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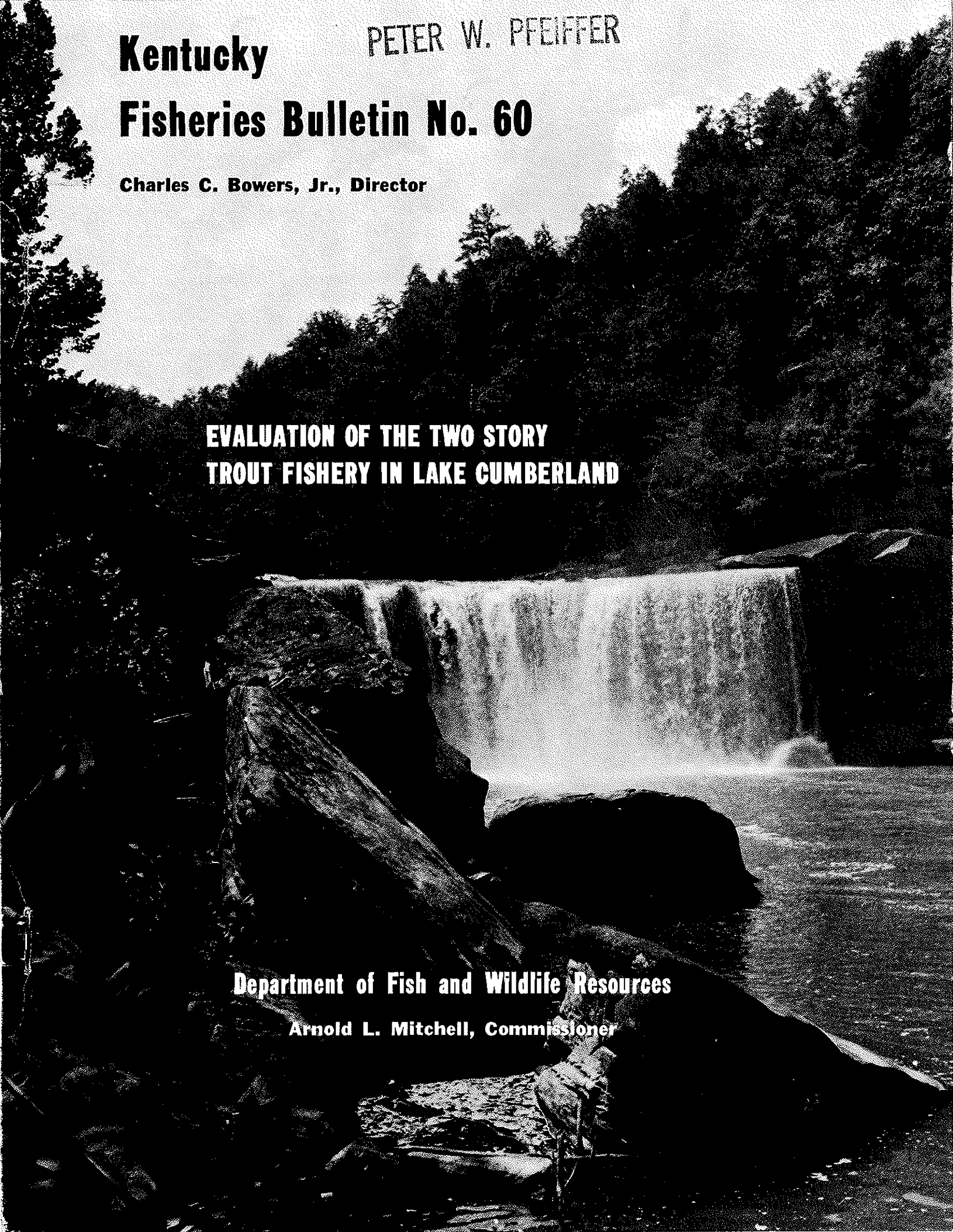

EVALUATION OF THE TWO STORY TROUT FISHERY IN LAKE CUMBERLAND

Department of Fish and Wildlife Resources

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EVALUATION OF THE "TWO-STORY" TROUT FISHERY IN LAKE CUMBERLAND

by

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C O N T E N T S

A B S T R A C T

Lake Cumberland has been stocked with rainbow trout (Salmo gairdneri Richardson*) since 1962. A "two-story" trout fishery has been established in the lower section of the lake, but with marginal success. Trout have adequate habitat, and forage, in the form of threadfin shad, Dorosoma petenense* (Günther)*, throughout the year. When stocked at 203 mm (8 in), trout approximately doubled their length and increased their weight tenfold. The vertical distribution study revealed that trout were most active from 4 pm to midnight during the summer months. It was during this period, particularly between sunset and midnight, that a majority of the trout were sought after and caught. The best year for trout fishing during the investigation was in 1969, when trout were harvested at a rate of 0.16 fish per hour from May through September.*

As the water temperatures increase during the summer, trout have a tendency to seek lower depths. The depths that trout prefer are primarily dependent upon water temperature. During the distribution study, the greatest frequency of occurrence for trout was between 59° and 63°F. The greatest depth at which a trout was captured was 73 feet in August of 1972.

The two major problems encountered in developing the trout fishery in Lake Cumberland are the loss of trout by predation, and escapement through the discharge at the dam. By stocking trout that average 230 mm (9 in) in length, most of the predation by black basses can be avoided. Results of the predation studies indicated that black basses utilized trout that were less than 203 mm (8 in) in length. Whether the stocking of 230 mm trout will also reduce predation by striped bass, Morone saxatilis (Walbaum)*, is questionable. To minimize the escapement of trout through the dam, trout should be stocked a safe distance from the dam, preferably at*

Ramsey's Point (20 miles above dam). A more suitable stocking location would be at Rowena Ferry (4.5 miles above dam), but the lake is being held at least 23 feet below normal summer pool through 1979 in order to repair the dam. A greater-than-normal annual discharge is anticipated to keep the lake at this lower level, so Ramsey's Point appears to be a more appropriate stocking site until the dam is repaired.

The stocking date, either October or February, had an enormous effect on the harvest. Trout stocked in February contributed more to the catch than did the October stocking every year between 1969 and 1972. In 1971, returns from the February stocking outnumbered returns from the October 1970 stocking by a ratio of 74:1. Since 1971, trout have been stocked in either late January or in February.

A re-evaluation of the trout fishery in Lake Cumberland should be made after the fishery has been given at least three years to develop following the recommendations described.

INTRODUCTION

Lake Cumberland, a U.S. Army Corps of Engineers' lake designed primarily for flood control and power, was created by the impoundment of the Cumberland River in 1952. When at the normal summer pool of 22.0 m above msl (723 ft above msl), the lake has a surface acre of 20,335 ha (50,250 a) and contains 4.93 x 10^9 m^3 (4 million a-ft) of water. The lake is approximately 162.5 km (101 mi) long and has an average depth of 27.4 m (90 ft). The theoretical water exchange rate for Lake Cumberland at 723 ft msl is 225 days.

A sufficient amount of "winter-stored" water having temperatures and dissolved oxygen concentrations suitable for trout exists in the lower section of the lake throughout the year. Rainbow trout *(Salmo gairdneri* Richardson*)* have been stocked yearly in Lake Cumberland since 1962 (Table 1) in an attempt to develop a "two-story" trout fishery. Since 1967, 170-260 mm (6.6-10.1 in) trout have been stocked, primarily in October and/or February. The "Lake Cumberland Trout Studies" project was undertaken in 1967 to document trout habitat, distribution, growth and longevity, and contribution to the sport fishery. In addition, a vertical distribution study of rainbow trout and threadfin shad, *Dorosoma pentenense* (Günther), was conducted in 1971 and 1972.

METHODS

Trout habitat in Lake Cumberland was defined by using criteria of $\leq$ 21.1C (70F) and $\geq$ 4.0 mg/l (4 ppm) dissolved oxygen. Temperature and oxygen profiles were determined with a Yellow Springs Instrument Model 51 oxygen-temperature meter at 15 stations, biweekly from April through October, 1968-70.

In 1967, inaccurate temperatures were taken with a telethermometer that was insensitive to temperature change; data collected that year were disregarded. Water quality data for 1968 are also omitted because abnormal water conditions were created when the lake was drawn down 13.1 m (43 ft) below summer pool to repair a leak in the dam.

The surface area of trout habitat was estimated by measuring the area with a planimeter on a preimpoundment topographic map. Area was multiplied by average depth of the trout pool to estimate the volume of habitat available.

Tributary streams were sampled for trout each month from November through March, 1967-71. Sampling areas were blocked off at the lower end with a block net and were treated with sodium cyanide. Trout were measured to the nearest 0.1 inch and weighed to the nearest 0.01 pound. Scale samples were taken and fin-clipped trout noted.

Operators of four boat docks in the lower section of the lake kept records of trout crossing their docks throughout the year from 1967 through 1971. Trout were measured, inspected for clipped fins, and recorded as to the date of capture.

A systematic creel survey was designed to determine the trout harvest in Lake Cumberland. The survey area extended 1.6 km (1 mi) above the dam and represented the area considered to include nearly all of the trout fishing pressure.

The survey was scheduled from September 1967 through May 1968 and from December 1968 through March 1969. A 12-hour day represented one day of fishing, beginning at 7 am (CDT) and ending at 7 pm. Each census day was divided into six 2-hour periods. One 2-hour period was surveyed each census

day, during which time total counts were recorded and as many fishermen interviewed as time allowed. Each weekday was sampled monthly, while each weekend day was sampled twice each month.

The boat dock survey during 1967-68 revealed that most of the trout were being caught during the summer months at night. Consequently, the systematic creel survey in 1969-73 was scheduled at night from May through September.

This survey was based on a 6-hour day, starting at 9 pm (CDT) and ending at 3 am. A census day was divided into two 3-hour periods. One 3-hour period was worked each census day during which time each fisherman was interviewed: the number of interviewees represented the total count. Creel data from the 1967-73 surveys were compiled to determine fishing pressure, angler success, and trout catch. Data were projected by using the mean count method (Lambou, 1962).

The trout catch during the winter months was estimated by surveying the lower sections of four tributary streams--Gross Creek, Fall Creek, Greasy Creek, and Caney Creek--where fishing pressure for trout was regarded to be greatest. These streams were surveyed between November and March, 1970-72. A fishing day was equivalent to the daylight hours of 8 am to 4 pm CST.

The four streams were paired so that one pair would be surveyed each census day. Four weekdays and 1 weekend day were scheduled per week. Each stream was surveyed on 4 weekdays and 1 weekend day during each 2-week period. To estimate the total pressure and catch from the 4 streams in 1 day, the effort was estimated by the product of the average count per survey hour and

32 (32 = 8 hours of fishing x 4 streams). The total catch equaled the total pressure x rate of success (trout per hour). The catch for 1 week was estimated by multiplying the catch during the 4 weekdays by 1.25 and adding this to the product of the catch of 1 weekend day and 2.

