

HETCH HETCHY FISHERY INVESTIGATION
TUOLUMNE RIVER, CALIFORNIA

1990 PROGRESS REPORT

Prepared by:

U.S. Fish and Wildlife Service
Fish and Wildlife Enhancement
Sacramento Field Office

March 13, 1991

Hetch Hetchy Fishery Investigation 1990 Progress Report

Introduction

The Hetch Hetchy Fishery Investigation is being done under agreement between the City and County of San Francisco and the U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement Field Office, Sacramento, California. Its purpose is to determine the effect of operating the Kirkwood Powerhouse, and the Kirkwood Addition, on fishery values within the Tuolumne River between O'Shaughnessy Dam, at Hetch Hetchy Reservoir, and the diversion structure at Early Intake, 12 miles downstream.

The plan of study for the Hetch Hetchy Fishery Investigation is divided into four elements: 1) Evaluate Instream Flow Requirements; 2) Develop Habitat Suitability Criteria; 3) Survey Fish Populations; and, 4) Temperature Data and Temperature Monitoring. All study elements are scheduled to be completed by December 1992.

This report is the third in a series of progress reports since field work began in October 1987. It describes study activities completed through December 1990.

Study Element 1: Evaluate Instream Flow Requirements

The Fish and Wildlife Service, Instream Flow Incremental Methodology (IFIM) is being used to complete this study element. The methodology is described in

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Instream Flow Information Paper No. 12 (Bovee, FWS/OBS, 82/26, 1982).

The habitat mapping approach (described in our 1989 Progress Report) is being used in applying the IFIM to the Tuolumne River between Hetch Hetchy Reservoir and Early Intake. This approach relies on the distribution of habitat types important to the fishery and the proportional sampling of these habitats. Physical habitat characteristics (water surface elevation, discharge, water depths, water velocities, and substrate type), gathered at known "calibration" flows provide the basis for the hydraulic simulation of these characteristics at other flows. This hydraulic simulation along with fish habitat suitability criteria (being developed through study element 2) are the input to the Physical Habitat Simulation (PHABSIM) Model which will aid in the evaluation of instream flow requirements for the Tuolumne River between Hetch Hetchy Reservoir and Early Intake.

Descriptions of habitat surveying procedures and habitats types used in this, and other study elements, are provided in previous progress reports and the plan of study for Study Element 2 - Habitat Suitability Criteria Development. A description of the 5 Tuolumne River study sections, measured lengths and areas of each habitat type within these sections, and habitat maps are provided in Appendix A of the 1989 Progress Report.

Figure 1 illustrates the location of the Hetch Hetchy Fishery Investigation Study Area along with individual study reaches.

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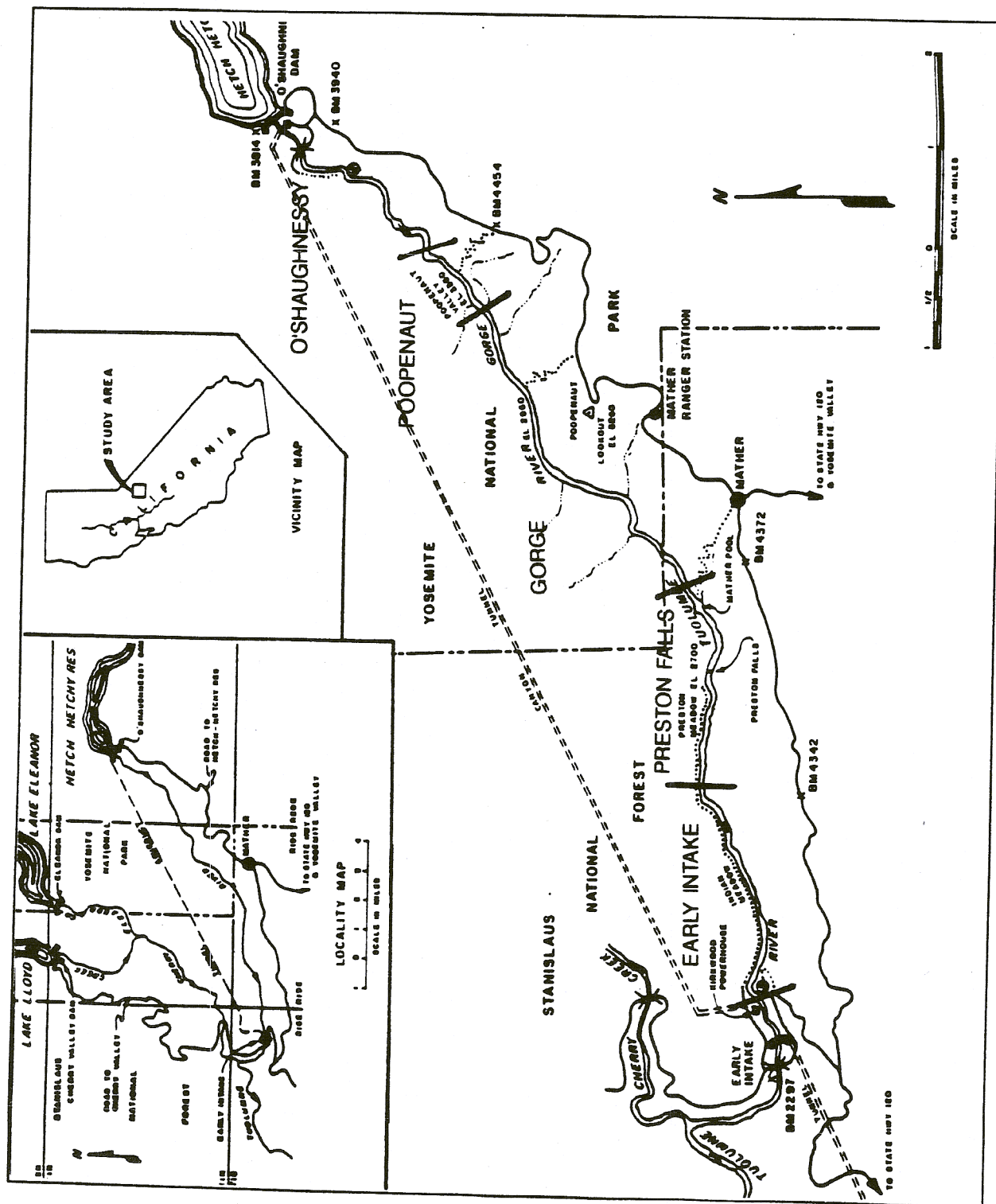


Figure 1. Location map of Hetch Hetchy Fishery Investigation Study Reaches.

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Data describing the hydrological characteristics (water velocity, water depth, water surface elevations, and substrate) were gathered at 3 calibration flows (250, 125, and 25 cubic feet per second), measured as releases from O'Shaughnessy Dam, between July 18, 1989 and October 13, 1989.

These data have subsequently been reviewed, tabulated into computer data files, and edited. Final input data files for the IFIM are partially complete. Additional data analysis and IFIM modeling was suspended through 1990, pending completion of field data gathering for study element 2 and development of final Habitat Suitability Criteria which will provide the biological input to the Physical Habitat Simulation Model. This effort is scheduled for completion in 1991.

Study Element 2: Develop Habitat Suitability Criteria

Previous efforts have been described in our 1988 and 1989 Progress Reports. Additional habitat use and available habitat observations for all life stages of rainbow and brown trout within the study reach were made during 1990. These data have been added to the existing data base. A summary of habitat use observations through June 1990 is provided in Table 1. Trout fry are those individuals less than 2 inches in total length, juveniles are those equal to or larger than 2 inches but smaller than 5 inches, and adults are those equal to or larger than 5 inches in total length. Habitat use observations, by study section and life stage are provided in Tables 2 and 3.

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Table 1. Summary of trout habitat use observations for the period October 20, 1987 through June 14, 1990, Hetch Hetchy Fishery Investigation.

Number of Observations by Life Stage			
Rainbow Trout		Brown Trout	
Spawning	38	Spawning	93
Fry	72	Fry	100
Juveniles	134	Juveniles	152
Adults	153	Adults	101
Totals	365		364

Table 2. Distribution of Rainbow Trout habitat use observations, by study reach and life stage, made for the period October 20, 1987 through June 14, 1990, Hetch Hetchy Fishery Investigation.

Study Reach	Number of Observations				TOTAL
	Spawning	Fry	Juvenile	Adult	
O'Shaughnessy	31	0	7	47	85
Poopenaut Valley	0	47	22	5	74
Gorge	0	0	0	0	0
Preston Falls	7	21	48	26	102
Early Intake	0	4	57	75	136
TOTALS	38	72	134	153	397

Table 3. Distribution of Brown Trout habitat use observations, by study reach and life stage, made for the period October 20, 1987 through June 14, 1990, Hetch Hetchy Fishery Investigation.

Study Reach	Number of Observations				TOTAL
	Spawning	Fry	Juvenile	Adult	
O'Shaughnessy	15	0	20	22	57
Poopenaut Valley	2	23	49	11	85
Gorge	18	0	0	0	18
Preston Falls	57	17	35	22	131
Early Intake	1	60	48	46	155
TOTALS	93	100	152	101	446

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Frequency distributions of habitat use for mean column water velocity, fish "nose" water velocity, total water depth, and substrate category, for each life stage of rainbow and brown trout observed are illustrated graphically in Appendix A.

