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Evaluation of Restrictive Regulations on Rainbow Trout and the Performance of Two Strains in the Lake Cumberland Tailwater

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EVALUATION OF RESTRICTIVE REGULATIONS ON RAINBOW TROUT AND THE PERFORMANCE OF TWO STRAINS IN THE LAKE CUMBERLAND TAILWATER

By

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ABSTRACT

Reservoir tailwaters can be an important resource for developing quality trout fisheries, especially when managed with restrictive regulations. The objective of this study was to evaluate the effectiveness of a 15-20 in protective slot limit on rainbow trout *Oncorhynchus mykiss* in the Cumberland River below Lake Cumberland, Kentucky. The regulations that were implemented in March 2004 also include a creel limit of 5 trout, only one of which may be over 20 in but did not include gear or bait restrictions. The purpose of the new regulations was to increase the overall number of rainbow trout in the tailwater, but especially the number of quality rainbow trout (≥15 in), while still allowing for a put-and-take fishery. The evaluation period ended in 2006 and was cut short due to the Wolf Creek Dam rehabilitation project that began in 2007. However, both the overall rainbow trout electrofishing catch per unit effort and the catch rate of fish ≥15 in increased in the three years following the regulation change. The total rainbow trout catch rate increased from a high of 137 fish/h in pre-regulation years to 220 fish/h in 2006 and the catch rate of ≥15 in rainbow trout increased from a high of 27.2 fish/h in pre-regulation years to 33.9 fish/h in 2006. Both of these numbers are the highest ever recorded in the Lake Cumberland tailwater. Creel surveys also showed the angler catch rate for rainbow trout increased 9.7% between 2002 and 2006 to 0.71 fish/h and the proportion of quality rainbow trout (≥15 in) in the angler catch increased 46% in 2006 to 12.7% of the total catch. As rainbow trout electrofishing and angler catch rates increased over time, no corresponding decrease in growth or condition was observed which lead to the conclusion that there were no negative density-dependent impacts. The limited amount of data available for the strain comparison indicated that the more wild McConaughy rainbow trout strain had better survival and growth than the more domesticated Arlee strain in a single season after stocking in the Lake Cumberland tailwater. The Arlee strain was more susceptible to anglers as 89% of the total harvest of the two strains was the Arlee strain. It is recommended to maintain the restrictive size and creel limits on rainbow trout after completion of the dam rehabilitation and the population should continue to be monitored. Future projects also recommended are a multi-year rainbow trout strain comparison and creel and angler attitude surveys.

INTRODUCTION

A reservoir tailwater can be described as that portion of a stream or river below a dam that is directly affected by the discharge of water through or over that dam (Parsons 1957). Tailwaters below most deep-release reservoirs offer relatively low turbidity, cold temperature, and more stable seasonal flow as well as abundant food for trout (Walburg et al. 1981). Between the efforts of the Tennessee Valley Authority and the U. S. Army Corps of Engineers (ACOE), New Deal-era dam construction exploded in the southeastern United States in the middle of the last century. The stocking and management of trout in the altered habitats below high-head dams subsequently became commonplace (Axon 1975) and thriving trout populations now exist in many of these tailwaters. However, many of these populations must be maintained by stocking because extreme short-term flow fluctuations and unsuitable spawning habitat in some of these environments limits natural reproduction (Pender and Kwak 2002; Holbrook and Bettoli 2006).

Since the 1970's, as the concept of catch and release fishing became more popular, there has been greater demand for quality trout angling experiences (Fatora 1978; Barnhart and Roelofs 1977, 1987; Harris and Bergersen 1985; Hartzler 1988; Gigliotti and Peyton 1993; Weiland and Hayward 1997). Tailwater trout fisheries are a resource that can satisfy this demand, sometimes in regions not normally conducive to coldwater fisheries. Further, the exceptional economic return from developing and maintaining high-quality tailwater trout fisheries throughout the US (USFWS 2006), combined with the increasingly limited supply of hatchery sources, requires that existing hatchery production be optimized by researching and using various fisheries management strategies. Fish population modeling has confirmed that limiting fishing mortality through either high minimum size limits or slot limits can lead to decreased harvest, and increases in abundance of the total population and of larger fish in the population if growth rates are maintained (e.g. Clark et al. 1980, 1981; Jensen 1981; Zagar and Orth 1986; Power and Power 1996; Nordwall et al. 2000). Knowledge of the post-stocking performance of various trout strains and then tailoring the strain's performance with the desired management strategy for the body of water can be another way of optimizing hatchery production (Hudy and Berry 1983; Fay and Pardue 1986; Babey and Berry 1989; Hume and Tsumura 1992).

Rainbow trout are the most common trout species stocked because they are highly vulnerable to sportfishing and serve well as a put-and-take species (Fatora 1978; Swink 1983; Hartzler 1988; Heidinger 1993). To offset heavy angling pressure, rainbow trout are often stocked at high densities (Weiland and Hayward 1997). Fisheries managers can attempt to balance the demands for increased recreational quality and make efficient use of hatchery production by implementing bait restrictions, restrictive size and creel limits, or some combination of these regulations.

The Kentucky Department of Fish and Wildlife Resources (KDFWR) manages a popular brown *Salmo trutta* and rainbow trout fishery in the Lake Cumberland tailwater. Rainbow trout were first stocked in 1956 while brown trout were first introduced in 1982. For years, both species were regulated together using no length limits and a combined eight trout daily creel limit of which three could be brown trout (Kosa 1999). Over the last two decades, the KDFWR has attempted to optimize stocking practices in the Lake Cumberland tailwater to increase its potential as a trophy brown trout fishery and increase the quality of the rainbow trout fishery. In 1995, a research project and a creel survey were initiated to evaluate movement, exploitation, and harvest of brown and rainbow trout in the upper 38.3 miles of the Lake Cumberland tailwater. Results of these studies were used to alter stocking locations and to feature brown trout as a trophy component of the fishery. In 1997, a 20.0-in minimum length limit and a one-fish-per-day creel limit was implemented on brown trout in an attempt to develop a trophy fishery. No bait or gear restrictions were enacted and rainbow trout regulations remained unchanged.

A second creel survey was conducted on the tailwater in 2002. Comparisons between the 1995 and 2002 creel surveys showed that there was a tremendous increase in angler usage, as fishing pressure, both in terms of number of trips and angler hours, had more than doubled. Catch rates of trout by trout anglers increased from 0.53 to 0.79 fish/h, but due to mandatory release of <20 in brown trout and increasing voluntary release of legal rainbow trout, the overall harvest rate of trout showed only a modest increase from 0.25 to 0.36 fish/h. However, this put more pressure on the rainbow trout population that in 2002 made up 99.6% of the trout harvest as compared to only 78.7% of the 1995 harvest. This represents a tripling of the harvest of rainbow trout.

The increasing fishing pressure on rainbow trout prompted KDFWR to consider implementing more restrictive regulations for this species in the tailwater. In the spring of 2003, the KDFWR conducted a trout angler mail survey to gauge the attitudes and opinions of Lake Cumberland tailwater trout anglers. When asked what size limit they would prefer on rainbow trout, 82% of anglers favored more restrictive size limits and 73% favored more restrictive creel limits. Subsequently, in March 2004, the KDFWR implemented a 15-20 in protective slot limit on rainbow trout along with a creel limit of 5 trout, of which only one could be over 20 in. No bait or gear restrictions were enacted with this regulation. The restrictive regulations were expected to prevent overharvest of rainbow trout and increase quality, while allowing for a put and take segment of the fishery.

There is a paucity of peer-reviewed research on the effects of restrictive minimum size and creel limits on salmonid populations (Power and Power 1996). An evaluation of the restrictive brown trout regulations on the Lake Cumberland tailwater has been completed (Dreves et al. 2014). So, the first goal of the current study was to evaluate the effectiveness of the rainbow trout restrictive harvest regulations which were enacted to attempt to increase the total number of rainbow trout and to especially increase the number of quality size fish in the slot (15.0 – 19.9 in). The objectives of this study were to (1) compare the relative abundance of several size groups of rainbow trout before and after the restrictive regulations were implemented and (2) determine if there were any changes in rainbow trout growth rates or condition. It was projected that there would be a 31.6% increase in the rainbow trout population under the new regulations.

Wolf Creek National Fish Hatchery annually stocks a minimum of five strains of rainbow trout. Long-term post-stocking performance of these various strains in the Lake Cumberland tailwater is unknown. The second goal of the study was to evaluate the post-stocking performance of two different strains of rainbow trout in the tailwater, one a relatively “domesticated” strain and the other a relatively “wild” strain. The specific objectives of the strain evaluation were to determine: (1) if the two strains exhibited differential growth and survival, (2) if “wild” strain fish are less susceptible to angling, and (3) the contribution that each strain makes to both the population and angler’s creel.

This project was originally slated to extend at least through 2008 to give ample time for the rainbow trout population to respond to the regulations along with being able to conduct the strain evaluation over multiple years. However, the rainbow trout population in the tailwater was highly negatively affected by the Wolf Creek Dam rehabilitation project which began in early 2007. Therefore, the project was cut short and only rainbow trout data through 2006 will be included in the evaluation.