Trout stocking sites at Ramsey's Point and Rowena Ferry were electrofished with a 230-volt AC, 180-cycle electroshocker the first or second night after trout were stocked to learn if predation on trout was occurring.

Growth of trout was estimated from fin-clipped trout returns from the tributary studies and creel surveys. Scales were collected from the left side of a trout between the anterior edge of the dorsal fin and above the lateral line. The mean monthly growth rate of marked trout was estimated by subtracting the average length of trout at the time of stocking from the length of the fish at capture and then dividing the remainder by the number of months the fish inhabitated the lake.

Eight vertical gill nets were fished weekly in Lake Cumberland from June 30 through October 1, 1971, and from May 3 through September 15, 1972, to determine the vertical distribution and activity of rainbow trout and threadfin shad. The netting station was located in pelagic water approximately 0.8 km (0.5 mi) above the dam (Fig. 1). Each net was 2.4 m (8 ft) long and 45.7 m (150 ft) deep. Two 1-inch, two 1 1/2-inch and two 2-inch mesh nets were selected to catch trout, while two 1/2-inch mesh nets were chosen to catch threadfin shad. A 3.0-m (10-ft) long, 98-mm (4-in) diameter aluminum pipe functioned as a floatation chamber and roller for each net. All eight rollers and nets were snapped to a common guide rope that was attached to a buoy at each end (Fig. 2). To avoid entanglement during high winds, nets were positioned 6.1 m (20 ft) apart.

Nets were arranged, according to mesh size, in the following order: 1/2" (nets #1 and #2), 1" (nets #3 and #4), 1 1/2" (nets #5 and #6), 2" (nets #7 and #8). As each net was lowered to the lake bottom (34.4 - 38.1 m), 2.4-m (8-ft) long, 25-mm (1-in) diameter aluminum rods (spreader bars) were attached to the nets horizontally at 9.1-m (30-ft) intervals.

Nets were fished weekly from 8 am on Wednesday (CDT) to 8 am on Friday. Fish activity was determined by pulling the nets every 8 hours. The side ropes of each net were calibrated in one-foot intervals to determine the depth of fish capture.

Species, total length (to the nearest 0.1 inch), and depth of capture were recorded for each fish that was netted. The catch of each net was recorded separately. In addition, trout were weighed, checked for clipped fins, and their stomach contents visually identified. At the end of each 24-hour netting period, temperatures and dissolved oxygen concentrations were recorded at 1.5-m (5-ft) intervals and at the depths fish were netted.

TROUT HABITAT

Water temperatures and dissolved oxygen (DO) concentrations meet the criteria selected for trout habitat $\leq$21.1 C and $\geq$ 4 mg/l DO, throughout Lake Cumberland from November through April. The lake becomes thermally stratified in May and during the following 4 to 5 months the uplake limit of the trout habitat progressively descends toward the dam as the average depth of the trout pool is reduced. By September, the pool approaches minimal dimensions.

In 1969, trout habitat was minimal during the beginning of September. At this time, the trout pool extended approximately 29.0 km, (18.0 mi) above the dam and averaged nearly 25.9 m (85 ft) thick (Fig. 3). This area had an area

of at least 4127 ha (10,197 a) with a volume of 10.6 m^3 x 10^8 (862,700 a-ft) (Table 2).The 4 mg/l oxygen layer descended toward the dam once in the region of trout habitat, while water temperatures were above 21.1 C (70 F) in the epilimnion and upper few feet of the metalimnion (Hutchinson, 1957).

In 1970, the latter part of September was the most critical period for trout in regard to area of suitable habitat: the period of minimal volume of trout water did not occur until the first part of October. The trout pool extended only 25.1 km (15.6 mi) above the dam in 1970 and had an average thickness of 21.9 m (71.7 ft) in late September (Fig. 3), while the surface area of the pool encompassed 3253 ha (8039 a) (Table 2). By the first part of October, the pool of"winter stored"water was only 17.1 m (56 ft) thick and contained 5.6^3 x 10^8 (452,600 a-ft) compared to 7.1 m^3 x 10^8 (567,400 a-ft) two weeks earlier.

T R I B U T A R Y S T R E A M S T U D I E S

Many of the tributary streams entering the lower section of Lake Cumberland are frequented by trout from November through March (Table 3). Trout were captured from eight of ten streams during this period in the 1967-71 studies (Fig. 1). Because of frozen stream conditions often encountered in January, few trout were captured during the January studies. Most of the trout found in the tributary streams during November, December, and February, originated from the October and February stockings. Resident trout were attracted to streams in March, as is indicated by the average weight of 538.7 g (1.19 lb) for trout captured that month, compared to 258.0 g (0.57 lb) or less for trout captured during other months.

More than half of the trout (117 of 209) captured during the tributary studies came from Fall Creek (Table 4). Trout concentrated in the lower section

of Fall Creek, below a waterfall, where they were very susceptible to capture. Trout were often prevented from entering Greasy, Gross, and Lily creeks by the presence of waterfalls, which became a barrier at certain lake elevations.

TROUT HARVEST

Boat Dock Survey

After the first two years of the survey, considerable difficulty was encountered in obtaining accurate catch records from the boat dock operators. Although these data were obtained sporadically, information of some value was gained from the survey. More than three-fourths of all trout creeled were brought to the docks between April and August, with May being the most productive month (Table 5). Trout fishermen concentrated their efforts near the dam at night from May through September, but found success during the remainder of the year in the tributary arms and streams entering the lower half of the lake.

The length of creeled trout varied from 229 to 559 mm (9-22 in) in 1971 to 203 to 661 mm (8-26 in) in 1967 (Table 6). There was a gradual decrease in mean length from 1967 (473 mm) to 1971 (305 mm), with the exception of 1970 when trout averaged 419 mm. A large part of the 1970 catch was contributed by fish from the October 1968 and February 1969 introductions.

Systematic Creel Survey

Findings from the stratified survey compared with results of the boat dock survey in respect to preference by trout fishermen to fish near the dam at night during the summer months (Table 7) and the fact that trout anglers enjoyed their greatest success in May (Table 8). Of the five years that the

nighttime survey was conducted, 1969 was the best year for catching trout. The catch rate that year (9 pm - 3 am, May-Sept.) was 0.16 trout per hour, while the expanded catch was 3882 trout.

(a) Stocking Date

One reason for such a good catch in 1969 can be contributed to the stocking of trout in February for the first time (Table 1). Trout had primarily been stocked in October prior to 1969.

A comparison can be made of the October 1968 and February 1969 stockings to illustrate the significance of the February stocking. During the 1969 survey, 205 of the 239 marked trout recorded were from the February 1969 stocking (Table 9); the remaining 34 belonged to the October 1968 stocking. Returns from the February stocking consistently outnumbered returns from the October stocking during each of the survey months. The success of the February stocking is even more outstanding when considering the fact that more trout were fin clipped (25,000) of the October 1968 stocking than of the February 1969 stocking (17,500). Returns form the February 1969 stocking were even greater than the October 1969 stocking during the 1970 survey (Table 10). No trout were stocked in February 1970; consequently, the trout declined considerably.

Trout stockings were discontinued in October after 1971. Although trout were stocked in February from 1971 through 1973, the trout fishery continued to decline. The February stocking did, however, contribute to the creel better than the October stocking in 1971 and 1972 by a ratio of 74:1 and 11:2, respectively, to substantiate the merits of a February stocking (Tables 11, 12).

(b) Stocking Location

In addition to the date of trout release, stocking location was also evaluated. Trout were marked and released at Ramsey's Point, 32.2 km (20.0 miles) above the dam, and at the dam in February 1972 (FIg. 1). In 1973, one lot of trout were fin-clipped and stocked at the dam. Another group of unmarked trout were stocked at Rowena Ferry, 7.2 km (4.5 miles) above the dam.

Trout stocked at the dam in 1972 entered the catch in greater numbers than the Ramsey's Point stocking by a ratio of 9:2 (Table 12). A similar comparison of returns (3:1) from the two stocking sites was encountered during the vertical distribution study which is discussed later in "The Vertical Distribution and Activity of Trout."

The expanded catch during the 1972 survey was 110 trout (Table 8), the lowest catch since the nighttime survey was initiated in 1969. Some of the trout--particularly those stocked at the dam--were speculated to have escaped through flood gates that were opened from February 28 to March 13. The extent of escapement could not be determined, but six trout that had originally been stocked near the dam were captured in the tailwater in June as a result of 9 hours of electrofishing.

There were few trout caught during the 1973 survey, as a total catch of only 8 trout was projected. Heavy rain in May may have been instrumental in causing such a low trout harvest. Flooding conditions downstream from the dam restricted the U. S. Army Corps of Engineers from releasing water below the dam for a period of about 2 weeks. The spillway crest of 22.0 m above msl (723 ft. msl), which is the normal summer pool elevation, was not achieved until July 16. This was at least 2 months later than when summer pool had been reached since the trout studies project was initiated in 1967. Many of

the trout that were stocked at the dam and Rowena Ferry were assumed to have been lost through the discharge. Because of the vulnerability of trout to escape from the lake when stocked at the dam, this location will no longer serve as a releasing point. A more preferable stocking site would be Rowena Ferry. This location was the site for stocking trout between 1964 and 1967, when trout fishing was reported by local fishermen to have been better than it has been since. A systematic survey will be scheduled 3 or 4 years from now to evaluate the trout fishery when it has had time to develop to a maximum potential through the implementation of management practices based on recommendations described in this report.

Tributary Creel Survey

An estimated 334 trout entered the creel during the November 1970-March 1971 tributary survey at a catch rate of 0.12 fish per hour (Table 13). The highest catch rate occurred in December (0.21 trout per hour), yet more trout were creeled in March, when the man-hours expended were greatest. Of 369 fishermen interviewed, 364 were fishing for trout; 10.6% were successful.

The stocking dates for 37 of the 62 trout recorded during the survey were determined by the presence or absence of the right pectoral fin. This fin had been clipped from trout that were stocked in February 1971. Twenty trout came from the February 1971 stocking, while 17 were from the October 1970 stocking.

The trout harvest during the 1971-72 survey period was considerably lower than the harvest the previous winter, although the fishing pressure was the same. Some 78 trout were creeled by 5.0% of the fishermen; no trout entered the creel until the last two months of the survey.

