Fisheries Report
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Duck River Creel Survey
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Submitted to

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By

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FORWARD

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INTRODUCTION

The trout fishery on the Duck River below Normandy Dam is intensively managed by the Tennessee Wildlife Resources Agency (TWRA) as a put-and-take fishery. Catchable rainbow trout (n = 52,951) were stocked at frequent intervals between February and December 2000. Between May and October 2000, a roving creel survey was used to examine pressure, harvest, and success rates of trout anglers fishing the Duck River. These characteristics of the fishery were first examined in 1995 (Bettoli 1996).

STUDY AREA

Normandy Dam is located on the Duck River at river kilometer 401 (river mile 249). Unlike most tributary impoundment dams in Tennessee, Normandy Dam is not a hydroelectric-generating facility. Water is released from the dam to meet downstream water requirements and for flood control. A guaranteed minimum flow from the dam of 1.13 m^3/s (40 cfs) is provided year-round. Between June and November, water releases are adjusted to provide minimum flows of 4.40 m^3/s (155 cfs) downstream at Shelbyville; between December and May, minimum flows of 3.40 m^3/s (120 cfs) at Shelbyville are guaranteed. The year 2000 was a dry year in the Duck River watershed; average daily discharge during the 2000 fishing season was the third lowest since 1990 (Figure1)

Discharged water passes through a regulated sleeve valve, which maintains oxygen levels above 4 mg/L. Water is withdrawn from different layers during periods of stratification to keep downstream water temperatures cool; however, elevated summer temperatures are occasionally problematic. The guaranteed minimum flows were meant to ensure that water temperatures at the Three Forks Bridge (the most downstream stocking site; Figure 2) do not exceed 22 C (72 F). However, the water discharged from the dam often exceeds that downstream-target temperature each summer (Figure 3). Although discharge rates vary substantially over the course of the year, the tailwater does not experience the large, daily fluctuations in flow common below hydroelectric dams that meet peak power demands.

Normandy Lake is eutrophic and the hypolimnion is anoxic by early summer. Since impoundment in 1976, elevated concentrations of iron and manganese below the dam have been problematic. No information is available that would suggest that iron and manganese concentrations in the tailwater are acutely toxic to trout and other aquatic organisms; however, these elements are toxic to aquatic life at high concentrations (Oglesby et al.1978). Also, water clarity is reduced when concentrations of these oxidized metals are high and the precipitates of these metals coat the substrate, reduce habitat quality, and hamper benthic macroinvertebrate production.

The Tennessee Valley Authority (TVA) began oxygenating the forebay of Normandy Lake in 1994 to improve downstream water quality. Over 3,700 m of diffuser lines were sunk in and around the original river channel in the forebay of the reservoir. Dissolved oxygen levels did not rise appreciably; therefore, in 1996 TVA expanded the system to

include an additional 2,900 m of diffuser lines and several more air compressors. Sammons and Bettoli (1999) noted that dissolved oxygen levels in the forebay's hypolimnion increased several parts per million after 1996.

Riffle habitat is scarce in the Duck River below Normandy Dam; deep pools and shallow runs predominate. Unlike other tailwaters in Tennessee that experience extreme fluctuations in flow on a daily basis, instream cover in the form of woody debris is common in the Duck River.

METHODS

The roving creel survey began May 1 and ended October 31. The reach of the river stocked with trout is short; therefore, the survey was not stratified by area. The survey was stratified by month and kind-of-day. During the five-month survey, the clerk worked 7-8 weekend days and 8-9 weekdays chosen at random each month. The number of daylight hours each day during the first and second half of each month was determined and each workday was then divided into AM (dawn to midday) and PM (midday to sunset) shifts. The AM and PM shifts were randomly chosen with equal probabilities.