STUDY SITE

The Lake Cumberland tailwater in Kentucky is a 75.2 mi section of the Cumberland River which extends from the Wolf Creek Dam to the Kentucky-Tennessee state line. It is located in the Highland Rim Province of southeastern Kentucky and is managed as a coldwater fishery. The study area for this project encompasses the upper 38.3-mi section beginning immediately below Wolf Creek Dam (Figure 1). Average daily discharge from the dam, released from 101 ft below maximum power pool, is 8,475 ft^3/s, but can fluctuate from 20 to 15,000 ft^3/s within 3 h. Daily discharge fluctuations and durations of minimum flows are variable and depend on hydropower demands. Daily water level fluctuations can range from 20 ft in the upper reaches of the tailwater to 6 ft at the lower end of the study area. River width varies from 200 to 400 ft. Long pools (0.5-4.0 mi) interspersed with riffles (0.1-0.7 mi) characterize the river with the first 8 miles of river below the dam having relatively swifter current and shallower water than further downstream (Hauser et al. 2004). Shoals associated with islands and small tributary streams, along with large woody debris along the banks, make up the primary in-stream habitat (Coopwood et al. 1987; Kosa 1999).

METHODS

Rainbow trout stocked in the Lake Cumberland tailwater were produced at the Wolf Creek National Fish Hatchery, which is located immediately below Wolf Creek dam. Catchable-size rainbow trout that averaged about 9.0 in total length (TL) were stocked monthly from April through December from 1995 to 2006 (Table 1). Rainbow trout stocking rates were lowest during 1995 and 1996, but increased to approximately 145,000 fish annually (3,786 per mi) thereafter. There is also a co-existing hatchery-supported brown trout population in the Lake Cumberland tailwater. Approximately 30,000 (783 fish per mi) catchable-size brown trout averaging 8.0 in TL were stocked in March or early April from 1995 to 2006 (Table 1).

Annual trout population sampling was conducted at night in November of each year from 1995-2006 using boat-mounted pulsed DC electrofishing gear at each of five fixed sites (Figure 1). Prior to sampling, a request was made to the ACOE to provide a constant single turbine release from Wolf Creek Dam to ensure that all crews experienced a stable flow, thereby reducing sampling variation (Dauwalter et al. 2009). Multiple timed samples (15-min) were collected at each site and consisted of three runs per site in 1995 and four runs per site in 1996 at

Sites 1, 2, 3, 4 and 6. From 1997-2006, because of the discontinuation of brown trout stocking near the dam, sampling was discontinued at Site 1 and this was effort shifted to the area designated as Site 5 (Figure 1). Beginning in 1997, sampling effort was increased to five runs at each site. Trout captured were measured to the nearest 0.1 in TL and any marks were identified. From 2000 through 2006, trout were weighed to the nearest 0.01 lb. The sampling data was not only used to calculate catch-per-unit-effort (CPUE, fish/h), but also to collect growth and relative weight (W_r) information. Relative weight was calculated based on the standard weight equation for rainbow trout as referenced in Anderson and Neumann (1996).

For growth rate determination, a rainbow trout cohort stocked in 2004 was batch marked with an adipose fin clip. It was predicted that a normal months stocking allotment of about 20,000 rainbows was not enough fish to mark and expect to find again later in sufficient numbers with electrofishing. So instead, a two month allotment of rainbow trout (9.5 in, SE=0.05 in, N=400), or about 38,000 fish were marked in 2004 and stocked in late April. In 2006, two strains of rainbow trout were differentially marked to analyze differences in relative survival, growth, and susceptibility to angling. Arlee strain rainbow trout were the more domesticated strain used and were marked with a right pelvic fin clip (9.9 in, SE=0.04 in, N=500). McConaughy strain rainbow trout were the more wild strain used and were marked with a left pelvic fin clip (9.4 in, SE=0.05 in, N=450). Similar to 2004, two month allotments of rainbow trout were marked for each strain and so 42,000 Arlee strain rainbow trout were stocked on 1-June 2006 while 43,500 McConaughy strain were stocked on 31-July. This study design is not ideal as it would have been preferable to have a more direct comparison by stocking the two strains of similar length at the same time. However, hatchery production limitations prevented that scenario. Feeding rates were adjusted in an attempt to have each cohort of fish the same mean length at the time of stocking. Mean length, weight, and fin clip efficacy were estimated from a random subsample of fish from each cohort prior to stocking the marked fish. Through anecdotal field observations, fin regeneration of adipose fin clips was rare to non-existent. Pelvic fin regeneration was more common; however, anomalous fin characteristics of regenerated fins usually made marked fish obvious.

A five mile section of the tailwater encompassing Site 4 was sampled monthly from May to December in 2004 and 2006 to monitor monthly changes in growth and condition of marked rainbow trout. All trout collected were measured, weighed, and checked for fin clips, and in each sampling event, successive 15-minute runs were made until a minimum of 30 marked rainbow trout of that year’s cohort were collected.

Since the rainbow trout population was severely negatively impacted by the Wolf Creek Dam rehabilitation beginning in 2007, there are only three years of post-regulation data (2004-2006). This is not enough time for the ≥15 in rainbow trout to fully respond to the regulation changes so rigorous statistical analyses of pre- and post-regulation electrofishing data was not conducted. However, some statements about the effectiveness of the regulations were made by the examination of rainbow trout electrofishing catch rates.

Several other population parameters were collected to determine if there were any density dependent effects due to possible rainbow trout population increases. First year average monthly growth rates in length and weight were calculated by taking the slope of the regression equation of length or weight on date and multiplying times 30 days. Comparisons of monthly growth in length and weight were made between 2004 and 2006.

Roving creel surveys were conducted on the upper 38.3 mi section of the Cumberland River in 1995, 2002, and 2006. In the 2006 creel survey, clerks were trained to identify fin-clipped rainbow trout observed in the angler's creel to differentiate the relative harvest of the two rainbow trout strains. The creel surveys were conducted from March through November and creel clerks surveyed 18 days per month, including eight weekend days. The study area was divided into four reaches ranging in size from 4.5 to 12 miles and a single reach was covered on each survey day. Because of greatly different usage patterns, the area of study was stratified into two strata for data summary: the 4.5 mi reach from the dam to Helm's Landing was the upper stratum and the remaining three reaches combined from Helm's Landing to Highway 61 bridge (33.8 mi) were the lower stratum.

RESULTS AND DISCUSSION

Regulation Evaluation

Rainbow trout electrofishing catch rates increased in the three years following the implementation of the restrictive regulations. In fact, the overall rainbow trout catch rates in 2005 and 2006 were the highest recorded since intensive sampling of the Lake Cumberland tailwater began in 1995 (Figure 2). The 2006 electrofishing catch rate of 219.7 fish/h represents a 63.8% increase from the catch rate observed in 2002, which more than exceeded the 15.6% projected increase. In just three years, the regulations had the desired effects of both protecting more fish below the slot because of the reduced creel limit and increasing abundance of larger fish in the slot. Stacked length frequency histograms also showed the substantial increases in relative abundance across all inch classes after the regulations were implemented in 2004 (Figure 3). Further analysis shows that by fall 2006 the catch rate of 15.0-17.9 in rainbow trout were at an all-time high and the catch rate of 18.0-19.9 increased dramatically after 2003 and approached the all-time high that was observed in 2001 (Figure 4). Taken in aggregate, the catch rate of ≥15 in rainbow trout was also at an all-time high in 2006 at 33.9 fish/h. However, no change was seen in the catch rate of ≥20 in rainbow trout because the length of the evaluation study was limited to three years and due to the negative effects of the dam rehabilitation. The ≥20 in rainbow trout catch rate was expected to increase by more than a factor of 1100. A high degree of variability was observed between sample sites within any particular year and within sample sites between years (Table 2). Rainbow trout catch rates were always greater at the Above Helm's and Below Helm's sites in any year. In 2005 and 2006, it was evident that the rainbow trout population was improving over a broad area as electrofishing catch rates rose dramatically at all five sampling sites. In these two years, several of the sampling crews even reported that they were at dipping saturation for part of some sampling runs, meaning so many fish were stunned that two dippers could not physically dip all the fish that were immobilized.

There were extremely high numbers of first-year stocked rainbow trout in the 2005 and 2006 fall samples as indicated by number of fish in the 6 through 12 in size classes (Table 2, Figure 3). Since the size at stocking does not vary that much, the fact that the peak relative abundance shifted upwards for the second consecutive year after the restrictive regulations were implemented is evidence that the overall growth rate of rainbow trout in the first year after stocking did not decline. Though we only have two years of comparison, the monthly growth rate of rainbow trout in their first year in the tailwater was 0.48 in/month in 2004 (Figure 5) and was in excess of 0.6 in/month in 2006 (Figure 6). The growth in weight of rainbow trout followed a similar pattern (Figures 5 and 6). However, the length frequency of rainbow trout from Above Helm's (Table 2) may indicate slower growth in this area where the rainbow trout catch rate was 478 fish/h, a figure 86% greater than the catch rate at the next highest site. It was the only site of the five that was slightly skewed to the left for the 6 through 12 inch classes as the mode was the 10 inch class and there were relatively higher numbers of 10 inch class and below rainbow trout as compared to the 11 and 12 inch classes.

The November relative weight of 8-12.9 in rainbow trout declined slightly from 2005 to 2006 (Table 3). However, further analysis again revealed that this decline only occurred at the Above Helm's sampling site. The relative weight of 8-12.9 in rainbow trout was 85 for Above Helm's fish while relative weights for this size fish ranged from 94 to 97 at the other four sites. It is possible that resources were becoming limiting for rainbow trout in this area closest to the dam because of the high density of fish that resulted from the much higher stocking rates at this site (Table 1).