In February and March, 9 trout were caught that had been stocked at Ramsey's Point in February 1972 (Fig. 1). Six of these fish were taken from Fall Creek (March 4-17), which is approximately 12.9 km (8 mi) uplake from the stocking area. Three marked trout were caught in Greasy Creek (March 12-21) nearly 20.9 km (13 mi) downlake from the stocking site. Fishermen expended 720 man-hours in March while enjoying their best success at catching trout (0.063 fish per hour).

Reasons for a decrease in the trout catch during the winter of 1971-72 may be attributed to the stocking of trout at locations different from previous years and/or a reduction in the total number of trout stocked (Table 1).

LOSS OF TROUT BY PREDATION

Loss of trout by predation appears to be the principal cause for lower returns of trout stocked in October versus February when less predation exists. Predation studies in October 1970 and 1971 confirmed that predation on trout was occurring. Predators of trout were the largemouth bass, *Micropterus salmoides* (Lacèpéde); smallmouth bass, *Micropterus dolomieui* Lacèpéde; spotted bass, *Micropterus punctulatus* Rafinesque; and striped bass, *Morone saxitilis* (Walbaum) (Tables 14-16). These fish were feeding on 150 to 206 mm (6.0-8.1 in) trout stocked in October. The average total length of trout stockings during the predation studies was between 180 and 206 mm (7.0-8.1 in).

A 257 mm (10.1-in) spotted bass was the smallest fish collected which had consumed a trout. This bass contained one trout which measured 150 m (6.0 in) in length. A striped bass (rockfish) contained the largest number of trout (5). No predation was observed during electrofishing in February 1971.

To assure minimum loss by predation, at least 203 mm (8-in) trout should be stocked. Because of the size variance in a group of trout that average

203 mm, 229 mm (9-in) trout are recommended for stocking to reduce the number of trout less than 203 mm that are more susceptible to predation.

TROUT GROWTH

The scale method for determining trout growth in Lake Cumberland proved to be of no value. Had there been a sufficient number of carry-over trout, the scale method would have been more useful. The stocking date had to be known to calculate the growth rate of trout while in the lake. By marking trout to identify them with their stocking date, growth between time of stocking and capture could be measured.

The average monthly growth rate varied from 17.8 mm (0.7 in), for trout stocked in October 1969 during their first 10 months in the lake, to 30.5 mm (1.2 in) for trout stocked in October 1967 during their first 6 months in the lake (Table 17). The greatest monthly gain in weight was 90.7 g (0.20 lb), shown by trout stocked in February 1969 during their first year in the lake.

Trout grew fastest in July. Sufficient numbers of trout were recorded from the February 1969 and 1970 stockings to illustrate this phenomenon (Table 18). In July, young-of-year threadfin shad are usually most abundant and, as the primary forage for trout, are a logical reason for stimulating trout growth during this month.

The only stocking that provided information on growth of residual trout was the February 1969 stocking. Fifteen trout from this group were recorded in the 1970 creel survey between May and July (no weights were taken by the creel clerks). These fish had gained an average of 16.8 mm (0.66 in) per month while in Lake Cumberland.

VERTICAL DISTRIBUTION AND ACTIVITY OF TROUT

The catch during the 1971-72 vertical distribution study was 1841 fish, including 12 species (Table 19). These fish were comprised of 5 paddlefish, *Polyodon spathula* (Walbaum); 52 longnose gar, *Lepisosteus osseus* (Linnaeus); 101 gizzard shad, *Dorosoma cepedianum* (Lesueur); 1336 threadfin shad; 42 rainbow trout; 16 mooneye, *Hiodon tergisus* Lesueur; 11 channel catfish, *Ictalurus punctatus* (Rafinesque); 19 white bass, *Morone chrysops* (Rafinesque); 87 spotted bass; 158 white crappie, *Pomoxis annularis* Rafinesque; 1 black crappie, *Pomoxis nigromaculatus* (Lesueur); and 13 freshwater drum, *Aplodinotus grunniens* Rafinesque. Fish were netted from the lake surface to 30.2 m (99 ft) in depth where a gizzard and threadfin shad were taken. The largest fish to enter the nets was a 130-cm (51.0-in) paddlefish. The greatest fish activity during both years of the study occurred between midnight and 8 am CDT (period 3), during which time 52% of the catch entered the nets.

Selectivity of the 1-, 1.5-, and 2-inch-mesh nets for trout was reflected by the mean length of trout caught by these nets. The 1-inch-mesh nets caught 8 trout that averaged 290 mm (11.4 in), while the 1.5-inch-mesh nets caught 20 trout that averaged 343 mm (13.5 in). Fourteen trout, having a mean length of 437 mm (17.2 in), entered the 2-inch-mesh nets.

The digestive tracts of 29 trout were visually inspected for contents. Young-of-year threadfin shad were observed in the stomachs of 20 trout. Other ingested food found in trout were the earthworm; brook silverside, *Labidesthes sicculus* (Cope); and May beetle (*Phyllophaga* sp.), which was taken from two trout in May 1972. May beetles were commonly found on the lake surface in May 1972, particularly along the shoreline.

Trout Activity

Trout were most active during the 4 pm to midnight netting period (period 2), when 29 trout entered the nets (Table 19). This catch compared with 13 trout that were netted between midnight and 8 am, and only 1 trout that was caught during the 8 am to 4 pm period (period 1). The only month when more trout were caught during a period other than period 2 was in May 1972 (Table 23); 3 trout were netted that month during period 3, whereas only 2 trout entered the nets during period 2.

Trout Distribution

The vertical distribution of trout followed a descending pattern after Lake Cumberland thermally stratified in May. In May of 1972, prior to stratification, trout were netted between depths of 0.6 m (2 ft) and 5.5 m (18 ft) (Table 21). The catch in June 1972 did not include trout, which may be attributed to the low number of threadfin shad (primary forage of trout) that were in pelagic water where the nets were stationed (Table 25). Threadfin were seen spawning along the shoreline and the dam in June, giving reason for the lowest monthly catch of threadfin during the study.

All but one of the 20 trout netted in July of 1971 and 1972 were located at depths of 10.1 to 17.7 m (33-58 ft) or 0.0 to 7.3 m (0-24 ft) below the metalimnion (Hutchinson, 1957). Trout in this region of the lake were concentrated at two depth intervals--10.1 to 13.7 m (33-45 ft) and 16.8 to 18.0 m (55-59 ft)--in 1971 (Table 20), but not in 1972, although threadfin shad were primarily in two areas of concentration in July during both years (Tables 24, 25). The location of the trout and threadfin concentrations in 1971 did not coincide either.

There was no similarity between the depth distribution of trout and threadfin in August. Threadfin remained more numerous in two separate layers of the lake, but trout were dispersed at depths of 9.8 to 18.0 m (32-59 ft) in 1971 and 14.6 to 22.2 m (48-73 ft) in 1972. Trout entered the nets at approximately the same location in relation to the metalimnion as trout that were netted in July. All of the 11 trout netted in August were located between 0.0 and 7.0 m (0-23 ft) below the metalimnion.

Six trout were captured in September 1971 between depths of 12.5 and 19.8 m (41-65 ft). This region was 0.6 to 7.3 m (2-24 ft) below the metalimnion.

Although trout were captured at various depths during the study, they were consistently found between 0.0 and 7.3 m (0-24 ft) below the metalimnion (Tables 20, 21). The distribution of threadfin shad appeared to have no significant bearing on where trout were distributed since trout were concentrated below the depths where threadfin were most abundant.

Dissolved oxygen (DO) concentrations at the netting station varied from 2.4 to 12.0 mg/l (ppm) during the study (Tables 26, 27). Oxygen depletion occurred within and below the metalimnion during the period of thermal stratification, but apparently had no influence on trout distribution since trout remained in the area of oxygen depletion and were netted at DO concentrations as low as 2.8 mg/l (Table 22).

The tendency of trout to be concentrated in a region of the lake below the metalimnion is associated with water temperature, particularly in July. By calculating the total units of effort as net exposure (one unit of effort is equal to 1 eight-hour setting of six 8-foot-wide trout nets), a catch per unit effort (CPUE) was determined for each 5° temperature interval between 54° and 78°F.

The CPUE was substantially greater between 59° and 63°F in July (Table 28). In fact, all of the trout netted in July 1972 were captured within the 59° to 63°F range. Eight of 13 trout captured in July 1971 were also in this temperature range. A temperature preference by trout during the other months of the study could not be determined because of the small number that were captured. If the CPUE is summarized for each year, 59° to 63°F represents the temperature range in which the CPUE is greatest in 1972. In 1971, however, the CPUE was greater between 69° and 73°F.

SUMMARY

A "two-story" trout fishery has been established in Lake Cumberland, but with minimal success as of 1973. From trout habitat studies, we know that there is sufficient habitat for rainbow trout throughout the year in the area immediately above the dam. Trout grow well during their first year in the lake, feeding primarily on young-of-year threadfin shad that are in abundance during the summer months. A 203-mm (8-in) trout, after a year's growth in the lake, has more than doubled in length and increased its weight by ten-fold. Some of the tributaries to Lake Cumberland, such as Fall, Greasy, and Gross creeks, provide trout fishing during the months of November through March when residual and recently-stocked trout seek these streams, but the total harvest during this period is relatively low. During the summer months, particularly May through July, the trout harvest and catch rate are best; but to be successful,an angler must know when and approximately how deep to fish. Results of the vertical distribution study indicated that trout activity is at its peak between 4 pm and midnight, which was verified by observing the fishing preference of trout anglers during this time (especially between dusk and midnight). The best year for trout fishing during the life of the project was in 1969, when trout were harvested between May and September at a rate of 0.16 fish per hour. Water temperature appeared to be the major factor influencing depth distribution. Trout occurred more frequently at depths where the temperature was between 59° and 63°F.

Several factors are suppressing the trout fishery from reaching its potential. Many of the trout are lost to predators such as largemouth bass, spotted bass, and striped bass. The stocking location can have an adverse effect on the fishery if trout are stocked too far up lake or too

close to the dam. During 1972, the harvest of trout stocked at the dam was substantially greater than the harvest of trout stocked at Ramsey's Point (20 miles above dam); however, the total harvest was low. Marked trout from the dam stocking were captured below the dam, indicating that trout were escaping from the lake, particularly those trout released immediately above the dam. The 1973 harvest of trout stocked at Rowena Ferry (4.5 miles above dam) and at the dam was the lowest encountered. Because of flooding conditions and an unusually long period of high discharge, a great number of trout were assumed to have escaped. The success of stocking trout near the dam depends somewhat on the amount of discharge. The stocking date, either October or February, was very significant. Trout stocked in February contributed to the catch better than did the October stocking during each of the years between 1969 and 1972. The greatest difference occurred in 1971, when returns from the February stocking outnumbered those from the 1970 stocking by a ratio of 74:1.

