CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT
Bear Creek
Report Revised April 14, 2006
Report Completed 2000
Assessment Completed 1996

INTRODUCTION

A stream inventory was conducted during the summer of 1996 on Bear Creek. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish, and other aquatic species with an emphasis on anadromous salmonids in Bear Creek. The objective of the biological inventory was to document the salmonid and other aquatic species present and their distribution.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for Chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Bear Creek is a tributary to McDonnell Creek which flows into Maacama Creek, a tributary of the Russian River, located in Sonoma County, California (see Bear Creek map, page 2). The legal description at the confluence with the McDonnell Creek is T10N, R8W, S22. Its location is 38°42'5" N. latitude and 122°44'9" W. longitude. Seasonal vehicle access exists from private gated roads via highway 128 between Calistoga and Healdsburg.

Bear Creek and its tributaries drain a basin of approximately 2.5 square miles. Bear Creek is a second order stream and has approximately 3.2 miles of blue line stream, according to the USGS Mt. St. Helena 7.5 minute quadrangle. Elevations range from about 380 feet at the mouth of the creek to 2940 feet in the headwaters. Oak-woodland and grassland dominate the watershed, which is entirely privately owned. The Socrates Mine Jewelflower (*Streptanthus brachiatus ssp. brachiatus*) was listed in DFG's Natural Diversity Database for Bear Creek Watershed.

METHODS

The habitat inventory conducted in Bear Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flossi and Reynolds, 1994). The Americorps Volunteers 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 and was supervised by Bob Coey, Russian River Basin Planner (DFG).

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 Bear Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows were also measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1996). This methodology is described in the California Salmonid Stream Habitat Restoration Manual. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity.

3. Temperatures:

Water and air temperatures, and time, are measured by crew members with hand held thermometers and recorded at each tenth unit typed. Temperatures are measured in Fahrenheit at the middle of the habitat unit and within one foot of the water surface.
Temperatures are also recorded using remote Temperature recorders which log temperature every two hours, 24 hours/day.

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". Bear

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 unit lengths were measured, additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were completely sampled (length, mean width, mean depth, maximum depth and pool tail crest depth). All measurements were in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Bear Creek, embeddedness was visually estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4). Additionally, a rating of "not suitable" (NS) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All shelter is then classified according to a list of nine shelter types. In Bear Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the shelter. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent covered. 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 measured habitat units, dominant and sub-dominant substrate elements were visually estimated using a list of seven size classes.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the California Salmonid

Stream Habitat Restoration Manual, 1998. Canopy density relates to the amount of stream shaded from the sun. In Bear 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 visually into percentages of evergreen or deciduous trees.

9. Bank Composition:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Bear Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully measured unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, 3) electrofishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE IV 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 tables and appendices:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Shelter by habitat types
- Dominant substrates by habitat types
- Vegetative cover and dominant bank composition
- Fish habitat elements by stream reach

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for Bear Creek include:

- Level II Habitat Types by % Occurrence and % Total Length
- Level IV Habitat Types by % Occurrence
- Pool Habitat Types by % Occurrence
- Maximum Depth in Pools
- Pool Shelter Types by % Area
- Substrate Composition in Low Gradient Riffles
- Percent Cobble Embeddedness by Reach
- Mean Percent Canopy
- Mean Percent Canopy by Reach
- Percent Bank Composition and Bank Vegetation

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HABITAT INVENTORY RESULTS

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

The habitat inventory of June 13-27, 1996 was conducted by Eddie Sanchez, Sarah Nossaman, and Ann Huber (AmeriCorps) and data analyzed by Ken Bunzel (DFG). The survey began at the confluence with the McDonnell Creek and extended up Bear Creek to the end of the survey. The total length of the stream surveyed was 7,731 feet (1.5 miles), with an additional 255 feet of side channel. A flow of 0.75 cfs was measured on June 27, 1996 about 100 feet upstream of the mouth (habitat unit 3). Another flow of 0.06 cfs was measured on August 27, 1996 about 60 feet from the mouth (habitat unit 2). Both flows were measured using a Marsh-McBirney Model 2000 flowmeter.

This section of Bear Creek has four channel types: from the mouth to 2,362 feet a B4; next 765 feet an A2; next 1,254 feet an F4 and the upper 3,349 feet a B2. B4 channel types are moderately entrenched, moderate gradient (2-4%), riffle dominated channels, with infrequently spaced pools, a very stable plan and profile, stable banks and have a predominantly gravel substrate. B2 channel types are similar except with a predominantly boulder substrate. A2 channel types are steep (4-10%), narrow, cascading, step-pool streams with a high energy/debris transport associated with depositional soils and a predominantly boulder substrate. F4 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly gravel substrate.

Water temperatures ranged from 56-64°F. Air temperatures ranged

from 56-87°F. Summer temperatures were also measured using a remote temperature recorder placed in a pool in Reach 1 (habitat unit 31). The recorder logged temperatures every 2 hours from June 20 - October 4, 1996 (see Temperature Summary graph at end of report). The highest temperature recorded was 69.8°F in July and the lowest was 57.6°F in October. The mean of the daily highs was 65.8°F for the month of June, 67.6°F for July, 64.3°F for August, 61.0°F for September, and 59.8°F for October.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 42% flatwater units, 31% pool units, 26% riffle units, and 1% dry streambed units. Based on total **length** there were 49% flatwater units, 26% riffle units, 23% pool units, and 2% dry streambed units (Graph 1).

One hundred, twenty-seven habitat units were measured and 37% were completely sampled. Seventeen Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffles at 23%, runs 21%, step runs 11% and mid-channel pools 8% (Graph 2). By percent total **length**, low gradient riffles made up 24%, runs 21%, step runs 18%, and glides 7%.

Forty pools were identified (Table 3). Scour pools were most often encountered at 55%, and comprised 45% of the total length of pools (Graph 3). No backwater pools were identified. Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Thirty-seven of the 40 pools (93%) had a depth of two feet or greater (Graph 4). These deeper pools comprised 21% of the total length of stream habitat.

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. Pool types had the highest shelter rating at 48. Riffles had the lowest rating with 7 and flatwater rated 20 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 54, and main channel pools rated 41 (Table 3). Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were boulders at 63%, root masses 13%, and undercut banks 8%. Graph 5 describes the pool shelter in Bear Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in three of the nine (33%) low gradient riffles measured. Small cobble was dominant in two of the low gradient riffles (Graph 6). The depth of cobble embeddedness was estimated at pool tail-outs. Of the 40 pool tail-outs

measured, nine had a value of 1 (23%); eighteen had a value of 2 (45%); twelve had a value of 3 (30%); and one had a value of 4 (3%). On this scale, a value of one is best for fisheries.

The mean percent canopy density for the stream reach surveyed was 76%. The mean percentages of deciduous and evergreen trees were 43% and 57%, respectively. Graph 8 describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 65% and the mean percent left bank vegetated was 65%. For the habitat units measured, the dominant vegetation types for the stream banks were: 50% evergreen trees, 26% deciduous trees, 23% grass, and 1% bare soil (Graph 11). The dominant substrate for the stream banks were: 67% silt/clay/sand, 22% bedrock, 8% boulder and 3% cobble/gravel (Graph 10).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

On June 25, 1996 a biological inventory was conducted in four sites of Bear Creek to document fish species composition and distribution. Each site was single pass electrofished using one Smith Root Model 12 electrofisher. Fish from each site were counted by species, and returned to the stream. The air temperature ranged from 66-72°F and the water temperature ranged from 61-64°F. The observers were Nossaman, Huber and Fort (AmeriCorps).

The inventory of Reach 1 started 100 feet above the confluence with McDonnell Creek and continued for approximately 1243 feet in habitat units 4-26. In pool and riffle habitat types 70 0+, 8 1+ and 2 2+ steelhead were observed along with 6 juvenile sculpin (Cottus Sp.).

The inventory of Reach 2 was conducted in habitat units 41-156. In pool and riffle habitat types 41 0+, seven 1+ and one 2+ were observed. This section was approximately 1445 feet.

