MAMMOTH CREEK 2002 FISH COMMUNITY SURVEY

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INTRODUCTION

Instream flow needs for fish resources in Mammoth Creek, Mono County, California have been the focus of several investigations since the 1970's. As a result of these investigations, mean daily instream flow regimes have been recommended that are intended to sustain aquatic habitat and the fishery resources in Mammoth Creek. Several entities have been involved in the collection of Mammoth Creek fisheries data (see Hood et al., 1993-95, Jenkins and Dawson 1996-97, Hood 1998, 2000-2001, and Jenkins 1999). However, this report focuses on the data set collected from the 1992 through 2002 fish community surveys. For these surveys, data was collected using a consistent sampling methodology and therefore is most useful in assessing the Mammoth Creek fishery in terms of species composition, abundance, and size and age class structure. The 1992-2002 surveys compare population changes over time under various hydrological conditions.

This report documents the results of the 2002 fish resource assessment survey conducted from September 30, 2002 through October 3, 2002. Specific objectives of this study were:

- To estimate the total fish population and evaluate the size and age class structure and species composition of fish throughout the Mammoth Creek study area and within each sampling section;
- To compare the results of this year's study with previous studies of Mammoth Creek and other similar Sierra Nevada streams; and
- To relate the results of this year's fish population dynamics with the hydrologic conditions of Mammoth Creek over the water year preceding the survey.

Because of the differences in the sampling methodology used by Beak in 1988 and CDFG in1991, the analyses used in this report will focus on the data set collected from the 1992-2002 surveys.

STUDY AREA

The Mammoth Creek study area extends from Lake Mary downstream to the confluence of Mammoth Creek and Hot Creek, a distance of approximately 10.4 miles. Five distinct reaches were identified in Mammoth Creek in 1988 (Bratovich *et al.* 1990), based upon analysis of topographic maps, calculation of gradient profiles, visual inspection of the creek and associated morphological characteristics, tributaries, riparian vegetation and surrounding topography. Four of these reaches were located in the lower 8.9 miles (86.3 percent of the entire length) of the creek, and were characterized by gradients that range from 0.7 to 3.8 percent. By contrast, a fifth reach comprised of approximately the upper 1.4 miles (13.7 percent) of the creek was characterized by a gradient of approximately 12.3 percent. Habitat in this high-gradient reach typically consisted of a cascade-plunge pool sequence in which the amount of usable fish habitat was not determined by stream

discharge, but by sectional (streambed rock) hydraulic controls. Pursuant to concerns expressed by CDFG and the USFS during the preliminary scoping meeting held in 1988 regarding the accuracy of modeling Reach A using the Instream Flow Incremental Methodology (IFIM), habitat characterization and all subsequent investigations were restricted to the remaining four study reaches (Bratovich *et al.* 1992). Therefore, for comparative purposes, the same four reaches were the focus of this 2002 investigation.

METHODS AND MATERIALS

Experimental Design

The experimental design and rationale of sampling site selection are described in detail in Bratovich *et al.* 1990. Distinct differences in the amount of riparian cover within each study reach were observed during the habitat mapping survey conducted in 1988 (Bratovich *et al.* 1990). To ensure representation of riparian cover and dispersion of sampling sections, fish sampling sections were located within *zones* of "high" and "low" riparian cover within each study reach. However, discretion must be used when comparing and interpreting the results between "high" and "low" riparian cover sites. For example, Site EH represents a *zone* of "high" riparian cover within Reach E. However, in comparison with other "high" riparian cover sites, it is characterized by a relatively low amount of riparian cover. Conversely, Site DL was randomly selected within a "low" riparian *zone* for Reach D but in fact has a high amount of willow cover. Additionally, since the initiation of these fish community surveys in 1988, the riparian cover at Site BL has changed significantly, and although it remains in a "low" riparian cover *zone*, rapid willow tree growth at this site has resulted in high riparian cover at the sample site.

Consistent with the previous nine surveys (1992-97 and 1999-2001), eight stream sections were sampled in 2002, with each 300-foot long sample site representing a "high" or "low" riparian vegetation cover *zone* within a study reach (Figure 1). The downstream boundary of the sampling sites remained the same for the 1992-2002 surveys with two exceptions. In 1995, the organization that conducted the 1995-96 surveys was unable to access the lowermost site. An alternate site extending 300 feet downstream from the eastern boundary of the Chance Ranch, just upstream from the confluence of Mammoth and Hot Creeks was established (Figure 1). The second sample site change occurred at Site CH because of a channel split. For this study we established the bottom of Site CH immediately upstream of the channel split. Although the sample site was moved upstream for this survey, the site was similarly characterized to the previous sample site and, therefore, no significant differences in the fish composition are likely.

Data Acquisition

Fish resource assessment surveys were conducted by electrofishing. One day prior to electrofishing, selected sampling sites were re-located and the upstream and downstream boundaries marked with 0.5-inch diameter rebar driven into each bank. The rebar also served as anchors for block nets. On the day of sampling, sites were closed using block nets comprised of 0.25-inch stretched mesh. The nets were placed simultaneously across the

