Comparison of 3 Electrofishing Gear Types Used to Capture Catfish

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Abstract: We compared catfish catch per unit effort (CPUE), species composition, and size distribution data collected by a Smith-Root 7.5 GPP boat-mounted electrofishing unit, a Smith-Root 7.5 GPP boat-mounted electrofishing unit used in conjunction with the Smith-Root "Catfish Zapper," and with the micro-electronic device known as the "Skoal Box." A combined 1,175 catfish were collected from 6 sites within the Cape Fear and Lumber rivers in the summers of 2000 and 2001. The Smith-Root 7.5 GPP (GPP) collected 549 catfish (46.7%) during the 2-year period while the Smith-Root 7.5 GPP used with the Catfish Zapper (GPP and Zapper) collected 466 catfish (39.7%). The Skoal Box collected 160 catfish (13.6%). ANOVA revealed no significant difference ($P = 0.88$) in catch rates of the GPP and the GPP and Zapper. However, the Skoal Box captured significantly fewer catfish compared to the GPP ($P = 0.02$) and to the GPP and Zapper ($P = 0.03$). There were no significant differences ($P = 0.21$) in species relative abundance between the GPP and the GPP and Zapper. However, the Skoal Box consistently under performed both the GPP ($P = 0.01$) and the GPP and Zapper ($P = 0.04$) by capturing significantly fewer overall fish. Fish lengths ranged in size from 33 mm to 1,025 mm and did not differ significantly among gear types.

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Blue catfish *(Ictalurus furcatus)* and flathead catfish *(Pylodictis olivaris)* are influencing fish communities in many of North Carolina's lakes and rivers. Both species were introduced to many of North Carolina's river basins through accidental or intentional stockings. The introduction of these species has pleased many anglers who prefer to catch large catfish. Since their introduction into the Yadkin River, the fishery for flathead catfish now supports a flathead catfish tournament trail (M. Chambers, N. C. Wildl. Resour. Comm., pers. commun.). The Cape Fear River has had a substantial blue catfish and flathead catfish sport fishery for many years and the current North Carolina state records for both species have come from that river.

Other anglers complain that flathead catfish are adversely affecting largemouth bass *(Micropterus salmoides)* and sunfish fisheries (*Lepomis* spp.). Flathead catfish predation on sunfish has been well-documented (Guier et al. 1981, Nelson et al.

1985, Quinn 1986, Ashley and Buff 1987, Thomas 1995). Carolina Power and Light (CP&L) and North Carolina Wildlife Resources Commission (WRC) biologists are concerned that introduced flathead catfish might be one of the reasons for the declining largemouth bass sport fishery in Sutton Lake near Wilmington (CP&L 1998, Herndon and Waters 2000). The WRC initiated a program to remove them from Sutton Lake in 1999 (Herndon and Waters 2000). Furthermore, in response to the many complaints from local anglers about flathead catfish, Bladen County Commissioners enacted a local law in 1984 allowing the recreational use of hand-powered telephone magnetos to electrofish catfish on the Cape Fear River within Bladen County.

To effectively manage catfish populations, fisheries biologists must have the ability to consistently collect representative samples without size or species bias. Nelson and Little (1985) conducted a gear selectivity study on catfish populations in the Neuse River comparing the catch rates, size selectivity, and species selectivity of hoop nets, gill nets, catfish traps, electrofishers, and trotlines. They recommended using multiple gear types for sampling catfish to improve estimates of size distributions and species composition. However, time and monetary constraints often make the use of multiple gear types impractical, resulting in the use of electrofishing gear that is known to be biased toward larger individuals and exhibits species selectivity (Catchings et al. 1984, Reynolds 1996).

The current electrofishing hardware setup used for catfish sampling by the WRC in coastal North Carolina is the Smith-Root 7.5 GPP system, with settings at 500 V pulsed-DC and 1–2 A. The paint is removed from the bottom of the boat, which serves as the cathode, to increase conductance and improve performance. The anode extends approximately 2 m in front of the boat and consists of 2, 1-m diameter metal rings constructed from 13-mm EMT conduit. Suspended from each ring are 8 droppers, constructed from galvanized cable and stainless steel pipe, approximately 1 m in total length. Electrofishing proceeds downstream following outside river bends at a speed approximating the current velocity.

