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Norris tailwater creel survey : fishermen responses to quality regulations

William Calvert. Fraser

To the Graduate Council:

I am submitting herewith a thesis written by William Calvert. Fraser entitled "Norris tailwater creel survey : fishermen responses to quality regulations." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

Richard J. Strange, Major Professor

We have read this thesis and recommend its acceptance:

Ralph W. Dimmick, J. Mark Fly

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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NORRIS TAILWATER CREEL SURVEY: FISHERMEN RESPONSES TO QUALITY REGULATIONS

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

William Calvert Fraser
August 1995

Abstract

Norris Tailwater is located in Anderson county in East Tennessee. It was created when Norris dam impounded the Clinch River in 1936 and hypolimnetic discharges for power generation changed the cool-water river to a cold-water tailwater. The tailwater has been an important trout fishery since the 1950's when regular stocking of rainbow trout (Oncorhynchus mykiss) and brown trout (Salmo trutta) began. On March 1, 1993 the Tennessee Wildlife Resources Commission implemented a new quality zone on 6.4 km of tailwater from Cane Creek to the bottom of Llewellyn Island. The new regulation stated only 2 fish over 14 in could be kept and only artificial lures could be used in the quality zone. Because of local controversy, the regulations were changed in 1994 to 3 fish, only one could be over 14 in and no bait restrictions applied to the quality zone. This study was undertaken to evaluate the effect of these new regulations.

An access point creel survey of float anglers was conducted in 1993. The survey was administered at two boat ramps within the 16.4 km study area. The area was divided into three approximately equal zones; the upper zone, the quality zone, and the lower zone. In 1993, quality zone anglers' catch rate (0.6 fish/hour), total effort (360 man hours), and total catch (200 trout) was significantly lower ($P < 0.05$) than the lower zone anglers' catch rate (1.4 fish/hour), total effort (1720 man hours), and total catch (2420 trout). Percent release was high in the quality zone (94%) but was not significantly different from the lower zone (62%). The most common gear used over the entire

area was spincast gear (91%). The most common bait used over the entire area was artificial bait (43%). It was impossible to determine if fish caught within the quality zone were larger because of the small sample size (n = 5) measured in the quality zone. Most float fishermen (59.5%) came from nearby Knox county which was the most populated county in the region.

The data gathered in 1993 led to changes in the design in 1994. In 1994, two wading access points were added, survey periods were lengthened to interview more types of anglers, and questions were added to obtain fishermen's opinions of quality regulations. In 1994 float and wade anglers were interviewed. No bank anglers were included in this survey. Anglers within the quality zone had approximately the same catch rate (1.3 fish/hour) as anglers in the lower zone (1.2 fish/hour). Quality zone anglers' total effort (3090 man hours) and total catch (4070 fish) were significantly lower ($p < 0.05$) than lower zone anglers' total effort (7190 man hours) and total catch (8590 fish). Anglers within the quality zone released significantly more fish (95%) than anglers in the lower zone (74%). The most prevalent gear over the entire area was flyfishing gear (46%) and artificial bait was the most prevalent bait (68%). Again, it was impossible to determine if fish within the quality zone were larger because of the small sample size from the quality zone (n = 4). As in 1993, most fishermen came from Knox county (56.1%) in 1994. More anglers were in favor of quality regulations (68%) than were against (18%). Sixty-nine percent of anglers interviewed indicated the quality regulations did not change the way they fished the tailwater.

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Chapter I

Introduction

Tailwaters in Tennessee are an important fisheries resource utilized by many fishermen. Swink (1983) named 9 tailwaters which were important trout fisheries; Appalachia, Center Hill, Dale Hollow, Fort Patrick Henry, Normandy, Norris, South Holston, Tims Ford, and Watauga. These comprised approximately 203 km of river. These tailwaters are used for salmonid fisheries because cold hypolimnetic discharges from the dams create suitable habitat for trout (Swink 1983). Little (1978) estimated tailwaters provide 177 km of year-round trout habitat and stated these tailwaters also provide more surface acreage for favorable trout growth and survival than all natural streams in Tennessee.

In most cases, rainbow trout and brown trout are the species of choice for stocking tailwaters. In 1980, approximately 555,550 trout including both rainbow and brown trout, catchables (> 150 mm), as well as fingerlings (< 150 mm) were stocked in Tennessee tailwaters. This was approximately 46% of all trout stocked in Tennessee in 1980. The species and size most stocked were rainbow catchables (51%) followed by rainbow fingerlings (43%). Brown trout fingerlings were less numerous (5%) and brown trout catchables comprised less than 1% of all trout stocked in 1980 (Swink 1983). With costs of $0.68 per fish for catchable trout (Hartzler 1988, Wiley et al. 1993) and $0.13 per fish for subcatchables (Wiley et al. 1993), Tennessee is investing

considerable money into the state's tailwaters. Wiley et al. (1993) estimated that the cost of fish returned to the creel was $3.67 for catchables and $6.29 for subcatchables, making the price of fish caught considerably higher than production costs.

Problems have been associated with tailwaters. When dams have been built on warm or cool water rivers, water has been released from the lower, cold hypolimnion and the ecology of the river drastically altered. The most prominent problems have been low dissolved oxygen (DO) levels and inadequate minimum flows when turbines were idle (Yeager et al. 1987). These problems have caused declines in species diversity of aquatic plants and invertebrates (Pfitzer 1954, Cushman 1985, Yeager et al. 1987, Yeager et al. 1994, Yeager 1994), interfered with fish reproduction, disrupted fish migrations (Yeager 1994), and displaced or killed many species (Pfitzer 1954). Specific problems associated with invertebrate populations were reduced numbers of ephemeropterans, trichopterans, and plecopterans with an increase in amphipods, isopods, and gastropods (Yeager et al. 1994).

Yeager et al. (1994) stated Norris was the most heavily fished cold-water tailwater in Tennessee. Norris tailwater was created when The Tennessee Valley Authority (TVA) built Norris Dam on the Clinch River and impounded water on March 4, 1936 (Tarzwell 1938). The dam was built for power generation and flood control approximately 22.5 river km north of Clinton Tennessee in the Ridge and Valley province of Tennessee. Yeager et al. (1987) measured mean width of the tailwater to be between 94.6 m (low water) and 131.6 m (high water) with depths ranging from several cm to 3 m. Stream gradient

was approximately 0.4 m per km. Estimates taken by Tennessee Wildlife Resources Agency (TWRA) in 1993 and 1994 at Miller Island and Coldwater Farms indicated pools comprise approximately 20-40% of the stream with substrate ranging from silt to bedrock. Temperatures taken at these two sites in August of 1993 and 1994 ranged from 10-13^0 C. Other physical characteristics included: pH 7.0-8.2, conductivity 160-190 micromhos/cm, and dissolved oxygen 7.2-10.4 (Bivens et al. 1994, Tennessee Wildlife Resources Agency, unpubl. data).

In its early years, Norris tailwater experienced many problems associated with cold hypolimnetic discharges. The warm-water fishery below the dam was virtually destroyed and low DO (1 mg/l) and lack of adequate minimum flow (< 200 cfs) limited development of a cold-water trout fishery (Yeager et al. 1987). To address these problems The Reservoir Releases Improvements Program was created in 1980 by TVA. First, in 1980, a hub baffle system was added to one turbine, but did not significantly increase DO. In the following year, the system was tested on both turbines and DO was increased by 0.7 mg/l. In 1982, an air injection system was tested on unit number two, but was replaced by an improved hub baffle system. Finally, in 1983 both units received the improved hub baffle systems and DO was increased by 2-3 mg/l (Yeager et al. 1994). To address the minimum flow problems, TVA in 1984 built a $350,000 weir dam approximately 3.2 km from Norris Dam. The weir was built of gabions interspersed with a series of pipes and valves (Anonymous 1983). The new weir dam created a 200 cfs

minimum flow for 22.5 km of tailwater below the dam thereby increasing the depth and wetted area (Yeager et al. 1994).

Game fish species found by TWRA in 1993 and 1994 in the tailwater include: rainbow trout, brown trout, largemouth bass (Micropterus salmoides), smallmouth bass (Micropterus dolomieu), rock bass (Ambloplites rupestris), redbreast sunfish (Lepomis auritus), green sunfish (Lepomis cyanellus), bluegill (Lepomis macrochirus), walleye (Stizostedion vitreum), sauger (Stizostedion canadense), and yellow perch (Perca flavescens). Nongame fish include: channel catfish (Ictalurus punctatus), quillback (Carpiodes cyprinus), white sucker (Catostomus commersoni), northern hogsucker (Hypentelium nigricans), smallmouth buffalo (Ictiobus bubalus), black buffalo (Ictiobus niger), spotted sucker (Minytrema melanops), shorthead redhorse (Moxostoma macrolepidotum), river redhorse (Moxostoma carinatum), black redhorse (Moxostoma duquesnei), golden redhorse (Moxostoma erythrum), central stoneroller (Campostoma anomalum), common carp (Cyprinus carpio), bluntnose minnow (Pimephales notatus), blacknose dace (Rhinichthys atratulus), logperch (Percina caprodes), banded sculpin (Cottus carolinae), threadfin shad (Dorosoma petenense), gizzard shad (Dorosoma cepedianum), skipjack herring (Alosa chrysochloris), brook silverside (Labidesthes sicculus), and longnose gar (Lepisosteus osseus) (Bivens et al. 1994, Tennessee Wildlife Resources Agency unpubl. data).

TWRA sampled aquatic invertebrates in 1993 (Bivens et al. 1994). At Coldwater Farms, they found 764 organisms representing 19 taxa. At Miller Island 628 organisms representing 10 taxa were

collected. The sample at Coldwater Farms contained amphipods (56%), dipterans (22%), isopods (9%), ephemeropterans (4%), trichopterans (1%), and other (8%). Miller Island was less diverse and had representatives from Amphipoda (67%), Diptera (29%), and other (4%).

The first recorded stocking on Norris tailwater occurred in 1936 when rainbow trout were stocked below the dam. A few of these were taken by anglers in 1937 (Tarzwell 1938). In later years, (1950 through 1970) the Tennessee Game and Fish Commission stocked trout sporadically in Norris tailwater (Yeager et al. 1987). From 1973 through 1992 total fingerlings (< 178 mm) stocked ranged from a low of 134,400 in 1982 to 244,285 in 1974. Total catchables (> 178 mm) ranged from a low of 10,000 in 1981 to 130,750 in 1988. During the same time period, brown trout catchables were also stocked. The number of brown trout catchables was highest in 1988 when 60,000 were stocked and lowest in 1981 when only 5,000 were stocked (Yeager et al. 1994).

Until recently, all of Norris tailwater has been under general regulations, which permit fishermen to possess up to 7 fish of any size, caught with any type of bait. Because the river has produced trophy sized brown trout including the current state record of 28 lb 12 oz, special interest groups petitioned TWRA to develop a special regulation zone in the tailwater. In December of 1992, the Tennessee Wildlife Resources Commission (TWRC) passed a "Quality Zone" regulation for 6.4 km of tailwater to begin on March 1, 1993. The new regulation stated that fishermen inside the quality zone could possess only two

trout in excess of 14 in (355.6 mm) taken only by artificial lures (Bivens et al. 1994). This regulation caused a great deal of controversy in the local area. Float fishermen said they were not being treated fairly because they could not float through the quality zone with more than two trout or with bait in the boat. In the past, float fishermen had launched in the upper reaches of the river and floated the entire tailwater to Highway 61 bridge. Local landowners also voiced disapproval of the new regulation stating the new regulations were unfair to them as well. To address these problems TWRC changed the quality zone regulations for the next year. The new regulation, effective as of March 1, 1994, stated that fishermen could keep three trout of which one could be over 14 in. Any type of bait could be used, and float fishermen could float through the quality zone with more than three trout in the boat if they were not actively fishing in the quality zone. Because of continuing controversy, in March of 1995 the quality zone was abolished.

The purpose of this study was to evaluate fishing conditions and fisherman uses of Norris tailwater specifically as related to new quality regulations enacted on the tailwater. The four major objectives were:

1. To determine if fishing in the quality zone differed in fishing effort, total catch, and catch rate from adjacent general regulation zones.
2. To determine if size of trout creeled in the quality zone differed from adjacent general regulation zones.
3. To determine what effect the regulations on fish size and bag limits had on float fishing patterns.

4. To determine if the quality zone attracted fishermen from a broader service area (greater distance) than the adjacent general regulation zones.

Chapter II

Methods

1993 Survey of Float Anglers

In 1993, a survey of float anglers was undertaken. The design was a summer daylight hours survey. A study area from River Road access to Highway 61 bridge was chosen because of locations of boat ramps at the top (River Road boat ramp), middle (Peach Orchard boat ramp) and bottom (Highway 61 bridge boat ramp) of the area (Figure 1). The study area was divided into three zones. The upper zone was from River Road to Peach Orchard access. The quality zone was from Cane Creek to the bottom of Llewellyn Island. The lower zone was from Peach Orchard to the beginning of the quality zone and from the bottom of the quality zone to Highway 61 bridge. The lower zone covered areas on both sides of the quality zone. Each zone was similar in length; upper 5.6 km, lower 4.8 km, and quality 6.4 km.

An access point survey was conducted because access to the river was believed to be restricted by the land ownership pattern. Most fishermen could only access the river via boat ramps at the sites mentioned above. The only fishermen who accessed the river at points other than the boats ramps were believed to be private land owners and their guests. Another reason an access point survey was conducted was that the numbers of anglers could be counted directly for each sample period and no aerial pressure counts would have to be conducted. Other advantages of the access point survey included the

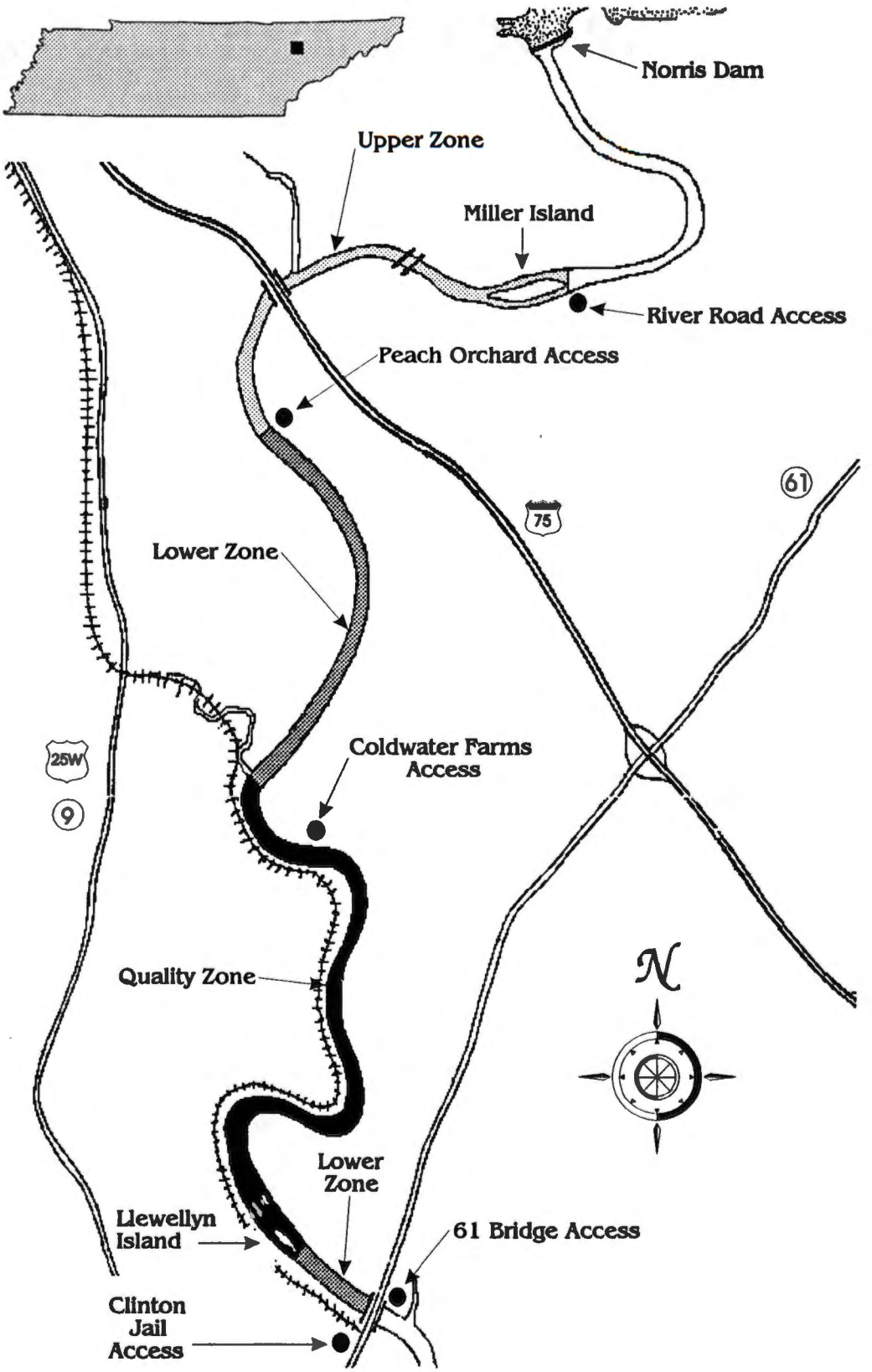

Figure 1. Map of study area with circles indicating access points.

fact that all data were based on finished trips, total catch retained by anglers could be counted directly, estimation of total fishing pressure is based on fishermen responses, type of aquatic recreation can be determined exactly, and the clerk was not exposed to the dangers of canoe travel (Hayne 1991). The access point method also had several constraints. The volume of fishermen leaving the access point could exceed the clerk's ability to interview them (Hayne 1991). To address this problem the clerk was to record all fishermen leaving the access point, even if no interview was conducted. Data would then be extrapolated to all fishermen. Another potential problem of an access point survey was that fishermen must be relied upon to correctly report time and place of fishing (Hayne 1991). The clerk used a 7.5 minute series United States Geological Survey map of the area to help fishermen determine where and when the fishing was conducted. The final constraint of an access point survey is that unknown access points could create negative bias in estimates of fishing (Hayne 1991).