R E C O M M E N D A T I O N S

In order to realize the potential of the trout fishery in Lake Cumberland, the following recommendations should be followed for at least the next three years, after which time a creel survey should be conducted to make a final evaluation of the fishery. Only then can one honestly be able to conclude whether the continuation of stocking trout in Lake Cumberland is justifiable.

1) Trout should be stocked in February.

2) Trout should be stocked at Ramsey's Point. Rowena Ferry would be a more preferable site under normal conditions, but the U. S. Army Corps of Engineers will hold the lake at least 7 m (23 ft) below summer pool through

1979 while repairing the dam. A greater-than-normal discharge will be required to keep the lake at this lower level, so the Rowena Ferry site would be too close to the dam.

3) Trout no smaller than 230 mm (9 in) should be stocked to minimize losses from predation.

4) If a successful trout fishery can be developed within 3 years, then the number of trout stocked annually should be gradually increased from the 100,000 now being stocked until creel survey data indicate that the point of diminishing returns has been reached.

A C K N O W L E D G M E N T S

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A P P E N D I X

(Figs. 1-3, Tables 1-28)

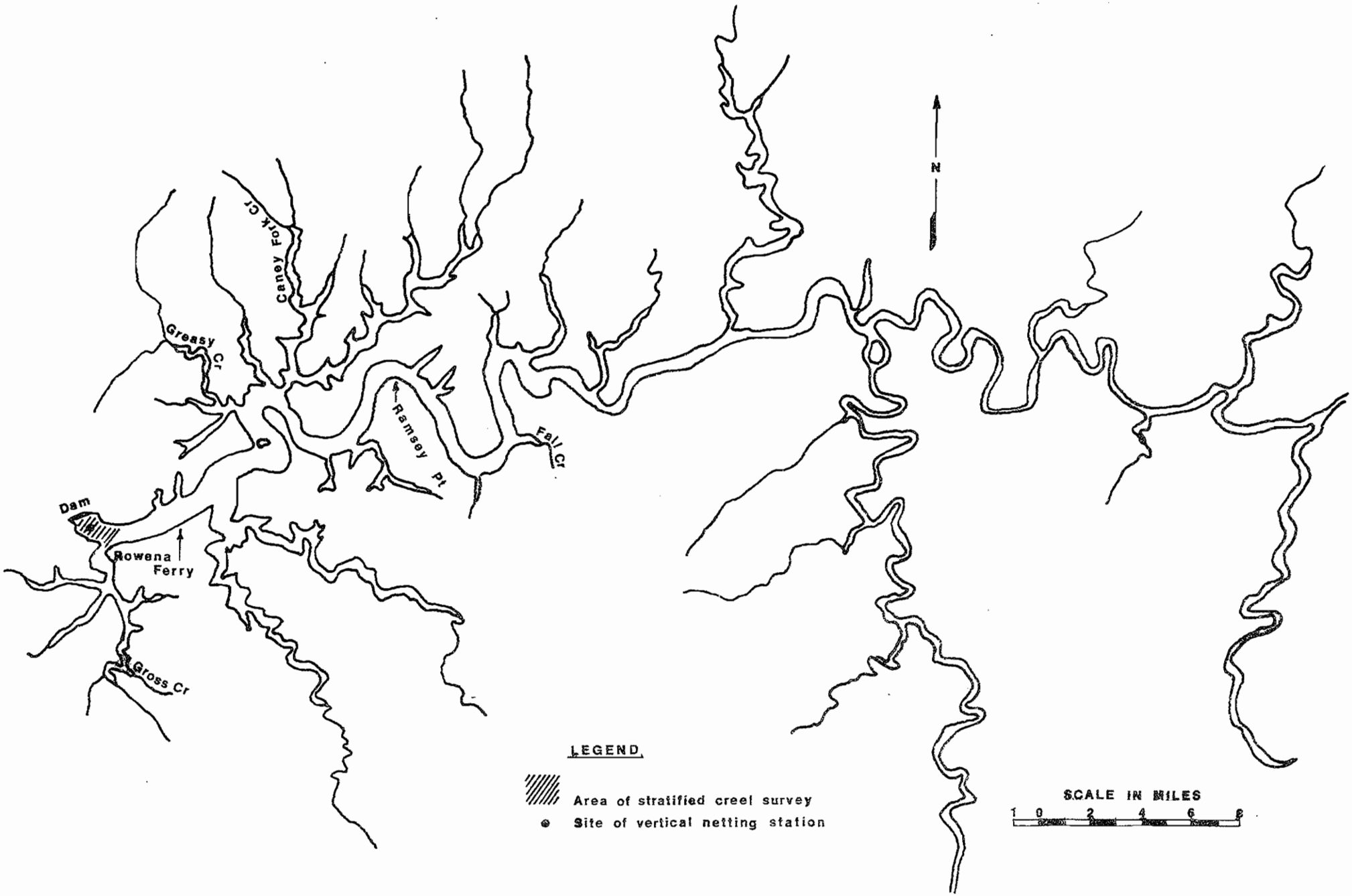

Figure 1. Map of Lake Cumberland, indicating the location of the stratified creel survey, tributary survey streams, vertical netting station and predation study sites for rainbow trout.

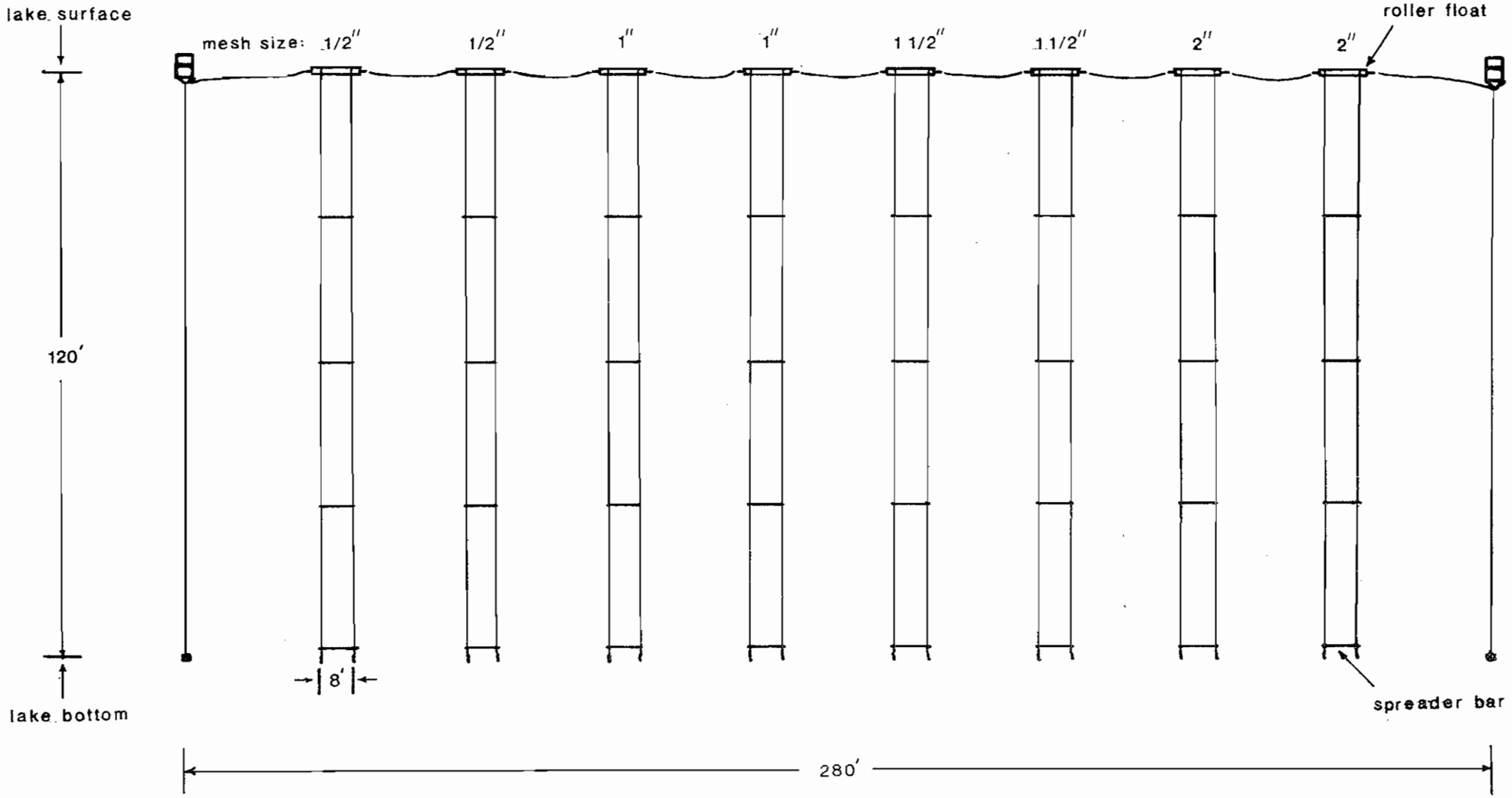

Figure 2. Schematic drawing of the vertical netting station, located 0.5 mile above the dam in Lake Cumberland. Nets were fished each week from 8:00 am (CDT) on Wednesday to 8:00 am on Friday from June 30 to October 1, 1971, and May 3 to September 15, 1972, to determine the vertical distribution and activity of rainbow trout.

