Data Report 1999-2001:
Russian River Basin Steelhead and Coho Salmon Monitoring Program Pilot Study

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INTRODUCTION

This data report summarizes fish and habitat data collected for the Russian River Basin Steelhead and Coho Salmon Monitoring Program (Pilot Study) in 1999-2001. The monitoring program is designed to detect trends in salmonid populations and identify possible fisheries management and enhancement opportunities. The program began in fall 1999 with a pilot study to collect detailed information on the distribution, habitat use, and abundance of juvenile steelhead (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*) in streams of the Russian River basin. Electrofishing and snorkel surveys were used to sample fish in 5 tributaries of the Russian River.

METHODS

Study methods for the Pilot Study included electrofishing surveys and visual snorkel surveys in the Russian River basin. Electrofishing was conducted in 3 streams, while snorkel surveys were conducted in 2 other streams. Survey techniques and organization of data analysis are discussed below.

Electrofishing Surveys

Electrofishing surveys were conducted in Santa Rosa, Millington, and Mark West creeks. Santa Rosa and Millington creeks were selected for the first year pilot study in 1999 because habitat surveys conducted in 1998 indicated that suitable salmonid habitat was present. Also, the habitat data was used to select sampling locations. In 2000, Mark West Creek was also sampled because of its close proximity to Santa Rosa and Millington creeks and historic occurrence of coho salmon. In 2001, fish sampling was conducted in Santa Rosa and Millington creeks.

In the 3 study streams, fish sampling was conducted along selected reaches. These reaches were distinguished by channel type as described by Rosgen (1996). The 4 channel types sampled in the study included:

- B2 Channel: streams with moderate entrenchment, moderate gradient, boulder substrate, and aquatic habitat dominated by riffles and occasional pools;
- C4 Channel: low gradient meandering streams dominated by riffle and pool habitats with a gravel substrate; and
- F2b Channel: low gradient entrenched streams with a broad bed, boulder substrate, and dominated by riffle and pool habitats.
- F4 Channel: low gradient entrenched streams with a broad bed, gravel substrate, and dominated by riffle and pool habitats.

Typically, channel types in the study area included F4 channels in the flat lowlands, C4 channels in the foothills, and B2 channels in mountainous terrain in the upper headwaters of a stream. An exception was the headwater reach of Millington Creek with a F2b/B2 channel type. The channel types present in the 3 study streams included B2, C4, and F4 in Santa Rosa Creek; F2b/B2 in

Millington Creek; and F4, Lower B2, C4, and Upper B2 in Mark West Creek. In 2001 the Santa Rosa Creek F4 channel was not sampled due to public health concerns related to poor water quality.

Each channel type was divided into segments and habitat units for fish sampling purposes. Within each stream segment, habitat data was sorted into 3 general habitat types: riffle, flatwater, and pool. All study reaches included the 3 habitat types.

Surveys were conducted by a crew of 3 to 6 biologists. One or two Smith-Root Model 12B© Backpack Electrofishers were used to conduct the surveys, depending on the size of the habitat unit to be sampled. Block nets were erected at the upper and lower ends of the unit to be sampled. Multiple pass electrofishing, in accordance with Hankin and Reeves (1988) methodologies, was used to generate population estimates in each reach. Captured fish were anesthetized, measured, weighed, allowed to recover, and then released. Fish scales from a sample of captured fish were collected for age analysis. Scale annuli (i.e., scale growth rings) were used to correlate fish age with size class. Habitat data was collected at habitat units, including maximum water depth, length, and average width.

Snorkel Surveys

Snorkel surveys were conducted to evaluate the feasibility of using divers to determine the presence/absence and distribution of juvenile coho salmon in lower Russian River tributaries. Surveys were conducted by teams of 2 or 3 diver-trained biologists in Sheephouse Creek from September 26 to October 5, 2000 and Green Valley Creek from August 22 to September 6, 2001.

All pools with maximum depths greater than 40 cm and underwater visibility greater than 200 cm were surveyed by divers along Sheephouse Creek and upper Green Valley Creek. Pools that met the depth and visibility criteria were identified during habitat surveys that preceded diving on each stream. The length, mean width, and maximum depth of 4 habitat types (pool, riffle, flatwater, and cascade) were recorded for each stream segment. The survey reach on Sheephouse Creek consisted of 1 contiguous segment from the stream's mouth at the Russian River estuary to the confluence of 2 first-order tributaries approximately 3.3 km upstream. The reach on Green Valley Creek was composed of 4 stream segments that were defined by private landowner right of entry agreements. The segments on Green Valley Creek ranged in length from 188 to 1,053 m and encompassed sites sampled during a long term coho monitoring study (M. Fawcett, Merritt Smith Consulting, personal communication). The Green Valley Creek reach also included California Department of Fish and Game (CDFG) collection sites for a coho salmon captive broodstock program at Warm Springs Hatchery (B. Coey, CDFG, personal communication).

Fish numbers in Sheephouse Creek were estimated by a two-phase sampling design using repeated dives and the method of bounded counts (MBC) for calibration (Hankin 1999). Because the primary interest was to determine coho presence/absence and distribution, all pools that met the depth and visibility criteria were snorkeled by a single diver during the first phase of sampling. Initial diver counts were subject to calibration (second phase sampling) in 25% of the first phase pools. A procedure called Adaptive Sequential Independent Sampling (ASIS) was used to select the second phase calibration pools (Hankin 1999).

All fish were counted during the first phase of sampling on Green Valley Creek but poor underwater visibility precluded the use of MBC and dive counts were not calibrated. Many pools in Green Valley Creek were either isolated or received very little inflow and fine sediment disturbed during first phase sampling remained suspended long after diving. The use of repeated dive counts and MBC for calibration is conditioned on the ability of divers to observe all fish in a pool (Hankin 1999). Multiple pass electrofishing, an alternative method of calibration for two-phase sampling designs, was prohibited under the terms of the federal Endangered Species Act Section 7 permit granted by the National Marine Fisheries Service to conduct the Pilot Study.

Data Analysis

Sonoma County Water Agency staff completed data analysis for the electrofishing and snorkel surveys. Steelhead young-of-the-year population estimates from electrofishing studies were based on Microfish version 3.0 statistical analyses. Capture numbers for steelhead greater than age 1 (i.e., age 1+) were low and population estimates based on a statistical model were not appropriate. However, captured 1+ steelhead were compared among years to evaluate trends. The snorkel count and habitat survey data for Green Valley and Sheephouse creeks was analyzed using NCSS version 6.0 following formulas presented by Hankin (1999).

RESULTS

A summary of results from the electrofishing studies in Santa Rosa, Millington, and Mark West creeks and snorkel surveys in Green Valley and Sheephouse creeks are included in this section. Figures and tables with supporting information are included in the back of this report and are grouped in the following sections:

Electrofishing

I. Species Composition and Study Locations
II. Population Estimate and Fish Density Summary
III. Length Frequency and Age Class

Snorkeling

IV. Sheephouse Creek Snorkel Surveys
V. Green Valley Creek Snorkel Surveys

Electrofishing Surveys

Our extensive electrofishing surveys found no coho salmon, while steelhead were captured in all 3 study streams and in most sampled habitat units. A total of 31,795 fish were captured at 276 sample sites during the three-year study and 6,835, or 22%, were steelhead. In general, steelhead were the predominant species in the B2 channel headwater reaches of the study streams indicating that headwaters are the primary spawning and rearing sites for steelhead. The study details for each creek are discussed below.

Santa Rosa Creek

The Santa Rosa Creek study reach extended from near the confluence with the Laguna de Santa Rosa to the headwaters, a linear distance of approximately 27 km (see Figures I-1, -2, and -3). The elevation of the creek in the study area ranged from 20 to 300 m. Santa Rosa Creek is a third-order tributary to Laguna de Santa Rosa, which is a tributary to the Russian River. The study reach included an F4 channel located on the Santa Rosa plain, C4 channel in the foothills above the City of Santa Rosa, and B2 channel in the mountainous headwaters in and near Mt. Hood Regional Park. The condition of the study reach included a channelized F4 channel, a low to moderately altered C4 channel, and a relatively undisturbed B2 channel. Depending on the study year, the survey area included 7 to 13 segments containing 31 to 63 habitat units.

Steelhead were found throughout the Santa Rosa Creek study reach, but were most abundant in the headwaters. The total number of steelhead captured in the study reach included 1,338 in 1999, 1,948 in 2000, and 592 in 2001 (see Figures I-1, -2, and -3). These totals are not comparable because the number of habitat units sampled varied among years. Species composition along this reach ranged from a combination of several warm-water native and non-native fish species in the F4 channel to exclusively 3 native species (i.e., steelhead, sculpin [*Cottus* sp.], and lamprey [*Lampreta* sp.]) in the B2 channel. Steelhead were detected at very low numbers in the F4 channel, which is likely due to marginal habitat. In the C4 channel between 1999 and 2001 the steelhead composition ranged from 8% to 15% of the catch. Steelhead dominated the fish composition in the B2 channel and ranged from 64% to 73% of the fish composition. The predominant age class was young-of-the-year with a few older fish present (see Section II table and figures). In 1999, the age class composition of 1+ steelhead was 0% in the F4 channel, 8% in the C4 channel, and 17% in the B2 channel. Similar age class trends occurred in 2000 and 2001.

