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A Comparison of Fish Collection Methods after Rotenone Application in New River, Virginia

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Abstract—Previous work has demonstrated the desirability of utilizing a block net during rotenone application in a large river. An attempt was made at nine rotenone stations on the upper New River in North Carolina and Virginia to assess the relative efficiency of the use of a block net versus the use of personnel with dip nets. The block net was set, rotenone applied, and 6 experienced biologists using standard D-frame dip nets collected fish above the block net for a period of approximately 30 minutes. Use of the block net resulted in significantly higher numbers of species and specimens collected per locality than by dip netting alone. The most significant difference in capture frequency occurred in the Etheostomatini (Percidae) where 92 percent of all specimens taken was collected in the block net.

Introduction

Lennon et al. (1970) and Schnick (1974) reviewed the use of rotenone in fisheries management. Schnick (1974) related that it was first used as a fisheries tool in the United States in 1934 and that by 1949, 34 states and several Canadian provinces were applying it to management and survey problems. By 1974, rotenone was available in the United States under 30 registration numbers representing 17 different companies on file with the U. S. Environmental Protection Agency in three basic formulations: 5 percent emulsifiable concentrate, 2.5 percent synergized emulsifiable concentrate and 5 percent wettable powder. Rotenone usefulness in fisheries research was demonstrated recently by Smith (1973), Hocutt, Hambrick and Masnik (1973), Hall (1974) and Chadwick (1976).

Hocutt et al. (1973) reported that less than 10 percent of the fish affected by rotenone was collected using dip nets when compared to the number collected in a block net located immediately downstream of the treated area. The estimation was based on qualitative field observations while sampling fish by rotenone in the New River, Virginia. The purpose of this study was to refine the above estimation with quantitative data and to determine the relative capture efficiency of each collection method for several families of fishes. Hocutt et al. (1973) related data on morphometry of New River.

Materials and Methods

The following methods for employing the block net in swift current were given in Hocutt et al. (1973). A 91 m × 3.6 nylon block net with 6. 3-mm mesh was set downstream from the area to be rotenoned. Depending upon conditions (current velocity, substrate, etc.) a minimum width of 36 m was blocked with the net. Approximately 68 to 91 meters of river immediately upstream of the block net were treated with rotenone. Application of five percent powdered rotenone was made just above riffle areas whenever possible to facilitate mixing. Potassium permanganate was used to neutralize the rotenone below the block net. All collections were made in the upper New River (Figure 1).

Six experienced field biologists used standard D-frame kick nets to capture distressed and drifting fish within the treated area. No special instructions were given to the biologists as to the kinds of fish to collect, however, a bias to the collection of larger fish probably existed. Fish collected with the dip nets were placed in formalin as quickly as possible. At the end of the effective rotenone period, approximately 30 minutes after rotenone application, dip netting ceased and the block net was cleaned. Fish collected in the block net were preserved separately from the dip netted specimens. Preserved fish were sorted and placed in permanent storage in the Virginia Polytechnic Institute and State University fish collection. Numbers of specimens of each species collected by dip nets and block nets were recorded separately for each of the nine stations.

Results and Discussion

A total of 6,381 specimens representing 36 species was collected during the investigation (Table 1), with the majority of taxa at each station taken in the block net (Table 2). At four stations the block net collected specimens of every species taken. In each of the other five instances, dip-netted samples increased the total number of species collected only by a single species. In each of these cases, the species not collected by the block net were represented by one or two large specimens that probably would have drifted into the block net if they were not dip netted.

Table 3 shows the number of specimens taken at each station and compares the relative (percent) efficiency of each collecting method. At each station, more specimens were taken by the block net than the dip nets alone. The percent of the total number of specimens taken at a station by dip nets ranged from 7 to 38 percent of the total, with an average of 14 percent for all 9 stations. This number is probably a high estimate since several of those specimens taken by dip nets would probably have drifted down to and become lodged in the block net. These data confirm the qualitative estimate of Hocutt et al. (1973) that 10 percent of the affected fish were caught with dip nets.

