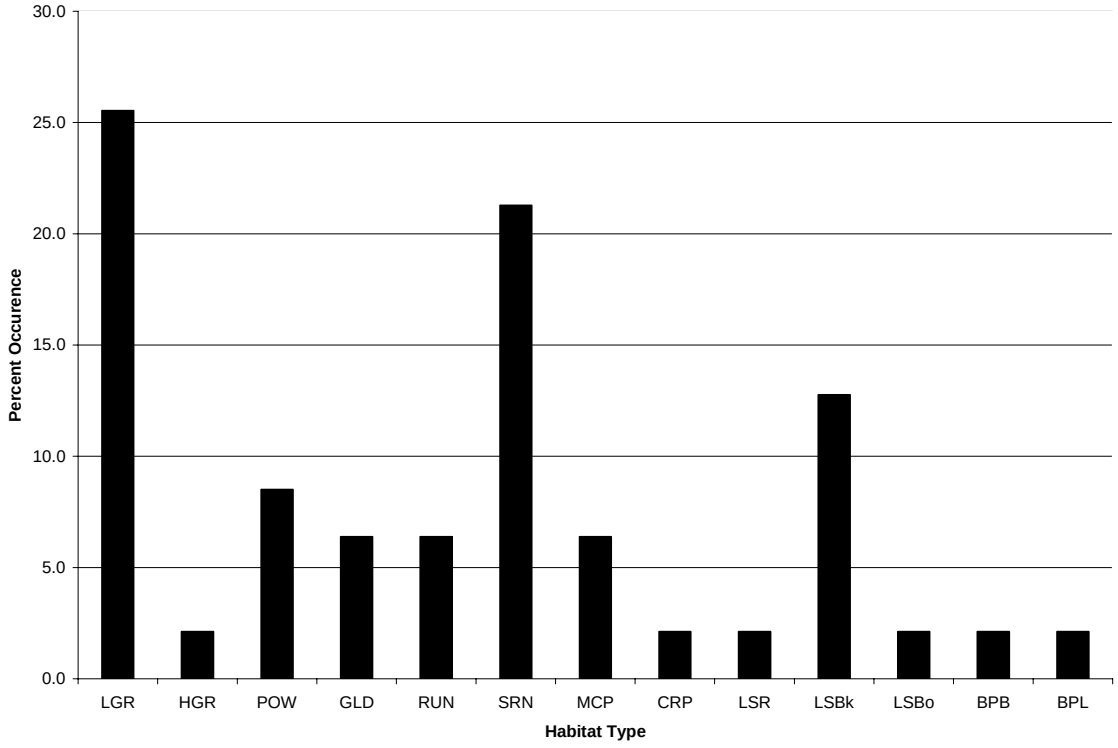

Figure F-1. Percent occurrence of habitat types surveyed in segment CG01 within the Greenwood WAU, 2003.

Greenwood Creek (Segment CG04)

The segment surveyed was composed of 35% pool, 23% riffle, and 42% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered fair, although there was a high frequency of flatwater habitat. The majority of pools were lateral scour formed by bedrock (35%, Figure F-2). Boulders (41%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 3.2 feet, with 53% of pools having residual depths ≥3 feet. The shelter rating was moderate (70), mainly due to a high availability of cover. There were minimal amounts of key LWD (1.1 pieces per 328 feet) observed in the segment and there were few pools formed by LWD (18%). However, there were 3.6 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was large gravel and the embeddedness rating was moderate (25-50%).

Spawning Habitat

Spawning habitat in the segment appeared to be good due to a high percentage of spawnable gravels available to fish in tailouts (60% of tailout area). The dominant tailout substrate size (large gravel) was within the preferred range of salmonids and the spawning gravels were slightly embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was fair due to the high occurrence of pools with residual depths ≥3 feet, moderate frequency of pools, and a moderate shelter rating. However, there were minimal amounts of key LWD.

Overwintering Habitat

Overwintering habitat in the segment was fair due to the high occurrence of pools with residual depths ≥3 feet, moderate frequency of pools, and a moderate shelter rating. However, there were minimal amounts of key LWD and a minimal amount of overwintering substrate.

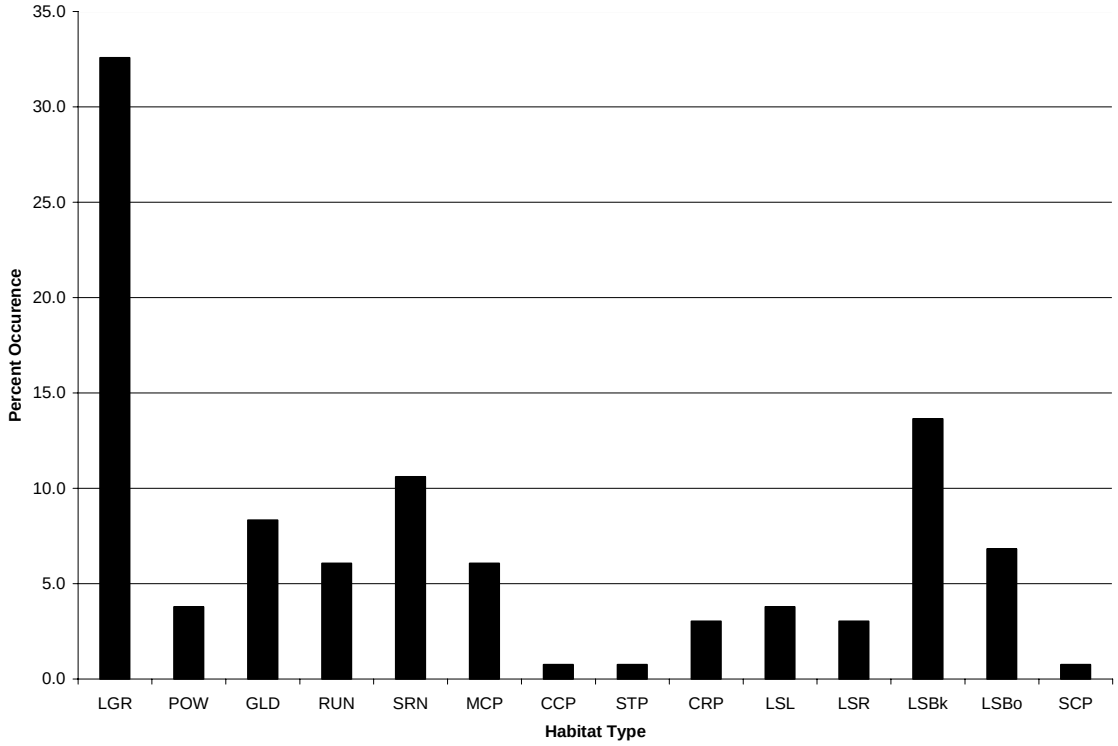

Figure F-2. Percent occurrence of habitat types surveyed in segment CG04 within the Greenwood WAU, 2003.

Pond Tributary (Segment CG16)

The segment surveyed was composed of 21% pool, 72% riffle, and 7% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low with a high frequency of riffle habitat. The majority of pools were mid-channel pools (54%, Figure F-3). LWD (58%, Table F-3) was the dominant cover available to fish in pools in the segment. The mean residual pool depth was 1.2 feet, with 0% of pools having residual depths ≥3 feet. The shelter rating was moderate (77), mainly due to high availability of cover. There were significant amounts of key LWD (13.8 pieces per 328 feet) observed in the segment, although there were few pools formed by LWD (21%). Additionally, there were 21.0 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was small gravel, and the embeddedness rating was high (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to a moderate percentage of spawnable gravels available to fish in tailouts (37% of tailout area). However, the dominant tailout substrate size (small gravel) is slightly smaller than the preferred range of salmonids and the spawning gravels were embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was fair due to the significant amounts of key LWD and a moderate shelter rating. However, there was an absence of pools with residual depths ≥3 feet and a low frequency of pools.

Overwintering Habitat

Overwintering habitat in the segment was fair due to the significant amounts of key LWD, a moderate shelter rating, and a moderate amount of overwintering substrate. However, there was an absence of pools with residual depths ≥3 feet and a low frequency of pools.