The population trend in Santa Rosa Creek varied by habitat type, but included a peak in 2000 with relatively lower numbers observed in 1999 and 2001 (see Section II table and figures). In general, fish numbers were highest in pools (see Section III tables and figures). An exception was the F4 channel flatwater. The F4 channel flatwater habitat in 2000 had a high population estimate of 67.0 steelhead young-of-the-year. This exception is likely due to the small sample size (n=1) and relatively large area of the habitat unit. The steelhead population estimate for the F4 channel showed no apparent trend from 1999 to 2001. The C4 channel population trend for young-of-the-year steelhead included a peak in 1999 at 27.3 fish/pool. In subsequent years the peak steelhead population estimates were 19.0 fish/flatwater in 2000 and 9.0 fish/flatwater in 2001. In addition, 1+ steelhead showed a similar trend in numbers between 1999 and 2000. Steelhead population estimates in Santa Rosa Creek were highest in the B2 channel pool habitat. The B2 channel population trend for steelhead young-of-the-year included annual peaks in the pool habitat type during the three-year study with the largest population estimate in 2000 at 39.1 fish/pool. 1+ Steelhead showed a similar trend in numbers with a peak in 2000 of 14.2 fish/pool.

Fish densities showed a similar trend with steelhead population estimates (see Section II tables and figures). The highest density of young-of-the-year steelhead was observed in 1999 with 0.66

fish/m^2 in the B2 channel riffle habitat. The highest fish density in the C4 channel was also in 1999 in riffles at 0.15 fish/m^2. The fish density in the F4 channel flatwater in 1999 ranged from 0.0 fish/m^2 in riffles to 0.03 fish/m^2 in flatwater.

In summary, the species composition, habitat use, population estimate, and fish density data support a similar trend. The lower reach of Santa Rosa Creek (F4 channel) contains several fish species but few steelhead, while in the upper reach (C4 and B2 channels) fewer species were present and the dominant species was steelhead. This data suggests that the C4 and B2 channels provide moderate to good rearing habitat for steelhead and the F4 channel provides marginal habitat.

Millington Creek

Millington Creek is a small first-order headwater tributary of Santa Rosa Creek (see Figures I-1, -2, and -3). The study reach is located in the relatively pristine Mt. Hood Regional Park and extends from the confluence with Santa Rosa Creek upstream approximately 0.8 km. The channel type is an F2b and B2 combination and has an elevation of approximately 300 m. The survey area included 3 segments containing 15 to 23 habitat units depending on the survey year.

Steelhead were the dominant species observed in Millington Creek (see Figures I-1, -2, and -3). The total number of steelhead captured included 356 in 1999, 551 in 2000, and 169 in 2001. These fish counts are not comparable because the number of habitat units sampled varied among years. Species composition consisted of native steelhead and sculpin.

The predominant age class of steelhead was young-of-the-year; however, older steelhead were observed (see Section III tables and figures). During the three-year study, steelhead composition ranged from 87% to 97% of the catch. Within the steelhead catch, the young-of-the-year age class ranged from 78% to 89%, while 1+ steelhead ranged from 11% to 22%. Steelhead were disproportionately found in pool habitats (64%) followed by flatwater (25%) and then riffles (12%). These data indicate that pools are the primary rearing habitat for steelhead in Millington Creek.

The population trend from 1999 to 2001 in Millington Creek included a peak in 2000 with relatively lower numbers observed in 1999 and 2001 (see Section II table and figures). Pools had the largest numbers for both steelhead young-of-the-year and 1+ steelhead. In 2000, the average population estimate for young-of-the-year steelhead in pool habitats was 31.7 fish and 6.4 for 1+ steelhead. The density of steelhead showed no apparent trend based on age class, year, or habitat type. Fish densities ranged from 0.25 to 1.22 fish/m^2 for young-of-the-year and 0.04 to 0.34 fish/m^2 for 1+ steelhead. The Pilot Study indicates that Millington Creek has good rearing habitat for steelhead and steelhead were abundant throughout the study reach.

Mark West Creek

Mark West Creek is a tributary of the Russian River and the study reaches extended from near the confluence with the Laguna de Santa Rosa to the headwaters near Diamond Mountain, a linear distance of approximately 32 km (Figure I-4). The elevation of the creek in the study area ranged from 20 to 420 m. Surveys were conducted in 2000 only and included 4 reaches

containing 61 habitat units. The reaches included an F4 channel above the confluence with Laguna de Santa Rosa, a Lower B2 channel located in a steep canyon, a C4 channel in the foothills, and an Upper B2 channel in the mountainous headwaters.

Steelhead were found throughout Mark West Creek and their relative numbers increased from downstream to upstream. A total of 1,870 steelhead were captured. Species composition varied from several native and non-native warm-water species in the F4 channel with less than 1% steelhead to a composition of 100% steelhead in the Upper B2 channel (Figure I-4). The middle reaches had steelhead compositions of 19% in the Lower B2 channel and 12% in the C4 channel. Steelhead were disproportionately found in pool habitats with 76% of steelhead found in this habitat type (see Section III tables and figures). The predominant age class of steelhead was young-of-the-year with a few fish older than 1 year. The age class of 1+ steelhead ranged from 46% in the F4 channel to 13% to 16% in the Lower and Upper B2 channels; however, steelhead numbers were substantially larger in the B2 channels than in the F4 channel.

Population estimates and fish densities showed a similar trend as the steelhead composition (see Section II table and figures). The lowest population estimate for young-of-the-year steelhead was in the F4 channel at 0.0 fish/riffle and highest in the Upper B2 channel at 46.4 fish/pool. The largest number of 1+ steelhead was in the C4 and Upper B2 channels at 12.8 and 11.5 fish/pool, respectively. The lowest density of steelhead young-of-the-year was found in the F4 channel (0.0 fish/m^2) and the highest densities were found in the B2 channels (0.46 fish/m^2 Lower B2 channel and 1.21 fish/m^2 Upper B2 channel). These data indicate that the B2 and C4 channels provide good rearing habitat for steelhead. Because surveys were conducted during a single year, no population trends could be evaluated.

Snorkel Surveys

Sheephouse Creek

A total of 300 habitat units were identified along a 3.3 km reach of Sheephouse Creek during our snorkel study (Table VI-1). Pools were most numerous and composed the greatest proportion of the reach length (57%) followed by riffles (18%) and dry streambed (17%). Most areas of dry streambed were confined to the lower gradient downstream portion of the reach and would likely have been classified as riffles had there been flow. The average maximum depth of 157 pools was 50 cm. One hundred and twenty-two pools met the depth and visibility criteria and were sampled by divers.

No coho salmon were observed along the study reach. Two-phase sampling estimated 680 ± 60 young-of-year and 280 ± 37 age 1+ steelhead (Table VI-2). Mean densities were 5.6 (SD 3.6) for young-of-the-year and 2.3 (SD 1.5) age 1+ fish/pool. Additional species observed included sculpin and Sacramento sucker (*Catostomus occidentalis*). Suckers were not numerous and resided in the downstream portion of the reach.

Green Valley Creek

One hundred and eighty-nine habitat units were identified along 2.4 km of Green Valley Creek during snorkel surveys (Table VII-1). Pools and dry streambed comprised 56% and 34% of the reach length, respectively. The proportion of dry channel and isolated pools increased upstream.

Average maximum pool depth was 47 cm. Forty-four percent of the 98 pools in the reach met the criteria and were sampled by divers.

A total of 422 young-of-the-year coho salmon, 230 young-of-the-year steelhead, and 78 age 1+ steelhead were observed (Table VII-2). Coho were well distributed throughout the reach and were present in 95% of the pools sampled. Steelhead occurred in 81% of the sampled pools. Average young-of-the-year coho and steelhead densities were 10 (SD 9) and 5 (SD 6) fish/pool, respectively. We conducted our sampling approximately 2 weeks after CDFG collected 212 coho from the upper portion of the survey reach for a captive broodstock program. Other species observed included California roach (*Hesperoleucus symmetricus*), sculpin, threespine stickleback (*Gasterosteus aculeatus*), and green sunfish (*Lepomis cyanellus*).

REFERENCES

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Hankin, D. G. 1999. Improved two-phase survey design for estimation of fish and abundance in small streams. Humboldt State University, Department of Fisheries, Arcata, CA. 61pp.