Counts were made ran from Normandy Dam to the Three Forks Bridge, a distance of 15 river km (Figure 2). The clerk visited each of the access points (which corresponded to stocking locations) to make the counts and he counted anglers twice each work shift. The time to start the first count was randomly selected from a list of possible start times for each shift, beginning at daylight (or midday) and every 30 minutes thereafter until 2 hours before the end of the shift. The second count was made at a randomly chosen time 1-5 hours after the first count and the average of the two counts was used in subsequent calculations of fishing effort. Before and after each count, the clerk interviewed anglers.

If anglers agreed to be interviewed, they were asked how long they had been fishing, whether they were finished fishing, and how many rainbow trout they caught. The clerk measured the total length of any harvested trout. Anglers were asked their state of residency and Tennessee residents were asked for their county of residence. Finally, the clerk recorded the method of fishing being used by each angler.

Mean daily counts were expanded to estimate effort in each stratum (i.e., kind-of-day), then pooled to estimate effort each month following the methods of Pollock et al. (1994). Catch and harvest rates were measured using the mean of ratios method, which is recommended for roving creel surveys (Pollock et al. 1997); interviews of parties that had been fishing for less than 30 minutes were excluded from the analysis. The numbers of rainbow trout caught and harvested were then estimated for each month. Completed trip interviews provided information on trip length; these data were pooled over the entire survey and average trip length was calculated. The total number of hours of pressure over the survey was then divided by mean trip length to estimate the number of trips anglers made to the river. Standard errors of catch, harvest, and effort were calculated according

to Pollock et al. (1994). A spreadsheet was used to perform all necessary calculations and calculate 95% confidence intervals around each estimate of catch, harvest, and effort.

RESULTS and DISCUSSION

Angler Characteristics

Only 16 (3%) of the 595 anglers interviewed on the Duck River were not Tennessee citizens. The majority (55%) of the anglers fishing the Duck River were from the two counties adjacent to the tailwater (Bedford and Coffee); anglers were evenly divided between those two counties. Rutherford county (adjacent to Bedford county) accounted for 13% of the anglers and 25 other Tennessee counties accounted for the remaining 32% of the anglers interviewed. The residency of anglers in the 1995 survey was very similar to these findings for the 2000 fishing season: the only substantive difference was that the percentage of local anglers dropped from 69% in 1995 to 55% in 2000.

As in the 1995 survey, stillfishing with bait was by far the most common technique (66%) used by trout anglers fishing the Duck River; the percentage was 70% in 1995. Anglers spinfishing with artificial lures and flyfishermen accounted for 26% and 8 % of all the anglers interviewed, respectively; the percentage of anglers flyfishing increased slightly from 22% in 1995.

Fishing Pressure

The clerk interviewed 595 anglers in 381 parties. Unlike other tailwaters in Tennessee (and the Duck River in 1995), more than a third (37%) of parties interviewed on the Duck River in 2000 indicated they were not specifically targeting trout. By way of comparison, the percentage of anglers targeting trout in other Tennessee tailwaters is consistently between 95% and 99% (e.g., Elk River – 97%; Caney Fork River – 98%; Hiwassee River – 98%; Watauga River – 96%).

Over the 28-week survey, fishing pressure totaled 20,089 hours (Table 1). Compared to the same five-month period (May-September) in 1995, fishing pressure in 2000 was 19,538 hours, or about 14% higher than in 1995 (Bettoli 1996). The average trip length in 2000 equaled 2.23 hours; therefore, an estimated 9,000 trips were made by fishermen during the 2000 survey. Monthly pressure was highest during the first month of the survey (May) and steadily declined through the summer and fall, which indicates that future surveys should be initiated earlier in the year.

Catch and Harvest

Anglers reported catching 12,411 rainbow trout, of which an estimated 8,085 were harvested (Table 2). The difference between the number of rainbow trout harvested and caught represented a release rate of 35%. The number of rainbow trout harvested was only 22% of the total number of catchable rainbow trout stocked (n = 35,954) during the survey. Low rates of return for stocked trout were also noted in the 1995 survey.

