JCC

Department of Water and Power — the City of Los Angeles

May 11, 2000

Mr. Jim Canaday
Division of Water Rights
State Water Resources Control Board
901 P Street
Sacramento, California 95814

Dear Mr. Canaday:

Los Angeles Department of Water and Power's Compliance Report

On April 20, 2000, Los Angeles Department of Water and Power (LADWP) mailed you a draft partial copy of the Mono Basin report entitled "Compliance Reporting" for Runoff Year 1999. The report was considered draft and partial since the Mono Basin Operations for Runoff Year 2000-2001 could not be finalized until after the May 1st forecast was completed, and the report did not contain Mr. Chris Hunter's 1999 fish monitoring report. Please find enclosed Mr. Hunter's final report and four color inserts.

The Mono Basin May 1st forecast has been completed and there was only a minor change to the runoff forecast; therefore, the preliminary April 1st Operations Plan contained in your binder should be considered final.

The four inserts are replacements for the Report entitled "Compliance with the State Water Resources Control Board Order Nos. 98-05 and 98-07". These color inserts are to replace pages 8, 10 and 11. There are no significant changes from the original pages except for Rush Creek, which has been split into two pages (Pages 8A and 8B). The original pages were of poor quality and because of the scale very difficult to read.

If you have any questions, please contact Steve McBain at (213) 367-0963.

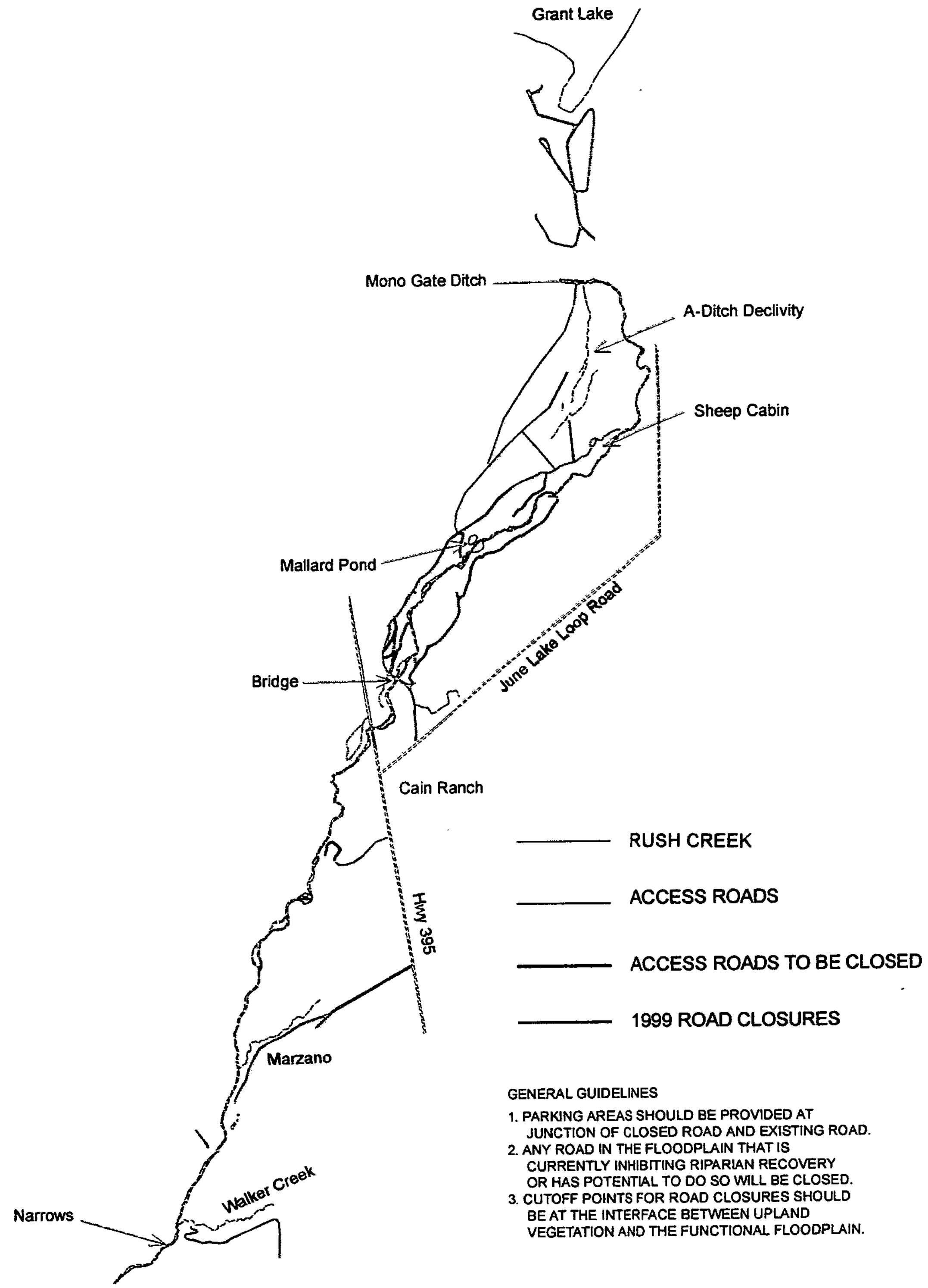
Sincerely,

THOMAS M. ERB
Director of Water Resources

Enclosures

c: Mr. Steven B. McBain

LADWP RUSH CREEK ACCESS ROADS



1-2

4/00

Figure 9: Location of Rush Creek road closures.

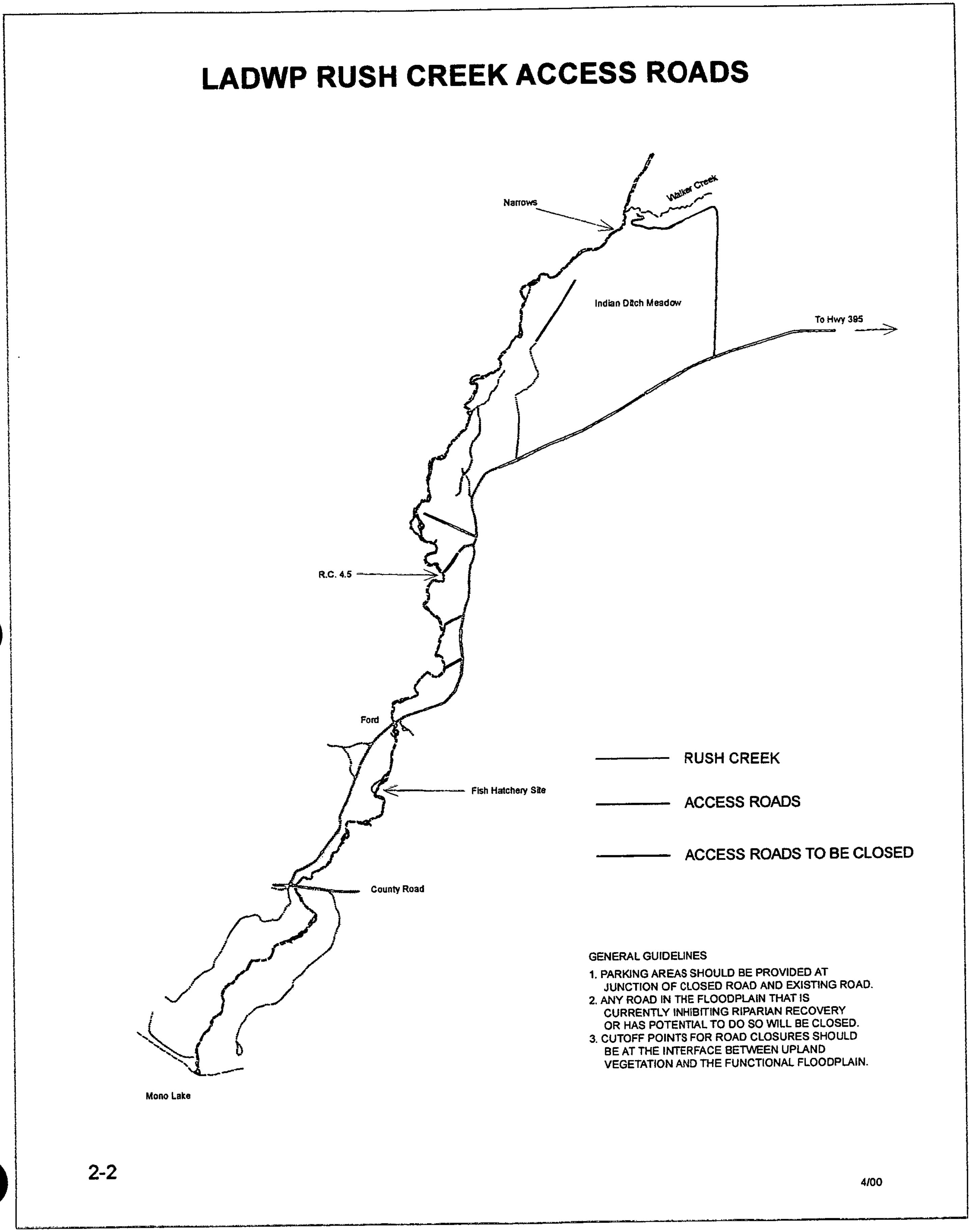


Figure 9: Location of Rush Creek road closures.

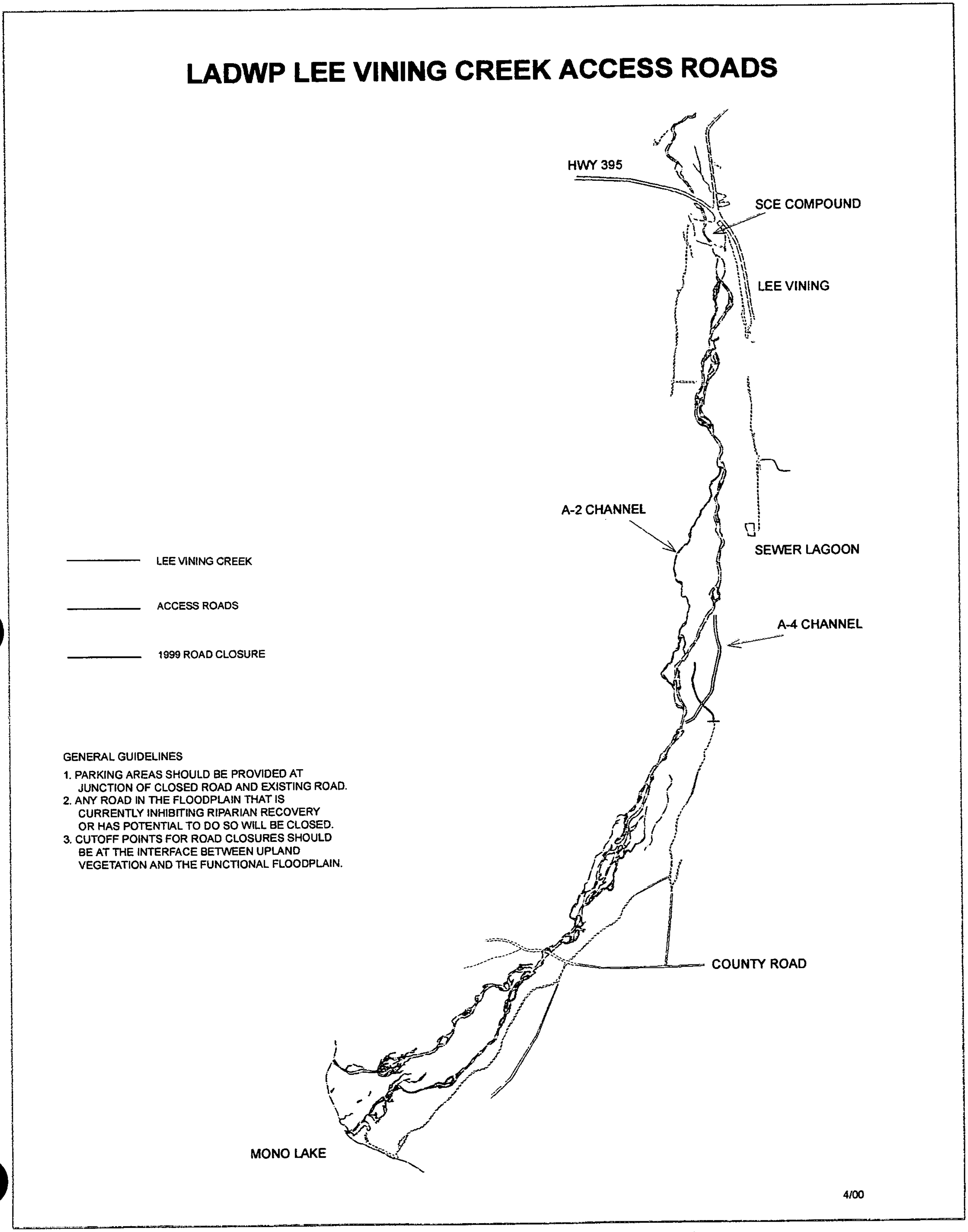


Figure 10: Location of Lee Vining Creek road closures.