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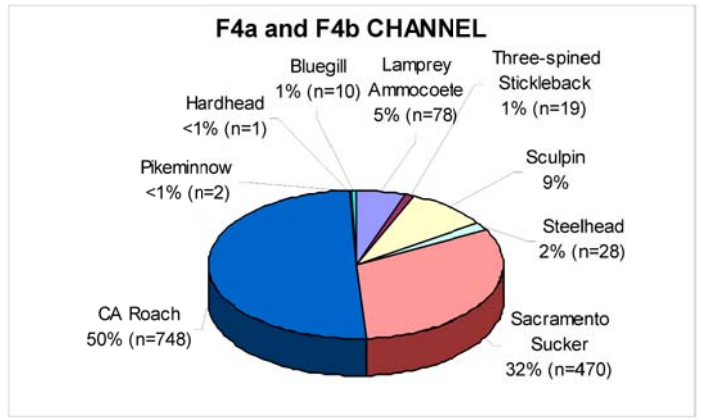
I. SPECIES COMPOSITION AND STUDY LOCATION

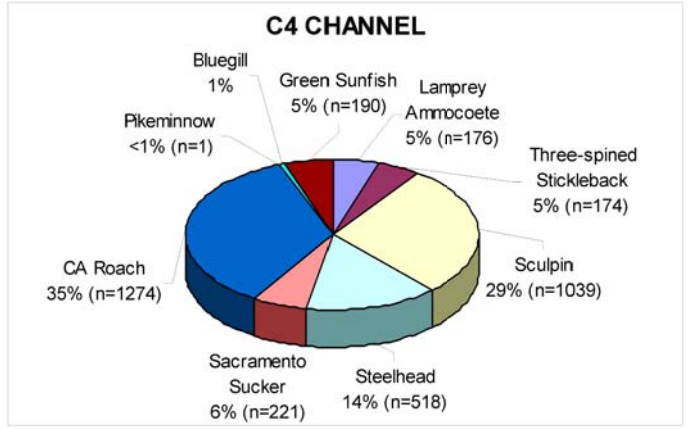
Santa Rosa Creek / Millington Creek

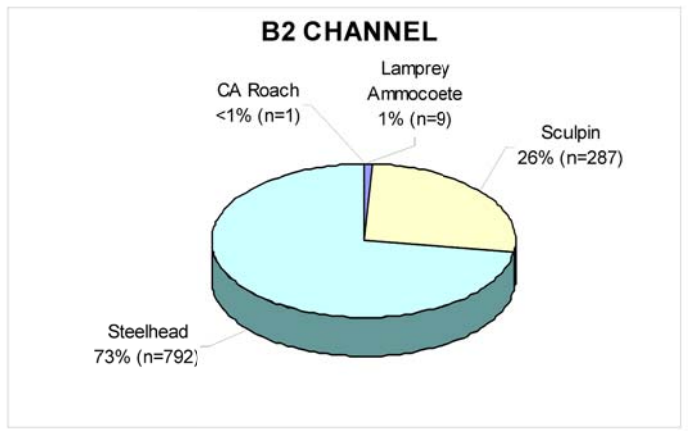
Mark West Creek

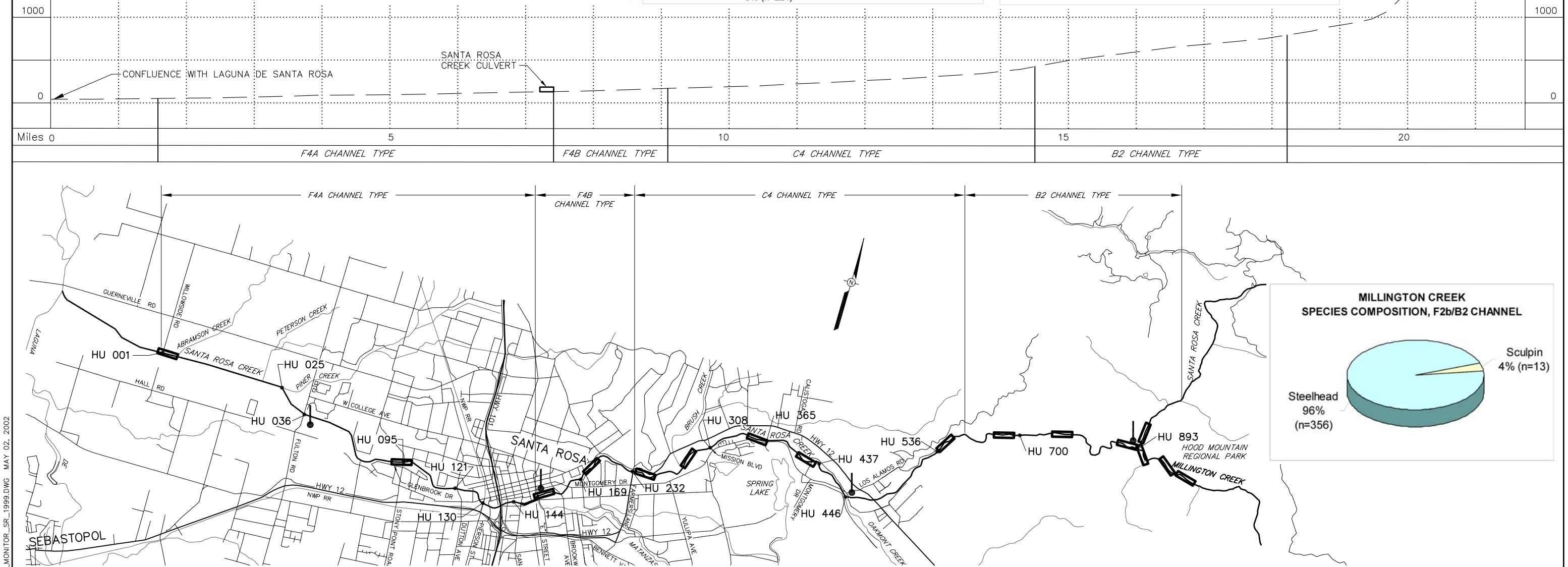
Sheephouse Creek / Green Valley Creek

SANTA ROSA CREEK LONGITUDINAL PROFILE & SPECIES COMPOSITION









LEGEND:

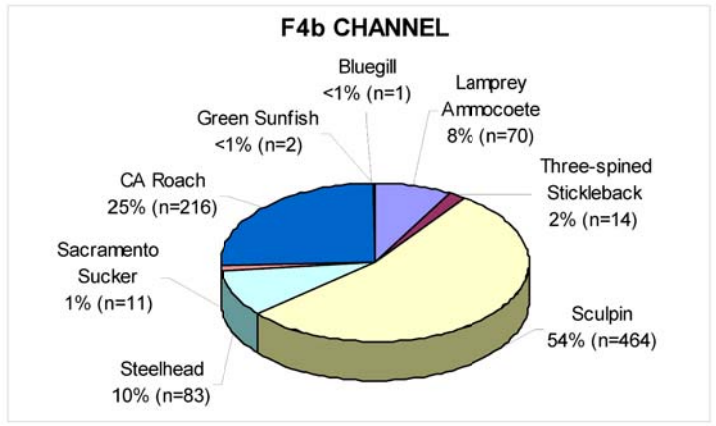
- SUB–REACH AND ELECTROFISHING SAMPLING SITES
- HU 000 HABITAT UNIT
- TEMPERATURE MONITORING STATION

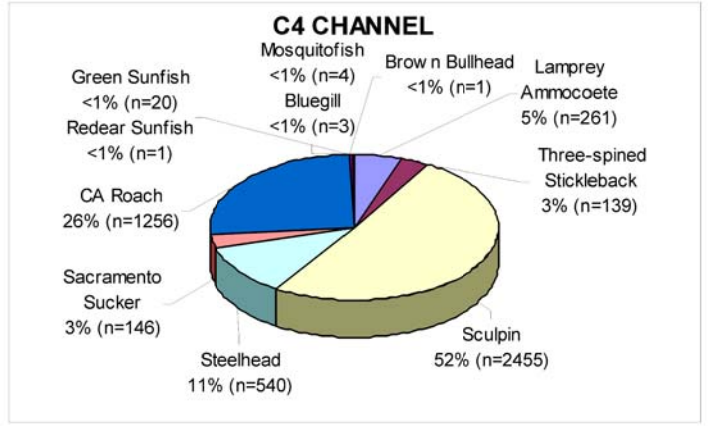
SONOMA COUNTY WATER AGENCY

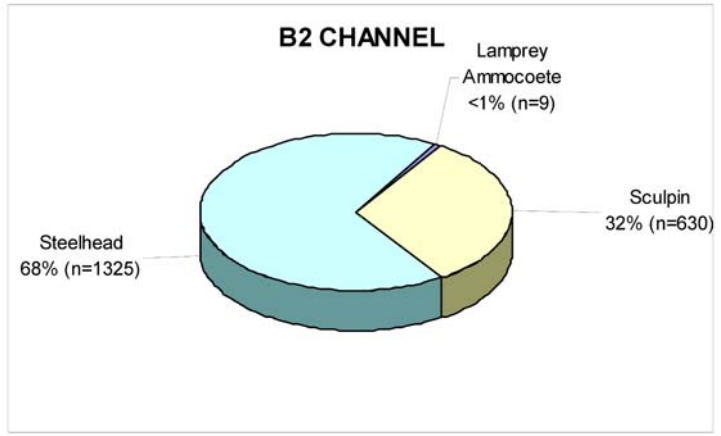
FIGURE I–1
SPECIES COMPOSITION AND STUDY LOCATION, SANTA ROSA AND MILLINGTON CREEKS, 1999