The range of lengths of rainbow trout that were creeled was centered on the average size of trout stocked into the river (about 26 cm total length; Figure 3). No data on growth rates were available, but few trout overwinter in the Duck River and that suggests that the larger trout harvested (30-35 cm TL) were simply larger-than-average trout at stocking.

The high percentage of anglers that were targeting species other than trout (or not targeting any particular species) was reflected in the number of fish other than trout ("non-trout") that were creeled. Data were not expanded to estimate how many non-trout were harvested over the survey period; however, nearly twice as many non-trout fishes were observed in the creel as rainbow trout (Table 2). Twelve non-trout species were harvested and the bulk of the catch was represented by bluegills. In terms of the species diversity and number of non-trout harvested, the Duck River trout fishery stands alone among Tennessee trout fisheries.

Fishing Success

Catch rates (number of fish caught per hour) for rainbow trout remained high (0.77 – 0.97) through August, but plummeted in September and October (Table 1). The low catch rates in September and October may have resulted from the elevated temperature of the water discharged from Normandy Dam (Figure 4); water temperatures by late August were acutely lethal (i.e., 27 C) to rainbow trout and temperatures did not fall below 22 C until mid October. The pooled catch rate over the entire survey (intended anglers only) was 0.84 trout /hour, which was identical to the catch rate for rainbow trout and brown trout (combined) in the 1995 survey.

CONCLUSIONS & RECOMMENDATIONS

Efforts by TWRA to publicize the Duck River fishery began when the 1995 survey was being conducted. Those efforts may have been rewarded with a slight increase (14%) in fishing pressure in 2000 over comparable five-month periods. It is unknown whether fishing pressure year-round increased between the two survey periods.

TWRA electrofishing surveys in 1998 revealed that few rainbow trout holdover from one year to the next in the Duck River (Cleveland et al. 1999), which is probably due to high water temperatures in late summer and fall. Scott et al. (1996) noted that warmwater species were abundant in the Duck River below Normandy Dam; in fact, fish species diversity (36-43 species) was more indicative of a warmwater stream then a coldwater trout fishery. The number and diversity of non-trout fish species observed in the creel also indicates that the Duck River is not a good candidate for a year-round trout fishery.

Water temperatures observed at the dam in September and October 2000 were the highest recorded in any Tennessee tailwater managed for trout. Water temperatures 15 km downstream at Three Forks Bridge would have been even higher at those times.

Although the precise temperature that will kill a rainbow trout will vary according to several factors, stocking trout in the Duck River in late summer, when temperatures routinely exceed 25 C, is clearly a waste of resources. Fishing pressure is low, catch rates are poor, and few trout live long enough to be harvested. TWRA should consider severely curtailing all trout stockings after the July 4th holiday weekend and not resume them until October, at the earliest. Fishing pressure was so low in September and October that few fishermen would probably notice that few trout were being stocked.

No water quality data were collected during this survey, but such studies are needed. In addition to being warm, the late summer discharges were malodorous (due to hydrogen sulfide); it is presumed that iron and manganese concentrations are still elevated. Catches of all species were very low after August and it may be that few species (not just rainbow trout) are capable of persisting in the Duck River immediately below the dam at that time of year. Collecting some electrofishing samples in the first few km of the river below Normandy Dam in early fall would provide information to address that concern.

The high frequency at which non-trout fishes were caught and harvested indicated that TWRA should not ignore the warmwater fishery (and its clientele) in the Duck River. Those observations also suggest that the Duck River should be managed as a seasonal, not year-round, trout fishery. It is believed that few trout survive through the critical late-summer period; thus, the Duck River could be a candidate for delayed harvest regulations, at least in certain reaches of the river. For instance, the reach between the first bridge and the dam could be managed with statewide regulations (because of the excellent access and parking facilities) and the lower reaches could be managed with a delayed harvest regulation to maximize catch rates in spring and early summer. Delayed harvest regulations are common in waters of adjoining states (e.g., North Carolina) that can not support trout year-round, although it is unknown whether the anglers that fish the Duck River would favor such regulations.