The survey days were from July 12 to September 6, 1993. Every weekend day was surveyed, as well as two randomly selected weekdays. The creel clerk interviewed anglers at either Peach Orchard or Highway 61 bridge in the morning from 10am to 2pm and at the alternative site in the afternoon from 3pm to 7pm. The hour between periods was left open so the clerk could travel to the next survey point. No surveys were conducted at River Road access because the survey was concerned with lower portions of the tailwater closer to the quality zone. The location where the clerk was to start the survey day (10am to 2pm) was randomly selected.

At each survey time the creel clerk would go to the designated location and remain at the boat ramp for the entire period. When fishermen would approach the ramp, the clerk would intercept the fishermen and inquire if they were finished fishing for the day. If they responded yes, the interview would begin. The first statement would be "I am a University of Tennessee student conducting a creel survey and was wondering if I could ask you a few questions?". If the response was favorable, the actual interview would begin. After the interview, the clerk would ask if the fish kept by the fishermen could be measured and weighed. After the interview and measurements were finished the fishermen would be thanked. At the end of the survey period, the clerk would tally the number of fishermen who came off that ramp and record that on a separate sheet. The fishermen who were not interviewed were counted as well. The date, location, and number of boats that left the river were also recorded. If it rained during the survey period, no fishermen were interviewed, because they were less willing to participate. During rain, only fishermen numbers were recorded. If it was raining and the parking lot was empty, the clerk would declare a rain day and conduct no more interviews.

During the 1993 survey, the following fisherman-related data were recorded for each interview on the creel instrument (Appendix 1): date, survey location (Peach Orchard or 61 bridge), interview number, launching point, start time, finish time, zone fished (upper zone, lower zone or quality zone), time spent in each of the three zones, number in party, and zip code. The following fish-related data were also recorded for each interview (each zone was recorded separately): species caught,

number kept, number released, method of fishing (spincast or flyfishing with lures, livebait, corn, or other). Fish harvested were weighed to the nearest gram with a spring balance and measured to the nearest millimeter. Species and the zone from which they were caught were recorded.

1994 Survey of Float and Wade Anglers

The 1994 survey was also designed as a summer daylight hours survey. During the 1993 creel survey, several problems occurred with the survey design and methods. First, during the 1993 survey the creel clerk realized the wading portion of the fishing population was being overlooked because many fishermen told the clerk of wading access points. This seemed to indicate a problem with the survey design. It was originally assumed that anglers (other than land owners and guests) only had access to the river via the boat ramps. In 1993 the creel clerk learned that fishermen were parking at Clinton Jail (public property) and either entering the river there or crossing private property to gain access to wading areas at and below Llewellyn Island (Figure 1). Also, fishermen could walk along the railroad tracks into the quality zone and wade fish. Another access point discovered during the 1993 survey was Coldwater Farms in the quality zone which was leased by a local chapter of Trout Unlimited. This area could only be used by members and guests who paid for parking passes. When the creel clerk learned of these new access points, it was realized wade fishermen were being missed in the survey. Another smaller segment of the population was

also overlooked; a small segment of fishermen fished after 7pm during high water periods for trophy brown trout in the quality zone.

To address these problems, the survey design and methods were changed for the 1994 season. The original study zones were kept the same as in the 1993 survey, but during 1994 two survey access points were added. The first was Clinton Jail. The creel clerk sat in the jail parking lot and intercepted fishermen leaving the wadeable portions of the lower tailwater. The creel clerk also gained access to the Coldwater Farms, Trout Unlimited access point, the only wade access point within the quality zone.

The 1994 survey season was lengthened to cover more of the year. The survey started May 5 and continued until August 18, 1994. All weekend days and one randomly selected weekday were surveyed. To address late evening fishing, the survey day was lengthened. Also, the creel day was divided into 3 periods. The periods were from 10am-1pm, 2pm-5pm, and 6pm-9pm or dark. It was assumed few fishermen would leave the water before 10am.

The survey was carried out in the same manner as in 1993 except that additional information was recorded (Appendix 2): period surveyed (10am-1pm, 2pm-5pm, and 6pm-dark), and type of fishing (wade or float). Also, two opinion questions were added to obtain information about fishermen's feelings toward the new quality regulations. The first question was: "What is your opinion of the quality zone? Are you strongly in favor, in favor, undecided, against, or strongly against?". Fishermen were also encouraged to give their comments about the quality zone and all responses were recorded.

The next question was: "Has the quality zone changed the way you fish on the Clinch River?". If the response was yes, the fisherman would be asked to state in what way.

The addition of wade anglers to the survey complicated statistical analysis of the data. In 1993, the data were extrapolated to all daylight hours and to all days within the survey. This could not be done in the 1994 survey because wade anglers could only fish at lower water levels. When two generators are running at the dam, it is impossible to wade Norris tailwater. To address this problem, the creel clerk would call a public service telephone number and receive water release schedules for the day. Then the clerk would actively wade fish to determine when the area became un-fishable. The clerk would also ask fishermen when the water became un-fishable and compare what they reported to the daily generation schedule. Using this information, the clerk developed water release profiles for the two wade access points (Coldwater Farms and Clinton Jail). At the end of the 1994 season, TVA generation schedules for every day in the survey period were examined. For each day, the amount of time wade anglers could fish at the two wade sites was determined. Those numbers were used to extrapolate the wade anglers' statistics. Float anglers' statistics were extrapolated to all daylight hours and all days within the survey period.

The University of Tennessee Agricultural Extension, Statistical and Computer Services Department conducted statistical analyses on the data with SAS. Student t tests ($p < 0.05$) were used to compare catch per unit effort (CPUE), total effort, total catch, and percent release in the quality zone and the lower zone in 1993 and 1994. Student t

tests ($p < 0.05$) were also conducted on all fish measurements in all zones in 1993 and 1994. Chi-square tests ($p < 0.05$) were used to determine dependence of county of residence on use of quality zone (distance traveled) in 1993 and 1994.

Chapter III

Results

1993 Survey of Float Anglers

During the 1993 creel season, 208 interviews were conducted and 592 trout were weighed during 31 survey days. The data were for float fishermen only and estimates are for the 57 day survey period, not for the entire year.

Catch per unit effort was significantly lower in the quality zone (0.6 fish/hour) compared to the lower zone (1.4 fish/hour)(Figure 2). Float anglers spent significantly less time in the quality zone (360 man hours) compared to the lower zone (1720 man hours). Total effort for the survey period was estimated to be 3840 man hours for the entire area (Figure 3). The estimate of the numbers of trout caught was significantly higher in the lower zone (2420 trout) than the quality zone (200 trout). Total trout caught for all three areas was estimated to be 4470 (Figure 4). Of 2094 trout reported caught, only 19 were brown trout. The only non-salmonid species mentioned by float fishermen during the 1993 creel season were 4 common carp caught and released. Mean trip duration ranged from 2.6 hours in the quality zone to 3.3 hours in the upper zone. Trip length for the entire study area was estimated to be 4.9 hours (Figure 5). Although more trout were released in the quality zone (94%) than any other zone, this estimate was not significantly different from the lower zone (62%). Overall percent release was 60% (Figure 6).

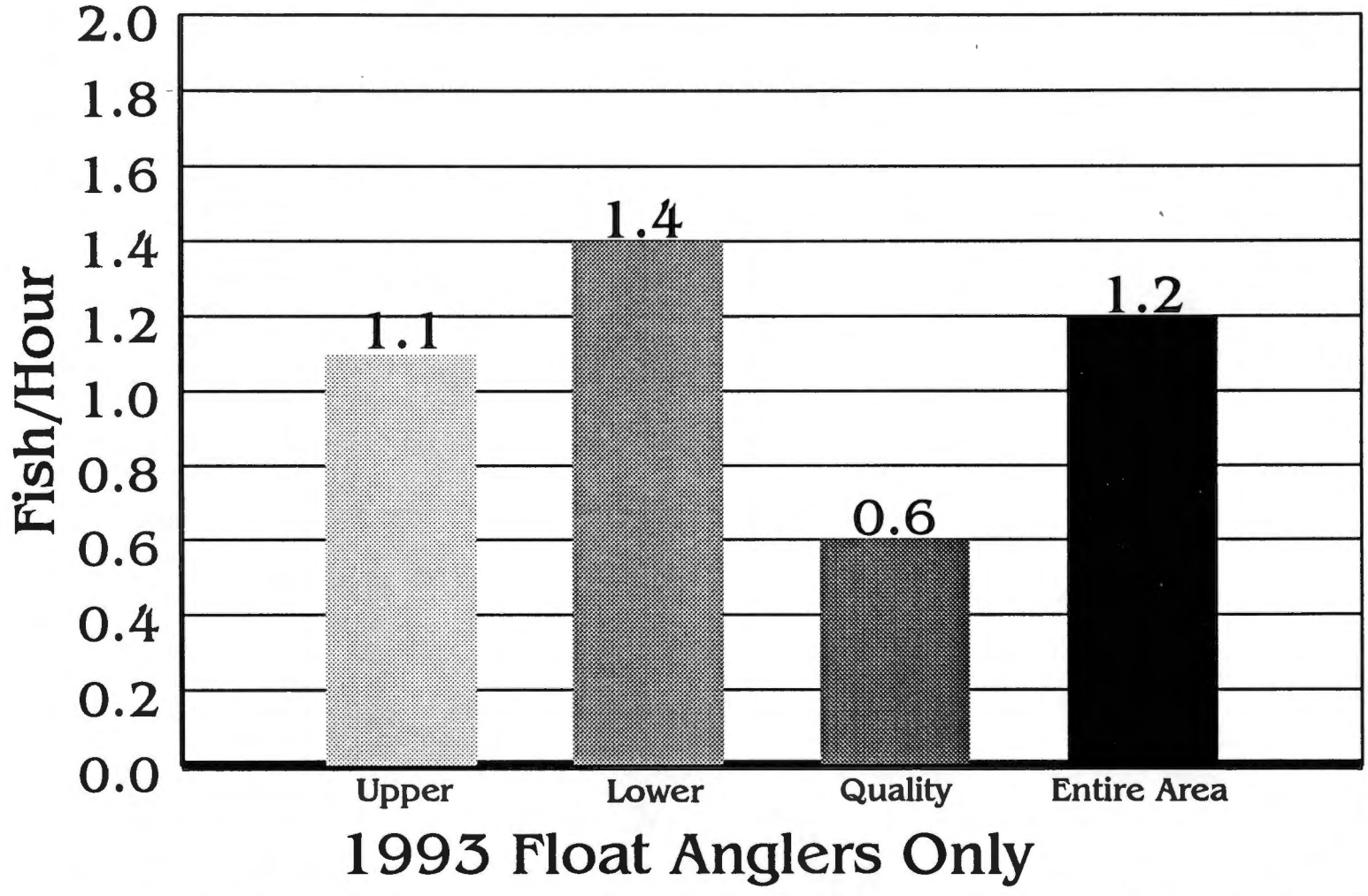

Figure 2. Estimate of catch per unit effort (CPUE) for fishermen on Norris tailwater during the 1993 creel season.

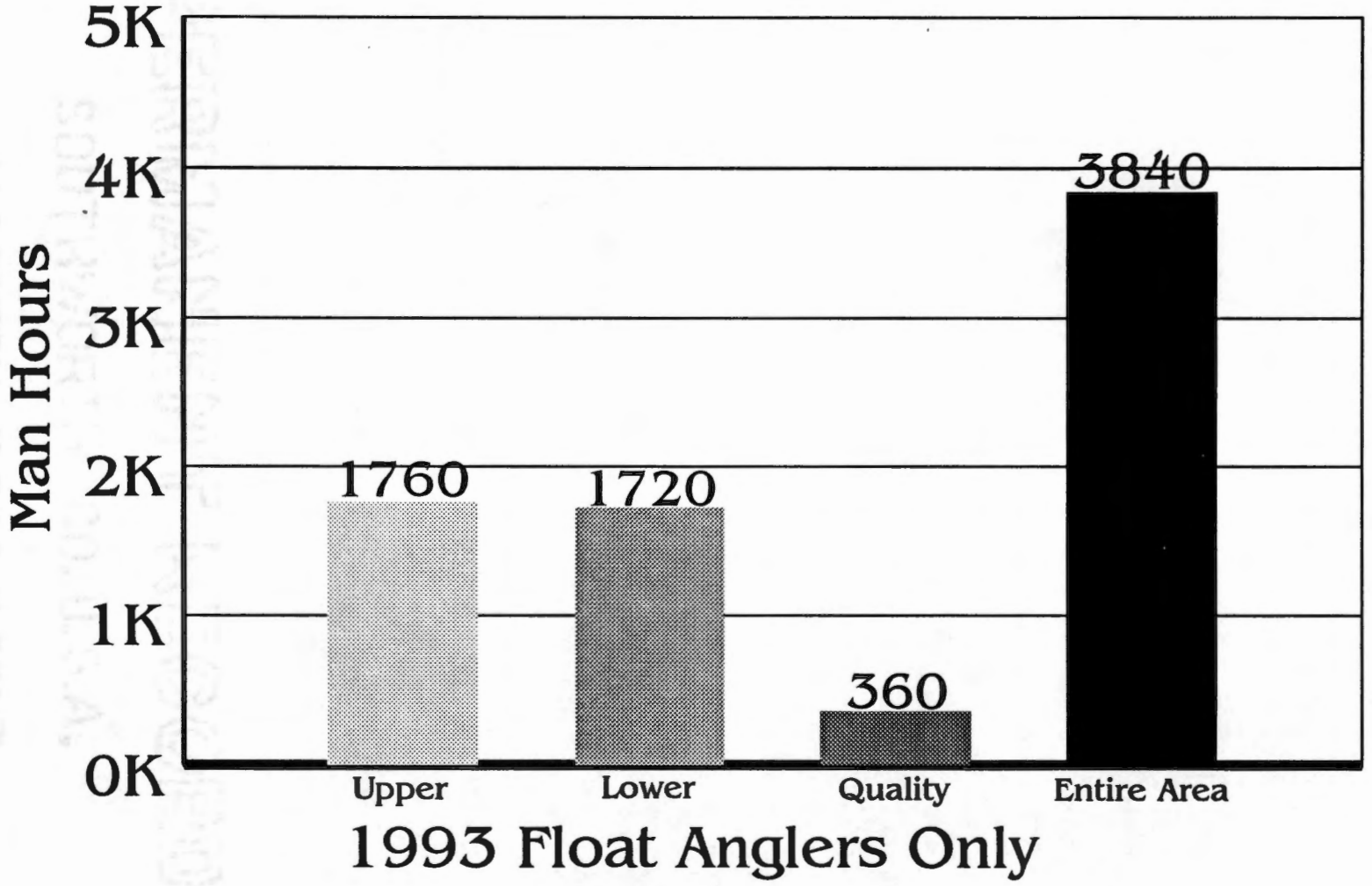

Figure 3. Estimate of fisherman effort on Norris tailwater during the 1993 creel season.