Study Element 3: Survey Fish Populations

Previous fish population surveys conducted by the Service (1970, 1977) and by Bruce Vondracek (1985) are not directly comparable in that the techniques used were different. However, they can be used to compare apparent increases or decreases in the overall trout population levels although caution should be applied in drawing any conclusions from such comparisons.

We chose to use the approach described by Vondracek (1985). Even though this approach can not yield a population estimate with a known degree of confidence it does, however, at least allow for a relative estimate of the population size. By making our population counts over a period of 3 consecutive years (1988, 1989, and 1990), using the same representative habitats and techniques, we should be able to make some determination regarding general population level and trends within the study area. A total of 18 representative habitats (described in previous progress reports) were identified and used during each years field surveys. Generally, these surveys occurred during the month of

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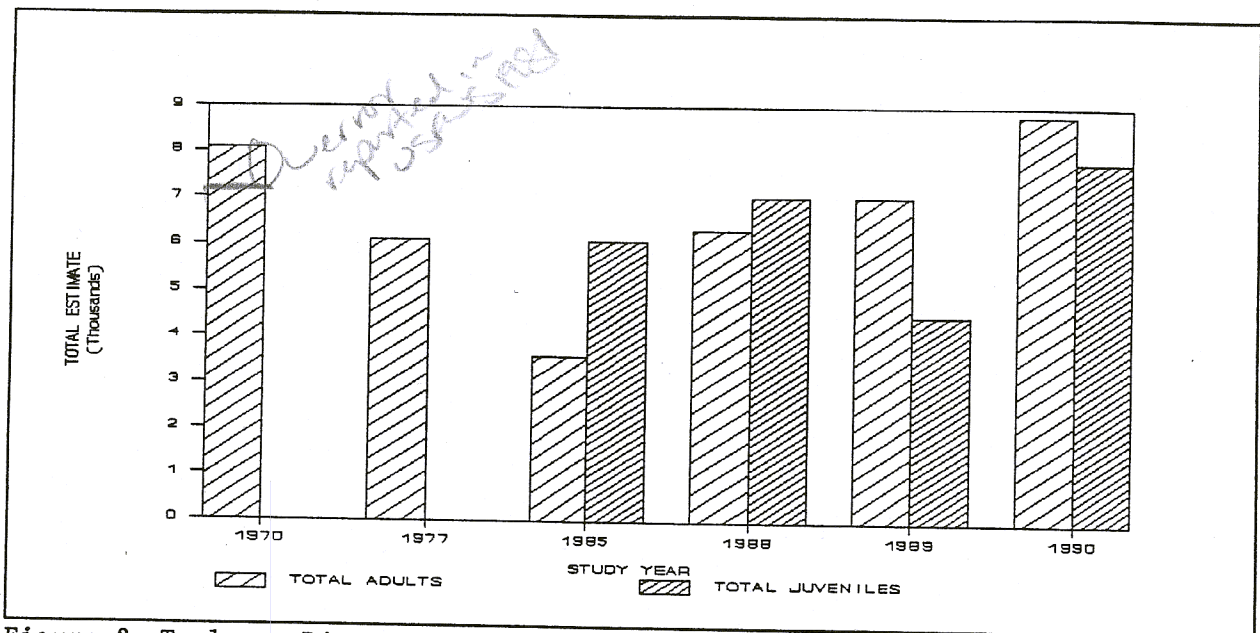


Figure 2. Tuolumne River trout population estimates for the reach between Hetch Hetchy reservoir and the diversion at Early Intake.

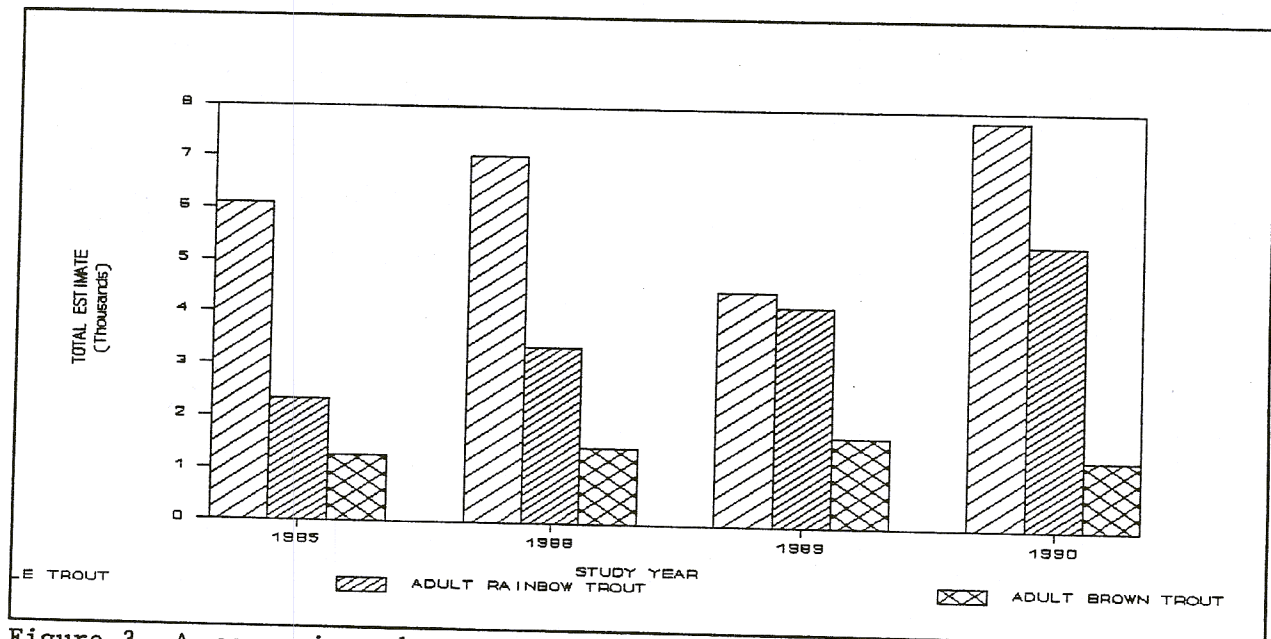


Figure 3. A comparison between adult rainbow trout, adult brown trout, and juvenile trout populations within the Tuolumne River between Hetch Hetchy reservoir and the diversion at Early Intake.

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August each year. Trout population trends with the study area, over the past three years, are illustrated in Figure 2. A comparison between the trends in adult rainbow trout, adult brown trout, and juvenile trout populations are illustrated in Figure 3. Summaries of 1990, 1989, and 1988 population survey data are also provided in Appendix B of this report.

Study Element 4: Temperature Data and Temperature Modeling

Two water temperature monitoring stations, located near existing U.S. Geological Survey (USGS) gaging stations just below O'Shaughnessy Dam and just above Early Intake on the Tuolumne River were installed in August 1987. Daily minimum and maximum water temperature record are now available from USGS and are summarized in their annual surface water reports. Since the summer months, June through October, are the primary months of concern for trout populations we have summarized the USGS water temperature data for the Tuolumne River near Hetch Hetchy and above Early Intake. These data are illustrated in Figure 4.

Work Planned for 1991

Table 4 summarizes activities planned for 1991 and target completion dates. We expect to complete the IFIM analysis using the hydraulic data gathered during 1989 and trout habitat suitability curves (FISHFILS) developed through study element 2. We plan to complete development of final rainbow and brown trout habitat suitability curves and build FISHFILS to be used in the final IFIM

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analysis. A final report for the completed Hetch Hetchy Fishery Investigation under the existing contract will be completed by September 30, 1991.

Table 4. Planned activities and target completion dates for 1991, Hetch Hetchy Fishery Investigation, Tuolumne River, California.

Activity	Target Completion Date
1. Develop Habitat Preference Curves.	
a. Complete data summary	04/91
b. Build Curves (FISHFIL)	06/91
2. Complete Habitat Preference Criteria Report	07/91
3. Complete Population Survey Report	06/91
4. Instream Flow Analysis	
a. Completed & calibrate IFIM data input decks	06/91
b. Run initial PHABSIM Model	07/91
c. Review and run final PHABSIM Model	09/91
5. Complete summary and review of instream instream temperature data	09/91
6. Complete final Hetch Hetchy Fishery Investigation Report	10/91