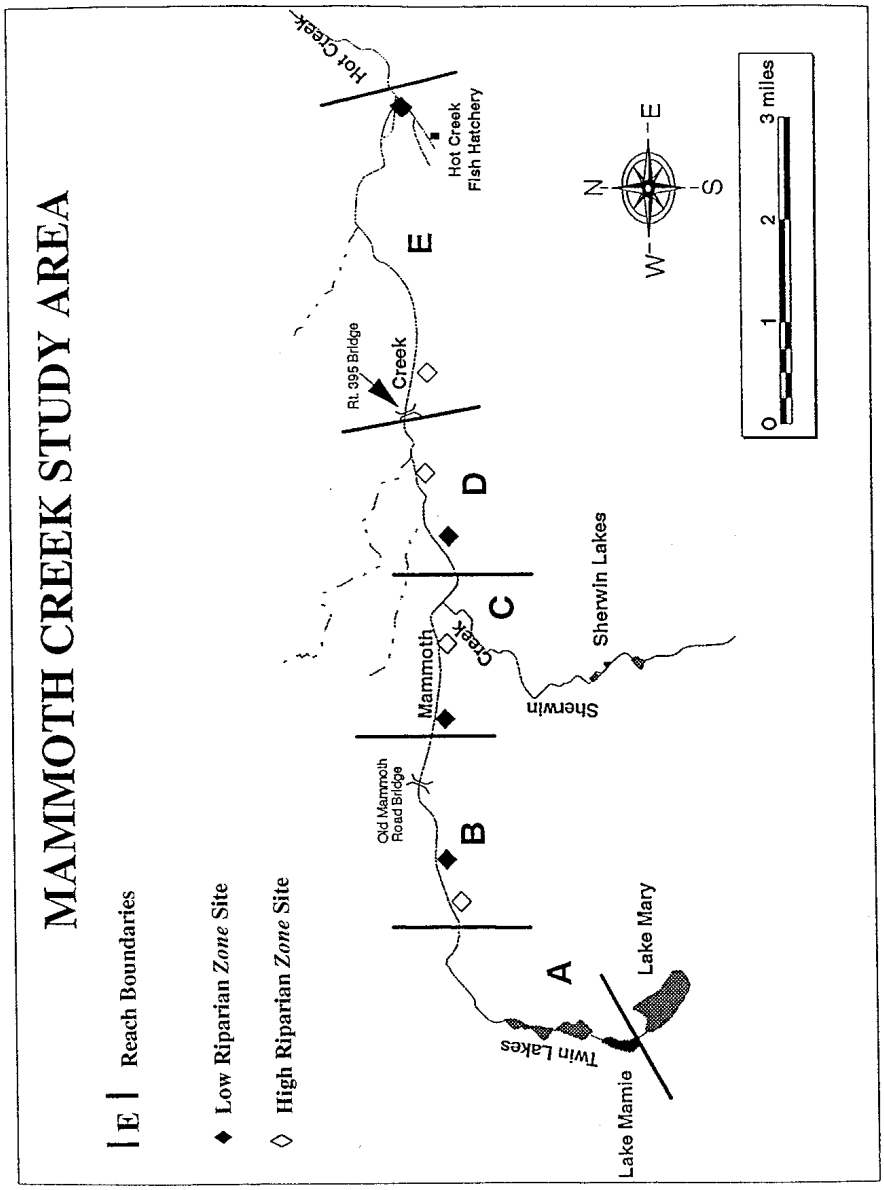

Figure 1. Electrofishing sites sampled on Mammoth Creek September 30th through October 3rd, 2002.

upstream and downstream boundaries to preclude movement of fish into or out of the sampling section.

Electrofishing was conducted using a Smith-Root Model 12 battery powered backpack electrofisher. A four-person crew was used to capture and process fish. One person operated the electrofisher and two people, one positioned at each side of the operator, netted fish. The fourth person processed the catch while electrofishing continued.

A multiple-pass removal method of electrofishing was used for fish population estimation. Three complete passes were conducted at each sampling section. Each pass (or removal occasion) was conducted using a standardized technique to ensure equal effort.

The standardized technique included a systematic sampling approach that consisted of:

- electrofishing along the downstream block net;
- moving upstream in a recurring diagonal (acute angle) pattern from bank to bank, completely covering the area until encountering the upstream block net;
- electrofishing along the upstream block net; and,
- sampling along the downstream block net to collect any impinged fish.

Captured fish were placed in 5-gallon buckets and transferred to shore for processing. Captured fish were anesthetized (as necessary) using carbon dioxide (CO_2), identified to species, measured (to the nearest millimeter (mm) fork length (FL)), and weighed (to the nearest 0.1-gram (g) up to 10.0g and to the nearest 1g over 10g). When possible, fish of hatchery origin were identified by typical deformed and abraded fins. All possible precautions were taken to prevent stress and handling or holding mortality. Anesthetized, processed fish were immediately revived in oxygen-rich water. Processed fish were held in holding pens placed in the stream outside of the sampling area. After the completion of all removal passes, fish were returned to the general area of the stream section from which they were captured.

Data Analysis

Population Estimation

Fish numbers occurring within each sampling section were estimated with a maximum likelihood estimator (White *et al.* 1982) facilitated by use of the Microfish 2.3 software package (Van Deventer and Platts 1986). For each sampling section, the estimated total numbers of brown and presumed "wild" rainbow trout (and associated 95 percent confidence intervals) were expressed as the number of fish per stream mile. Estimated brown trout totals and 95 percent confidence intervals, expressed as the number of fish per stream mile, were summarized in a tabular format for each sampling section and visually compared between the 1992-2002 surveys. Additionally, the numbers of brown trout per stream mile in Mammoth Creek were calculated and compared among data collected by CDFG on nearby similar creeks in 1983 and 1984 (Deinstadt *et al.* 1985), and the previous consecutive year's surveys. Numbers of presumed "wild" rainbow trout per stream mile in

Mammoth Creek were calculated and compared among data collected in the previous consecutive year's surveys.

Size and Age Structure
Length-frequency distributions were calculated and graphed (using 10 mm size groups) on frequency histograms to summarize body size and *inferred* age class information for all trout captured in the Mammoth Creek study area in 2002. Length-frequency (and inferred age) distributions of brown trout were calculated for the entire creek and for each study reach. In addition, length-frequency distributions of presumed "wild" rainbow trout were calculated and graphed for fish captured throughout the entire creek.

RESULTS

Species Composition and Relative Abundance

This report assumes that native fishes in Mammoth Creek include rainbow trout (*Oncorhynchus mykiss*), Tui chub (*Gila bicolor*) and Owen's sucker (*Catostomus fumeiventris*). Brown trout (*Salmo trutta*) were brought to the United States in 1883 and were introduced into trout streams in most states by the late 1800's or early 1900's (Fuller 1999). CDFG regularly stocks catchable-sized rainbow trout in Mammoth Creek.

A total of 883 fish representing six species were captured by electrofishing in Mammoth Creek from September 30, 2002 through October 3, 2002 (Table 1). Brown trout comprised 73.2% of the total catch.