A comparison of the three most recent creel surveys shows that though the total catch of rainbow trout in the 2006 creel survey was down slightly from 2002 (Table 4). However, this was more a function of decreased fishing pressure (383,660 man-hours expended for trout in 2006 vs. 516,200 man-hours in 2002; Table 5) as the catch rate of rainbow trout increased 9.7% from 2002 to 2006 (0.65 fish/hour in 2002 and 0.71 fish/hour in 2006; Table 5). Further analysis of the unexpanded length frequency distributions demonstrates that the changes in regulations resulted in improved size structure of the angler catch (Table 4). Rainbow trout that were ≥15 in accounted for 2.7 % of the catch (42 of 1,572) in the 1995 creel survey, 8.7 % of the catch (550 of 6,292) in 2002 and 12.7 % of the catch (551 of 4,329) in 2006.

The observed increases in electrofishing and angler catch rates of rainbow trout between 1995 and 2002 can most likely be attributed to the tremendous increase in the number of rainbow trout stocked in the Lake Cumberland tailwater, increasing over 86% during this time period (Table 1). By comparison, the numbers of rainbow trout stocked over the 2002-2006 time period were stable, so this could not be a factor in the observed catch rate increases after 2002.

Strain Evaluation

There were some differences observed between the Arlee and McConaughy strains of rainbow trout even with the staggered stocking dates. The estimated growth in length of the Arlee strain from May 23 to December 6 was 0.60 in per month, although sample sizes were generally very low (Figure 6). The estimate growth in length of the McConaughy strain from July 20 to December 6 was 0.67 in per month (Figure 6). The estimated weight change over these same periods was 0.09 lbs per month for both strains. Because of the lower sample sizes later in 2006, the Arlee data gives greater emphasis to growth shortly after stocking. In examining the average length and weight on each sampling date, it seemed that increasing water temperatures at the end of the growing season adversely affected the Arlee strain to a greater extent than the McConaughy strain, particularly in terms of weight (Figure 6). An analysis of trout relative weight in the growing season after stocking shows a distinct seasonality. Condition typically declines in the month after stocking and then increases rapidly through October before falling in November and December, with the degree of drop-off related to the severity of the increase in water temperature in that particular year. A comparison of relative weight between the two strains over the course of the year reveals that the condition of both strains followed the normal seasonality (Table 6). The later stocking date may not have allowed the McConaughy strain a comparable amount of time during the prime growing season to reach a similar relative weight as the Arlee strain. However, by December, the drop from the peak relative weight for the Arlee strain was much more severe than for McConaughy strain, which may indicate that the Arlee strain is less tolerant of the warmer water temperatures that may occur in the Lake Cumberland tailwater in some years.

The fact that the Arlee samples sizes were so much lower than for the McConaughy strain in the section of river sampled for monthly growth and condition analysis was surprising (Table 6). It is possible that this disparity was related to the fact that the sampling area (a few miles on either side of Rainbow Run) is about midway between the Helm's Landing and Winfrey's Ferry stocking sites, and is about 6 miles from either stocking site. It appears that the Arlee strain did not disburse nearly as much as the McConaughy strain. This same pattern held true during the intensive fall sampling. At the Above Winfrey's site (Rainbow Run), the catch rate of Arlee strain was 3.2 f/h while the McConaughy strain catch rate was 52.8 f/h (Table 7). There was quite a disparity in catch rate between the two strains at all 5 fall sampling areas and it is certain that Arlee strain were more susceptible to angling, as will be seen in the creel survey analysis. The Arlee strain generally was a little over an inch greater in mean length than the McConaughy strain at each of the five sites in the November sample (Table 8). However, by the time the McConaughy strain were stocked the Arlee strain had been in the river for about two months and already averaged about 2 in longer. So, in just 3 months, the McConaughy strain was able to gain nearly an inch in mean length on the Arlee Strain.

There were dramatic differences between the two rainbow trout strains observed in the 2006 Cumberland tailwater creel survey. The Arlee strain rainbow trout were harvested in much greater numbers than the McConaughy strain (Table 9). Though the Arlee strain were released two months earlier and therefore susceptible to harvest longer, creel clerks observed over 5 times more of the Arlee strain (901 fish) were harvested than the McConaughy strain (156 fish). An analysis of expanded data by month reveals that the higher harvest of the Arlee strain is not due to being stocked earlier. For the months of August through November when both strains were at-large and susceptible to harvest, it was estimated that anglers harvested approximately 26,000 of the Arlee strain rainbow trout compared with 5,400 of the McConaughy strain, even though the initial Arlee number had already been reduced after two months at-large (Table 10). The Arlee strain rainbow trout were harvested at higher rates than McConaughy for both bank and boat anglers except in October and November when the strains were harvested at the same rate by bank anglers (Table 11).

It is apparent that the restrictive creel limit and protective slot limit regulations implemented for rainbow trout in 2004 had begun to alter the rainbow trout population in positive ways and it was unfortunate that the project had to be caught short before the population reached equilibrium under the new regulations. However, the success of fisheries regulations ultimately depends on angler acceptance (Fatora 1978; Anderson and Nehring 1984; Brousseau and Armstrong 1987; Pierce and Tomcko 1998). Some anglers place high value on harvesting fish, while others enjoy catching and releasing high numbers of fish or simply catching large fish. Fatora (1978) stated that the ultimate goal of trout management should be to provide quality fishing for the varied desires of the resource users, and suggested that the trout resources in a given area should be managed differently in an effort to accommodate all angler desires. The Lake Cumberland tailwater rainbow trout regulations accomplish this by allowing for limited harvest of mostly smaller fish to satisfy the put-and-take component of the fishery yet protect enough large fish for a put-grow-and-take strategy that leads to good numbers of trophy fish. The different rainbow trout strain characteristics may also be used to further these differing management strategies. It may be desirable to stock the upper tailwater, nearer the dam, with the more angling susceptible Arlee strain since this section is where most of the harvest-oriented angling takes place. The McConaughy strain which seems to grow faster and is less susceptible to harvest may be better suited to the section of river from Helm's Landing and below because these areas have not traditionally had as much harvest. Alternatively, if the management strategy is to produce the highest quality fishery in terms of increasing average fish length then the preference may be to focus more effort on stocking just the McConaughy strain over all sections of the river. If the management strategy is to increase angler catch rates only then more Arlee strain should be stocked. With any of the above strategies, the rainbow trout population needs to be continually monitored and the stocking rates adjusted if any evidence recurs of stockpiling of fish.

CONCLUSIONS

Several observations and conclusions were drawn from this study, even though it was cut short due to negative impacts to the rainbow trout population resulting from the Wolf Creek Dam rehabilitation. In just three years following the regulation change, both the overall rainbow trout electrofishing catch per unit effort and the catch rate of fish ≥15 in increased. Both numbers are the highest ever recorded in the Lake Cumberland tailwater. Creel surveys showed that the angler catch rate of rainbow trout and the proportion of quality rainbow trout (≥15 in) in the angler catch also increased. It was also concluded that there were not any overall negative density dependent effects as no decreased growth or condition was observed at the population level. In a single season of comparing two rainbow trout strains, the more wild McConaughy strain had better survival and growth than the more domesticated Arlee strain. The Arlee strain was much more susceptible to anglers.

MANAGEMENT RECOMMENDATIONS

1. Results of this evaluation indicate that the restrictive size and creel limits regulation on rainbow trout will have the desired effects and should remain following completion of the dam rehabilitation and a return to normal flows.
2. It is recommended that the rainbow trout population in the Lake Cumberland tailwater continued to be monitored to track population response after a return to normal conditions and to determine when the rainbow trout population reaches equilibrium under the restrictive regulations and at what level.

3. Density dependent mechanisms negatively affecting the rainbow trout population would most likely first be observed in the area just below the dam because of the high stocking density. The rainbow trout stocking rate in this area should be reduced and these fish distributed to areas downstream if any evidence of stockpiling is observed.
4. Conduct a multi-year rainbow trout strain comparison study to determine if the results of the one year study are accurate. It is recommended that the comparison be designed such that the strains are stocked at the same time and at similar lengths.
5. Conduct creel and angler attitude surveys to determine if pressure, catch rates, and angler satisfaction have returned to pre-dam rehabilitation levels.

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Table 1. Catchable-size rainbow and brown trout annual stocking numbers and locations in the Lake Cumberland tailwater from 1995 to 2006.

Stocking site	River mile	Year											
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
		Rainbow Trout											
Dam	0.0				73,700	50,050	66,300	72,000	72,000	69,000	63,000	68,300	71,000
Helm's Landing	4.5	70,990	78,841	104,500	12,000	10,500	16,500	17,000	17,500	17,500	20,500	17,500	18,500
Winfrey's Ferry	15.7				12,000	9,000	16,500	17,000	12,500	21,500	20,500	17,500	18,500
Crocus Creek	25.7				14,000	9,000	14,000	14,500	18,000	16,000	19,000	16,000	16,000
Burkesville Ramp	33.5	7,160	22,250	40,250	12,000	29,500	14,000	14,500	17,500	14,000	14,000	14,000	14,000
Hwy. 61 Ramp	38.3				8,000	6,000	8,500	8,000	8,000	8,000	8,000	8,000	8,000
Total		78,150	101,091	144,750	131,700	114,050	135,800	143,000	145,500	146,000	145,000	141,300	146,000
		Brown Trout											
Dam	0.0	2,984	0	0	0	0	0	0	0	0	0	0	0
Indian Creek	2.0	3,152	6,000	0	0	0	0	0	0	0	0	0	0
Helm's Landing	4.5	7,506	7,000	3,000	6,500	7,407	3,006	3,050	3,000	3,000	3,000	3,500	3,000
Winfrey's Ferry	15.7	6,959	7,000	9,000	8,985	7,407	9,018	8,930	9,000	9,000	9,000	9,000	9,000
Crocus Creek	25.7	5,053	5,000	9,000	6,150	5,752	9,018	8,930	9,300	9,000	9,000	9,000	9,000
Burkesville Ramp	33.5	4,506	5,000	9,000	6,345	5,752	5,010	5,010	5,300	5,000	5,000	5,000	5,000
Hwy. 61 Ramp	38.3	0	0	5,000	1,237	5,752	4,008	4,030	4,100	4,000	4,000	4,000	6,700
Total		30,160	30,000	35,000	29,217	32,070	30,060	29,950	30,700	30,000	30,000	30,500	32,700

Table 2. Length-frequency distribution and CPUE (fish/h) of rainbow trout collected by nocturnal electrofishing in the Lake Cumberland tailwater in November (1995-2006). Data for each location in 1997-2006 consists of five fifteen-minute samples. Four fifteen-minute samples were collected at each location in 1996 and three fifteen-minute samples were collected at each location in 1995 (Four samples at Below Helm's site). Standard errors are in parentheses.