LADWP LEE VINING CREEK 1999 REVEGETATION

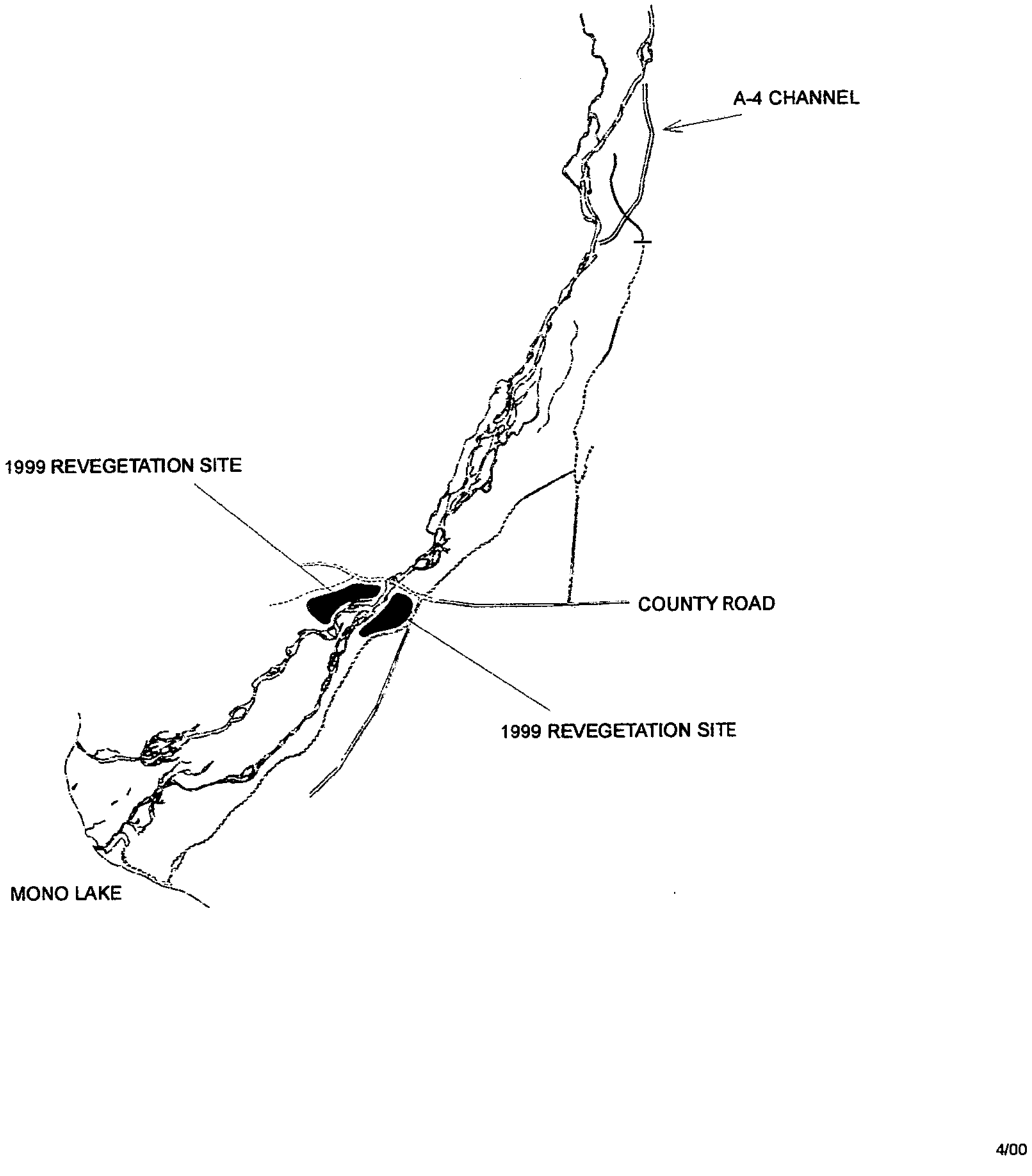


Figure 11: Location of Jeffery Pine revegetation site on lower Lee Vining Creek.

TAB
5

Fisheries Monitoring Report
For
Rush, Lee Vining, Parker and Walker creeks
1999

Prepared by: Chris Hunter
Brad Shepard
Darren Mierau
Ken Knudson
Ross Taylor

Prepared for: Los Angeles Department of Water and Power

Date: May 5, 2000

Table of Contents

Tables and Figures

Executive Summary

This report presents the results of the first year of fish population monitoring for Rush, Lee Vining, Parker and Walker Creeks pursuant to State Water Resources Control Board (SWRCB) WR 98-07. We evaluated four different techniques to estimate trout populations: mark-recapture electrofishing, mark-recapture utilizing electrofishing for the marking run and snorkeling (day and night) for the recapture run; snorkeling and electrofishing depletion. We concluded that mark-recapture electrofishing provided the most reliable estimates for the larger waters (Rush and Lee Vining creeks). Electrofishing depletion estimates provided reliable estimates for Parker and Walker creeks.

We recommend that the methods described in the White Book (LADWP, 1997) be changed to reflect the results of the 1999 efforts. Electrofishing mark-recapture should be used to estimate fish populations in Rush and Lee Vining creeks. Electrofishing depletion estimates should be conducted on Parker and Walker creeks.

We compared the estimated fish population data for Rush and Lee Vining creeks to the termination criteria adopted by the SWRCB. The termination criteria are:

1. Lee Vining Creek sustained catchable brown trout averaging 8-10 inches in length.
2. Rush Creek fairly consistently produced brown trout weighing ¾ to 2 pounds. Trout averaging 13 to 14 inches were also regularly observed.

Lee Vining does contain a small population of brown trout 8 inches and greater in length. However the numbers are so low, less than 6 per 100 meters in the lower sampling section and less than 7 per 100 meters in the upper sampling section, that we don't believe the population can be sustained in the face of harvest.

We collected two fish in Rush Creek that would meet the termination criteria of weighing between ¾ and 2 pounds or attaining a length of 13 to 14 inches. We collected one fish that would meet these criteria in each of the Upper and Lower sections of Rush Creek.. We did not sample any fish in the County Road section that would meet these criteria.

The State Water Resources Control Board requires us to recommend additional quantitative termination criteria for Rush and Lee Vining creeks as well as

quantitative termination criteria for Parker and Walker creeks. The lack of historic fish population data makes it very difficult to make recommendations for quantitative termination criteria with any confidence that they are reasonable. We recommend that data collection be continued for a few more years before we attempt to define additional quantitative termination criteria.

We recommend that the two existing termination criteria be changed to specifically state they must be met by self-sustaining trout populations. We also recommend that the following two termination criteria be adopted:

1. Fish population monitoring shall be terminated for any stream if it is opened to any level of harvest or if fish stocking is initiated.
2. Fish population monitoring of Lee Vining Creek shall be terminated because the stream has been opened to harvest. If the monitoring is continued, then a creel census study should be conducted to evaluate the effect of harvest on the trout population. If harvest is shown to have a negative effect on the self-sustaining trout population, then the harvest should be stopped or the fish population monitoring terminated.

Introduction

This report presents the results of the first year of fish population monitoring for Rush, Lee Vining, Parker and Walker creeks pursuant to the State Water Resources Control Board (SWRCB) Order WR 98-07. Fish population monitoring will continue until the streams have met termination criteria included in Order WR 98-07. These termination criteria describe what are believed to be the pre-project conditions for fish population structure:

1. Lee Vining Creek sustained catchable brown trout averaging 8-10 inches in length. Some trout reached 13 to 15 inches.
2. Rush Creek fairly consistently produced brown trout weighing ¾ to 2 pounds. Trout averaging 13 to 14 inches were also regularly observed.

No termination criteria were set forth for Parker and Walker creeks.

In addition to these criteria, Order WR 98-07 states the monitoring team will develop and implement a means for counting or evaluating the number, weights, lengths and ages of fish present in various reaches of Rush Creek, Lee Vining Creek, Parker Creek and Walker Creek.

By this order the monitoring team must recommend additional quantitative termination criteria. The monitoring team shall consider young-of-year (YOY) production, survival rates between age classes, growth rates, total fish per mile and any other quantified forms as possible termination criteria, although the order does not compel the choice of any one form.

This report provides the fish population data mandated by the SWRCB. In addition we make recommendations regarding termination criteria and future fish population monitoring. Fish length data is reported in millimeters (mm) in this report. For the reader not used to working in the metric system, an easy numerical reference point is 200 mm which is approximately 8 inches. An eight inch trout is often referred to as a 'catchable' trout.

Historical Perspective

Rush Creek downstream of Grant Reservoir was largely without flow for the better part of 40 years until Grant Lake began to spill in June 1982. Similarly Lee Vining Creek had been dry downstream of Highway 395 for approximately 45 years when a spill began in May of 1986. These spills, and the legal action they prompted, resulted in court ordered minimum flows in both streams. The flow releases to Rush Creek from 1984-1989 were most often approximately 20 cubic feet per second (cfs). The Mono County Superior Court ordered a 10 cfs minimum streamflow release in Lee Vining to benefit the brown trout population. Based on a December 1986 fish population study indicating that the brown trout population had not expanded to the area below Highway 395, the minimum streamflow release was reduced in October 1987 to 4 cfs.

Subsequent court orders resulted in higher stream flows as did SWRCB Decision 1631 in 1994. However, these flows were inadequate to providing scouring of the bed and banks. Recurring high flows are necessary to carve the bed and banks forming pools and undercut banks essential for brown trout and to scour streambed gravels to provide adequate spawning areas to allow the fish populations to thrive.

The stream restoration plan prepared by Los Angeles Department of Water and Power (LADWP) called for higher channel maintenance flows than any ordered by the court. The flow regime over the past three years (96-99) has more closely approximated the natural flow regime than any other period for at least the last 60 years

Methods

Fish population sampling occurred August 30 through September 9, 1999. Approximate flows were 50-60 cfs in Upper Rush Creek, 60-70 in Lower Rush Creek and Rush Creek at the County Road. All of the flow was concentrated in a single channel in the County Road section unlike the Lower Rush section where it was distributed among several channels. Flows in Parker and Walker creeks were approximately 4-6 cfs and 3-5 cfs respectively. Flow in Lee Vining Creek was approximately 25-30 cfs distributed among several channels.

Fish population estimates were done by electrofishing and snorkel observation in seven stream sections during 1999 (Figure 1). The lengths and widths of the sampling section channels are provided in Table 1. These stream sections were chosen as being representative of the streams as a whole and are the same sections being used for geomophology and vegetation monitoring. Several different estimation techniques were applied to estimate fish populations. We compared estimates from each technique to evaluate which technique was deemed most appropriate for providing reliable population estimates in each water type.

The White Book (LADWP 1997) states that snorkeling will be used to estimate fish populations and that the snorkeling estimates would be validated using electrofishing. If validation with electrofishing shows that daytime snorkeling is not sufficiently precise, then night snorkeling would be tried and evaluated with electrofishing. If the electrofishing demonstrates that night snorkeling is not precise, then snorkeling would be abandoned in favor of electrofishing. In addition to making fish population estimates using snorkeling we used two other widely accepted techniques for estimating fish populations.