The inventory of Reach 3 was conducted in habitat units 59-78. In pool and riffle habitat types 41 0+, steelhead were observed along with 6 frogs and one newt. This section was approximately 1070 feet.

The inventory of Reach 4 was conducted in habitat units 86-100. In pool and riffle habitat types 37 0+, two 2+ steelhead were observed

along with 2 frogs. This section was approximately 890 feet.

A summary of historical and recent data collected appears in the table below.

Species Observed In DFG 1996 Survey	
SPECIES	**Native/Introduced**
Steelhead	N
Sculpin	N

No introduced species were observed, and historical records reflect no hatchery stocking, transfers, or rescues have occurred in the watershed.

DISCUSSION

Bear Creek has four channel types: B4, A2, F4 and B2. There are 2,362 feet of B4 channel type in Reach 1. According to the DFG Salmonid Stream Habitat Restoration Manual, fishery enhancement opportunities in B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs.

There are 765 feet of A2 channel type in Reach 2. The high energy, steep gradient A2 channel types have stable stream banks and poor gravel retention capabilities and are generally not suitable for instream enhancement structures.

There are 1,254 feet of F4 channel type in Reach 3. F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover.

There are 3,349 feet of B2 channel type in Reach 4. B2 channel types are excellent for low and medium-stage plunge weirs, single and opposing wing deflectors and bank cover. The above B and F channel types have gradients and the stable stream banks that are suitable for instream habitat improvement alternatives designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish.

The water temperatures recorded on the survey days June 13-27, 1996

ranged from 56-64°F. Air temperatures ranged from 56-87°F. This temperature regime is favorable to salmonids. Summer temperatures measured using a remote temperature recorder placed in a pool in Reach 1 ranged from 58-70°F. The Temperature Summary graph shows that for the months of June and July the lower watershed exhibited temperatures optimal for salmonids.

Pools comprised 23% of the total **length** of this survey. 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. In Bear Creek, the pools are relatively deep with 93% having a maximum depth of at least 2 feet, comprising 21% of the total length of stream habitat.

The mean shelter rating for pools was 48, provided primarily by boulders. Instream shelter provides rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

Fifty-six percent of the low gradient riffles measured had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In a reach comparison, Reach 2 had the least amount of sediment, with all pool tail-outs having a rating of 1. Typically, A2 channels have low levels of fine sediment due to the steep gradient and high energy carrying fine particles downstream. However, the predominantly boulder substrate limits utilization for spawning salmonids. Reach 4 (B2 channel type) had the highest embeddedness ratings with more than half of the pool tail-outs having a rating of 3 or 4. This channel type has some gravel and cobble available , however, the substrate is predominantly boulder. The best spawning habitat exists in Reaches 1 and 3, where embeddedness ratings are good and gravel is plentiful. Overall, the amount of fine sediment in potential spawning habitat seems to be minimal.

The mean percent canopy for the survey was 76%. This is a fair percentage of canopy, since 80 percent is generally considered desirable.

SUMMARY

Biological surveys were conducted to document fish distribution and are not necessarily representative of population information. The 1996 spring surveys documented many 0+ fish indicating successful

spawning, and many 1+ fish were observed indicating good rearing conditions the year before or good holding-over conditions in general.

Water temperatures are slightly high where stream shade canopy is slightly low. Good spawning habitat exists in Reaches 1 and 3 where there is adequate gravel and low levels of fine sediment. The quantity and depth of pool habitat and shelter is higher than in other tributaries within the McDonnell watershed.

GENERAL RECOMMENDATIONS

Bear Creek should be managed as an anadromous, natural production stream.

Winter storms often bring down large trees and other woody debris into the stream, which increases the number and quality of pools. This woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

SPECIFIC FISHERY ENHANCEMENT RECOMMENDATIONS

1) Increase the canopy on Bear Creek (Reach 3) by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at desired levels.

2) There are existing and bank erosion problems in Reaches 1 and 2 that could lead to increased sediment deposition downstream. Identified sites should then be treated to reduce the amount of fine sediments entering the stream. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against grazing and runoff.

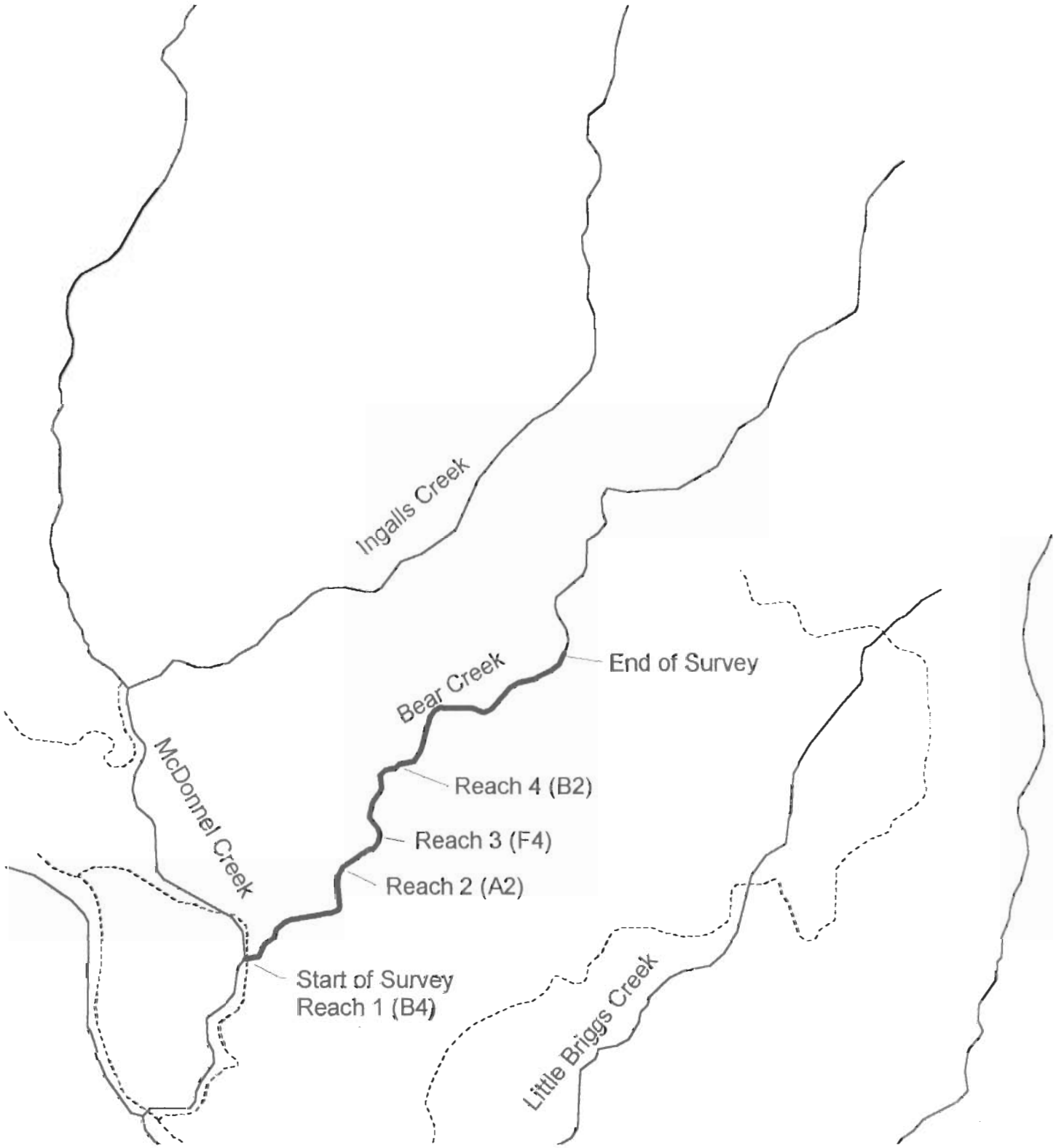
3) Due to its excellent habitat qualities, Bear Creek should be monitored for fish and macroinvertebrate populations. Data collected will aid in restoring other similar Russian River tributaries.

