COMPARISON OF DAY AND NIGHT ELECTROFISHING FOR LARGEMOUTH AND SMALLMOUTH BASS IN THREE NORTH CAROLINA RESERVOIRS

Final Report

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Abstract.—This study compared day and night electrofishing catch rates of largemouth bass *Micropterus salm*oides and smallmouth bass *Micropterus dolomieu* during the spring from twenty-eight 300-m sites established on the Catawba Arm of Lake James, the Linville Arm of Lake James, Lake Hickory, and Belews Lake. With the exception of the Linville Arm of Lake James, where catch rates of SMB were significantly higher at night, no significant differences were found between day and night catch rates of black bass. These results suggest that future bass sampling surveys, with the exception of surveys targeting smallmouth bass on the Linville Arm of Lake James, should be conducted during the day, Given the added logistical difficulties and safety hazards associated with night sampling, the suitability of sampling smallmouth bass during the day in the fall should be investigated as an alternative for sampling the Linville Arm of Lake James.

Fish managers often use shoreline electrofishing techniques to sample black bass *Micropterus* spp. populations from reservoirs. During the 1950s and 1960s several studies suggested that electrofishing at night was more effective than day sampling (Frankenburger 1960; Latta and Meyers 1961; Kirkland 1965). However, these studies did not compare quantitative data between day and night surveys and very few dealt with centrarchid species (Dumont and Dennis 1997). Recent quantitative comparisons of day and night electrofishing surveys have been conducted that are specific to black bass (McInery and Cross 2000; Dumont and Dennis 1997; Paragamian 1989), and these surveys also reported that catch rates were usually higher during nighttime samples.

The North Carolina Wildlife Resources Commission (NCWRC) uses spring shoreline electrofishing to sample black bass populations in reservoirs. The time of day that these samples occur varies between water bodies and personnel, as standard protocols have not been determined with respect to day and night electrofishing. However, considerable interest in determining the effectiveness of day and night electrofishing exists within the NCWRC. Nighttime surveys are more time consuming due to the additional time required for navigation and fish processing (Dumont and Dennis 1997). Nighttime surveys also present more safety hazards than daytime surveys since there are innate difficulties associated with working in the dark and working late into the night subjects personnel to more fatigue. Additionally, sampling at night often requires more people than day sampling, as an additional boat and two person crew usually accompany the staff performing the electrofishing as a safety measure. For these reasons, nighttime surveys would only be considered for sampling reservoirs by the NCWRC if nighttime catch rates for black bass were significantly higher than those obtained during the day, and or the size structure was significantly different than what was observed during the day. The following reports the findings from a comparison of day and night electrofishing surveys for black bass on three lakes.

Study Area

Lake James

Lake James is a 2636-ha impoundment of the Catawba and Linville Rivers. Constructed in 1923, it is the uppermost impoundment on the Catawba River and is

operated by Duke Power Company for power generation, recreation, and water supply. The lake contains several major sportfish species, including largemouth bass *Micropterus salmoides,* smallmouth bass *Micropterus dolomieu,* black crappie *Pomoxis nigromaculatus,* and walleye *Sander vitreus.*

Lake James is composed of two main sections, the Linville Arm and the Catawba Arm. These two sections differ in water clarity and nutrient levels. As a result, data collected from the two arms was analyzed separately.

Lake Hickory

Lake Hickory is a 1660-ha impoundment of the Catawba River, located between Lake Rhodhiss and Lookout Shoals Reservoir. The impoundment was formed in 1927 by Duke Power for power generation, recreation, and water supply. The major sportfish of Lake Hickory include largemouth bass, black crappie, and striped bass *Morone saxatilis.*

Belews Lake

Belews lake is a 1560-ha impoundment located in the Dan River drainage. The reservoir, built by Duke Power in 1973 for power generation and recreation, impounds Belews Creek, East Belews Creek, and West Belews Creek. Major sportfish in Belews Lake include largemouth bass, black crappie, and white crappie *Pomoxis annularis*.

Methods

Black bass were collected using boat mounted 1000V DC, pulsed direct current electrofishing equipment (high voltage setting, adjusted to 4-A output) from Lake James and Lake Hickory during the spring of 2003, and from Belews Lake during the spring of 2004. Eight 300-m sites were selected from Lake Hickory as well as Belews Lake. Twelve 300-m sites were selected on Lake James, with sites being evenly divided between the Catawba Arm and the Linville Arm.