	Inch Class																										Mean CPUE
Location	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total	(fish/h)
Above Helm's (1995)				1	5	11	24	22	3	1	1				1											69	92.0 (25.0)
Above Helm's (1996)				1	3	16	30	28	14	10	4		1													107	107.0 (25.5)
Above Helm's (1997)				3	10	60	62	21	7		1	2						1								167	133.6 (38.4)
Above Helm's (1998)		1	1	1	9	31	38	23	5	1																110	88.0 (23.2)
Above Helm's (1999)			1	1	6	60	76	68	25	18	6	1	1													263	212.8 (41.6)
Above Helm's (2000)				1	10	29	49	48	22	10	6	3	3	3												184	148.0 (39.6)
Above Helm's (2001)		1	1	1	2	28	71	63	48	32	12	2	1		1											263	209.2 (46.8)
Above Helm's (2002)			1	1	19	73	108	64	27	2	3	4	1		1											304	243.2 (37.3)
Above Helm's (2003)			1		12	52	49	20	10	5	3				1											153	122.4 (31.5)
Above Helm's (2004)					31	72	30	8	6	3	1															151	120.8 (25.0)
Above Helm's (2005)				2	13	131	216	87	22	10			3													484	387.2 (50.7)
Above Helm's (2006)				2	6	69	190	164	84	27	20	17	7	7	3			1								597	477.6 (80.3)
Below Helm's (1995)				1	6	13	31	30	14	4	6															105	105.0 (6.0)
Below Helm's (1996)						12	29	21	14	13	1		1		1											92	92.0 (16.8)
Below Helm's (1997)				1	15	54	67	30	15	4	1	1														188	150.4 (13.8)
Below Helm's (1998)					3	22	26	11	4	3		1														70	56.0 (6.6)
Below Helm's (1999)					2	8	15	18	13	13	5	3														77	61.6 (14.0)
Below Helm's (2000)				1	1	12	21	21	29	16	26	4	5	5		1										142	113.6 (17.9)
Below Helm's (2001)			2	0	1	6	27	47	47	38	30	19	13	7	5	5	1									248	198.4 (7.0)
Below Helm's (2002)					6	15	57	51	43	32	23	13	11	9		1										261	208.8 (34.2)
Below Helm's (2003)				1	5	17	32	31	9	11	4	2			2											114	91.2 (20.5)
Below Helm's (2004)					6	25	13	22	16	2	2															86	68.8 (15.7)
Below Helm's (2005)					2	26	63	76	63	57	29	7	6	1	1											331	264.8 (19.5)
Below Helm's (2006)				2	2	18	63	100	47	19	9	17	22	11	11											321	256.8 (42.8)

Table 2. cont.

Location	Inch Class																									Total	Mean CPUE (fish/h)
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		
Above Winfrey's (1995)						1	5	14	17	3	1	1														42	56.0 (18.0)
Above Winfrey's (1996)							4	1	9	19	10	3	2	1		1										50	50.0 (16.7)
Above Winfrey's (1997)				1	3	8	2	6	2	6	3	2	1			1										35	28.0 (6.1)
Above Winfrey's (1998)			3	3	7	19	9	5	2	4	3		1													56	44.8 (7.5)
Above Winfrey's (1999)					1		2	1	2	7	2		2	2	1					1					1	22	17.6 (3.5)
Above Winfrey's (2000)							2	6	6	3	8	5	4	4	1		2	1								42	33.6 (9.6)
Above Winfrey's (2001)				1	0	1	5	5	6	10	16	17	9	10	9	4			1							94	75.2 (22.5)
Above Winfrey's (2002)						4	9	4	8	16	25	8	3	2	4	1	4	1								89	59.3 (21.6)
Above Winfrey's (2003)					1	1	5	2	7	5	6	3	2	2	2	1	1									38	30.4 (7.2)
Above Winfrey's (2004)					3	8	9	6	12	10	3	3	3	1	2	1										61	48.8 (6.6)
Above Winfrey's (2005)							12	9	16	13	22	14	6	5	6	1										104	83.2 (18.9)
Above Winfrey's (2006)				1		11	20	40	33	5	4	13	15	12	3	3										160	128.0 (35.2)
Below Winfrey's (1997)					2	3	4	10	14	3	2	1		1	3	1		1								45	36.0 (9.9)
Below Winfrey's (1998)						2	2	3	1	1	1					1										11	8.8 (2.3)
Below Winfrey's (1999)					2	5	4	6	4	8	2	2	1		1											35	28.0 (3.3)
Below Winfrey's (2000)						3	2	5	10	8	8	8	6	4	3	3										60	48.0 (10.4)
Below Winfrey's (2001)		2	2	3	2	2	12	22	10	6	20	11	13	12	5	3	1	1								127	101.6 (27.6)
Below Winfrey's (2002)		1		2	3	10	18	21	18	12	9	6	2	1		2	1									106	84.8 (11.0)
Below Winfrey's (2003)			1		1	5	7	5	8	9	2	3	1													42	33.6 (8.5)
Below Winfrey's (2004)						9	4	5	4	7	3			1	1											34	27.2 (5.1)
Below Winfrey's (2005)			1	1	1	8	24	19	6	8	8	9	3	1	2	2										93	74.4 (10.8)
Below Winfrey's (2006)						4	8	27	11	11	5	7	13	9	5	1	1									102	81.6 (18.0)

Table 2. cont.

Location	Inch Class																									Total	Mean CPUE (fish/h)
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28		
Crocus Creek (1995)				1	2	8	14	5	2	1	1	2	1													37	49.3 (- -)
Crocus Creek (1996)					1	2	7	8	8	6	2		1			1										36	36.0 (11.4)
Crocus Creek (1997)					3	8	7	9	3	1	2			1	1											35	28.0 (6.7)
Crocus Creek (1998)		2	2	1	1	2	4	7	2	1	1									1						24	19.2 (4.5)
Crocus Creek (1999)						6	8	5	8	11	2		1													41	32.8 (8.2)
Crocus Creek (2000)					1	3	12	15	8	9	2	1	1	1												53	42.4 (6.2)
Crocus Creek (2001)		2	1	1	3	2	17	18	8	13	11	7	5			1										89	89.0 (26.0)
Crocus Creek (2002)		2	2	1	3	10	27	22	2	2		2	4	1												78	62.4 (31.6)
Crocus Creek (2003)						7	1	5	4																	17	13.6 (10.7)
Crocus Creek (2004)				5	20	36	15	7	10			3	1	2												99	79.2 (33.9)
Crocus Creek (2005)			3	3	1	14	31	11	10	17	4	1	2		1											98	78.4 (15.5)
Crocus Creek (2006)					1	4	18	35	38	42	21	12	15	6	1											193	154.4 (27.4)
Total (1995):				3	13	33	74	71	36	9	9	3	1		1											253	78.2 (9.2)
Total (1996):				1	4	30	70	58	45	48	17	3	5	1	1	2										285	64.0 (9.7)
Total (1997):				5	33	133	142	76	41	14	9	6	1	2	4	2		2								470	75.2 (13.7)
Total (1998):		3	6	5	20	76	79	49	14	10	5	1	1			1				1						271	43.4 (7.4)
Total (1999):			1	1	11	79	105	98	52	57	17	6	5	2	2					1					1	438	70.6 (16.9)
Total (2000):				2	12	47	86	95	75	46	50	21	19	17	4	4	2	1								481	77.1 (12.5)
Total (2001):		5	6	6	8	39	132	155	119	99	89	56	41	29	20	13	2	1	1							821	136.8 (17.0)
Total (2002):		3	3	4	31	112	219	162	98	64	60	33	21	13	5	4	5	1								838	134.1 (19.5)
Total (2003):			2	1	19	82	94	63	38	30	15	8	3	2	5	1	1									364	58.2 (11.3)
Total (2004):				5	60	150	71	48	48	22	9	6	4	4	3	1										431	69.0 (10.5)
Total (2005):			4	6	17	179	346	202	117	105	63	31	20	7	10	3										1110	177.6 (28.2)
Total (2006):				5	9	106	299	366	213	104	59	66	72	45	23	4	1	1								1373	219.7 (34.4)

Table 3. Condition of rainbow trout (Wr) collected by nocturnal electrofishing in Lake Cumberland tailwater in fall 2000-2006. Standard errors are in parentheses.