Justus (1994) reported using the Smith-Root 7.5 GPP with a Smith-Root boom/dropper array to collect blue catfish, flathead catfish, and channel catfish *(I. punctatus)* in waters up to 15 m deep. The Smith-Root 7.5 GPP array has been effective in collecting all sizes of flathead catfish, white catfish *(I. catus),* and a variety of bullhead species (*Ameiurus* spp.) in different habitats (unpubl. data). It has also been effective at collecting small blue catfish and channel catfish (< 381 mm). However, collecting larger fish of these two species with the standard 7.5 GPP electrofishing system has been difficult.

Many advances in electrofishing hardware and techniques have occurred since 1985 and additional devices are now being used to collect catfish. One such device is the Smith-Root "Catfish Zapper." The Zapper is a pulsed, low-voltage device that operates at 12 V DC, 15 Hz with a maximum current output of 200 milliamps. The device is used in conjunction with a standard 7.5-GPP boat-mounted electrofisher. Another unit being used is a micro-electronic device called the "Skoal Box." This inexpensive device is a pulsed, low frequency generator that operates at 12 V DC with a frequency of 10–15 Hz. McSwain (1988) reported that under optimum condi-

tions, the Skoal Box is capable of harvesting as much as 6,600 kg of catfish per day. Micro-electronic devices have been used with success to harvest flathead catfish (Gilliland 1987, Dobbins et al. 1999). McSwain (1988) reported these micro-electronic devices are also efficient at harvesting blue catfish.

Good populations of flathead catfish, channel catfish, and blue catfish exist in many of North Carolina's public waters. Catfish are listed as nongame fish in North Carolina and with few exceptions, have no size or creel limits. Little information exists on these populations. In 1996, the WRC's Division of Inland Fisheries appointed a catfish committee, charging it with the task of developing a management plan for both wild and hatchery stocked catfish populations. One of the information needs identified by the committee was to determine the stock assessment techniques most efficient in providing quantitative catfish population samples. Therefore, there was a need to compare these electrofishing devices to determine the most efficient unit. The most efficient gear type could then be used to collect population data such as population densities, age and growth, food habits, and reproduction needed to effectively manage the state's catfish populations.

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Methods

Six sample sites (3 on the Cape Fear River and 3 on the Lumber River) were subjectively selected for good catfish habitat and ease of sampling. These 3 sites were designated upstream, midstream, and downstream. Each site consisted of an 800-m measured distance of similar habitat type. Each site was sampled 6 times (3 each during 2000 and 2001) using each of the following gear types: standard WRC electrofishing boat utilizing the Smith-Root 7.5 GPP (GPP), electrofishing boat utilizing the Smith-Root 7.5 GPP in conjunction with the Smith-Root Catfish Zapper (GPP and Zapper), and the Skoal Box (McSwain 1988). Electrofishing CPUE was defined as the number of catfish captured per meter of sampling. Each year on each river, sampling order and gear type were randomly assigned so that all possible sampling orders/gear types were applied to each site. At least 7 days were allowed between samples at each site before sampling was repeated with a different gear type.

Output settings on the electrofishing boat using the Smith Root 7.5 GPP unit were 500 V DC, 15 pulses per second, and 1–2 A. The Catfish Zapper used the boat's 12 V DC power supply with the positive lead attached to the battery's positive terminal and the negative lead attached to the battery's negative terminal. The battery's negative lead was attached to the hull of the boat with the bottom of the boat serving as the cathode for the Catfish Zapper. The anode consisted of 7.62 m of 10-gauge stranded copper wire with a 30-cm piece of lead attached to the end. Some minor modifications were made to the Catfish Zapper. A 1-m section of 0.95-cm chain was attached to the end of the anode as additional weight to keep it near the bottom. The battery leads of the Catfish Zapper were removed and replaced with an accessory

plug to facilitate ease of power connections. The anode of the Catfish Zapper was marked every 30 cm with colored tape to identify how much of the anode was in the water. A pulley with the anode run through it was attached to the shocking boat dropper ring allowing easier depth control of the anode. Settings for the Smith-Root 7.5 GPP when being used with the Catfish Zapper was 500 V DC, 15 pulses per second, and 1–2 A. Output settings for the Catfish Zapper were factory set at 12 V DC, 15 Hz at 200 milliamps.

The Skoal Box with the 12 V DC factory setting was operated at a frequency of 15 Hz to correspond with the settings of the Smith-Root 7.5 GPP and the Catfish Zapper. Configuration of this device (power supply, hookup, etc.) was identical to that for the Catfish Zapper. The anode consisted of 15 m of 6-gauge welding cable with a 30-cm piece of the insulation stripped off the end. A 1-m section of 0.95-cm chain was attached to the end of the anode as additional weight to keep it near the bottom.