For each of the four sets of sites (Catawba Arm, Linville Arm, Lake Hickory, and Belews Lake), half of the sites were sampled during the day on a Monday between 1000-1800 hours and the other half were sampled that Monday night beginning 30 min after sunset. On Thursday of the same week, the sites previously sampled Monday night were sampled during the day between 1000-1800 hours and the sites previously sampled on Monday during the day were sampled at night, beginning 30 min after sunset. In this way, all sites were sampled during the day and the night, with three days in between the two samples for any given site.

Upon capture at each site, all black bass were anesthetized with clove oil, identified to species, and measured for total length (TL, mm). Upon recovery, all black bass were released along the shoreline in the middle of the 300-m site. Secchi depths were taken

and measured to the nearest tenth of a meter during all daytime samples on Lake Hickory and Belews Lake.

The number of largemouth and smallmouth bass captured during the day and night for each site was determined for each species. For each lake (Lake Hickory, Belews Lake, Catawba Arm of Lake James, and Linville Arm of Lake James), the day and night catch rates obtained were statistically compared with a cross-over test (Fleiss 1986) to determine if significant differences in catch rates occurred between day and night samples. This test allowed for the determination of treatment (day vs. night) effects as well as period (Monday vs. Thursday) effects. Proportional stock densities for largemouth and smallmouth bass (Gabelhouse 1984) were calculated for all day and night samples collected at each lake and were statistically compared with a chi-square test. The significance level for all statistical tests was $\alpha < 0.10$.

Results

Lake James / Catawba Arm

Largemouth bass were the predominant bass species in the Catawba Arm, with the mean catch rate per site ranging from 12 during the day to 15 at night (Table 1). Catch rates were similar between day and night samples ($P = 0.60$). However, nighttime catch rates differed significantly ($P = 0.08$) between the two sample periods (Monday and Thursday), increasing from 5 largemouth bass per site on Monday night to 23 per site on Thursday night. The PSD for largemouth bass was 8% greater during night samples (Table 1). Largemouth bass TL ranged from 77-465 mm during the day and 83-562 mm at night (Figure 1).

Mean catch rates of smallmouth bass in the Catawba Arm ranged from 1 fish per site during the day to 3 fish per site at night ($P = 0.27$). The PSD for smallmouth bass was 9% greater during night samples. Smallmouth bass TL ranged from 108-358 mm during the day and 89-403 mm at night (Figure 2).

Lake James / Linville Arm

The mean catch rate for largemouth bass in the Linville Arm was more evenly distributed across the two treatments ($P = 0.50$) with 5 largemouth per site during the day and 4 at night. The PSD for largemouth bass was 11% greater during day samples. Largemouth bass TL ranged from 94-538 mm during the day and 91-549 mm at night (Figure 3).

Smallmouth bass were the predominant black bass species encountered in the Linville Arm. Mean catch rates for all six sites combined averaged 5 fish per site during the day and 13 fish per site at night. The catch rate of smallmouth bass in the Linville Arm was significantly higher ($P = 0.07$) at night than during the day. The PSD for

smallmouth bass was 12% greater during night samples. Smallmouth bass TL ranged from 96-413 mm during the day and 88-501 mm at night (Figure 4).

Lake Hickory and Belews Lake

Largemouth bass are the only black bass species in Lake Hickory and Belews Lake. The mean catch rate for all eight sites combined ranged from 22 fish per site during the day to 27 fish per site at night for Lake Hickory, and 6 fish per site during the day to 7 fish per site at night for Belews Lake. There was no significant difference found between catch rates of largemouth bass from day and night samples on either lake (Lake Hickory, $P = 0.36$; Belews Lake, $P = 0.63$). However, PSD measurements differed significantly ($P < 0.1$) between day and night samples from both Lake Hickory and Belews Lake. Largemouth bass TL ranged from 76-561 mm during the day and 71-532 mm at night from Lake Hickory (Figure 5). On Belews Lake, largemouth bass TL ranged from 105-505 mm during the day and 80-460 mm at night (Figure 6). Secchi depths taken during all daytime samples ranged from 0.6-1.9 m on Lake Hickory and 2.0-3.1 m on Belews Lake.

Discussion

Lake James / Catawba Arm

There was no significant difference between day and night sampling for black bass on the Catawba Arm of Lake James. As a result, future sampling on this section of Lake James should be conducted during the day.

There was a significant difference between the two night samples for largemouth bass on this section of the lake. However, several factors influence black bass shoreline electrofishing catch rates, including water transparencies, conductivity, temperature (Dumont and Dennis 1997), and weather. It is possible that changes in these or other parameters influenced capture efficiency between the two night samples. Water quality/clarity measurements should be taken during future studies to help explain variability in catch rates.