Rainbow trout accounted for 26.3% of the total catch. Owens sucker comprised 0.2% of the total catch, Tui chub made up 0.2% of the total catch and brook trout (*Salvelinus fontinalis*) accounted for .1% of the total catch.

Two hundred and thirty two rainbow trout were captured in the entire study area. Forty-nine of these fish (21.1 %) exhibited evidence that they were of hatchery origin by virtue of abraded fins. The remaining 78.9% of rainbow trout captured were presumed to be "wild". Brown and rainbow trout were captured in all four reaches and at each of the eight sample sites. Only two tui chub and two Owens suckers were captured over the entire study area. All tui chub and Owens sucker were caught in the "low" riparian cover *zone* of the lowermost reach, Reach E. One brook trout was captured at Site BH.

Trout Population Estimation

The estimated number of brown trout captured in all sampling sections ranged from 14 fish at Site CL to 331 fish at Site BH (Table 2). Extrapolation of these numbers resulted in a range of 246 to 5,826 trout/mile. Brown trout population estimates in sites characterized by "high" riparian cover ranged from 563 brown trout/mile at Site DH up to

Table 1. All fish captured by electrofishing Mammoth Creek, Mono County, California from September 30, 2002 through October 3, 2002.

Common Name	Scientific Name	Reach	Cover		Total
			High	Low	
Brown trout	(*Salmo trutta*)	B	284	48	**332**
		C	59	14	**73**
		D	30	93	**123**
		E	103	15	**118**
		TOTAL	**476**	**170**	**646**
Rainbow trout (presumed "wild")	(*Oncorhynchus mykiss*)	B	55	44	**99**
		C	7	7	**14**
		D	29	27	**56**
		E	13	1	**14**
		TOTAL	**104**	**79**	**183**
Rainbow trout (hatchery origin)	(*Oncorhynchus mykiss*)	B	0	0	**0**
		C	1	10	**11**
		D	30	4	**34**
		E	4	0	**4**
		TOTAL	**35**	**14**	**49**
Brook trout	(*Salvelinus fontinalis*)	B	1	0	**1**
		C	0	0	**0**
		D	0	0	**0**
		E	0	0	**0**
		TOTAL	1	0	**1**
Tui chub	(*Gila bicolor*)	B	0	0	**0**
		C	0	0	**0**
		D	0	0	**0**
		E	0	2	**2**
		TOTAL	**0**	**2**	**2**
Owens sucker	(*Catostomus fumeiventris*)	B	0	0	**0**
		C	0	0	**0**
		D	0	0	**0**
		E	0	2	**2**
		TOTAL	**0**	**2**	**2**

5,826 brown trout/mile at Site BH. The "low" riparian cover *zone* population estimates ranged from 246 brown trout/mile at site CL to 1,672 brown trout/mile at Site DL. Maximum likelihood catch statistics for brown trout in each of the eight sampling sections are presented in Appendix A.

The estimated number of presumed "wild" rainbow trout captured in all sampling sections ranged from 1 fish at Site EL to 59 fish at Site BH (Table 2). Extrapolation of these numbers resulted in a range of 18 to 1,038 rainbow trout/mile. Rainbow trout population estimates in sites characterized by "high" riparian cover ranged from 123 rainbow trout/mile at Site CH up to 1,038 rainbow trout/mile at Site BH. The "low" riparian cover zone population estimates ranged from 18 rainbow trout/mile at site EL to 810 rainbow trout/mile at Site BL. Maximum likelihood catch statistics for presumed "wild" rainbow trout in each of the eight sampling sections are presented in Appendix A.

Table 2. Estimated abundance by sample site and extrapolated densities (trout/mile) of brown and presumed "wild" rainbow trout captured by electrofishing in Mammoth Creek, Mono County, California, from September 30, 2002 through October 3, 2002.

Site	Number of brown trout	Brown trout/mile	Number of rainbow trout	Rainbow trout/mile
BH	331	5826	59	1038
BL	51	898	46	810
CH	60	1056	7	123
CL	14	246	7	123
DH	32	563	30	528
DL	95	1672	27	475
EH	106	1866	13	229
EL	15	264	1	18

Trout Length-Frequency Distribution

The length-frequency distribution calculated for all brown trout captured during this study exhibit a multimodal distribution similar to that observed in previous years studies (Figure 2). A distinct group (51 to 120 mm FL) in the distribution was apparent for the length-group likely representing young-of-year (YOY) fish. Additional age groups within the catch were also readily apparent, representing multiple age classes present in Mammoth Creek.

For the entire brown trout population captured in 2002, there were at least three distinct age groups similar to the groupings used in previous studies (Bratovich *et al.* 1990; Hood 1998). The group of the smallest sized fish was comprised of 459 fish ranging from 51 to 110 mm FL, with 59.4 percent of the fish in this group ranging from 80 to 107 mm FL. Brown trout within the lower size group are most likely YOY fish. The next group included140 fish ranging from 126 to 199 mm FL, and was probably Age I fish. The next group was comprised of 37 fish ranging from 202 to 246 mm FL, and most likely was Age II fish. Ten fish were in the 254 to 296 mm FL size range and may represent Age III fish.

Although ages of fish were not determined in this study, the length groups of this study correlate well with previous investigations for brown trout in East Slope Sierra Nevada streams as reported in Snider and Linden (1981).

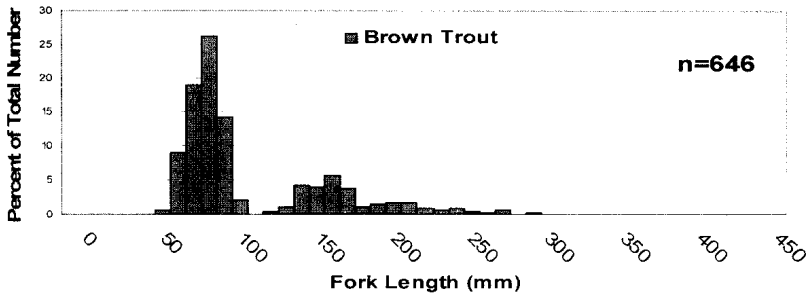

Figure 2. Length-frequency distribution of all brown trout captured at all electrofishing sites in the Mammoth Creek study area, September 30, 2002 through October 3, 2002.