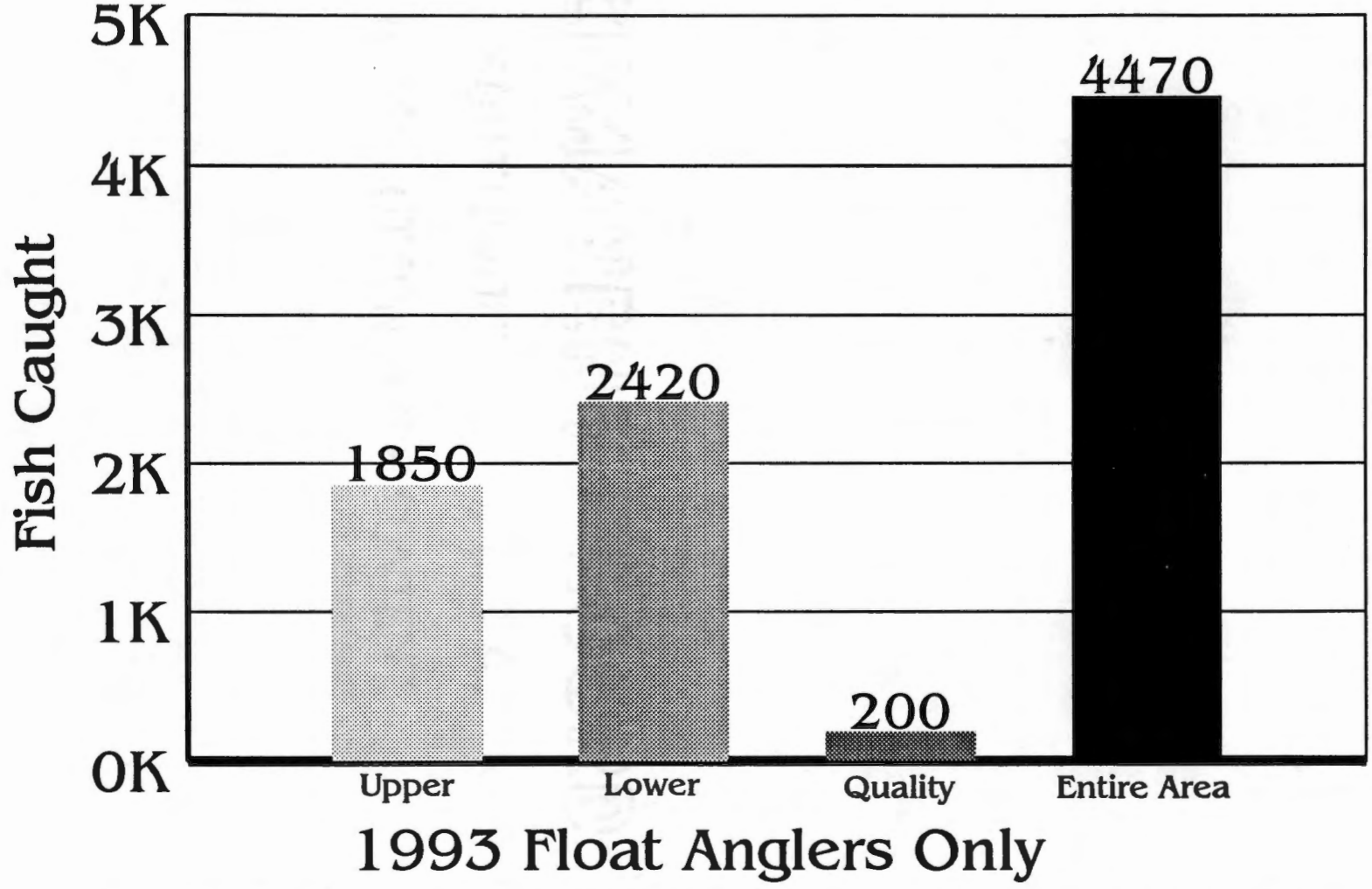

Figure 4. Estimate of trout caught by fishermen on Norris tailwater during the 1993 creel season.

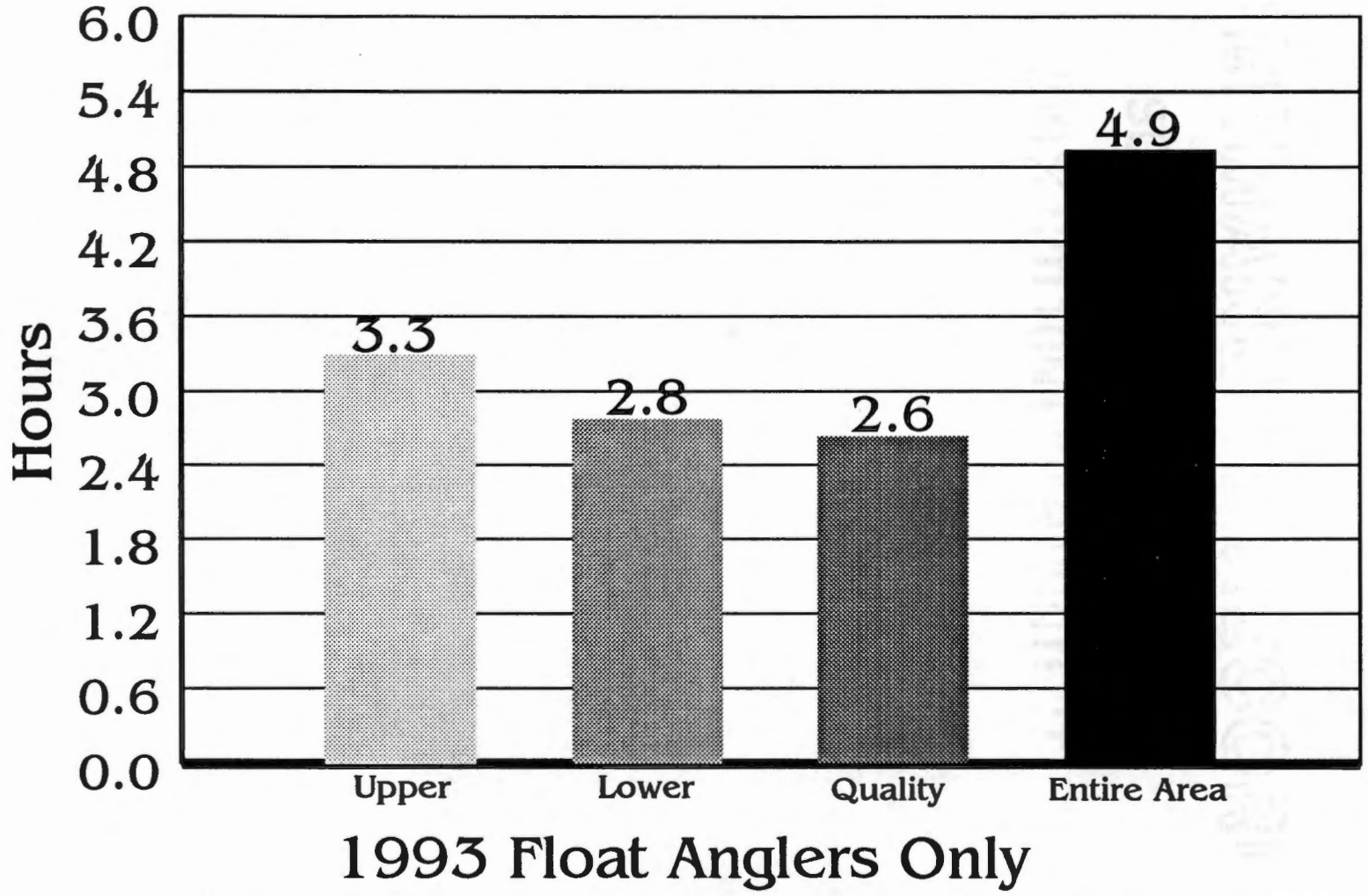

Figure 5. Estimate of mean trip duration for fishermen on Norris tailwater during the 1993 creel season.

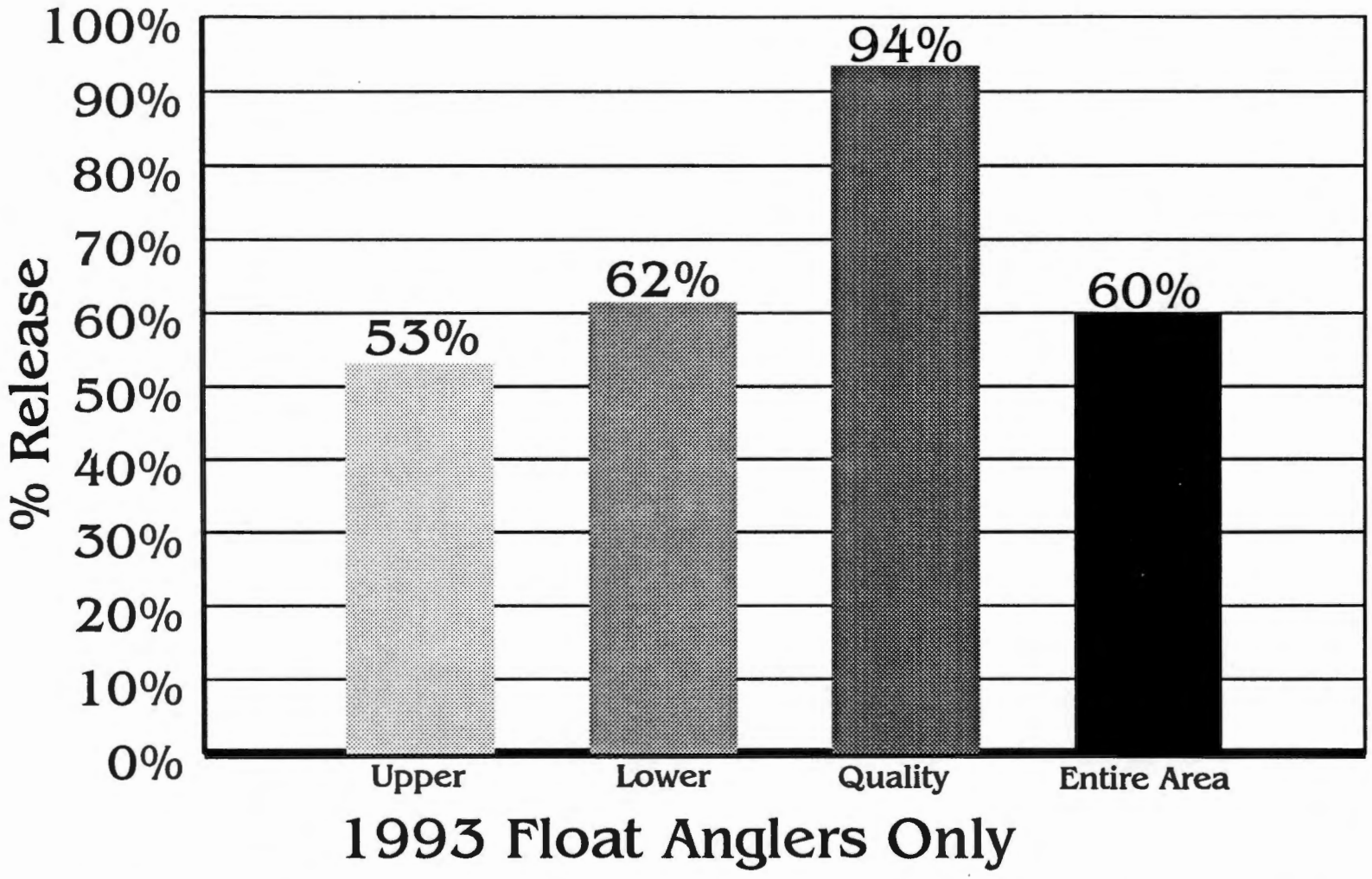

Figure 6. Percent of trout released by fishermen on Norris tailwater during the 1993 creel season.

More than 90% of float fishermen in 1993 used spincast gear; only 3% used flyfishing gear exclusively (Figure 7). Forty three percent of float fishermen used artificial bait, 29% used natural bait, and 27% used both types (27%)(Figure 8). Mean fish lengths ranged from 288 mm in the lower zone (n = 276) to 369 mm in the quality zone (n = 5). The mean length for all zones combined was 293 mm (n = 592)(Figure 9). The estimate of mean fish weight was also highest in the quality zone (553 g)(n = 5) and the lowest was in the lower zone (292 g)(n = 276). Mean trout weight for the entire area was estimated to be 299 g (n = 592)(Figure 10).

In 1993, most float fishermen came from Knox county (59.5%). The next most common county of residence (16%) was Anderson county, where the tailwater is located. Blount, Sevier, and out of state each accounted for 3.5% of the fishing population (Table 1). There was no significant relationship between county of residence and use of the quality zone. In 1993, fewer anglers in all county categories used the quality zone compared to non-quality areas (Table 2).

1994 Survey of Float and Wade Anglers

During the 1994 creel season, 351 interviews were conducted and 420 trout were weighed and measured during 35 survey days. The survey included both float and wade fishermen. All estimates are for the 90 day survey period, not for the entire year.

The quality zone had the highest estimate of catch per unit effort for float and wade anglers combined (1.3 fish/hour), but was not significantly different from the lower zone (1.2 fish/hour). The lowest

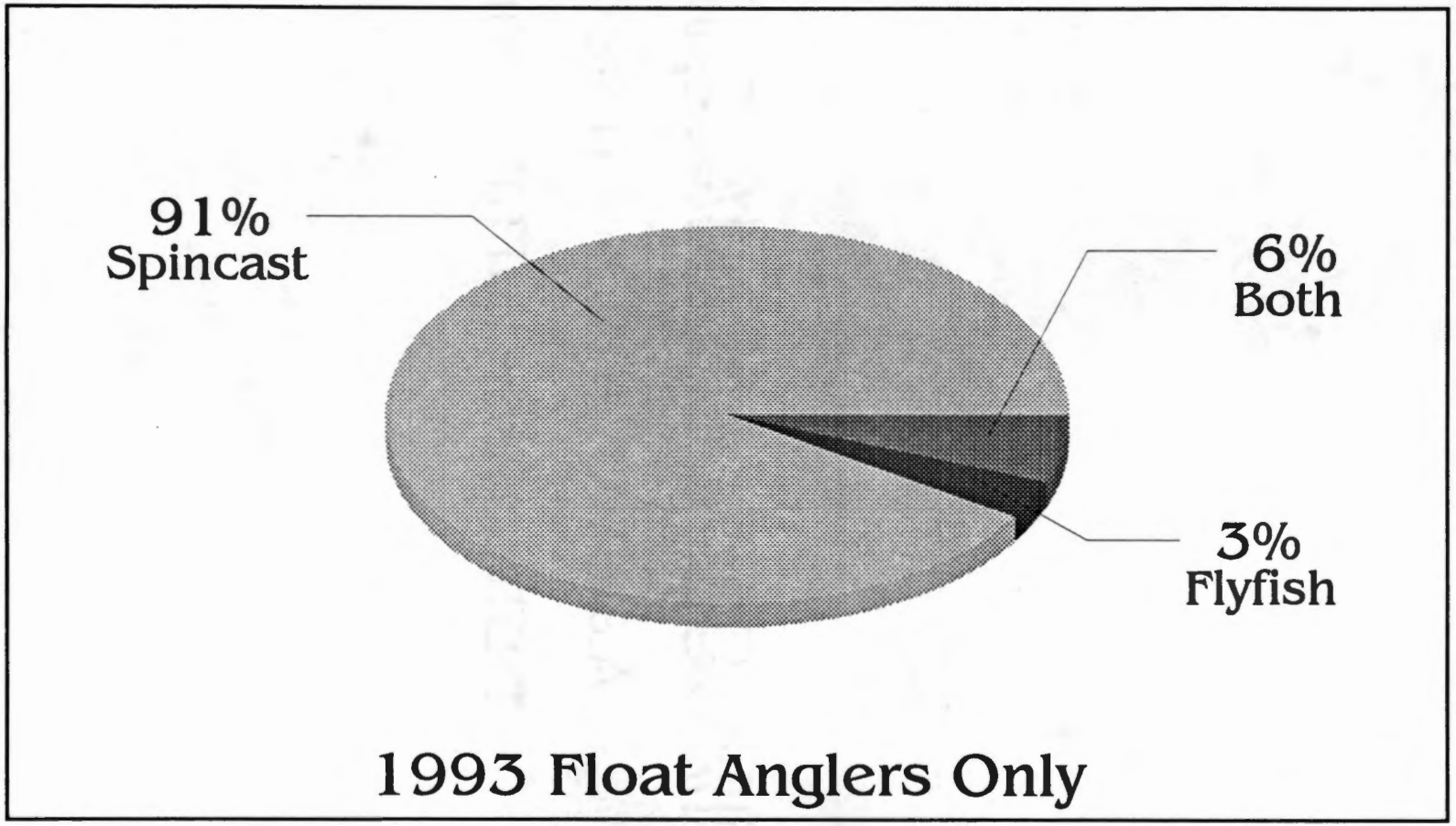

Figure 7. Type of gear used by fishermen on Norris tailwater during the 1993 creel season.