PROBLEM SITES AND LANDMARKS - BEAR CREEK SURVEY COMMENTS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

HABITAT UNIT #	STREAM LEN (FT.)	COMMENTS
1.00	40	TEMP AT CONFLUENCE-60°F.
2.00	73	ROAD CROSSES THROUGH CREEK.
23.00	1202	ROAD ALONG UPPER LEFT BANK, CHANNEL TYPING-B4.
28.00	1408	CRAYFISH SEEN, GOOD TEMP MENTOR AND EF SPOT.
30.00	1601	CHANNEL TYPING-B4.
33.00	1806	LEFT BANK BLOWOUT, 80'L X 8'H X 3'W
35.00	1948	DRY TRIBUTARY LEFT BANK.
37.00	2077	DRY TRIBUTARY LEFT BANK.
38.00	2116	1+ STEELHEAD, JUV. SQUAWFISH.
41.00	2365	BLOWOUT RIGHT BANK,SEE FORM
42.00	2410	ERODIBLE RIGHT BANK,CHANNEL CHANGE FROM B4 TO A2
43.00	2515	DRY TRIB RIGHT BANK, CHANNEL TYPING - A2.
44.00	2603	TOP OF CASCADE
48.00	2960	LANDSLIDE SCARP, RIGHT BANK- 80'H X 80'L X 40'W, HIGHLY ERODIBLE AREA.
49.00	3131	EUTROPHICATION OCCURRING ONLY IN THIS UNIT. DRY TRIBUTARY LEFT BANK AND HIGHLY ERODIBLE LEFT BANK
54.00	3475	DRY CREEK BED
64.00	4215	TWO 1+ STEELHEAD, DRY TRIBUTARY RIGHT BANK.
65.00	4246	CHANNEL TYPING -F4
70.00	4464	DRY TRIBUTARY RIGHT BANK.
77.00	4837	BARBED WIRE CATTLE FENCE ACROSS CREEK, CHANNEL TYPING -B2.
81.00	5016	TRIBUTARY RIGHT BANK W/ SPRING AT BASE-59°F, 61°F AT CONFLUENCE
87.00	5182	TRIB. LF BANK-67°F, CONFLUENCE-63°F NO HABITAT.
91.00	5381	DRY TRIB. RIGHT BANK, CHANNEL TYPING -F2.

Bear Creek


Ingalls Creek
Bear Creek
End of Survey
McDonnel Creek
Reach 4 (B2)
Reach 3 (F4)
Reach 2 (A2)
Start of Survey
Reach 1 (B4)
Little Briggs Creek
Bear Creek Survey
Roads
Streams
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Inland Fisheries Division
Department of Fish and Game
July 19, 1997
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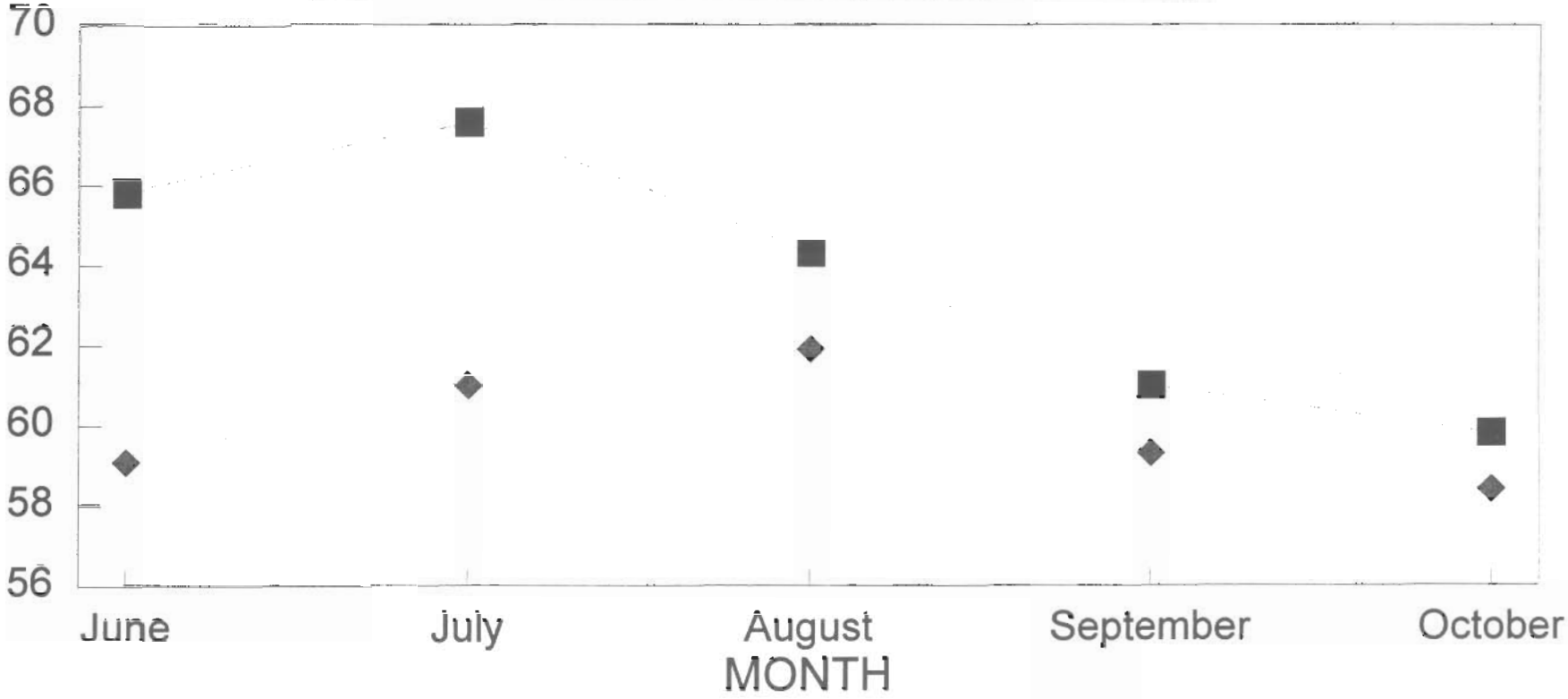
Tempmentor Summary

Bear creek



Sample Period: Jun 20 - Oct 04, 1996
Location: Habitat unit # 31

Bear Creek

Drainage: McDonnel Creek, Maacama Creek, Russian River

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES

Survey Dates: 06/13/96 to 06/27/96

Confluence Location: QUAD: MT ST HELE LEGAL DESCRIPTION: T10NR8WS2 LATITUDE: 38°42'5" LONGITUDE: 122°44'9"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
33	12	RIFFLE	26	64	2102	26	12.3	0.5	461	15211	211	6962	0	7
53	14	FLATWATER	42	73	3891	49	10.2	0.7	601	31866	488	25846	0	20
40	21	POOL	31	46	1853	23	13.8	2.3	597	23878	1485	59396	1179	48
1	0	DRY	1	140	140	2	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
127	47	7986	70955	92203

Bear Creek

Drainage: McDonnel Creek, Maacama Creek, Russian River

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS

Survey Dates: 06/13/96 to 06/27/96

Confluence Location: QUAD: MT ST HELE LEGAL DESCRIPTION: T7ONR8WS2 LATITUDE: 38°42'5" LONGITUDE: 122°44'9"

