

NOTES ON THE TROUT FISHERY OF HIDDEN VALLEY LAKE, A COLD WATER IMPOUNDMENT, IN SOUTHWEST VIRGINIA

By ROBERT E. WOLLITZ and JOHN H. JESSE
Virginia Commission of Game and Inland Fisheries

ABSTRACT

Hidden Valley Lake is an acid water, shallow trout impoundment located in southwest Virginia at an elevation of approximately 3,600 feet above sea level.

Renovation of the dam and outlet structures and fish management procedures are discussed.

Subsurface water temperatures and dissolved oxygen values were obtained during the summers of 1965 and 1966. These are discussed in relation to an aeration system installed during the fall of 1965. No definite conclusions concerning beneficial effects on the fishery were arrived at; although dissolved oxygen in bottom waters was higher during the summer in which the aeration system was in operation. The aeration did appear to be effective in removing ice from around the outlet tower.

Rainbow trout, *Salmo gairdneri*, brook trout, *Salvelinus fontinalis* brown trout, *Salmo trutta* were introduced into the lake. Brook trout appeared to achieve a better growth rate than either of the other two species. Evidence of reproduction was found only for the brook trout.

Creel information indicated the brook trout to be more readily taken than either the rainbow or brown trout, as is shown by the increase in rate of harvest in 1968 when brook trout entered the creel in significant numbers.

Trophy size trout were taken occasionally. Rainbow 19-inches in total length and brown trout 21-inches in total length have been reported caught.

INTRODUCTION

Hidden Valley Lake lies in a high mountain valley (elevation—about 3,600 feet above sea level) in southwest Virginia on the Headwaters of Big Prumley Creek. The lake was impounded in 1957 and was to have been incorporated into a large privately owned resort area. The lake was initially stocked with 1,000 brook trout following impoundment. An additional 1,500 brook trout were introduced in 1958. Many of these fish were reportedly harvested by anglers. The resort failed to prosper and in December 1961 was sold to The Virginia Commission of Game and Inland Fisheries. The surface area of the lake is approximately 61 acres. The maximum depth is 24 feet and the average depth is about 15 feet.

Much of the lake basin was formerly swamp which undoubtedly was responsible for the acid (pH, 6.2-6.8) condition of the water. The lake water is very soft and poorly buffered with a total alkalinity of 7-14 parts per million (Table D.)

At the time of purchase, the lake was devoid of fish life and the dam badly in need of repair. In 1963, the lake was drained and renovated. Renovation consisted of the construction of an outlet drain tower into which was incorporated facilities for bottom draw and a 24-inch valve to supplement draining. The dam was reshaped and dressed, and brush and trees were removed from the lake basin. This work was completed in September, 1963 and the flood gate closed.

In January, 1964, when the lake was approximately one-half filled with water, about 20 inches of ice formed on it. With continued filling, the ice moved the tower enough to break the 24-inch concrete outlet pipe.

The lake was again drained completely in the spring of 1964, the outlet pipe repaired, and the lake refilled with water during the following fall and winter (1964).

Initially the lake was to have been managed as a put, grow, and take trout fishery. In this type fishery, sub-adult (5-10 inches) trout are introduced, allowed to grow to a designated size, then harvested. A 10-inch minimum size limit was adopted to allow trout to grow to a desirable size. Angling was restricted to the use of artificial lures and barbless hooks to prevent the introduction of exotic species and to reduce the harvest. A creel limit of five fish per day was imposed, also to reduce the harvest.

Since spawning facilities in Brumley Creek upstream from the lake appeared to be limited and the trout stocked were fall spawning rainbow, it was doubted that the fishery could be maintained through natural reproduction. Thus, plans were made to carry out supplemental introductions of sub-adult rainbow trout yearly.

The low pH (6.2-6.8) indicated that Hidden Valley Lake might provide a more suitable brook trout habitat than a rainbow trout habitat. Thus, in May, 1966, brook trout were introduced into the lake. They survived and grew well, and later observations indicated Brumley Creek could provide adequate facilities for brook trout reproduction, at least during periods of normal or above normal rainfall. During periods of little or no rainfall, observations indicated stream flow to be inadequate for trout to ascend the creek for spawning purposes.

The introduction of brook trout brought about a change in management. Rather than rely on yearly introductions of sub-adult rainbow, it was decided to study the ability of the resident brook trout to maintain the fishery through natural reproduction.