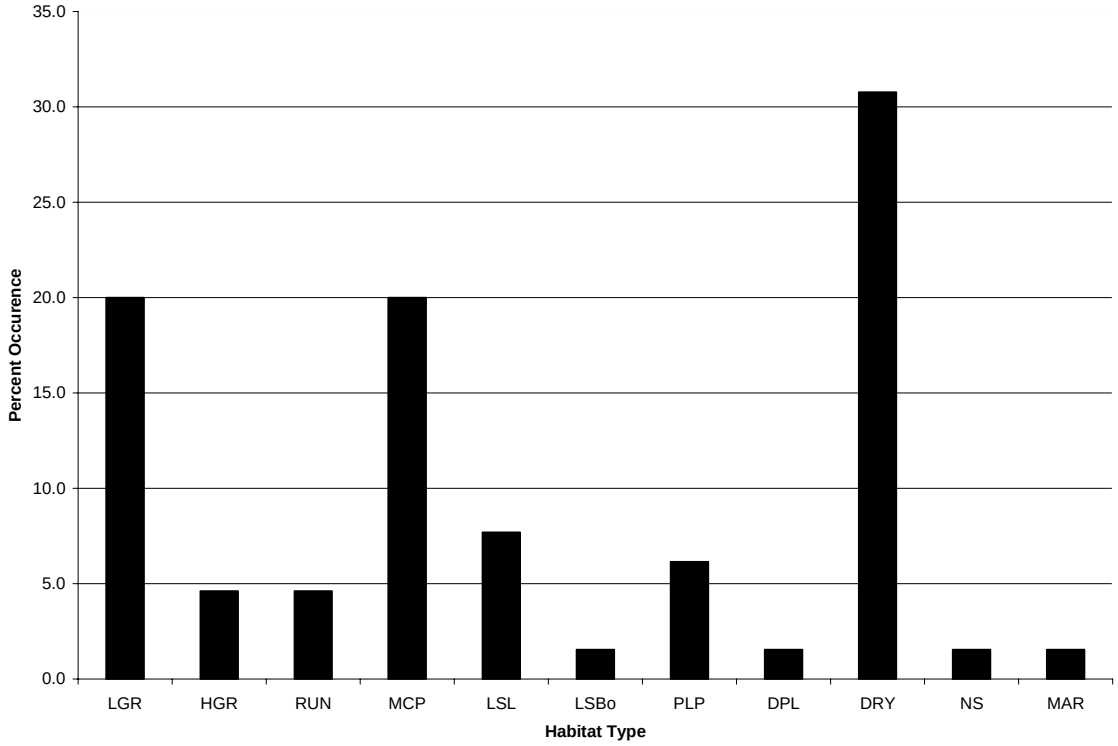

Figure F-3. Percent occurrence of habitat types surveyed in segment CG16 within the Greenwood WAU, 2003.

Corrals Tributary (Segment CG25)

The segment surveyed was composed of 14% pool, 62% riffle, and 24% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low with a high frequency of riffle habitat. The majority of pools were lateral scour pools formed by rootwads (43%, Figure F-5). Boulders (29%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 1.8 feet, with 7% of pools having residual depths ≥3 feet. The shelter rating was moderate (66), mainly due to a high availability of cover. There were minimal amounts of key LWD (1.7 pieces per 328 feet) observed in the segment, although the majority of pools were formed by LWD (50%). However, there were 7.4 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was small gravel, and the embeddedness rating was high (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to a moderate percentage of spawnable gravels available to fish in tailouts (38% of tailout area). However, the dominant tailout substrate size (small gravel) is slightly smaller than the preferred range of salmonids and the spawning gravels were embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was poor due to the low occurrence of pools with residual depths ≥3 feet, low frequency of pools, and minimal amounts of key LWD. However, the shelter rating was moderate.

Overwintering Habitat

Overwintering habitat in the segment was poor due to the low occurrence of pools with residual depths ≥3 feet, low frequency of pools, minimal amounts of key LWD, and a minimal amount of overwintering substrate. However, the shelter rating was moderate.

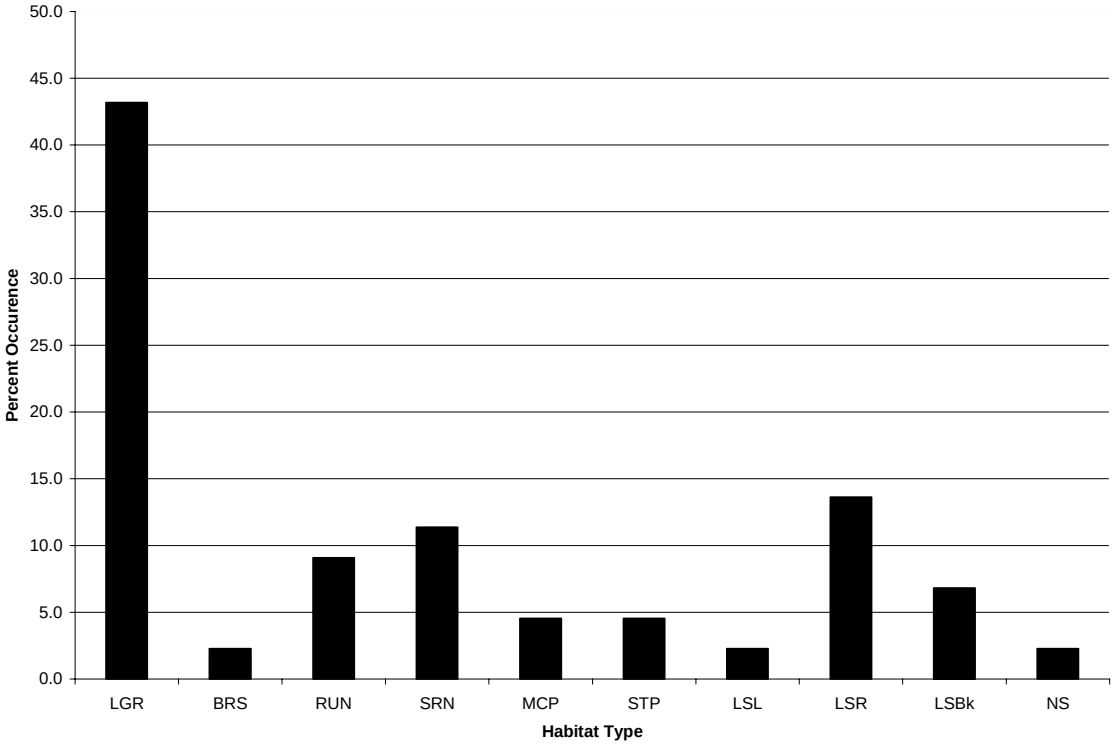

Figure F-4. Percent occurrence of habitat types surveyed in segment CG25 within the Greenwood WAU, 2003.

Corrals Tributary (Segment CG26)

The segment surveyed was composed of 6% pool, 87% riffle, and 7% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low with a high frequency of riffle habitat. There was a similar distribution of pool types: mid-channel pools (33%), lateral scour pools formed by rootwad (33%), and plunge pools (33%, Figure F-5). Boulders (100%, Table F-3) were the dominant cover available to fish in pools in this segment. The mean residual pool depths was 1.7 feet, with 0% of pools having residual depths ≥3 feet. The shelter rating was low (37), mainly due to a lack of cover availability. There were minimal amounts of key LWD (2.0 pieces per 328 feet) observed in the segment. However, 33% of pools were formed by LWD, and there were 4.0 pieces of woody debris ≥10" diameter per 328ft. observed in the segment. The dominant tailout substrate was large gravel, and the embeddedness rating was moderate (25-50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to the dominant tailout substrate size (large gravel) was within the preferred range of salmonids and the spawning gravels were slightly embedded. However, only a low percentage of spawnable gravels were available to fish in the tailouts (20% of tailout area).

Summer Rearing Habitat

Summer rearing habitat in the segment was poor due to the absence of pools with residual depths ≥3 feet, very low frequency of pools, minimal amounts of key LWD, and a low shelter rating.

Overwintering Habitat

Overwintering habitat in the segment was poor due to the absence of pools with residual depths ≥3 feet, very low frequency of pools, minimal amounts of key LWD, and a low shelter rating. However, there was a moderate amount of overwintering substrate.