HABITAT UNITS #	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE %	MEAN LENGTH ft.	TOTAL LENGTH ft.	TOTAL LENGTH %	MEAN WIDTH ft.	MEAN DEPTH ft.	MAXIMUM DEPTH ft.	MEAN AREA sq.ft.	TOTAL AREA EST. sq.ft.	MEAN VOLUME cu.ft.	TOTAL VOLUME EST. cu.ft.	MEAN RESIDUAL POOL VOL cu.ft.	MEAN SHELTER RATING	MEAN CANOPY %
29	9	LGR	23	67	1929	24	13	0.4	1.1	548	15890	229	6655	0	6	75
3	2	HGR	2	47	140	2	10	0.7	1.2	246	737	168	503	0	10	88
1	1	CAS	1	34	34	0	8	1.2	3.0	109	109	131	131	0	10	95
3	3	POW	2	72	215	3	12	0.7	2.7	419	1257	303	910	0	58	67
9	3	GLD	7	65	581	7	14	0.9	2.0	661	5953	617	5556	0	13	71
27	5	RUN	21	63	1692	21	9	0.5	1.4	466	12590	207	5598	0	4	71
14	3	SRN	11	100	1403	18	8	0.7	2.4	862	12062	879	12308	0	15	78
2	2	TRP	2	52	104	1	11	3.3	5.8	477	953	1431	2862	1036	90	85
10	6	MCP	8	39	392	5	15	3.8	5.0	534	5339	2534	25336	2186	26	76
1	1	CCP	1	36	36	0	13	1.5	2.1	450	450	675	675	315	10	100
5	2	STP	4	98	490	6	14	1.6	4.0	1080	5399	1814	9070	1550	58	88
1	1	CRP	1	107	107	1	10	1.4	2.3	1017	1017	1423	1423	712	15	45
7	4	LSR	6	35	246	3	13	1.6	4.2	493	3448	825	5777	586	87	87
4	3	LSBk	3	35	139	2	14	1.9	4.2	439	1755	873	3491	594	36	78
9	1	LSBo	7	34	310	4	15	1.6	4.1	563	5069	1008	9068	720	37	69
1	1	PLP	1	31	31	0	10	1.8	3.3	310	310	558	558	434	80	95
1	0	DRY	1	140	140	2	0	0.0	0.0	0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
127	47	7986	72337	89919

Bear Creek

Drainage: McDonnel Creek, Maacama Creek, Russian River

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: 06/13/96 to 06/27/96

Confluence Location: QUAD: MT ST HELE LEGAL DESCRIPTION: T10NR8WS2 LATITUDE: 38°42'5" LONGITUDE: 122°44'9"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
18	11	MAIN	45	57	1022	55	14.0	3.0	675	12142	2108	37942	1778	41
22	10	SCOUR	55	38	832	45	13.7	1.7	527	11597	924	20332	640	54

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
40	21	1853	23739	58274

Bear Creek

Drainage: McDonnel Creek, Maacama Creek, Russian River

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES

Survey Dates: 06/13/96 to 06/27/96

Confluence Location: QUAD: MT ST HELE LEGAL DESCRIPTION: T10NR8WS2 LATITUDE: 38°42'5" LONGITUDE: 122°44'9"

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
2	TRP	5	0	0	0	0	0	0	0	0	2	100
10	MCP	25	0	0	0	0	7	70	2	20	1	10
1	CCP	3	0	0	0	0	1	100	0	0	0	0
5	STP	13	1	20	0	0	1	20	2	40	1	20
1	CRP	3	0	0	0	0	1	100	0	0	0	0
7	LSR	18	0	0	1	14	4	57	0	0	2	29
4	LSBk	10	0	0	0	0	3	75	0	0	1	25
9	LSBo	23	0	0	1	11	4	44	3	33	1	11
1	PLP	3	0	0	0	0	0	0	1	100	0	0

TOTAL UNITS
40

Bear Creek

Drainage: McDonnel Creek, Maacama Creek, Russian River

Table 5 - Summary of Shelter by Habitat Type

Survey Dates: 06/13/96 to 06/27/96

Confluence Location: QUAD: MT ST HELE LEGAL DESCRIPTION: T10NR8WS2 LATITUDE: 38°42'5" LONGITUDE: 122°44'9"

UNITS MEASURED	UNITS SHELTER MEASURED	HABITAT TYPE	SQ. FT. UNDERCUT BANKS	SQ. FT. SWD	SQ. FT. LWD	SQ. FT. ROOT MASS	SQ. FT. TERR. VEGETATION	SQ. FT. AQUATIC VEGETATION	SQ. FT. WHITE WATER	SQ. FT. BOULDERS	SQ. FT. BEDROCK LEDGES
29	9	LGR	151	66	0	0	0	248	0	102	0
3	2	HGR	0	0	0	0	0	0	0	62	0
1	1	CAS	0	0	0	0	0	0	0	27	0
3	3	POW	0	25	25	49	0	0	88	502	0
9	3	GLD	86	0	0	0	0	66	0	9	0
27	5	RUN	40	42	21	0	0	0	5	20	0
14	3	SRN	0	0	0	0	0	0	18	99	0
2	2	TRP	0	0	15	0	0	0	7	424	0
10	10	MCP	135	15	0	145	0	0	20	546	0
1	1	CCP	0	0	27	18	0	0	0	0	0
5	5	STP	0	56	56	0	0	0	202	1818	0
1	1	CRP	152	0	0	0	0	0	0	0	0
7	7	LSR	0	180	146	443	31	16	0	16	0
4	4	LSBk	71	39	51	0	0	0	5	216	53
9	9	LSBo	47	11	6	88	0	3	10	583	0
1	1	PLP	43	0	0	43	0	0	25	12	0
1	0	DRY	0	0	0	0	0	0	0	0	0
TOTAL 127	66		725	434	347	786	31	333	380	4436	53
			10%	6%	5%	10%	0%	4%	5%	59%	1%
TOTAL FOR POOLS 40	40		448	301	301	737	31	19	269	3615	53
			8%	5%	5%	13%	1%	0%	5%	63%	1%

Bear Creek

Drainage: McDonnel Creek, Maacama Creek, Russian River

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE

Survey Dates: 06/13/96 to 06/27/96

Confluence Location: QUAD: MT ST HELE LEGAL DESCRIPTION: T10NR8WS2 LATITUDE: 38°42'5" LONGITUDE: 122°44'9"

TOTAL HABITAT UNITS	UNITS SUBSTRATE MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
29	9	LGR	11	0	33	22	22	11	0
2	2	HGR	0	0	0	0	0	100	0
1	1	CAS	0	0	0	0	0	100	0
3	3	POW	0	0	33	0	33	33	0
9	3	GLD	0	33	67	0	0	0	0
7	5	RUN	0	0	80	0	20	0	0
4	3	SRN	0	0	0	0	33	67	0
2	2	TRP	0	0	50	0	0	50	0
6	6	MCP	0	67	0	0	17	17	0
1	1	CCP	0	100	0	0	0	0	0
2	2	STP	0	0	0	0	0	100	0
1	1	CRP	0	100	0	0	0	0	0
4	4	LSR	0	25	50	0	0	25	0
3	3	LSBk	0	33	67	0	0	0	0
1	1	LSBo	0	0	100	0	0	0	0
1	1	PLP	0	0	100	0	0	0	0
1	0	DRY	0	0	0	0	0	0	0

Bear Creek

APPENDIX A. Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Evergreen	Mean Percent Decidous	Mean Right bank % Cover	Mean Left Bank % Cover
76.40	57.44	42.56	65.31	64.58

APPENDIX B.

Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Total Mean Percent
Bedrock	10	11	21.88
Boulder	3	5	8.33
Cobble/Gravel	2	1	3.13
Silt/clay	33	31	66.67

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Total Mean Percent
Grass	11	11	22.92
Brush	0	0	0
Deciduous Trees	12	13	26.04
Evergreen Trees	24	24	50
No Vegetation	1	0	1.04

APPENDIX C. FISH HABITAT INVENTORY DATA SUMMARY

STREAM NAME: Bear Creek
SAMPLE DATES: 06/13/96 to 06/27/96
STREAM LENGTH: 7731 ft.
LOCATION OF STREAM MOUTH:
USGS Quad Map: MT ST HELE — Latitude: 38°42'5"
Legal Description: T10NR8WS2 — Longitude: 122°44'9"

SUMMARY OF FISH HABITAT ELEMENTS BY STREAM REACH

STREAM REACH 01

Channel Type: B4	Canopy Density: 72%
Channel Length: 2362 ft.	Evergreen Component: 62%
Riffle/Flatwater Mean Width: 12 ft.	Deciduous Component: 38%
Total Pool Mean Depth: 1.6 ft.	Pools by Stream Length: 22%
Base Flow: 0.0 cfs	Pools >=3 ft. deep: 23%
Water: 59 - 61 °F Air: 56 - 69 °F	Mean Pool Shelter Rtn: 48
Dom. Bank Veg.: Evergreen Trees	Dom. Shelter: Boulders
Vegetative Cover: 73%	Occurrence of LOD: 35%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 0 ft.