Brown trout length-frequency distributions varied slightly among study reaches (Figure 3). Distinct length groups for YOY brown trout were dominant in all four reaches. YOY were most abundant in Reach B. The YOY group of fish (≤120 mm FL) accounted for 88.6 percent of the total catch in Reach B and accounted for 35.6, 52.0, and 63.6 percent of the catch in Reaches C, D, and E, respectively. The Age I fish group (>120 but ≤190mm) accounted for 5.4 percent of the total catch in Reach B and was 48.0, 33.3, and 30.5 percent of the catch in Reaches C, D, and E, respectively. Large brown trout (>190 mm FL) were present in all four Reaches ranging from 5.9 percent in Reach E up to 16.4 percent in Reach C.

Of the 183 presumed "wild" rainbow trout captured, 153 (83.6%) fell into the YOY size class range (≤ 120 mm FL) (Figure 4). Fish in this size range are not planted by CDFG in Mammoth Creek and therefore, it is believed that these trout were produced instream.

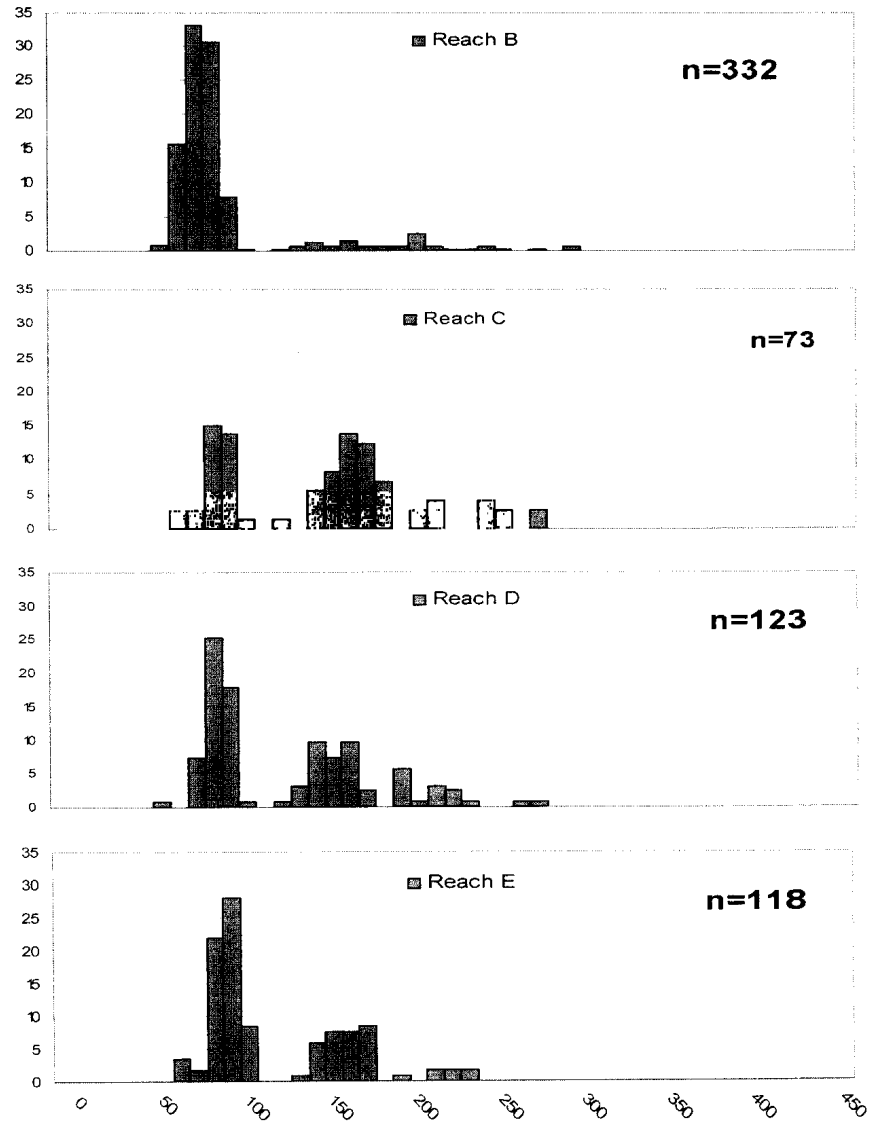

Figure 3. Length-frequency distribution of all brown trout captured in Reaches B, C, D and E in the Mammoth Creek study area, September 30, 2002 through October 3, 2002.

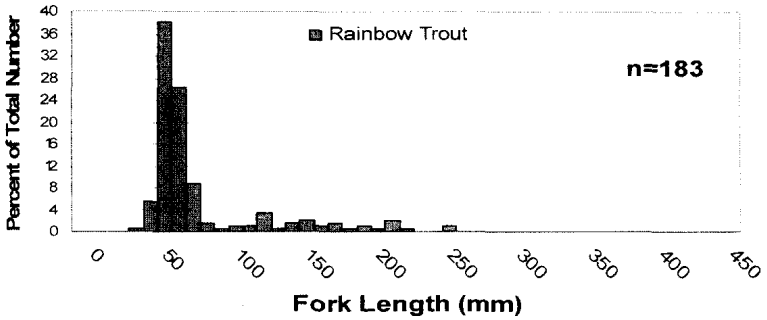

Figure 4. Length-frequency distribution of all presumed "wild" rainbow trout captured at all sites in the Mammoth Creek study area, September 30, 2002 through October 3, 2002.

DISCUSSION

Sufficient instream flow is necessary for maintaining an aquatic environment that allows for a healthy fish population both in terms of population size and the ability to maintain successful reproduction (i.e. "good condition"). Over the past fifteen years there have been twelve similar fish community surveys conducted within Mammoth Creek (1988, 1991-2002). Trout abundance and length-frequency data collected from these studies allows us to compare the responses of the fish community to the various hydrologic conditions to which they were exposed over that same time period and make general inferences as to the "condition" of the Mammoth Creek fishery.