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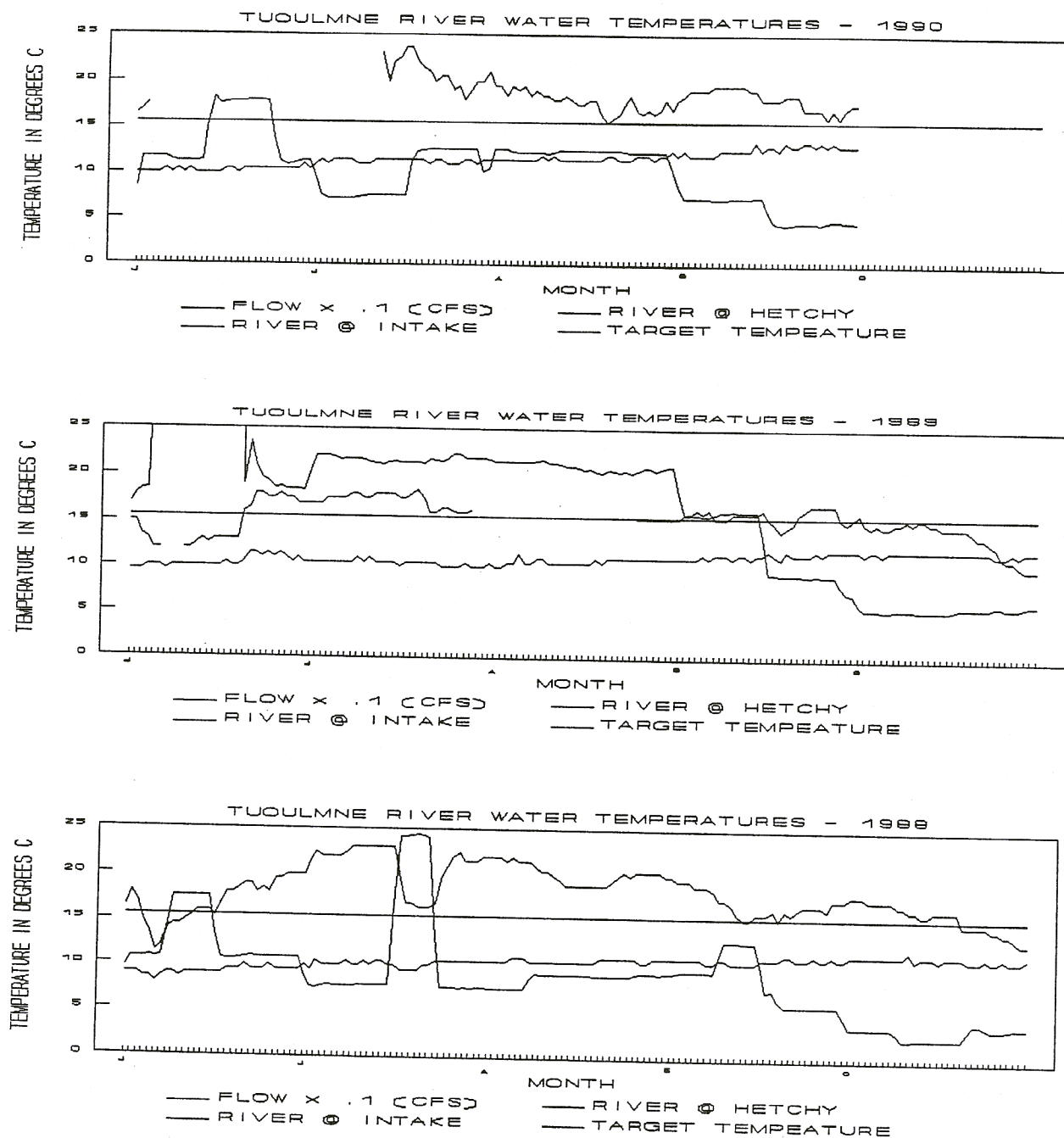


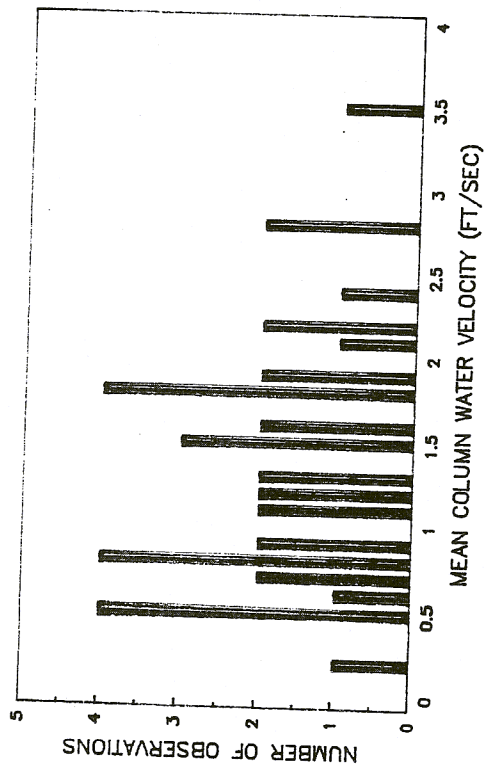
Figure 4. A comparison of Tuolumne River water temperatures for the months of June through October within the Hetch Hetchy Fishery Investigation Study reach for the years 1990, 1989, and 1988.

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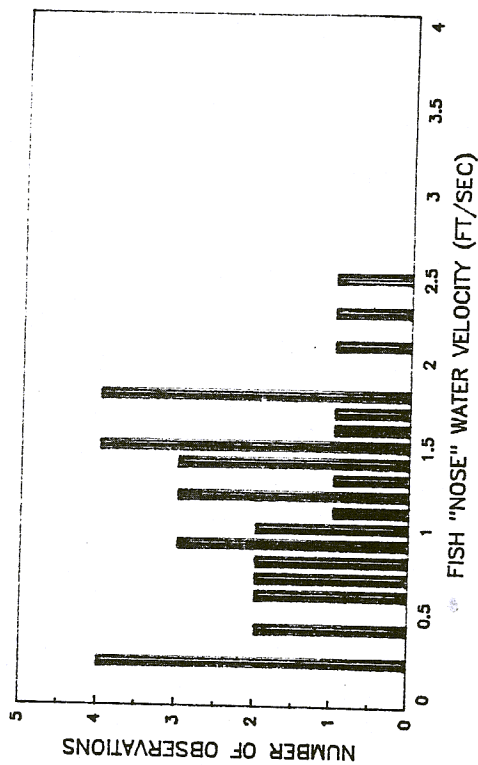
APPENDIX A

HISTOGRAMS OF HABITAT USE OBSERVATIONS FOR
TOTAL DEPTH, WATER VELOCITY, AND DOMINANT SUBSTRATE

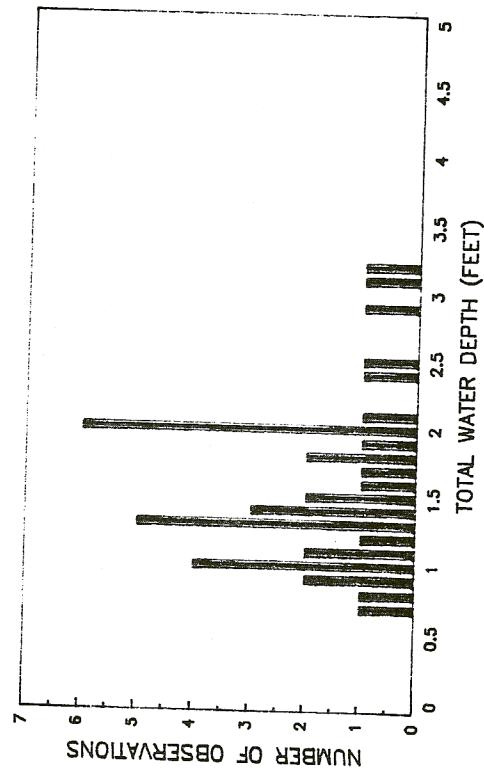
RAINBOW TROUT - SPAWNING (n=38)