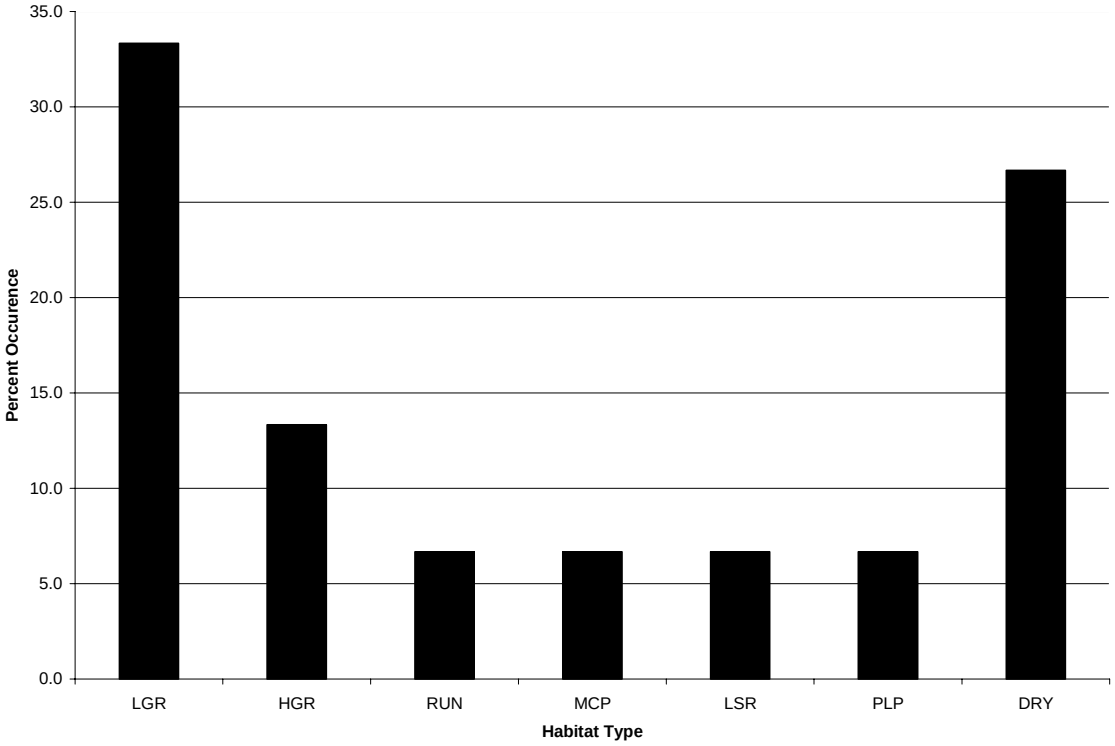

Figure F-5. Percent occurrence of habitat types surveyed in segment CG26 within the Greenwood WAU, 2003.

Barn Gulch (Segment CG30)

The segment surveyed was composed of 15% pool, 75% riffle, and 10% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low with a high frequency of riffle habitat. The majority of pools were plunge pools (33%, Figure F-6). Rootwads (33%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 1.5 feet, with 0% of pools having residual depths ≥3 feet. The shelter rating was moderate (98), mainly due to the availability of cover. There were good amounts of key LWD (12.2 pieces per 328 feet) observed in the segment and there were several pools formed by LWD (22%). Additionally, there were 17.3 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was small gravel, and the embeddedness rating was high (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to a high percentage of spawnable gravels available to fish in tailouts (58% of tailout area). However, the dominant tailout substrate size (small gravel) was slightly smaller than the preferred range of salmonids and the spawning gravels were embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was fair due to a moderate shelter rating and a significant amount of key LWD. However, there is an absence of pools with residual depths ≥3 feet and a low frequency of pools.

Overwintering Habitat

Overwintering habitat in the segment was fair due to a moderate shelter rating and a significant amount of key LWD. However, there is an absence of pools with residual depths ≥3 feet, minimal amount of overwintering substrate, and a low frequency of pools.

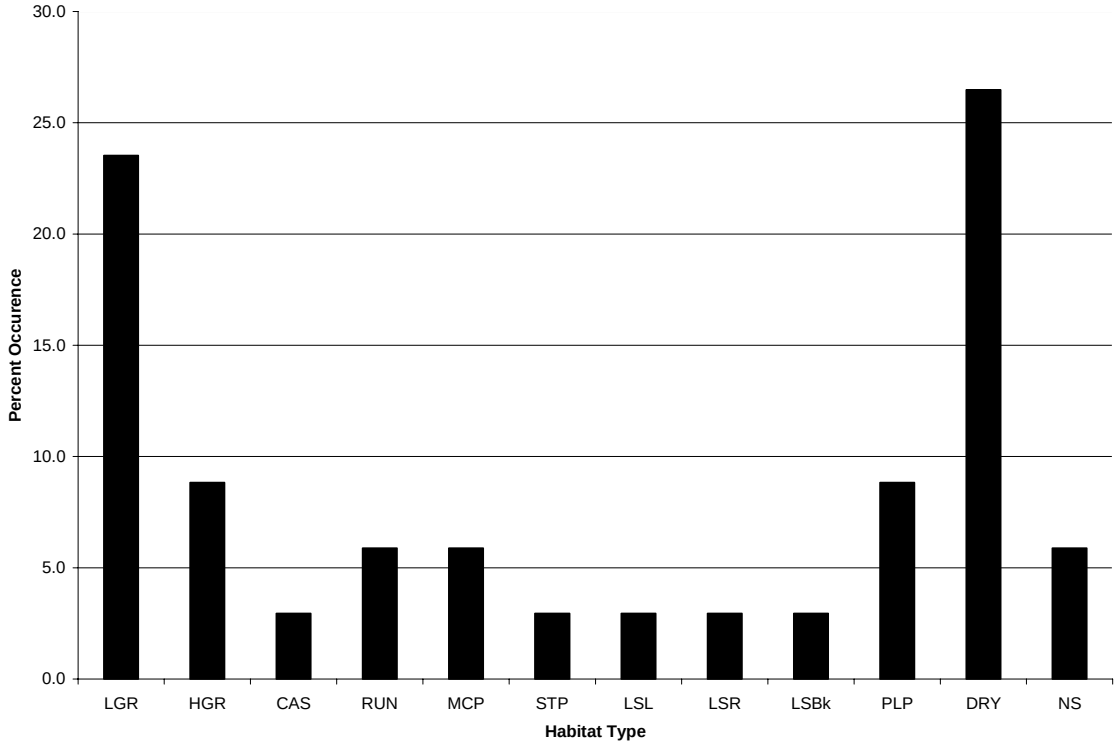

Figure F-6. Percent occurrence of habitat types surveyed in segment CG30 within the Greenwood WAU, 2003.

Upper Greenwood Creek Planning Watershed

Upper Greenwood Creek (Segment CU02)

The segment surveyed was composed of 17% pool, 42% riffle, and 41% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low, although there was a high frequency of flatwater habitat. The majority of pools were lateral scour pools formed by boulders (29%, Figure F-7). Boulders (43%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 2.5 feet, with 24% of pools having residual depths ≥3 feet. The shelter rating was moderate (108), mainly due to the availability of cover. There were no key LWD pieces observed in the segment. However, there were several pools formed by LWD (24%) and also 3.9 pieces of woody debris ≥10"diameter per 328ft.surveyed. The dominant tailout substrate was large gravel, and the embeddedness rating was high (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be good due to a high percentage of spawnable gravels available to fish in tailouts (57% of tailout area). Gravel size (large gravel) was within the preferred range of salmonids, although the spawning gravels were embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was poor due to the low occurrence of pools with residual depths ≥3 feet, low frequency of pools, and an absence of key LWD. However, there was a moderate shelter rating.

Overwintering Habitat

Overwintering habitat in the segment was poor due to the low occurrence of pools with residual depths ≥3 feet, low frequency of pools, an absence of key LWD, and a minimal amount of overwintering substrate. However, there was a moderate shelter rating.