Finally, the Duck River is the shortest trout tailwater managed by TWRA. Conducting instantaneous counts in order to estimate pressure is simple and does not take more than 20 –30 minutes; the calculations are also straightforward. It is the interview process (which collects information on catch rates) that requires the most time and effort in a creel survey. Consideration should be given to conducting a yearlong survey of fishing pressure on the Duck River using TWRA staff based at the Normandy Fish Hatchery. This arrangement would provide TWRA with the most important information that these surveys provide and at little cost. Also, the chronic problems encountered in hiring and retaining part-time creel clerks would be avoided.

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Table 1. Fishing pressure, catch, and harvest rates of rainbow trout on the Duck River, 2000. Standard errors in parentheses. N = sample size for catch rate calculations

Month	Pressure (h)	Number Caught	Number Harvested	Catch Rate[1]	N
May	6,719 (711)	4,526 (695)	3,157 (613)	0.97 (0.12)	75
June	4,565 (554)	2,769 (703)	1,792 (537)	0.92 (0.16)	46
July	4,701 (526)	3,457 (1,746)	2,182 (914)	0.87 (0.22)	45
August	2,430 (417)	1,010 (248)	564 (124)	0.77 (0.13)	34
September	1,123 (183)	416 (162)	188 (115)	0.34 (0.11)	19
October	551 (65)	233 (90)	202 (95)	0.51 (0.17)	12
Total	20,089 hours (2,348)	12,411 (2,441)	8,085 (1,693)	0.84 (0.07)	231

[1] - Intended anglers who had been fishing at least 30 minutes before being interviewed

Table 2. Number of fish creeled by anglers on the Duck River, May – October 2000.

Common Name	Scientific Name	Number
Gar	*Lepisosteus* spp.	1
Redhorse sucker	*Moxostoma* spp.	2
Rainbow trout	*Onchorhynchus mykiss*	312
Channel catfish	*Ictalurus punctatus*	10
Redear sunfish	*L. microlophus*	1
Warmouth	*L. gulosus*	32
Bluegill	*L. macrochirus*	507
Black crappie	*Pomoxis nigromaculatus*	15
Smallmouth bass	*Micropterus dolomiei*	9
Spotted bass	*M. punctulatus*	1
Largemouth bass	*M. salmoides*	27
White bass	*Morone chrysops*	3
Walleye	*Stizostedion vitreum*	1
Number of Fish Creeled		921
Number of Non-trout Creeled		609