The mark-recapture method requires collecting and marking a number of fish and returning them live to the stream. After a period of time, usually a week, fish are again captured. The product of the number of fish captured on the two collecting passes, divided by the number of marked fish recaptured during the recapture run provides the population estimate. We used electrofishing for the marking run. We conducted recapture runs using electrofishing and snorkeling allowing us to compare these two variations on the method.

We also evaluated the depletion estimation method. The depletion estimation method relies on a decreasing number of fish being captured on each subsequent electrofishing pass. Fish captured during each pass are placed in live cars in the stream. If there is a good reduction in number between passes, then a population estimate may be made. It usually requires at least three passes through a sampling section, and often four passes, to get sufficient reduction in numbers to generate a valid estimate. After the eletrofishing has

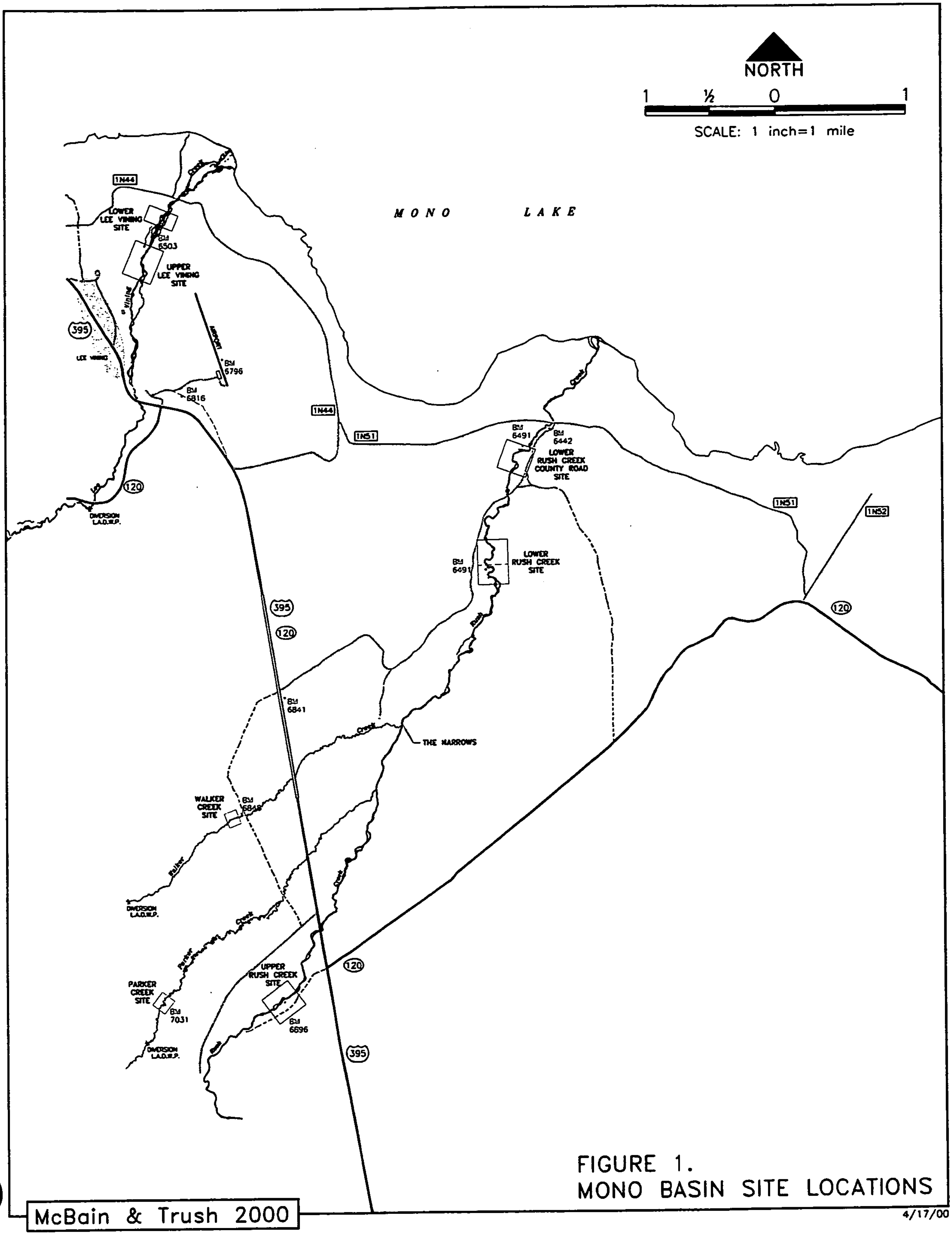


FIGURE 1.
MONO BASIN SITE LOCATIONS

Table 1. Total length (m), average wetted width (m), and total surface area of sample sections in Rush, Lee Vining, Parker, and Walker creeks sampled during September 1999.

Section	Length (m)	Width (m)	Area (sq m)
Rush - Lower	405	5.4	2187
Rush - Upper (lower half)	220	7.4	1628
Rush - Upper (upper half)	210	5.6	1176
- Upper added SC	58	4.1	237.8
TOTAL Upper	430		3041.8
Lee Vining - Lower	187	4.8	897.6
Lee Vining - Lower-B1	189	5	945
TOTAL Lower			1842.6
Lee Vining - Upper-main	330	5.8	1914
Lee Vining - Upper-A4	201	4.2	844.2
TOTAL Upper			2758.2
Parker	98	2.2	215.6
Walker	100	1.9	190

been completed the captured fish are redistributed throughout the sampling section.

Two Smith Root® BP backpack electrofishers (Model 12B) were used to capture fish for depletion estimates and to capture, mark and recapture fish for mark-recapture estimates. In larger channels electrofishing was done by a crew of five: two electrofisher operators; two netters; and a crew member that transported captured fish to live buckets and carried a net to back up primary netters. Electrofishing was done in an upstream direction. Generally one electrofisher and netter worked up each side of the channel, except when the channel became narrow and deep, then one electrofisher and netter followed behind the other pair. This protocol was used in the Upper and Lower sections of Rush Creek, the Upper Section of Lee Vining Creek, and the main channel within the Lower Section of Lee Vining Creek. In sections where the stream channel was smaller (Walker and Parker Creek sections, and the A-4 side channel in the Lower Lee Vining Creek section) a single electrofisher and netter were used along with someone to hold and transport captured fish.

To meet the assumption of closed populations for sampling purposes, all sample sections were blocked prior to sampling. In the Upper and Lower Rush Creek sections 12 mm mesh hardware cloth fences were installed at the upper and lower boundaries of the sections. These hardware cloth fences were installed by driving fence posts at approximately two-meter intervals through the bottom portion of the hardware cloth approximately 15 cm from its bottom edge and into the channel substrate. Rope was then strung across the top of each fence post and anchored on each bank. The hardware cloth was held vertically by wiring the top of the cloth to the rope with baling wire. Fences were maintained by daily cleaning between mark and recapture sampling. In all other sample sections 12 mm mesh block seines were placed at sample section boundaries during depletion efforts.

Electrofishing depletion estimates were made in Lower and Upper Rush Creek, Lower and Upper Lee Vining Creek, and a single sample section in both Parker and Walker creeks.

Sampling section lengths varied from 98 m in Walker Creek to 430 m in Upper Rush Creek. In the Upper Rush Creek section separate depletion estimates were made for the lower and upper halves of the sample section. All captured fish were held in live cars within the stream channel. After each electrofishing pass, all captured fish were measured to the nearest mm and most were weighed to the nearest gram. In the case of YOY not all fish were weighed due to the large number of fish. A large percentage (over 70%) of the YOY were weighed to determine the range of weights of the age (size) class. All fish were held in live cars until after the last pass was made through the section. They were then distributed throughout the section. Depletion estimates were calculated using a maximum likelihood estimator (Van Deventer and Platts, 1989).

Young-of-the-year fish depletion estimates were not made in the Upper and Lower Rush Creek sections because we did not achieve adequate reduction in numbers between passes. This is not uncommon when sampling YOY in larger waters with complex habitats. Smaller fish are less susceptible to the electrical field created in the water and larger water bodies with complex habitat can make it virtually impossible to show a reduction in YOY numbers on subsequent passes. Consequently no depletion estimates could be made for this age (size) group at these stations.

In the Upper and Lower Rush Creek sections, all captured fish had their upper caudal fin clipped to conduct mark-recapture estimates in these sections. When clipping the upper caudal fin a scissors was used to make a straight vertical cut from the top of the caudal fin down approximately 3 mm. This vertical cut was located about 3 mm from the posterior edge of the fin. This resulted in a 3x3 mm flap of tissue that hung down and could be easily seen by divers. Divers noted that these flaps were already beginning to regrow on some fish when observed during the snorkel recapture run made 8-9 days later.

Day snorkel counts were made in the County Road, Lower, and Upper Rush Creek sections. In the Upper Rush Creek section, only the lower half of the section was snorkeled. A night snorkel count was also made in Lower Rush Creek. Two divers conducted each snorkel count, except in the lower half of the Upper Rush Creek section where four divers were used. Each diver worked their way upstream and only counted fish in their lane. Divers worked up the middle of the channel together each looking toward the stream bank on their side. In water that was too fast or deep to crawl up the center of the channel, each diver crawled upstream near the bank and looked toward the center of the channel. A crew member walked behind the divers on the bank and recorded all their observations. Divers communicated often with each other to ensure they did not count the same fish twice and discuss observations of fish. During snorkel counts in Upper and Lower Rush Creek, divers recorded whether observed fish could be seen well enough to observe their caudal fin to identify if the upper portion was clipped and, if so, whether the fin was, or was not, clipped.

Mark-recapture estimates were made from electrofishing recapture catches using the Chapman modification of the Peterson estimator (Ricker 1975). The Chapman modification results in an estimation equation:

$$N = \frac{(M+1)*(C+1)}{(R+1)};$$

where N is the estimated population, M is the number of fish marked on the marking run, C is the total number of fish captured on the recapture run (including both previously marked and unmarked fish), and R is the number of previously marked fish recaptured on the capture run.

During the recapture electrofishing run made in the Lower Rush Creek section the number of fish not previously marked was also used as a fourth depletion pass. This resulted in both three-pass and four-pass depletion estimates being completed for this section. Total snorkel counts made during the day and night were used as an estimate of fish populations in those sections where snorkel counts were completed. In addition, day and night snorkel counts were used as recapture events for the Upper and Lower Rush Creek sample sections.

Results

Rush Creek

County Road Section

A cursory day snorkel count completed in a 250 m long (6.1 m average width) portion of the County Road section of Rush Creek observed only four rainbow trout, but numerous young-of-year (YOY) brown trout and 32 brown trout 125-199 mm (Table 2). No brown trout longer than 199 mm were observed.

We were not able to effectively electrofish this section with backpack electrofishers due to the size of the channel, the amount of flow and the depth of some pools. We recommend that a boat-mounted electrofisher be used to sample this section.

Lower Section

Several different techniques were used to estimate fish populations in the 405 m long by 5.4 m average width Lower Rush Creek section. We believe the mark-recapture electrofishing estimate provided the "best" estimate of the true population in this section (Table 3). The products of the number of fish marked (M) and the number of fish examined for marks on the recapture run (C) were larger than 4 times the population (M*C>4*N). The number of recaptures (R) were at least 7 for all size classes. These are criteria that Robson and Regier (1964) found led to negligible bias with 95% confidence.

Using day snorkel counts as a recapture effort for mark-recapture estimates seemed to provide positively biased estimates for all size classes. The 95% confidence intervals associated with these day snorkel-recapture estimates were relatively broad thus electrofishing mark-recapture estimates were within these intervals (Figure 2). The day snorkel-recapture estimate of YOY brown trout (979) was very close to the electrofishing mark-recapture estimate (911).

When night snorkel counts were used as the recapture effort for mark-recapture estimates the estimated number of YOY brown trout was almost twice that estimated from electrofishing mark-recapture (1700 versus 911). However, estimates from night snorkel-recaptures for the other two size classes of brown trout were very close (Tables 2 and 3, Figure 2).

Three and four-pass depletion estimates were lower than electrofishing mark-recapture estimates by about 75-80% for brown trout 125-199 mm, but were within 10% for brown trout 200 mm and longer (Tables 3 and 4, Figure 2).

Table 2. Total snorkel counts of rainbow (RB) and brown (LL) trout in three sections of Rush Creek during the day or night by length class.