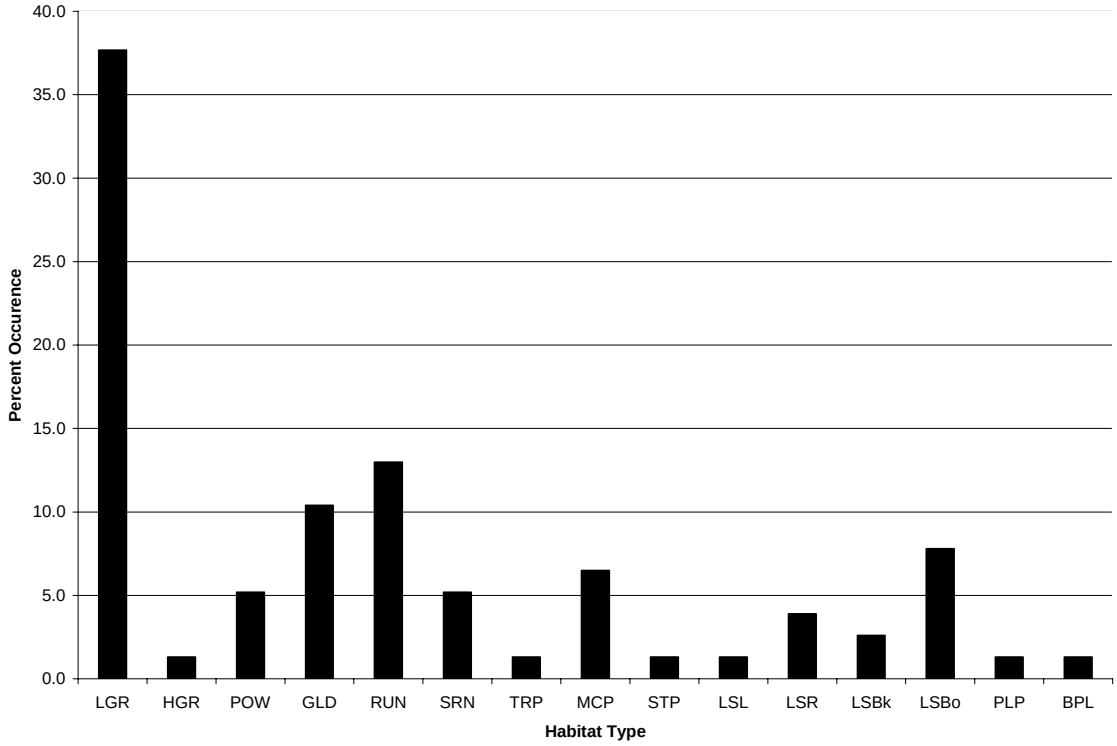

Figure F-7. Percent occurrence of habitat types surveyed in segment CU02 within the Greenwood WAU, 2003.

Upper Greenwood Creek (Segment CU04)

The segment surveyed was composed of 21% pool, 27% riffle, and 52% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low, although there was a high frequency of flatwater habitat. The majority of pools were mid-channel pools (53%, Figure F-8). Boulders (29%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 3.7 feet, with 67% of pools having residual depths ≥3 feet. The shelter rating was moderate (62), mainly due to availability of cover. There were no key LWD pieces observed in the segment. However, there were some pools formed by LWD (7%) and there were 4.2 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was small gravel, and the embeddedness rating was moderate (25-50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to the moderate percentage of spawnable gravels available to fish in tailouts (39% of tailout area) and the spawning gravels were slightly embedded. However, the dominant tailout substrate size (small gravel) was slightly smaller than the preferred range of salmonids.

Summer Rearing Habitat

Summer rearing habitat in the segment was fair due to the high occurrence of pools with residual depths ≥3 feet and moderate shelter ratings. However, there was an absence of key LWD and a low frequency of pools.

Overwintering Habitat

Overwintering habitat in the segment was fair due to the high occurrence of pools with residual depths ≥3 feet and a moderate shelter rating. However, there was an absence of key LWD, a minimal amount of overwintering substrate, and a low frequency of pools.

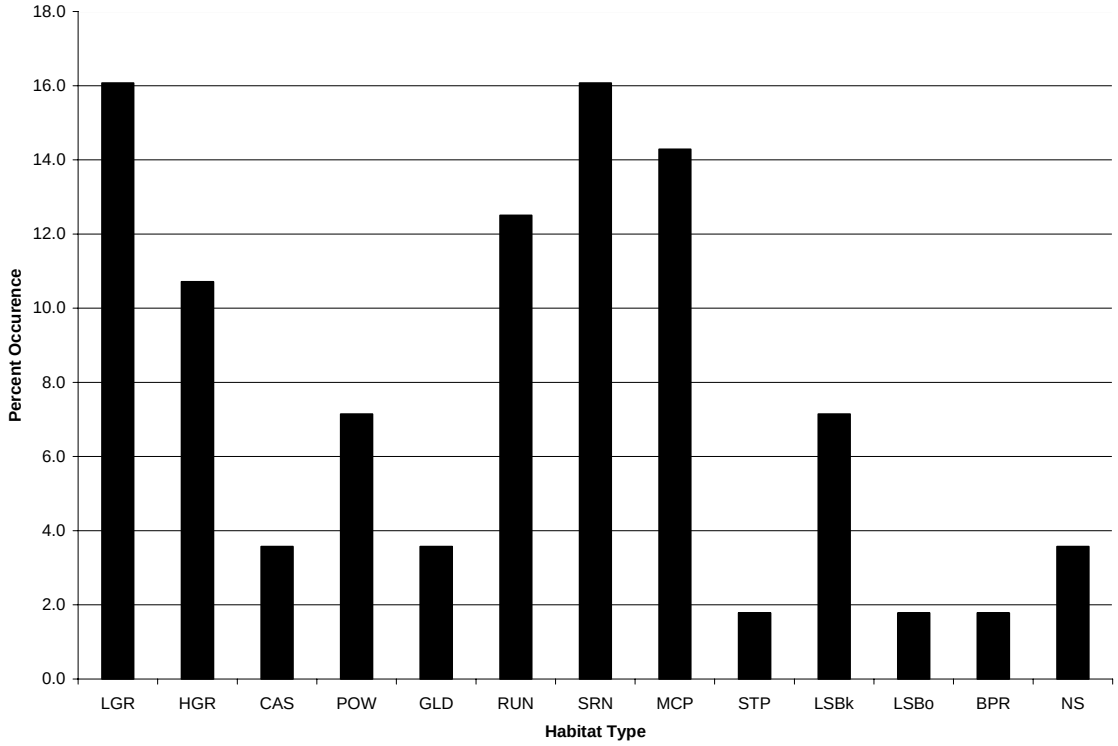

Figure F-8. Percent occurrence of habitat types surveyed in segment CU04 within the Greenwood WAU, 2003.

Valenti Gulch (Segment CU06)

The segment surveyed was composed of 19% pool, 51% riffle, and 30% flatwater by stream length (Table F-5). The frequency of pools in the segment was low with a high frequency of riffle habitat. The majority of pools were lateral scour pools formed by logs (36%, Figure F-9). The dominant cover available to fish in pools in the segment was LWD (55%, Table F-3). The mean residual pool depth was 1.8 feet, with 5% of pools having residual depths ≥3 feet. The shelter rating was moderate (80), mainly due to the availability of cover. There were moderate amounts of key LWD (4.2 pieces per 328 feet) observed in the segment. The majority of pools in this segment were formed by LWD (45%), and there were also 15.0 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was small gravel, and the embeddedness rating was high (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to a moderate percentage of spawnable gravels available to fish in tailouts (43% of tailout area). However, the dominant tailout substrate size (small gravel) is slightly smaller than the preferred range of salmonids and the spawning gravels were embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was poor due to a low occurrence of pools with residual depths ≥3 feet, low frequency of pools. However, a moderate shelter rating and a moderate amount of key LWD were present.

Overwintering Habitat

Overwintering habitat in the segment was poor due to a low occurrence of pools with residual depths ≥3 feet, low frequency of pools, and a minimal amount of overwintering substrate. However, a moderate shelter rating and a moderate amount of key LWD were present.

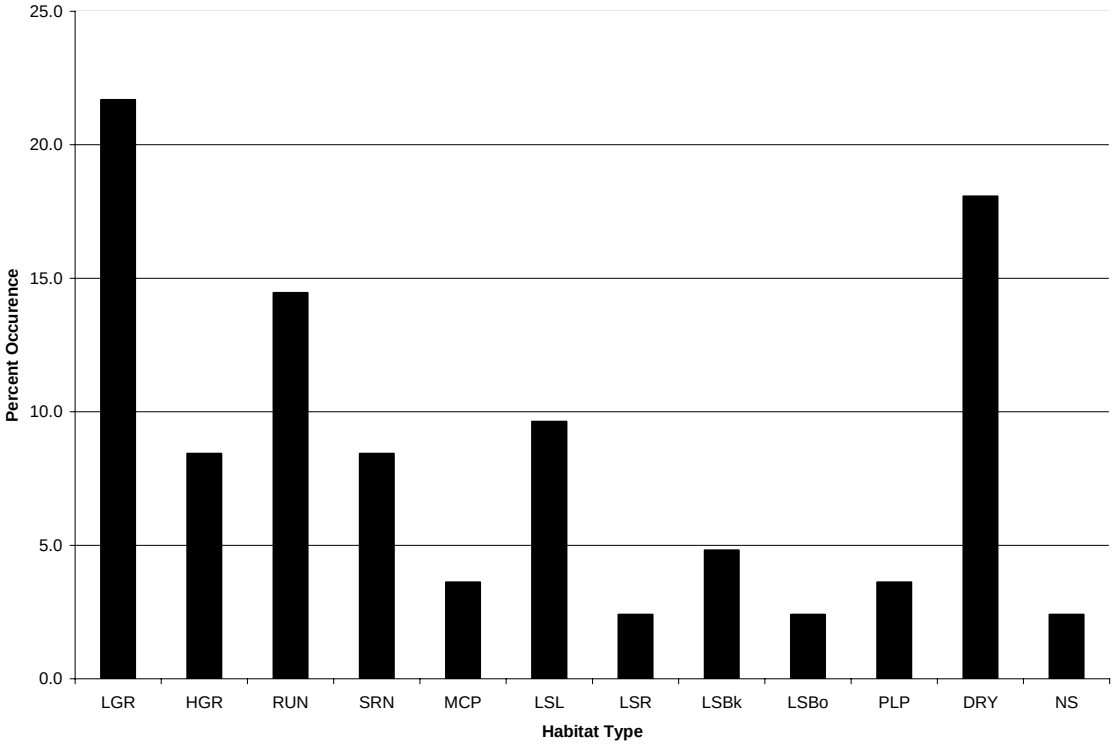

Figure F-9. Percent occurrence of habitat types surveyed in segment CU06 within the Greenwood WAU, 2003.