TEMPERATURE—OXYGEN CONSIDERATIONS

Temperature and dissolved oxygen determinations were made at five foot depth intervals in Hidden Valley Lake twice monthly from July through September, 1965 and June through September 7, 1966. Water temperatures did not exceed 74 degrees F. at the surface and at the five foot depth during 1965, being usually 72 degrees F. or less (figure 1). Thermal stratification was first noted on July 7, 1965. Temperature declined from 72 degrees F. at the ten foot depth to 60 degrees F. at fifteen feet and to 56 degrees F. at 20 feet. After the first of August, water temperatures began to gradually cool, becoming nearly uniform from top to bottom by early September.

Dissolved oxygen was usually seven ppm or higher in the upper ten feet of water, except for July 26 when it dropped to four ppm at ten feet (figure 1). Below ten feet, dissolved oxygen ranged from two to ten ppm, being usually less than five.

During the fall of 1965 an aeration system was installed in the lake in an attempt to provide more desirable water quality and to prevent ice from freezing around the outlet tower and damaging it. This system consisted of two units (Figure 2). Each unit consisted of an oil-less compressor connected to 750 feet of perforated aeration hose by 250 feet of nonperforated hose. Each unit was laid out in an approximate circle on the bottom of the lake adjacent to each other (figure 2). One unit surrounded the outlet tower and the other was adjacent on the upstream side.

The system was operated continuously, except for a brief period in the fall of 1966, for one year. After approximately one year of operation both oil-less compressors suffered burned out bearings and had to be replaced.

Summer depth profiles of temperature and dissolved oxygen were again determined in 1966 to evaluate the aeration system. Water tem-

peratures and thermal stratification were similar to those of 1965 although, temperatures averaged slightly warmer (about 2 degrees F.) (figure 3).

Dissolved oxygen in the entire lake appeared to be somewhat improved over that of 1965 (figure 3). Dissolved oxygen in the upper 15 feet of water was usually 10 ppm except for July 13 and 27 when it declined to three and four ppm at the 15-foot depth. At the 20-foot depth dissolved oxygen was 10 parts per million at all times except for three occasions—June 16, July 13 and 27. On these dates it was 5, 0, and 2 ppm respectively.

Comparisons of depth profiles of temperature and dissolved oxygen during 1965 and 1966 indicates that water temperatures were slightly warmer in 1966 and that dissolved oxygen concentrations of 10 ppm were encountered more frequently at greater depths in 1966 than in 1965. These differences may have been the result of the aeration systems but they also may have been only natural variations. Future depth profiles of temperature and oxygen may clarify this.

Observations were conducted during the winters of 1965-66 and 1966-67 to determine the effectiveness of the aeration systems in preventing the formation of ice cover. During the winter of 1965 and 1966 no ice cover was noted in the vicinity of the aeration systems. Ice cover did form on other portions of the lake. The systems were not in continual operation during the winter of 1966-67. However, on one occasion during this period, ice formed around the outlet tower. One compressor was put in operation and after a period of 24 hours, ice cover had melted around the tower. The remainder of the lake remained frozen.

FISH POPULATION

On January 21, 1965, 5,000 rainbow trout *Salmo gairdneri* were introduced into the lake. These fish ranged from five to ten inches, total length, and averaged 7.6 inches. At the same time, 500 brown trout *Salmo trutta* were introduced into Big Brumley Creek below the lake. A few of these brown trout were inadvertently introduced into the lake, as was later revealed by creel records. The next introduction occurred on December 29, 1965. At this time 700 rainbow fingerlings were stocked. Lengths were not recorded for these fish but they are believed to have been approximately the same size as those stocked previously. On May 6, 1966 the last substantial stocking of trout took place. On this date, 41,186 2-3 inch brook trout *Salvelinus fontinalis* were introduced.

Fish population samples were taken at infrequent intervals by means of gill nets and hook and line to note the growth of fish stocked (table 2). On March 17, two, 24-hour gill net sets were made with 200 feet each of one and one and one-half inch gill nets. A total of 17 rainbow trout were taken in the one inch net. These fish ranged from 8-9 inches in length (table 2) and averaged 8.0 inches. No fish were taken in the one and one-half inch net. On June 3, 1965, two additional 24-hour gill net sets were made. A total of 18 trout were taken in these sets, but only in the one inch net. Lengths of these fish ranged from 8-10 inches and averaged 9.0 inches. Thus, the indicated growth during the five months these fish were in the lake was one and one-half inches (January, 1965—June, 1965).