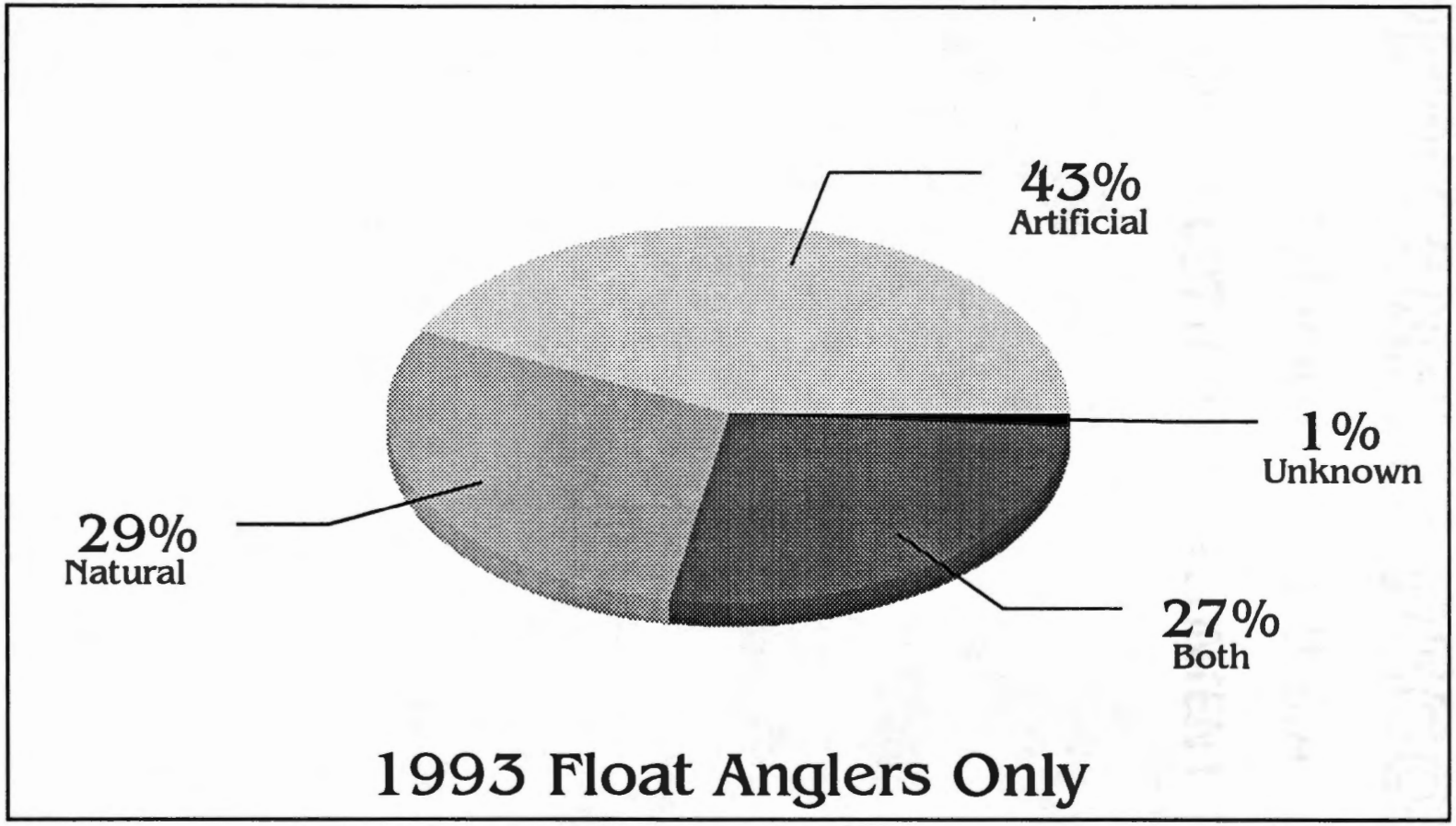

Figure 8. Bait type used by fishermen on Norris tailwater during the 1993 creel season.

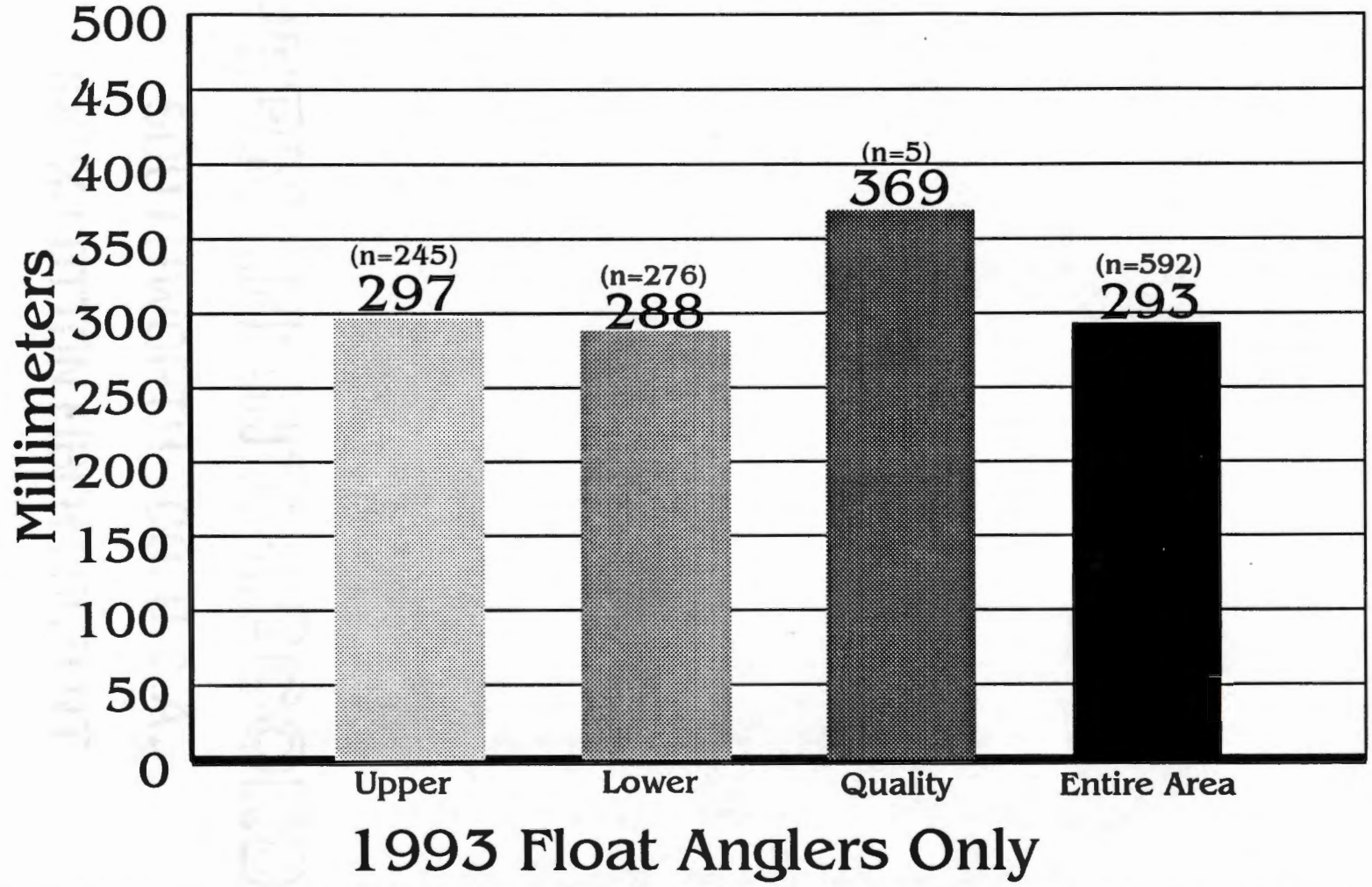

Figure 9. Mean length of trout measured on Norris tailwater during the 1993 creel season.

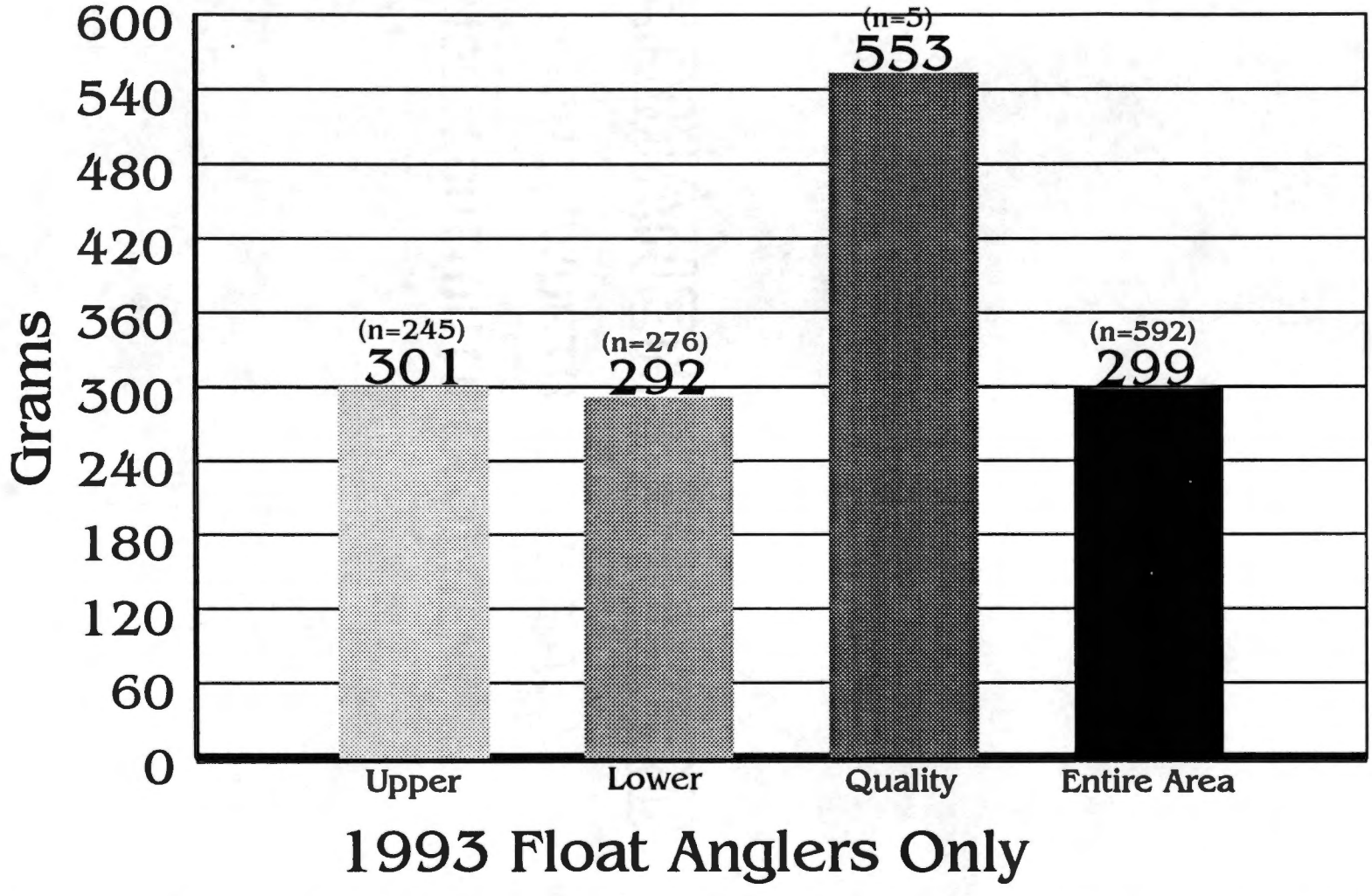

Figure 10. Mean weight for trout weighed on Norris tailwater during the 1993 creel season.

Table 1. Counties of residence of float fishermen who fished Norris tailwater during the 1993 creel season.

	Number of Fishermen	Percent of All Fishermen
Knox	119	59.5%
Anderson	32	16.0%
Blount	7	3.5%
Sevier	7	3.5%
Out of State	7	3.5%
Loudon	6	3.0%
Jefferson	5	2.5%
Campbell	4	2.0%
Hamblen	4	2.0%
Roane	2	1.0%
Other[1]	7	3.5%
Total	200	100.0%

1. One fisherman from each county: Hamilton, Davidson, Grainger, Hancock, Hawkins, Monroe, and Scott.

Table 2. Number and percent of fishermen who used the quality zone by county of residence.

	Yes	%	No	%	Total
1993 & 1994					
Knox	119	37.66%	197	62.34%	316
Anderson	36	41.38%	51	58.62%	87
Blount/Loudon	18	35.29%	33	64.71%	51
Sevier/Jefferson	7	25.00%	21	75.00%	28
East TN [1]	15	36.59%	26	63.41%	41
Not East TN [2]	13	46.43%	15	53.57%	28
1993					
Knox	39	32.77%	80	67.23%	119
Anderson	10	31.25%	22	68.75%	32
Blount/Loudon	2	15.38%	11	84.62%	13
Sevier/Jefferson	1	8.33%	11	91.67%	12
East TN [1]	7	43.75%	9	56.25%	16
Not East TN [2]	1	12.50%	7	87.50%	8
1994					
Knox	80	40.61%	117	59.39%	197
Anderson	26	47.27%	29	52.73%	55
Blount/Loudon	16	42.11%	22	57.89%	38
Sevier/Jefferson	6	37.50%	10	62.50%	16
East TN [1]	8	32.00%	17	68.00%	25
Not East TN [2]	12	60.00%	8	40.00%	20

1. Cumberland, Claiborne, Cocke, Hamilton, Campbell, Hancock, Hawkins, Monroe, Morgan, Polk, Hamblen, Scott, Sullivan, Grainger, Roane.

2. Out of state, Hickman, Putnam, Shelby, Davidson.

CPUE was estimated to be 0.7 fish/hour in the upper zone. The entire study area was estimated to have a 1.1 fish/hour CPUE (Figure 11). Total effort for the entire study area was estimated to be 14,070 man hours with most effort occurring in the lower zone (7190 man hours). The significantly lowest effort occurred in the quality zone (3090 man hours) (Figure 12). Total trout caught for the entire survey area was estimated to be 15,310 with an estimation of 8590 in the lower zone, 4070 for the quality zone, and 2650 in the upper zone (Figure 13). Of the 2740 trout reported caught in 1994, only 126 were browns. Other species reported by float and wade fishermen included 1 skipjack herring, 1 bluegill, 1 Morone sp., one common carp, and 1 brook trout (Salvelinus fontinalis). Mean trip duration was about the same in all zones; upper (3.5 hours), lower (3.1 hours), and quality (3.5 hours). Trip duration for the entire area was 4.8 hours indicating some anglers fished more than one area (Figure 14). The quality zone had a significantly higher percent release (95%) compared to the lower zone (74%)(Figure 15).

There was little difference in gear used by wade and float anglers in 1994. Flyfishing gear was used 46% of the time and spincast gear 45% of the time (Figure 16). Artificial bait was most the common bait used by float and wade anglers (68%). Natural baits were only used 20% of the time by float and wade anglers (Figure 17). Mean trout length was again greatest in the quality zone with an estimate of 357 mm (n = 4). The lowest mean length came from the upper zone and was estimated to be 275 mm (n = 110). Mean trout length for the entire area was estimated to be 283 mm (n = 420) (Figure 18).

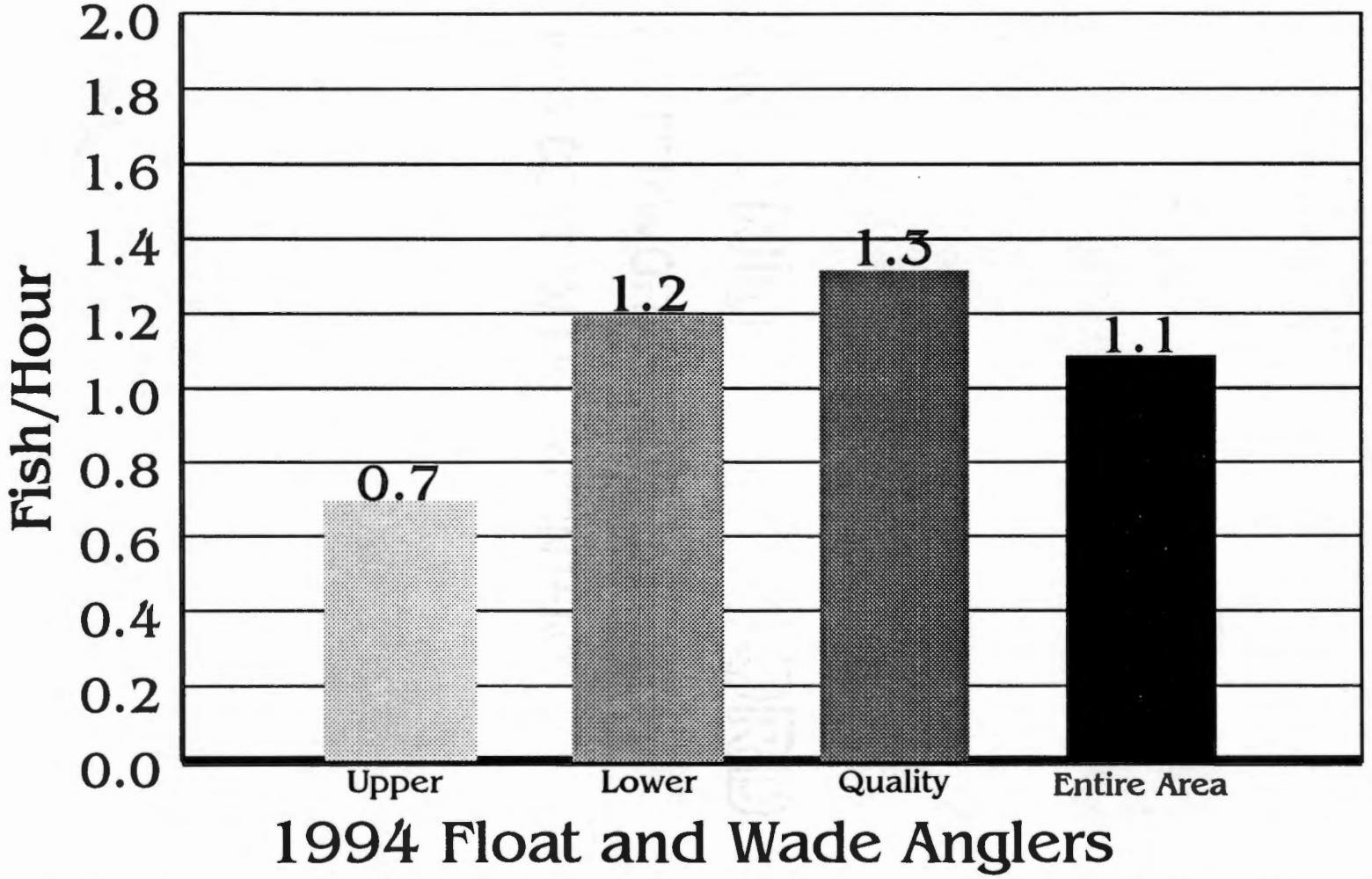

Figure 11. Estimate of catch per unit effort (CPUE) for fishermen on Norris tailwater during the 1994 creel season.