Section (Day or Night)	Species	Young-of-year	125 to 199 mm	200 + mm
County Road – Rush Creek				
(Day)	RB	0	2	2
	LL	87	32	0
Lower – Rush Creek				
(Day)	RB	0	1	0
	LL	85	53	5
Lower – Rush Creek[a/]				
(Night)	RB	0	0	0
	LL	94	135	18
Upper (lower half) – Rush Creek				
(Day)	RB	7	4	2
	LL	352	102	5

[a/] Only night snorkel count conducted.

Table 3. Mark-recapture estimates showing number of fish marked (M), number of fish captured on recapture run (C), number recaptured on recapture run (R), and number of mortalities (Morts) between mark and recapture run by stream section, species and length group in September 1999.

Stream (Section) Species Length Group	Mark-Recapture M	C	R	Morts	Estimated[1] number	S.E.
Rush Creek (Lower Section – Electrofishing Estimate)						
Brown Trout						
YOY	135	66	9	22	911	253
125-199 mm	146	53	37	4	209	18
200 + mm	117	50	46	0	128	5
Rainbow Trout						
YOY	7	4	0	0	NP[2]	
125 + mm	3	3	3	0	4	0
Rush Creek (Lower Section – Night Snorkel Estimate)						
Brown Trout						
YOY	135	74	5	21	1700	616
125-199 mm	146	120	81	4	217	14
200 + mm	117	17	17	0	118	0
Rainbow Trout						
YOY	7	0	0	0	NP	
125 + mm	3	0	0	0	NP	
Rush Creek (Lower Section – Day Snorkel Estimate)						
Brown Trout						
YOY	135	71	9	21	979	274
125-199 mm	146	45	18	4	356	61
200 + mm	117	5	4	0	142	24
Rainbow Trout						
YOY	7	0	0	0	NP	
125 + mm	3	1	0	0	NP	
Rush Creek (Upper Section – Lower Half – Day Snorkel Estimate)						
Brown Trout						
YOY	129	118	8	29	1719	523
110-199 mm	118	65	18	0	413	78
200 + mm	54	5	4	1	66	11
Rainbow Trout						
YOY	5	2	0	0	NP	
125 + mm	7	4	3	0	10	2

[1] To arrive at a complete estimate the "Morts" should be added to the "Estimated number.

[2] "NP" indicates it was not possible to make an estimate.

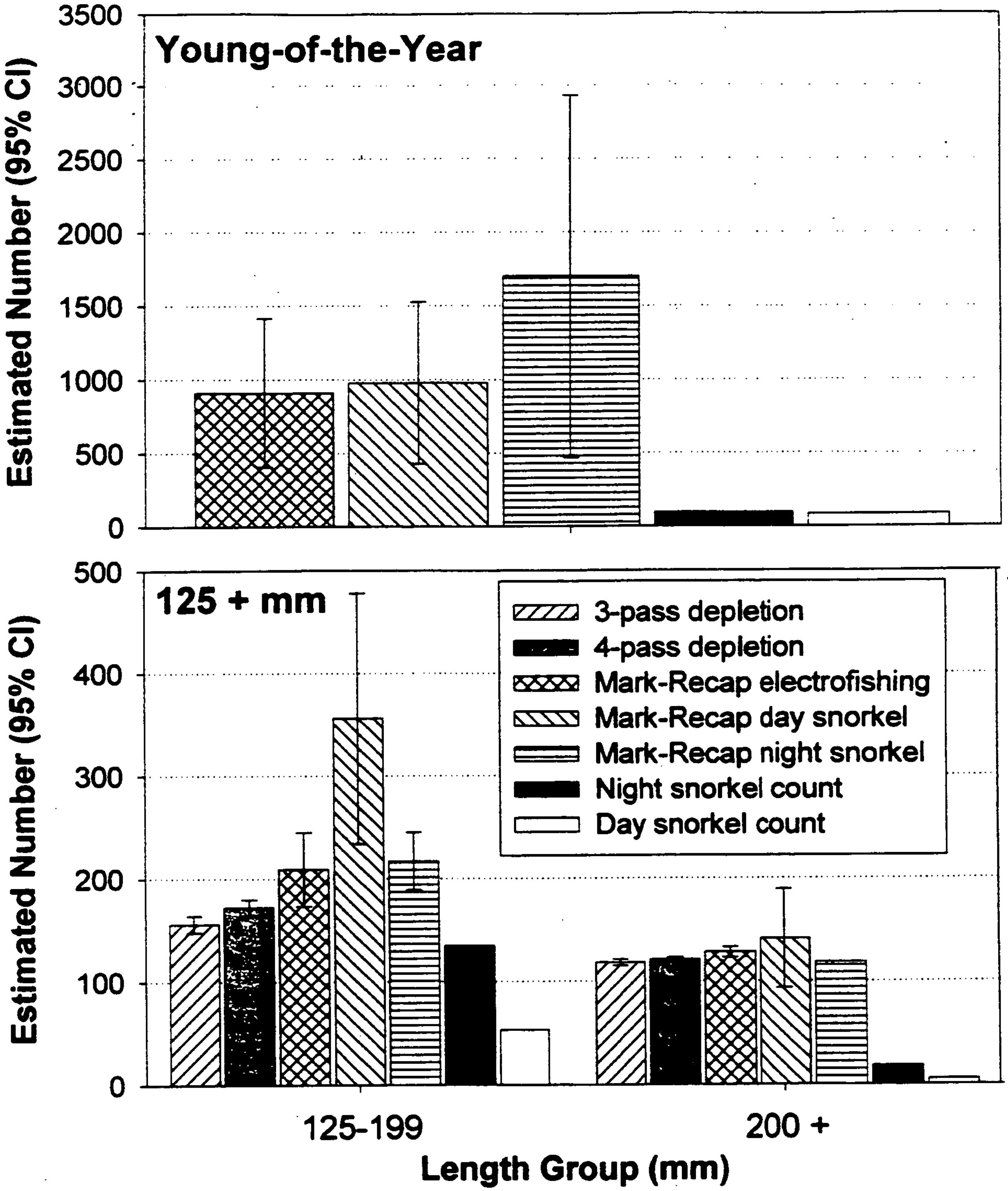


Figure 2. Estimated numbers of young-of-the-year (top) and 125 to 199 mm and 200 mm and longer (bottom) brown trout in Lower Rush Creek during September 1999. Vertical lines represent 95% confidence intervals.

Table 4 . Catch per pass and number of fish estimated by a maximum likelihood depletion estimator with associated standard errors (S.E.) by stream section, species, and length group in September 1999.

Stream (Section) Species Length Group	Number captured per pass 1	2	3	4	Estimated number	S.E.
Parker Creek						
Brown Trout						
YOY (0-90 mm)	46	33	33	14	172	22.6
100 + mm	9	2	0	1	12	0.3
Walker Creek						
Brown Trout						
YOY (0-90 mm)	6	2	2	0	10	0.6
100 + mm	31	5	1	1	38	0.3
Lee Vining Creek (Lower Main Channel)						
Brown Trout						
YOY (<100 mm)	40	15	17	-	90	11.7
100-199 mm	24	13	8	-	53	6.8
200 + mm	15	1	0	-	16	0.1
Rainbow Trout						
YOY (<100 mm)	4	1	0	-	5	0.2
100 + mm	5	2	1	-	8	0.8
Lee Vining Creek (Lower Side Channel)						
Brown Trout						
YOY (<100 mm)	20	8	16	5	55	12.7
100-199 mm	10	1	2	0	13	0.3
200 + mm	3	1	1	1	6	1.0
Rainbow Trout						
YOY (<100 mm)	5	5	2	3	19	6.2
100 + mm	3	0	0	0	3	-
Lee Vining Creek (Upper Main Channel)						
Brown Trout						
YOY (<100 mm)		Not estimated				
100-199 mm	36	11	5	-	53	1.8
200 + mm	13	8	1	-	22	1.1
Rainbow Trout						
100-199 mm	4	0	0	-	4	-
200 + mm	5	2	1	-	8	0.8

Stream (Section) Species Length Group	Number captured per pass 1	2	3	4	Estimated number	S.E.
Lee Vining Creek (Upper Side Channel)						
Brown Trout						
YOY (<100 mm)		Not estimated				
100-199 mm	17	2	0	-	19	0.1
200 + mm	11	3	0	-	14	0.3
Rainbow Trout						
100-199 mm	4	1	0	-	5	0.2
200 + mm	7	0	0	-	7	-
Rush Creek (Lower Main Channel)						
Brown Trout						
125-199 mm	107	26	17	16[1]	156[2]	3.6
200 + mm	95	13	9	4[1]	118[3]	1.4
Rainbow Trout						
125 + mm	3	1	0	0[1]	4	0.2
Rush Creek (Upper Section – lower half)						
Brown Trout						
110-199 mm	54	43	21	-	158	20.7
200 + mm	35	15	5	-	57	2.4
Rainbow Trout						
100 + mm	2	3	2	-	11	10.6
Rush Creek (Upper Section – upper half)						
Brown Trout						
110-199 mm	35	16	13	6	77	4.9
200 + mm	28	7	8	2	46	1.6
Rainbow Trout						
100 + mm	2	2	0	0	4	0.3

[1] These fish were unmarked fish captured on the recapture run of mark-recapture estimate conducted five days later.

[2] The estimate based on a four-pass depletion with the recapture run counted as a final pass was 172 (SE: 3.6).

[3] The estimate based on a four-pass depletion with the recapture run counted as a final pass was 121 (SE: 0.8).

Counts of fish observed by divers during both day and night dives were much lower than numbers estimated by mark-recapture electrofishing, by factors of at least 10 for YOY, 2 for 125-200 mm fish, and 8 for fish 200 mm and longer (Table 2 versus 3). Snorkel counts at night observed about three times as many fish over 125 mm than day counts, but were still much lower than mark-recapture electrofishing estimates.

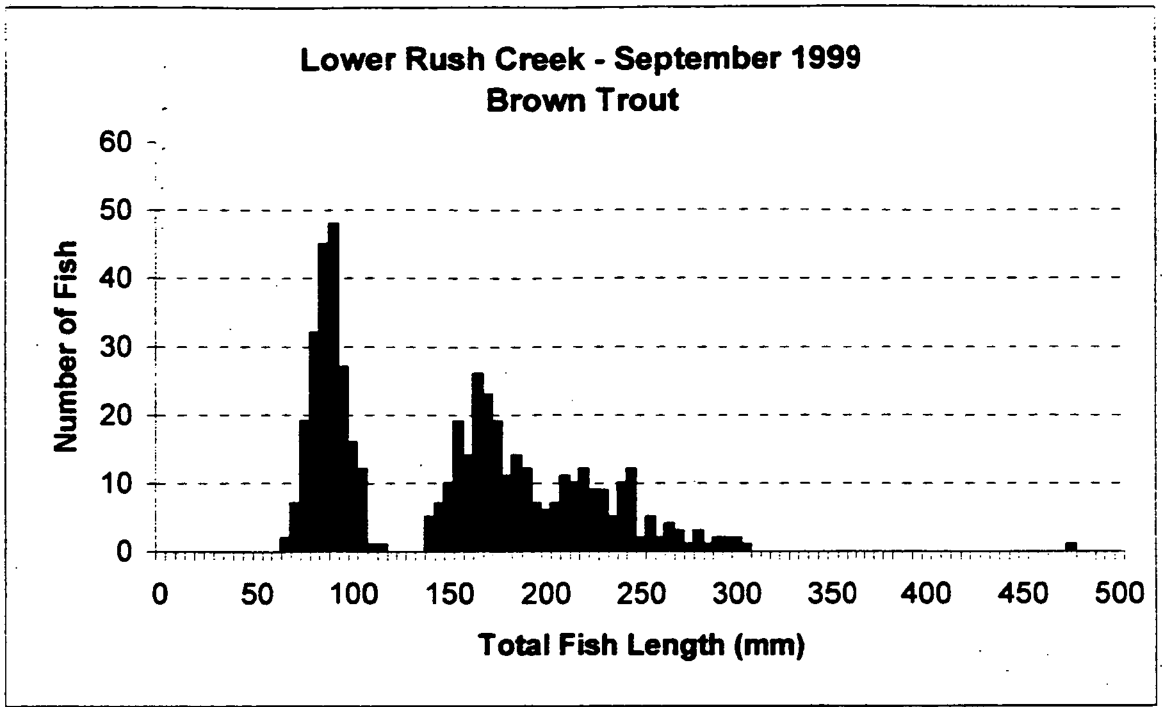
Length frequencies of captured brown trout indicated YOY's ranged from 60 to 110 mm, age 1's ranged from 140 to about 200 mm, age 2's were between 200 and 230 mm, and the rest were age 3 and older (Figure 3). It must be remembered that since these fish were captured in September, they had attained most of their growth for the year and were unlikely to grow much more before their next year of age. It was also noteworthy that a 480-mm (19 inch) brown trout was captured in this section. Few rainbow trout were captured but the length frequency histograms indicate YOY's were approximately 50-60 mm in length, age 1's were 150 to 180 mm, and age 2's were between 200 and 250 mm. No rainbow trout over 250 mm were captured.