Embeddness Value: 1. 23% 2. 69% 3. 8% 4. 0%

STREAM REACH 02

Channel Type: A2	Canopy Density: 80%
Channel Length: 765 ft.	Evergreen Component: 61%
Riffle/Flatwater Mean Width: 10 ft.	Deciduous Component: 39%
Total Pool Mean Depth: 1.8 ft.	Pools by Stream Length: 30%
Base Flow: 0.0 cfs	Pools >=3 ft. deep: 50%
Water: 59 - 64 °F Air: 63 - 81 °F	Mean Pool Shelter Rtn: 95
Dom. Bank Veg.: Evergreen Trees	Dom. Shelter: Boulders
Vegetative Cover: 45%	Occurrence of LOD: 12%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 0 ft.

Embeddness Value: 1. 100% 2. 0% 3. 0% 4. 0%

STREAM REACH 03

Channel Type: F4	Canopy Density: 61%
Channel Length: 1254 ft.	Evergreen Component: 29%
Riffle/Flatwater Mean Width: 11 ft.	Deciduous Component: 71%
Total Pool Mean Depth: 1.7 ft.	Pools by Stream Length: 15%
Base Flow: 0.0 cfs	Pools >=3 ft. deep: 67%
Water: 61 - 64 °F Air: 79 - 87 °F	Mean Pool Shelter Rtn: 7
Dom. Bank Veg.: Evergreen Trees	Dom. Shelter: Boulders
Vegetative Cover: 82%	Occurrence of LOD: 75%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 140 ft.

Embeddness Value: 1. 67% 2. 0% 3. 33% 4. 0%

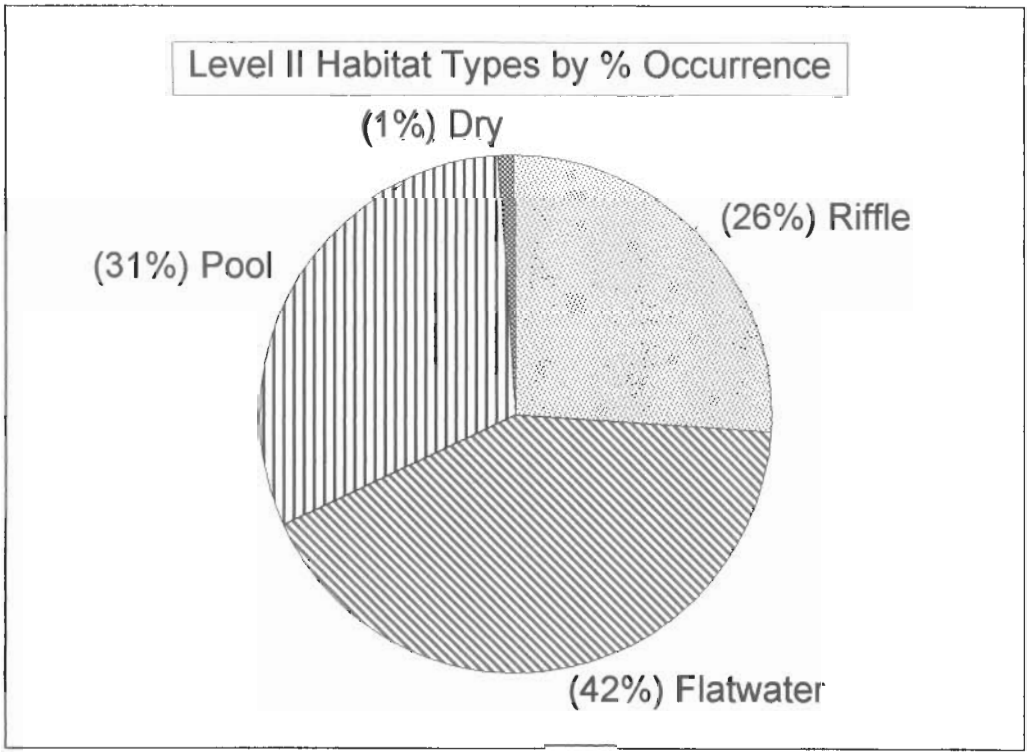
STREAM REACH 04

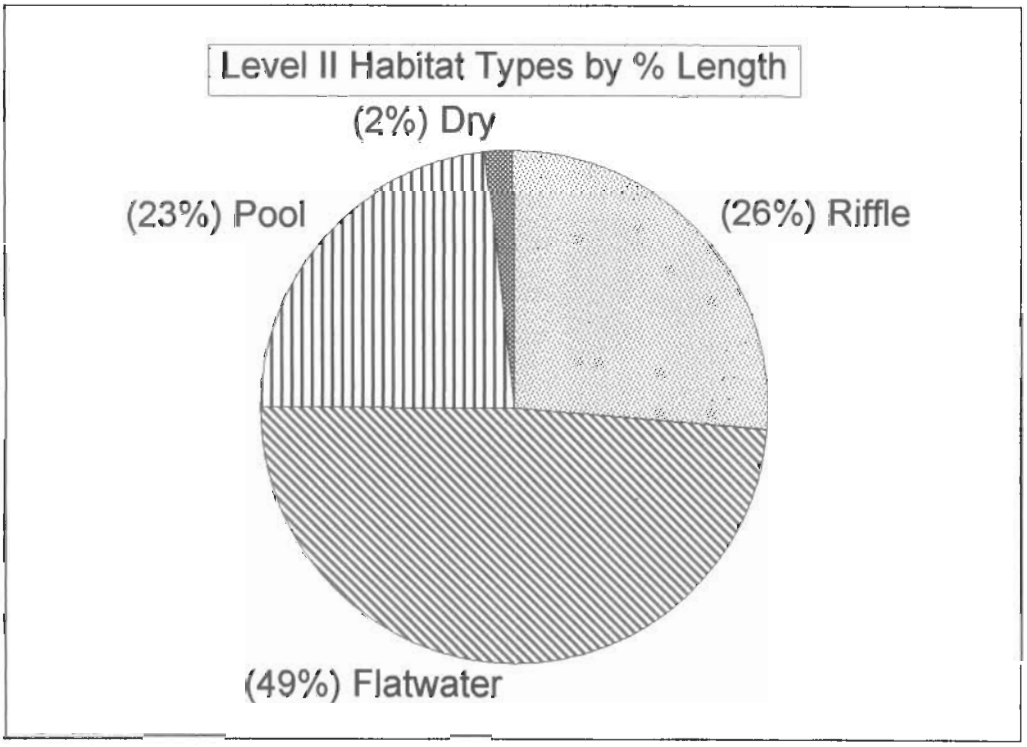
Channel Type: B2	Canopy Density: 83%
Channel Length: 3349 ft.	Evergreen Component: 62%
Riffle/Flatwater Mean Width: 11 ft.	Deciduous Component: 38%
Total Pool Mean Depth: 2.9 ft.	Pools by Stream Length: 27%
Base Flow: 0.0 cfs	Pools >=3 ft. deep: 45%
Water: 56 - 62 °F Air: 62 - 87 °F	Mean Pool Shelter Rtn: 45
Dom. Bank Veg.: Evergreen Trees	Dom. Shelter: Boulders
Vegetative Cover: 60%	Occurrence of LOD: 33%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 0 ft.