Valenti Gulch (Segment CU09)

The segment surveyed was composed of 7% pool, 77% riffle, and 16% flatwater by stream length (Table F-5). The frequency of pools in the segment was considered low with a high frequency of riffle habitat. There was a similar percentage of lateral scour pools formed by logs (50%) and lateral scour pools formed by rootwads (50%, Figure F-10). Boulders (50%, Table F-3) were the dominant cover available to fish in pools in the segment. The mean residual pool depth was 1.7 feet, with 0% of pools having residual depths ≥3 feet. The shelter rating was low (40), mainly due to a lack of cover availability. There were moderate amounts of key LWD (4.9 pieces per 328 feet) observed in the segment. All of the pools were formed by LWD (100%) and there were 17.8 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was boulder, and the embeddedness rating was high (100%).

Spawning Habitat

Spawning habitat in the segment was poor due to the low percentage of spawnable gravels available to fish in tailouts (0% of tailout area). A boulder dominated tailout does not provide spawnable substrates for salmonids, and the spawning gravels were highly embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was poor due to an absence of pools with residual depths ≥3 feet, a low frequency of pools, and a low shelter rating. However, there was a moderate amount of key LWD.

Overwintering Habitat

Overwintering habitat in the segment was poor due to an absence of pools with residual depths ≥3 feet, a low frequency of pools, a minimal amount of overwintering substrate, and a low shelter rating. However, there was a moderate amount of key LWD.

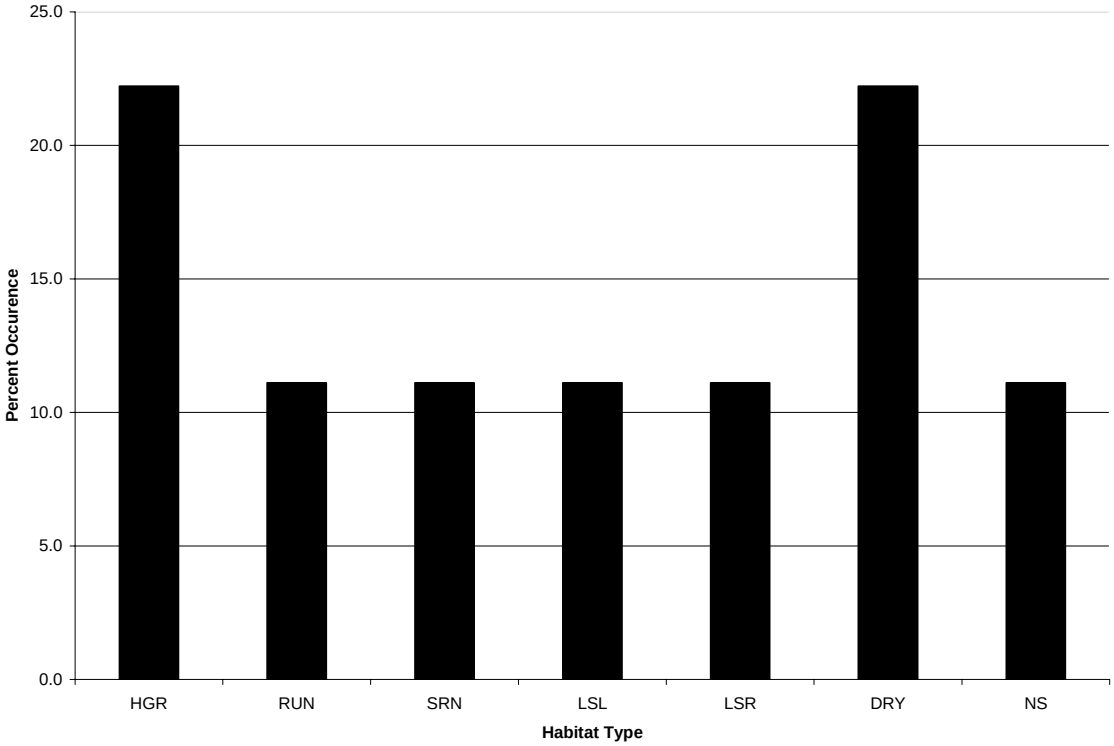

Figure F-10. Percent occurrence of habitat types surveyed in segment CU09 within the Greenwood WAU, 2003.

Big Tree (Segment CU10)

The segment surveyed consisted of 31% pool, 59% riffle, and 10% flatwater by stream length (Table F-5). The percentage of pools in the segment was moderate and there was a high percentage of riffle habitat. The majority of pools were mid-channel pools (65%, Figure F-11). The dominant cover available to fish in pools in the segment was LWD (74%, Table F-3). The mean residual pool depth was 1.8 feet, with 0% of pools having residual depths ≥3 feet. The shelter rating was high (128), mainly due to good cover complexity and availability. There were significant amounts of key LWD (31.9 pieces per 328 feet) observed in the segment, although the majority of the key LWD was present in debris accumulations. Only 10% of pools were formed by LWD and there were 26.4 pieces of woody debris ≥10" diameter per 328ft. surveyed. The dominant tailout substrate was large gravel, and the embeddedness rating was moderate (>50%).

Spawning Habitat

Spawning habitat in the segment appeared to be fair due to a moderate percentage of spawnable gravels available to fish in tailouts (35% of tailout area). The dominant tailout substrate size (large gravel) was within the preferred range of salmonids, and spawning gravels were moderately embedded.

Summer Rearing Habitat

Summer rearing habitat in the segment was fair due to high amounts of key LWD and a high shelter rating. However, there was an absence of pools with residual depths ≥3 feet and a low frequency of pools.

Overwintering Habitat

Overwintering habitat in the segment was fair due to high amounts of key LWD and high shelter ratings. However, there was an absence of pools with residual depths ≥3 feet, a minimal amount of overwintering substrate, and a low frequency of pools.