Upper Section

The 430 m long Upper Rush Creek section was split into two sub-sections. The lower sub-section was 220 m long and averaged 7.4 m wide, while the upper sub-section was 210 m long and averaged 5.6 m wide. The upper sub-section also had a 58 m long side channel that averaged 4.1 m wide. Depletion estimates were 158 with a standard error (SE) of 21 for brown trout 110-199 mm and 57 (SE: 3) for brown trout 200 mm and longer in the lower sub-section and 77 (SE: 5) and 46 (SE: 2) for the same respective size groups of brown trout in the upper sub-section (Table 4). Estimates of rainbow trout were much lower.

Divers counted numerous YOY and juvenile brown trout, but few larger brown trout in the lower sub-section of Upper Rush Creek during the day (Table 2). Some rainbow trout were also observed. The day snorkel mark-recapture estimate was 1,719 (SE: 523) for YOY, 413 (SE: 78) for 110-199 mm, and 66 (SE: 11) for 200 mm and longer brown trout (Table 3).

Length frequency histograms indicated age 0 brown trout were from 50 to 95 mm, age 1's were from about 120 to 180 mm, and age 3's appeared to be from about 180 to 230 mm (Figure 5). These length ranges by age for brown trout were slightly smaller than for the lower section. Age 0 rainbow trout were about 50 mm (Figure 4). The age 1 year-class of rainbow trout was from 150 to 175 mm and the age 2 year-class was over 200 mm.



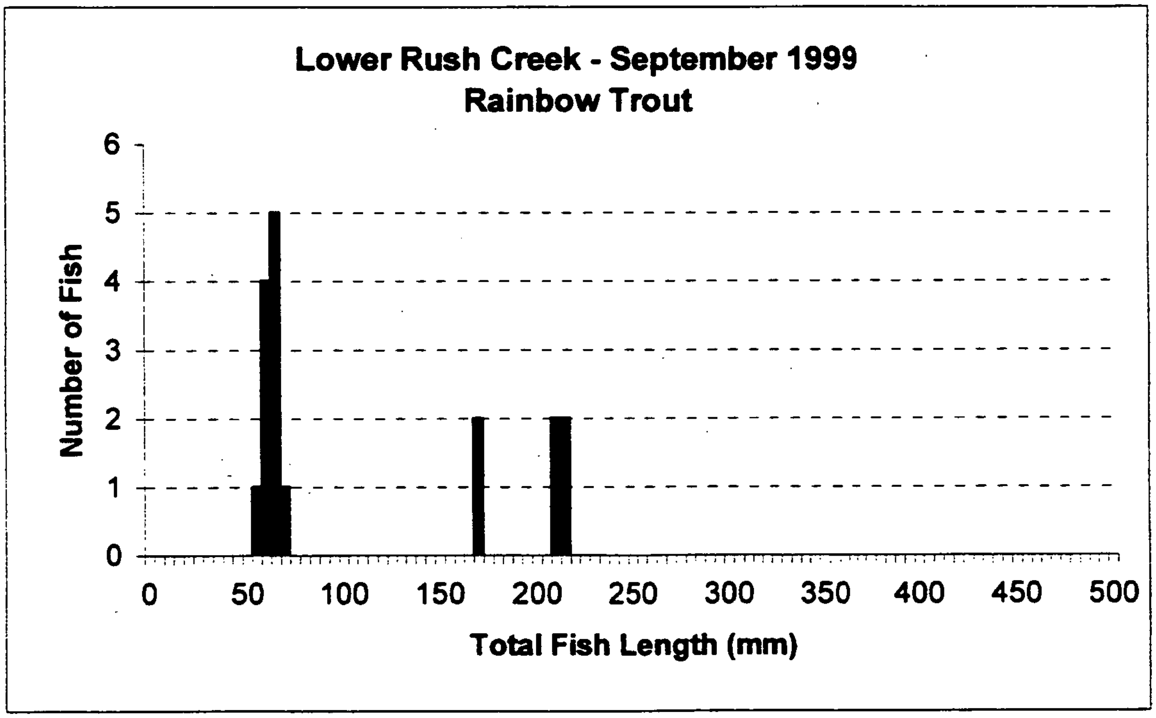
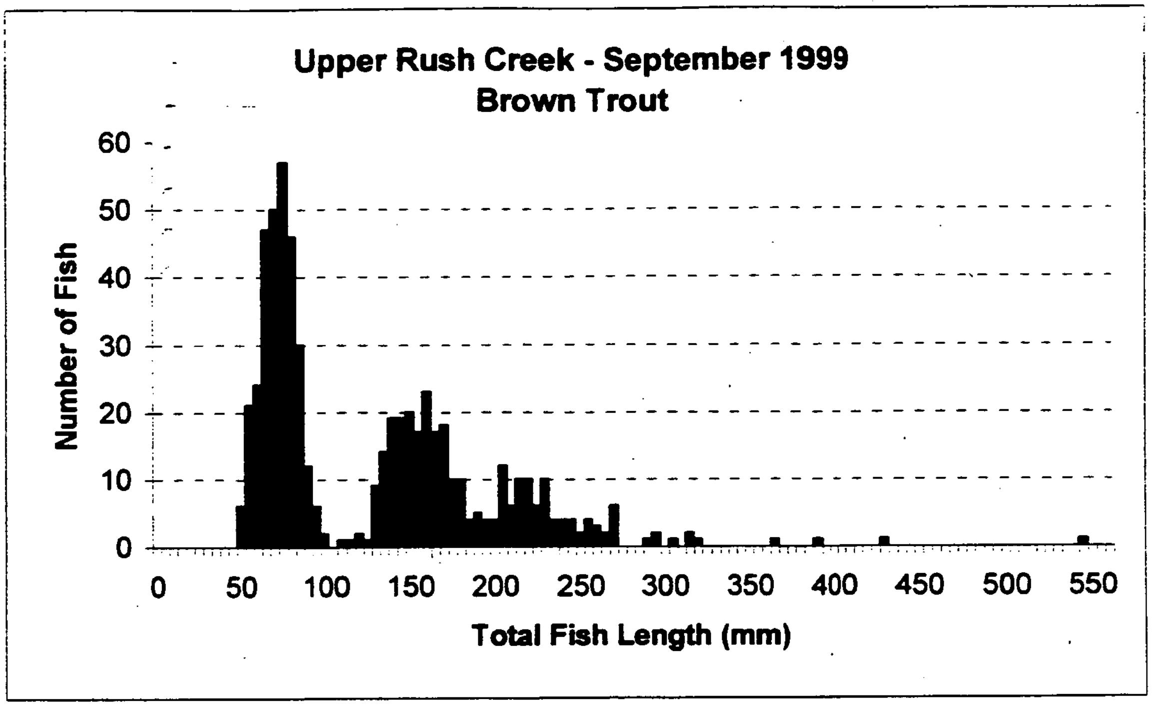


Figure 3. Length frequency histograms for brown trout (top) and rainbow trout (bottom) captured in Lower Rush Creek during September 1999.



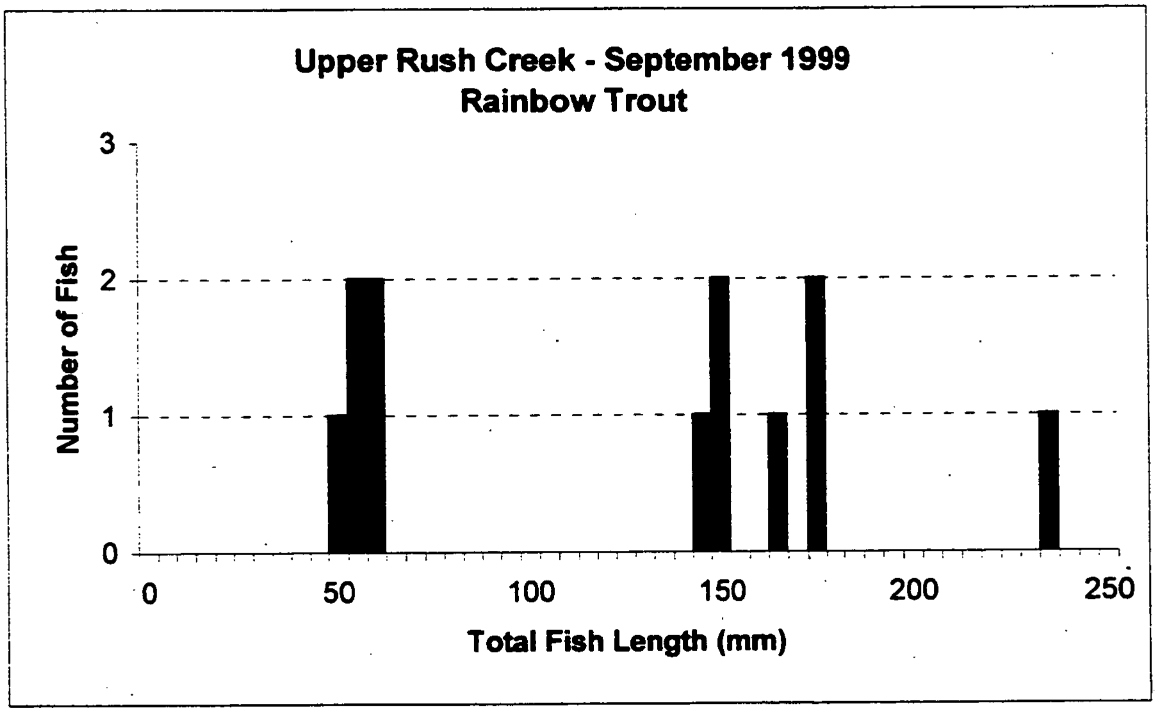


Figure 4. Length frequency histograms for brown trout (top) and rainbow trout (bottom) captured in Upper Rush Creek during September 1999.