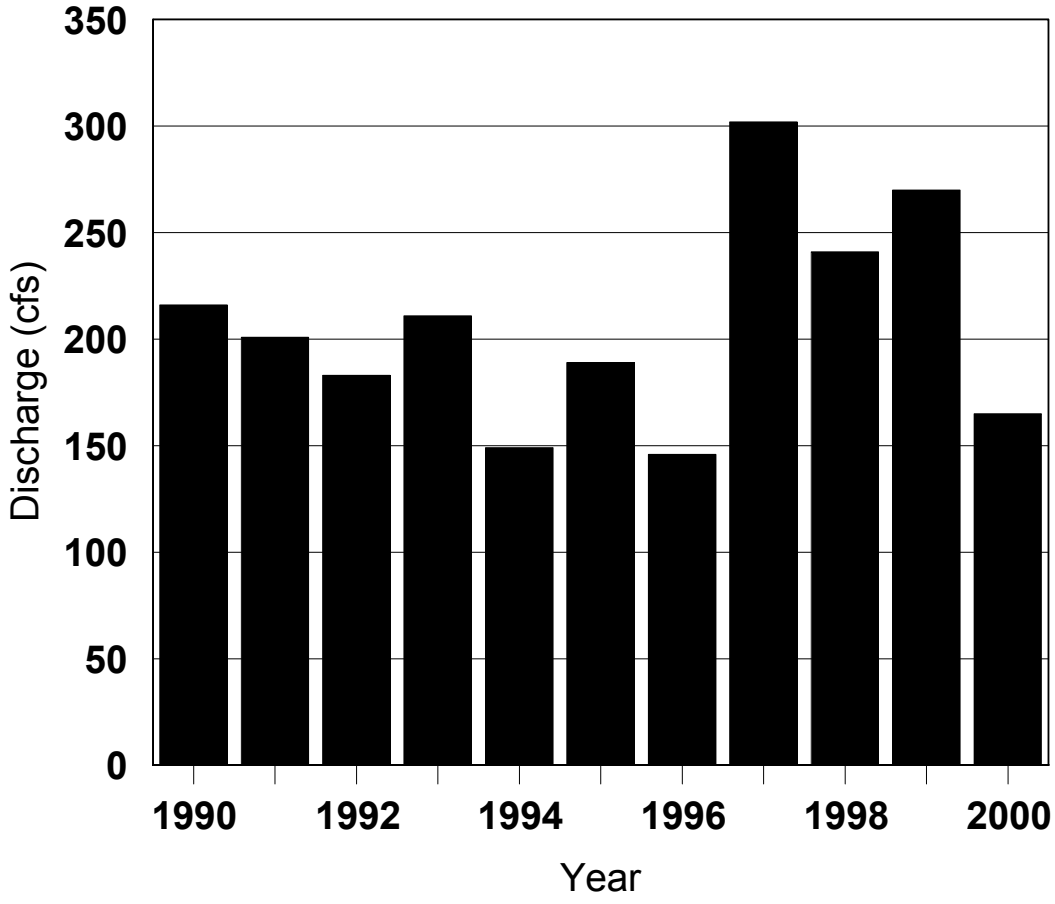

Figure 1. Average daily discharge from Normandy Dam during May - October 1990-2000.