Embeddness Value: 1. 0% 2. 45% 3. 50% 4. 5%

Bear Creek

Level II Habitat Types

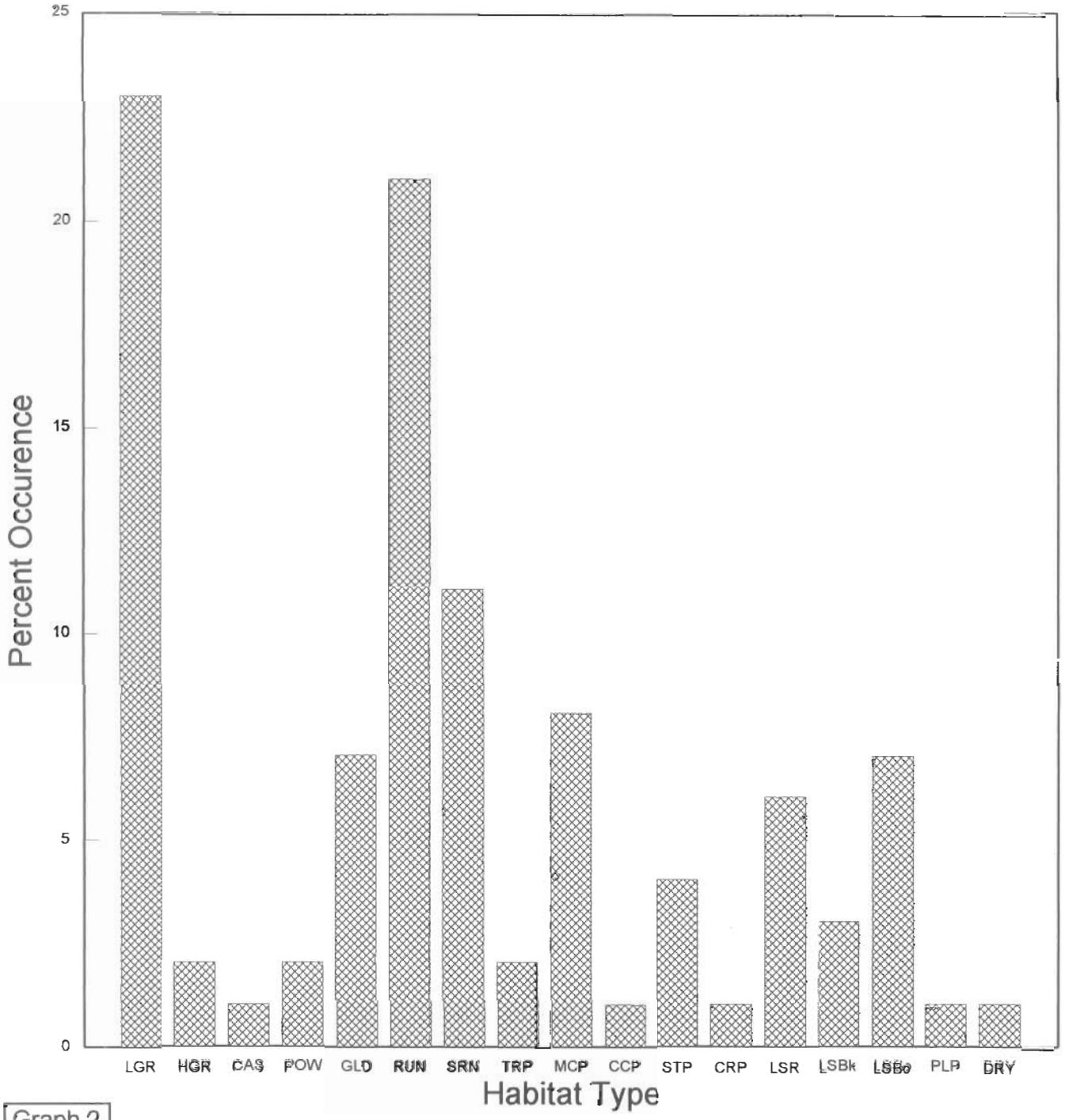




Graph 1

Bear Creek

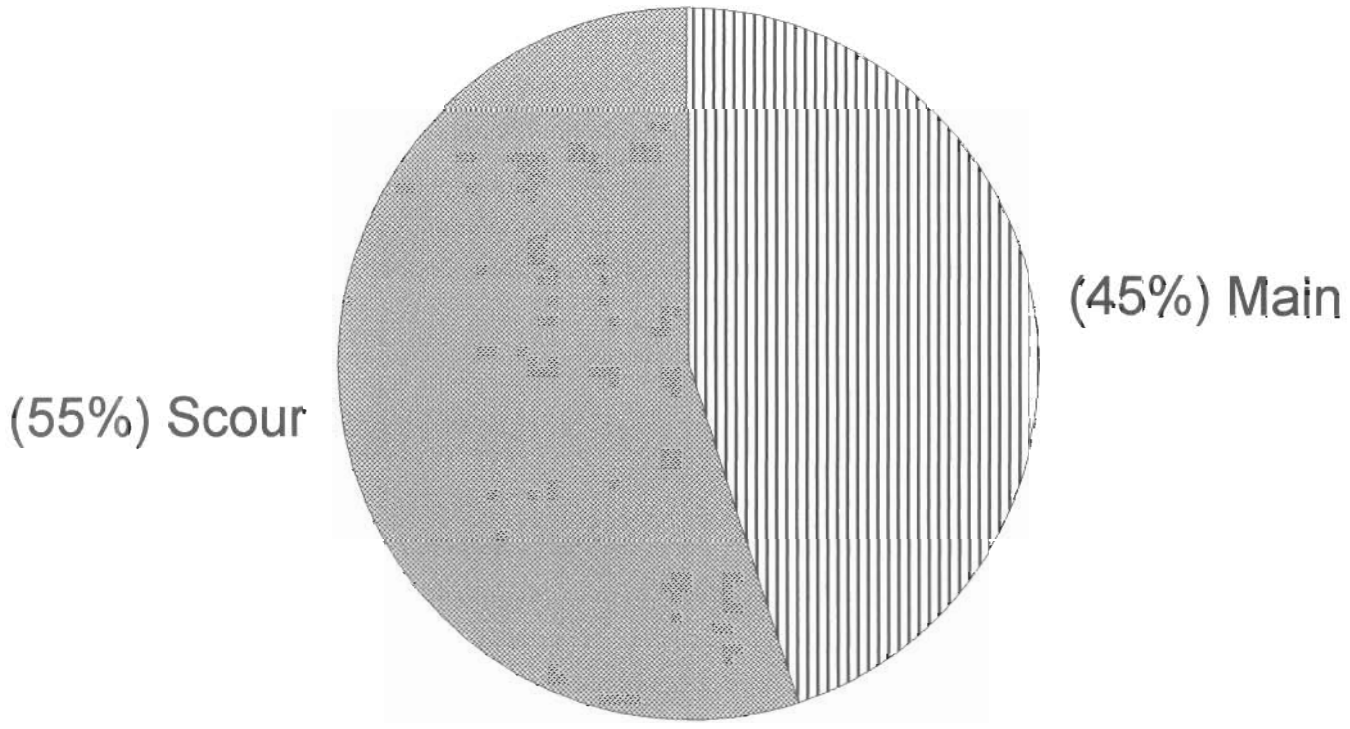
Level IV Habitat Types by % Occurrence



Graph 2

Bear Creek

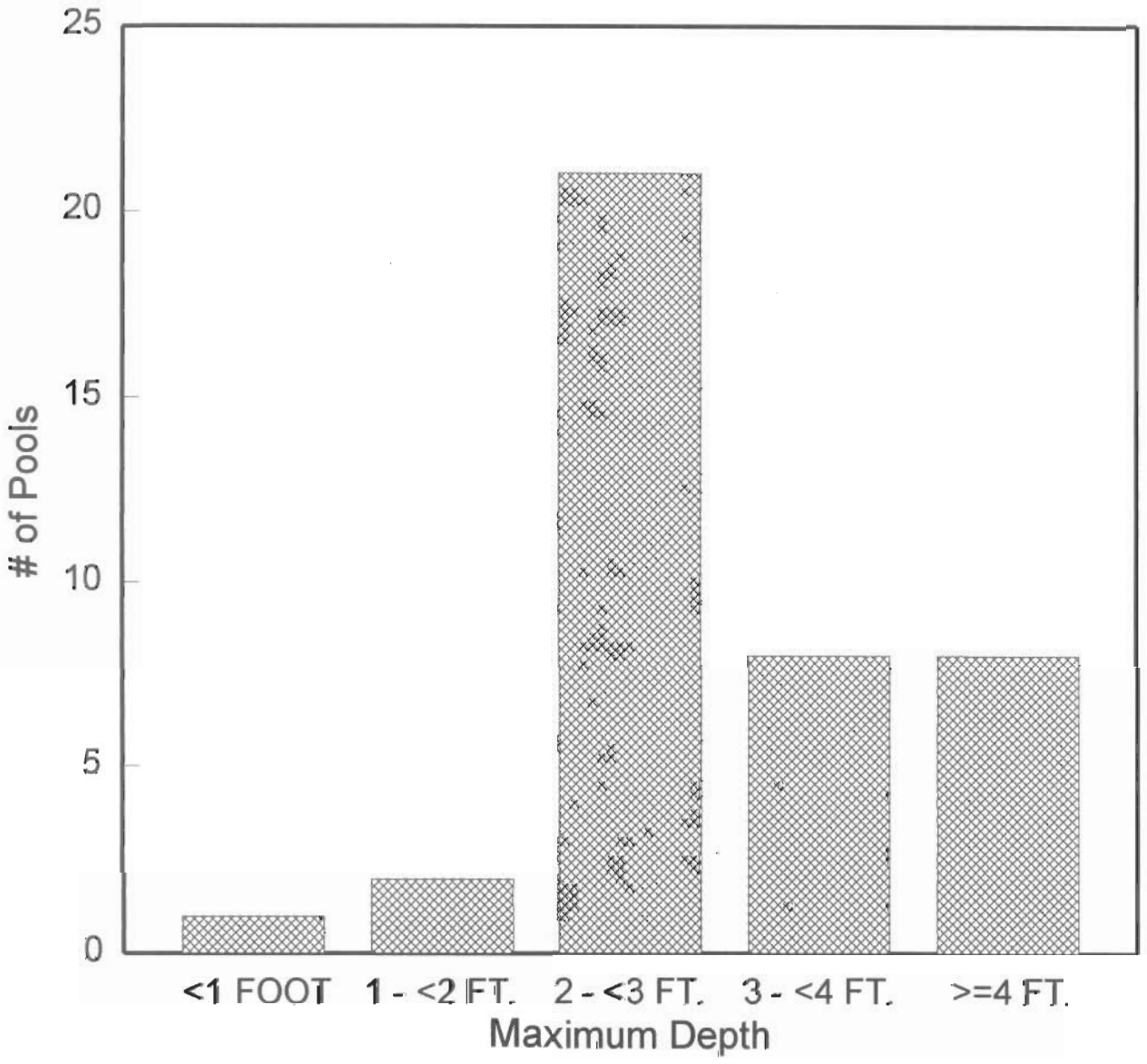
Pool Habitat Types by % Occurrence



Graph 3

Bear Creek

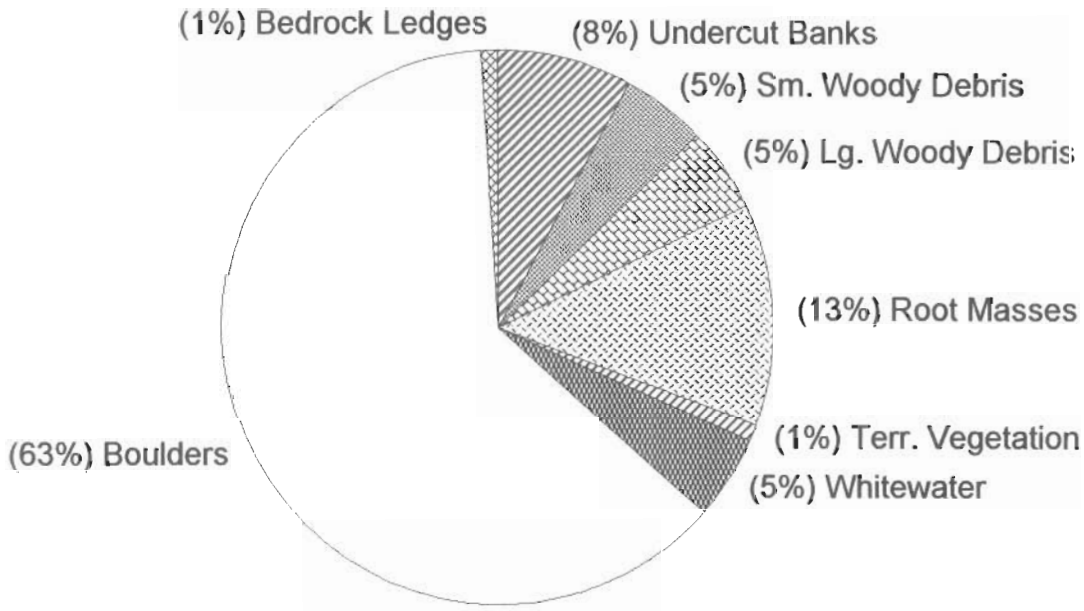