Lake James / Linville Arm

Nighttime sampling was significantly more effective at capturing smallmouth bass on the Linville Arm of Lake James, while the size structure and catch rates of largemouth bass were similar between day and night samples. These findings suggest the following with regards to planning black bass electrofishing surveys on the Linville arm of Lake James: (1) surveys focused only on collecting smallmouth bass should be conducted at night, (2) surveys focused only on collecting largemouth bass should be conducted during the day, and (3) surveys in which data from both largemouth and smallmouth bass is desired should be conducted at night.

Additionally, as an alternative to electrofishing at night, daytime electrofishing during the fall may be an option to consider on the Linville River arm of Lake James. Sammons and Bettoli (1999) compared the effectiveness of spring and fall electrofishing for both largemouth and smallmouth bass. They found that catch rates of largemouth bass were higher in the spring, but that smallmouth bass catch rates were higher in the fall. Given the difficulties associated with nighttime sampling, it may be worthwhile to conduct a daytime electrofishing sample for smallmouth bass in the fall to determine if the data it produces is similar to spring nighttime electrofishing data.

Lake Hickory and Belews Lake

The data obtained during largemouth bass sampling does not appear to be affected by time of day on Lake Hickory or Belews Lake. As a result, future shoreline electrofishing samples for largemouth bass on these two lakes should be done during the day. This should improve sample efficiency and safety of personnel conducting the samples without compromising the data obtained. Dumont and Dennis (1997) suggested that spawning largemouth bass exhibit a more uniform diurnal distribution along shoreline habitats in Texas reservoirs, and as a result, probably exhibit similar electrofishing gear vulnerability regardless of time of day.

The significant difference between the number of stock and quality size largemouth bass captured between the two treatments on both Lake Hickory and Belews Lake suggests that either the percentage of $\geq$300 mm fish increased during the day, or the percentage of 200-299 mm fish increased at night. Regardless, it is impossible to say which of the two treatments provides the most accurate data with respect to the actual distribution of largemouth bass sizes in either lake. Although a PSD difference of 10 between the two sample times may not be exceptionally alarming, it was significant, and further suggests the need to carefully scrutinize sample data before making management decisions.

Reynolds (1983) stated that catch rates are higher in intermediate water transparency, because bass will often avoid capture due to increased visibility of the boat in clear water. However, secchi depths did not appear to affect catch rates during daytime samples on Lake Hickory, as the site with the deepest secchi reading (1.9 m) also resulted in the highest daytime catch rate (N = 31). Likewise, no clear distinction between catch rates and water clarity were observed on Belews Lake, with the next to lowest secchi recording (2.1 m) resulting in the lowest catch rate (N = 2). There are many factors that could have prevented the detection of a relationship between water clarity and catch rates. However, the lack of variability between daytime and nighttime catch rates on Lake Hickory and Belews Lake, despite fairly deep secchi depths (mean secchi depth = 2 m), suggests hat factors other than water clarity were more important in determining capture efficiency of largemouth bass on these two lakes during this study.

Recommendations

1) Black bass sampling on the Catawba Arm of Lake James, Lake Hickory, and Belews Lake should be done during daylight hours.

2) Smallmouth bass surveys on the Linville Arm of Lake James should be attempted during the day in the fall to determine if catch rates are significantly different from those obtained at night in the spring.

3) If no significant difference is found between smallmouth bass fall sampling during the day and spring sampling at night, then largemouth bass daytime catch rates obtained during the spring should be compared with those obtained during the fall on the Linville Arm of Lake James.

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TABLE 1.—Mean catch rate per 300-m site and PSD calculations for largemouth and smallmouth bass from day and night electrofishing. The 90% confidence intervals are shown in parentheses. Asterisks denote catch rates and PSD values that are significantly different ($P < 0.10$) between day and night.