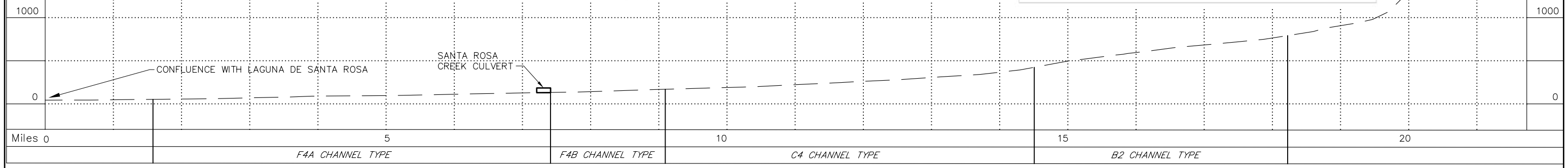
\SPECIAL PROJECTS\FISHERIES\STUDIES\POP_MONITOR_SR_1999.DWG MAY 02, 2002

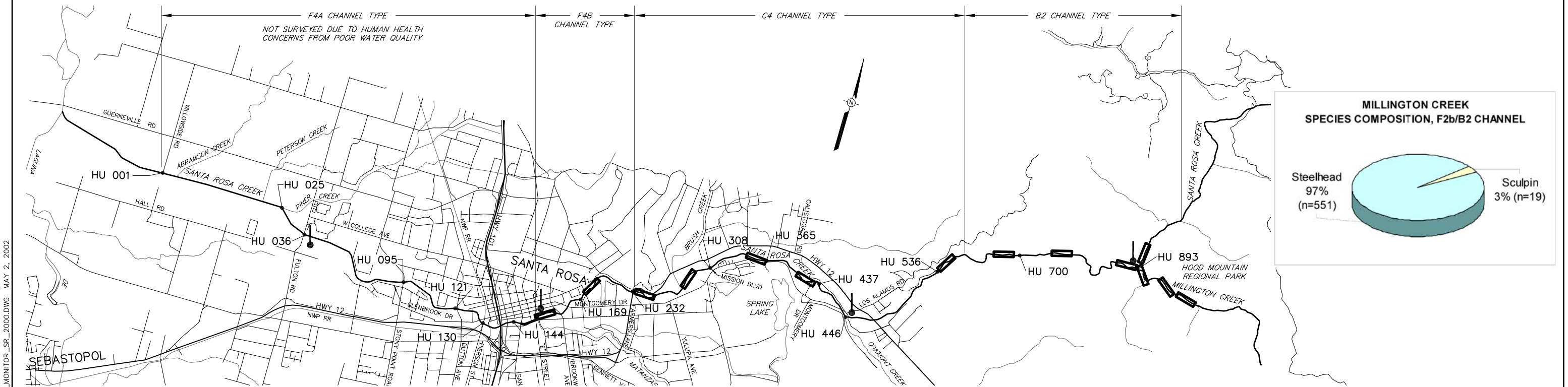
SANTA ROSA CREEK LONGITUDINAL PROFILE & SPECIES COMPOSITION











LEGEND:

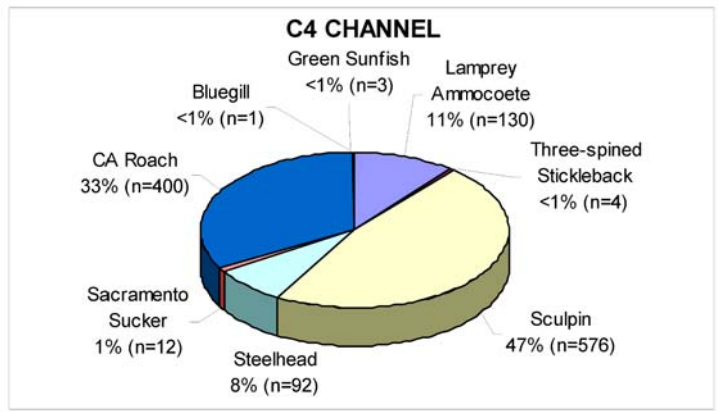
- SUB–REACH AND ELECTROFISHING SAMPLING SITES
- HU 000 HABITAT UNIT
- TEMPERATURE MONITORING STATION

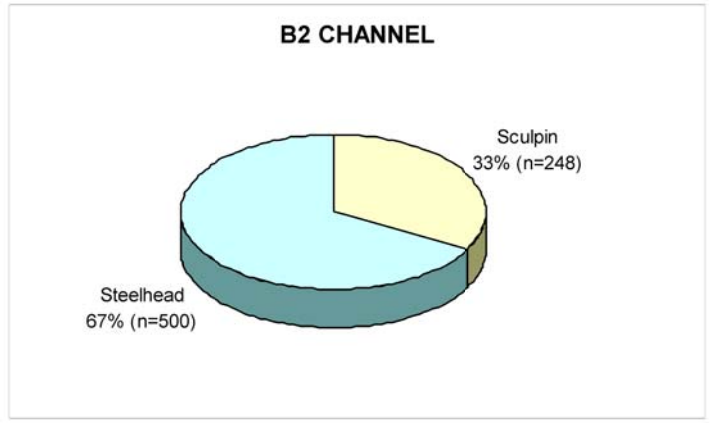
SONOMA COUNTY WATER AGENCY

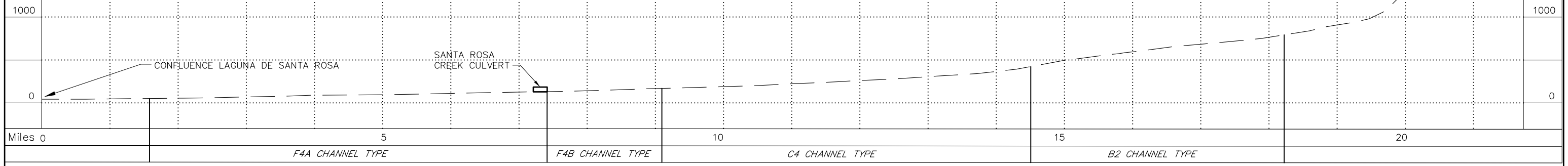
FIGURE I–2
SPECIES COMPOSITION AND STUDY LOCATION,
SANTA ROSA AND MILLINGTON CREEKS, 2000

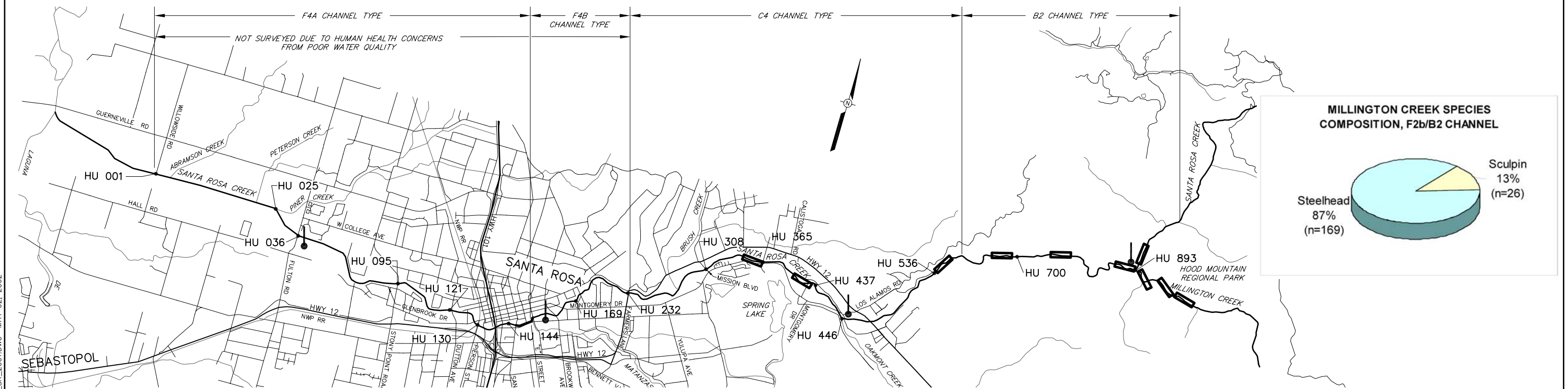
\SPECIAL PROJECTS\FISHERIES\STUDIES\POP_MONITOR_SR_2000.DWG MAY 2, 2002

SANTA ROSA CREEK LONGITUDINAL PROFILE & SPECIES COMPOSITION









LEGEND:

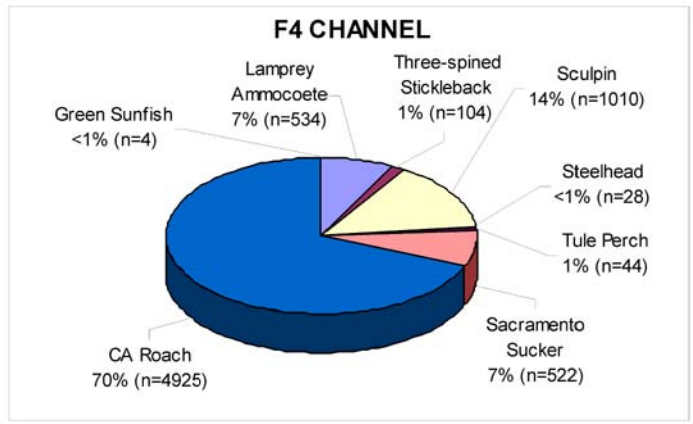
- SUB–REACH AND ELECTROFISHING SAMPLING SITES
- HU 000 HABITAT UNIT
- TEMPERATURE MONITORING STATION

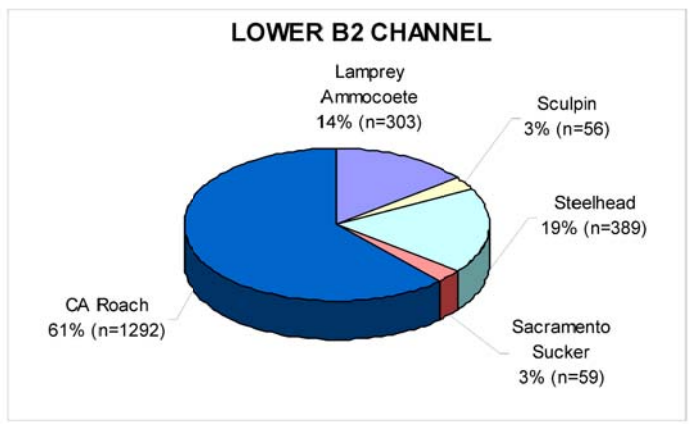
SONOMA COUNTY WATER AGENCY

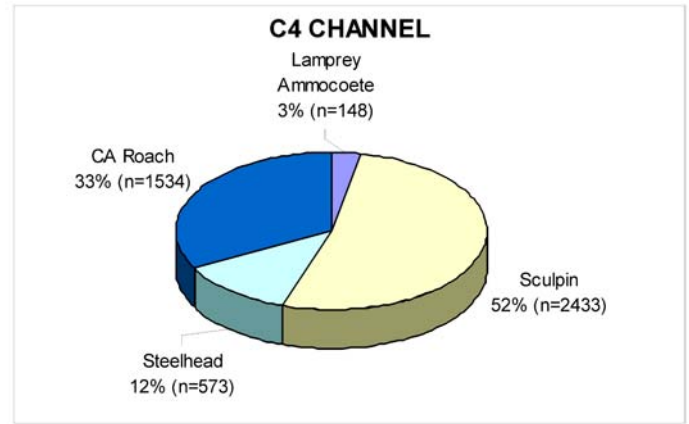
FIGURE I–3
SPECIES COMPOSITION AND STUDY LOCATION, SANTA ROSA AND MILLINGTON CREEKS, 2001