Population samples were next taken in March, 1966, by means of gill net and by hook and line. Gill net samples indicated very little growth since sampling in June, 1965. However, hook and line samples showed fish ranging in length from nine to twelve inches. They averaged 10.5 inches indicating an average growth of one and one-half inches during the nine months following the last sample; and three inches during their 14 month stay in the lake following stocking.

Following the introduction on 2-3 inch brook trout in May, 1966; observations were made to note the growth of this species. Observations

from anglers creels indicated these fish to range in length from 4-5 inches by September, 1966. Hook and line population samples were taken on August 29, 1967. A total of 19 brook trout and one rainbow were obtained. The brook trout ranged from 7-9 inches and averaged about 8 inches in total length (table 2). This represents an average growth of 5-6 inches during the 16 months they were present in the lake. Population samples were again taken on August 20, 1968 by means of gill nets. A total of 21 brook trout and one rainbow were taken. The brooks ranged in length from 9-11 inches and averaged 10 inches, indicating an average growth of two inches during the year following the last sampling date and 7-8 inches during their 28 month stay in the lake. The only rainbow caught was 13 inches in length.

Determinations of sex and maturity were made from seven brook trout taken from the August, 1967 population samples. Five of these fish appeared to be mature males and two were mature females. From this, it was assumed that spawning would take place that fall. During the latter part of October and early November brook trout spawning activity was noted in Big Brumley Creek, upstream from the lake. On several occasions during this time nests were observed with adult trout nearby or over the nest. No actual spawning was observed; however, on one occasion a nest was examined and viable eggs found in it. The following spring, observations and seine hauls in the creek revealed numerous young of the year trout, indicating that successful reproduction had taken place. The brook trout were of two size groups; the largest group were about one inch in length and the smaller group approximately 2.0 - 2.5 inches in length; indicating an early and a late spawn.

CREEL SURVEY

During April, 1966, a daily creel survey was conducted by a creel clerk stationed on the only access road leading to the lake. Creel was conducted during May and June in the same manner but only on four weekend days each month. Creel information obtained during the remainder of the summer was voluntary. Voluntary creel stations were established in two locations; one was located at a heavily used area on the lake and the other was adjacent to the access road leading from the lake. At each station a mailbox with a measuring board attached was nailed to a tree. Information, calling attention of the anglers, was printed on the side of each mailbox. Creel cards and a pencil were placed in each mailbox. Information on brown trout is not included because of the relatively small number reported caught (57 over the three year period).

During April, 1967, a daily creel was again taken as in 1966. The hours the creel clerk worked were adjusted so as to insure an equal amount of effort expended during morning and afternoon during both years the creel clerk was employed. During the remainder of the summer of 1967 and during the entire summer of 1968, creel information was of the voluntary type.

A total of 520 angler trips were recorded during April, 1966. The average time spent fishing was 2.8 hours per trip. A total of 351 Rainbow were taken, all of which were legal trout (over 10-inches). During April, 1967, 279 angler trips produced 687 rainbow, brown and brook trout of which 586 were released, presumably as sublegal brook trout (under 10-inches). Harvest rates declined from 0.22 trout per hour in April, 1966 to 0.13 in 1967 (table 3).

Weekend creel data obtained during May and June, 1966, indicated angler trips to be somewhat longer during these two months (3.2 and 3.6 hours respectively) than during April (2.8 hours). This may have been due to the lack of weekday data but is more likely an actual increase in time spent fishing. April data show little difference between weekday and weekend days with respect to the length of fishermen trips. Rate of harvest during May remained the same as in April (0.22) but declined to 0.10 in June.

Voluntary creel data was obtained July through October, 1966; May through October, 1967; and April-October, 1968. During the four month period in 1966, data from 88 valid angler trips were obtained (table 4). These 88 trips produced 385 trout of all species of which 118 were released, presumably as sublegals. Time spent fishing averaged 4.3 hours per trip, somewhat longer than April and May trips (2.8 hours). During the six month period in 1967 in which voluntary creel information was obtained, 47 angler trips were recorded which produced 491 trout of which 390 were sublegal. The average time spent fishing per angler trip was 4.1 hours, similar to that of 1966. A total of 168 angler trips were recorded in a seven month period during 1968. Each trip lasted an average of 3.3 hours. This was slightly less than that recorded in 1966 and 1967, probably due to the inclusion of April angler trips which have been shown to be shorter than those of other months. During this period 563 trout were caught of which 128 were released as sublegals.