Relatively dry hydrologic conditions prevailed in Mammoth Creek from the late 1980's through 1992 and in 1994. The 2001 hydrologic year was relatively dry, with flows remaining below 100 cfs. In contrast, wetter conditions were predominant in 1993 and 1995-2000 with the 1995 runoff year being the wettest of the past eleven years (see Hood 2002). In 2002, Mammoth Creek hydrology compared well with water year 1992 and 1994 (Figure 5; reference KDH 2002, Appendix B). Comparison of the population estimates and age structure, based on data collected before and after these flow conditions occurred in the creek, provides an opportunity to evaluate the adequacy of the historical flows for maintaining fish populations in "good condition".

Results discussed in this report do not take into account other factors that may influence trout populations; most notably, information regarding rainbow trout stocking and harvesting. Because hatchery-reared fish may increase fishing pressure, influence instream reproduction, and displace other fish species it is difficult to quantify their influence on Mammoth Creek fish populations.

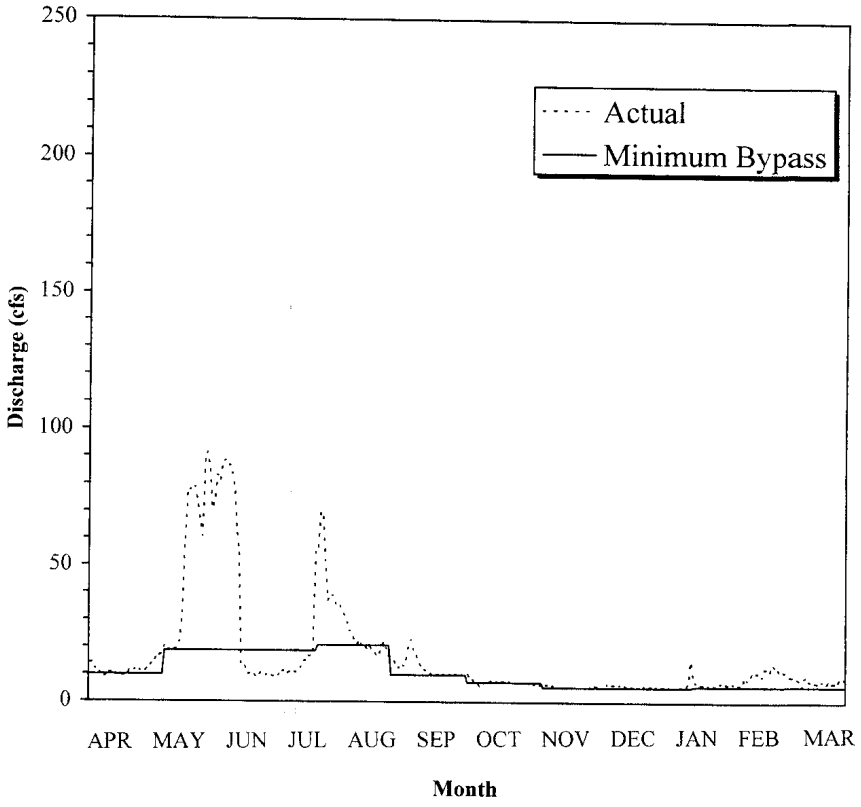

Figure 5. Mean daily flow (cfs) in Mammoth Creek (measured at the Old Mammoth Road Gage) during runoff year 2002, and the recommended operational minimum mean daily bypass regime.

Species Composition and Relative Abundance Estimates

Native Species

The numbers of native fishes (tui chub and Owens sucker) captured during this study continue to be extremely low. Only two tui chub and two Owens sucker were caught in the lowermost reach. Although most of the study area does not provide the slower-moving, warmer water preferred by these species, they historically dominated the catch in Reach E through 1994 (Table 3) where the stream gradient decreases, riparian cover is minimal and cut-banks are the primary instream cover. After 1994, the sample site was moved downstream and it's proximity to the confluence with Hot Creek may explain the shift in composition and abundance.

In 2002, one brook trout was captured at site BH. Brook trout have been recorded at this site in previous years although they are clearly not part of the natural trout population within Mammoth Creek. It is likely that brook trout occasionally spill over from upstream lakes and can therefore be found in upstream areas of Mammoth Creek.

Table 3. Total number of all Tui Chub and Owens Sucker captured in Reach E by electrofishing in Mammoth Creek, Mono County, California, 1992-2002.

Year	Number of Tui Chub	Number of Owens Sucker
1992	417	205
1993	855	425
1994	392	524
1995	69	58
1996	48	84
1997	2	2
1999	6	49
2000	2	18
2001	2	6
2002	2	2

Rainbow Trout

The highest estimates of presumed "wild" rainbow trout were captured in Reach B (1038 trout/mile). No hatchery-origin rainbow trout were recorded within this reach. Estimated abundance of rainbow trout ranged from 18 trout/mile to 1038 trout/mile with six of the eight sites ranging from 123 to 810 trout/mile. As part of the CDFG's "put-and-take" planting program, Mammoth Creek is regularly stocked with hatchery-reared rainbow trout. Hatchery reared rainbow trout were caught at five of the eight sites. The largest numbers of those fish were found at sites CL (10 fish) and DH (30 fish). Stocking of hatchery-reared rainbow trout appears to have been decreased from the 2001 season. Presumed "wild" rainbow trout outnumbered hatchery-origin fish at all sites except two (CL and DH) where the numbers of "wild" versus hatchery fish were very similar (Table 1). In comparison with previous survey years, the rainbow trout population in 2002 was below the average by approximately 20% (Table 4). The numbers

of rainbow trout have increased, however, from 379 trout/mile in 2001 to 418 trout/mile in 2002. When ranking survey years by total estimated population of rainbow trout, the 2002 survey year ranks as the fifth highest.