	Catch rate		PSD	
Lake	Day	Night	Day	Night
		Largemouth bass		
Catawba Arm	12 (± 5)	15 (± 9)	60 (± 0.6)	65 (± 0.4)
Linville Arm	5 (± 3)	4 (± 2)	89 (± 0.6)	79 (± 1.2)
Hickory	22 (± 13)	26 (± 16)	74 (± 0.2)	64* (± 0.2)
Belews	6 (± 3)	7 (± 4)	70 (± 0.8)	52* (± 0.8)
		Smallmouth bass		
Catawba Arm	1 (± 1)	3 (± 3)	40 (± 6.4)	44 (± 2.2)
Linville Arm	5 (± 3)	13* (± 6)	64 (± 1.5)	73 (± 0.4)

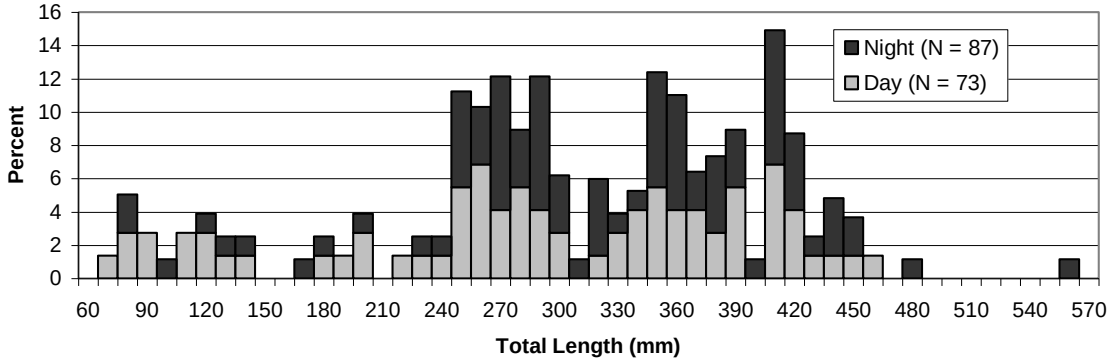

FIGURE 1.—Length-frequency distribution of largemouth bass captured during day and night electrofishing from the Catawba Arm of Lake James, May 2003.

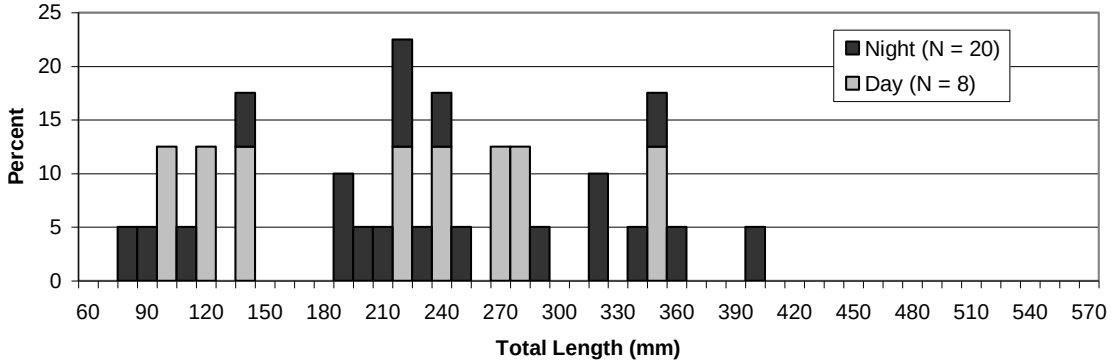

FIGURE 2.—Length-frequency distribution of smallmouth bass captured during day and night electrofishing from the Catawba Arm of Lake James, May 2003.

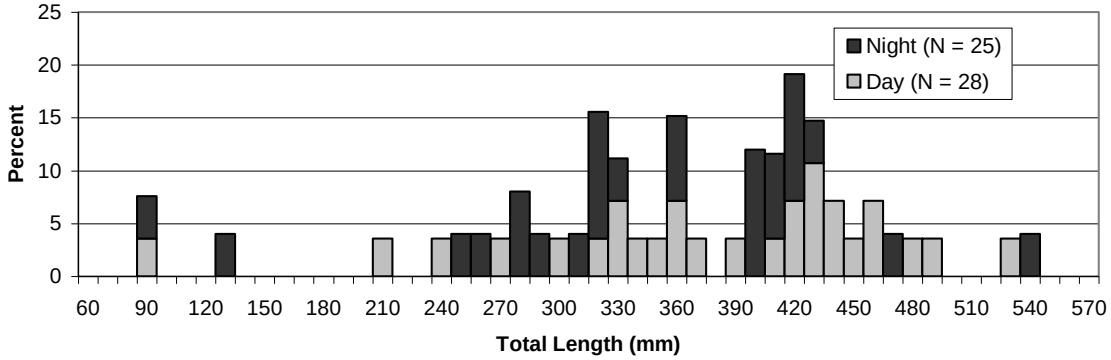

FIGURE 3.—Length-frequency distribution of largemouth bass captured during day and night electrofishing from the Linville Arm of Lake James, May 2003.