	Size Range			
	8.0-12.9 in		≥13.0 in	
Year	No.	Wr	No.	Wr
2000	116	95.8 (1.0)	92	96.7 (1.0)
2001	92	108.2 (1.9)	147	101.2 (1.4)
2002	173	104.5 (2.0)	121	92.6 (1.3)
2003	131	84.8 (0.7)	51	89.6 (1.2)
2004	374	90.0 (0.4)	49	90.0 (1.3)
2005	860	94.0 (0.4)	238	94.0 (0.6)
2006	634	91.8 (0.5)	363	94.1 (0.6)

Table 4. Comparison of length distributions of both harvested and released rainbow trout in the Lake Cumberland tailwater creel surveys (Wolf Creek Dam to Hwy 61 Bridge) during 1995, 2002 and 2006. (Lengths for released fish are estimated)

Year		Inch Class																						
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	Total
1995	Harvested				1	1	76	311	373	221	137	45	26	15	9	4		2	3	1					1225
	Released				2	10	47	31	93	76	52	16	12		4	3	1								347
	Total				3	11	123	342	466	297	189	61	38	15	13	7	1	2	3	1					1572
2002	Harvested				5	18	135	363	802	852	722	296	295	138	84	68	35	16	7	2	1				3839
	Released	3	1	8	68	53	266	230	575	161	547	115	227	50	73	28	28	3	9	1	5	1	1		2453
	Total	3	1	8	73	71	401	593	1377	1013	1269	411	522	188	157	96	63	19	16	3	6	1	1		6292
2006	Harvested						26	149	454	553	596	304	160	25	8	3	5	3	4	2	1				2293
	Released			4	22	20	97	101	371	142	448	151	180	150	135	64	91	37	15	5		2		1	2036
	Total			4	22	20	123	250	825	695	1044	455	340	175	143	67	96	40	19	7	1	2		1	4329

Table 5. Comparison of statistics derived from daytime creel surveys on Lake Cumberland tailwater (Wolf Creek Dam to Hwy 61 bridge) during 1995, 2002 and 2006. (rm = river mile)

	1995				2002				2006			
	Rainbow Trout	Brown Trout	Trout Combined	Total	Rainbow Trout	Brown Trout	Trout Combined	Total	Rainbow Trout	Brown Trout	Trout Combined	Total
Fishing trips												
Number of fishing trips				52,431				104,963				102,844
Average trip length				5.1				5.1				3.9
Fishing pressure												
Total man-hours			244,107	269,123			516,200	539,034			383,660	405,754
Standard Error (S.E.)				25,783				39,080				33,434
Man hours/rm			6,374	7,027			13,478	14,074			10,017	10,594
Catch/harvest												
Number of fish caught	63,651	29,221	92,872	108,478	310,331	108,102	418,434	436,649	257,137	48,504	305,641	326,996
Number of fish harvested	48,029	13,023	61,052	65,667	184,745	663	185,126	193,169	120,364	2,087	122,451	123,583
Pounds of fish harvested	24,809	6,357	31,166	44,428	125,655	2,305	127,961	139,720	77,364	3,269	80,633	90,030
Catch and release rate (%)	25	55	34		40	99	56		53	96	60	
Catch rates												
Fish/hour	0.41	0.12	0.53	0.40	0.65	0.14	0.79	0.81	0.71	0.11	0.82	0.81
Fish/rm			2,425	2,832			10,925	11,401			7,980	8,538
Harvest rates												
Fish/hour			0.25	0.24			0.36	0.36			0.32	0.30
Pounds/hour			0.13	0.17			0.25	0.26			0.21	0.22
Fish/rm	1,254	340	1,594	1,715	4,824	17	4,834	5,044	3,143	54	3,197	3,227
Pounds/rm	648	166	814	1,160	3,281	60	3,341	3,648	2,020	85	2,105	2,351
Miscellaneous characteristics (%)												
Male				84				87				86
Female				16				13				14
Resident				82				75				78
Non-resident				18				25				22
Method (%)												
Still fishing				72				55				62
Casting				20				24				26
Fly fishing				7				15				11
Trolling				1				6				1

Table 6. Stock-size rainbow trout relative weight (Wr) throughout the growing season in the Lake Cumberland tailwater in 2004 and for "Arlee" and "McConaughy" strains

	April			May			June			July			August			September			October			November			December		
Year	N	Wr	SE	N	Wr	SE	N	Wr	SE	N	Wr	SE	N	Wr	SE	N	Wr	SE	N	Wr	SE	N	Wr	SE	N	Wr	SE
2004	400*	94.9	0.5	32	97.0	2.2	46	106.2	1.7	86	104.8	0.9	35	98.7	1.3	34	94.5	1.0	37	88.9	1.3	20	86.0	1.3	19	86.1	1.9
2006 "Arlee"				500*	91.4	0.5	7	88.4	5.3	32	100.5	1.6	12	106.4	2.3	8	117.1	5.1	2	115.1	9.5	4	97.3	7.1	9	82.2	3.3
2006 "McConaughy"										450*	93.6	0.6	65	85.3	1.2	58	105.1	1.1	9	109.8	6.8	66	95.0	1.1	37	90.9	1.1

*Rainbow trout were stocked several days after measurements taken.

Table 7. Length-frequency distribution and CPUE (fish/h) of Arlee and McConaughy strains of rainbow trout collected by nocturnal electrofishing in the Lake Cumberland tailwater in November 2006.

	Inch Class									CPUE	Std
Location	8	9	10	11	12	13	14	15	Total	(fish/h)	Error
Above Helm's											
Arlee rainbow trout			9	48	60	13	1	1	132	105.6	29.8
McConaughy rainbow trout	2	26	104	83	10		2		227	181.6	37.3
Below Helm's											
Arlee rainbow trout				6	7	9	1		23	18.4	3.0
McConaughy rainbow trout		2	19	74	37	3			135	108.0	18.8
Above Winfrey's											
Arlee rainbow trout				1	1		2		4	3.2	2.3
McConaughy rainbow trout			7	28	29	2			66	52.8	16.0
Below Winfrey's											
Arlee rainbow trout				1	1	7	3	1	13	10.4	3.5
McConaughy rainbow trout		1	2	19	9	4		1	36	28.8	11.2
Crocus Creek											
Arlee rainbow trout				1	16	25	1		43	34.4	12.3
McConaughy rainbow trout			6	23	18	3			50	40.0	4.2
Total											
Arlee rainbow trout			9	57	85	54	8	2	215	34.4	9.6
McConaughy rainbow trout	2	29	138	227	103	12	2	1	514	82.2	14.3

Table 8. Mean lengths and weights of Arlee and McConaughy strain rainbow trout collected by nocturnal electrofishing at five sites in the Lake Cumberland tailwater in November 2006.

	Length (in)			Weight (lbs)		
Location	N	Mean	Std Err	N	Mean	Std Err
Above Helm's						
Arlee rainbow trout	132	12.1	0.07	78	0.64	0.02
McConaughy rainbow trout	227	10.8	0.05	70	0.46	0.03
Below Helm's						
Arlee rainbow trout	23	12.7	0.18	22	0.78	0.04
McConaughy rainbow trout	135	11.6	0.06	96	0.63	0.01
Above Winfrey's						
Arlee rainbow trout	4	13.2	0.75	4	0.88	0.11
McConaughy rainbow trout	66	11.9	0.08	66	0.63	0.01
Below Winfrey's						
Arlee rainbow trout	13	13.8	0.27	13	0.97	0.05
McConaughy rainbow trout	36	12.0	0.18	36	0.64	0.04
Crocus Creek						
Arlee rainbow trout	43	13.0	0.08	41	0.81	0.02
McConaughy rainbow trout	50	11.6	0.10	47	0.59	0.02
Total						
Arlee rainbow trout	215	12.5	0.06	158	0.74	0.01
McConaughy rainbow trout	514	11.3	0.04	315	0.59	0.01

Table 9. Length distribution of both harvested and released Arlee and McConaughy strains of rainbow trout and other rainbow trout in the Lake Cumberland tailwater creel survey (Wolf Creek Dam to Hwy 61 Bridge) during 2006. Arlee were stocked on 01-Jun-06 and McConaughy were stocked on 31-Jul-06. (Lengths for released fish are estimated)

	Inch Class																				
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	26	Total
Arlee rainbow trout																					
Harvested				4	47	148	280	311	86	25											901
Released						1	2	3	1												7
McConaughy rainbow trout																					
Harvested				4	13	34	57	33	13	2											156
Released						1		5													6
Other rainbow trout																					
Harvested				18	89	272	216	252	205	133						4	2	1			1192
Released	4	22	20	97	101	339	140	440	150	180	150	135	118	91	37	15	5		2	1	2047

Table 10. Number and mean length of Arlee and McConaughy strains of rainbow trout and other rainbow trout harvested in the Lake Cumberland tailwater (Wolf Creek Dam to Hwy 61 Bridge) during the 2006 creel survey. Arlee strain were stocked on 01-Jun-06 and McConaughy strain were stocked on 31-Jul-06.

	Arlee rainbow trout harvested		McConaughy rainbow trout harvested		Other rainbow trout harvested		Total rainbow trout harvested	
Month	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)
Mar	0	0.0	0	0.0	6,258	11.5	6,258	11.5
Apr	0	0.0	0	0.0	5,807	11.2	5,807	11.2
May	0	0.0	0	0.0	5,848	11.7	5,848	11.7
Jun	8,746	10.1	0	0.0	20,470	11.1	29,216	10.6
Jul	9,324	10.9	0	0.0	7,273	12.0	16,597	11.4
Aug	4,600	11.4	966	10.3	1,992	12.7	7,558	11.6
Sep	11,143	11.8	1,500	11.1	5,495	12.1	18,138	11.8
Oct	7,918	11.9	2,417	11.2	7,067	11.6	17,402	11.6
Nov	2,439	12.4	528	12.0	3,099	11.7	6,067	12.0
Total	44,170	11.4	5,411	11.0	63,308	11.7	112,889	11.5

Table 11. Number and mean length of Arlee and McConaughy strains of rainbow trout and other rainbow trout harvested by bank and boat anglers at Lake Cumberland tailwater (Wolf Creek Dam to Hwy 61 bridge) during the 2006 creel survey. Arlee strain were stocked on 01-Jun-06 and McConaughy strain were stocked on 31-Jul-06.