Brown Trout

Brown trout abundance ranged from 246 trout/mile at Site CL to 5826 trout/mile at Site BH. Overall, brown trout numbers were down from the 2001 survey year and five of the eight sites (BL, CL, DH, EH and EL) were down from average population estimates recorded over the 1992-2002 survey period. Sites CL, DH and EL had the most notable declines. Estimates at these three sites were at 60%(CL), 36%(DH) and 24%(EL) of the average estimated population previously recorded. Site DH had the lowest brown trout abundance (563 trout/mile) recorded throughout the 1992-2002 survey period. Conversely, brown trout abundance estimates were up 20%, 3% and 33% from the previously recorded averages at sites BH, CH and DL respectively. Estimated brown trout abundance at Site DL was the highest recorded (1672 fish/mile) at that site for the 1992-2002 survey period (Table 4).

Brown trout population estimates (trout/mile) for each sampling site for the 1992-2002 survey period are presented in Appendix B. Mammoth Creek remains similar to nearby creeks in terms of estimated trout abundance. CDFG estimated from 877 to 4,822 brown trout per mile for four sections in Convict Creek, and from 600 to 1,109 brown trout per mile in McGee Creek (Deinstadt *et al.* 1985).

Table 4. Estimated average population densities (trout/mile) of brown and presumed "wild" rainbow trout captured by electrofishing in Mammoth Creek (1992-2002).

Year	Brown trout per mile	Rainbow trout per mile
2002	1,549	418
2001	1,558	379
2000	1,734	1,377
1999	1,951	530
1997	2,385	579
1996	1,379	588
1995	592	78
1994*	2,079	437
1993*	1,289	57
1992*	1,681	222

* Note: Site EL was moved from its original location in 1995.

Brown trout populations in Mammoth Creek have fluctuated, but have remained fairly stable (Figure 6). One exception is survey year 1995, when flows were dramatically high. It is presumed that the high flows adversely affected the fish community by flushing fish and debris downstream. Excluding the 1995 survey data, the mean estimated population of brown trout in Mammoth Creek is 1734 trout per mile over the ten year period of this study.

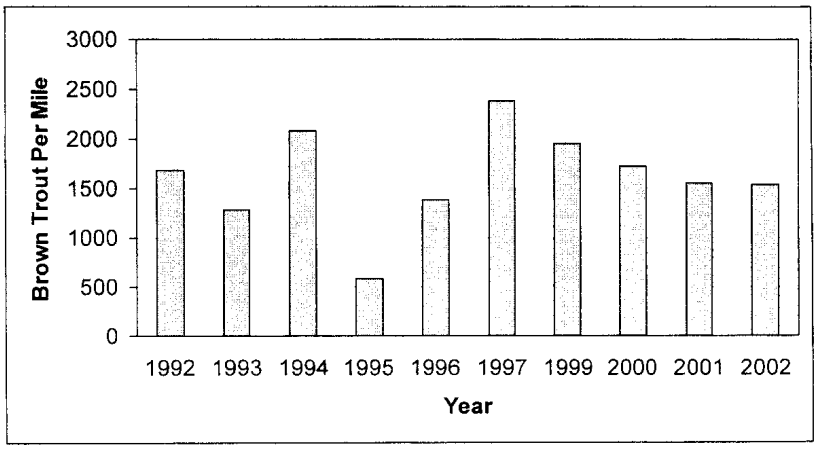

Figure 6. Estimated average population densities (trout/mile) of brown trout captured by electrofishing in Mammoth Creek (1992-2002).

Table 5. Population estimates (trout/mile) for brown trout captured by electrofishing Mammoth Creek, Mono County, California, 1992-2002. Bold numbers indicate highest value for each site. Numbers in parenthesis indicate where the 2002 survey results ranked among the previous years.

	Sample Site							
	BH	BL	CH	CL	DH	DL	EH	EL [a]
2002	5826(3rd)	898(6th)	1056(6th)	246(tie 5th)	563(9th)	**1672(1st)**	1866(5th)	264(8th)
2001	4717	1707	1496	246	1144	1162	1461	528
2000	6670	634	1074	88	810	1162	1179	**2253**
1999	5333	1338	1443	299	2200	616	2182	2200
1997	**8589**	704	**1690**	211	616	1654	3819	1795
1996	4840	158	1302	158	1901	634	898	1144
1995	1760	546	334	88	616	18	334	1038
1994	4171	2253	810	528	**4418**	1584	2464	405
1993	2957	**2658**	510	**1232**	1056	510	1232	158
1992	3045	1848	563	845	1390	1584	**3978**	194

[a] Different EL site locations were used for survey years 1992-94 and 1995-2002.

Trout Length-Frequency Distribution

In addition to population densities. the size class structure of a fish population can provide evidence of reproductive success and survival, and a general indication of a fish population's overall condition. To assess potential differences in the age structure of the brown trout population in Mammoth Creek during the past ten years, length-frequency data from the present study were compared to the 1992-2001 data set (Figures 5a and 5b). In general, the length-frequency distribution calculated for all brown trout captured during the 2002 survey exhibited a length-frequency distribution very similar to that calculated from previous studies. YOY fish continue to make up the highest proportion of the total catch for all years sampled.

Seventy-one percent of this year's catch was comprised of YOY fish. The highest YOY proportion was in the 1997 survey (81%) followed by 2000 (75%), 1996 (73%), 2001 (71%), 1994 and 2001 (70%), 1999 (68%), 1992 (68%), 1993 (55%) and the lowest in 1995 (46%)[1]. Water years 1992, 1994 and 2001 resulted in similar flows in Mammoth Creek. Those same years exhibit similar estimates of YOY trout, linking the hydrologic conditions of the creek to trout rearing potential. In addition to the YOY age class, at least two or more brown trout age groups were present in every reach for every year (Figures 5a and 5b).

CONCLUSIONS

- Trout density and age structure (length-frequency) information obtained from the electrofishing survey conducted in September and October 2002 suggest that both the brown and rainbow trout populations in Mammoth Creek remain in good condition. Analysis of the data shows no drastic changes in the fish community's overall numbers or age-class distribution. The high proportion of YOY fish (both brown trout and rainbow trout) suggests that the fish community of Mammoth Creek continues to successfully reproduce and provide subsequent recruitment to the population.