Maximum Depth in Pools



Graph 4

Bear Creek

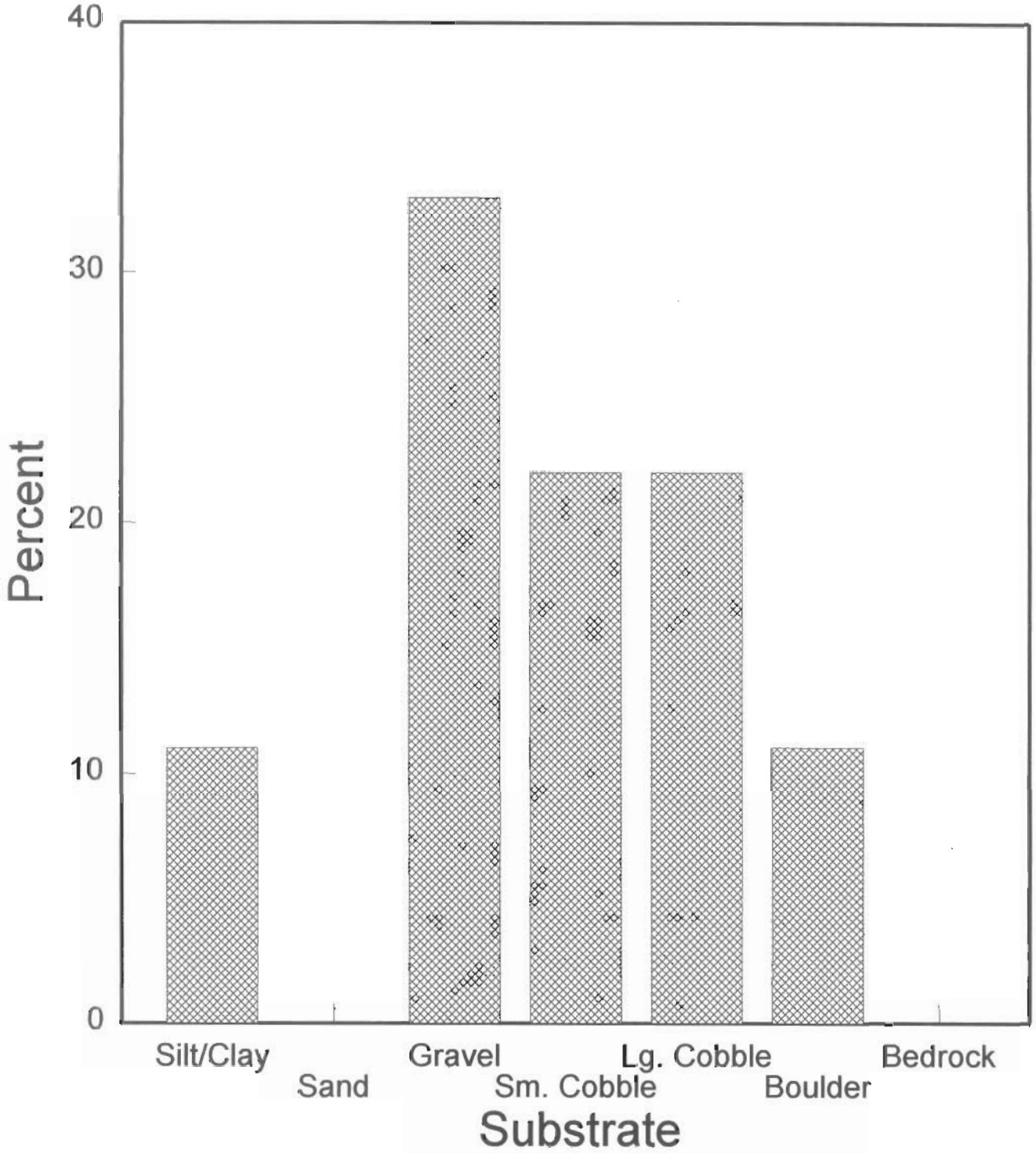
Pool Shelter Types by % Area



Graph 5

Bear Creek

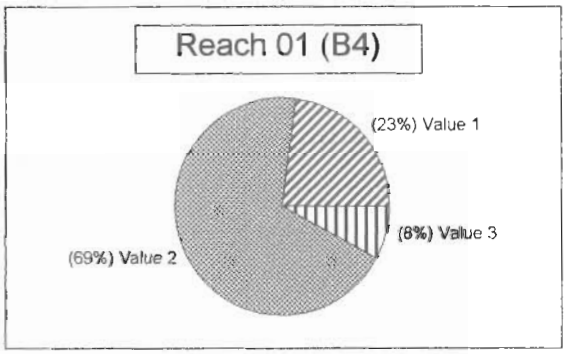
Substrate Composition in Low Gradient Riffles

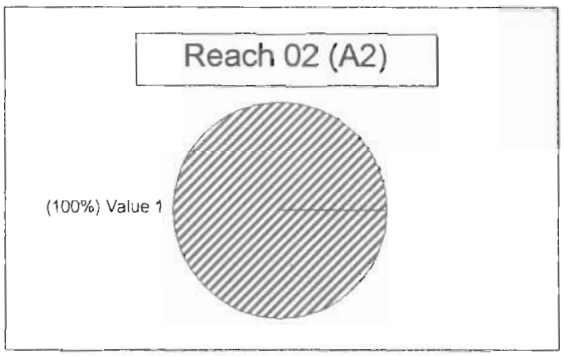


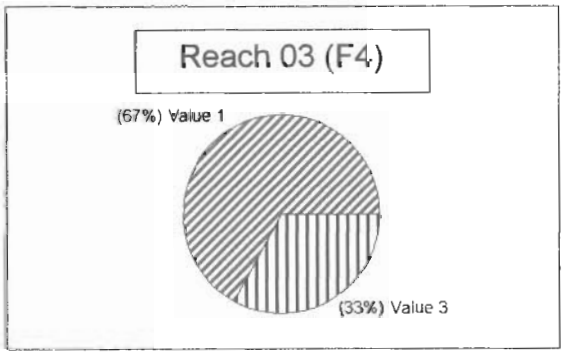
Graph 6

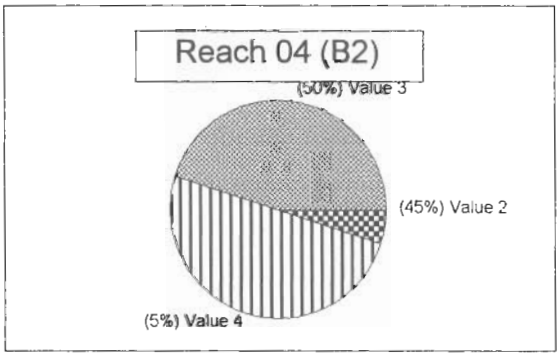
Bear Creek