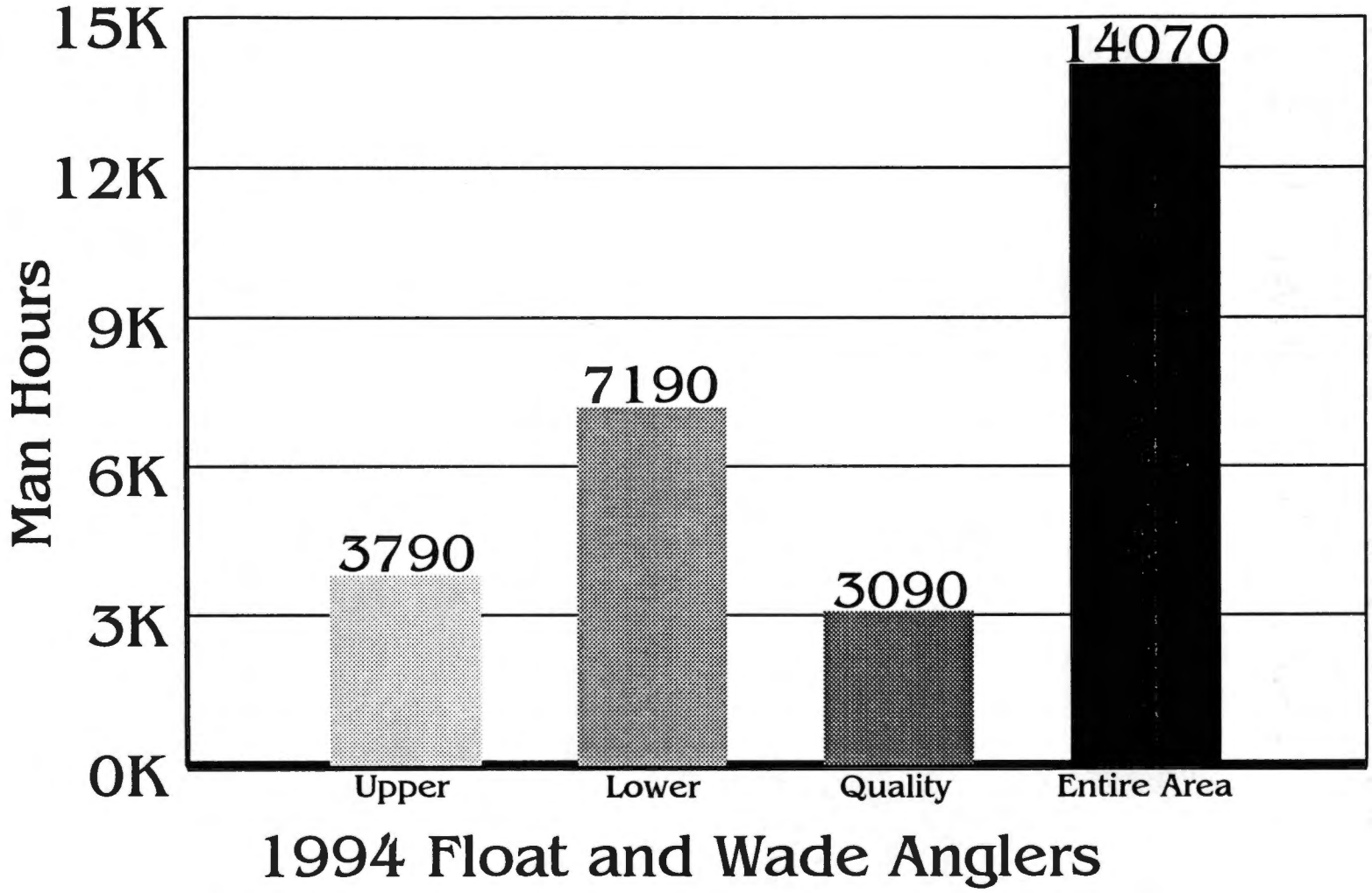

Figure 12. Estimate of fisherman effort on Norris tailwater during the 1994 creel season.

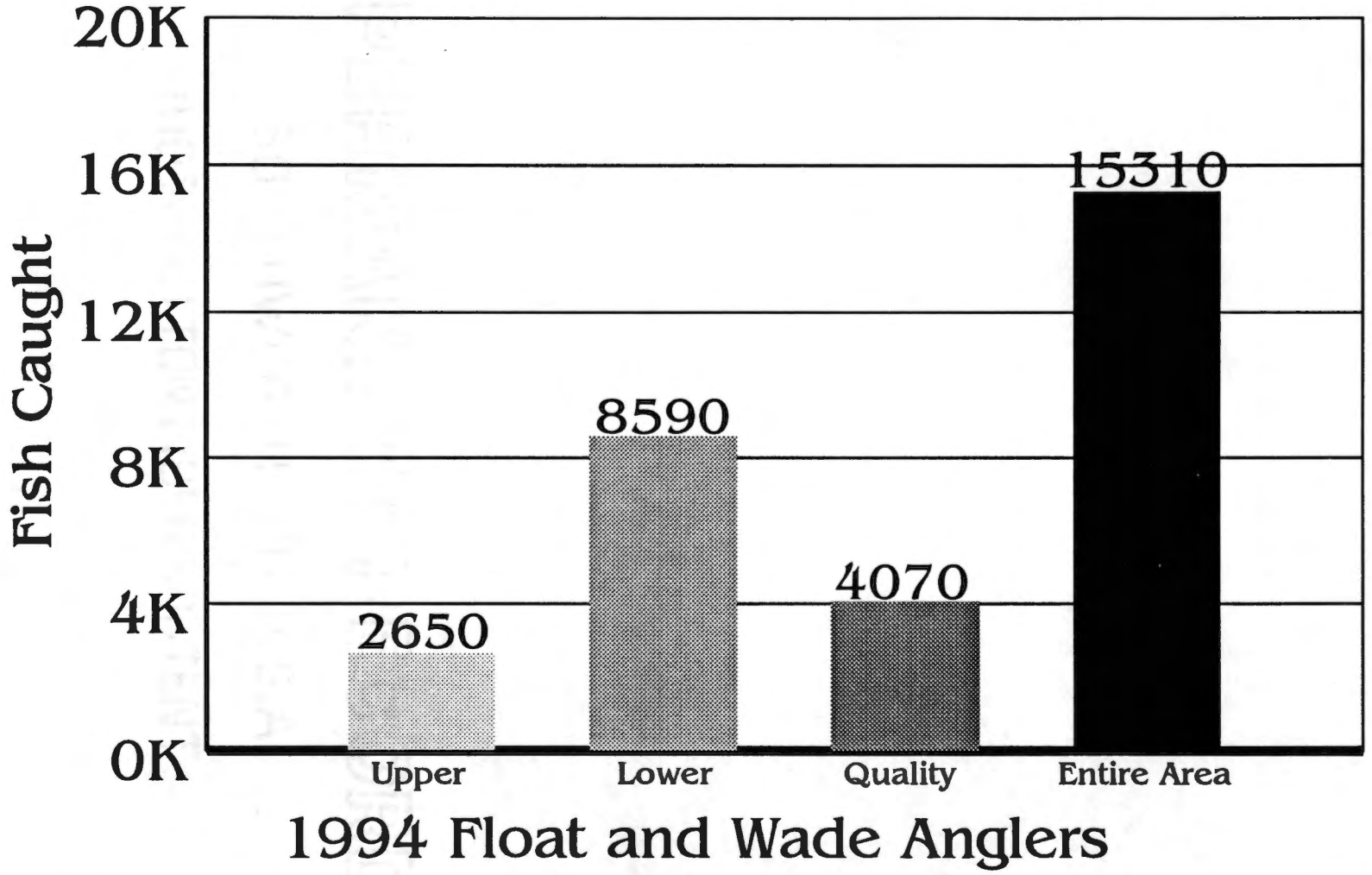

Figure 13. Estimate of trout caught by fishermen on Norris tailwater during the 1994 creel season.

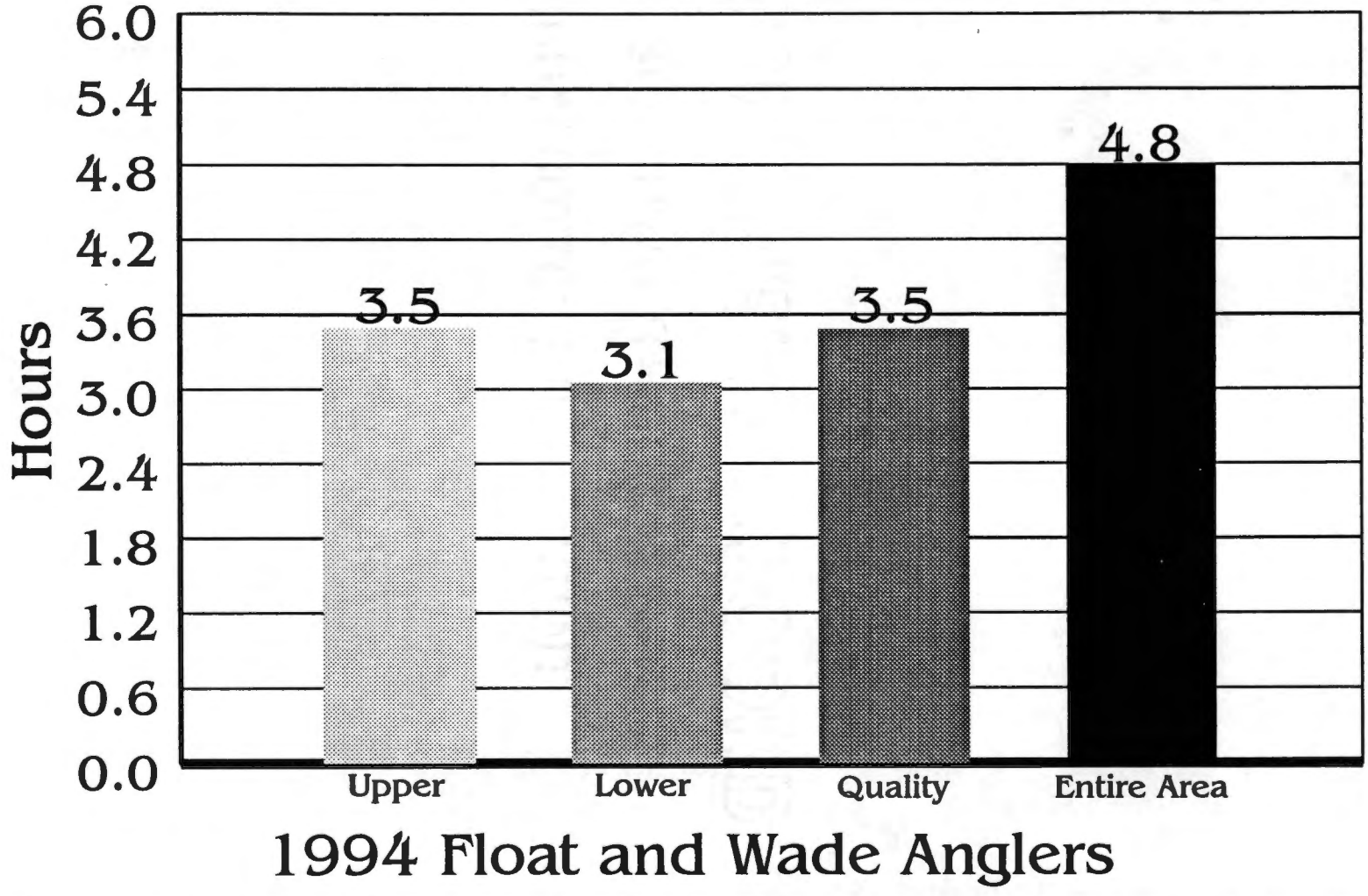

Figure 14. Estimate of mean trip duration for fishermen on Norris tailwater during the 1994 creel season.

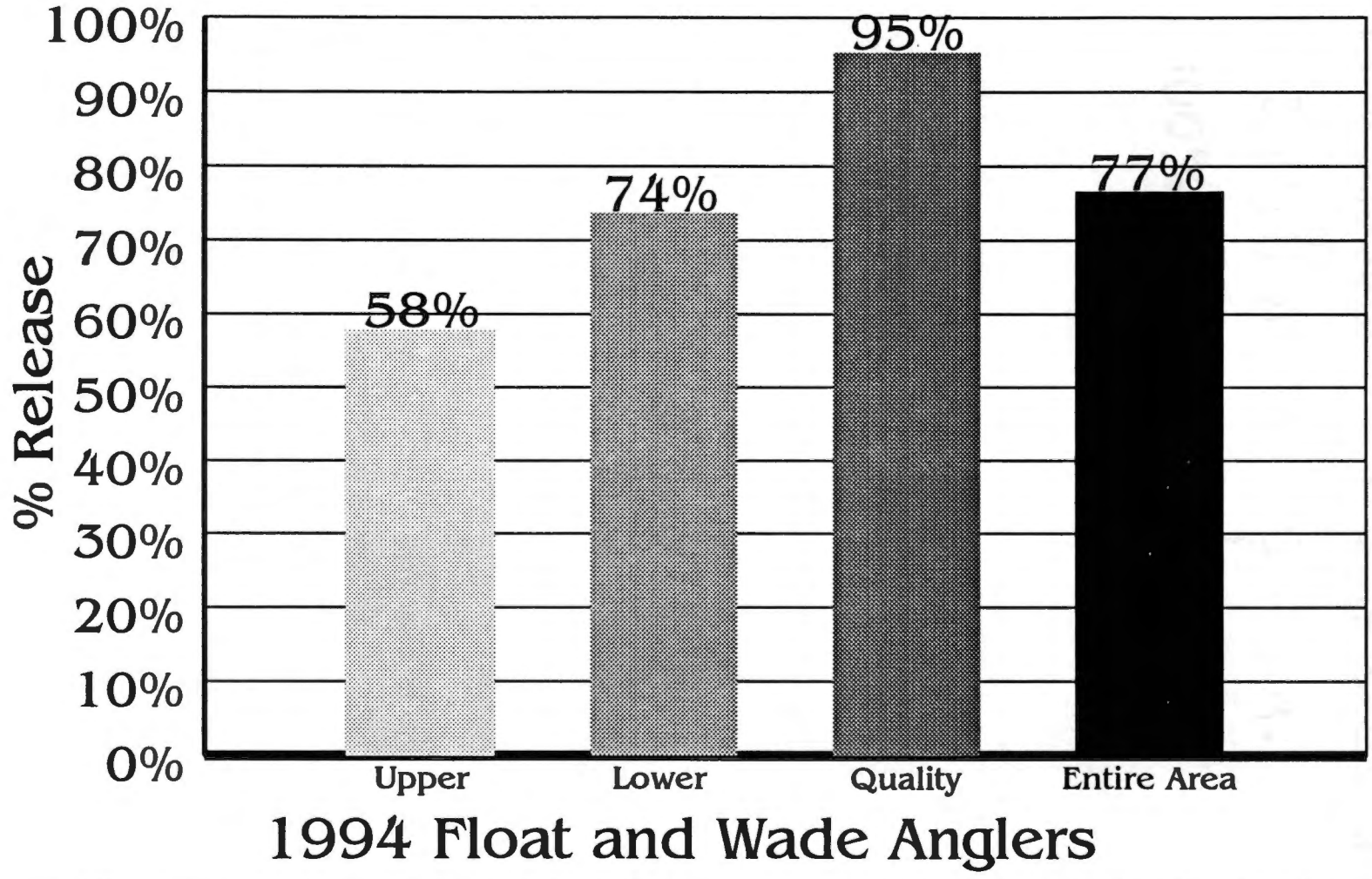

Figure 15. Percent of trout released by fishermen on Norris tailwater during the 1994 creel season.