- It appears that the trout population in Mammoth Creek continues to endure natural annual population density variation as a result of the hydrologic conditions to which they are subjected. They have exhibited the ability to withstand and continue to recover from various uncontrollable environmental factors such as the extreme snowmelt conditions as experienced in 1995 and the drought induced low flow conditions of the early 90's.

[1] YOY proportion estimates are approximated using the same size class grouping for all years ($\leq$ 120 mm FL).

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APPENDIX A
Maximum Likelihood Catch Statistics

Stream: **MAMMOTH CREEK-SITE BH**
Species: Brown Trout

Removal Pattern: 151 95 38
Total Catch = 284
Population Estimate = 331

Chi Square = 2.791
Pop Est Standard Err = 15.305
Lower Conf Interval = 300.850
Upper Conf Interval = 361.150

Capture Probability = 0.477
Capt Prob Standard Err = 0.042
Lower Conf Interval = 0.394
Upper Conf Interval = 0.559

Stream: **MAMMOTH CREEK-SITE BL**
Species: Brown Trout

Removal Pattern: 29 14 5
Total Catch = 48
Population Estimate = 51

Chi Square = 0.285
Pop Est Standard Err = 3.054
Lower Conf Interval = 48.000
Upper Conf Interval = 57.136

Capture Probability = 0.593
Capt Prob Standard Err = 0.087
Lower Conf Interval = 0.418
Upper Conf Interval = 0.768

Stream: **MAMMOTH CREEK-SITE CH**
Species: Brown Trout

Removal Pattern: 41 16 2
Total Catch = 59
Population Estimate = 60

Chi Square = 1.935
Pop Est Standard Err = 1.482
Lower Conf Interval = 59.000
Upper Conf Interval = 62.965

Capture Probability = 0.720
Capt Prob Standard Err = 0.063
Lower Conf Interval = 0.593
Upper Conf Interval = 0.846

Stream: **MAMMOTH CREEK-SITE CL**
Species: Brown Trout

Removal Pattern: 12 2 0
Total Catch = 14
Population Estimate = 14

Chi Square = 0.340
Pop Est Standard Err = 0.175
Lower Conf Interval = 14.000
Upper Conf Interval = 14.379

Capture Probability = 0.875
Capt Prob Standard Err = 0.088
Lower Conf Interval = 0.686
Upper Conf Interval = 1.064

Stream: **MAMMOTH CREEK-SITE DH**
Species: Brown Trout

Removal Pattern: 19 6 5
Total Catch = 30
Population Estimate = 32

Chi Square = 1.311
Pop Est Standard Err = 2.654
Lower Conf Interval = 30.000
Upper Conf Interval = 37.413

Capture Probability = 0.577
Capt Prob Standard Err = 0.113
Lower Conf Interval = 0.346
Upper Conf Interval = 0.808

Stream: **MAMMOTH CREEK-SITE DL**
Species: Brown Trout

Removal Pattern: 63 25 5
Total Catch = 93
Population Estimate = 95

Chi Square = 1.514
Pop Est Standard Err = 2.217
Lower Conf Interval = 93.000
Upper Conf Interval = 99.403

Capture Probability = 0.694
Capt Prob Standard Err = 0.053
Lower Conf Interval = 0.589
Upper Conf Interval = 0.799

Stream: **MAMMOTH CREEK-SITE EH**
Species: Brown Trout

Removal Pattern: 71 23 9
Total Catch = 103
Population Estimate = 106

Chi Square = 0.261
Pop Est Standard Err = 2.683
Lower Conf Interval = 103.000
Upper Conf Interval = 111.313

Capture Probability = 0.673
Capt Prob Standard Err = 0.052
Lower Conf Interval = 0.570
Upper Conf Interval = 0.776

Stream: **MAMMOTH CREEK-SITE EL**
Species: Brown Trout

Removal Pattern: 10 3 2
Total Catch = 15
Population Estimate = 15

Chi Square = 0.940
Pop Est Standard Err = 0.955
Lower Conf Interval = 15.000
Upper Conf Interval = 17.048

Capture Probability = 0.682
Capt Prob Standard Err = 0.136
Lower Conf Interval = 0.389
Upper Conf Interval = 0.974

The population estimate lower confidence intervals for seven of the sites were set equal to the total catches. Actual calculated lower confidence intervals (LCI) were:

Site	Calculated LCI
BL	44.86445
CH	57.03518
CL	13.62143
DH	26.58674
DL	90.59666
EH	100.6867
EL	12.95214

Stream: **MAMMOTH CREEK-SITE BH**
Species: Presumed "wild" rainbow trout

Removal Pattern: 33 15 7
Total Catch = 55
Population Estimate = 59

Chi Square = 0.161
Pop Est Standard Err = 3.689
Lower Conf Interval = 55.000
Upper Conf Interval = 66.385

Capture Probability = 0.573
Capt Prob Standard Err = 0.084
Lower Conf Interval = 0.405
Upper Conf Interval = 0.741

Stream: **MAMMOTH CREEK-SITE CH**
Species: Presumed "wild" rainbow trout

Removal Pattern: 4 3 0
Total Catch = 7
Population Estimate = 7

Chi Square = 2.204
Pop Est Standard Err = 0.578
Lower Conf Interval = 7.000
Upper Conf Interval = 8.415

Capture Probability = 0.700
Capt Prob Standard Err = 0.193
Lower Conf Interval = 0.228
Upper Conf Interval = 1.172

Stream: **MAMMOTH CREEK-SITE BL**
Species: Presumed "wild" rainbow trout

Removal Pattern: 26 16 2
Total Catch = 44
Population Estimate = 46

Chi Square = 3.865
Pop Est Standard Err = 2.337
Lower Conf Interval = 44.000
Upper Conf Interval = 50.706

Capture Probability = 0.629
Capt Prob Standard Err = 0.086
Lower Conf Interval = 0.455
Upper Conf Interval = 0.802