An unquantifiable bias exists in the study due to the passive nature of the block net. If the block net were not present, the composition of dip-netted samples would be unchanged; however, if dip netting were not conducted in conjunction with the block net, a significant portion of the specimens that appeared in the dip-netted samples would have ulti-

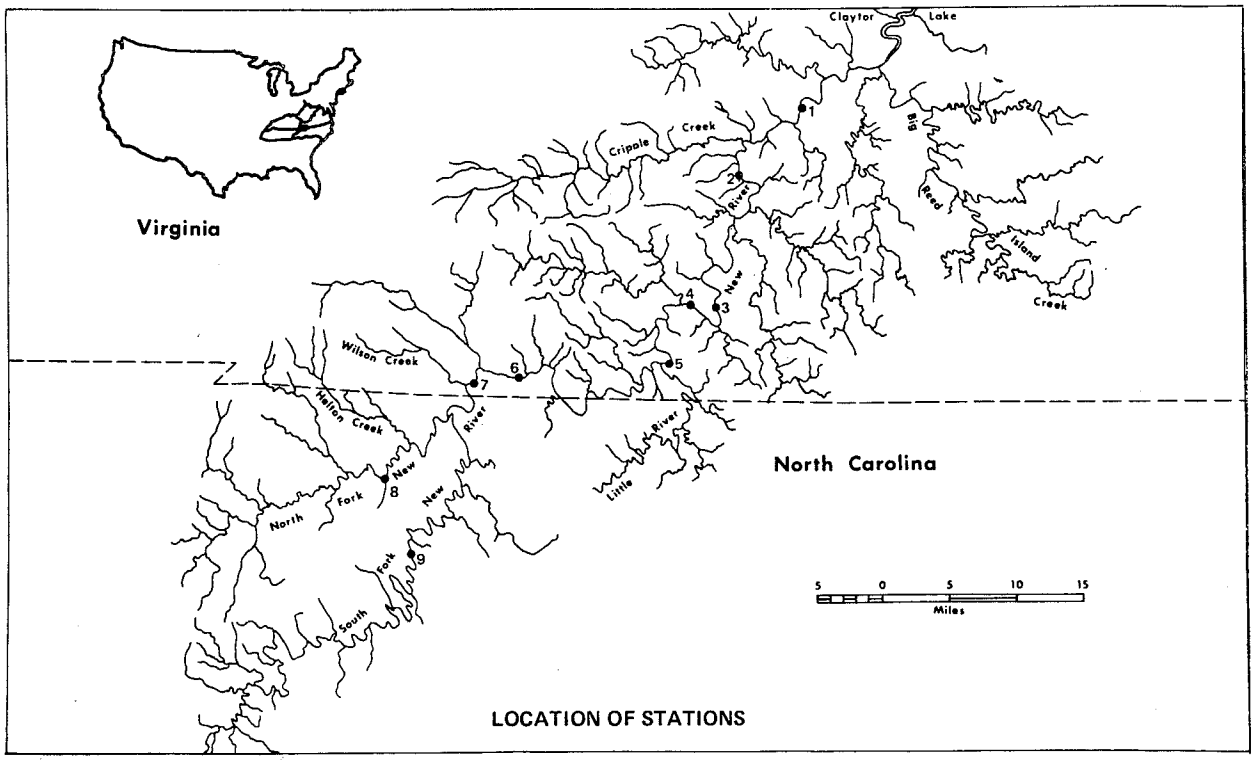

FIG. 1. Map of study area with fish sampling localities noted.