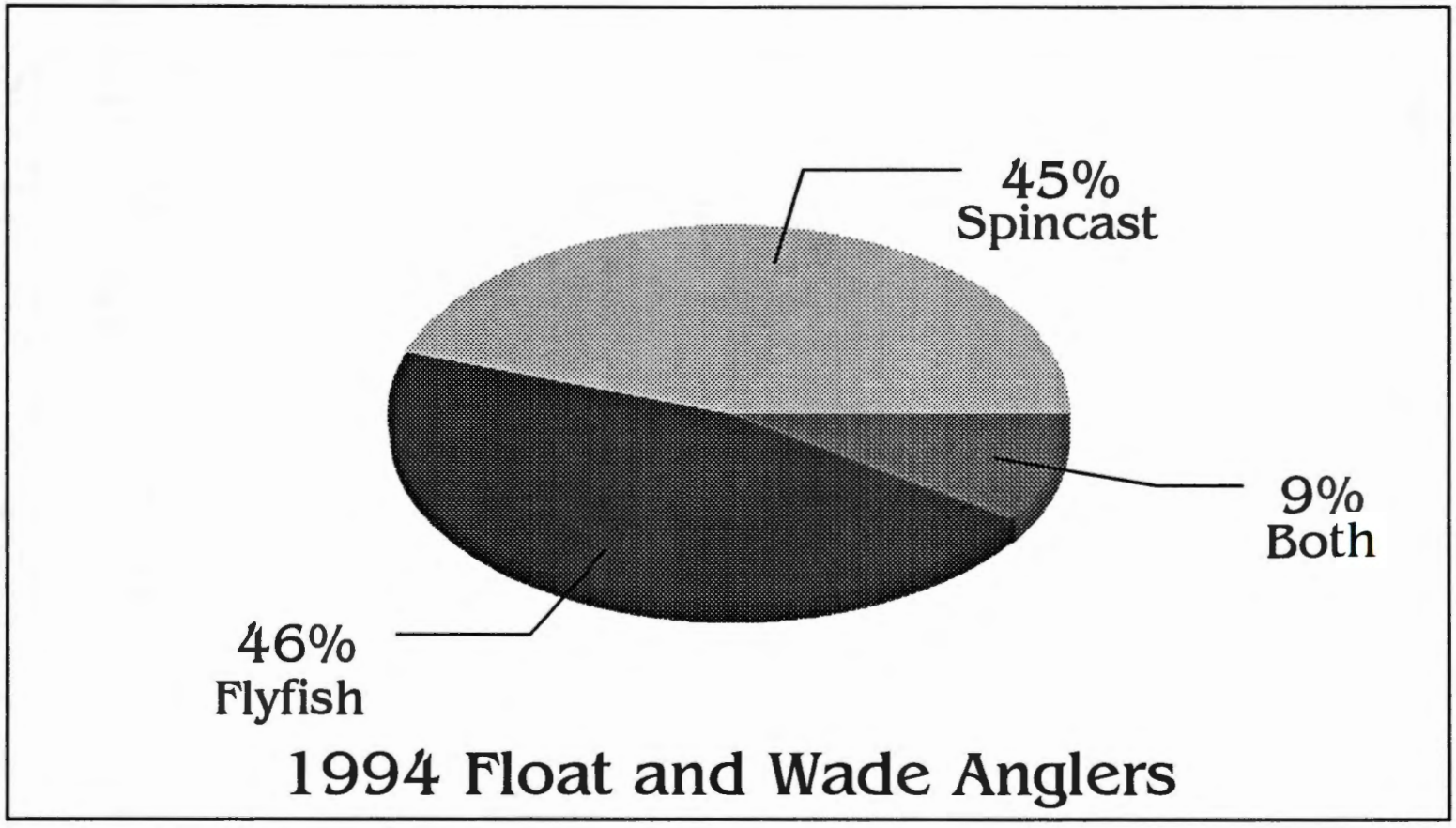

Figure 16. Type of gear used by fishermen on Norris tailwater during the 1994 creel season.

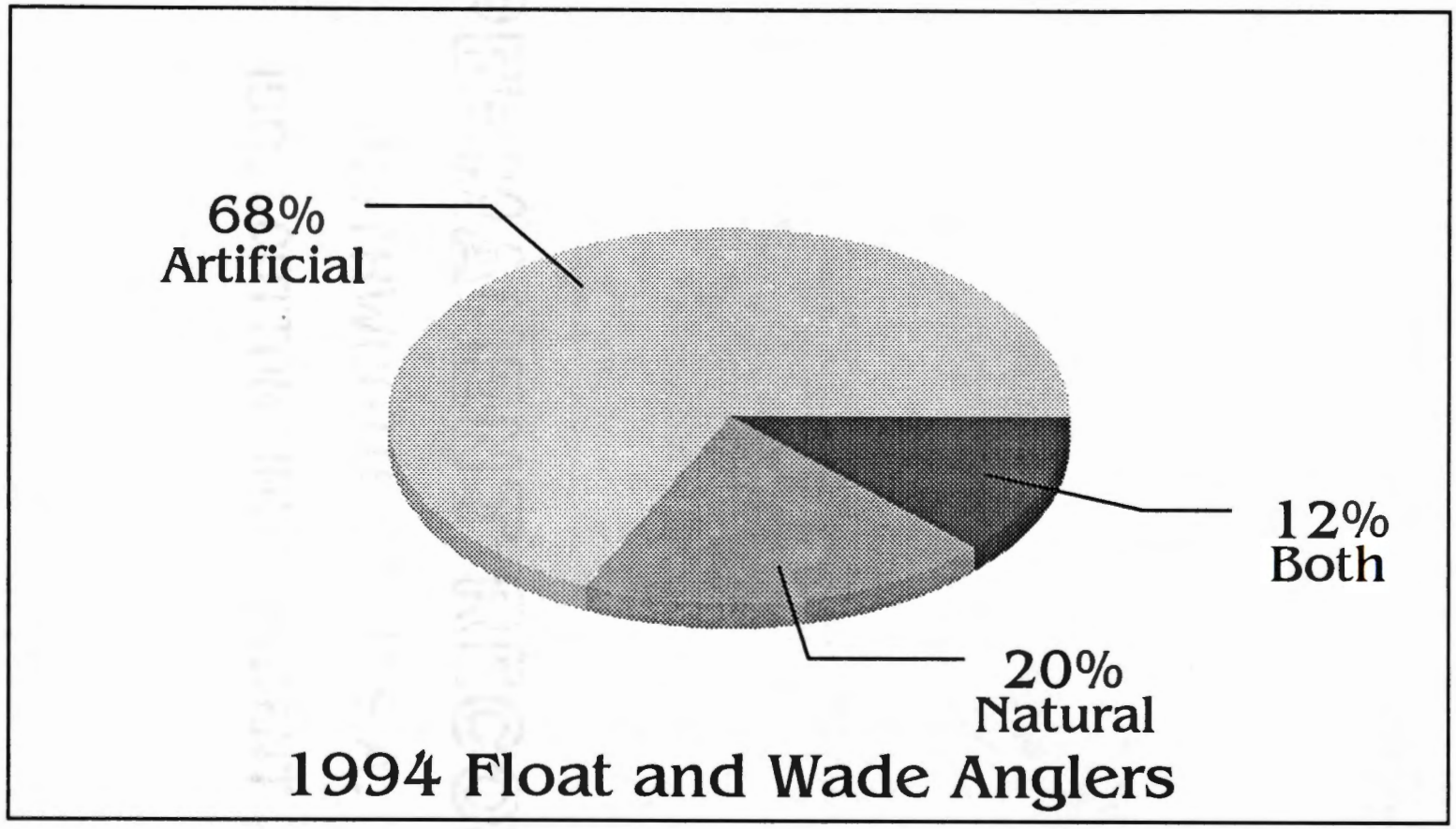

Figure 17. Bait type used by fishermen on Norris tailwater during the 1994 creel season.

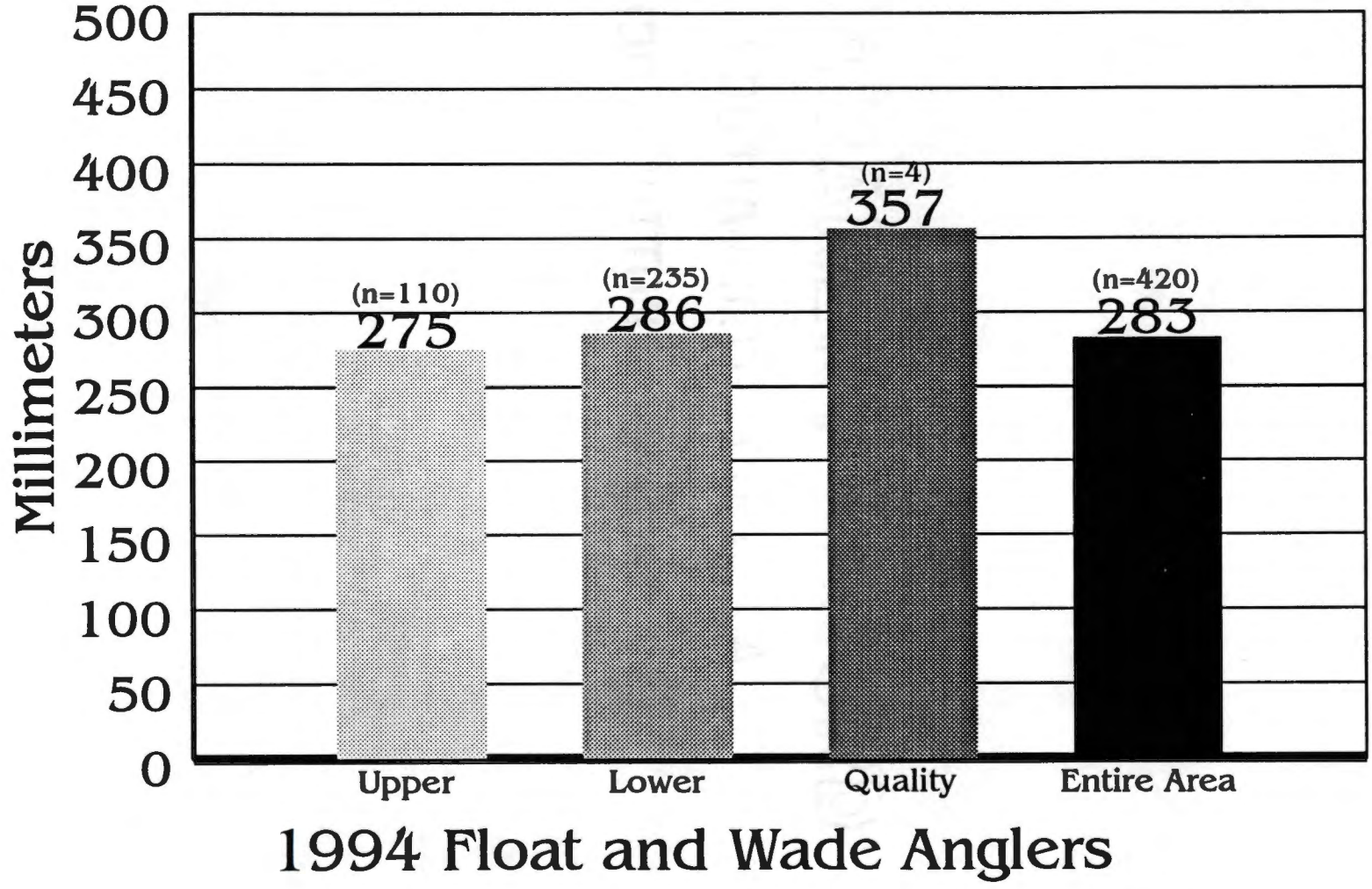

Figure 18. Mean length of trout measured on Norris tailwater during the 1994 creel season.

Estimates of mean weights were also greatest in the quality zone (541 g)(n = 4) and lowest in the upper zone (236 g)(n = 110). Overall mean weight was estimated to be 250 g (n = 420)(Figure 19).

As in 1993, Knox county was the most common county of residence in 1994 with 56.1% of the population of float and wade fishermen. Anderson was next (15.7%) followed by Blount (7.4%), Sevier (3.4%), and Loudon (3.4%). Fishermen from other states comprised 3.1% of the Norris tailwater's float and wade fishermen population (Table 3). Again there was no relationship between county of residence and usage of the quality zone (Table 2).

Most float and wade fishermen liked the quality zone with 42% strongly in favor and 26% in favor. Fewer fishermen expressed dislike for the quality zone with 8% against and 10% strongly against (Figure 20). The most frequently stated comments about the quality zone were that regulations should be more restrictive/the quality zone should be longer. Positive comments were more common than negative comments (Table 4). Sixty-nine percent of float and wade fishermen interviewed stated the quality zone has not changed the way they fish Norris tailwater (Figure 21). Of the fishermen who stated the quality zone has changed the way they fish on Norris tailwater most said they fished the quality zone and adjacent areas more (46.8%). Thirty-one percent indicated that they do not fish the quality zone now (Table 5).

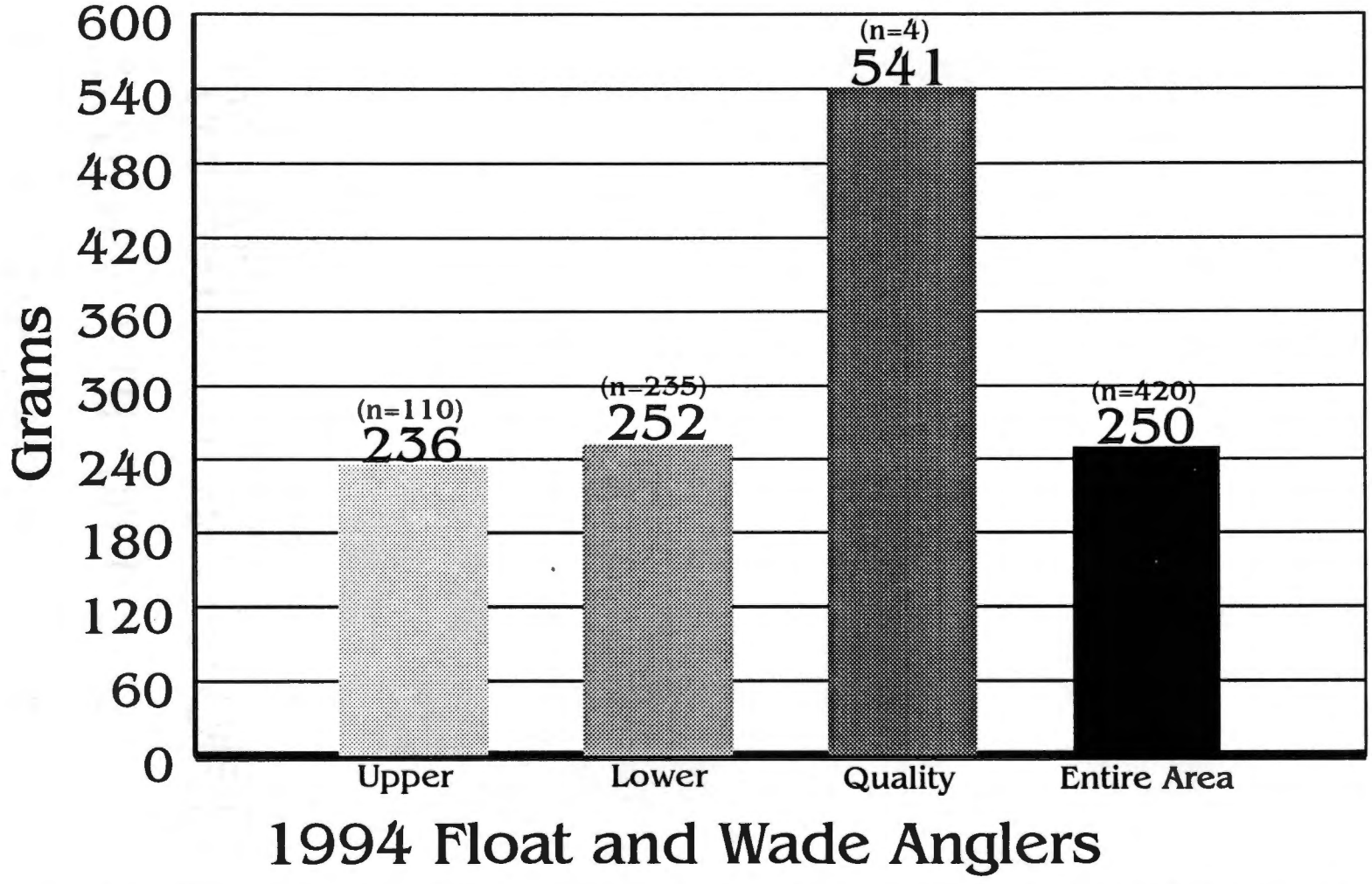

Figure 19. Mean weight for trout weighed on Norris tailwater during the 1994 creel season.