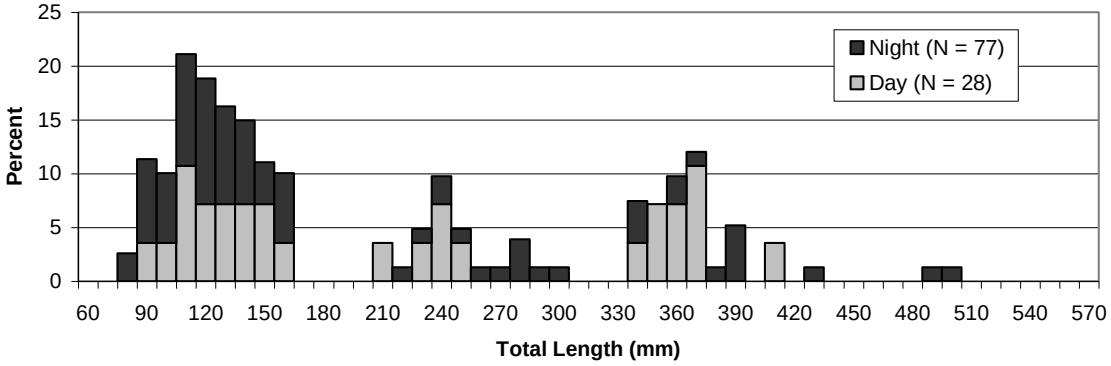

FIGURE 4.—Length-frequency distribution of smallmouth bass captured during day and night electrofishing from the Linville Arm of Lake James, May 2003.

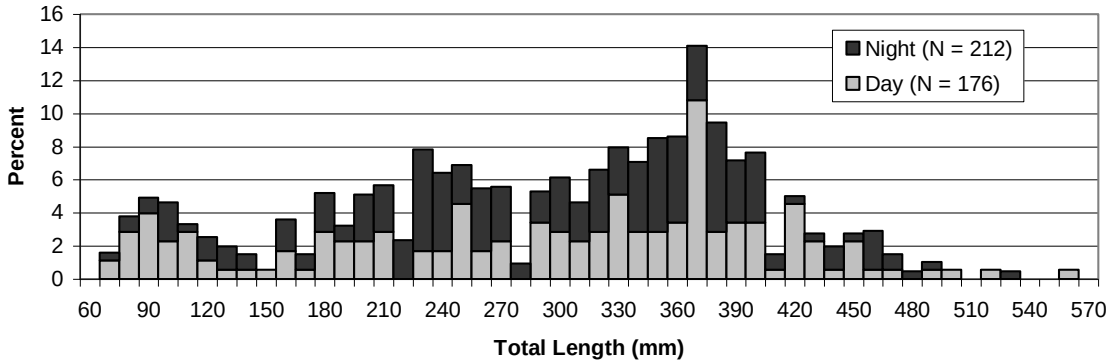

FIGURE 5.—Length-frequency distribution of largemouth bass captured during day and night electrofishing from Lake Hickory, May 2003.

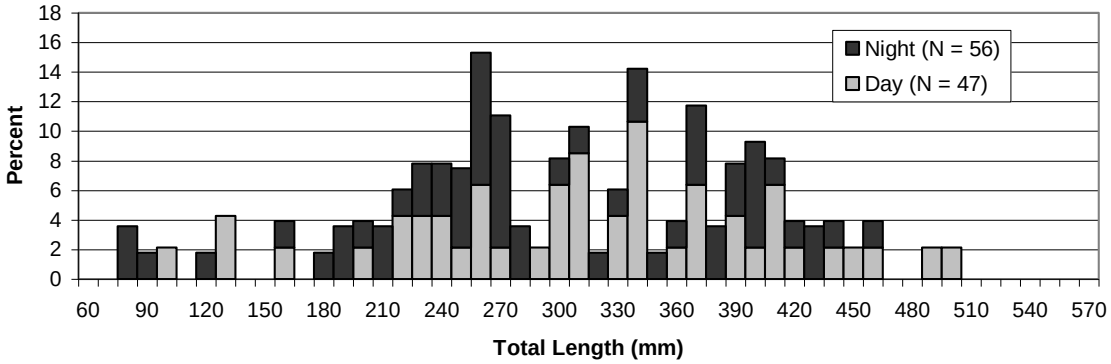

FIGURE 6.—Length-frequency distribution of largemouth bass captured during day and night electrofishing from Belews Lake, April 2004.