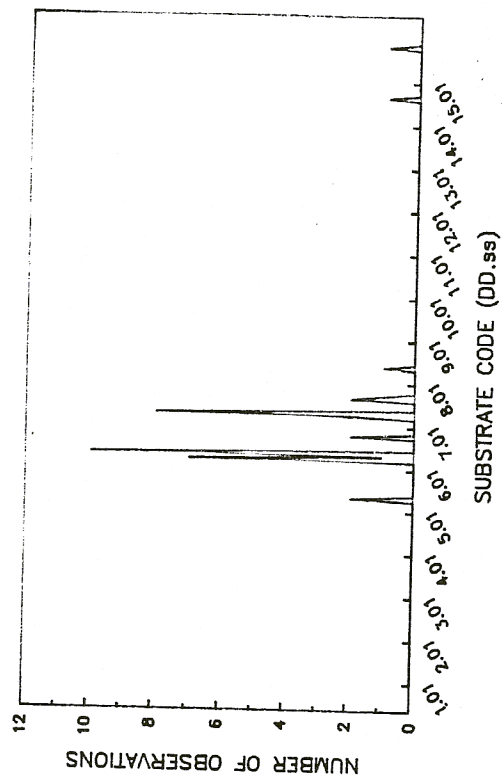
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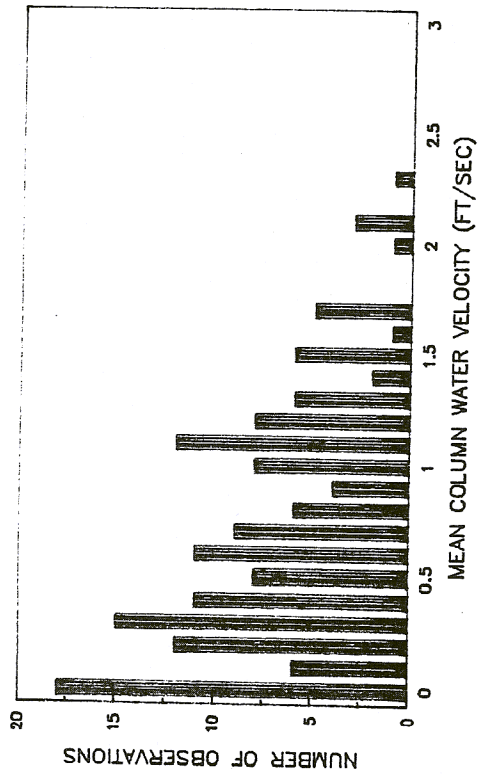
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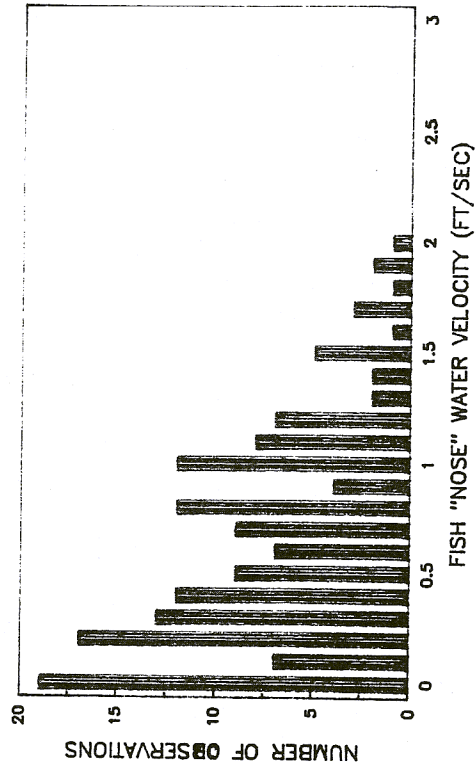
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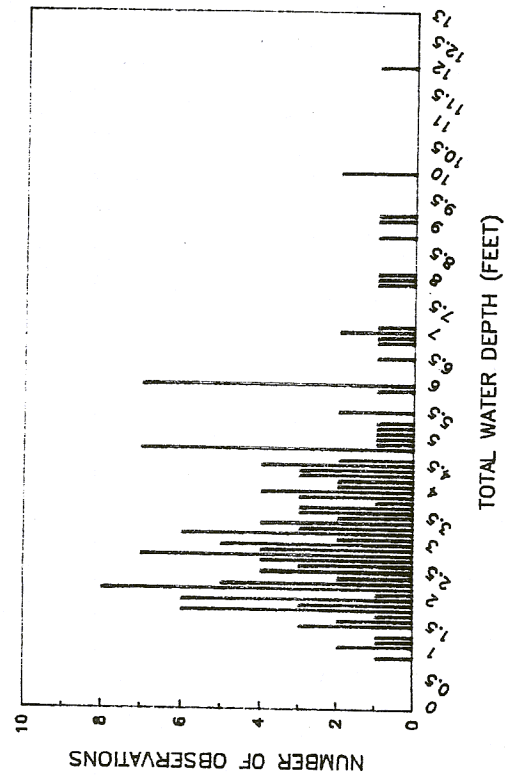
RAINBOW TROUT -- ADULTS (n=153)



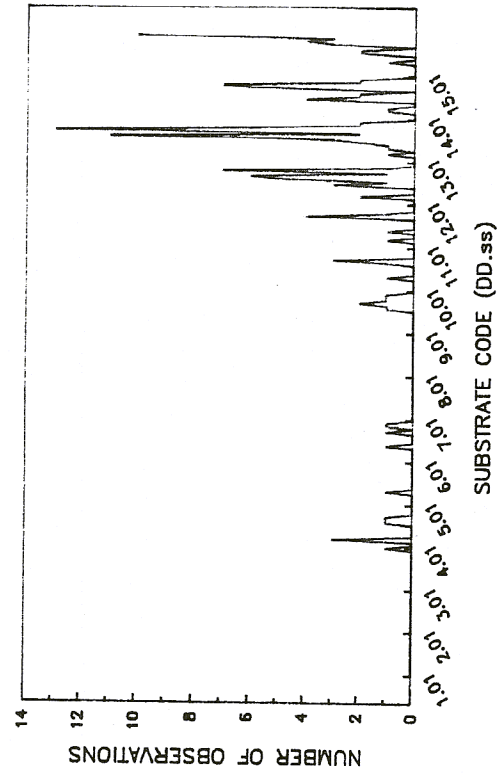
RAINBOW TROUT -- ADULTS (n=153)



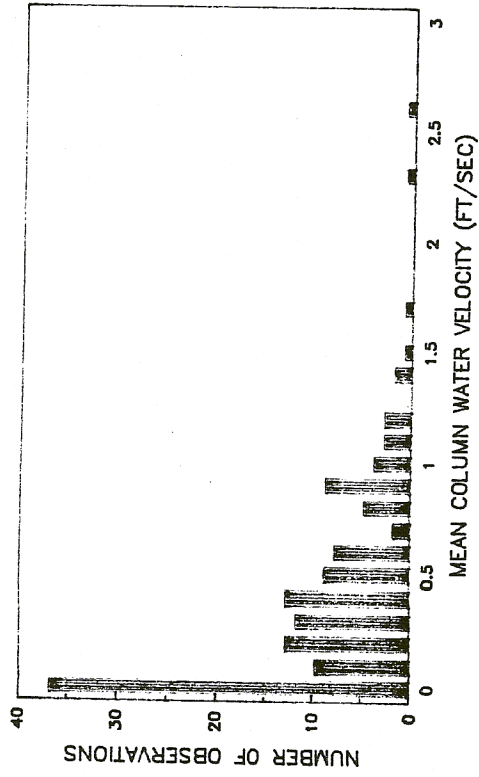
RAINBOW TROUT -- ADULTS (n=153)



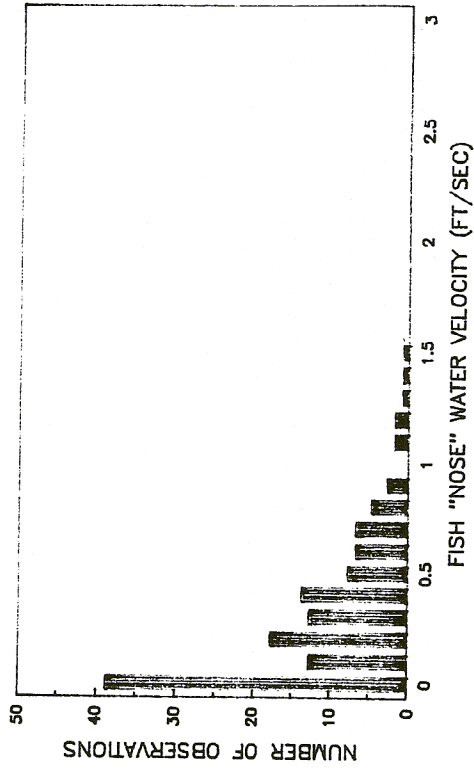
RAINBOW TROUT -- ADULTS (n=153)



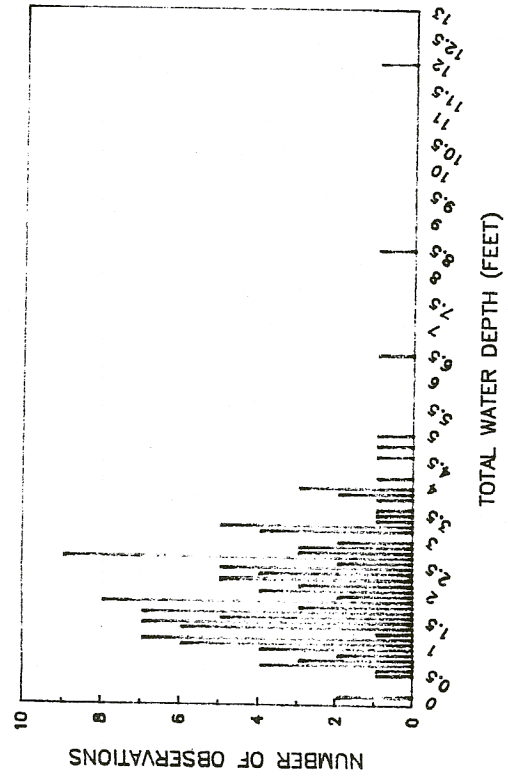
RAINBOW TROUT - JUVENILES (n=134)



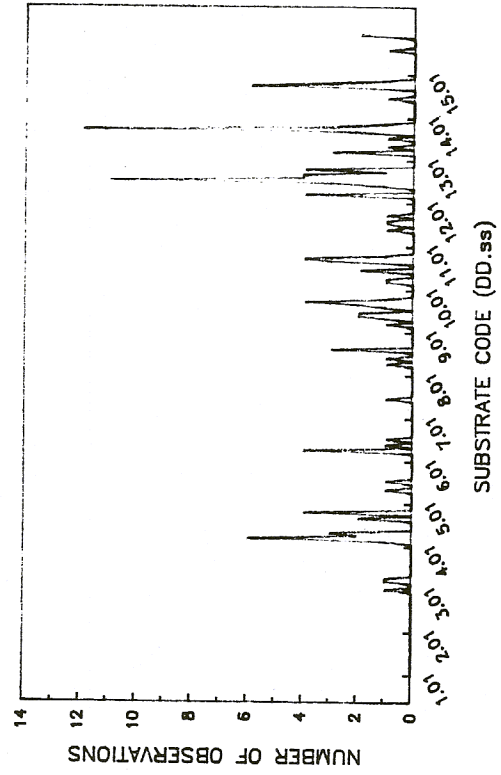
RAINBOW TROUT - JUVENILES (n=134)