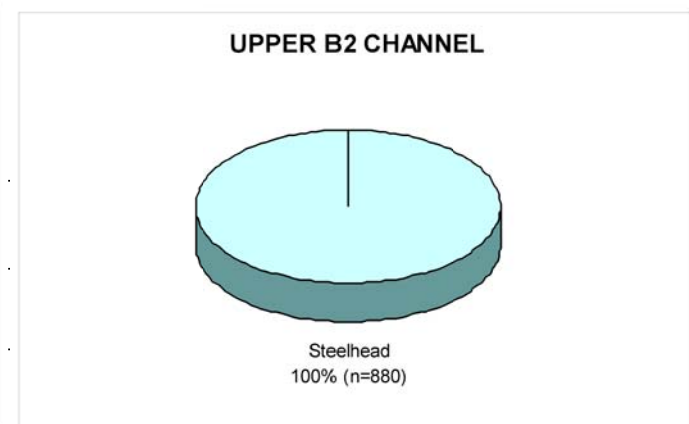
\SPECIAL PROJECTS\FISHERIES\STUDIES\POP_SR_2001.DWG MAY 02, 2002

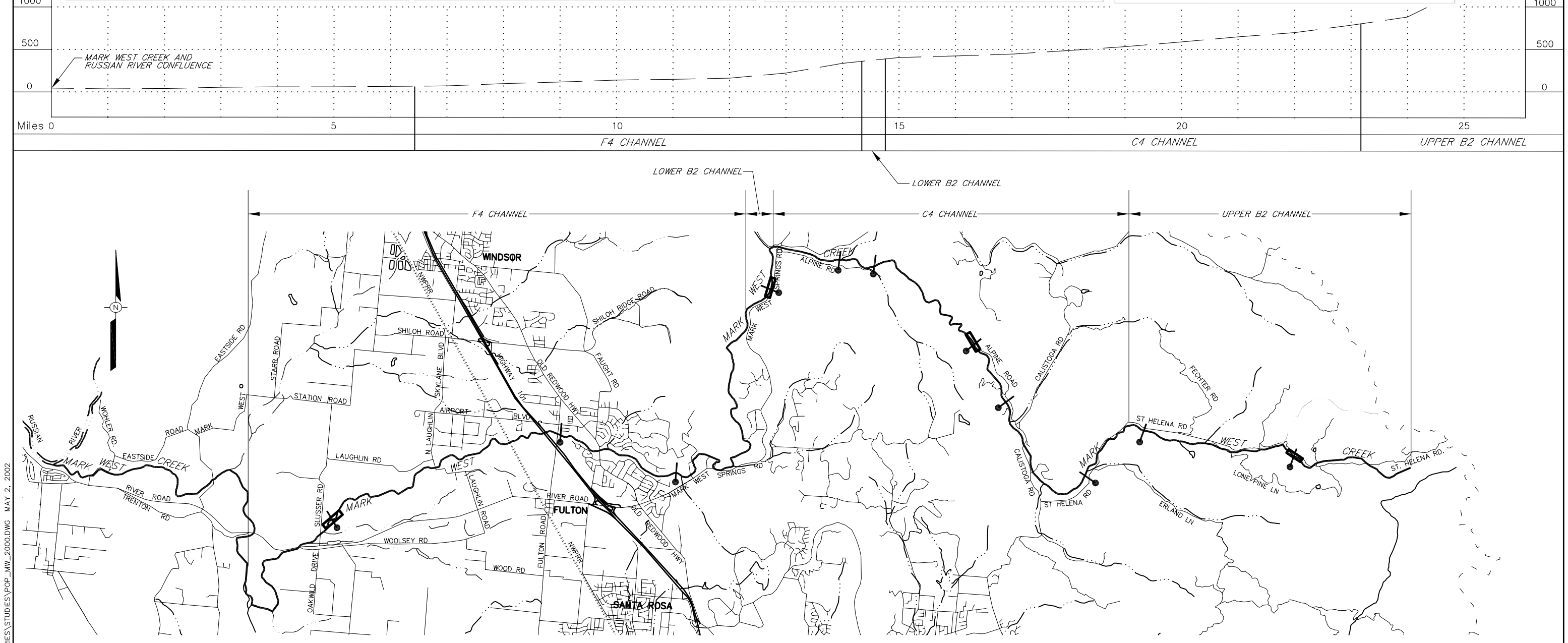
MARK WEST CREEK LONGITUDINAL PROFILE & SPECIES COMPOSITION











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SUB-REACH AND ELECTROFISHING SAMPLING SITES

TEMPERATURE MONITORING STATION

SONOMA COUNTY WATER AGENCY

FIGURE 1-4
SPECIES COMPOSITION AND STUDY LOCATION,
MARK WEST CREEK, 2000

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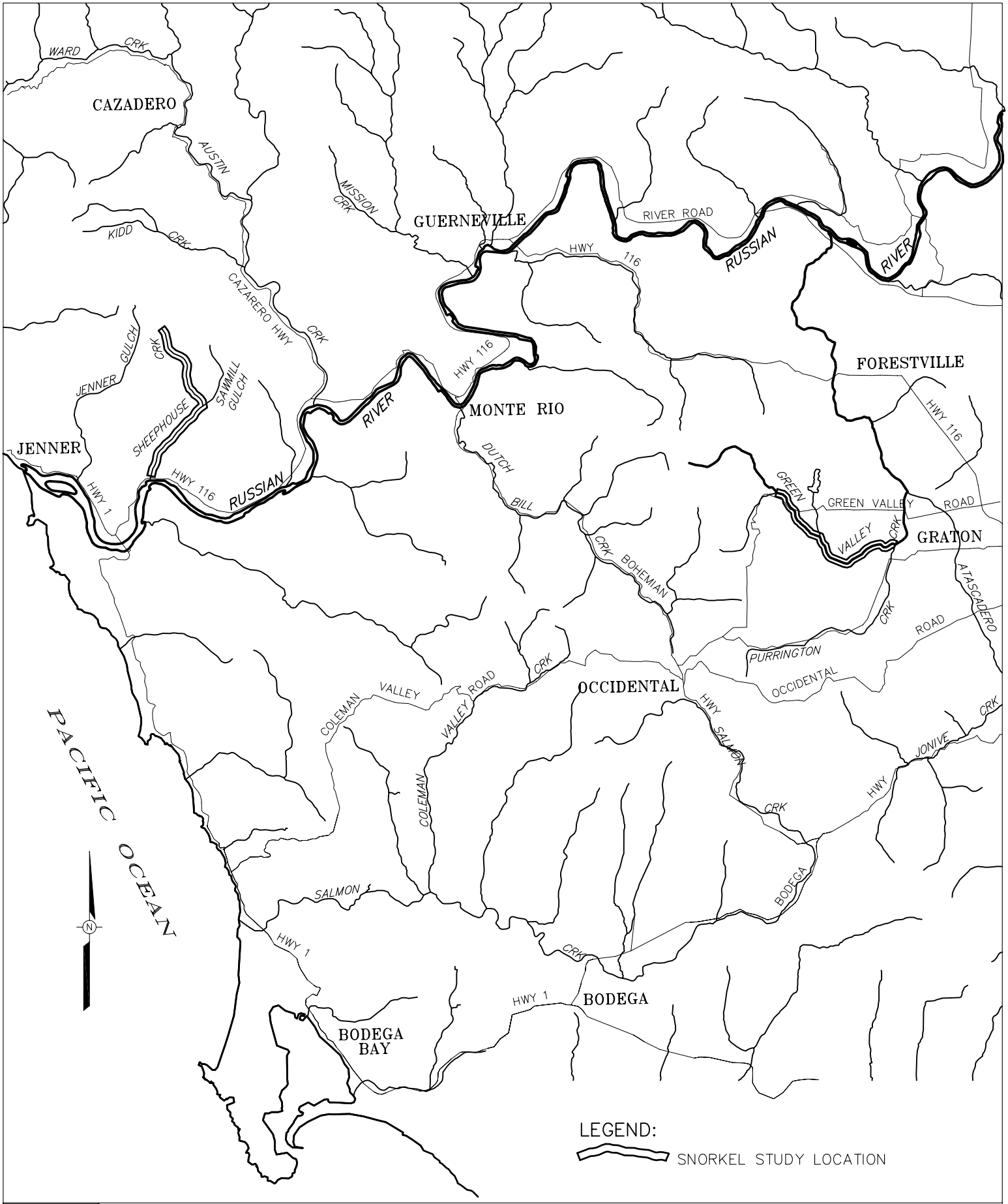

\FISHERIES\STUDIES\SNORKEL_SHEEPHOUSE_GREEN-VALLEY 6 JUNE 2002

SONOMA COUNTY WATER AGENCY

FIGURE I-5
SNORKEL STUDY LOCATIONS SHEEPHOUSE & GREEN VALLEY CREEKS 2000-01

II. POPULATION ESTIMATE AND FISH DENSITY

ALL CREEKS

SANTA ROSA CREEK

F4 Channel

C4 Channel

B2 Channel

MILLINGTON CREEK

F2b/B2 Channel

MARK WEST CREEK

F4 Channel

Lower B2 Channel

C4 Channel

Upper B2 Channel

Table II-1. Steelhead Population Estimate Summary for Santa Rosa, Millington, and Mark West Creeks, 1999-2001

Channel Type	Year	Habitat Type	n	Habitat Units		Steelhead Population Estimate (Young-of-the-Year & 1-3+ Age Classes)						
				Avg Length (m)	Avg Area (m2)	Avg YOY Est	SD	Avg YOY Density (fish/m2)	Avg 1-3+ Est	SD	Avg 1-3+ Density (fish/m2)	Total Pop Est
Santa Rosa Creek												
F4	1999	Flatwater	3	45.5	198.8	5.7	9.8	0.03	0.0	0.0	0.00	17.0
F4	2000	Flatwater	1	No data	No data	67.0	n/a	n/a	4.0	n/a	n/a	71.0
F4	1999	Pool	3	54.1	307.6	2.0	1.7	0.01	0.0	0.0	0.00	6.0
F4	2000	Pool	2	No data	No data	1.0	1.4	n/a	6.5	0.7	n/a	15.0
F4	1999	Riffle	2	14.5	59.3	0.0	0.0	0.00	0.0	0.0	0.00	0.0
F4	2000	Riffle	1	No data	No data	0.0	n/a	n/a	0.0	n/a	n/a	0.0
C4	1999	Flatwater	6	20.2	94.2	11.5	6.7	0.12	0.0	0.0	0.00	69.0
C4	2000	Flatwater	8	No data	No data	19.0	19.6	n/a	2.9	4.4	n/a	175.0
C4	2001	Flatwater	2	24.5	64.8	9.0	1.4	0.14	2.0	2.8	0.03	22.0
C4	1999	Pool	8	31.7	212.8	27.3	11.5	0.13	2.6	2.6	0.01	239.0
C4	2000	Pool	9	No data	No data	9.3	22.1	n/a	1.8	6.4	n/a	100.0
C4	2001	Pool	7	24.5	114.6	7.0	7.1	0.06	0.9	1.5	0.01	55.0
C4	1999	Riffle	7	9.3	38.8	5.7	4.4	0.15	0.3	0.5	0.01	42.0
C4	2000	Riffle	9	No data	No data	9.9	6.4	n/a	0.7	1.0	n/a	95.0
C4	2001	Riffle	7	11.6	23.7	1.9	1.3	0.08	0.3	0.8	0.01	15.0
B2	1999	Flatwater	6	14.5	32.0	17.3	12.7	0.54	0.7	0.8	0.02	108.0
B2	2000	Flatwater	7	No data	No data	26.4	20.5	n/a	0.7	1.5	n/a	190.0
B2	2001	Flatwater	1	14.6	58.0	27.0	n/a	0.47	0.0	n/a	0.00	27.0
B2	1999	Pool	16	19.6	80.8	28.1	14.2	0.35	8.3	4.5	0.10	581.0
B2	2000	Pool	17	No data	No data	39.1	23.9	n/a	14.2	9.0	n/a	907.0
B2	2001	Pool	8	29.4	117.9	34.1	15.7	0.29	12.3	5.5	0.10	371.0
B2	1999	Riffle	8	12.6	22.6	14.9	18.4	0.66	0.3	0.5	0.01	121.0
B2	2000	Riffle	8	No data	No data	31.5	26.9	n/a	1.4	1.3	n/a	263.0
B2	2001	Riffle	7	20.2	40.3	14.9	7.3	0.37	0.0	0.0	0.00	104.0

Table II-1. Steelhead Population Estimate Summary for Santa Rosa, Millington, and Mark West Creeks, 1999-2001 (Continued)

Channel Type	Year	Habitat Type	n	Habitat Units		Steelhead Population Estimate (Young-of-the-Year & 1-3+ Age Classes)						
				Avg Length (m)	Avg Area (m2)	Avg YOY Est	SD	Avg YOY Density (fish/m2)	Avg 1-3+ Est	SD	Avg 1-3+ Density (fish/m2)	Total Pop Est
Millington Creek												
F2b/B2	1999	Flatwater	2	7.5	8.4	8.0	0.0	0.95	2.0	1.4	0.24	20.0
F2b/B2	2000	Flatwater	5	9.4	22.2	27.0	21.8	1.22	1.2	1.8	0.05	141.0
F2b/B2	2001	Flatwater	3	12.1	22.8	5.7	9.0	0.25	1.3	1.5	0.06	21.0
F2b/B2	1999	Pool	5	9.3	29.1	15.8	9.4	0.54	5.2	4.3	0.18	105.0
F2b/B2	2000	Pool	7	9.2	31.9	31.7	13.2	0.99	6.4	1.3	0.20	267.0
F2b/B2	2001	Pool	7	9.2	12.7	13.4	9.8	1.06	4.3	3.5	0.34	124.0
F2b/B2	1999	Riffle	5	3.2	5.5	3.2	1.4	0.58	0.4	1.4	0.07	18.0
F2b/B2	2000	Riffle	4	6.8	11.7	13.8	11.6	1.18	1.3	1.5	0.11	60.0
F2b/B2	2001	Riffle	5	9.1	13.5	4.4	2.4	0.33	0.6	0.5	0.04	25.0
Mark West Creek												
F4	2000	Flatwater	7	30.8	169.1	1.0	1.5	0.01	0.4	0.5	0.00	10.0
F4	2000	Pool	6	33.3	162.2	1.0	1.7	0.01	2.0	3.3	0.01	18.0
F4	2000	Riffle	2	12.2	47.2	0.0	0.0	0.00	0.0	0.0	0.00	0.0
Lower B2	2000	Flatwater	3	10.5	57.8	26.7	9.7	0.46	0.3	0.6	0.01	81.0
Lower B2	2000	Pool	10	14.7	81.2	21.4	15.0	0.26	4.7	3.2	0.06	261.0
Lower B2	2000	Riffle	6	6.3	18.4	7.0	6.4	0.38	0.7	0.8	0.04	46.0
C4	2000	Flatwater	3	7.6	31.3	4.3	4.5	0.14	0.7	0.6	0.02	15.0
C4	2000	Pool	10	32.2	193.8	37.5	17.2	0.19	12.8	10.3	0.07	503.0
C4	2000	Riffle	4	15.9	52.8	14.5	9.8	0.27	0.0	0.0	0.00	58.0
Upper B2	2000	Flatwater	2	12.2	39.1	33.5	6.4	0.86	3.0	2.8	0.08	73.0
Upper B2	2000	Pool	11	11.6	38.4	46.4	30.2	1.21	11.5	7.0	0.30	636.0
Upper B2	2000	Riffle	6	12.0	38.8	27.7	28.2	0.71	1.0	2.0	0.03	172.0