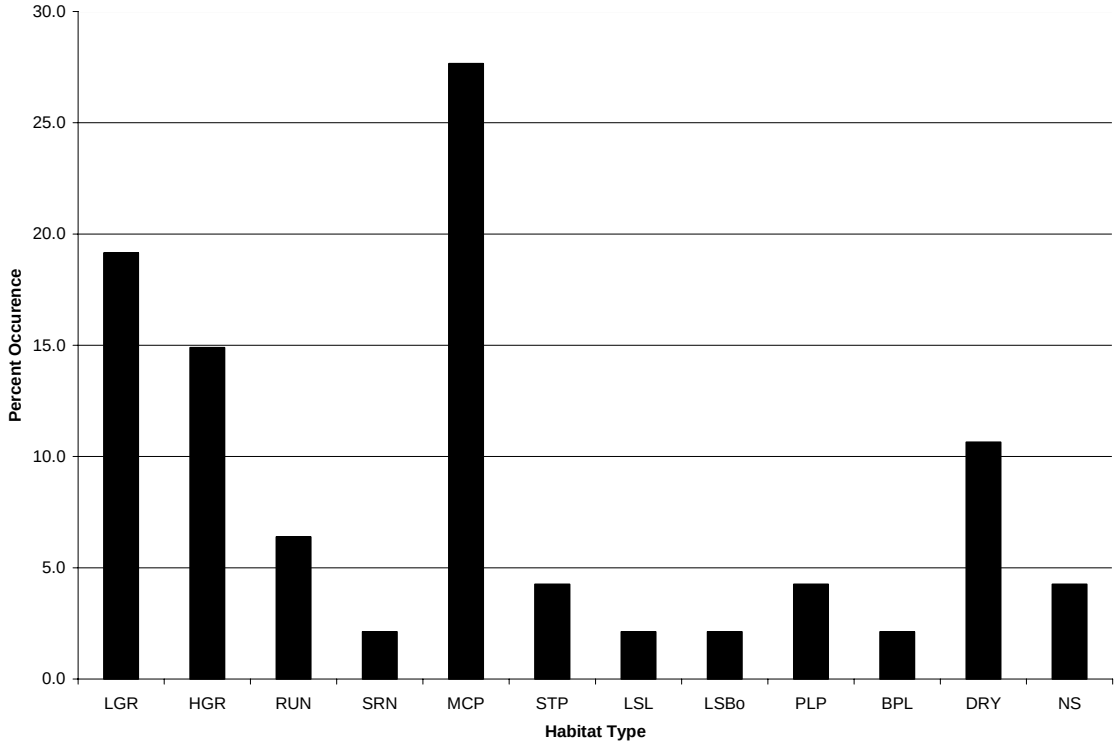

Figure F-11. Percent occurrence of habitat types surveyed in segment CU10 within the Greenwood WAU, 2003.

Permeability and Bulk Gravel Samples

Results from permeability and percent fine particles <0.85 mm for the Greenwood WAU are presented in Table F-6. MRC uses the following criteria for evaluating permeability: 0-3000 cm/hr is deficient, 3000-10,000 cm/hr is marginal, and >10,000 cm/hr is on target. The geometric mean permeability observations for the stream segment observed (4 are long term channel monitoring segments) in the Greenwood WAU are deficient. These observations are something that will have to be watched over time. Particularly due to the fact that the trend observed is toward decreasing permeability from 2001-2003. A mean observation, as presented for the segments, provides an index of the segment's condition, however, even with the low mean observations all of the segments have permeability observations in the range of the marginal criteria. This suggests that though the mean observations are low, and of concern, there are areas of good quality spawning gravels within the segments sampled. However, in 2001 the range of permeability extended into our on target category, while 2003 did not have any on target observations.

The percentage of fine sediment (<0.85 mm) was excellent in the Greenwood WAU. The highest observations was for 6 percent fine particles <0.85 mm in the CU1 segment. The estimated percent survival of emerging steelhead, as calculated from Tappel and Bjorn equations (1983), varied from 83% to 100% and 73% to 88% for 2001 and 2003 respectively (Table F-5). These observations show good results while the permeability observations do not. With only 2 years of observations it is difficult to interpret what this means.

These survival indices reflect conditions at pool tail-outs where a spawning fish has not worked the gravel into a redd. Therefore they reflect the relative quality of stream gravel that a spawning fish encounters upon entering the stream. Areas of stream gravel with a high survival percentage would likely be preferred by spawning fish and likely have better survival success for emerging fish. Areas of stream gravel with a low survival index percentage may not be of completely poor quality; particularly because the permeability and gravel quality will be improved following redd development.

Table F-5. Permeability and Percent Fine Sediment <0.85 mm and Associated Survival Indices for One Long Term Monitoring Segment of the Greenwood WAU; 2001 and 2003.

Stream Name	Year	Geometric Mean Permeability for Segment (cm/hr)	Standard Error Permeability (cm/hr)	Range of Permeability Observations (cm/hr)	Survival Index (Taggart/ McCuddin)	Tappel/ Bjorn Steelhead Survival Index	Range Percent Particles <0.85mm
Greenwood Creek (CU1)	2001	819	2208	1-42,846	17%	83-100%	0-5%
	2003	357	317	1-5,717	5%	76-88%	4-6%

Aquatic Species Distribution

Map F-1 represents the salmonid distribution in the Greenwood WAU as we currently know it. Map F-1 was generated using data collected during the aquatic species distribution surveys. If no adult salmonid upstream migration barrier was found, then the upper extent of salmonid (steelhead and coho) distribution is mapped as far upstream as juveniles have been found. In most circumstances this is close to the actual extent of salmonid distribution. However, in some streams salmonid distribution may extend further upstream, this is interpreted as the potential

distribution. The potential distribution is our interpretation at this point in time for larger streams; it is highly likely the actual potential distribution is larger.

There is a taxonomic uncertainty that is important to note. Juvenile steelhead and resident rainbow trout cannot be distinguished between in the field. For the purpose of this report, *Oncorhynchus mykiss* juveniles are referred to as "steelhead" if there is not a known migration barrier downstream. If there is a migration barrier downstream the juveniles are referred to as "rainbow trout". Some streams lack aquatic species distribution information. Data from six years of aquatic species distribution surveys (MRC 2002) are located in Appendix F. The Site ID's presented in Appendix F are also depicted on Map F-1.

LITERATURE CITED

Barnhard, K. and S. McBain. 1994. Standpipe to determine permeability, dissolved oxygen, and vertical particle size distribution in salmonid spawning gravels. Fish Habitat Relationships Tech. Bull. No 15. USDA- Forest Service. Six Rivers National Forest, Eureka, CA. 12p.

Bilby R.E., and J.W. Ward. 1989. Changes in characteristics and function of woody debris with increasing size of streams in Western Washington. Transactions of the American Fisheries Society 118: 368-378.

Bisson P.A., R.E. Bilby, M.D. Bryant, C.A. Dolloff, G.B. Grette, R.A. House, M.L. Murphy, K.V. Koski, and J.R. Sedell. 1987. Large woody debris in forested streams in the Pacific Northwest: past, present, and future. Streamside Management: Forestry and Fishery Interactions, pp. 143-190. Contribution 57. University of Washington Institute of Forest Resources, Seattle.

Bjorn T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Influences of forest and rangeland management on salmonid fishes and their habitats. Transactions of the American Fisheries Society 117: 262-273.

CDFG. 2002. California Stream Habitat Restoration Manual. Third Edition. Vol. 2. CDFG.

Flosi G., and F.L. Reynolds. 1994. California Stream Habitat Restoration Manual. California Department of Fish and Game.

Louisiana Pacific. 1996. Louisiana Pacific Watershed Analysis Manual. Louisiana-Pacific Corporation, Forest Resources Division. Calpella, CA.

McCuddin, M.E. 1977. Survival of salmon and trout embryos and fry in gravel-sand mixtures. M.S. Thesis, University of Idaho, Moscow.

Mendocino Redwood Company. 2000. Preliminary results of redd vs. non-redd permeabilities in the Garcia River. Company Report, Fort Bragg, CA.

Mendocino Redwood Company. 2002. Aquatic species distribution on Mendocino Redwood Company forestlands, 1994-1996 and 2000-2002. Company Report, Fort Bragg, CA.

Montgomery D.R., J.M. Buffington, R.D. Schmidt. 1995. Pool spacing in forest channels. Water Resources Research, 31: 1097-1104.

Platts W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA-Forest Service Gen. Tech. Rep. INT-138.

Stillwater Ecosystems, Watershed and Riverine Sciences. 1998. Chapter 3, Stream Channel Monitoring in Draft report on adoptive management and monitoring, pp.13-36. Louisiana-Pacific.

Stillwater Ecosystems, Watershed and Riverine Sciences. 2000. Personal communication of stream permeability index.

Tagart, J.V. 1976. The survival from egg deposition to emergence of coho salmon in the Clearwater River, Jefferson County, Washington. M.S. Thesis, University of Washigton.

Tappel, P.D. and T.C. Bjorn. 1983. A new method of relating size of spawning gravel to salmonid embryo survival. North American Journal of Fisheries Management 3: 123-135.

Terhune. L. D. B. 1958. The Mark IV groundwater standpipe for measuring seepage through salmon spawning gravel. Fish Res. Bd. Canada, 15(5), pp. 1027-1063.

Washington Forest Practice Board. 1997. Board Manual: Standard Methodology for Conducting Watershed Analysis. Version 4.0. Washington Forest Practice Board, Olympia, WA.