Rate of harvest varied during the three years in which voluntary information was obtained. This rate varied from 0.69 trout per hour in 1966 to 0.53 during 1967 and 0.76 during 1968. This variation was thought partly due to the different length of time in which data was taken during each year. More important, however, was the apparent variation in numbers of legal sized fish available to the angler. During 1966, the population of legal sized rainbow and brown trout was reduced considerably by angling and no introductions were made to replace those removed. Thus, considerably fewer legal sized fish were available to the angler in 1967.

Although the rate of harvest of legal fish declined in 1967, the overall rate of catch increased (1966—1.0 trout per hour, 1967—2.6 trout per hour). This appeared to be the result of the large population of sublegal brook trout (stocked in May, 1967) entering the fishery. By 1968, however, these brook trout were being taken in large numbers as legal trout and the harvest rate correspondingly increased from 0.53 trout per hour in 1967 to 0.76 in 1968, and the overall catch rate (legals and sublegals combined) decreased to about 1.0 fish per hour, as it was in 1966.

The apparent replacement of rainbow trout by brook trout in the creel is indicated by length frequency records of creeled fish (figure 4 and 5). The 1966 and 1967 data is somewhat biased because of the more complete data obtained by the creel clerk for the month of April of each year. This bias is not thought to be important to the overall picture, however. The catch of 10, 11 and 12 inch rainbow during 1966 is the highest for any year in which creel information is available. This high harvest of legal fish is also reflected in the catch rate as has been mentioned. After 1966, the number of rainbow larger than 10-inches in the creel decreased steadily through 1968. At the same time legal rainbow were on the decline, legal brook trout were becoming increasingly abundant in the creel (figures 4 and 5.) Legal sized rainbow decreased from 493 in 1966 to 99 in 1967 to 66 in 1968. During the same periods, legal brook trout increased in number from 18 in 1967 to 271 in 1968. Although legal rainbow trout decreased in number from year to year; they increased progressively in size (figure 4). Maximum length of rainbow creeled increased from 14-inches in 1966 to 16-inches in 1967 and to 19-inches in 1968. Maximum lengths of brown trout also increased from year to year. The largest brown trout reported caught was 21-inches in length.

This length frequency information indicates the basic aims of this lake are being met. These are to provide quality angling for wild trout as opposed to a put and take fishery. The harvest of 14-21 inch trout is considered quality angling and the availability of the sublegal brook trout in the fishery adds another dimension—fish for fun for small trout.

ACKNOWLEDGMENTS

Appreciation is expressed to Mr. E. W. Surber for critically reading the manuscript.

TABLE 1. Water Chemistry from Hidden Valley Lake

Date	Depth	pH	Total Hardness	Total Alkalinity	Phenolphthalein Alkalinity
9-10-63	Surface	6.2	17 ppm	20.4 ppm	6.8 ppm
6- 4-65	Surface	6.8	17.0 ppm	14.0 ppm	
7- 7-65	Surface	6.8	17.0 ppm	6.8 ppm	0
6- 1-66	Surface	6.2	17.0 ppm	13.6 ppm	0
6-16-66	Surface	6.3	17.0 ppm	6.8 ppm	0
	Bottom	5.8	17.0 ppm	6.8 ppm	0
7-13-66	Surface	6.8	17.0 ppm	20.4 ppm	0
	Bottom	6.3	17.0 ppm	54.4 ppm	0
7-27-66	Surface	7.5	17.0 ppm	6.8 ppm	0
	Bottom	6.5	17.0 ppm	40.8 ppm	0
8-10-66	Surface	6.9	17.0 ppm	20.4 ppm	6.8 ppm
8-25-66	Surface	6.5	17.0 ppm	20.4 ppm	6.8 ppm
9- 7-66	Surface	6.5	17.0 ppm	20.4 ppm	0
	Bottom	6.3	17.0 ppm	20.4 ppm	0

TABLE 2. Length Frequency of Brook and Rainbow Trout Taken in Population Samples—1965, 1967, 1968.

	LENGTH						
	7	8	9	10	11	12	13
RAINBOW:							
Gill Net—3/17/65	..	12	5	..	..	..	..
Gill Net—6/3/65	..	3	8	7	..	..	..
Gill Net—3/4/66	..	1	6	9	..	..	..
Hook and Line—3/16/66	1	8	10	1	..
Hook and Line—8/29/67	1	..	..
Gill Net—8/20/68	1
BROOK:							
Hook and Line—8/29/67	4	13	2	..	..	..	..
Gill Net—8/20/68	3	16	2	..	..