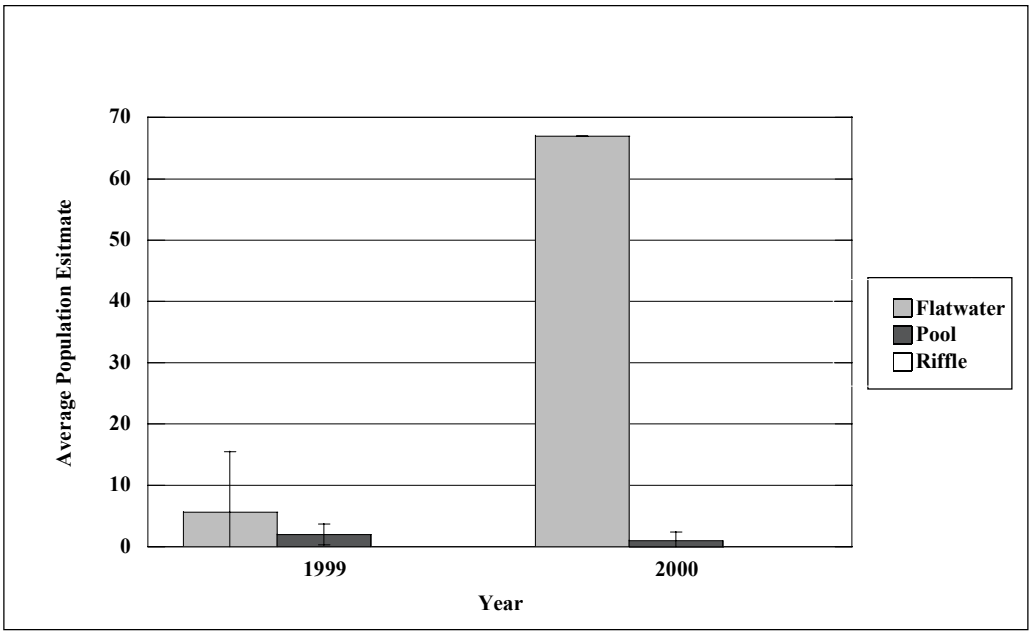

Figure II-1. Population estimate for young-of-the-year steelhead, averaged by habitat type, Santa Rosa Creek, F4 Channel, 1999-2000.

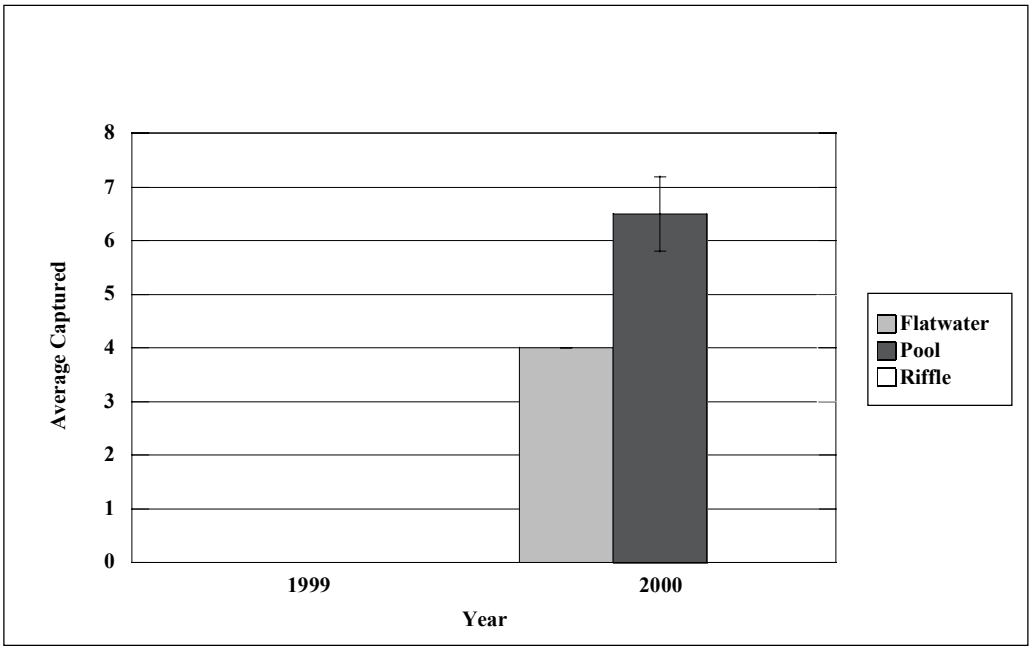

Figure II-2. Average number of captured steelhead aged 1-3+, averaged by habitat type, Santa Rosa, F4 Channel, 1999-2000.

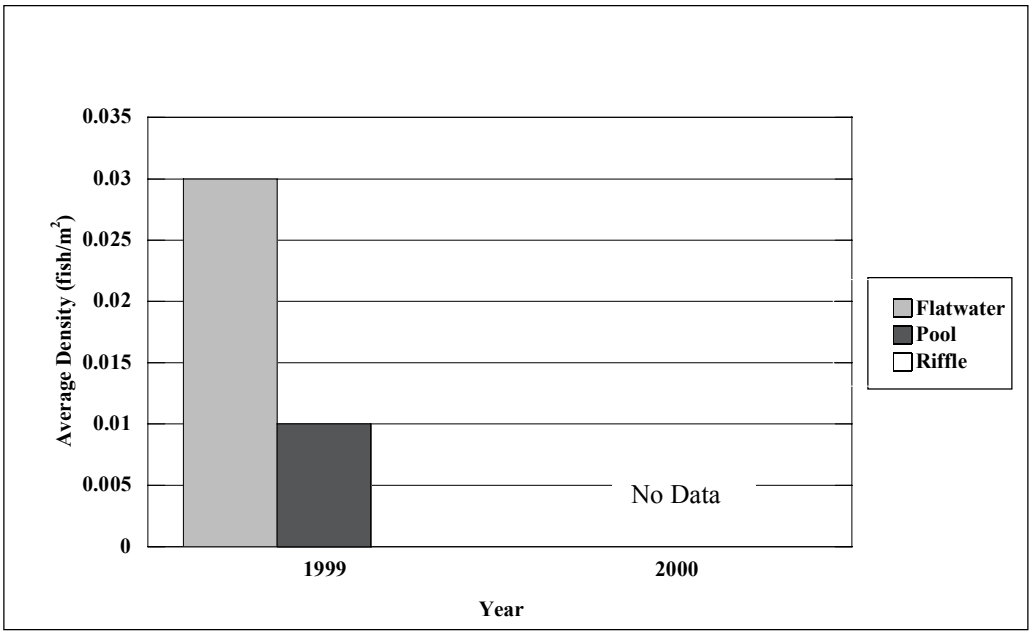

Figure II-3. Average density of young-of-the-year steelhead, Santa Rosa Creek, F4 Channel, 1999-2000.