APPENDIX F

Table A121. Summary of results for aquatic species surveys within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

STREAM NAME	SITE ID	DATE	STH <70 MM	STH 70-130 MM	STH >130 MM	COH <70 MM	COH 70-130 MM	OTHER SPECIES
GREENWOOD CREEK	84-01	8/4/1994	2	3	2			SCP STB
GREENWOOD CREEK	84-01	6/16/1995	PRESENT	PRESENT	PRESENT			SCP STB
GREENWOOD CREEK	84-01	7/27/1996	PRESENT	PRESENT	PRESENT			RCH STB YLF
GREENWOOD CREEK	84-01	7/28/2000	11	2				CRY SCP
GREENWOOD CREEK	84-01	7/27/2001	11	5				CR PR YLF
GREENWOOD CREEK	84-01	8/30/2002	5	17	2			STB
TRIB TO GREENWOOD CREEK #1	84-02	8/12/1996	PRESENT	PRESENT	PRESENT			PGS
TRIB TO GREENWOOD CREEK #1	84-02	7/28/2000	10					RLF
TRIB TO GREENWOOD CREEK #1	84-02	7/30/2001	9					PGS
GREENWOOD CREEK	84-03	8/4/1994	18	9	1			PGS RCH
GREENWOOD CREEK	84-03	6/22/1995	PRESENT	PRESENT	PRESENT			RCH
GREENWOOD CREEK	84-03	6/13/1996	PRESENT	PRESENT	PRESENT			NEW RCH YLF
GREENWOOD CREEK	84-03	7/28/2000	16	3				PGS
GREENWOOD CREEK	84-03	7/27/2001	45	7	1			YLF
HEATHER GULCH	84-04	8/4/1994	24	5				PGS

* Species Abbreviations; AMM=Pacific Lamprey Larvae; BLF=Bullfrog; BKS=Black Salamander; BUFO=Western Toad; CDS=Clouded Salamander; CHK=Chinook Salmon; CNT=California Newt; COH=Coho Salmon; CR=Coast Range Sculpin; CRY=Crayfish; LAM=Pacific Lamprey; NAL=Northern Alligator Lizard; NEW=Newt (Unidentified Species); NWP=Western Pond Turtle; PBL=Pacific Brook Lamprey; PGS=Pacific Giant Salamander; PR=Prickly Sculpin; PTF=Pacific Tree Frog; RCH=California Roach; RLF=Red Legged Frog; RSN=Rough Skinned Newt; SCP=Sculpin (Unidentified Species); SKR=Sacramento Sucker; STB=Stickleback; STH=Steelhead Trout; TLF=Olympic Tailed Frog; WAGS=Western Aquatic Garter Snake; YLF=Yellow Legged Frog.

* Blank spaces indicate that no organisms were observed.

*Click here to view physical data.
*Click on a Site ID to view map.

Table A122. Summary of results for aquatic species surveys within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

STREAM NAME	SITE ID	DATE	STH <70 MM	STH 70-130 MM	STH >130 MM	COH <70 MM	COH 70-130 MM	OTHER SPECIES
HEATHER GULCH	84-04	6/22/1995	PRESENT	PRESENT				CNT NEW
HEATHER GULCH	84-04	6/13/1996	PRESENT					
HEATHER GULCH	84-04	7/28/2000	17					PGS
HEATHER GULCH	84-04	7/27/2001	17	1				PGS
TRIB TO HEATHER GULCH #1	84-10	7/28/2000	13	6				PGS YLF
TRIB TO HEATHER GULCH #1	84-10	7/27/2001	6	1				PGS
HEATHER GULCH	84-05	8/12/1996	PRESENT	PRESENT	PRESENT			PGS YLF
HEATHER GULCH	84-05	7/28/2000	3	1	1			PGS
HEATHER GULCH	84-05	7/27/2001		5	1			PGS YLF
HEATHER GULCH	84-05	7/4/2002	21	11				PGS
TRIB TO GREENWOOD CREEK #2	84-06	8/4/1994	2	10	2			PGS
TRIB TO GREENWOOD CREEK #2	84-06	8/4/1995	PRESENT	PRESENT				PGS
TRIB TO GREENWOOD CREEK #2	84-06	6/13/1996	PRESENT					
TRIB TO GREENWOOD CREEK #2	84-06	7/31/2000	8					PGS
TRIB TO GREENWOOD CREEK #2	84-06	7/26/2001	9	5	1			PGS

* Species Abbreviations; AMM=Pacific Lamprey Larvae; BLF=Bullfrog; BKS=Black Salamander; BUFO=Western Toad; CDS=Clouded Salamander; CHK=Chinook Salmon; CNT=California Newt; COH=Coho Salmon; CR=Coast Range Sculpin; CRY=Crayfish; LAM=Pacific Lamprey; NAL=Northern Alligator Lizard; NEW=Newt (Unidentified Species); NWP=Western Pond Turtle; PBL=Pacific Brook Lamprey; PGS=Pacific Giant Salamander; PR=Prickly Sculpin; PTF=Pacific Tree Frog; RCH=California Roach; RLF=Red Legged Frog; RSN=Rough Skinned Newt; SCP=Sculpin (Unidentified Species); SKR=Sacramento Sucker; STB=Stickleback; STH=Steelhead Trout; TLF=Olympic Tailed Frog; WAGS=Western Aquatic Garter Snake; YLF=Yellow Legged Frog.

* Blank spaces indicate that no organisms were observed.

*Click here to view physical data.
*Click on a Site ID to view map.

Table A123. Summary of results for aquatic species surveys within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

STREAM NAME	SITE ID	DATE	STH <70 MM	STH 70-130 MM	STH >130 MM	COH <70 MM	COH 70-130 MM	OTHER SPECIES
TRIB TO GREENWOOD CREEK #2	84-06	7/22/2002	6					PGS
BIG TREE CREEK	84-07	8/4/1994	20	8				
BIG TREE CREEK	84-07	8/4/1995	PRESENT	PRESENT				PGS
BIG TREE CREEK	84-07	6/13/1996	PRESENT	PRESENT				
BIG TREE CREEK	84-07	7/31/2000	12	2				PGS
BIG TREE CREEK	84-07	7/26/2001	1					PGS
BIG TREE CREEK	84-07	7/22/2002	6					PGS
BIG TREE CREEK	84-11	7/22/2002						PGS
GREENWOOD CREEK	84-08	8/4/1994	7	4	3			RCH
GREENWOOD CREEK	84-08	6/16/1995	PRESENT	PRESENT				NEW PGS
GREENWOOD CREEK	84-08	6/13/1996	PRESENT	PRESENT	PRESENT			
GREENWOOD CREEK	84-08	7/31/2000	23	10	1			PGS RCH YLF
GREENWOOD CREEK	84-08	7/26/2001	26	2	1			PGS YLF
GREENWOOD CREEK	84-08	7/22/2002	9	2				PGS RCH
GREENWOOD CREEK	84-09	8/12/1996	PRESENT	PRESENT	PRESENT			PGS

* Species Abbreviations; AMM=Pacific Lamprey Larvae; BLF=Bullfrog; BKS=Black Salamander; BUFO=Western Toad; CDS=Clouded Salamander; CHK=Chinook Salmon; CNT=California Newt; COH=Coho Salmon; CR=Coast Range Sculpin; CRY=Crayfish; LAM=Pacific Lamprey; NAL=Northern Alligator Lizard; NEW=Newt (Unidentified Species); NWP=Western Pond Turtle; PBL=Pacific Brook Lamprey; PGS=Pacific Giant Salamander; PR=Prickly Sculpin; PTF=Pacific Tree Frog; RCH=California Roach; RLF=Red Legged Frog; RSN=Rough Skinned Newt; SCP=Sculpin (Unidentified Species); SKR=Sacramento Sucker; STB=Stickleback; STH=Steelhead Trout; TLF=Olympic Tailed Frog; WAGS=Western Aquatic Garter Snake; YLF=Yellow Legged Frog.

* Blank spaces indicate that no organisms were observed.

*Click here to view physical data.
*Click on a Site ID to view map.

Table A124. Summary of results for aquatic species surveys within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

STREAM NAME	SITE ID	DATE	STH <70 MM	STH 70-130 MM	STH >130 MM	COH <70 MM	COH 70-130 MM	OTHER SPECIES
GREENWOOD CREEK	84-09	7/31/2000	3	2				PGS
GREENWOOD CREEK	84-09	7/26/2001		2				CNT PGS
GREENWOOD CREEK	84-09	7/22/2002	3	3				PGS

* Species Abbreviations; AMM=Pacific Lamprey Larvae; BLF=Bullfrog; BKS=Black Salamander; BUFO=Western Toad; CDS=Clouded Salamander; CHK=Chinook Salmon; CNT=California Newt; COH=Coho Salmon; CR=Coast Range Sculpin; CRY=Crayfish; LAM=Pacific Lamprey; NAL=Northern Alligator Lizard; NEW=Newt (Unidentified Species); NWP=Western Pond Turtle; PBL=Pacific Brook Lamprey; PGS=Pacific Giant Salamander; PR=Prickly Sculpin; PTF=Pacific Tree Frog; RCH=California Roach; RLF=Red Legged Frog; RSN=Rough Skinned Newt; SCP=Sculpin (Unidentified Species); SKR=Sacramento Sucker; STB=Stickleback; STH=Steelhead Trout; TLF=Olympic Tailed Frog; WAGS=Western Aquatic Garter Snake; YLF=Yellow Legged Frog.