Stream: **MAMMOTH CREEK-SITE DH**
Species: Presumed "wild" rainbow trout

Removal Pattern: 19 6 4
Total Catch = 29
Population Estimate = 30

Chi Square = 0.927
Pop Est Standard Err = 1.866
Lower Conf Interval = 29.000
Upper Conf Interval = 33.815

Capture Probability = 0.630
Capt Prob Standard Err = 0.106
Lower Conf Interval = 0.413
Upper Conf Interval = 0.847

Stream: **MAMMOTH CREEK-SITE CL**
Species: Presumed "wild" rainbow trout

Removal Pattern: 6 1 0
Total Catch = 7
Population Estimate = 7

Chi Square = 0.170
Pop Est Standard Err = 0.124
Lower Conf Interval = 7.000
Upper Conf Interval = 7.303

Capture Probability = 0.875
Capt Prob Standard Err = 0.124
Lower Conf Interval = 0.572
Upper Conf Interval = 1.178

Stream: **MAMMOTH CREEK-SITE DL**
Species: Presumed "wild" rainbow trout

Removal Pattern: 21 6 0
Total Catch = 27
Population Estimate = 27

Chi Square = 1.765
Pop Est Standard Err = 0.452
Lower Conf Interval = 27.000
Upper Conf Interval = 27.930

Capture Probability = 0.818
Capt Prob Standard Err = 0.075
Lower Conf Interval = 0.663
Upper Conf Interval = 0.973

Stream: **MAMMOTH CREEK-SITE EL**
Species: Presumed "wild" rainbow trout

Removal Pattern: 8 3 2
Total Catch = 13
Population Estimate = 13

Chi Square = 0.949
Pop Est Standard Err = 1.088
Lower Conf Interval = 13.000
Upper Conf Interval = 15.372

Capture Probability = 0.650
Capt Prob Standard Err = 0.155
Lower Conf Interval = 0.311
Upper Conf Interval = 0.989

The population estimate lower confidence intervals for seven of the sites were set equal to the total catches. Actual calculated lower confidence intervals (LCI) were:

Site	Calculated LCI
BH	51.61482
BL	41.29386
CL	6.696743
CH	5.584834
DH	26.18459
DL	26.07027
EH	10.62823

The presumed "wild" rainbow trout removal pattern for sample site EL was 1-0-0. Microfish software cannot calculate confidence intervals for these results. Therefore, the estimated population for site EL is one.

APPENDIX B
Brown Trout Population Estimates (1992-2002)

Appendix B
Population Estimates for All Electrofishing Reaches from 1992 through 2001

Table B-1. Population estimates (trout/mile) and 95 percent confidence intervals for brown trout captured by electrofishing Reach B, Mammoth Creek, Mono County, California, 1992 through 2002.

Site	Year	Lower Confidence Boundary	Population Estimate	Upper Confidence Boundary
BH	1992	2992	3045	3128
	1993	2558	2957	3356
	1994	3915	4171	4427
	1995	1654	1760	1901
	1996	3942	4840	5738
	1997	8200	8589	8978
	1999	4789	5333	5877
	2000	6003	6670	7337
	2001	4290	4717	5144
	2002	5295	5826	6356
BL	1992	1830	1848	1895
	1993	2570	2658	2770
	1994	2235	2253	2309
	1995	528	546	616
	1996	158	158	158
	1997	669	704	788
	1999	1162	1338	1582
	2000	616	634	690
	2001	1637	1707	1814
	2002	845	989	1006

Table B-2. Population estimates (trout/mile) and 95 percent confidence intervals for brown trout captured by electrofishing Reach C, Mammoth Creek, Mono County, California, 1992 through 2002.

Site	Year	Lower Confidence Boundary	Population Estimate	Upper Confidence Boundary
CH	1992	546	563	621
	1993	475	510	609
	1994	722	810	980
	1995	299	334	453
	1996	1250	1302	1390
	1997	1637	1690	1785
	1999	1426	1443	1494
	2000	1056	1074	1135
	2001	1461	1496	1571
	2002	1038	1056	1108
CL	1992	827	845	906
	1993	1038	1232	1514
	1994	528	528	567
	1995	88	88	100
	1996	158	158	194
	1997	211	211	232
	1999	299	299	330
	2000	88	88	97
	2001	246	246	270
	2002	246	246	253

Table B-3. Population estimates (trout/mile) and 95 percent confidence intervals for brown trout captured by electrofishing Reach D, Mammoth Creek, Mono County, California, 1992 through 2002.

Site	Year	Lower Confidence Boundary	Population Estimate	Upper Confidence Boundary
DH	1992	1338	1390	1482
	1993	1056	1056	1089
	1994	4268	4418	4567
	1995	563	616	737
	1996	1778	1901	2059
	1997	546	616	771
	1999	2042	2200	2383
	2000	810	810	848
	2001	1126	1144	1201
	2002	528	563	658
DL	1992	1584	1584	1611
	1993	510	510	551
	1994	1514	1584	1696
	1995	a	18	a
	1996	563	634	792
	1997	1619	1654	1725
	1999	598	616	678
	2000	1144	1162	1209
	2001	1091	1162	1281
	2002	1637	1672	1749

[a]Due to a capture pattern of 1-0-0, estimate is assumed to be exactly correct, with no confidence limits.

Table B-4. Population estimates (trout/mile) and 95 percent confidence intervals for brown trout captured by electrofishing Reach E, Mammoth Creek, Mono County, California, 1992 through 2002.

Site	Year	Lower Confidence Boundary	Population Estimate	Upper Confidence Boundary
EH	1992	3925	3978	4053
	1993	1197	1232	1302
	1994	2006	2464	2929
	1995	299	334	458
	1996	810	898	1056
	1997	3749	3819	3911
	1999	2147	2182	2255
	2000	1109	1179	1109
	2001	1355	1461	1616
	2002	1813	1866	1959
EL	1992	194	194	209
	1993	158	158	169
	1994	405	405	412
	1995	1038	1038	1062
	1996	1144	1144	1162
	1997	1742	1795	1880
	1999	2076	2200	2349
	2000	2094	2253	2434
	2001	528	528	546
	2002	264	264	300