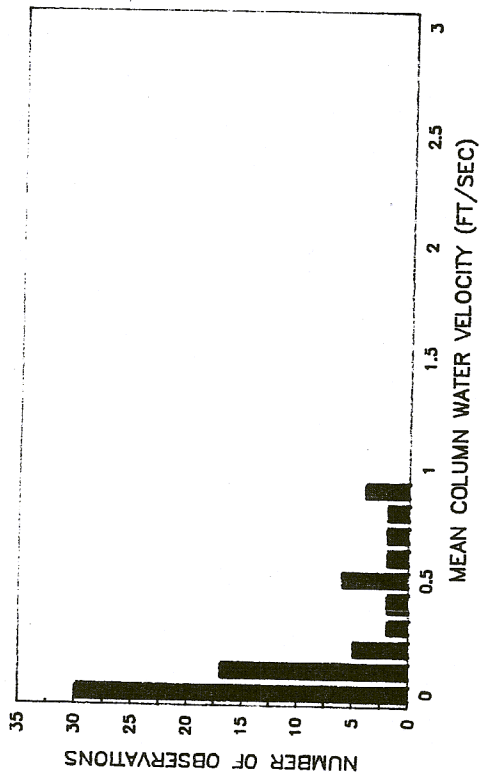
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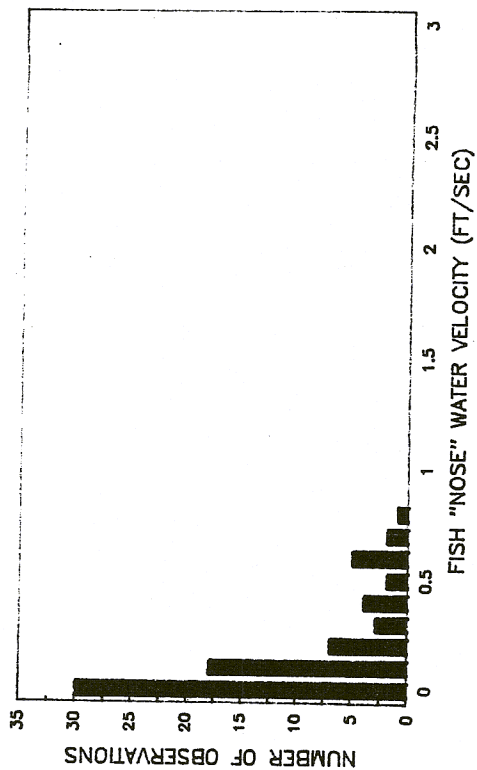
RAINBOW TROUT - JUVENILES (n=134)



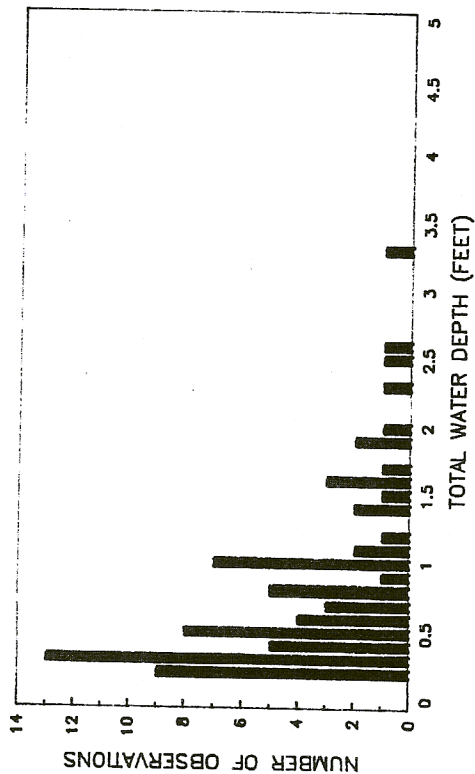
RAINBOW TROUT - FRY (n=72)



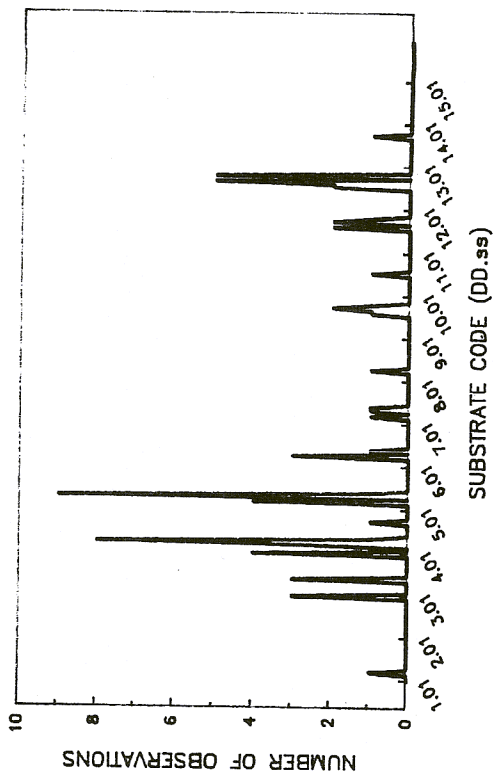
RAINBOW TROUT - FRY (n=72)



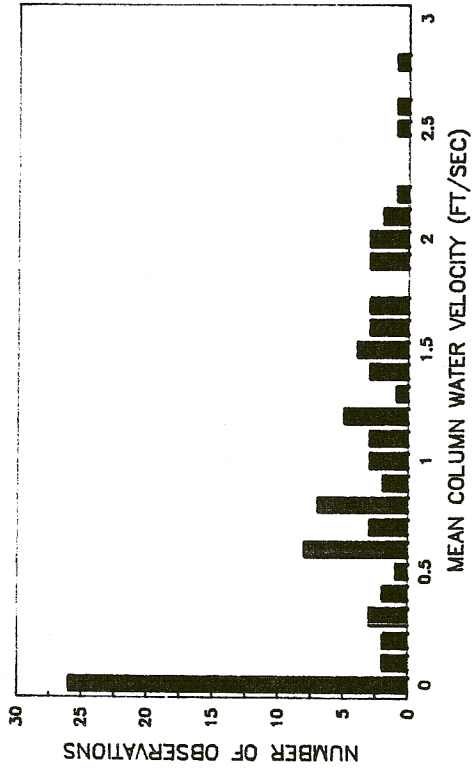
RAINBOW TROUT - FRY (n=72)



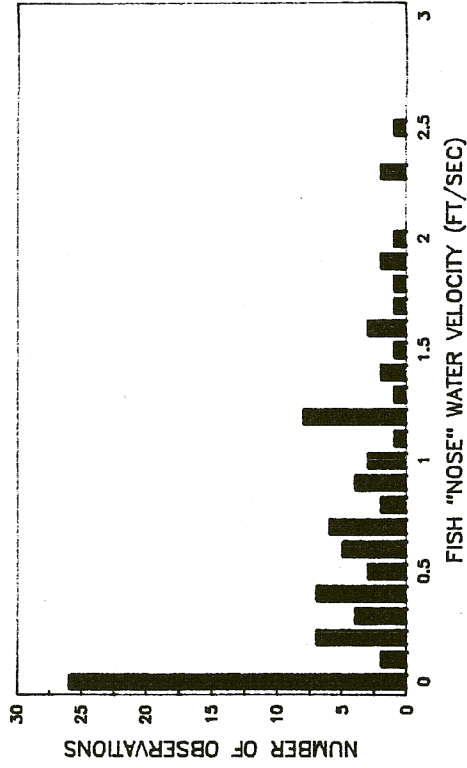
RAINBOW TROUT - FRY (n=72)



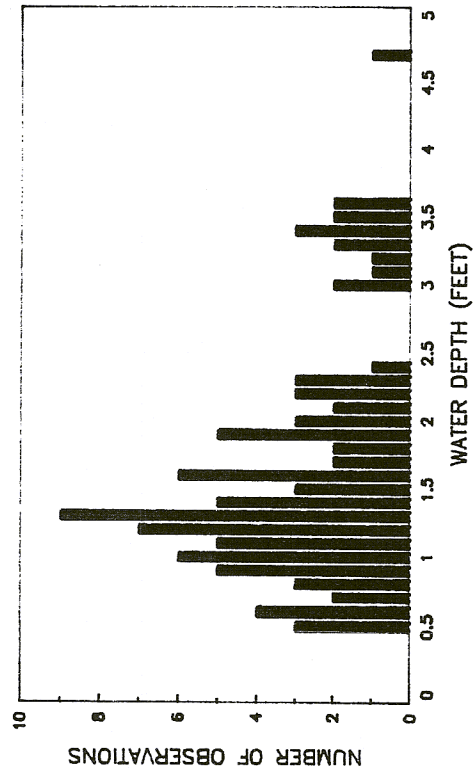
BROWN TROUT - SPAWNING (n=93)