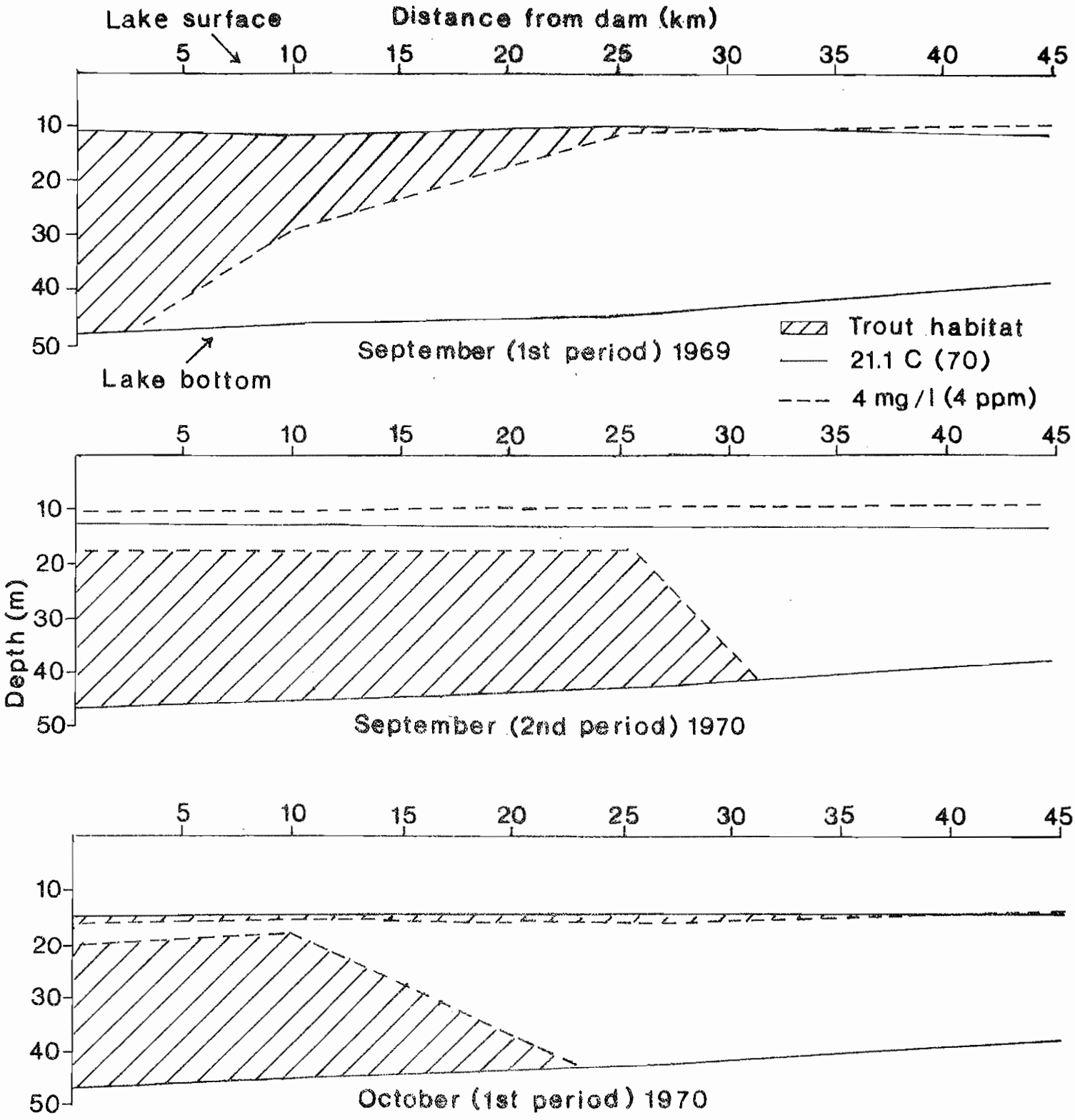

Figure 3. Trout habitat in the main channel of Lake Cumberland during the critical periods in 1969 and 1970.

Table 1. Summary of rainbow trout stocking in Lake Cumberland, 1962-73.

Date	Number	Number fin-clipped	Average total length (inches)	Location
11/28/62	5,100		6-8	Otter Creek
1/8/63	6,100		5-8	Otter Creek
10/22/63	3,432		8-10	Entire lake
10/24/63	3,393		8-10	Entire lake
10/29/63	3,375		8-14	Entire lake
9/24/64	5,837		10-11	Rowena Ferry
11/17/64	27,060		3-5	Rowena Ferry
11/19/64	4,551		10-11	Rowena Ferry
11/24/64	31,710		3-5	Rowena Ferry
12/8/64	29,400		4-5	Rowena Ferry
12/10/64	3,220		10-12	Rowena Ferry
5/ /65	25,000		6-8	Rowena Ferry
4/14/66	12,960		5.1	Rowena Ferry
4/19/66	12,040		5.1	Rowena Ferry
2/14/67	4,990		10.0	Rowena Ferry
2/16/67	3,810		10.0	Rowena Ferry
9/26,28/67	22,428		8.0	Rowena Ferry
9/28/67	3,505	25,474*	8.9	Beaver Lodge
10/3/67	19,000		6.6	Rowena Ferry
10/8/68	13,565	13,565**	8.3	Ramsey's Point
10/10/68	18,220	11,435**	8.5	Rowena Ferry
10/15/68	13,740		8.3	Beaver Lodge
2/4,5,6/69	7,097		8.2	Ramsey's Point
	8,809	17,500***	8.2	Beaver Lodge
	8,525		8.2	Conley Bottom
	9,783		8.2	Burnside Dock
4/29/69	7,886		10.1	Rowena Ferry
10/7,9/69	8,995		7.8	Ramsey's Point
10/14/69	4,000		7.8	Burnside Dock
10/14/69	8,000		7.7	State Park
10/14/69	7,000		7.7	Conley Bottom
10/16/69	8,708		7.8	Beaver Lodge
10/20,21/69	58,499	58,499**	6.7	Rowena Ferry
10/21/69	28,271	28,271**	6.8	Ramsey's Point
10/22/69	17,813	17,813**	6.6	Conley Bottom
11/25/69	20,015		7.7	Burnside Dock
10/13/70	7,528		7.0	Ramsey's Point
10/13/70	7,305		7.0	Rowena Ferry
10/15/70	7,366		7.0	Ramsey's Point
10/15/70	7,217		7.0	Rowena Ferry
10/15/70	11,834		7.0	Beaver Lodge

* Left pectoral fin clipped
** Right pectoral fin clipped
*** Left pectoral and adipose fin clipped

Table 1. (continued)

Date	Number	Number fin-clipped	Average total length (inches)	Location
2/3/71	3,213		8.9	Twyfords Point
2/3/71	6,291		8.9	Camp Earl Wallace
2/3,4/71	25,117	52,280**	8.6-8.9	Rowena Ferry
2/4/71	6,960		8.7-8.9	Ramsey's Point
2/4/71	10,699		8.7-8.9	Beaver Lodge
10/12,13/71	6,250		8.1	Rowena Ferry
10/12,13/71	6,250		8.1	Beaver Lodge
10/12,13/71	6,250		8.1	Twyfords Point
10/12,13/71	6,250		8.1	Ramsey's Point
2/1/72	18,237	18,237*	8.1	Ramp at dam
2/2/72	17,485	17,485**	8.2	Ramsey's Point
1/17,18/73	51,249		7.8	Ramp at dam
1/15,16/73	49,160	49,160**	7.8	Rowena Ferry

* Left pectoral fin clipped
** Right pectoral fin clipped

Table 2. Trout habitat during the critical months of 1969 and 1970 in Lake Cumberland.

Critical period	1969				1970			
	Area		Volume		Area		Volume	
	hectares	acres	$m^3 \times 10^8$	acre-ft $\times 10^3$	hectares	acres	$m^3 \times 10^8$	acre-ft $\times 10^3$
September								
1st period	4,127	10,197	10.6	862,700	5,577	13,780	13.5	1,096,900
2nd period	7,399	18,282	13.8	1,115,200	3,253	8,039	7.1	576,400
October								
1st period	9,619	23,768	12.3	998,300	3,271	8,083	5.6	452,600

Table 3. Frequency of occurrence for trout in eight tributary streams of Lake Cumberland from November through March, 1967-71.

Date	Number collected	Weight		Number per		Weight		Number per		Weight	
		g	lb	ha	acre	g	lb	km	mile	g	lb
Nov.	61	9,838.6	21.69	20.75	8.43	3,346.5	3.00	10.68	17.18	1,723.0	6.11
Dec.	52	8,990.4	19.82	28.89	11.69	4,994.7	4.45	16.15	26.00	2,792.0	9.91
Jan.	15	3,869.2	8.57	6.85	2.78	1,766.8	1.59	5.62	9.04	1,449.1	5.16
Feb.	47	7,593.3	16.74	27.81	11.24	4,493.1	4.00	15.72	25.27	2,539.6	9.00
March	34	18,316.4	40.38	9.16	3.71	4,937.0	4.40	10.21	16.43	5,500.4	19.51
Total	209	48,607.9	107.20								
Mean				16.95	7.13	3,942.2	3.66	11.66	18.83	2,712.5	9.66

Table 4. Number of trout collected in eight tributary streams of Lake Cumberland from November through March, 1967-71. Caney Creek, Fall Creek, Lily Creek and Wolf Creek were not studied in 1967-68.

Stream	1967-68	1968-69	1969-70	1970-71	Total
Beaver	7	6		13	26
Caney		3	2	2	7
Fall		59	25	33	117
Greasy	18			4	22
Gross	9				9
Lily		2		20	22
Otter				3	3
Wolf			2	1	3
TOTAL	34	70	29	76	209

Table 5. Trout catch from the boat dock survey, 1967-70.

Month	1967	1968	1969	1970	Total
Jan.	68	3	1	0	72
Feb.	28	0	0	14	42
Mar.	156	50	40	31	277
Apr.	454	266	149	26	895
May	1,011	497	1,069	104	2,681
June	687	260	710	16	1,673
July	621	145	401	0	1,167
Aug.	109	189	94	12	404
Sept.	32	43	7	0	82
Oct.	30	33	81	3	147
Nov.	3	47	42	0	92
Dec.	6	4	20	0	30
TOTAL	3,205	1,537	2,614	206	7,562

Table 6. Size distribution, in inch classes*, of trout recorded during the 1967-71 boat dock surveys.

Inch class	1967 Number	1968 Number	1969 Number	1970 Number	1971 Number
8	20	14	15		
9	45	39	62	5	1
10	108	49	142	9	3
11	149	23	225	10	18
12	352	48	372	14	34
13	307	57	388	16	6
14	328	116	609	12	
15	232	161	266	13	1
16	228	213	194	9	1
17	276	229	159	17	
18	379	197	94	27	
19	244	183	47	24	1
20	198	74	20	28	
21	128	48	8	12	
22	90	43	9	8	1
23	66	32	2	2	
24	41	8	2		
25	8	3			
26	6				
TOTAL	3,205	1,537	2,614	206	66

*Example: 8.0 - 8.9 inch trout belong to the 8-inch class.

Table 7. Creel data from the 1967-73 trout surveys on Lake Cumberland. The first three surveys were conducted during the day, while the other surveys were at night.

Date	Estimated total catch	Catch rate per hour	Number Interviewed	Angler success (percent)
Sept. 1967 - Mar. 1968	214	0.14	70	14.3
April-May 1968	318	0.15	76	32.9
Dec. 1968 - Mar. 1969	97	0.31	14	35.7
May-Sept. 1969	3,882	0.16	1,191	27.9
May-Sept. 1970	839	0.09	555	22.2
May-Sept. 1971	514	0.06	543	12.3
May-Sept. 1972	110	0.02	339	0.05
May-Sept. 1973	8	0.001	303	0.003

Table 8. Creel survey statistics from the 1969-73 trout surveys conducted between 9 pm and 3 am CDT, May through September, on Lake Cumberland.