* Blank spaces indicate that no organisms were observed.

*Click here to view physical data.
*Click on a Site ID to view map.

Table B121. Summary of site parameters within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

Stream Name	SITE ID	DATE	METHOD e=electrofish d=dive v=visual	EFFORT (minutes)	DISTANCE SAMPLED (feet)	POOL:RIFFLE: FLATWATER SAMPLED (%)	VISIBILITY*	FLOW*	DO (mg/l)	TEMP (°C)	pH
GREENWOOD CREEK	84-01	8/4/1994	E	5	100		3	2		15	
GREENWOOD CREEK	84-01	6/16/1995	D				3	3		13	
GREENWOOD CREEK	84-01	7/27/1996	D				3	3		15	
GREENWOOD CREEK	84-01	7/28/2000	E	4	117	23:53:24	3	1	9.7	15	7.8
GREENWOOD CREEK	84-01	7/27/2001	E	4	112	52:48:0	3	2	10.5	15.1	8.0
GREENWOOD CREEK	84-01	8/30/2002	D		200	100:0:0	3	2	8.4	14.3	8
TRIB TO GREENWOOD CREEK #1	84-02	8/12/1996	E	5			3	1		14	
TRIB TO GREENWOOD CREEK #1	84-02	7/28/2000	E	3	97	56:44:0	3	1	7	14	7.2
TRIB TO GREENWOOD CREEK #1	84-02	7/30/2001	E	2	90	51:49:0	3	0	5.08	13.6	6.6
GREENWOOD CREEK	84-03	8/4/1994	E	5	95		3	1		20	
GREENWOOD CREEK	84-03	6/22/1995	D				3	3		13	
GREENWOOD CREEK	84-03	6/13/1996	D				3	3		15.5	
GREENWOOD CREEK	84-03	7/28/2000	E	5	263	70:30:0	3	1	10	18	8.2
GREENWOOD CREEK	84-03	7/27/2001	E	4	119	71:29:0	3	2	7.8	16.2	7.8
HEATHER GULCH	84-04	8/4/1994	E	5	90		2	1		15	

*Visibility: 1=<1 ft. 2=1-5 ft. 3=>5 ft.

*Flow: 0=Intermittent 1=<1 CFS 2=1-5 CFS 3=>5 CFS

*Blank spaces indicate that no data was collected.

*Click here to view biological data.
*Click on a Site ID to view map.

Table B122. Summary of site parameters within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

Stream Name	SITE ID	DATE	METHOD e=electrofish d=dive v=visual	EFFORT (minutes)	DISTANCE SAMPLED (feet)	POOL:RIFFLE: FLATWATER SAMPLED (%)	VISIBILITY*	FLOW*	DO (mg/l)	TEMP (°C)	pH
HEATHER GULCH	84-04	6/22/1995	D				3	2		12	
HEATHER GULCH	84-04	6/13/1996	D				3	2		14	
HEATHER GULCH	84-04	7/28/2000	E	2	122	19:65:16	3	1	9.3	16	8
HEATHER GULCH	84-04	7/27/2001	E	2	115	37:63:0	3	1	8.1	13.1	7.5
TRIB TO HEATHER GULCH #1	84-10	7/28/2000	E	3	74	73:27:0	3	1	9.2	16	7.7
TRIB TO HEATHER GULCH #1	84-10	7/27/2001	E	2	118	31:69:0	3	1	7.17	12.1	7.2
HEATHER GULCH	84-05	8/12/1996	E	5			3	1		16.5	
HEATHER GULCH	84-05	7/28/2000	E	2	90	47:20:33	3	1	7.67	15	7.4
HEATHER GULCH	84-05	7/27/2001	E	3	90	53:47:0	3	1	6.04	12.7	6.8
HEATHER GULCH	84-05	7/4/2002	V		900	44:56:0					
TRIB TO GREENWOOD CREEK #2	84-06	8/4/1994	E	5	75		2	1		18	
TRIB TO GREENWOOD CREEK #2	84-06	8/4/1995	E	7			3	1		14.5	
TRIB TO GREENWOOD CREEK #2	84-06	6/13/1996	V	8			3	2		15	
TRIB TO GREENWOOD CREEK #2	84-06	7/31/2000	E	2	87	63:37:0	3	1	8.26	14	7.9
TRIB TO GREENWOOD CREEK #2	84-06	7/26/2001	E	3	111	49:51:0	3	1	7.2	13.6	7.4

*Visibility: 1=<1 ft. 2=1-5 ft. 3=>5 ft.

*Flow: 0=Intermittent 1=<1 CFS 2=1-5 CFS 3=>5 CFS

*Blank spaces indicate that no data was collected.

*Click here to view biological data.
*Click on a Site ID to view map.

Table B123. Summary of site parameters within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

Stream Name	SITE ID	DATE	METHOD e=electrofish d=dive v=visual	EFFORT (minutes)	DISTANCE SAMPLED (feet)	POOL:RIFFLE: FLATWATER SAMPLED (%)	VISIBILITY*	FLOW*	DO (mg/l)	TEMP (°C)	pH
TRIB TO GREENWOOD CREEK #2	84-06	7/22/2002	E	1	82	59:41:0	3	0	7.39	14.5	7.1
BIG TREE CREEK	84-07	8/4/1994	E	5	50		2	1		17.5	
BIG TREE CREEK	84-07	8/4/1995	E	4			3	1		15	
BIG TREE CREEK	84-07	6/13/1996	D				2	2		13	
BIG TREE CREEK	84-07	7/31/2000	E	4	108	69:20:10	3	1	8.1	15	7.6
BIG TREE CREEK	84-07	7/26/2001	E	3	94	38:62:0	3	1	7.11	13.8	6.6
BIG TREE CREEK	84-07	7/22/2002	E	1	92	35:65:0	3	1	7.17	14.5	7.2
BIG TREE CREEK	84-11	7/22/2002	E	2	157	69:31:0	3	0	5.16	14.3	6.8
GREENWOOD CREEK	84-08	8/4/1994	E	5	50		3	1		18	
GREENWOOD CREEK	84-08	6/16/1995	D				3	3		12.5	
GREENWOOD CREEK	84-08	6/13/1996	D				3	2		14	
GREENWOOD CREEK	84-08	7/31/2000	E	6	129	81:9:9	3	1	7.9	17	8.2
GREENWOOD CREEK	84-08	7/26/2001	E	4	102	45:55:0	3	2	8.45	14.6	7.6
GREENWOOD CREEK	84-08	7/22/2002	E	1	97	61:39:0	3	1	7.37	16.2	7.5
GREENWOOD CREEK	84-09	8/12/1996	E	7			3	1		16.5	

*Visibility: 1=<1 ft. 2=1-5 ft. 3=>5 ft.

*Flow: 0=Intermittent 1=<1 CFS 2=1-5 CFS 3=>5 CFS

*Blank spaces indicate that no data was collected.

*Click here to view biological data.
*Click on a Site ID to view map.

Table B124. Summary of site parameters within the Greenwood Creek watershed, Mendocino Co., California. Refer to Maps 26-27.

Stream Name	SITE ID	DATE	METHOD e=electrofish d=dive v=visual	EFFORT (minutes)	DISTANCE SAMPLED (feet)	POOL:RIFFLE: FLATWATER SAMPLED (%)	VISIBILITY*	FLOW*	DO (mg/l)	TEMP (°C)	pH
GREENWOOD CREEK	84-09	7/31/2000	E	5	177	57:43:0	3	1	8	15	8.2
GREENWOOD CREEK	84-09	7/26/2001	E	4	96	47:53:0	3	2	6.7	16.5	7.5
GREENWOOD CREEK	84-09	7/22/2002	E	2	91	65:22:13	3	1	8	15.7	7.3

*Visibility: 1=<1 ft. 2=1-5 ft. 3=>5 ft.

*Flow: 0=Intermittent 1=<1 CFS 2=1-5 CFS 3=>5 CFS

*Blank spaces indicate that no data was collected.

*Click here to view biological data.
*Click on a Site ID to view map.