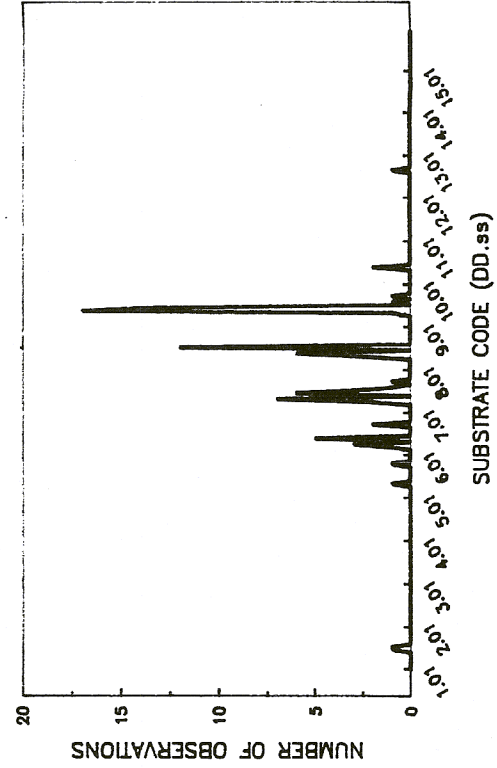
BROWN TROUT - SPAWNING (n=93)



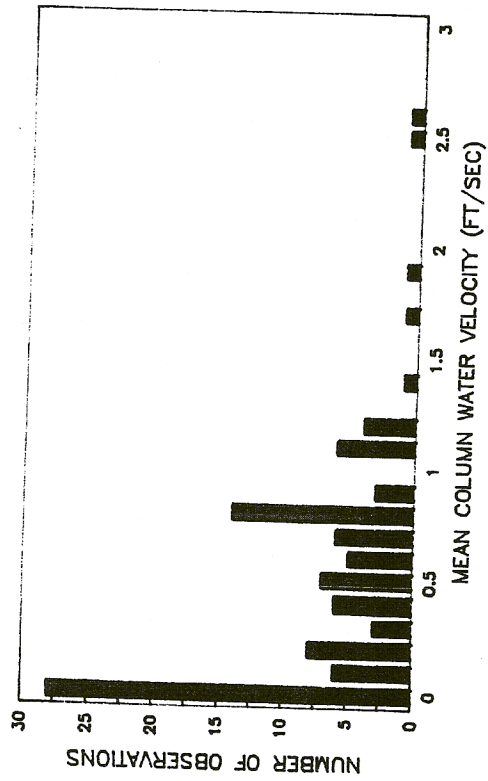
BROWN TROUT - SPAWNING (n=93)



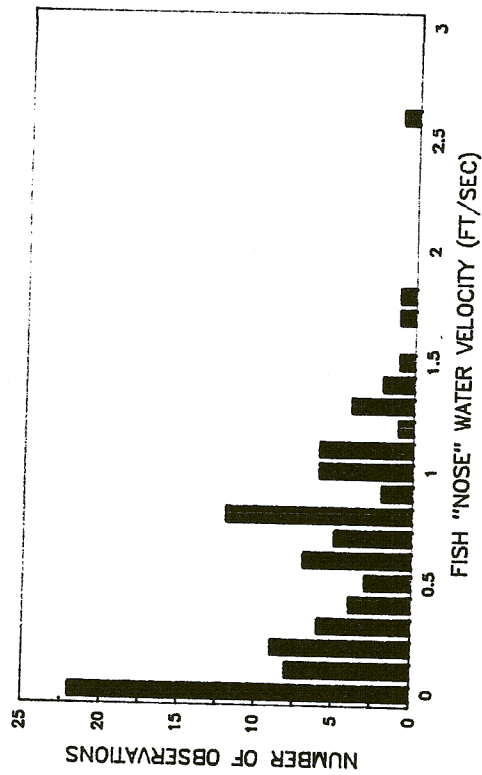
BROWN TROUT - SPAWNING (n=93)



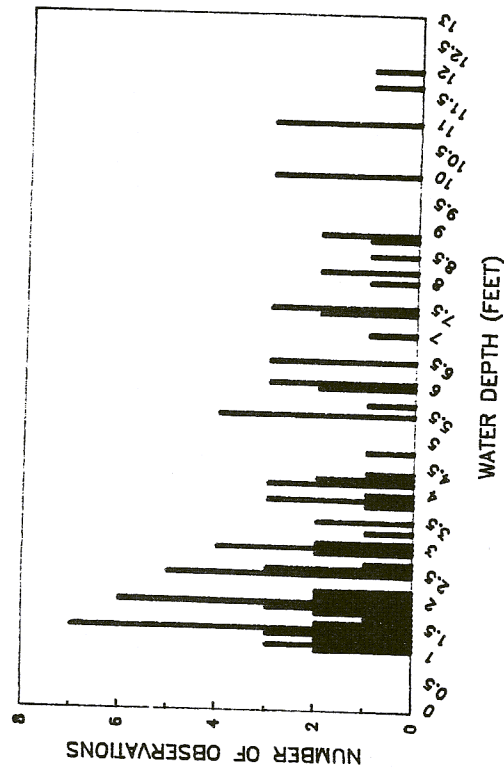
BROWN TROUT - ADULTS (n=101)



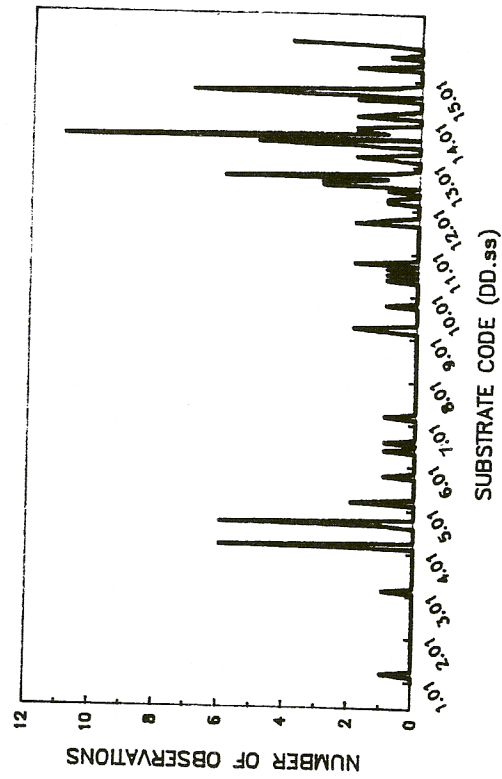
BROWN TROUT - ADULTS (n=101)



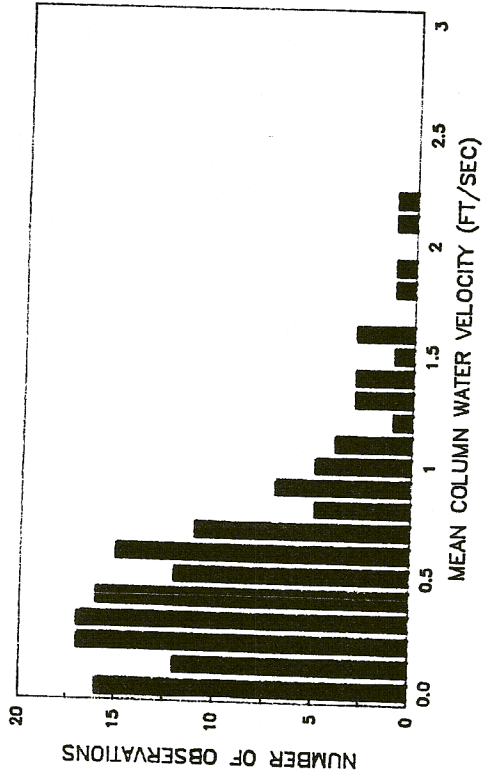
BROWN TROUT - ADULTS (n=101)



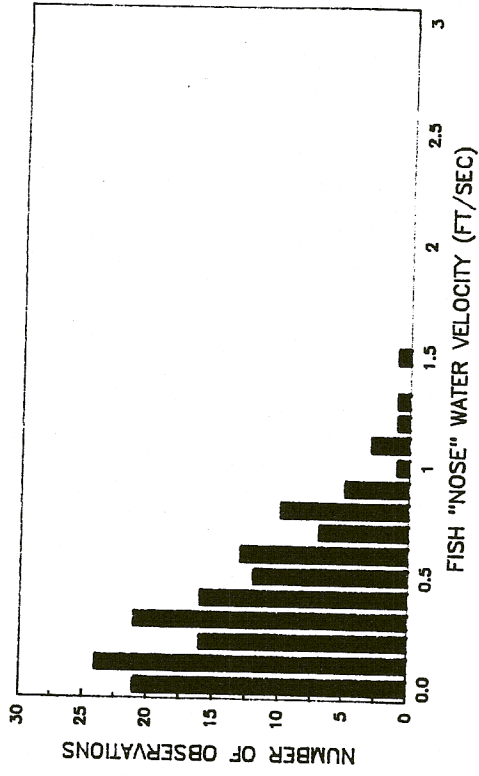
BROWN TROUT - ADULTS (n=101)