Lee Vining Creek

Lower Section

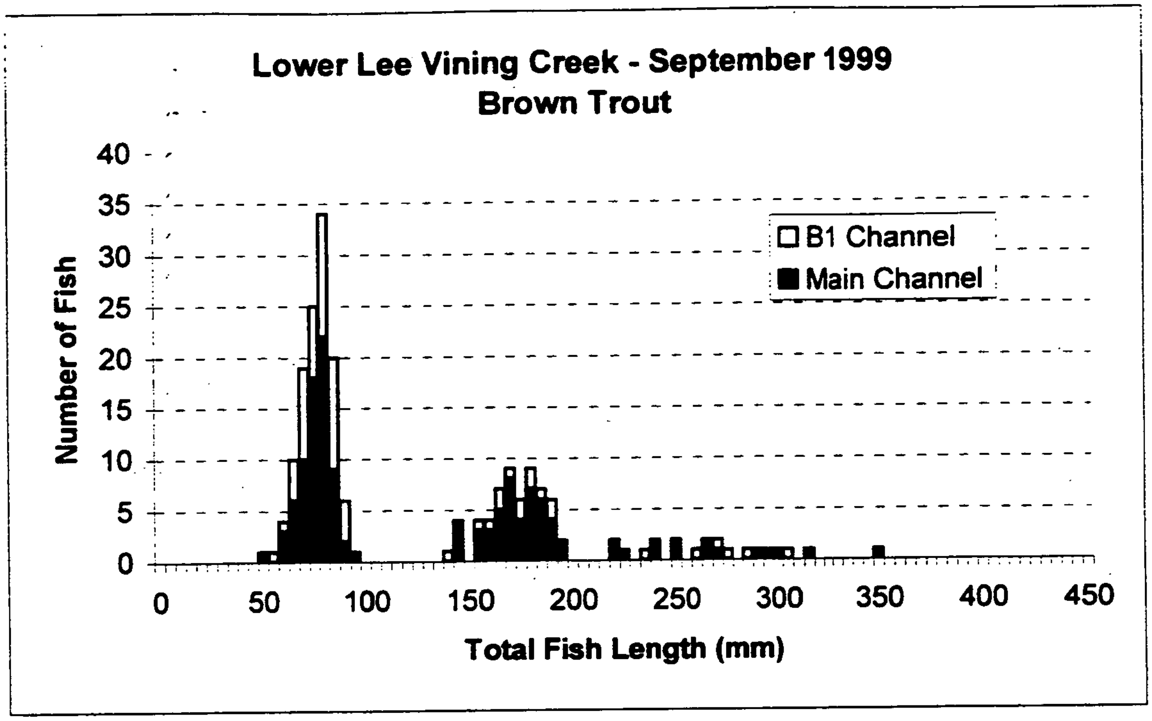
The Lower Lee Vining section consisted of two channels. The sampled portion of the main channel was 187 m long and 4.8 m wide, while the sampled portion of the B1 channel was 189 m long and averaged 5.0 m wide. We estimated the main channel supported 90 (SE: 12) YOY, 53 (SE: 7) 100-199 mm, and 16 (SE: 1) 200 mm and longer brown trout (Table 4). This estimate was based on a three-pass depletion estimate. The B1 side channel supported an estimated 55 (SE: 13) YOY, 13 (SE: 1) 100-199 mm, and 6 (SE: 1) 200 mm and longer brown trout (Table 4). The estimate in the B1 side channel was based on a four-pass depletion estimate. More rainbow trout YOY were estimated to be in the side channel than in the main channel (19 versus 5; Table 4), but the main channel supported more rainbow trout 100 mm and longer.

Few brown trout over 200 mm were captured (Figure 5), less than 6 per 100 m of stream. Age 0 brown trout ranged from 50 to 90 mm in length and age 1 brown trout ranged from 140 to 190 mm. YOY rainbow trout were smaller in the B1 side channel and more YOY rainbow were captured in this side channel than in the main channel (Figure 5).

Upper Section

The Upper Lee Vining section also consisted of two channels. The sampled portion of the main channel was 330 m long and averaged 5.8 m wide, while the sampled portion of the A4 channel was 201 m long and averaged 4.2 m wide. The main channel supported an estimated 53 (SE: 2) 100-199 and 22 (SE: 2) 200 mm and longer brown trout (Table 4). The A4 side channel supported an estimated 19 (SE: 1) 100-199 mm and 14 (SE: 1) 200 mm and longer brown trout (Table 4). Estimates were based on three-pass estimates and brown trout YOY were not estimated. The main and side channels supported similar numbers of rainbow trout (Table 4).

The largest brown trout were captured in the A4 side channel (Figure 6). The number of brown trout over 200 mm in length collected during sampling was less than 7 per 100 m of stream channel. Age 0 brown trout were from 50 to 90 mmin length, age 1 brown trout were from about 140 to 200 mm, and age 2 brown trout were 200 to 250 mm in length. Two rainbow trout 400 mm and longer were captured in the A4 side channel (Figure 6). Age 0 rainbow trout ranged from 35 to 80 mm, age 1's ranged from 140 to 200 mm, and age 3's appeared to range from 240 to 300 mm.



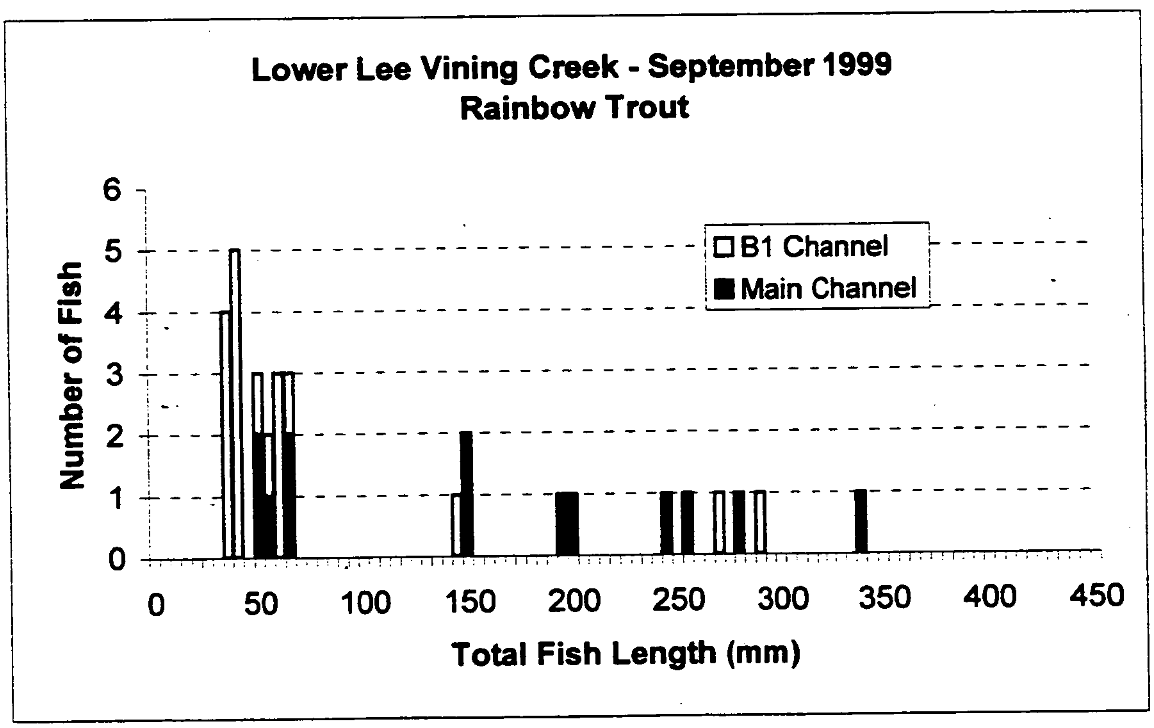
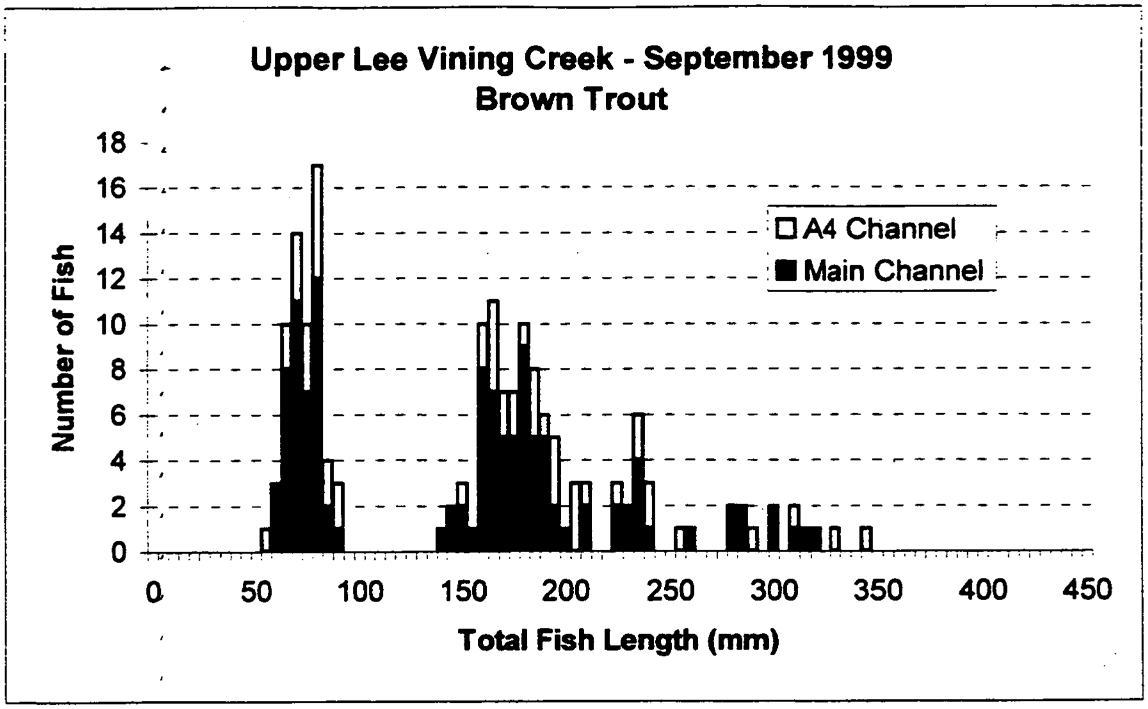


Figure 5. Length frequency histograms for brown trout (top) and rainbow trout (bottom) captured in Lower Lee Vining Creek during September 1999. Open bars represent fish captured in the B1 side channel and filled bars represent fish captured in the main channel.