A chase boat assisted in the pick up of stunned catfish. All catfish collected were identified to species, counted, measured (total length in mm), and weighed (wet weight in g).

The relative efficiency of the 3 gear types based on CPUE, was compared among gear types within each river using analysis of variance (ANOVA) (Sokal and Rohlf 1981). Non-normality of the CPUE data required log transformation for statistical analysis. All hypothesis testing was done at $\alpha = 0.10$. To determine if different species and sizes were collected using the 3 gear types, species and length frequency distributions (25-mm size groups) were generated and compared using a chi-square test of independence (Sokal and Rohlf 1981).

Results

A total of 897 catfish weighing 142.5 kg were collected from the 3 sample sites on the Cape Fear River in 2000 and 2001 (Table 1). The year 2000 was the most productive with 709 fish being collected compared to 188 during 2001. Two hundred seventy-eight catfish weighing 102.2 kg were collected from the 3 sample sites on the Lumber River in 2000 and 2001, 120 being collected in 2000 and 158 in 2001.

Examining the catch by river and gear type, the GPP collected 412 catfish from the Cape Fear River resulting in a CPUE of 0.08 fish/m (Tables 2,3). The GPP and Zapper collected the second highest number of fish (359) for a CPUE of 0.07 fish/m. The Skoal Box only collected 126 fish from all 3 sites for a CPUE of 0.03 fish/m. The GPP also collected the most fish (137) from the Lumber River with a CPUE of 0.03 fish/m (Tables 2,3). One hundred and seven fish were collected by the GPP and Zapper, resulting in a CPUE of 0.02 fish/m. The Skoal Box collected the fewest fish (34) for a CPUE of 0.01 fish per meter. There was no significant difference ($P = 0.88$) in catch rates between the GPP and the GPP and Zapper. However, the CPUE was significantly lower for the Skoal Box compared to either the GPP ($P = 0.02$) or the GPP and Zapper ($P = 0.03$).

Species abundance examined by river and gear type revealed the GPP collected

Table 1. Number and weight (kg) of catfish collected by year and site from the Cape Fear and Lumber rivers, North Carolina.

	Cape Fear River				Lumber River				Totals	
	2000		*2001*		*2000*		*2001*			
	N	Wt (kg)	*N*	Wt (kg)	*N*	Wt (kg)	*N*	Wt (kg)	*N*	Wt (kg)
Upstream	271	33.9	66	32.3	104	29.6	150	34.7	591	130.5
Midstream	223	27.1	82	21.0	3	1.6	2	0.8	310	50.5
Downstream	215	18.8	40	9.4	13	18.7	6	16.8	274	63.7
Total	709	79.8	188	62.7	120	49.9	158	52.3	1,175	244.7
Grand Total (both years combined)			897	142.5			278	102.2		

Table 2. Number and CPUE (*N*/m) of catfish collected by river and gear type in the Cape Fear and Lumber rivers, North Carolina.

Location/gear type	Parameter	2000	2001	Total
Cape Fear River				
GPP	Total *N*	317	95	412
	CPUE	0.13	0.04	0.08
	Effort (m)	2400	2400	4800
GPP and Zapper	Total *N*	280	79	359
	CPUE	0.12	0.03	0.07
	Effort (m)	2400	2400	4800
Skoal Box	Total *N*	112	14	126
	CPUE	0.05	0.01	0.03
	Effort (m)	2400	2400	4800
Lumber River				
GPP	Total *N*	73	64	137
	CPUE	0.03	0.03	0.03
	Effort (m)	2400	2400	4800
GPP and Zapper	Total *N*	43	64	107
	CPUE	0.02	0.03	0.02
	Effort (m)	2400	2400	4800
Skoal Box	Total *N*	4	30	34
	CPUE	0.01	0.01	0.01
	Effort (m)	2400	2400	4800

the most fish, accounting for 46.7% (549 fish) of the total catch (Table 3). The total catch from both rivers collected by the GPP and Zapper was 466 fish (39.7%). The poorest collection method was the Skoal Box, accounting for only 13.6% (160 fish) of the total catch from both rivers (Table 3).

Channel catfish (182 fish) and blue catfish (169 fish) accounted for 85% of the total catch collected by the GPP from the Cape Fear River (Table 3). Blue catfish and

Table 3. Species abundance by river and gear type.