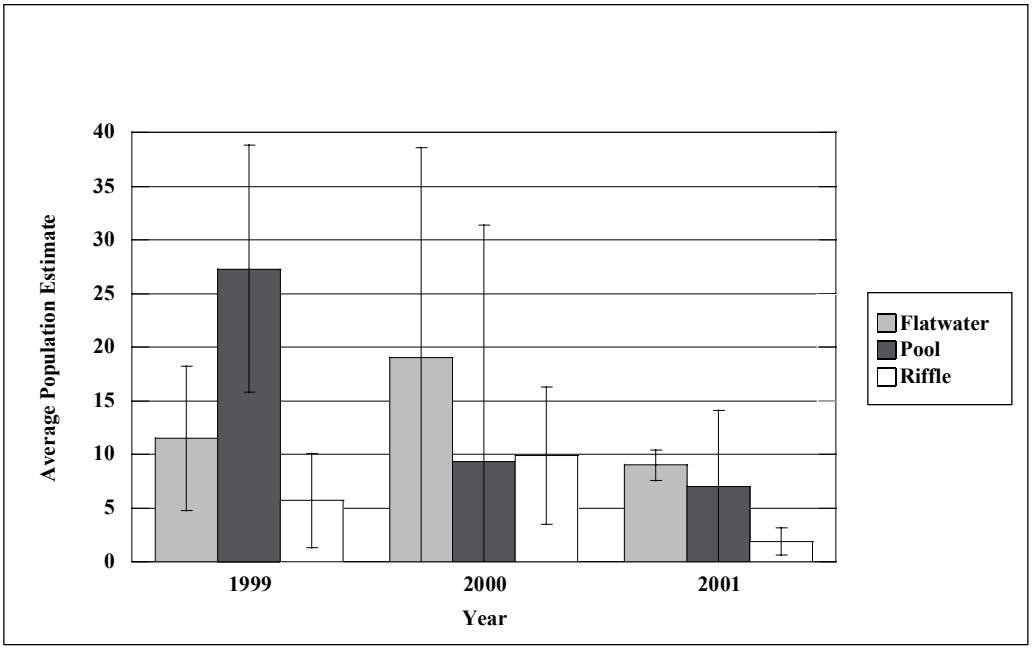

Figure II-4. Population estimate for young-of-the-year steelhead, averaged by habitat type, Santa Rosa Creek, C4 Channel, 1999-2001.

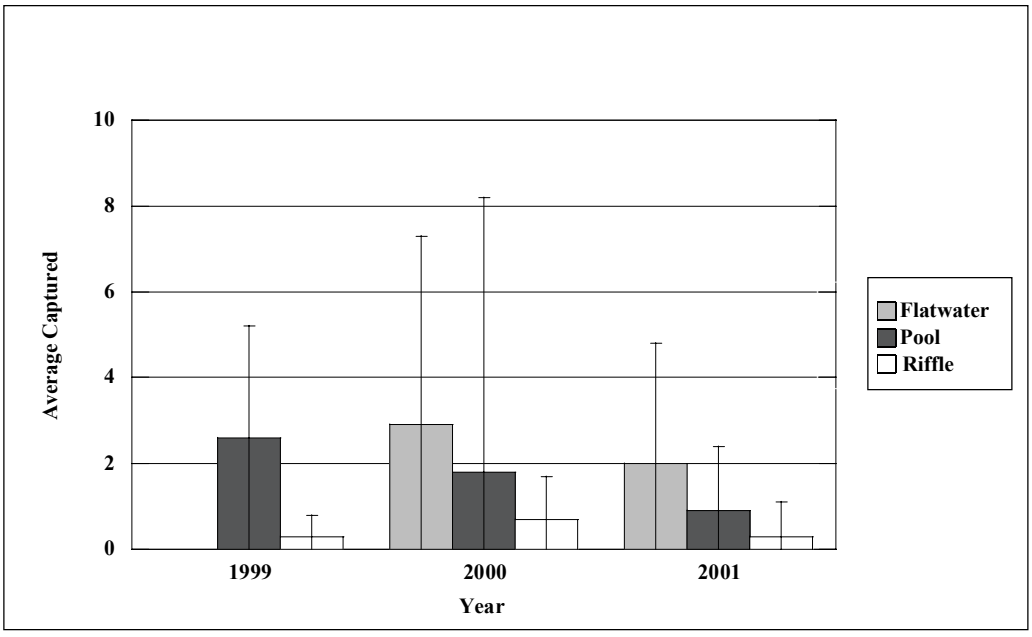

Figure II-5. Average number of captured steelhead aged 1-3+, averaged by habitat type, Santa Rosa Creek, C4 Channel, 1999-2001.

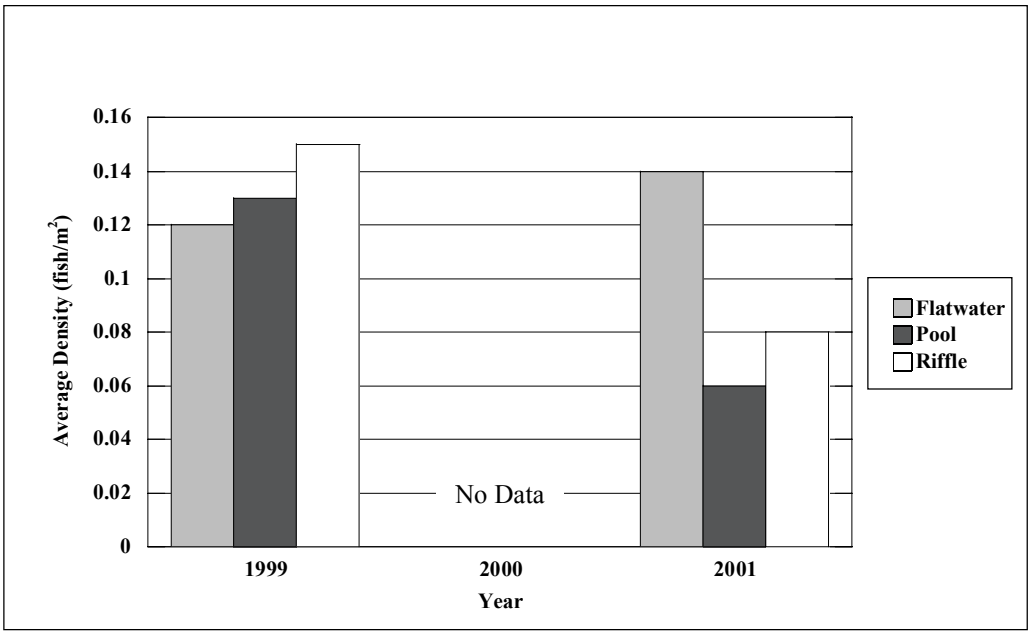

Figure II-6. Average density of young-of-the-year steelhead, Santa Rosa Creek, C4 Channel, 1999-2001.

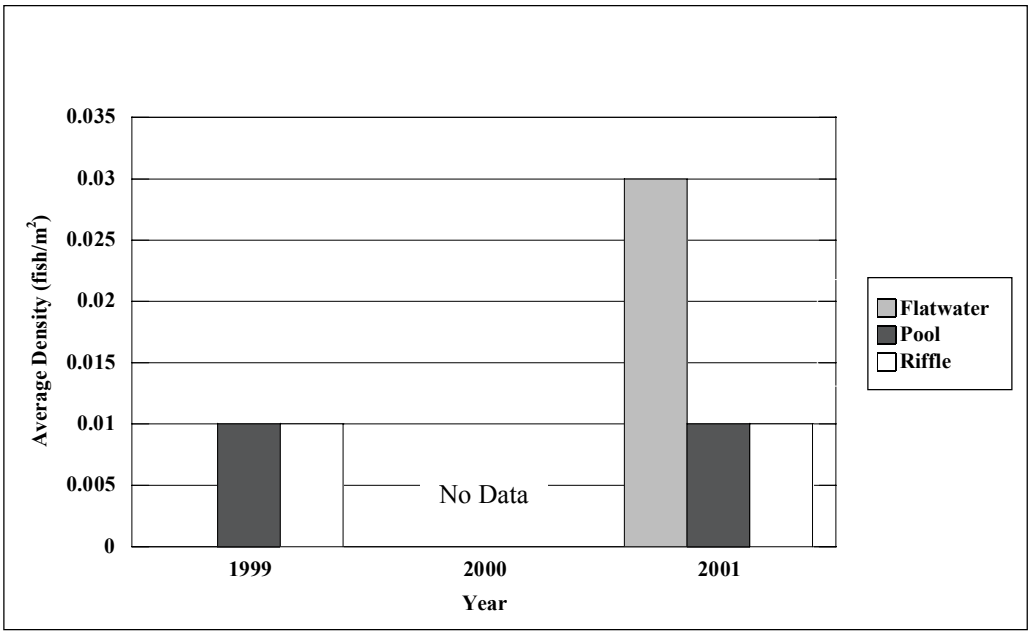

Figure II-7. Average density of 1-3+ aged steelhead, Santa Rosa Creek, C4 Channel, 1999-2001.

III. LENGTH FREQUENCY AND AGE CLASS

SANTA ROSA CREEK

F4 Channel

1999

2000

C4 Channel

1999

2000

2001

B2 Channel

1999

MARK WEST CREEK

F4 Channel

Lower B2 Channel

C4 Channel

Upper B2 Channel

IV. SHEEPHOUSE CREEK SNORKEL SURVEYS

V. GREEN VALLEY CREEK SNORKEL SURVEYS