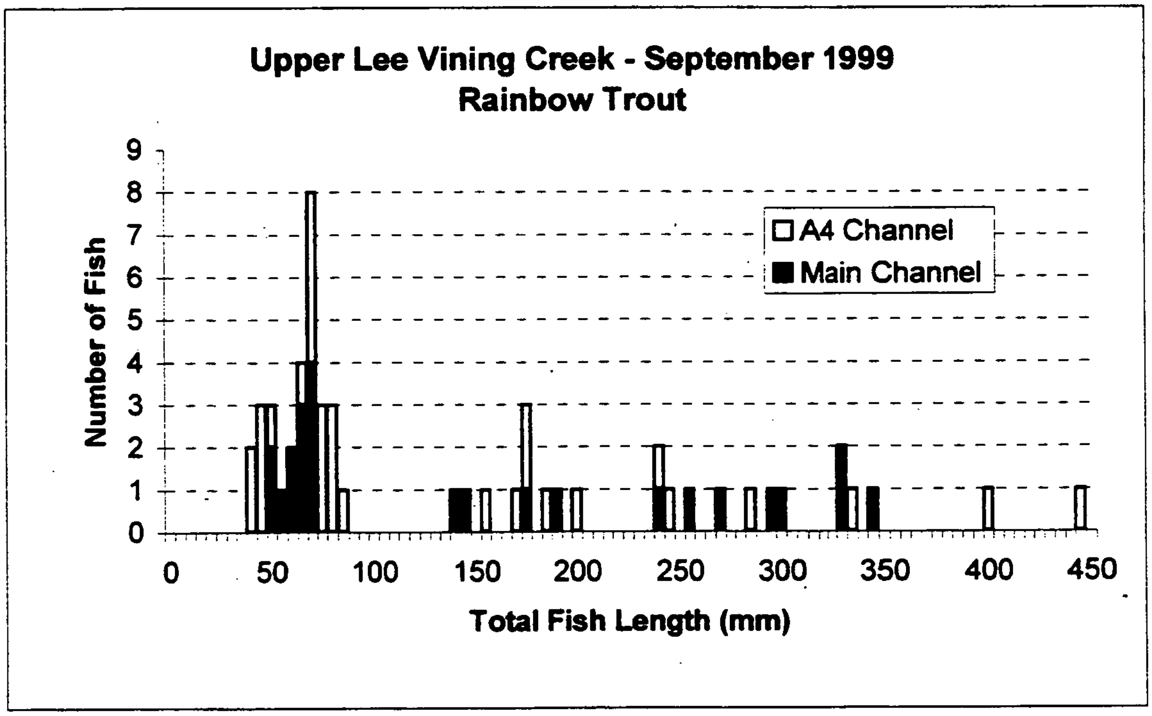


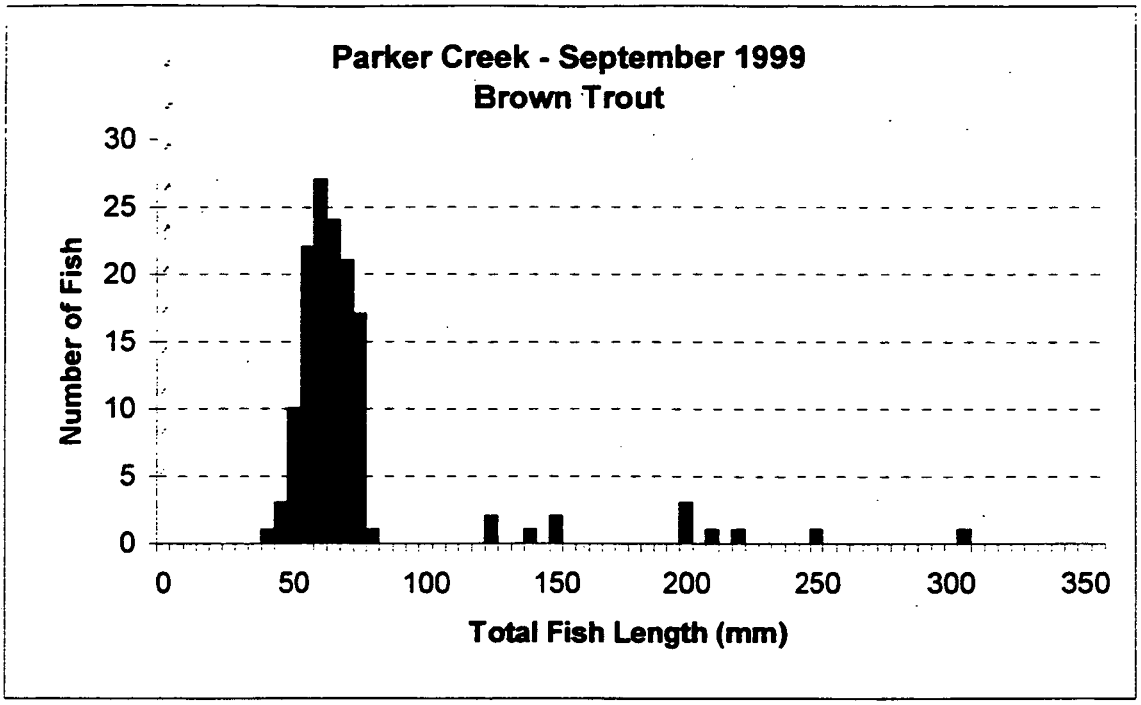
Figure 6. Length frequency histograms for brown trout (top) and rainbow trout (bottom) captured in Upper Lee Vining Creek during September 1999. Open bars represent fish captured in the A4 side channel and filled bars represent fish captured in the main channel.

Parker Creek

The sample section in Parker Creek was 98 m long and averaged 2.2 m wide. This section contained an estimated 172 YOY (SE: 23) and 12 100 mm and longer brown trout based on a four-pass estimate (Table 4). No rainbow trout were captured. While numerous YOY were captured, few brown trout over 100 mm were observed (Figure 7). Length frequency data indicates Parker Creek may be important for spawning brown trout, but most young brown trout appear to leave the stream after their first year.

Walker Creek

The sample section in Walker Creek was 100 m long and averaged 1.9 m wide. This section supported an estimated 10 (SE: 1) YOY and 38 100 mm and longer brown trout based on a four-pass depletion estimator (Table 4). No rainbow trout were captured. The population estimate and length frequency histogram (Figure 7) indicate Walker Creek provides spawning and rearing habitat for brown trout, but few adult-size brown trout reside in Walker Creek.



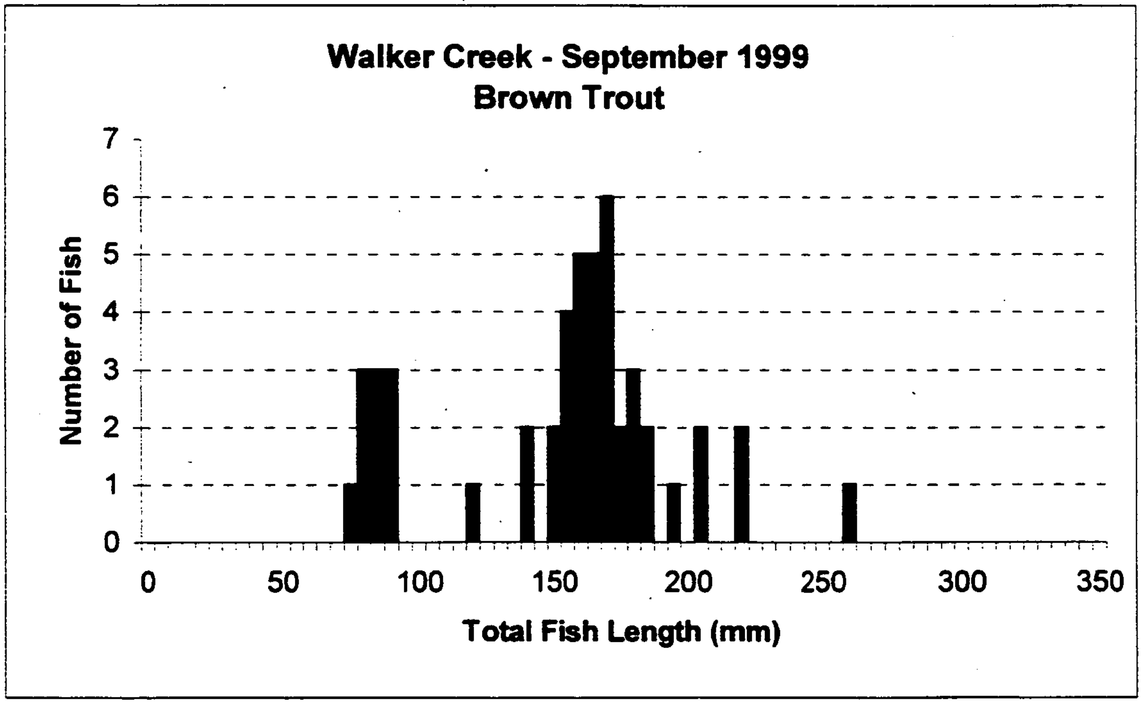


Figure 7. Length frequency histograms for brown trout captured in Parker Creek (top) and Walker Creek (bottom) during September 1999.

Discussion

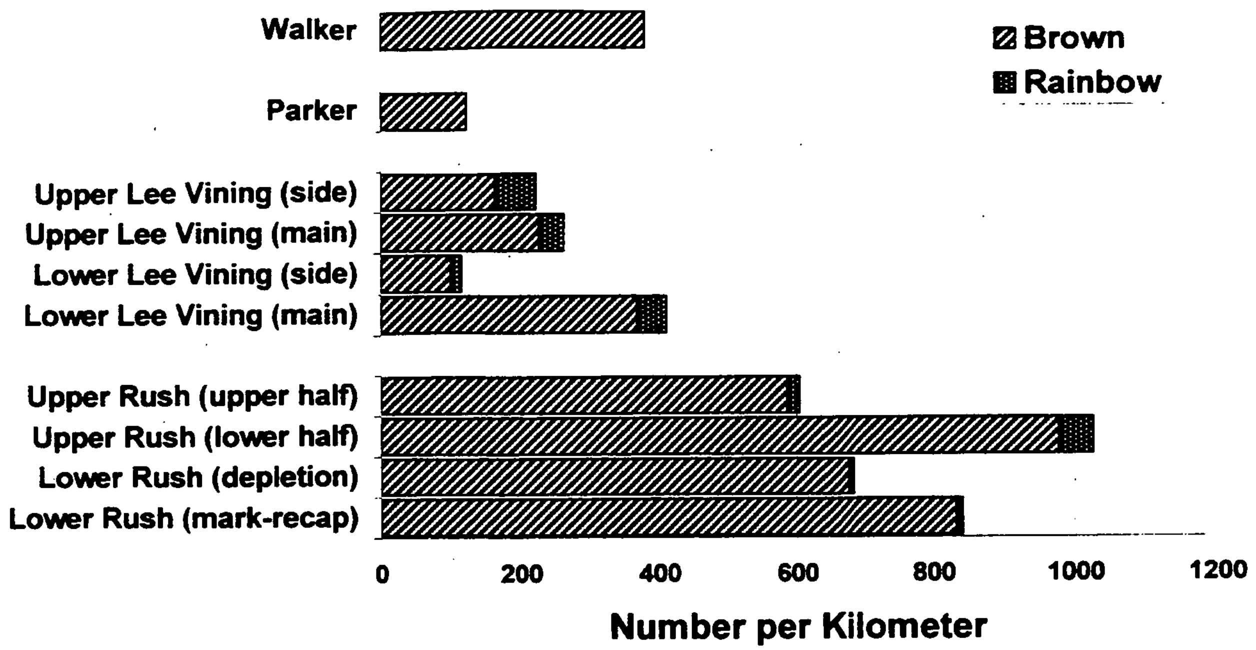
Relative Abundance of Trout

We believe estimates of trout were negatively biased for all sections, except the for the mark-recapture estimate in Lower Rush Creek, due to the bias of the depletion estimator. However, we believe bias associated with the depletion estimator was negligible for the Walker and probably Parker creek sections since their small size allowed for more efficient sampling. Estimates for the number of age 1 and older trout per kilometer of stream length and per hectare of stream area indicated that the Upper Rush Creek section supported the highest frequencies of trout (number per kilometer), while the Walker Creek section supported the highest densities (number per hectare; Figure 8).

The Lower Rush Creek section supported the highest biomass (kilograms per hectare) of trout age 1 and older, especially as measured by electrofishing mark-recapture (R-L MR; Figure 9), than all other sample sections. The estimated biomass this section supported based on the mark-recapture electrofishing estimate was 131.5 kg/ha. The depletion estimate for this same section was about 113.5 kg/ha, or about 86% of the mark-recapture electrofishing estimate. Other depletion estimates of biomass ranged from 19.5 kg/ha in Parker Creek, 28.7 to 93.2 kg/ha in Lee Vining Creek sections, 90.4 kg/ha in the Walker Creek section, and around 100 kg/ha in Upper Rush Creek (Figure 9).

Sample Size Necessary for Mark-Recapture Estimates

Since we made reasonably good estimates of population sizes in Lee Vining and Rush Creek sample sections, we can estimate how many fish in each size group we will need to mark and recapture to obtain desired levels of population change we wish to detect. Robson and Regier (1964) provided figures for estimating the number of fish that should be marked and recaptured for making estimates with the desired level of precision (1- = 0.95) and various levels of deviation from the true population (expressed as the percentage of the population;) based on "known" population sizes. We desire a level of precision of 0.95 and p of 0.10, which is the level Robson and Regier recommend for research. We can estimate the number of trout we need to mark in Lower Rush Creek to achieve our desired level of precision and our ability to detect change. By using our estimated numbers as "known" populations and equalizing the number marked and examined for marks we estimate that we will need to mark about 400 YOY, 110 125-199 mm and 65 200 mm and longer brown trout in Lower Rush Creek.