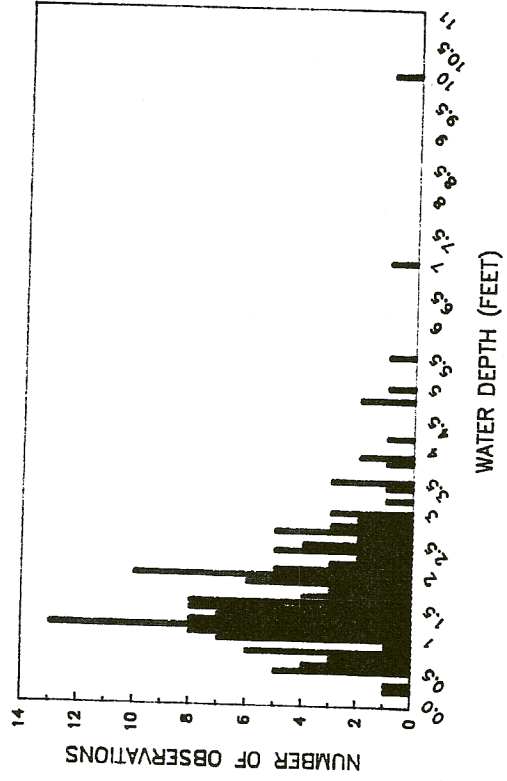
BROWN TROUT - JUVENILES (n=152)



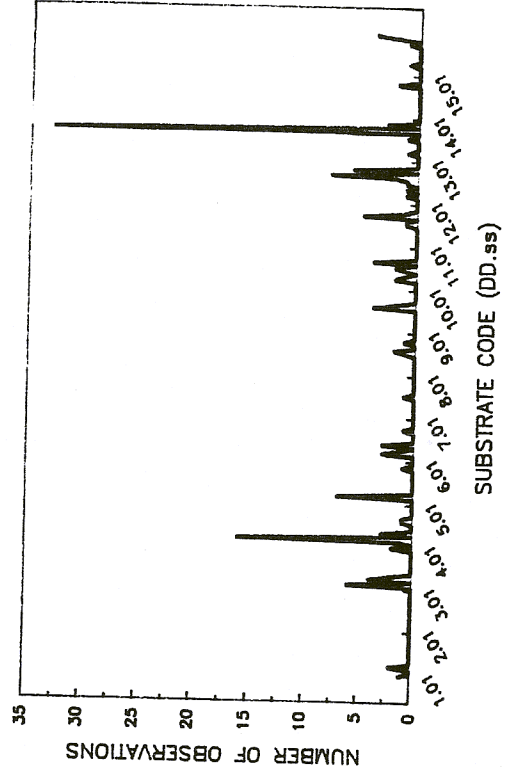
BROWN TROUT - JUVENILES (n=152)



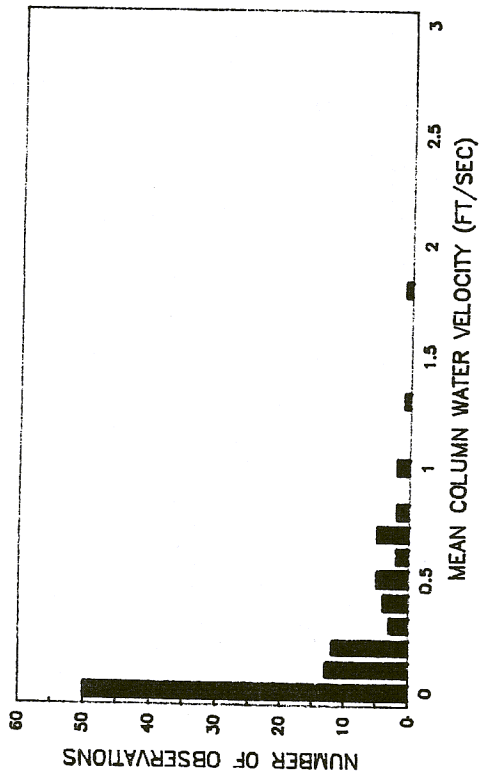
BROWN TROUT - JUVENILES (n=152)



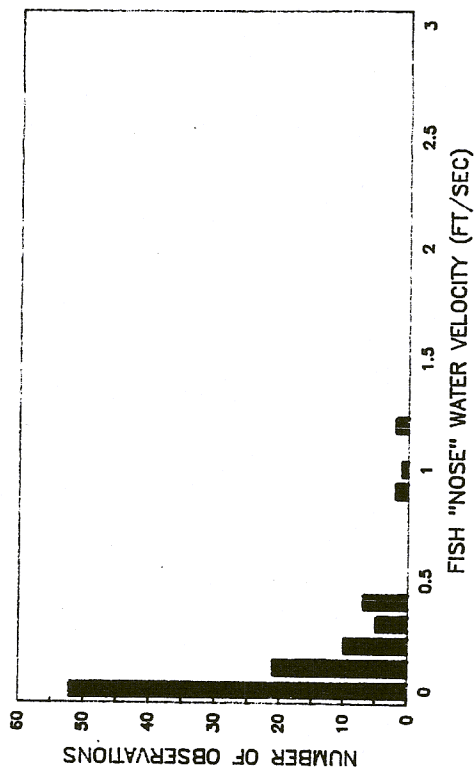
BROWN TROUT - JUVENILES (n=152)



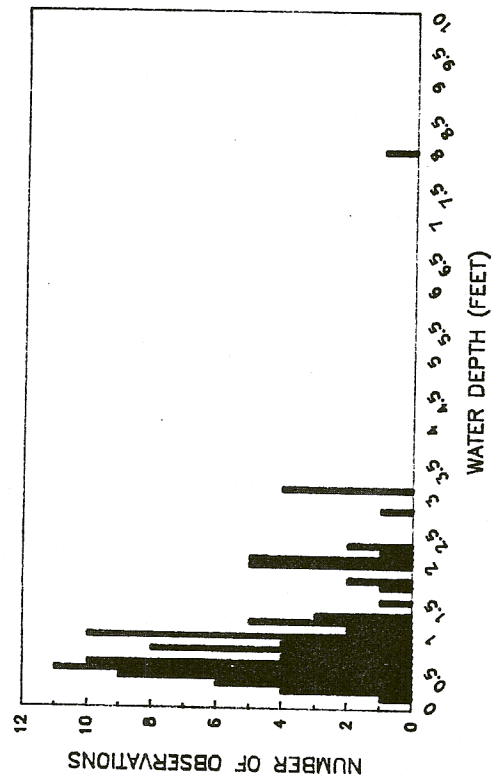
BROWN TROUT -- FRY (n=100)



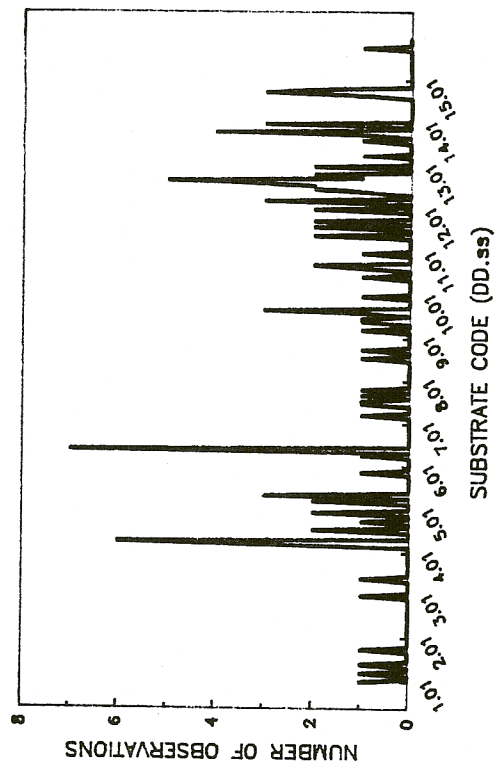
BROWN TROUT -- FRY (n=100)



BROWN TROUT -- FRY (n=100)



BROWN TROUT -- FRY (n=100)



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APPENDIX B

SUMMARIES OF TROUT POPULATION SURVEYS FOR 1988, 1989, AND 1990

HETCH HETCHY POPULATION SURVEY DATA
 AUGUST 27 THROUGH 30, 1990
 METHOD = MASK AND SNORKLE
 COMPILED BY MIKE ACEITUNO, FWS-ES, SACRAMENTO

REACH	HABITAT TYPE LENGTH(FT)	DIRECTION	RAINBOWS	BROWNS	JUVENILES	UNKNOWN ADULTS	TOTAL ADULTS	
O'SHAUGHNESSY	SP 125	UP1	6	5	2	2	13	
		UP2	5	3	1	1	9	
		UP3	5	6	3	0	11	
		TOTAL	16	14	6	3	33	
		AVG	5	5	2	1	11	
	PW 100	UP1	9	4	0	0	13	
		UP2	10	2	0	0	12	
		UP3	8	4	0	0	12	
		TOTAL	27	10	0	0	37	
		AVG	9	3	0	0	12	
	DP 150	UP1	6	1	2	4	11	
		UP2	3	1	1	4	8	
		UP3	1	6	2	4	11	
		TOTAL	10	8	5	12	30	
		AVG	3	3	2	4	10	
REACH TOTALS		375	GRAND TOTAL	53	32	11	15	100
			AVG	18	11	4	5	33