	Arlee rainbow trout harvested				McConaughy rainbow trout harvested				Other rainbow trout harvested				Total rainbow trout harvested			
	Bank		Boat		Bank		Boat		Bank		Boat		Bank		Boat	
Month	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)	Number	Mean lgth (in)
Mar	0	0.0	0	0.0	0	0.0	0	0.0	5,942	11.2	316	12.4	5,942	11.2	316	12.4
Apr	0	0.0	0	0.0	0	0.0	0	0.0	2,292	10.7	3,515	11.5	2,292	10.7	3,515	11.5
May	0	0.0	0	0.0	0	0.0	0	0.0	3,241	11.5	2,607	11.9	3,241	11.5	2,607	11.9
Jun	3,688	10.1	5,058	10.2	0	0.0	0	0.0	15,669	10.4	4,801	12.1	19,357	10.2	9,859	11.0
Jul	5,209	10.8	4,115	11.0	0	0.0	0	0.0	4,764	11.7	2,509	12.3	9,972	11.2	6,624	11.5
Aug	3,083	11.2	1,517	11.5	533	9.8	432	10.9	1,970	12.4	895	12.8	2,805	11.1	2,845	11.9
Sep	2,229	11.7	8,914	11.9	369	11.3	1,131	11.1	1,106	11.2	4,389	12.4	3,704	11.4	14,434	11.9
Oct	1,063	12.1	6,855	11.8	1,041	11.2	1,376	11.2	1,752	11.2	5,314	11.7	3,856	11.4	13,546	11.7
Nov	81	11.8	2,358	12.5	77	11.7	452	12.2	765	11.6	2,335	11.8	922	11.6	5,145	12.1
Total	15,352	11.0	28,818	11.6	2,020	10.7	3,391	11.2	37,500	11.2	26,682	12.0	52,091	11.1	58,891	11.7

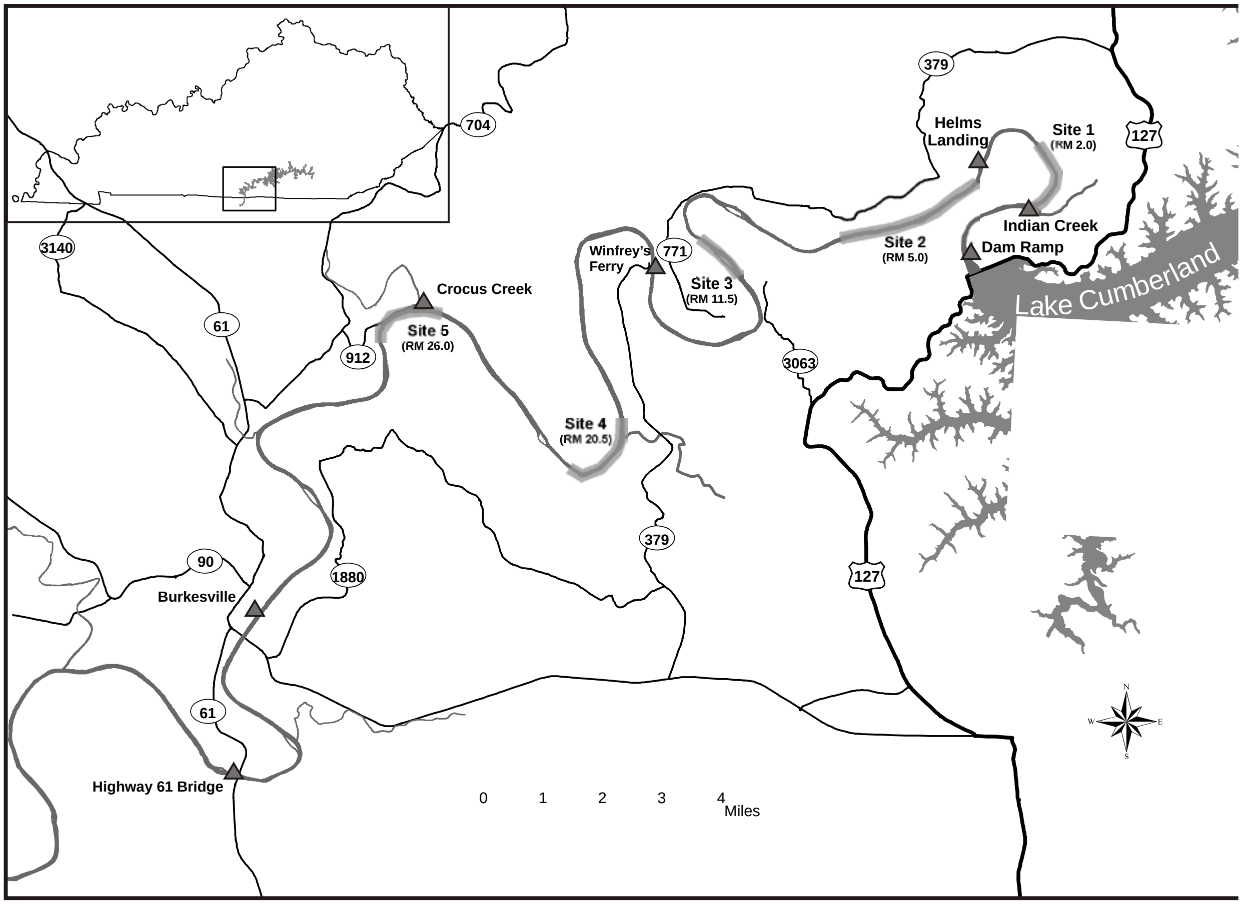

Figure 1. Map depicting the location of Lake Cumberland in south central Kentucky (inset) and the Cumberland River below Wolf Creek Dam. Solid triangles represent the trout stocking sites. The five standardized fall sampling sites are shaded with Site 1 being the uppermost site. The approximate river mile (RM) for each site is in parentheses.

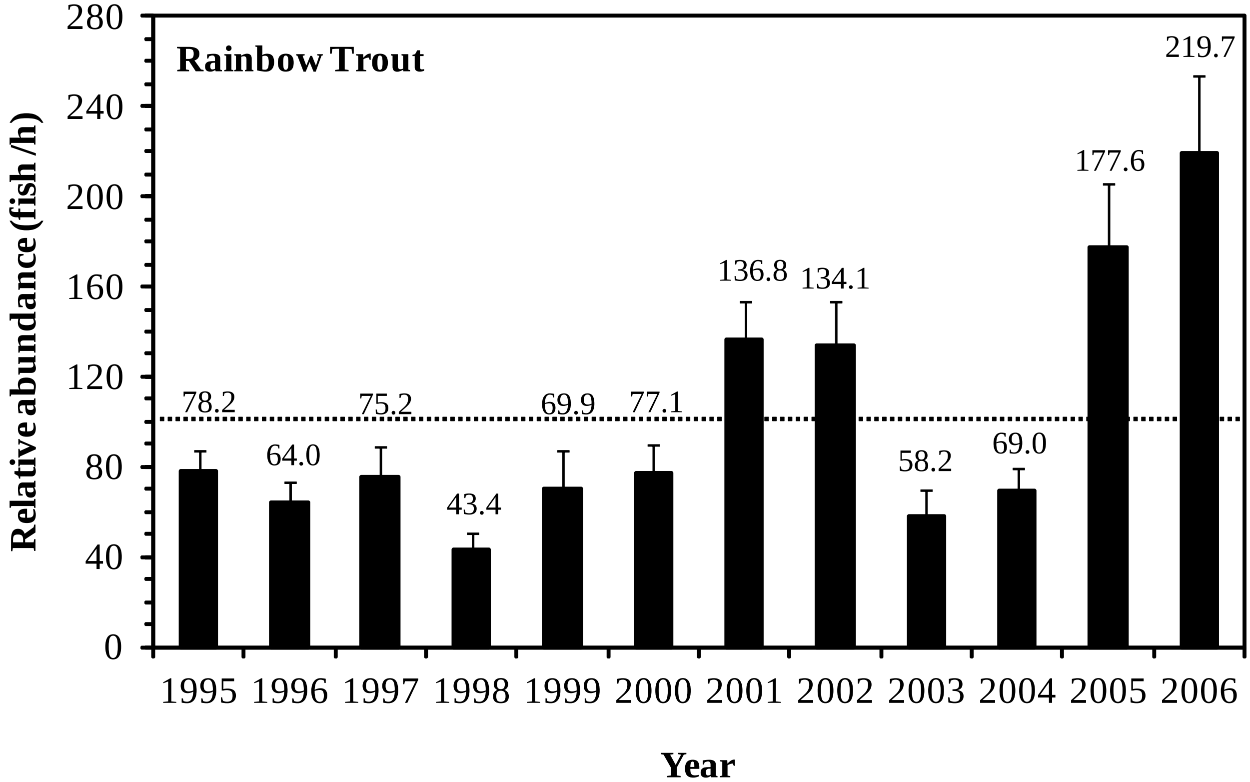

Figure 2. Fall electrofishing mean relative abundance (fish/h) of rainbow trout in the Lake Cumberland tailwater from 1995 to 2006. Bars represent the standard error. Dotted line indicates the mean CPUE for rainbow trout in the Lake Cumberland tailwater from 1995 to 2006.