River	Species	*N* / % within species	GPP	*Gear type* GPP & Zapper	Skoal box	Total
Cape Fear River	Blue catfish	*N*	169	160	33	362
		%	46.7	44.2	9.1	100.0
	Channel catfish	*N*	182	137	62	381
		%	47.8	36.0	16.3	100.0
	Flathead catfish	*N*	61	62	31	154
		%	39.6	40.3	20.1	100.0
	Total	*N*	412	359	126	897
		%	46.0	40.0	14.0	100.0
Lumber River	Blue catfish	*N*	1	1	0	2
		%	50.0	50.0	0.0	100.0
	Channel catfish	*N*	2	0	0	2
		%	100.0	0.0	0.0	100.0
	Flathead catfish	*N*	9	10	5	24
		%	37.5	41.7	20.8	100.0
	Flat bullhead	*N*	20	10	0	30
		%	66.7	33.3	0.0	100.0
	Snail bullhead	*N*	99	85	27	211
		%	46.9	40.3	12.8	100.0
	White catfish	*N*	6	1	2	9
		%	66.7	11.1	22.2	100.0
Total		*N*	137	107	34	278
		%	49.2	38.5	12.2	100.0
Grand total (combined)		*N*	549	466	160	1,175
		%	46.7	39.7	13.6	100.0

channel catfish, accounting for 44.6% and 38.2%, of the total catch also dominated the total catch of the GPP and Zapper from the Cape Fear River (Table 3). Sixty-two fish (49.2%) collected by the Skoal Box from the Cape Fear River were channel catfish (Table 3). Flathead catfish numbers from the Cape Fear were consistent between the GPP (61) and the GPP with the Zapper (62). The number of flathead catfish collected with the Skoal Box from the Cape Fear River (31) was much higher than the number collected from the Lumber River (5).

Snail bullheads (99 fish) accounted for 72.3% of the total catch collected by the GPP from the Lumber River while most (79.4%) of the total catch by the GPP and Zapper consisted of snail bullheads (85 fish). Snail bullheads also accounted for 79.4% of the total catch by the Skoal Box from the Lumber River. Flathead catfish was the only species collected from each of the 3 sites on the Lumber River. White catfish, flat bullheads, and snail bullheads were not collected from the Cape Fear River and were only collected at the upstream site on the Lumber River (Table 3).

Little difference existed in the percent of total catch by gear type between years. The GPP caught 47% of all species in the year 2000, while the GPP and Zapper collected 39% and the Skoal Box 14%. The following year almost identical results of

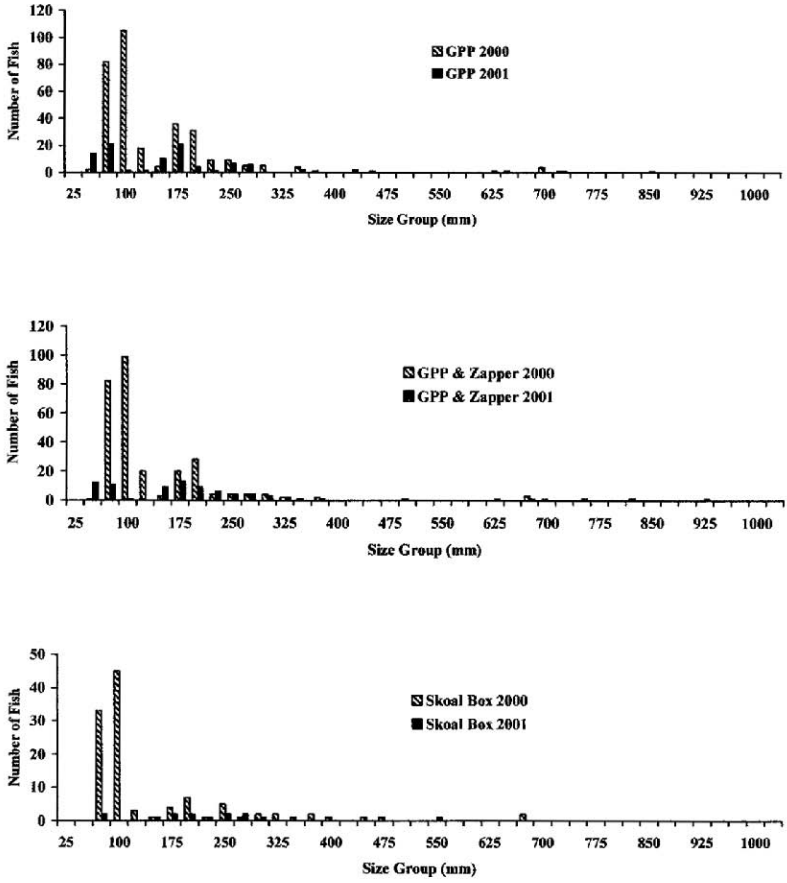

Figure 1. Length-frequency distribution (25-mm intervals) of all catfish collected from the Cape Fear River, by gear type, North Carolina, 2000–2001.