POOPENAUGHT VALLEY	RUN 150	UP1	0	0	40	0	0	
		UP2	0	0	46	0	0	
		UP3	0	0	54	0	0	
		TOTAL	0	0	140	0	0	
		AVG	0	0	47	0	0	
	RUN 150	UP1	0	0	54	0	0	
		UP2	0	0	57	0	0	
		UP3	0	0	53	0	0	
		TOTAL	0	0	164	0	0	
		AVG	0	0	55	0	0	
	DP 300	UP1	1	4	8	38	43	
		UP2	2	11	15	31	44	
		UP3	1	13	27	41	55	
		TOTAL	4	28	50	110	142	
		AVG	1	9	17	37	47	
REACH TOTALS		600	GRAND TOTAL	4	28	354	110	142
			AVG	1	9	118	37	47

GORGE	C/P	150	UP1	6	1	2	2	9	
			UP2	4	0	2	0	4	
			UP3	5	1	4	0	6	
			TOTAL	15	2	8	2	19	
			AVG	5	1	3	1	6	
	D/S	250	UP1	34	1	17	14	49	
			UP2	37	6	15	20	63	
			UP3	35	5	21	20	60	
			TOTAL	106	12	53	54	172	
			AVG	35	4	18	18	57	
	DP	200	UP1	1	37	21	26	14	
			UP2	11	10	38	17	38	
			UP3	2	1	26	40	43	
			TOTAL	14	48	85	83	145	
			AVG	5	16	28	28	48	
	RUN	200	UP1	4	10	122	3	17	
			UP2	2	12	96	1	15	
			UP3	4	9	119	1	14	
			TOTAL	10	31	337	5	46	
			AVG	3	10	112	2	15	
REACH TOTALS			800	GRAND TOTAL	145	93	483	144	382
				AVG	48	31	161	48	127

INDIAN MEADOW SP		150	UP1	18	2	5	0	20	
			UP2	23	2	6	0	25	
			UP3	18	2	10	0	20	
			TOTAL	59	6	21	0	65	
			AVG	20	2	7	0	22	
	PW	150	UP1	16	4	0	4	24	
			UP2	18	0	5	0	18	
			UP3	15	0	3	0	15	
			TOTAL	49	4	8	4	57	
			AVG	16	1	3	1	19	
	DP	200	UP1	49	2	11	1	52	
			UP2	53	1	15	0	54	
			UP3	42	2	9	0	44	
			TOTAL	144	5	35	1	150	
			AVG	48	2	12	0	50	
	PW	150	UP1	6	1	8	3	10	
			UP2	7	0	6	2	9	
			UP3	8	1	7	0	9	
			TOTAL	21	2	21	5	28	
			AVG	7	1	7	2	9	
REACH TOTALS			700	GRAND TOTAL	273	17	85	10	300
				AVG	91	6	28	3	100

EARLY INTAKE	C/P	150	UP1	22	1	19	0	23
			UP2	28	1	15	0	29
			UP3	28	0	21	0	28
			TOTAL	78	2	55	0	80
			AVG	26	1	18	0	27
	C/P	200	UP1	26	2	26	0	28
			UP2	20	1	20	1	22
			UP3	20	2	24	2	24
			TOTAL	66	5	70	3	74
			AVG	22	2	23	1	25
	PW	100	UP1	28	1	14	1	30
			UP2	22	0	8	0	22
			UP3	21	0	15	0	21
			TOTAL	71	1	37	1	73
			AVG	24	0	12	0	24
	DP	300	UP1	32	5	15	6	43
			UP2	48	8	23	6	62
			UP3	34	7	21	6	47
			TOTAL	114	20	59	18	152
			AVG	38	7	20	6	51
REACH TOTALS		750	GRAND TOTAL	329	28	221	22	379
			AVG	110	9	74	7	126

HETCH HETCHY POPULATION SURVEY DATA
AUGUST 27 THROUGH 30, 1990
COMPILED BY M. ACEITUNO FWS-ES, SACRAMENTO

** SUMMARY **

REACH	LENGTH (FT)	TOTALS	RAINBOWS	BROWNS	JUVENIL	UNKNOWN ADULTS	TOTAL ADULTS
O'SHAUGHNESSY	375		18	11	4	5	33
POOPENAUGHT	600		1	9	118	37	47
GORGE	800		48	31	161	48	127
INDIAN MEADOW	600		91	6	28	3	100
EARLY INTAKE	750		110	9	74	7	126
TOTAL	3125		268	66	385	100	434
GRAND TOTAL ESTIMATE	63360		5434	1338	7799	2034	8806

** SUMMARY BY HABITAT TYPE **

HABITAT TYPE	LENGTH (FT)	TOTALS	RAINBOWS	BROWNS	JUVENIL	UNKNOWN ADULTS	TOTAL ADULTS
DEEP POOL	1150		95	36	78	75	206
SHALLOW POOL	525		60	11	27	19	90
RUN	500		3	10	214	2	15
POCKET WATER	450		56	6	22	3	65
CASCADE/POCKET WATE	500		53	3	44	2	58
TOTAL	3125		268	66	385	100	434
GRAND TOTAL ESTIMAT	63360		5434	1338	7799	2034	8806

WETCH HETCHY POPULATION SURVEY DATA

AUGUST 7 THROUGH 11, 1989

COMPILED BY M. ACEITUNO, FWS-FWE, SACRAMENTO, CA.

** SUMMARY - BY STUDY REACH **

REACH	REACH LENGTH(FT) SURVEYED	LENGTH(FT) SURVEYED NO. ES #/1000 FT	RAINBOW TROUT NO. ES #/1000 FT	BROWN TROUT NO. ES #/1000 FT	UNK. ADULT TROUT NO. ES #/1000 FT	TOTAL ADULT TROUT NO. ES #/1000 FT	JUVENILE TROUT NO. ES #/1000 FT
O'SHAUGHNESSY	17849	375	3	8	0	3	11
POOPENAUT	4026	600	1	2	0	3	5
GORGE	21588	800	38	48	79	29	18
INDIAN MEADOW	12344	600	78	130	15	13	155
EARLY INTAKE	13098	750	71	95	8	20	65
TOTAL	68905	3125	191	61	25	16	203

** SUMMARY - BY HABITAT TYPE **

REACH	REACH LENGTH(FT) SURVEYED	LENGTH(FT) SURVEYED # OBS. #/1000 FT	RAINBOW TROUT # OBS. #/1000 FT	BROWN TROUT # OBS. #/1000 FT	UNK. ADULT TROUT # OBS. #/1000 FT	TOTAL ADULT TROUT # OBS. #/1000 FT	JUVENILE TROUT # OBS. #/1000 FT
DEEP POOL	32933	1150	45	39	56	11	98
SHALLOW POOL	2489	525	48	91	15	44	33
RUN	4259	500	4	8	2	2	166
POCKET WATER	13282	450	43	96	4	7	14
CASCADE/POCKET WATER	8656	500	51	102	1	8	54
TOTAL	61619	3125	191	61	78	15	203

HETCH HETCHY POPULATION SURVEY DATA
AUGUST 15 THROUGH 19, 1988
COMPILED BY M. ACEITUNO FWS-ES, SACRAMENTO

SUMMARY - USING UPSTREAM OBSERVATIONS ONLY

REACH	LENGTH (FT) SURVEYED	RAINBOW TROUT		BROWN TROUT		JUVENILE TROUT		UNK. ADULT TROUT		TOTAL ADULT TROUT	
		EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF
O'SHAUGHNESSY	375	15	40	7	19	1	3	1	3	23	61
POOPENAUT	600	3	5	11	18	62	103	35	58	49	82
GORGE	800	65	81	13	16	77	96	24	30	102	128
INDIAN MEADOW	600	31	52	22	37	97	162	6	10	59	98
EARLY INTAKE	750	43	57	11	15	89	119	1	1	55	73
TOTALS	3125	157	50	64	20	326	104	67	21	288	92

SUMMARY - USING DOWNSTREAM OBSERVATIONS ONLY

REACH	LENGTH (FT) SURVEYED	RAINBOW TROUT		BROWN TROUT		JUVENILE TROUT		UNK. ADULT TROUT		TOTAL ADULT TROUT	
		EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF
IGHNESSY	375	9	24	2	5	0	0	1	3	12	32
ENAUT	600	3	5	14	23	72	120	36	60	53	88
GORGE	800	57	71	13	16	63	79	28	35	97	121
INDIAN MEADOW	600	33	55	15	25	93	155	1	2	48	80
EARLY INTAKE	750	39	52	8	11	76	101	1	1	48	64
TOTALS	3125	141	45	52	17	304	97	67	21	258	83

SUMMARY BY HABITAT TYPE - USING UPSTREAM OBSERVATIONS ONLY

HABITAT TYPE	LENGTH (FT) SURVEYED	RAINBOW TROUT		BROWN TROUT		JUVENILE TROUT		UNK. ADULT TROUT		TOTAL ADULT TROUT	
		EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF	EST.	#/1000LF
DEEP POOL	1150	40	35	29	25	25	22	59	51	128	111
SHALLOW POOL	525	30	57	9	17	42	80	4	8	43	82
RUN	500	7	14	4	8	55	110	0	0	11	22
POCKET WATER	450	27	60	20	44	90	200	4	9	51	113
CASCADE/POCKET WATER	500	50	100	4	8	108	216	2	4	56	112
TOTALS	3125	154	49	66	21	320	102	69	22	289	92