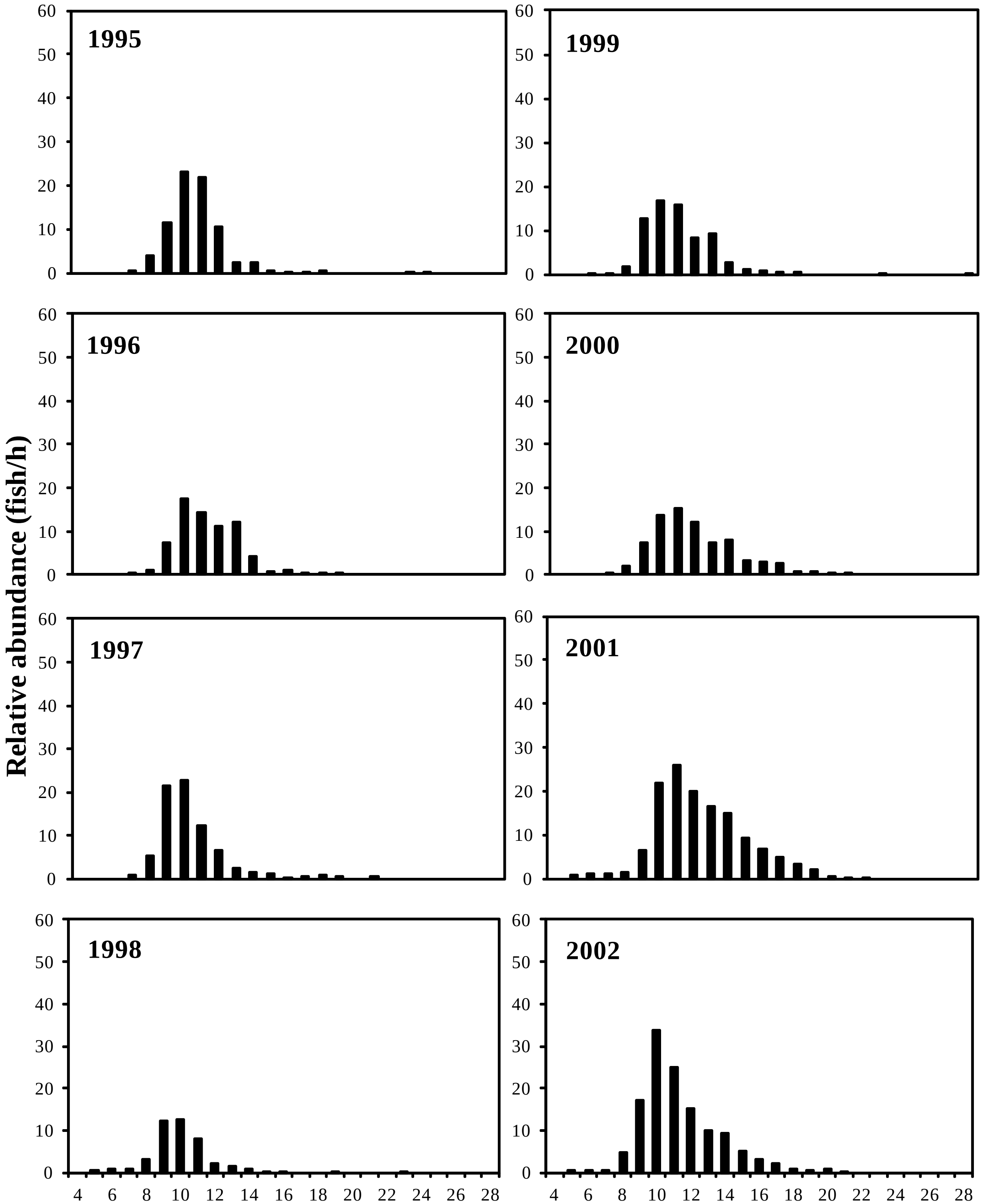

Figure 3. Fall electrofishing relative abundance of rainbow trout by inch class in the Lake Cumberland tailwater from 1995 to 2006.

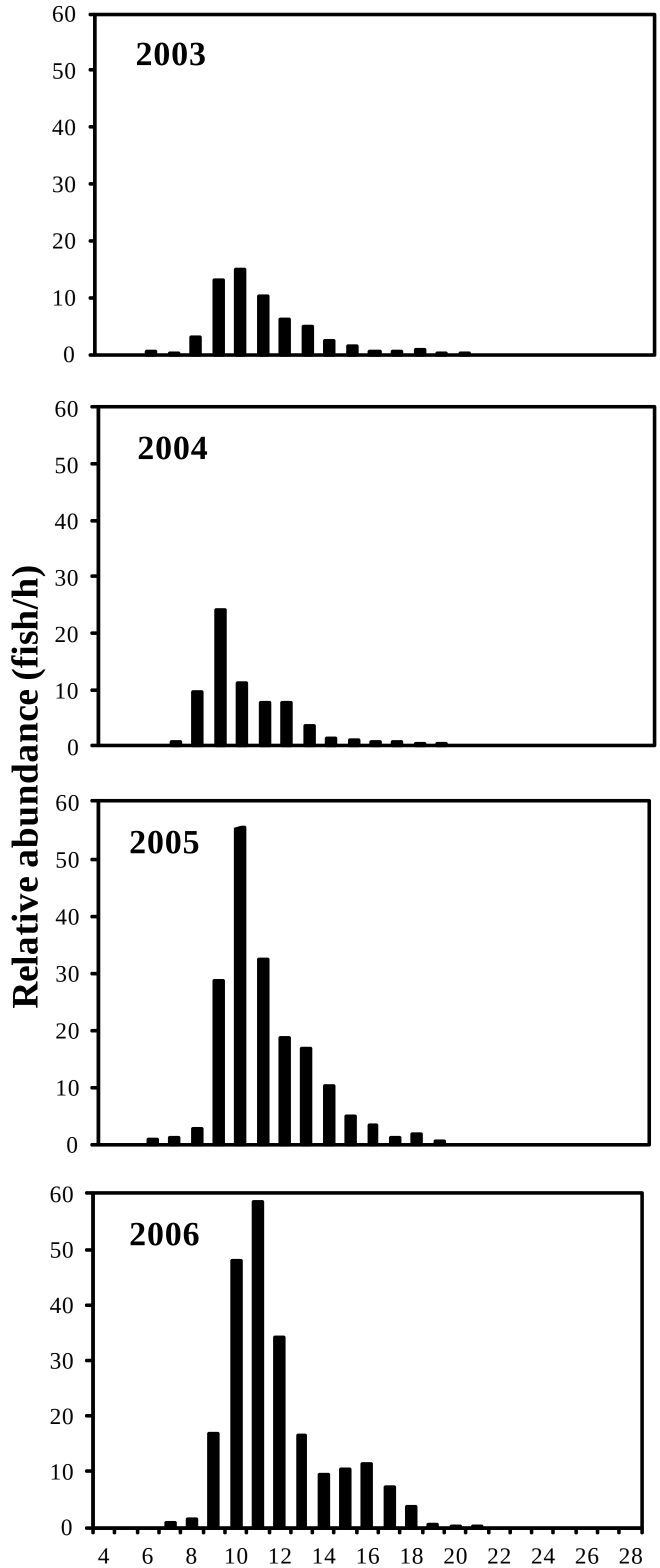

Figure 3. cont.

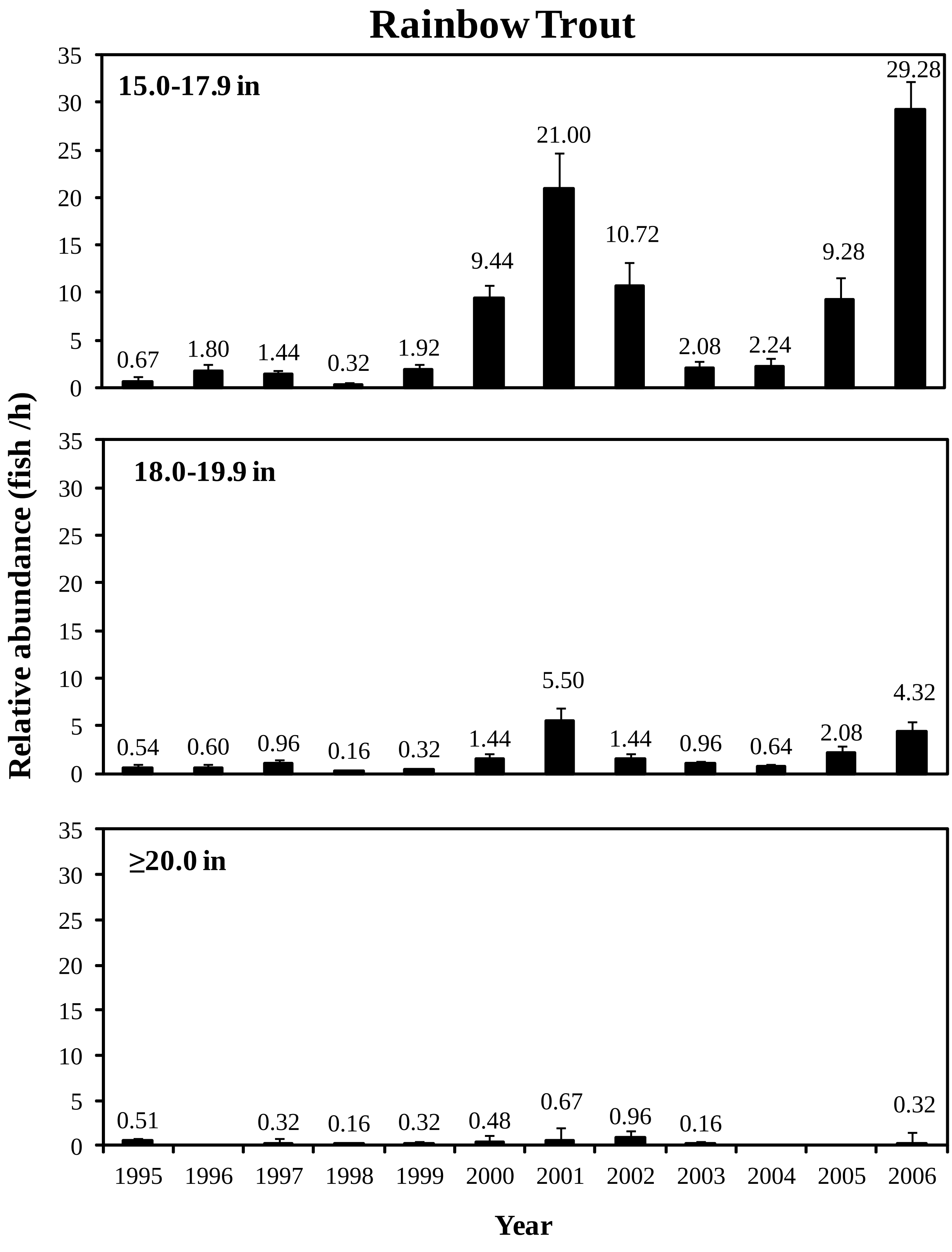

Figure 4. Fall electrofishing mean relative abundance (fish/h) of 15.0-17.9 in, 18.0-19.9 in, and ≥20.0 in rainbow trout in the Lake Cumberland tailwater from 1995 to 2006.