46%, 41%, and 13% were recorded. No significant differences ($P = 0.21$) were detected between the GPP and the GPP and Zapper. However, the Skoal Box consistently under performed both the GPP ($P = 0.01$) and the GPP and Zapper ($P = 0.04$) by capturing significantly fewer fish. The Skoal Box was also less efficient in collecting all the species present. The Skoal Box failed to collect any flat bullheads, snail bullheads, or white catfish in the year 2000; while in 2001, no snail bullheads and channel catfish were collected. ANOVA revealed significant differences in catch between the Skoal box compared to the GPP ($P = 0.02$) and the GPP and Zapper ($P = 0.03$) when collecting catfish from the Cape Fear and Lumber rivers. The Skoal Box collected the least number of fish and the fewest number of species.

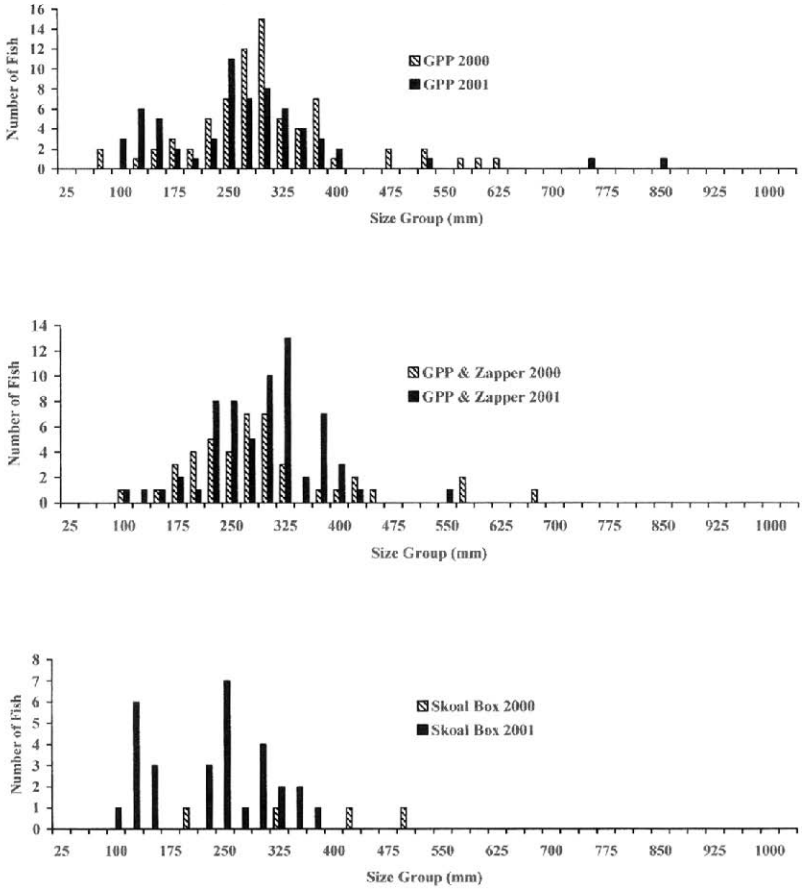

Figure 2. Length-frequency distribution (25-mm intervals) of all catfish collected from the Lumber River, North Carolina, 2000–2001.

Catfish from the Cape Fear River ranged in size from 33 to 1,025 mm. The skewness to the right of the length-frequency distribution graphs (Fig. 1) revealed a catfish population that was dominated by young-of-the-year (y-o-y) and small fish, regardless of which gear type was used. Fish from the Lumber River ranged in size from 62 to 826 mm (Fig. 2). The Lumber River catfish population can be characterized as having a polymodal size distribution dominated by fish 200 to 375 mm. Chi-square analysis revealed no significant difference between the 3 gear types ($P = 0.29$) for fish >200 mm.