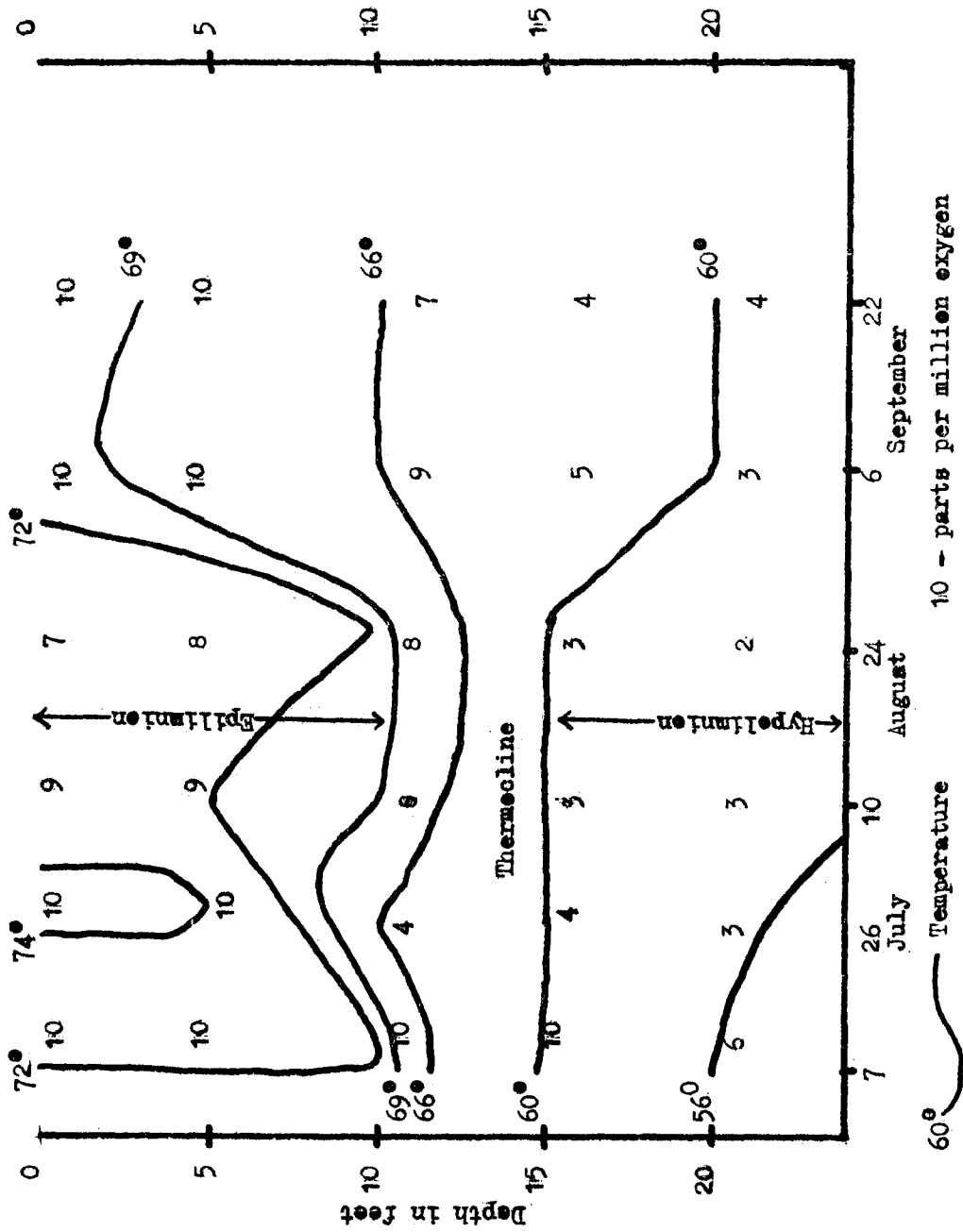
TABLE 3. Hidden Valley Creel Survey—April 1966 and 1967.

	1966	1967
Number Anglers	520	279
Number Hours Fished	1,469	761
Hours Per Angler	2.8	2.7
Number Trout Caught	351	687
Number Trout Released	28*	586
Trout Creeled Per Hour	0.22	0.13
Number Parties Checked	204	127
Number Parties Successful	79	35
Per Cent Successful Parties	38	27

* Released fish not recorded prior to April 16, 1966.