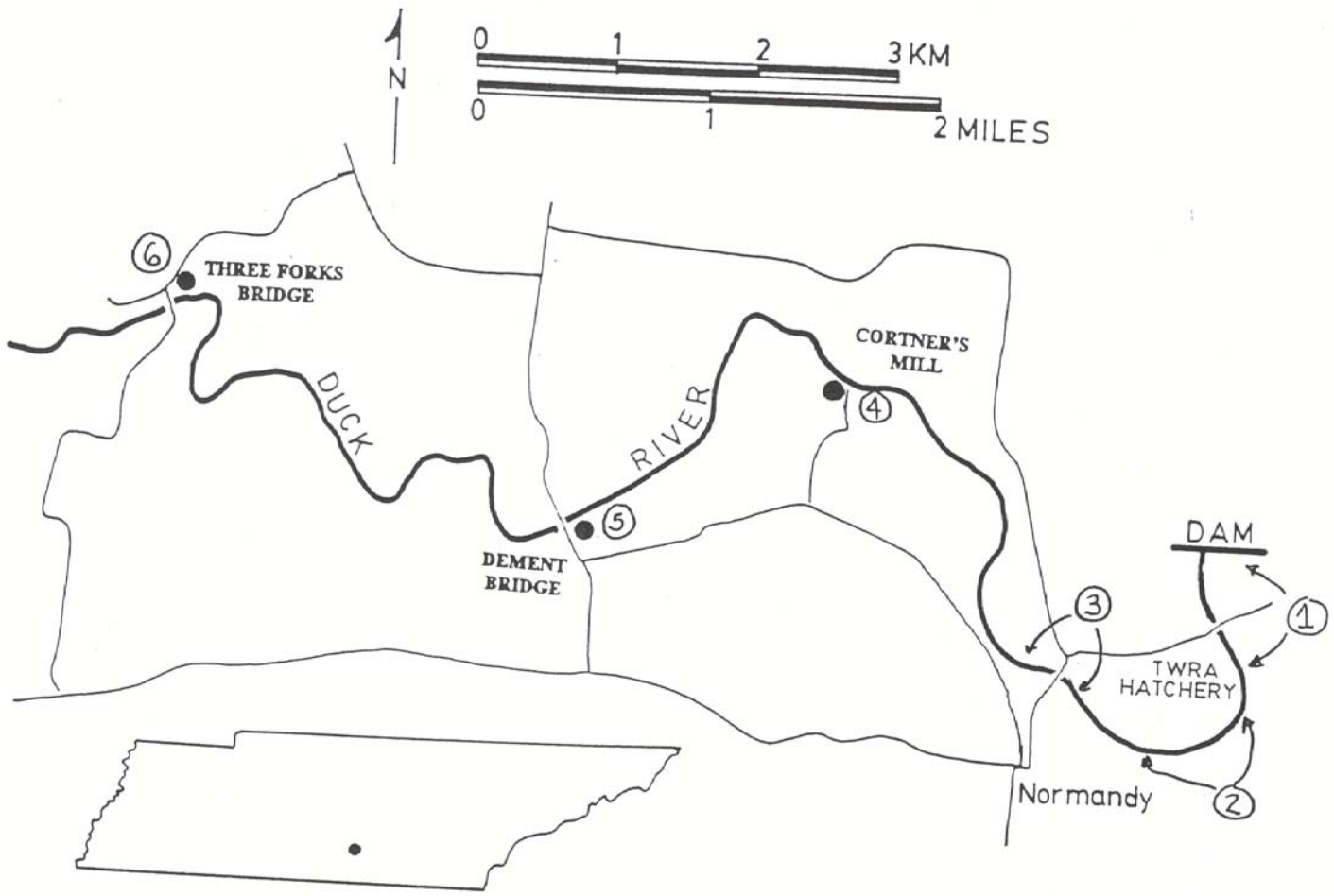

Figure 2. Map of the Duck River which was surveyed April - October 2000.

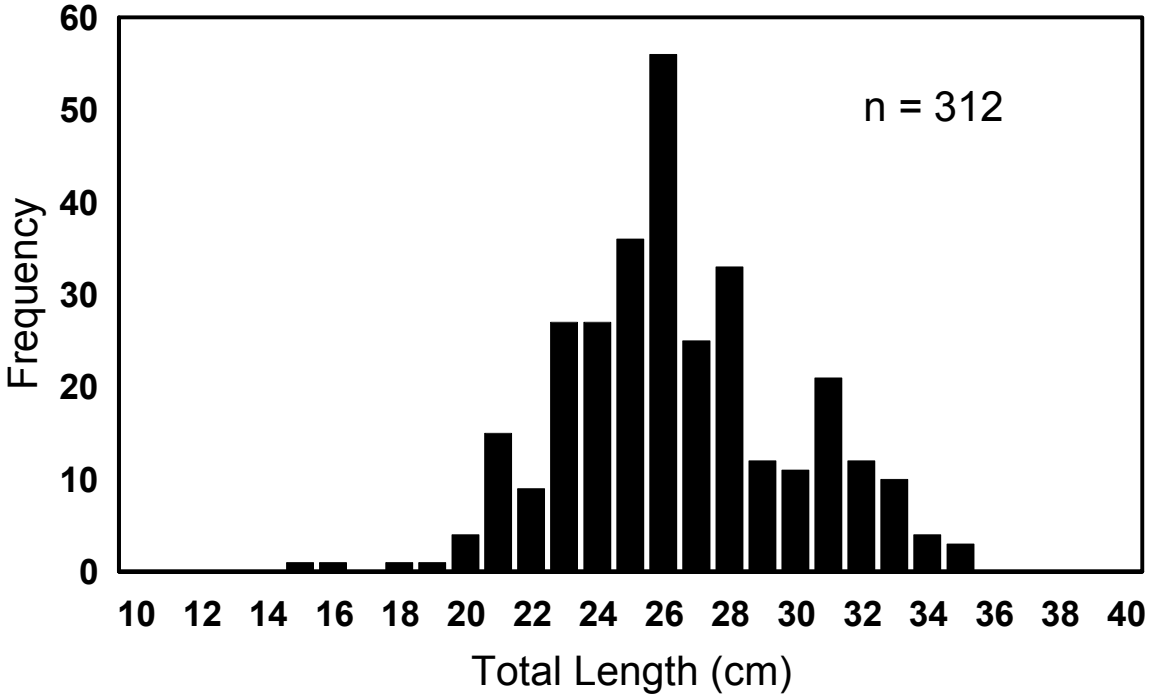

Figure 3. Length-frequency distribution for rainbow trout creeled on the Duck River, April - October 2000.