Discussion

Statistical analysis revealed significant temporal differences in the sampling schedule between 2000 and 2001 for the Cape Fear River. The first sample taken in 2000 was in mid-August but scheduling conflicts, adverse weather conditions, and low water levels delayed further sampling until late October of that year. Six hundred twenty-four (88%) of the 709 fish collected from the Cape Fear in 2000 were ≤ 200 mm. In an attempt to avoid many of the sampling problems encountered in 2000, sampling for the 2001 season was initiated the second week of July with the last sample taken at the end of that month. This meant that the third and final sample in 2001 was actually completed nearly 2 weeks before the first sample was taken in 2000. Most channel catfish and blue catfish in the Cape Fear River appear to spawn during late June to early July. We feel that by starting the 2001 sampling the second week of July, y-o-y were not as numerous and thus, not as available for collection as they were in 2000. Furthermore, of the 134 fish ≤ 200 mm that were collected in 2001, 25 were collected in the first or earliest sample, 34 in the second sample, and 75 in the last, providing additional support that as sampling progressed, more y-o-y fish were collected. Further analysis revealed the gear types operated essentially the same regardless of the river. Therefore, all catfish ≤200 mm were excluded from further statistical analysis and data from both rivers were combined (by year) to increase sample sizes and the power of the statistical analyses.

The GPP and the GPP and Zapper were more effective than the Skoal Box at collecting larger numbers of blue catfish and channel catfish at the settings used in this study; 500 V pulsed-DC, 15 pps, at 1–2 A. The Cape Fear River had a good population of blue catfish and channel catfish, accounting for 99.5% of the total number collected during the 2-year study. However, all of the blue catfish and channel catfish collected with the GPP and the GPP and Zapper were ≤ 381 mm. Both gear types failed to collect blue catfish and channel catfish larger than 381 mm. The Skoal Box collected the only large fish (>381 mm, blue catfish) from the Cape Fear. Only 2 blue catfish and 2 channel catfish were collected from the Lumber River during the study. However, the data suggest that blue catfish and channel catfish are successfully reproducing and are available for capture if different gear types are used. Nelson and Little (1985) used hoop nets with a 15-cm mouth for the collection of blue catfish and channel catfish > 381 mm, and such gear could be used to supplement electrofishing.

A chase boat was an effective method for increasing capture rates. Catfish stunned by the GPP surfaced as far as 10 m from the boat. Attempts to chase fish down with the electrofishing boat during earlier sampling always resulted in less fish being caught than if a chase boat was used (unpubl. data). Therefore, use of a chase boat to collect stunned catfish is essential in obtaining a sample adequate for population estimates. Fish stunned by the GPP and Zapper typically surfaced at a distance farther away from the anodes than those fish stunned by the GPP or the Skoal Box (up to 25 m). The increase in distance from the anodes made it more difficult to chase and collect fish that surfaced due to the brief amount of time the catfish remain on the surface. Conversely, most of the catfish stunned by the Skoal Box appeared within 2

m behind the boat, reducing the need for a chase boat. This could be an option for those agencies or individuals where monetary and labor constraints are factors in determining sampling protocols.

This study suggests that to effectively sample for y-o-y catfish on southern coastal plain rivers with similar characteristics, sampling should be conducted between mid-August and the end of September. Index of Biotic Integrity (IBI) sampling conducted annually by WRC during the month of August employing the Smith-Root 7.5 GPP system has been successful in collecting larger blue catfish and channel catfish (unpubl. data). Settings of 1000 V DC, 60 pps at 4–5 A while electrofishing shoreline and structure resulted in the capture of numerous catfish > 381 mm.

In summary, the boat employing the Smith-Root 7.5 GPP was more effective at collecting catfish than the Skoal Box. The boat employing the Smith-Root 7.5 GPP was just as effective as the boat employing the Smith-Root 7.5 GPP with the aid of the Smith-Root Catfish Zapper in collecting total numbers and species of catfish. No significant difference was observed among the 3 gear types in the size of the catfish collected.

Management Recommendations

Electrofishing should be conducted using the Smith-Root 7.5 GPP at 500 V DC, 15 pps at 1–2 amps to collect all sizes of catfish, except blue and channel catfish > 381 mm. Sampling of catfish populations should be conducted between mid-August and the end of September. To capture blue and channel catfish >381 mm, shoreline and structure electrofishing with a Smith-Root 7.5 GPP unit at 1000 VDC, 60 pps at 4–5 amps should be conducted from mid-June to September. A chase boat should be used to increase capture efficiency. Compare higher voltage and frequency settings with hoop nets for large catfish sampling.

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