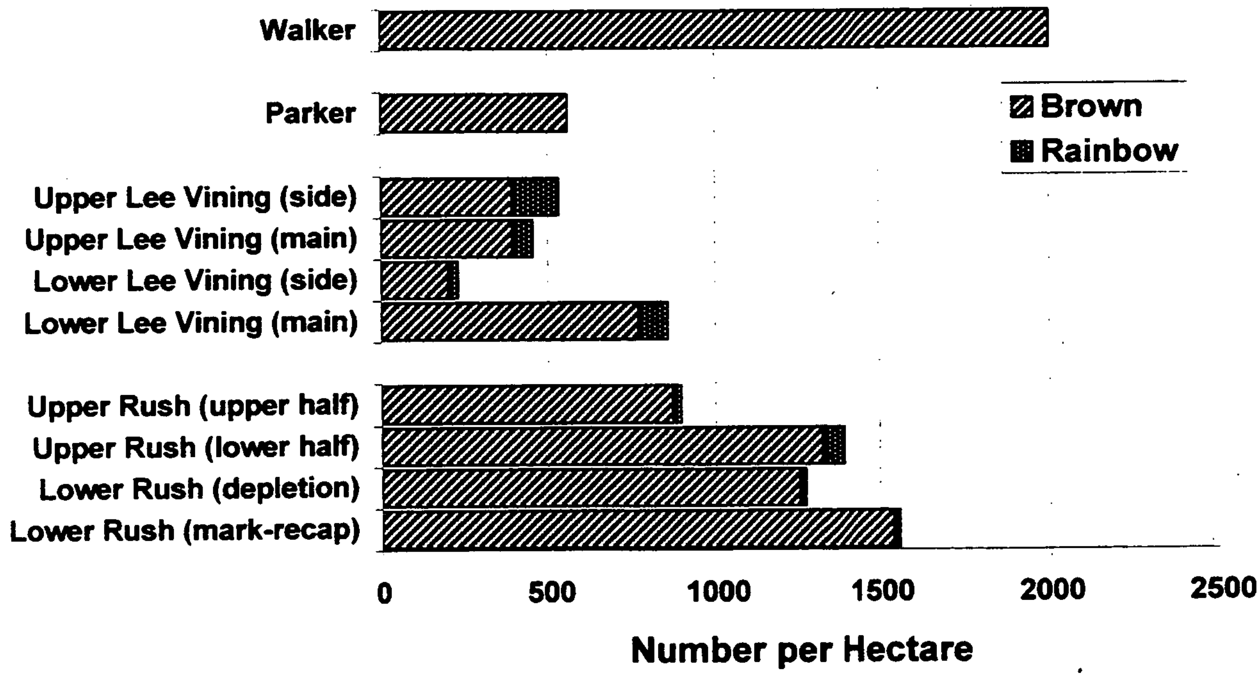


Figure 8. Estimates of age 1 and older brown and rainbow trout per kilometer of stream length (top) and per hectare of stream surface area (bottom) by stream section in September 1999. Estimates for Lower Rush Creek show both depletion and mark-recapture estimates. Estimates for Upper Rush Creek were split into estimates for the upper and lower halves of the section. Estimates for both the Lower and Upper Lee Vining Creek sections include separate estimates for side and main channels within each section.

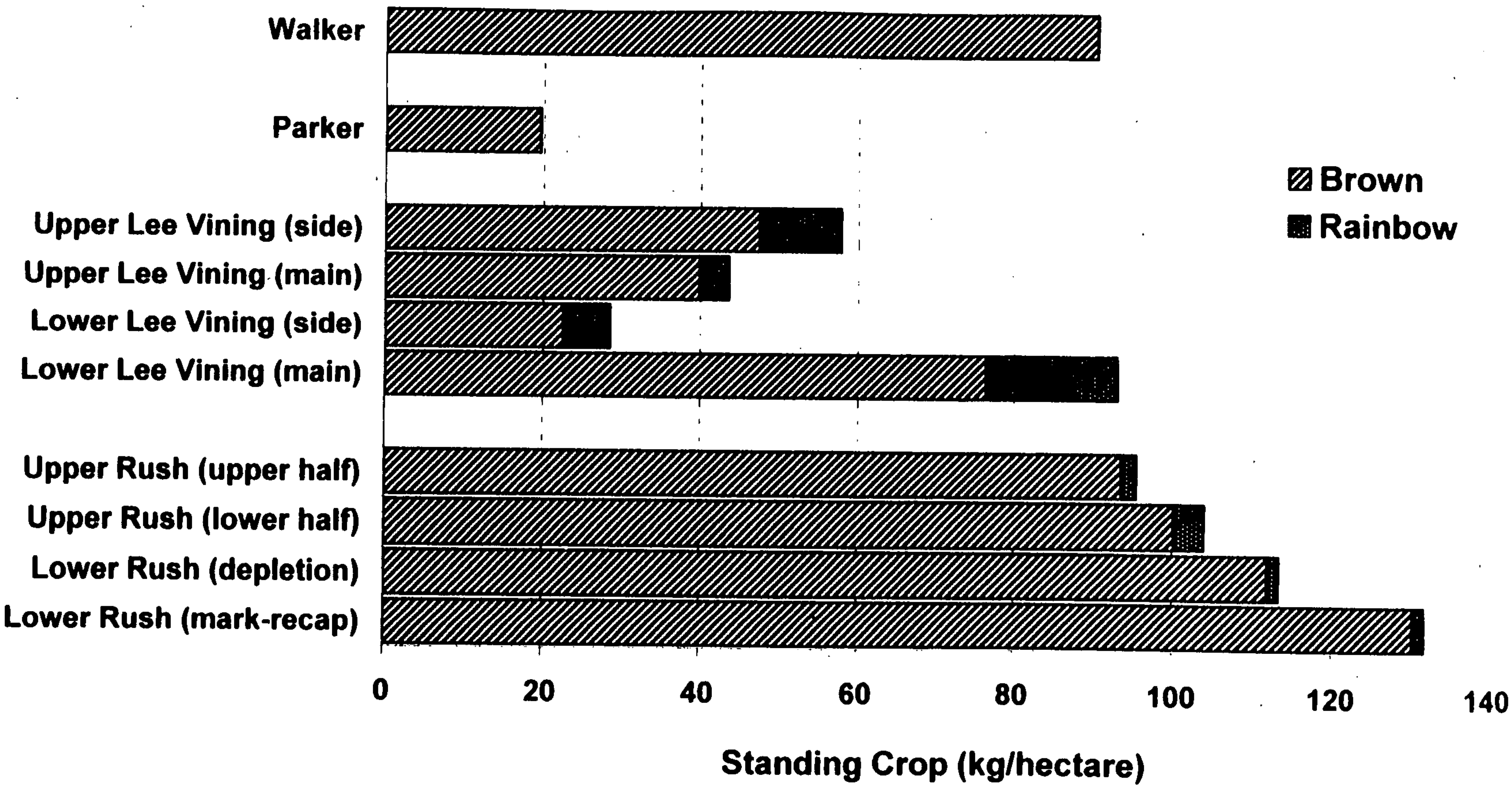


Figure 9. Estimated standing crop (kilograms per hectare) of age 1 and older trout (by species) in Mono Lake tributaries during September 1999. Estimates for Lower Rush Creek show both depletion and mark-recapture estimates. Estimates for Upper Rush Creek were split into estimates for the upper and lower halves of the section. Estimates for both the Lower and Upper Lee Vining Creek sections include separate estimates for side and main channels within each section.

Methods Evaluation

Current Methods

The fish population estimation methods used in 1999 reflect the White Book prepared by the Los Angeles Department of Water and Power (LADWP, 1997). These methods rely heavily on the use of snorkeling to estimate population size. The population estimates derived using snorkeling would be validated using electrofishing. If validation with electrofishing shows that daytime snorkeling does not work, then night snorkeling would be tried. If validation of night snorkeling demonstrates that night snorkeling is not working, it will be abandoned in favor of electrofishing.

Recommendations for Future Sampling

Our 1999 sampling indicated that mark-recapture electrofishing estimates provide the most reliable estimates. We recommend conducting mark-recapture electrofishing estimates in all three sections in Rush Creek and the two sample sections in Lee Vining Creek. We believe that depletion estimates may provide sufficiently reliable estimates for Walker and Parker creeks, but we may need to test the Parker Creek section in 2000 by conducting both a depletion and mark-recapture estimates.

Assumptions of mark-recapture estimates require that marked fish re-distribute within the population at random, or in direct proportion to how the population is distributed and that no movement into or out of the sample section occur. Therefore we recommend blocking both ends of each sample section with hardware cloth fences prior to conducting the marking runs. These fences shall be maintained for at least 6 days between marking and recapture sampling. This time period will allow for good re-distribution of marked fish and fences will prevent fish from moving into or out of sample sections. It may be impossible to block fence the County Road Section of Rush Creek due to its large size and multiple channels. Therefore, we recommend conducting a mark-recapture estimate over a much longer sample section that is not blocked by fences to minimize the impacts of movement at the lower and upper boundaries of the section. We suggest expanding the sample section to start at the road ford and end at the County Road.

Due to the large size of Rush Creek we recommend using a larger generator and electrofishing unit to increase sampling efficiencies. This type of gear would be best transported in a small boat. Using a small boat would also allow for less stress on captured fish as they could be transported in a large live car within the boat. Boat electrofishing capability would provide an opportunity to sample longer sections in upper Rush Creek. Boat electrofishing capability could also improve estimates in the main channel of Lee Vining Creek.

Termination Criteria

Comparison of 1999 Fish Population Estimates to Termination Criteria

The termination criterion for Lee Vining Creek is sustained catchable brown trout averaging 8-10 inches in length with some trout reaching 13 to 15 inches. Our sampling yielded less than 6 brown trout 8 inches or longer per 100 m of stream in the upper sampling reach and less than 7 brown trout 8 inches or longer per 100 m of stream in the lower sampling reach. The Lee Vining trout population does not meet this criterion at this time.

The agreed upon termination criterion for Rush Creek states Rush Creek fairly consistently produced brown trout weighing ¾ to 2 pounds. Trout averaging 13 to 14 inches were also regularly observed. We collected only one brown trout in each of the upper and lower Rush Creek sampling sections that met this criterion. We observed no trout in the county road section meeting them. The Rush Creek trout population does not meet these criteria at this time.

Recommended termination criteria

There is virtually no data available that provides us an accurate picture of the trout populations that these streams supported on a self-sustaining basis prior to 1941. This makes it very difficult to make recommendations for quantitative termination criteria with any confidence that the criteria aren't either too high to ever be attained or so low that they don't truly reflect the capability of the streams to produce trout on a self-sustaining basis.

A technique that is sometimes used when monitoring a fish population that is being affected by some activity is to compare it to fish populations in a another, similar stream that is not subject to the same impacts. Unfortunately this is not a very good option for these Mono Basin streams. The only information available for the region that might be useful is a Survey of Fish Populations in Streams of the Owens River Drainage: 1983-1984 (Deinstadt et al 1985). The authors conducted fish population surveys in 80 sections of twenty-nine streams in the Owens River drainage. Trout were present at 79 of the 80 sections sampled. The streams have a wide range of flow regimes, elevations and impacts. As the name implies, this study was a survey and the one-time population estimates resulting are probably less reliable than would be desirable for our purposes.

Therefore our recommendation is to collect additional fish population data from these streams for several years until we have a suitable amount of data upon which to base additional quantitative termination criteria.

We feel it is necessary to recommend termination criterion that address important social considerations.:

1.Fish population monitoring shall be terminated for any stream that is opened to any level of harvest or if fish stocking is initiated.
2. Fish population monitoring of Lee Vining Creek shall be terminated because the stream has been opened to harvest. If the monitoring is continued, then a creel census study should be conducted to evaluate the effect of harvest on the trout population. If harvest is shown to have a negative effect on the self-sustaining trout population, then the harvest should be stopped or the fish population monitoring terminated.

Finally we recommend that the two existing termination criteria be changed to specifically state they must be met by self-sustaining trout populations.

References

Deinstadt, J.M. D.R. McEwan and D.M. Wong. 1985. Survey of fish populations in streams of the Owens River Drainage: 1983-1984. Inland Fisheries Administative Report No. 85-2. State of California, The Resources Agency, Department of Fish and Game. 102 pp.

EA Engineering, Science and Technology, Inc. 1989. Draft report fish populations in lower Lee Vining Creek 1986-1988. Prepared for Department of Water and Power the City of Los Angeles. 38 pp. plus appendices.

__________________________________. 1990. Draft report fish populations in lower Rush Creek 1985-1989. Prepared for Department of Water and Power the City of Los Angeles. 48 pp. plus appendices.

Hunter, C.J. and B.B. Shepard. 1999. 1997 and 1998 Fisheries Monitoring, Rush and Lee Vining Creek. Prepared for Los Angeles Department of Water and Power. 19 pp.

Los Angeles Department of Water and Power. 1997. White Book. A plan for monitoring the recovery of Mono Basin Streams. Prepared for The State Water Resources Contol Board, Water Right Decision 1631. 26 pp.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin 191. Fisheries Research Board of Canada, Ottawa.

Van Deventer, J. S. and Platts, W. S. Microcomputer software system for generating population statistics from electrofishing data - User's guide for Microfish 3.0. General Technical Report INT-254. USDA Forest Service, Intermountain Research Station, Ogden, Utah.