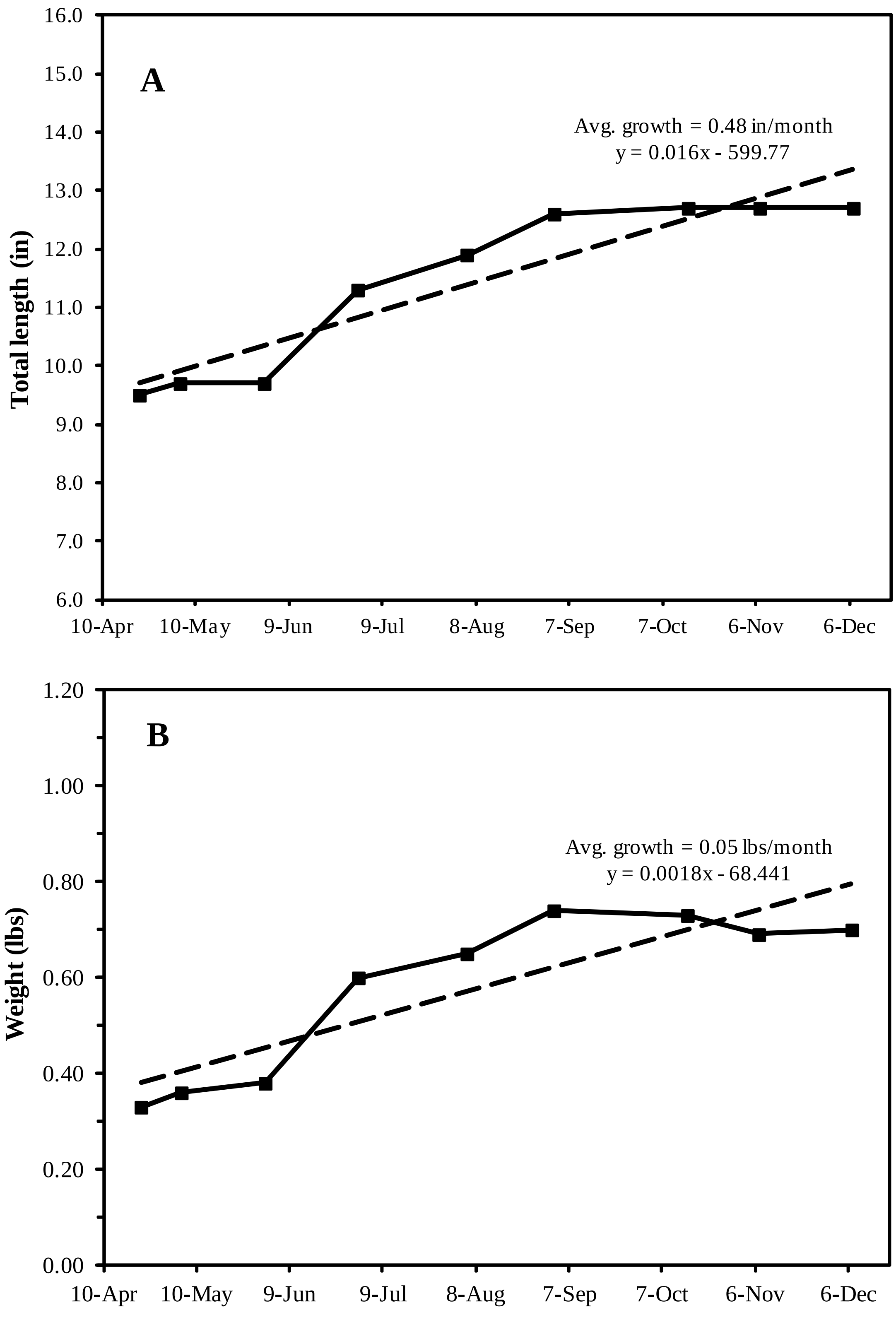

Figure 5. Seasonal growth of stock-size rainbow trout in the Lake Cumberland tailwater during 2004 based on mean length (A) and mean weight (B). The solid lines join the average for each sampling date and the dotted lines are the regression of the total length (A) or weight (B) on day of month.

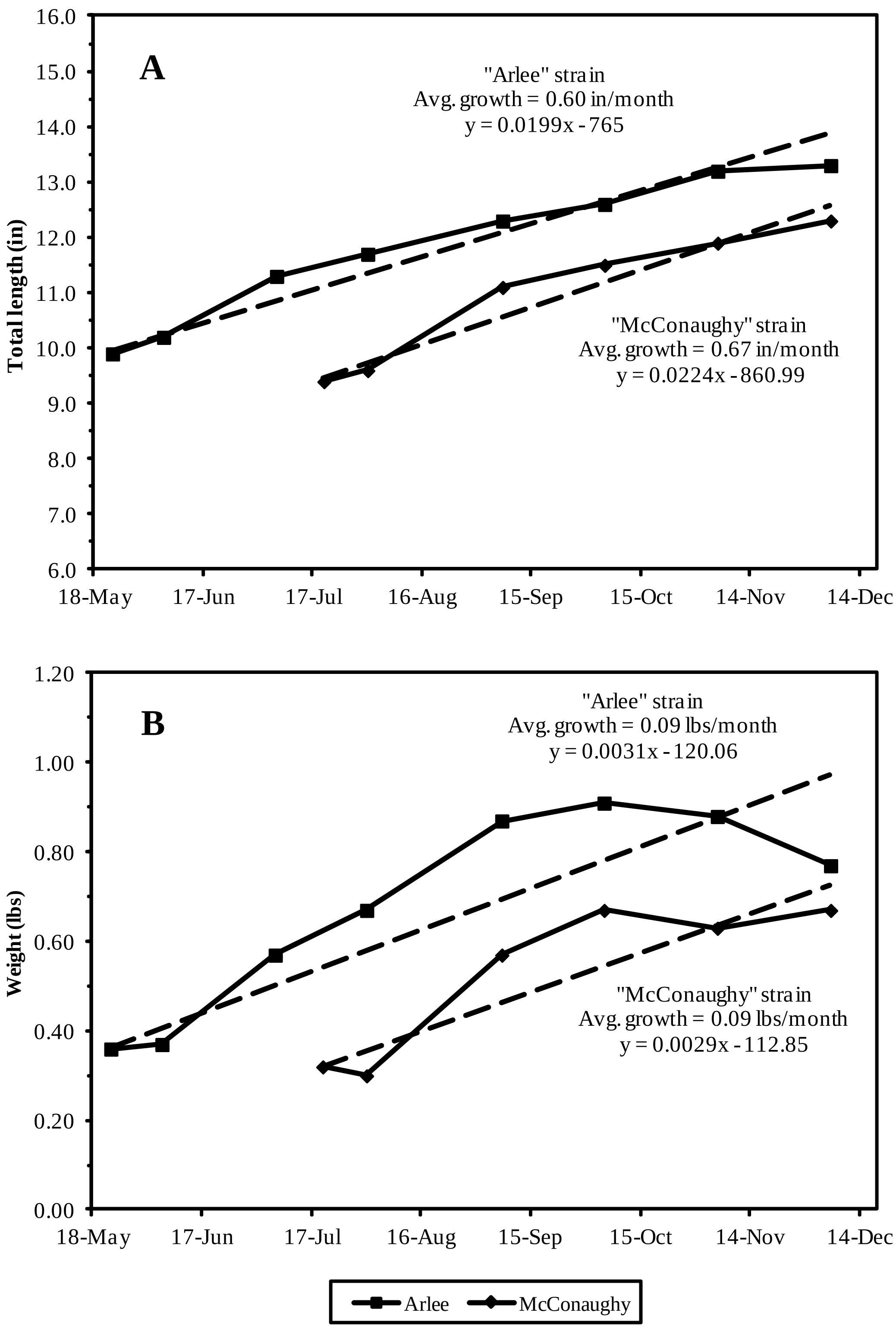

Figure 6. Seasonal growth of stock-size "Arlee" and "McConaughy" strain rainbow trout in 2006 based on mean total length (A) and mean weight (B). "Arlee" strain was stocked on 01-Jun-06 and "McConaughy" strain was stocked on 31-Jul-06. The solid lines join the average for each sampling date and the dotted lines are the regression of the total length (A) or weight (B) on day of month.