	May	June	July	Aug.	Sept.	Total	Mean
Man-hours							
1969	570	858	1,177	720	282	3,607	
1970	361	452	751	310	72	1,946	
1971	1,134	3,048	2,340	1,854	546	8,922	
1972	606	2,736	1,506	1,002	96	5,946	
1973	966	1,821	1,716	369	510	5,382	
Projected catch							
1969	1,553	792	1,083	433	21	3,882	
1970	154	120	383	133	49	839	
1971	45	171	180	120	44	562	
1972	42	22	45	0	0	110	
1973	0	8	0	0	0	8	
Catch per hour							
1969	0.32	0.17	0.13	0.11	0.01		0.16
1970	0.11	0.07	0.10	0.09	0.10		0.09
1971	0.04	0.06	0.08	0.06	0.08		0.06
1972	0.07	0.01	0.03	0.00	0.00		0.02
1973	0.00	0.004	0.00	0.00	0.00		0.001
Angler success (percent)							
1969	30.4	20.7	19.8	30.5	4.1		27.9
1970	31.6	16.4	28.2	15.4	10.8		22.2
1971	8.3	10.2	15.6	13.6	15.6		12.3
1972	0.1	0.03	0.08	0.0	0.0		0.05
1973	0.0	0.01	0.0	0.0	0.0		0.003

Table 9. Size distribution, in inch groups*, of trout recorded during the creel survey, May through September 1969. Fin-clipped trout, in italics, are indicated to the right of the total number of trout for each inch group.

Inch group*	May	June	July	Aug.	Sept.	Total
10	9	5				14
	*2***	*1*				*3*
11	37	17	3			57
	15	*6*	*1*			*22*
12	65	57	16	1		139
	26	*19*	*6*			*51*
13	37	48	51	11	1	148
	21	*19*	*27*	*3*		*70*
14	19	11	52	26	2	110
	3	*3*	*21*	*10*	*1*	*38*
15	5	4	13	25	1	48
		1	*5*	*8*	*1*	*15*
16	9	4	7	10		30
	1		*1*	*4*		*6*
17	3		4	4		11
18		1	3	2		6
19			1			1
20						0
21			1			1
TOTAL	184	147	151	79	4	565
	68	*49*	*61*	*25*	*2*	*205*

* Example: 9.5 - 10.4 inch trout belong to the 10 inch group

** Upper number represents trout with the right pectoral fin-clip (October 1968 stocking).

*** Lower number represents trout with the left pectoral and adipose fin-clip (February 1969 stocking).

Table 10. Size distribution, in inch groups*, of trout recorded during the creel survey from May through September 1970. Fin-clipped trout, in italics, are indicated to the right of the total number of trout for each inch group.

Inch group	May		June		July		Aug.		Sept.		Total	
9	2	-a -b *1*[c]									2	*1*
10	4										4	
11	8	*2*	14	*2*	3	*1*					25	*5*
12	3		9		15	*3*					27	*3*
13	1		1		24	*3*	3				29	*3*
14	2		1		11	*1*	4		2		20	*1*
15	4	*2*			9	*1*	13	*1*	2		28	*2* *2*
16	1		1		4	*1*	2	*1*	1		9	*2*
17					2		3		2		7	
18	8	*1* *4*	2	*1*	2						12	*1* *5*
19	1	*1*			4	*1*	2				7	*2*
20	1		1	*1*	2	*2*	1				5	*3*
21	3	*2*	2	*1*							5	*3*
TOTAL	38	*1* *9* *3*	31	*3* *2*	76	*3* *10*	28	*2*	7		180	*1* *15* *17*

* Example: 8.5 - 9.4 inch trout belong to the 9-inch group.
[a] Represents marked trout from October 1968 stocking.
[b] Represents marked trout from February 1969 stocking.
[c] Represents marked trout from October 1969 stocking.

Table 11. Size distribution, in inch groups*, of trout recorded during the creel survey from May through September 1971. Fin-clipped, or identified trout, in italics, are indicated to the right of the total for each inch group.

Inch group	May	June	July	Aug.	Sept.	Total
9	1[a] *1*[b]	1 *1*				2 *2*
10	1 *1*	1 *1*				2 *2*
11	2 *2* *1*	12 *12*	11 *11*			25 *25* *1*
12	1	2 *2*	13 *13*	8 *8*	2 *2*	26 *25*
13		2 *2*	4 *4*	7 *7*	3 *3*	16 *16*
14		1	2 *1*	2 *2*		5 *3*
15	2 *1*	2				4 *1*
16		4	1	1		6
17		4	1		1	6
18	1	2	1			4
19				1		1
20		1	1	1		3
TOTAL	8 *1* *5*	32 *18*	34 *29*	20 *17*	6 *5*	100 *1* *74*

*Example: 8.5 - 9.4 inch trout belong to the 9-inch group.

[a]Represents marked trout from October 1970 stocking.

[b]Represents marked trout from February 1971 stocking.

Table 12. Size distribution, in inch groups*, of trout recorded during the creel survey from May through September 1972. Fin-clipped or identified trout, in italics, are indicated to the right of the total number of trout for each inch group.

Inch group	May	June	July	Aug.	Sept.	Total
11	0 –[a] 3 *1*[b] *2*[c] *(1,1)***	*0* *1* *4 (3,1)*	3 *1* *7 (6,1)*	0	0	6 *1* *5 (3,2)*
12	1 *1 (1,0)*					1 *0* *1 (1,0)*
13			1 *1 (1,0)*			1 *0* *1 (1,0)*
14			4 *1*			4 *1* *3 (3,0)*
15		*1* 1				1 *1* *0* *0*
16	1 *1 (1,0)*					1 *0* *1 (1,0)*
17						*0* *0* *0*
18			2			2 *0* *0*
19		*1* 3				3 *1* *0* *0*
20			1			1 *0* *0*
TOTAL	5	*2* 4 *0* *0*	11	0	0	20 *2* *2* *11 (9,2)*

*Example: 10.5 - 11.4 inch trout belong to the 11-inch group

[a]February '71 stocking

[b]October '71 stocking

[c]February '72 stocking

** First number in parentheses represents number of trout from stocking at dam in February '72, while second number indicates number of trout from Ramsey's Point stocking.

Table 13. Creel survey statistics from the trout survey conducted on Caney Fork, Fall Creek, Greasy Creek and Gross Creek, November - March, 1970-71 and 1971-72. The 1971-72 data are in italics.

Month	Trout catch	Catch rate (trout per hour)	Man-hours	Estimated total catch	No. of interviewees	No. of trout anglers	Angler success percent
November	1	0.12	120	20	15	15	6.7
			48		*6*	*5*	*0.0*
December	6	0.21	80	31	20	18	20.0
			168		*20*	*20*	*0.0*
January	17	0.17	300	88	67	65	20.1
			224		*35*	*35*	*0.0*
February	9	0.05	516	90	129	129	4.7
	1	*0.010*	*408*	*5*	*58*	*58*	*2.0*
March	29	0.12	552	105	138	137	9.9
	11	*0.063*	*720*	*73*	*90*	*89*	*10.0*
TOTAL	62		1568	334	369	364	
	12		*1568*	*78*	*209*	*207*	
Mean		0.12					10.6
		0.003					*5.0*

Table 14. Results of electrofishing on October 13, 1970, to study bass predation on trout stocked in October at Ramsey's Point, Lake Cumberland.

Species captured	Total length (inches)	Total length of trout consumed (inches) No.1	No.2
Spotted bass	10.0		
Spotted bass	11.0		
Spotted bass	11.0	7.0	
Spotted bass	12.0	6.8	
Spotted bass	12.4	6.8	
Spotted bass	14.4	7.0	6.0
Spotted bass	16.8	6.0	6.0
Smallmouth bass	11.0		
White bass	15.5		

Table 15. Results of predation study at Ramsey's Point on Lake Cumberland, during the night of October 12, 1971.

Predatory fish	Total length (inches)	Total length of trout consumed (inches)
Largemouth bass	14.4	
Smallmouth bass	12.2	
Smallmouth bass	10.2	
Spotted bass	14.0	7.0
Spotted bass	13.5	
Spotted bass	13.3	
Spotted bass	13.3	
Spotted bass	13.2	8.0
Spotted bass	13.2	
Spotted bass	13.0	
Spotted bass	12.8	
Spotted bass	12.6	
Spotted bass	12.5	
Spotted bass	12.5	
Spotted bass	12.5	
Spotted bass	12.2	
Spotted bass	12.2	
Spotted bass	11.5	
Spotted bass	11.5	
Spotted bass	11.2	

Table 15. (continued)

Predatory fish	Total length (inches)	Total length of trout consumed (inches)
Spotted bass	11.2	
Spotted bass	10.9	
Spotted bass	10.8	
Spotted bass	10.2	
White bass	13.4	
White bass	12.7	
White bass	12.5	
White bass	12.1	
White bass	10.9	
White bass	9.5	

Table 16. Results of predation study at Rowena Ferry on Lake Cumberland, during the night of October 13, 1971.

Predatory fish	Total length (inches)	Total length of trout consumed (inches)				
		No.1	No.2	No.3	No.4	No.5
Striped bass	24.2	8.1	8.0	7.9	7.5	6.5
Largemouth bass	22.5	7.5	7.0			
Smallmouth bass	18.0	7.5	7.0			
Smallmouth bass	12.5					
Smallmouth bass	9.6					
Smallmouth bass	8.7					
Spotted bass	16.0	7.0				
Spotted bass	10.5					
Spotted bass	10.5					
Spotted bass	10.1	6.0				

Table 17. Mean monthly growth rates of rainbow trout during indicated time period that they inhabited Lake Cumberland.

Stocking date	Months in lake	Growth per month	
		length mm (in)	weight g (lb)
October 1967	6	30.5 (1.2)	49.9 (0.11)
October 1968	10	20.3 (0.8)	72.6 (0.16)
February 1969	12	20.3 (0.8)	90.7 (0.20)
October 1969	10	17.3 (0.7)	
October 1970	5	25.2 (1.0)	25.2 (0.06)

Table 18. Mean length and weight of rainbow trout captured from the February 1969 and 1971 stockings during their first summer in Lake Cumberland.

Stocking date	May	June	July	Aug.	Sept.
February 1969					
length mm (in)	259 (10.2)	282 (11.1)	300 (11.8)	320 (12.6)	315 (12.4)
weight g (lb)	186.0 (0.41)	222.3 (0.49)	299.4 (0.66)	344.7 (0.76)	331.1 (0.73)
February 1971					
length mm (in)	307 (12.1)	312 (12.3)	337 (13.3)	364 (14.3)	362 (14.2)
weight g (lb)	-	136.1 (0.30)	444.5 (0.98)	471.7 (1.04)	

Table 19. Species composition and total catch during each of the three netting periods of the 1971-72 vertical distribution study in Lake Cumberland. The 1972 catch is in parentheses.