TABLE 4. Voluntary Creel—July—October, 1966, May—Oct. 1967 and April—October, 1968

	1966	1967	1968
Number Anglers	88	46	168
Number Hours Fished	387	190	568
Hours Per Angler	4.3	4.1	3.3
Number Trout Caught	385	491	563
Number Trout Released	118	390	128
Trout Creeled Per Hour	0.69	0.53	0.76



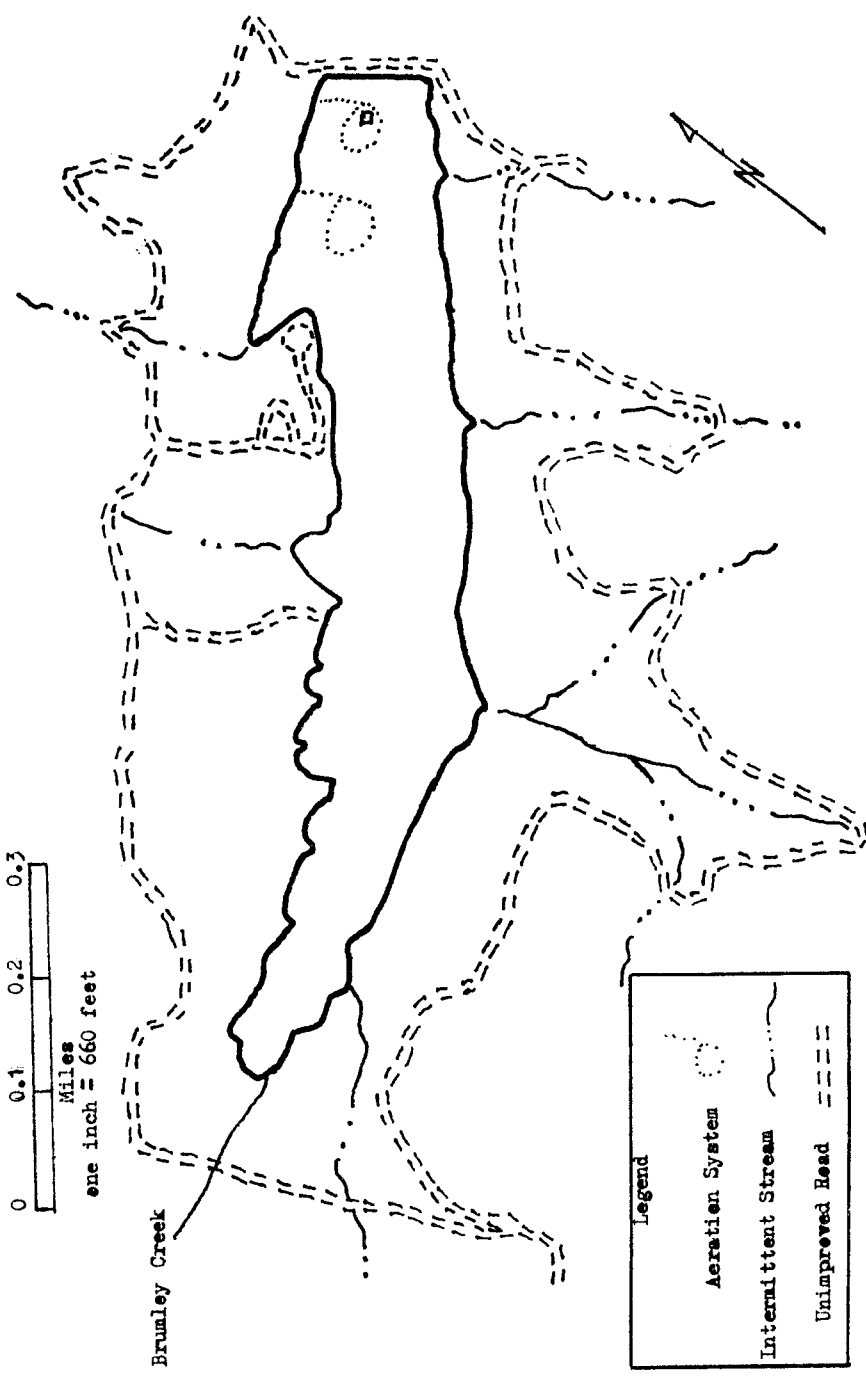


Figure 2. Hidden Valley Lake showing road, inlet streams and aeration system.