Percent Cobble Embeddedness by Reach







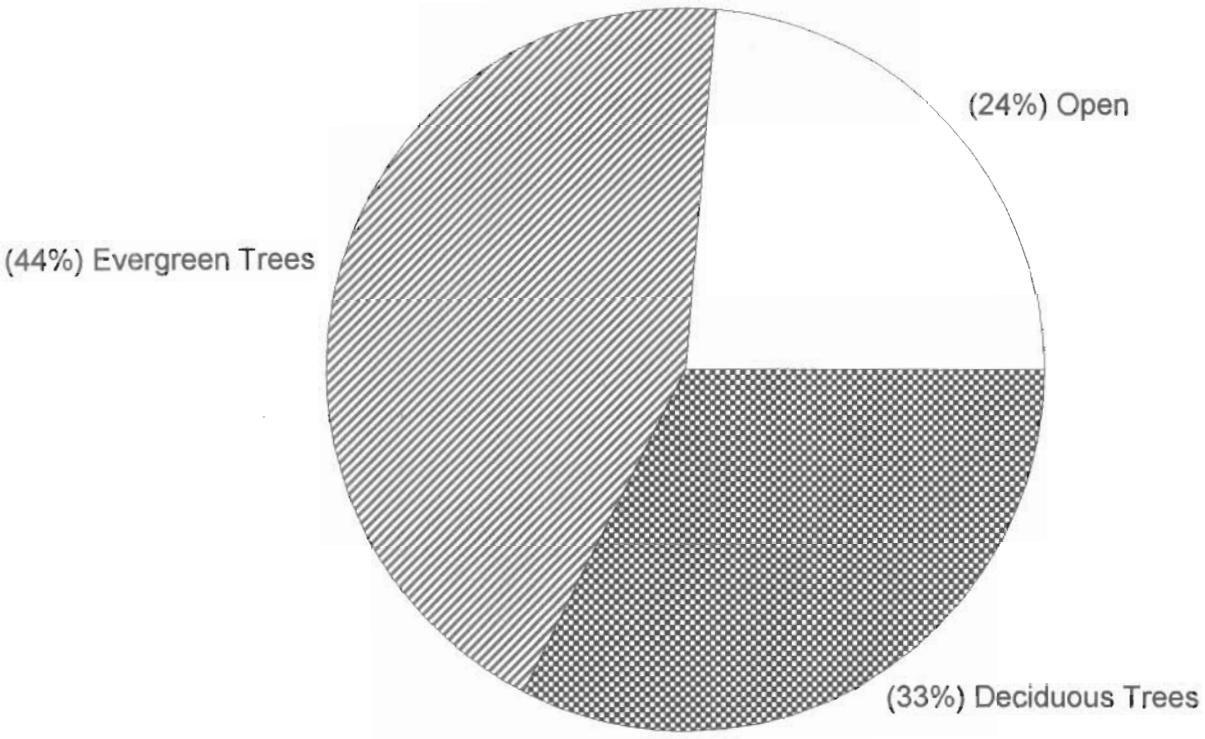


Value 1 = <25% Value 2 = 25-50% Value 3 = 51-75% Value 4 = >76%

Graph 7

Bear Creek

Mean Percent Canopy

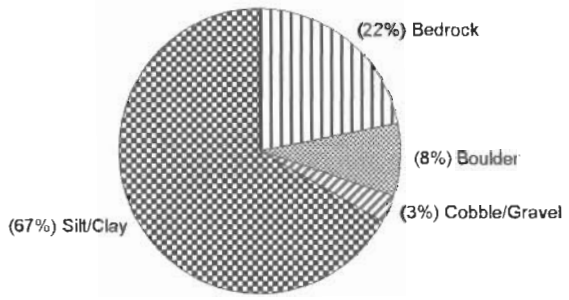


Graph 8

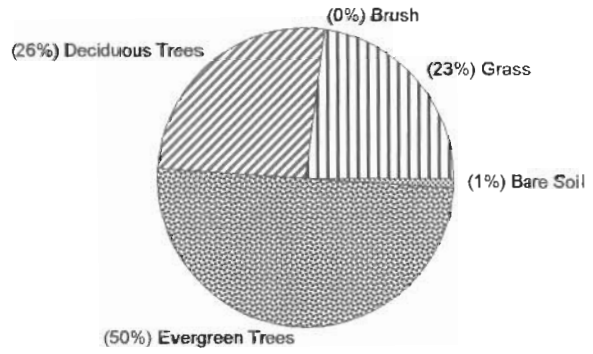
Bear Creek

Percent Bank Composition

Dominant Bank Substrate



Dominant Bank Vegetation



Graph 10