Table 3. Counties of residence of float and wade fishermen who fished Norris tailwater during the 1994 creel season.

	Number of Fishermen	Percent of All Fishermen
Knox	197	56.1%
Anderson	55	15.7%
Blount	26	7.4%
Sevier	12	3.4%
Loudon	12	3.4%
Out of State	11	3.1%
Campbell	6	1.7%
Davidson	5	1.4%
Jefferson	4	1.1%
Scott	4	1.1%
Shelby	3	0.9%
Claiborne	2	0.6%
Hamblen	2	0.6%
Monroe	2	0.6%
Roane	2	0.6%
Other [1]	8	2.3%
Total	351	100.0%

1. One fisherman from each county: Cocke, Cumberland, Grainger, Hickman, Hancock, Morgan, Putnam, and Sullivan.

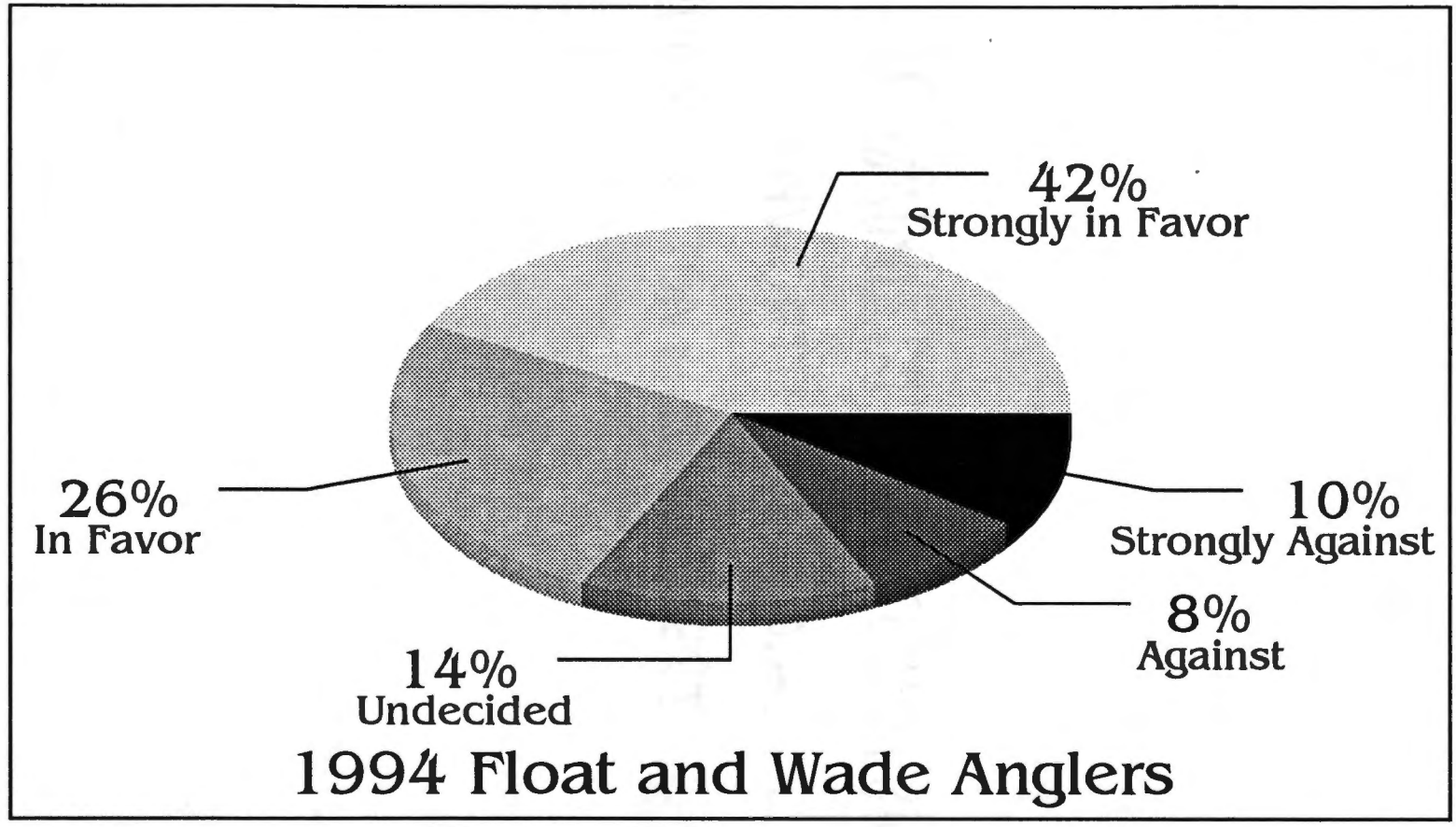

Figure 20. Fishermen's opinions of quality regulations during the 1994 creel season.

Table 4. Comments fishermen had about quality regulations on Norris tailwater during the 1994 creel season.

Comment	Number	%
1. Regulations should be more restrictive/ quality zone should be longer	59	22.1%
2. Generally positive comments	38	14.2%
3. Should go back to 1993 regulations	23	8.6%
4. Generally negative comments	22	8.2%
5. Need more enforcement	21	7.9%
6. Other regulation changes	16	6.0%
7. Has improved fishing	14	5.3%
8. Restricts float fishing	12	4.5%
9. Bad location	8	3.1%
10. Like 1994 regulations	7	2.6%
11. Move quality to dam or other area	7	2.6%
12. Has not helped fishing	7	2.6%
13. Quality done because of Trout Unlimited	5	1.9%
14. Need less restrictive regulations	4	1.5%
15. Regulations confusing	4	1.5%
16. Need more access	4	1.5%
17. Change discharge rates	4	1.5%
18. Less stocking	3	1.1%
19. More stocking and bigger fish	3	1.1%
20. Stock more browns	3	1.1%
21. Trash in and around river is a problem	3	1.1%
Total	267	100%

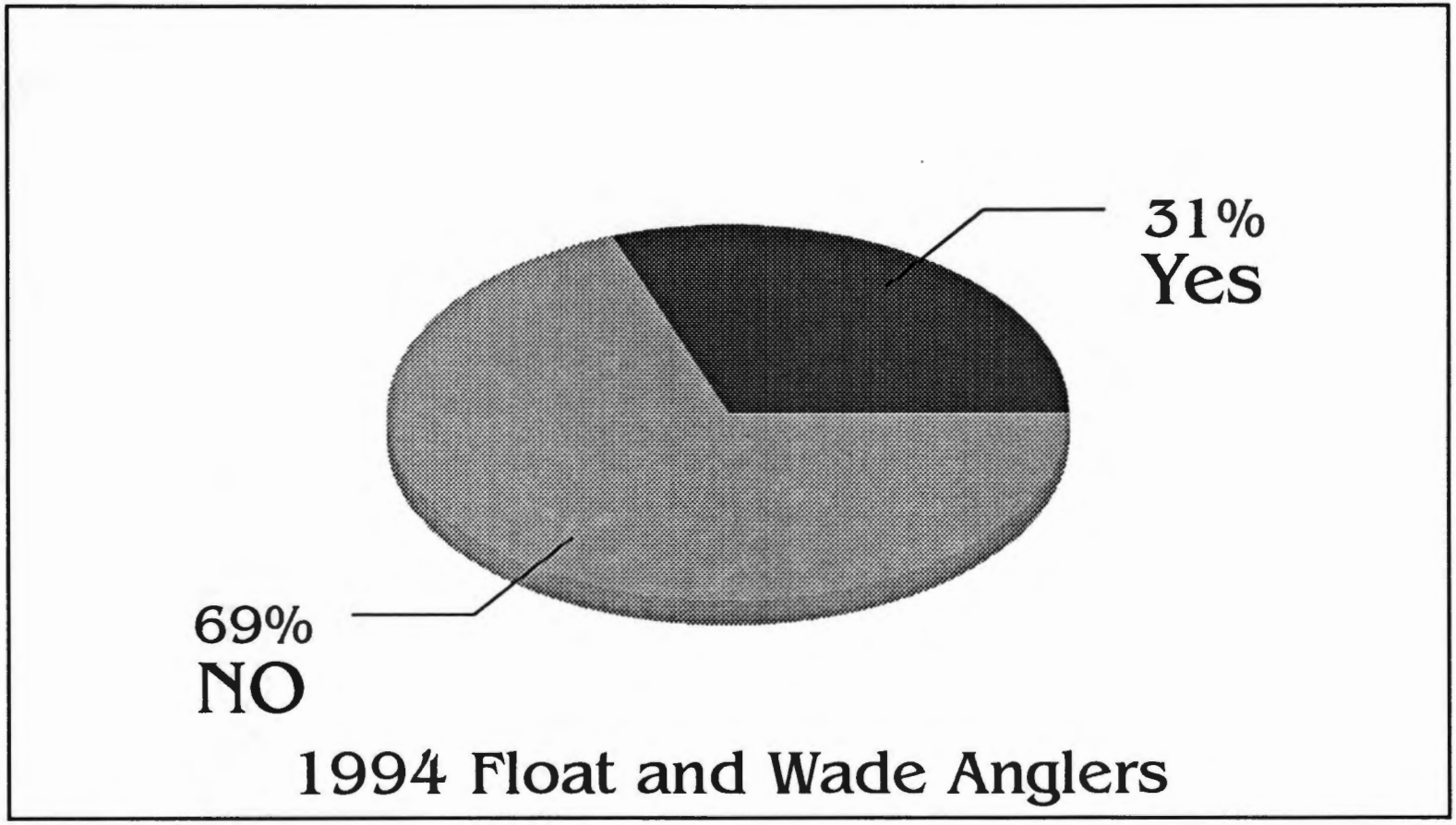

Figure 21. Fishermen's responses to the question; Did quality regulations change the way you fished Norris tailwater during 1994 creel season?.

Table 5. Changes in fishing patterns as a result of quality regulations reported by fishermen who said they had changed the way they fished on Norris tailwater during the 1994 creel season.

Reported Changes	Number	%
1. Fish quality and surrounding areas more	44	46.8%
2. Do not float through quality now	29	30.8%
3. Release more fish	11	11.7%
4. Use more artificial bait now	4	4.3%
5. Changed to wade fishing	3	3.2%
6. Started flyfishing	2	2.1%
7. Fish Clinch river less	1	1.1%
Total	94	100%

Chapter IV

Discussion

1993 Survey of Float Anglers

Because the 1993 and 1994 creel surveys were conducted under different study designs and different sets of fishing regulations the two years will be discussed separately. The 1993 creel survey was designed to question float anglers only. Wade and bank anglers were not part of this survey.

The quality zone had a significantly lower CPUE (0.6 fish/hour) when compared to the lower (1.4 fish/hour)(Figure 2). The lower success in the quality zone by float fishermen could be a function of their dislike of the quality regulations. Another possible reason for the lower CPUE for float fishermen in the quality zone could be the geography of the river. The area within the quality zone is more difficult to fish in boats, because when Norris Dam generates with less than two generators some boats cannot navigate the entire quality zone. When two generators are in use, the river is difficult to fish because of high flows and large amounts of dislodged algae. Total effort (Figure 3) and total catch (Figure 4) were also significantly lower in the quality zone. Lower total effort and total catch tend to indicate avoidance of the quality zone by float fishermen in 1993. Avoidance was also indicated when, even though no specific question about quality preference was asked during 1993, a number of float fishermen volunteered negative responses about the quality zone. In most cases,

they stated they actively avoided the quality zone. These volunteered opinions led to the addition of a specific set of questions to solicit fishermen's opinions of the quality zone in 1994. Gigliotti and Peyton (1993) found regulations that favored special interests (fly-angling) tended to reduce entry into the area by more harvest-oriented anglers (bait-anglers). Trip duration (Figure 5) was also lowest in the quality zone indicating that when float fishermen did venture into the quality zone, they spent less time there than they did in the other two zones. Another factor which might have led to less fishing in the quality zone by float fishermen is that stocking only occurred at boat ramps on the river. No fish were stocked directly into the quality zone in 1993. Several researchers suggest trout remain fairly close to locations where they are stocked. Heimer et al. (1985) and Kendall and Helfrich (1982) found most stocked rainbow trout were recaptured within a few hundred meters of the stocking site. Helfrich and Kendall (1982) found that 75% of all rainbow trout, brook trout, and brown trout stocked in a Virginia stream were recaptured within 1 km of the stocking site. The combination of more trout to fish for near the boat ramps and a dislike for the "new" regulations were the main factors which led to avoidance of the quality zone by float fishermen.

Although the percent release estimate for the quality zone was higher than the other two zones, this estimate is not significantly different from the lower zone. This indicated the quality zone was not successful in stimulating more catch and release among float anglers. Spincast gear was the most popular gear used by float fishermen in 1993 (Figure 7). Perhaps it is less traditional for fishermen to flyfish

while floating the river. Also, the use of natural bait was popular with float fishermen in 1993. The fact that most float fishermen had natural bait in the boat (56%)(Figure 8) also helps explain why many floaters avoided the quality zone. If float fishermen were in the quality zone with bait in 1993 they could be fined by TWRA. The only way to avoid this problem was to dispose of all natural baits before entering the quality zone.

The length and weight data (Figure 9 & 10) indicate that under a 14 inch length limit fishermen were keeping the larger fish within the quality zone. Because of the small sample size in the quality zone (n = 5), it is impossible to say the quality zone is producing larger fish. All fish from the quality zone were rainbow trout and the largest was 410 mm long and weighed 715 g. The largest fish seen in 1993 was a brown trout from the lower zone and measured 551 mm in length and weighed 2800 g.

In 1993 most float fishermen (59.5%) came from Knox county, the largest close urban area in east Tennessee. Knox county is only 30 minutes from Norris tailwater. At the beginning of the study, it was hypothesized that local residents would be less likely to be found in the quality zone. It was also believed anglers from more distant counties and out of state anglers would use the quality zone more. In 1993, this was not the case with float fishermen. No significant relationship was found between distance traveled and use of the quality zone. The likely reason for this was the newness of the regulations and lack of publicity for the quality zone. The regulation did not have time to become established and to have an effect on the fishing public.

1994 Survey of Float and Wade Anglers

The 1994 creel survey was designed to question wade and float anglers, unlike the 1993 creel survey that only included float anglers. As in 1993, the 1994 survey did not include bank fishermen.

Determining if a river is producing good fishing is difficult at best, but one way to determine if the fishery is pleasing the fisherman is to consider CPUE or catch/hour. What is considered a good catch rate for one angler may not be good for another. Wiley et al. (1993) stated 0.75 fish/hour is good fishing while a catch rate of 0.5 fish/hour is a decent fishery. Other researchers, McMichael and Kaya (1991) found that fishermen in Montana considered 0.6-0.7 fish/hour to be satisfactory while < 0.4-0.6 was unsatisfactory. By these standards, Norris tailwater produced good fishing. The lowest catch rate in 1994, for float and wade fishermen, was in the upper zone (0.7 fish/hour) while the highest catch rate was in the quality zone (1.3 fish/hour). The entire study area had a catch rate well above what is considered good fishing (1.1 fish/hour) (Figure 11). From 1973 through 1988 annual CPUEs on Norris tailwater ranged from 0.2-0.5 fish/hour. However, all creel work during these years was done from the dam to just below Miller Island and from Llewellyn Island to Highway 61 bridge (Yeager et al. 1994). Norris's CPUE was comparable to other southeastern tailwater's CPUEs. The Elk River had 0.6-1.3 CPUE in 1986 through 1988. The Caney Fork River had 0.4-0.97 CPUE in the same years (Bettoli 1989). The Hiwassee River has had CPUEs that ranged from 0.1-0.5 in 1973 through 1975 (Myhr 1977), 0.8-0.97 in 1987 through 1988 (Bettoli 1989), and 0.9-2.3 in 1989 through 1991 (Strange and

Lindbom 1993). Two tailwaters in Arkansas, Bull Shoals and Norfork, only produced CPUEs of 0.5-0.6 in 1980 to 1981, although Bull Shoals did have CPUEs of 0.8 in 1971 and 0.7 in 1972 (Oliver 1984).

Strange and Lindbom (1993) found higher catch rates in the quality zone (compared to the general regulations zone) of the Hiwassee River and stated the reasons for the higher catch rates were higher release percentages, lower effort, and similar stocking numbers inside the quality zone. Several researchers have found similar patterns in different types of riverine fisheries. Fatora (1970) found special regulations decreased pressure and increased catch rates as regulations became more restrictive. Anderson and Nehring (1984) found catch and release regulations produced 48% higher catch rates compared to general regulations. Also, fishing pressure typically was lower in areas managed under catch and release. Norris tailwater's quality zone did not have significantly higher catch rates compared to the lower zone (Figure 11). However, the quality zone did have significantly less pressure (Figure 12) and significantly higher percent release (Figure 15), for float and wade anglers, than the lower zone. Norris tailwater, unlike the Hiwassee, could not have fish stocked directly into the quality zone. Consequently, fish density in the quality zone was probably less than areas directly adjacent to stocking locations (boat ramps). This was indicated in 1993, when TWRA surveyed at Miller Island and Coldwater Farms. They had an electrofishing CPUE of 12 trout per hour at Coldwater Farms inside the quality zone and a CPUE of 60 trout per hour at Miller Island where trout are regularly stocked. This would indicate the quality zone has

fewer trout than areas outside the quality zone which are regularly stocked (Bivens et al. 1994).