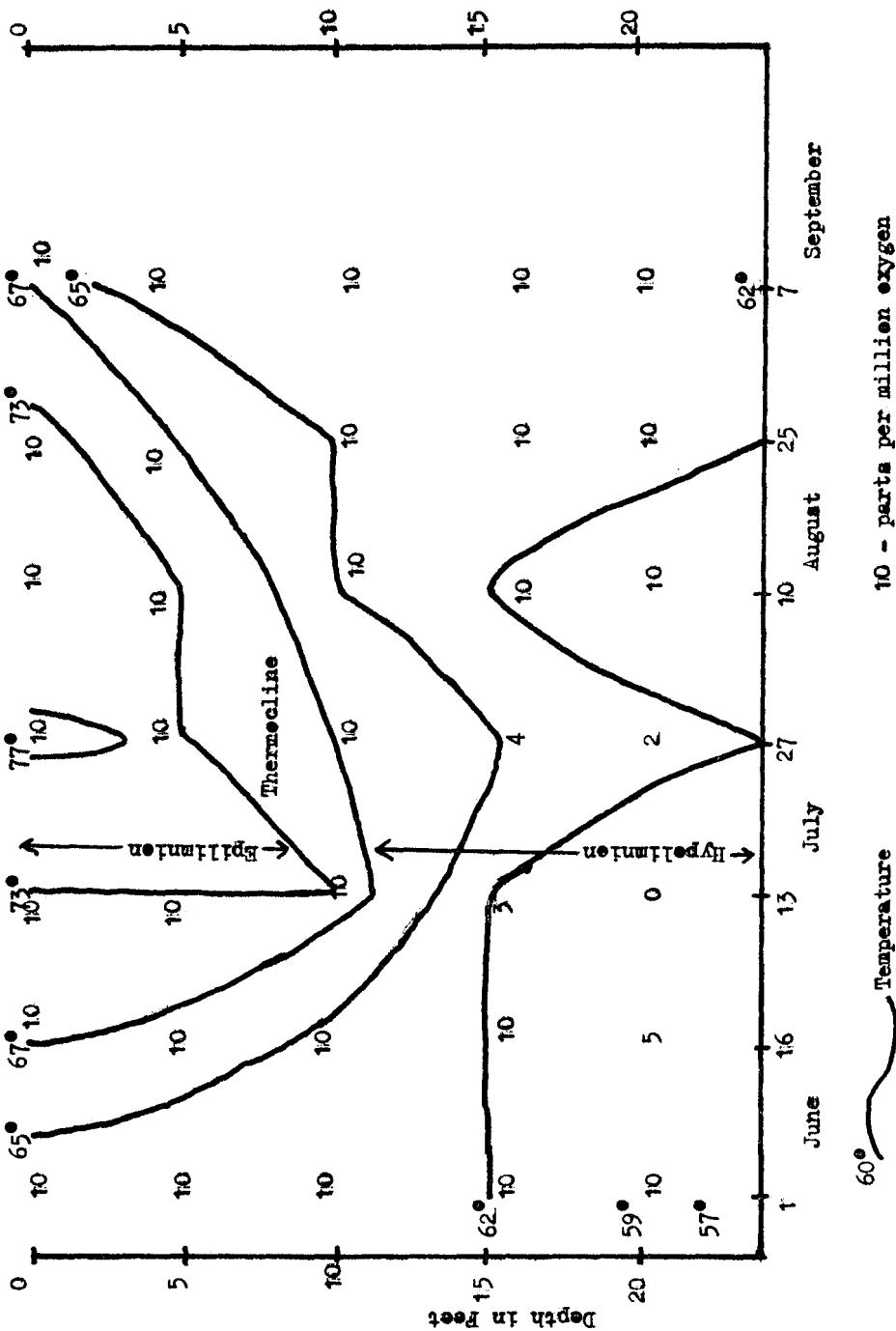


Figure 3. Temperature and oxygen conditions in Hidden Valley Lake, June - September, 1966.