Species	NETTING PERIOD						Total	
	8 AM - 4 PM		4 PM - midnight		midnight - 8AM			
Paddlefish	1		1		1	(2)	3	(2)
Longnose gar	2	(11)	4	(11)	6	(18)	12	(40)
Gizzard shad	1	(1)	25	(11)	43	(20)	69	(32)
Threadfin shad	105	(82)	157	(268)	306	(418)	568	(768)
Rainbow trout	1		16	(13)	6	(6)	23	(19)
Mooneye		(1)	2	(6)	1	(6)	3	(13)
Channel catfish		(1)	1	(3)	3	(3)	4	(7)
White bass	2		3	(8)	2	(4)	7	(12)
Spotted bass	14	(29)	7	(5)	15	(17)	36	(51)
White crappie	16	(32)	21	(16)	21	(52)	58	(100)
Black crappie		(1)						(1)
Freshwater drum		(2)		(7)	1	(3)	1	(12)
TOTAL	142	(166)	237	(348)	405	(549)	784	(1,057)

Table 20. Temperature profile (°F), location of metalimnion(s)* (in brackets), and depth of rainbow trout and temperature at depth of capture (in parentheses) during each day that trout were netted from July through September 1971.

Depth (ft)	July 1971						
	2	15	16	22	23	29	30
0	82	81	80	82	82	79	79
5	80	80	79	80	81	79	78
10	79	80	79	80	80	78	78
15	72	78	73	79	80	78 (19', 78°)	78
20	68	75	70	80	80	77	78
25	66	70	68	78	79	71	78
30	64	66	65	71	72	69	73 (33', 69°)
35	61	64	63 (39', 61°)	66 (37', 64°)	67	65	68
40	60	63	60	62 (41', 62°)	64	63 (40', 63°)	66
45	59	60	60	61 (41', 62°)	63	61	63 (45', 63°)
50	57	58	58	60	60	60	60
55	56 (58', 55°)	57 (57', 56°)	56	59 (55', 59°)	59 (56', 59°)	59	59 (55', 59°)
60	55	55	55	58	57	59	57
65	54	55	54	57	57	56	56
70	54	54	54	54	55	54	55
75	52	54	53	54	54	54	54
80	50	52	52	53	53	53	53
85	50	51	50	50	53	52	52
90	47	50	50	50	50	51	51
95	46	48	48	49	49	49	50
100	46	47	47	48	48	48	48
105	45	46	46	47	47	46	47

*e.g., the metalimnions are located at depths between 9 and 20 feet and 30 and 35 feet during July 2.

Table 20. (continued)

Depth (ft)	July 1971						
	2	15	16	22	23	29	30
110	45	46	46	46	46	46	46
115	45	46	46	46	46	46	46
120	44	45	45	45	46	46	45

Table 20. (continued)

Depth (ft)	August 1971 6	13	19
0	80	81	83
5	79	80	81
10	79	81	81
15	79	80	81
20	79	80	81
25	79	80	78
30	78	76	72 (32', 71°)
35	77	72	69 (37', 69°)
40	70	69	68
45	68	68	68
50	64	66 (49', 67°)	66
55	62	65	66
60	60 (59', 61°)	64	65
65	60	62	64
70	58	61	62
75	56	59	60
80	55	58	60
85	54	57	57
90	54	55	55
95	53	55	54
100	51	54	54
105	50	52	52
110	49	50	50
115	48	49	49
120	47	47	47

Table 20. (continued)

Depth (ft)	September 1971			
	9	16	17	30
0	83	79	78	79
5	82	78	78	76
10	82	78	78	76
15	81	78	78	75
20	81	78	78	75
25	81	78	77	75
30	78	75	75	75
35	74	72	73	74
40	(41', 70°) 70	70	71	74
45	68	68	(47', 69°) 69	72
50	68	68	68	68
55	(54', 67°) 67	(54', 67°) 66	67	(58', 67°) 68
60	66	65	66	66
65	64	64	64	(65', 65°) 65
70	64	63	63	64
75	62	60	61	63
80	60	59	60	60
85	57	57	58	59
90	55	56	56	57
95	55	55	55	56
100	53	53	53	54
105	52	51	51	53
110	50	50	50	50
115	48	48	48	49
120	47	47	47	48

Table 21. Temperature profile (°F), depth of rainbow trout and temperature at depth of capture (in parentheses) during each day that trout were netted in May, July, and August 1972. A metalimnion was not present when trout were captured in May.

Depth (ft)	May 1972		
	4	5	11
0	(2' 59°) 60	59	(3' 64°) 64
5	59	(6' 58°) 58	63
10	58	(10' 57°) 57	63
15	57	57	(18' 60°) 61
20	56	57	60
25	55	57	60
30	55	55	60
35	54	55	60
40	54	55	60
45	53	54	59
50	52	54	58
55	50	52	54
60	50	51	52
65	50	51	50
70	50	50	50
75	49	50	49
80	49	49	48
85	48	48	48
90	48	48	47
95	48	47	47
100	47	47	46
105	47	46	46
110	46	46	46
115	46	46	46
120	46	45	46

Table 21. (continued)

Depth (ft)	July 1972			
	14	20	27	28
0	80	82	84	84
5	80	82	83	83
10	78	79	81	81
15	77	78	78	78
20	74	77	75	75
25	73	74	71	71
30	68	71	68	68
35	64	68 (42', 62°)	64	64
40	61	64	61 (42', 60°)	61
45	59	60 (42', 62°)	59 (43', 60°)	59 (44', 59°)
50 (48', 59°)	58	59	57 (44', 59°)	57
55	56	57	56	56
60	55	56	55	55
65	54	55	54	54
70	52	53	53	53
75	51	52	51	51
80	50	51	50	50
85	50	50	50	50
90	49	50	50	50
95	48	49	49	49
100	48	48	47	47
105	48	48	47	47
110	47	47	47	47
115	47	47	46	46
120	46	47	46	46

Table 21. (continued)

Depth (ft)	August 1972			
	3	10	17	25
0	81	78	81	81
5	79	78	81	81
10	79	78	81	81
15	78	78	79	81
20	74	78	78	79
25	72	77	78	78
30	71	77	76	75
35	70	77	71	72
40	67	71	69	70
45	63	68	66	68
50	51' 60° 60	49' 64° 63	63	66
55	59	61	61	62
60	56	58	59	58' 63° 59
65	55	56	65' 57° 57	57
70	69' 54° 54	55	55	56
75	73' 54° 53	73 54 54	54	54
80	52	52	53	53
85	51	51	52	52
90	50	50	51	51
95	50	50	50	50
100	49	49	49	50
105	48	48	49	48
110	48	48	48	48
115	47	48	48	47
120	47	47	47	47

Table 22. Rainbow trout distribution in relation to dissolved oxygen (mg/l) during the June 30-October 1, 1971, vertical distribution study in Lake Cumberland. The three periods that nets were fished are represented by columns numbered 1 (8am-4pm), 2 (4pm-midnight), and 3 (midnight-8am). Each trout was measured to the nearest 0.1 inch (total length).

Dissolved oxygen	July			August			September		
	1	2	3	1	2	3	1	2	3
10.1		12.5							
8.8		11.8							
8.1		14.1							
7.6		16.4							
7.5		17.4							
7.4		12.3							
7.3			13.5						
7.2		12.6	12.8						
7.0		10.2	12.5						
6.6			15.5						
6.4		11.6							
6.1						14.0			
5.4					12.4				
					12.7				
4.7					12.8				
4.6									12.0
3.6								17.5	
3.4								13.3	
3.3							12.2	12.6	
2.8								12.0	
TOTAL NUMBER	0	9	4	0	3	1	1	4	1

Table 23. Rainbow trout distribution in relation to dissolved oxygen (mg/l) during the May 3-September 15, 1972, vertical distribution study in Lake Cumberland. The three 8-hour periods are represented by columns numbered 1 (8am-4pm), 2 (4pm-midnight), and 3 (midnight-8am). Each trout was measured to the nearest 0.1 inch (total length).

Dissolved oxygen	May			July			August		
	1	2	3	1	2	3	1	2	3
8.0		12.4	11.5						
7.3			17.0						
7.2		11.0						18.0	
7.1			10.1						
6.9									17.7
6.7								18.2	
6.5					15.8				
6.4					13.0 20.4				
6.3					20.1 18.7				
6.2								21.0	
5.7					13.1	13.1			19.6
5.4									
4.8								12.6 13.6	
TOTAL NUMBER	0	2	3	0	6	1	0	5	2

Table 24. Vertical distribution of threadfin shad captured during the 1971 vertical distribution study (June 30-October 1) in Lake Cumberland. The three periods each day that nets were fished are represented by the numbers 1 (8am-4pm), 2 (4pm-midnight), and 3 (midnight-8am).

Depth (ft)	July			August			September 8-October 1		
	1	2	3	1	2	3	1	2	3
1									
2									
3									
4					1				
5									
6			2						
7		1							
8			1						
9		1	3						
10			1			1			
11			5			2			
12			3		1				
13			5						
14		1	3		1			1	
15		2	1						1
16		1	1						
17		3	1						
18		1	5			1			2
19						2			1
20		2	3			1			
21		3	1						
22		6	6			2			

Table 24. (continued)

Depth (ft)	July			August			September 8-October 1		
	1	2	3	1	2	3	1	2	3
23			6		1	2			
24		6	2						
25		2	3		1				
26		4	2		2	3			2
27		2	5			4			1
28		1	3		3	2			1
29			1		3	2			3
30		1	2		3	6			
31		1	5		1	2			
32			5		1			1	1
33					2	1		3	1
34		1	1		1	7		3	2
35			2		4	3		2	
36				2	4	10		3	2
37					6	9			1
38			1		7				5
39					1	3		3	5
40					1	3		1	7
41			1		1	4		3	1
42				1				2	7
43				2	2	1	2	4	2
44			1	1	1	1		1	4
45			1	1	3	7	1	1	2

Table 24. (continued)

Depth (ft)	July			August			September 8-October 1		
	1	2	3	1	2	3	1	2	3
46			1		1	2		4	2
47				5	1	1	1		4
48					3	4			2
49				4		1	1		3
50					1	3		1	
51				5	1	4	2	2	
52						10			1
53				3		5	1		1
54					1	6			2
55				3		2	1	2	
56				2	1		1		1
57				2		2	2		
58							5		
59						2	2		
60									
61							1		
62							2		1
63				2		2	1		1
64						3	2		2
65				1			2	1	1
66								1	
67	1		4	1			2		
68			3			1	1		
69	1	2		1	1				

Table 24. (continued)

Depth (ft)	July			August			September 8-October 1		
	1	2	3	1	2	3	1	2	3
70		1	2						
71						1	1		
72			1	2					
73			2	3	2		1		1
74					4				1
75	1	1	1	2					
76				1		2			
77					1		1		
78			1	1	2				
79			1	1					
80				2		1			
81				3		4			
82				4					
83					1				
84				5	2				
85				1			1		
86				1		1			
87				1	1				
88				4					
89				1					
90									
91									
92									
93					1				
Total	3	43	97	68	75	135	34	39	74

Table 25. Depth distribution of threadfin shad netted during the 1972 vertical distribution study (May 3-September15) in Lake Cumberland. The three 8-hour periods of each netting day are represented by the numbers 1 (8am-4pm), 2 (4pm-midnight), and 3 (midnight-8am).