Another factor that must be considered is fishing gear and fisherman efficiency. In 1994, fly fishermen, who were 46% of the total fishing population (Figure 16), spent more time, caught more fish, and had a higher CPUE in the quality zone than any other group of fishermen. Spincast fishermen, 45% of total fishing population, spent more time in other areas of the river and had comparable success in all three zones. Fly fishermen were more successful in all areas of the river compared to spincast fishermen except in the upper zone where they both had 0.7 fish/hour (Table 6). Hunt (1991) found fly fishermen had higher CPUEs than spin fishermen or bait anglers. On the other hand, McMichael and Kaya (1991) found fly fishermen were only more successful than spin fishermen in some areas.

The lower zone, which surrounded the quality zone, appeared to be the most popular area for float and wade fishermen in 1994. Even though the lower zone did not have the highest catch rates, this zone did have the highest effort (Figure 12) and most fish caught (Figure 13). The reason for this section's popularity is the area is well adapted for wade and float fishing. At low water, wade fishermen can wade from Highway 61 Bridge well into the quality zone in addition to wading just above the quality zone. At low water, float fishermen can navigate from the boat ramp at Highway 61 bridge up stream approximately 100 m. At high water, they can reach all of the tailwater. Also, Peach Orchard is heavily used by float fishermen because the ramp is located within one of the longest, deepest pools on the river. In 1994, most float

Table 6. 1994 creel statistics broken into gear type (flyfish, spincast, or both) and type of fishing method (wade, float, or both).

	Effort[1]	Catch[2]	CPUE[3]	%Release
Flyfish				
Upper Zone	840	560	0.7	64%
Lower Zone	5020	8880	1.8	94%
Quality Zone	3000	4900	1.6	99%
Entire Area	8860	14340	1.6	94%
Spincast				
Upper Zone	3780	2450	0.7	54%
Lower Zone	5280	5780	1.1	51%
Quality Zone	820	840	1.0	68%
Entire Area	9880	9080	0.9	53%
Fly & Spincast				
Upper Zone	1040	1020	1.0	83%
Lower Zone	3080	2720	0.9	65%
Quality Zone	1300	770	0.6	94%
Entire Area	5410	4510	0.8	74%
Wade				
Upper Zone	440	120	0.3	91%
Lower Zone	5190	8340	1.6	86%
Quality Zone	2310	3590	1.6	99%
Entire Area	7930	12040	1.5	90%
Float				
Upper Zone	4640	3200	0.7	52%
Lower Zone	3260	3470	1.1	42%
Quality Zone	1160	900	0.8	73%
Entire Area	9060	7580	0.8	50%
Wade & Float				
Upper Zone	1350	1070	0.8	90%
Lower Zone	2990	2600	0.9	76%
Quality Zone	670	740	1.1	99%
Entire Area	5000	4410	0.9	83%

1. Effort in man hours.
2. Catch in numbers of fish.
3. CPUE in fish/hour.

fishermen spent their entire day in this long pool. Almost all of the data recorded for the upper area came from float anglers in this pool, although some float fishermen did float through the upper zone from River Road boat ramp. The only other data recorded for the upper zone came from wading anglers who started at Miller Island early in the morning and came to the lower reaches of the river to get ahead of the rising water.

The 1994 regulations were successful in producing significantly higher percent release within the quality zone, compared to the lower zone (Figure 15). These numbers were comparable to percent releases in the quality zone on the Hiwassee River in 1989 through 1991 (Strange and Lindbom 1993). The use of artificial bait was more popular with float and wade fishermen in 1994 (Figure 17) than with float fishermen only in 1993 (Figure 8). The high use of artificial baits help catch and release work more effectively. Taylor and White (1992) and Pauley and Thomas (1993) found that trout caught on natural bait were less likely to survive than trout caught on artificial baits.

As in 1993, fish from the quality zone had mean lengths and weights that were greater than fish from the other two areas (Figures 18 & 19). However, there were too few fish (4) from the quality zone to indicate the quality zone was producing bigger fish. The largest rainbow trout came from the lower zone and was 475 mm in length and weighed 1000 g. Brown trout were seldom caught in 1994. Of 402 fish measured only 12 were browns, about 3% of the total, with the largest being 315 mm in length and weighing 310 g.

Most float and wade fishermen came from Knox county followed by Anderson, Blount, Sevier, and Loudon. All of these counties are close to Norris tailwater. Out of state fishermen composed 3% of the fishing population (Table 3). Hunt (1991) found similar results in a Wisconsin catch and release fishery. Anglers living within a 24 mile radius accounted for 81% of anglers in the reference zone and 83% of anglers in the catch and release zone. Out of state fishermen only accounted for about 8% of total trips in each study zone. Lindbom (1992) found that fishermen on the Hiwassee River traveled significantly farther to fish the quality zone than the general regulations zone. Norris tailwater, on the other hand, did not show this pattern. There was no significant relationship between distance traveled and use of the quality zone by float and wade anglers in 1994 (Table 2).

Most float and wade fishermen (68%) interviewed in 1994 were in favor of quality regulations on Norris tailwater (Figure 20). Fatora (1970) submitted a questionnaire to anglers who used Noontootla Creek in northern Georgia which restricted fishermen to artificial bait and a minimum size of 16 inches. The fishermen were 80% in favor of the regulation as it was or with slight modification. In a study done by Anderson and Nehring (1984) anglers fishing the South Platte River, Colorado, were asked their opinion about "no kill" regulations on the river. The researchers found 75% of fishermen favored the regulations and 14% were opposed. Gigliotti and Peyton (1993) studied fishermen preferences of catch and release regulations and membership in fishing organizations. They found 41% of nonmembers were in favor of catch and release, 36% were against, and 23% were undecided. Among the

members of two fishing organizations, Trout Unlimited (TU) and Fly Fishing Federation (FFF), TU members were 67% in favor, 23% opposed, and 10% undecided, and FFF members were 75% in favor, 19% opposed, and 6% undecided. It was interesting to note, that of comments taken in 1994 the largest single category wanted the quality regulations to be more restrictive than stated in the 1994 quality regulations. Even the next two most common responses were in favor of quality zone regulations or returning to the 1993 more restrictive regulations (Table 4). These comments and responses to opinion questions indicated float and wade fishermen who responded favored quality management on Norris tailwater.

In 1994, Norris tailwater had excellent fishing between Miller Island and Highway 61 Bridge. The quality zone was unsuccessful in producing significantly higher catch rates but percent release was significantly higher in the quality zone. Total effort and total catch was significantly lower in the quality zone compared to the lower zone. Trout caught inside the quality zone were larger but too few were recorded from the quality zone to determine if the quality zone was consistently producing larger fish. Fishermen who used the quality zone did not travel farther than fishermen who did not use the quality zone. Also, most fishermen (68%) were in favor of the quality zone. Most fishermen (69%) indicated the quality zone did not change the way they fish Norris tailwater.

LIST OF REFERENCES

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Anderson, R. M., and R. B. Nehring. 1984. Effects of a catch-and-release regulation on a wild trout population in Colorado and its acceptance by anglers. North Am. J. Fish. Manage. 4:257-265.

Anonymous. 1983. TVA to weir the Clinch. Sports Fish. Inst. Bull. 344:6-7.

Bettoli, P. W. 1989. Survey of the recreational fisheries in the Caney Fork, Elk, and Hiwassee Rivers. Tenn. Coop. Fish. Resea. Unit, Tenn. Tech. University. Cookeville, Tenn. 55pp.

Bivens, R. D., C. E. Williams, and B. Carter. 1994. Region IV trout fishery data collection report. Tenn. Wildl. Resour. Agency. Tech. Rep. 94-21. Nashville, Tenn. 226pp.

Cushman, R. M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North Am. J. Fish. Manage. 5:330-339.

Fatora, J. R. 1970. Noontootla–a sixteen-year creel and use history of a Southern Appalachian trout stream under changing management regulations. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 24:622-637.

Gigliotti, L. M., and R. B. Peyton. 1993. Values and behaviors of trout anglers, and their attitudes toward fishery management, relative to membership in fishing organizations: a Michigan case study. North Am. J. Fish. Manage. 13:492-501.

Hartzler, J. R. 1988. Catchable trout fisheries: the need for assessment. Fish. 13:2-8.

Hayne, D. W. 1991. The access point creel survey: procedures and comparison with the roving-clerk creel survey. Pages 123-138 in D. Guthrie, J. M. Hoenig, M. Holliday, C. M. Jones, M. J. Mills, S. A. Moberly, K. H. Pollock, and D. R. Talhelm, ed. Creel and angler surveys in fisheries management. Am. Fish. Soc. Bethesda, Maryland.

Heimer, J. T., W. M. Frazier, and J. S. Griffith. 1985. Post-stocking performance of catchable-size hatchery rainbow trout with and without pectoral fins. North Am. J. Fish. Manage. 5:21-25.

Helfrich, L. A., and W. T. Kendall. 1982. Movements of hatchery-reared rainbow, brook, and brown trout stocked in a Virginia mountain stream. Prog. Fish-Cult. 44:3-7.

Hunt, R. L. 1991. Evaluation of a catch and release fishery for brown trout regulated by an unprotected slot length. Wis. Dep. Nat. Resour. Tech. Bull. 173. Madison, Wis. 39pp.

Kendall, W. T., L. A. Helfrich. 1982. Dispersion patterns of hatchery-reared rainbow trout stocked in a Virginia mountain stream. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 34:318-329.

Lindbom, D. R. 1992. Special regulations increase angler success on the Hiwassee River Tennessee. MS Thesis, University of Tennessee., Knoxville. 61pp.

Little, J. D. 1978. Coldwater fishery resources and management program in Tennessee. Southeastern Trout Resource: Ecology and Management Symposium Proceedings. U. S. For. Serv. Southeast. For. Exp. Stn. Ashville. N. C. 104-110.

McMichael, G. A., and C. M. Kaya. 1991. Relations among stream temperature, angling success for rainbow trout and brown trout, and fishermen satisfaction. North Am. J. Fish. Manage. 11:190-199.

Myhr, A. I. 1977. Hiwassee River investigations. Tennessee Wildlife Resources Agency. Tech. Rep. 77-51. Norris, Tenn. 86pp.

Oliver, M. L. 1984. The rainbow trout fishery in the Bull Shoals-Norfork tailwaters, Arkansas, 1971-81. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 38:549-561.

Pauley, G. B., and G. L. Thomas. 1993. Mortality of anadromous coastal cutthroat trout caught with artificial and natural bait. North Am. J. Fish. Manage. 13:337-345.

Pfitzer, D. W. 1954. Investigations of waters below storage reservoirs in Tennessee. Trans. North Am. Wildl. Conf. 19:271-282.

Strange, R. J., and D. R. Lindbom. 1993. Quality regulations increase angler success in a tailwater trout fishery. Tenn. Farm and Home Sci. 168:22-27.

Swink, W. D. 1983. Survey of stocking policies for tailwater trout fisheries in the Southern United States. Prog. Fish-Cult. 45:67-71.

Tarzwell, C. M. 1938. Changing the Clinch River into a trout stream. Trans. Am. Fish. Soc. 68:228-233.

Taylor, M. J., and K. R. White. 1992. A meta-analysis of hooking mortality of nonanadromous trout. North Am. J. Fish. Manage. 12:760-767.

Wiley, R. W., R. A. Whaley, J. B. Satake, M. Fowden. 1993. Assessment of stocking hatchery trout: a Wyoming perspective. North Am. J. Fish. Manage. 13:160-170.

Yeager, B. L. 1994. Impacts of reservoirs on the aquatic environment of regulated rivers. Tenn. Valley Authority. Tech. Rep. TVA/WR-93/1. Norris, Tenn. 109pp.

_____, T. McDonough, and D. A. Kenny. 1994. Status of aquatic resources in Norris tailwater 1971-92: summary of existing data. Tenn. Valley authority. Tech. Rep. TVA/WR-94/004. Norris, Tenn. 32pp.

_____. W. M. Seawell, C. M. Alexander, D. M. Hill, and R. Wallus. 1987. Effects of aeration and minimum flow enhancement on the biota of Norris tailwater. Tenn. Valley Authority. Tech. Rep. TVA/ONRED/AWR 87/41. Knoxville, Tenn. 90pp.

APPENDIXES

APPENDIX 1

1993 CREEL INSTRUMENT

Interview Sheet for Clinch River Creel Survey

Survey location: peach orchard ____
highway 61 bridge ____

Date (mo\day\yr): ______
Interview number: _____

Put in point: _____

Start time: _____

Finish time: _____

Area fished: upper area _____ % time in upper area _____
lower area _____ % time in lower area _____
trophy area _____ % time in trophy area _____

No. in party: _____

Zip code: _____

Upper Area

Species	Species fished for	No. kept	No. released	Total no. caught
Trout				
rainbow	_____	_____	_____	_____
brown	_____	_____	_____	_____
Other A	_____	_____	_____	_____
Other B	_____	_____	_____	_____

Method of fishing
Cast\Spin ____ Flyfishing ____ Lures ____ Live bait ____ Corn ____ Other ____

Lower Area

Species	Species fished for	No. kept	No. released	Total no. caught
Trout				
rainbow	_____	_____	_____	_____
brown	_____	_____	_____	_____
Other A	_____	_____	_____	_____
Other B	_____	_____	_____	_____

Method of fishing
Cast\Spin ____ Flyfishing ____ Lures ____ Live bait ____ Corn ____ Other ____

Trophy Area

Species	Species fished for	No. kept	No. released	Total no. caught
Trout				
rainbow	_____	_____	_____	_____
brown	_____	_____	_____	_____
Other A	_____	_____	_____	_____
Other B	_____	_____	_____	_____

Method of fishing
Cast\Spin ____ Flyfishing ____ Lures ____ Live bait ____ Corn ____ Other ____

Fish Observed

	Species	Length (mm)	Weight (g)	Area
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

APPENDIX 2

1994 CREEL INSTRUMENT

Interview Sheet for Clinch River Creel Survey

Period____

Survey location: peach orchard _____ coldwater farm_____
highway 61 bridge _____ Clinton jail_____

Date (mo\day\yr):_________
Interview number:_____

Put in point: _____

Start time: _____

Type of fishing: wade_____ float_____

Finish time: _____

Area fished: upper area _____ % time in upper area _____
lower area _____ % time in lower area _____
trophy area _____ % time in trophy area _____

No. in party: _____

Zip code: _____

Upper Area

Species	Species fished for	No. kept	No. released	Total no. caught
Trout				
rainbow	_____	_____	_____	_____
brown	_____	_____	_____	_____
Other A	_____	_____	_____	_____
Other B	_____	_____	_____	_____

Method of fishing

Cast\Spin _____ Flyfishing _____ Lures _____ Live bait _____ Corn _____ Other _____

Lower Area

Species	Species fished for	No. kept	No. released	Total no. caught
Trout				
rainbow	_____	_____	_____	_____
brown	_____	_____	_____	_____
Other A	_____	_____	_____	_____
Other B	_____	_____	_____	_____

Method of fishing

Cast\Spin _____ Flyfishing _____ Lures _____ Live bait _____ Corn _____ Other _____

Trophy Area

Species	Species fished for	No. kept	No. released	Total no. caught
Trout				
rainbow	_____	_____	_____	_____
brown	_____	_____	_____	_____
Other A	_____	_____	_____	_____
Other B	_____	_____	_____	_____

Method of fishing

Cast\Spin _____ Flyfishing _____ Lures _____ Live bait _____ Corn _____ Other _____

Fish Observed

	Species	Length (mm)	Weight (g)	Area
1.				
2.				
3.				
4.				
5.				
6.				
7.				
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20.				
21.				

What is your opinion of the quality zone?

strongly in favor **in favor** **undecided** **against** **strongly against**

Comments:

Has the quality zone changed the way you fish the Clinch river?

Yes No

If yes in what way?

VITA

Born and raised in Columbia, Tennessee, William Calvert Fraser knew he desired an aquatic wildlife vocation since the age of seven. His journey towards this end has included receipt of a B.S. in Biology from Lambuth University in 1986, a B.S. in Wildlife and Fisheries Science in 1993 from the University of Tennessee at Knoxville, and now continues upon completion of this thesis with a Master's Degree from UTK. His pursuit of perfection in his field has been honored by Xi Sigma Pi and with a nomination for the UTK Chancellors Citation Award. The only obstacle that stands in the way of success is the fear of failure.