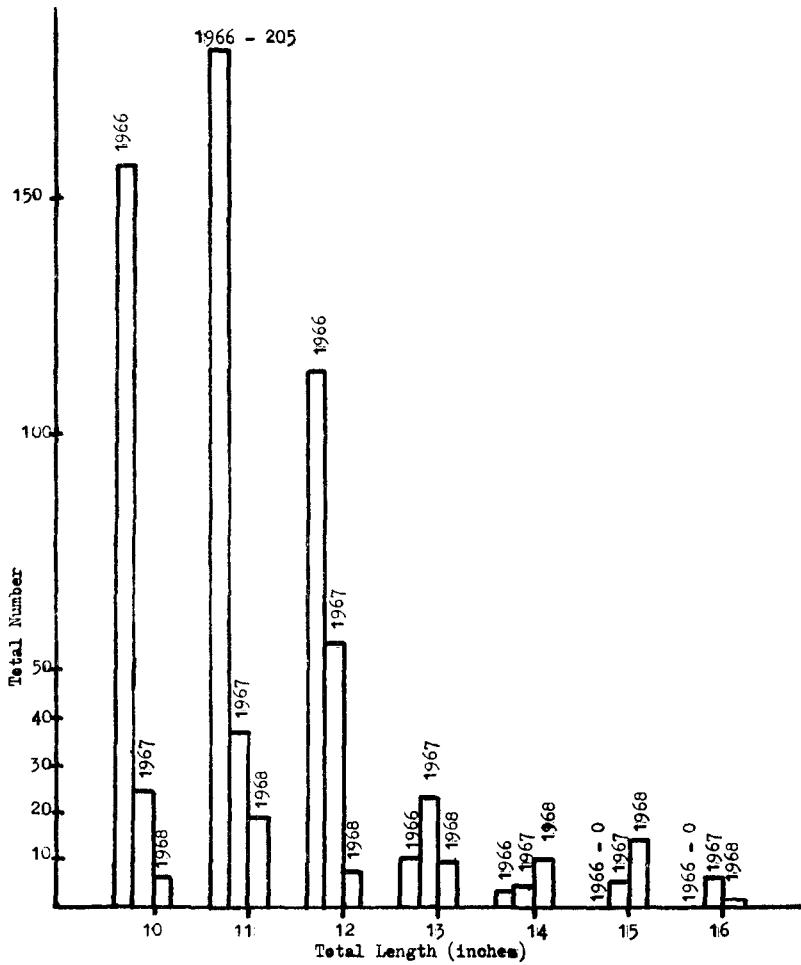


Figure 4. Length frequency of rainbow trout - 1966, 1967, 1968.

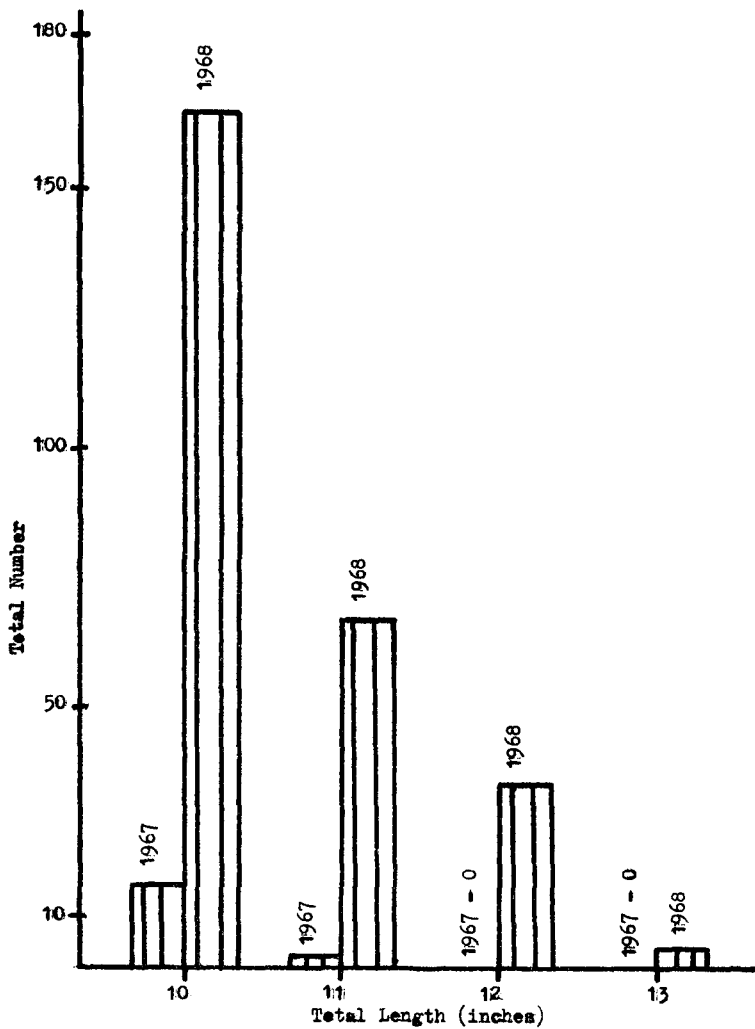


Figure 5. Length frequency of brook trout - 1967, 1968