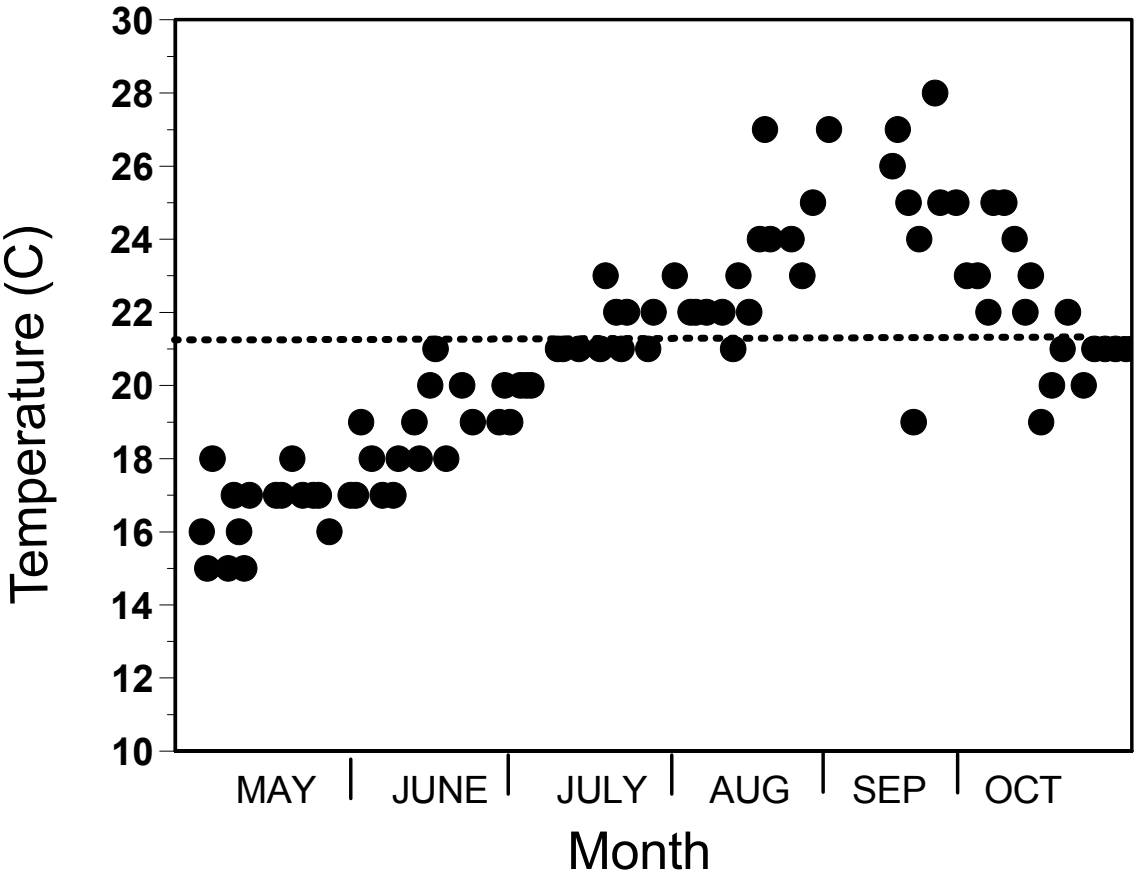

Figure 4. Temperatures measured at the Duck River below Normandy Dam in the summer and fall, 2000. Creel clerk recorded temperature at the start of first angler count; the time of the count was randomly determined each survey day.