Depth (ft)	May			June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
0			2												
1		5	11												
2		16	10			1									
3	1	22	26			3									
4		15	28			5									
5		3	20		2	5									
6		5	14		1	6		1	2						
7		5	17					1							
8	1	2	22		1			1	3					1	
9		9	10		2	1		2	6						
10	1	5	5		2	1		4	2		1				
11		1	6			2		4	4						
12		4	3		2	2		5	1			1			
13	1	1	2						2						
14			4			2					1				
15		1							2		1	1			

Table 25. (continued)

Depth (ft)	May			June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
16			1					1	1			1			
17		3										2			
18		2	2			1		1							
19		1	1					1	1					1	
20		2				2			2						
21		1			1			1	2			2			
22		2	1					4	2		1				
23		1	1						3		2	1			
24		2				1			1		1	1		1	
25						1			2			2			
26						1					1	2		1	
27		1	2						4		3				
28		1						1	1		1	3			
29		2			2			3	1		1	2			
30		1						1	3		1	2			

Table 25. (continued)

Depth (ft)	May			June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
31						2			4		2	6			
32		1				1		1	4		1	2		1	1
33		1							3		1	1		1	
34		2				1			1					1	
35						2		1			1	5			1
36												2			3
37		1			1						3	3		2	2
38		1	1									2		2	2
39		1									1	1			1
40									1		1				1
41		2									2	1		1	3
42		1										1		1	
43											2			4	5
44				1				1				3		1	2
45		1									1	2			2
46												2			1
47											2	1		3	
48														2	1

Table 25. (continued)

Depth (ft)	May			June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
49												2		2	
50		2							1			1		5	
51						1									2
52									1			3		1	2
53												1			1
54															1
55		1													2
56		2										2		1	
57									3					2	3
58															1
59		1							1		1	1			
60									2						
61		1					1								1
62												1			
63									1						
64							4		1						
65									1						

Table 25. (continued)

Depth (ft)	May			June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
66		2								1					
67										1					1
68															
69		1								4		1			
70						1				1			2		
71		1										2			2
72		1								3	1				2
73							1				1				
74		1								2	2	1			
75		1								5		2			
76		1								1	2	1			
77										1			1		1
78		1								2					1
79										2	1		4		
80		1								1					1
81										2	1		2		
82										3	1		1		
83										1	1	1	3		

Table 25. (continued)

Depth (ft)	May 1	May 2	May 3	June 1	June 2	June 3	July 1	July 2	July 3	August 1	August 2	August 3	September 1	September 2	September 3
84										7	1		2		
85		1								6			3		
86										3			2		
87															
88										1					
89										1			3		
90											1				
91															
92			1												
93															
94															
95															
96															
97															
98															
99			1												
TOTAL	4	143	191	1	14	41	6	34	69	48	44	70	23	33	47

Table 26. Dissolved oxygen concentrations (ppm) taken at 5-foot intervals in depth, at the distribution study area in Lake Cumberland from July 1 through September 30, 1971.

	July					August			September			
Depth	1	8	15	22	29	5	12	18	9	16	23	30
0	6.9	7.8	8.2	8.1	8.2	7.8	7.6	7.9	7.2	8.2	8.4	8.0
5	6.8	7.8	8.3	8.3	8.0	8.1	7.6	7.8	7.2	8.7	8.3	8.0
10	7.4	7.8	8.5	8.4	8.3	8.1	7.6	8.1	7.2	8.4	8.2	8.4
15	9.8	8.0	10.8	8.4	8.2	8.1	7.7	8.1	7.3	8.3	8.2	8.2
20	9.3	9.3	12.0	8.2	8.9	7.9	7.6	8.0	7.3	8.2	8.2	8.0
25	8.9	11.4	12.0	8.5	9.2	7.9	7.7	7.9	7.2	7.8	8.2	7.5
30	7.6	9.4	10.2	12.0	9.6	8.0	6.5	6.5	6.7	6.1	8.2	7.3
35	7.0	8.2	8.3	10.3	8.4	8.2	6.1	5.5	4.8	5.1	8.0	7.1
40	6.5	7.5	7.7	7.2	7.4	8.3	6.1	4.2	3.0	3.9	4.6	6.8
45	6.1	7.2	6.6	6.7	7.0	8.6	6.5	4.6	2.8	3.6	3.3	2.9
50	6.6	7.2	7.3	6.7	6.5	7.3	3.6	4.1	3.2	3.9	3.9	3.1
55	6.3	7.3	7.4	6.6	6.6	6.6	4.8	4.1	3.3	4.7	4.6	3.3
60	6.4	7.7	7.7	6.8	6.6	6.0	5.9	4.2	3.5	4.7	4.7	3.6
65	7.3	8.4	7.7	7.0	7.2	5.8	5.2	4.5	3.5	4.1	3.9	3.6
70	7.3	8.4	7.9	7.8	7.6	5.9	4.4	5.1	3.2	4.0	3.9	2.8
75	7.5	8.5	8.2	8.0	7.9	6.2	5.1	5.0	3.4	4.3	3.6	2.8
80	7.4	8.4	8.6	8.2	8.0	6.6	5.5	5.1	4.1	5.1	4.2	3.0
85	7.6	8.7	8.9	8.5	8.3	7.0	5.9	6.0	5.0	6.0	5.0	3.3

Table 26. (continued)

	July					August			September			
Depth	1	8	15	22	29	5	12	18	9	16	23	30
90	7.0	9.1	9.0	8.1	8.5	6.9	6.8	6.9	5.9	6.3	5.9	4.3
95	8.0	9.6	9.0	8.4	8.5	7.0	7.0	6.6	5.9	6.5	6.7	4.8
100	8.2	9.9	9.0	8.5	8.4	7.6	7.0	7.0	5.8	6.4	6.3	4.7
105	8.4	9.8	9.0	8.2	8.3	7.7	7.4	6.8	5.6	6.1	5.3	4.3
110	8.2	9.4	8.6	8.4	8.4	7.7	7.0	7.0	5.2	5.8	5.1	3.6
115	8.4	9.1	8.4	8.0	8.3	7.6	6.9	6.8	4.8	5.4	4.7	2.7
120	7.8	8.8	8.7	8.0	7.9	7.5	6.9	6.8	4.8	5.2	3.8	2.5

Table 27. Dissolved oxygen concentration (mg/l DO) profile (biweekly), in 5-foot intervals, at the vertical distribution study area in Lake Cumberland from May 1 through September 7, 1972.

	May		June			July		August		September
Depth	4	18	1	15	29	13	20	10	24	7
0	7.2	7.3	7.0	6.1	8.6	6.5	8.1	7.7	8.6	7.5
5	7.0	7.3	6.8	6.2	8.5	6.2	8.2	7.6	8.5	7.3
10	6.9	7.2	6.9	6.0	8.5	6.7	8.3	7.7	8.5	7.4
15	6.8	7.1	6.7	5.9	8.3	7.0	8.7	8.0	8.6	7.4
20	6.9	7.0	6.7	5.0	7.9	6.9	8.8	8.0	8.8	7.4
25	7.0	7.0	6.6	5.0	6.7	6.8	9.1	8.0	8.6	7.3
30	7.1	7.0	6.6	5.3	5.8	5.7	9.3	8.0	8.6	7.4
35	7.2	7.0	6.6	5.8	6.9	5.0	7.3	7.8	7.8	6.3
40	7.1	7.0	7.0	5.8	6.5	4.8	6.2	7.0	7.1	5.0
45	7.1	7.3	7.1	5.8	7.0	5.0	5.9	6.1	6.1	3.9
50	7.1	7.6	7.3	6.1	7.6	5.2	6.3	5.5	5.6	4.2
55	7.3	7.8	7.3	6.2	8.2	5.6	6.6	5.1	5.4	3.6
60	7.2	7.8	7.5	6.3	8.3	6.1	7.0	5.6	5.6	3.9
65	7.2	7.8	7.7	6.4	8.7	6.2	7.6	6.1	6.4	4.4
70	7.2	7.8	8.0	6.6	9.0	6.7	8.4	6.1	6.6	5.3

Table 27. (continued)

	May		June			July		August		September
Depth	4	18	1	15	29	13	20	10	24	7
75	7.3	8.0	8.0	6.9	9.2	6.7	8.5	7.4	7.0	5.8
80	7.4	8.0	8.0	7.0	9.3	7.2	9.2	7.6	7.5	6.0
85	7.5	8.0	8.0	7.1	9.6	7.2	9.0	8.4	7.7	6.3
90	7.5	8.0	8.0	7.2	9.6	7.3	9.0	8.4	8.0	6.3
95	7.5	8.0	8.0	7.2	9.3	7.5	8.9	8.4	8.2	6.5
100	7.5	8.0	8.0	7.3	9.3	7.2	9.0	8.0	8.4	6.4
105	7.5	8.0	7.7	7.0	9.3	7.0	8.7	7.8	8.0	5.7
110	7.5	8.0	8.0	7.0	8.7	7.0	8.4	7.5	7.3	5.5
115	7.5	8.0	8.1	6.8	8.5	6.7	8.0	7.5	7.6	4.8
120	7.5	8.0	7.8	6.6	8.6	6.7	7.9	7.0	6.0	

Table 28. Rainbow trout catch per unit effort by vertical gill nets at 5°F water temperature ranges during the 1971-72 vertical distribution studies on Lake Cumberland.

Temperature (°F)	1971			Total
	July	Aug.	Sept.-Oct. 1	
74°-78°	.0058			.0009
79°-73°	.0061	.0140	.0100	.0099
64°-68°	.0035	.0026	.0068	.0005
59°-63°	.0168	.0044		.0086
54°-58°	.0030			.0014

Temperature (°F)	1972					
	May	June	July	Aug.	Sept.	Total
64°-68°				.0052		.0012
59°-63°			.0331	.0063		.0073
54°-58°				.0088		.0020