TABLE 1

Numbers of specimens by taxon collected during rotenone sampling by dip net (D) and block net (B) at each station

	STATION																	
	1		2		3		4		5		6		7		8		9	
	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B
Cyprinidae—Total	7	93	111	1912	311	1671	14	86	42	162	45	267	109	554	38	76	30	175
Campostoma anomalum				10		2						1	1	9		2	24	78
Exoglossum laurae															3	1		
Nocomis leptocephalus			7	28	24	20	2	38	7	12	26	83	60	155				1
Nocomis platyrhynchus	6	32	1	13	78	293	4	9	23	21	10	61	24	68	34	37		5
Notropis albeolus		1			34	157	1	1		13		1						
Notropis ardens			7	69														
Notropis photogenis		2						1					1	9		3	1	19
Notropis rubellus			59	1189	12	137		7	3	30	3	88	1	68	1	31		19
Notropis rubricroceus											1	3						
Notropis scabriceps		3		56	57	239		1		11	3	20	4	70				30
Notropis spilopterus	1	49	4	15	7	71	2	15	3	13		3		1			2	3
Notropis volucellus		6	28	458	28	318	5	11	3	58	1	2	6	71				
Phenacobius teretulus				5	28	237					1	1	9	82		2	1	1
Pimephales notatus			5	69	43	197		3	3	3			3	19				8
Rhinichthys atratulus														1			1	6
Rhinichthys cataractae										1		4						
Semotilus atromaculatus																		5
Castostomidae—Total	3	5	1	1	3	32	0	4	13	19	1	2	6	23	0	0	1	1
Catostomus commersoni													1					
Hypentelium nigricans	3	5	1	1	3	32		4	13	19	1	2	5	23			1	1
Ictaluridae—Total	2	0	6	9	4	2	2	0	6	4	0	1	0	0	0	0	0	0
Ictalurus punctatus						1												
Pylodictis olivaris	2		6	9	4	1	2		6	4		1						
Centrarchidae—Total	4	5	17	33	24	34	32	46	12	19	3	18	6	13	1	0	0	5
Ambloplites rupestris			13	26	22	29	27	30	8	15	3	18	4	8				3
Lepomis auritus							5	8										
Lepomis cyanellus				1														
Lepomis gibbosus										1								

TABLE 1 *continued*

	STATION																	
	1		2		3		4		5		6		7		8		9	
	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B
Lepomis macrochirus		1								1								
Micropterus dolomieui	3	3	4	6	2	5		8	2	2			1	4	1			2
Micropterus punctulatus	1	1											1	1				
Pomoxis nigromaculatus									2									
Percidae—Total	2	13	6	40	2	12	0	6	0	14	0	30	0	3	0	4	0	0
Etheostoma blennioides			1	8	2	2		1		1				1				
Etheostoma flabellare		1		9		8				3		6		2		4		
Etheostoma kanawhae	1	1		1						1								
Percina caprodes		1		1														
Percina maculata		1	4	17		2		1		1		15						
Percina oxyrhyncha	1	9	1	4				4		8		9						
Cottidae—Total	0	4	4	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cottus carolinae subsp.		4	4	83														

mately drifted into the block net. Therefore, the absence of specimens in the block net that only appeared in the dip-netted samples is not as significant as the converse. Specimens collected in the block net and not appearing in the dip-netted samples would have remained uncollected.

Catches of Cyprinidae, Centrarchidae, and Percidae were examined separately to evaluate the effect of different behavioral responses to rotenone treatment. These three families were chosen due to their differing reactions to the ichthyocide (Hocutt et al., 1973; Kinney, 1968). Behavior of the organisms after exposure to the rotenone would significantly influence the capture effectiveness of each collection method. Hocutt et al. (1973) stated that darters (Percidae: Etheostomatini) reacted immediately by erratic swimming on or just below the surface for a few seconds, then sinking immediately. Personnel using dip nets would have a fairly short time to observe and capture these small specimens. Saltation along the bottom and entrainment in the river flow would ultimately carry many of the specimens downstream where they would become impinged on the net. Approximately 92 percent of the darters taken during the survey was collected in the block net, thus indicating that capture success with dip nets was minimal for this group (Table 1).

Hocutt et al. (1973) stated that other families of fish showed progressive resistance to the ichthyocide with cyprinids succumbing before centrarchids. Field observations have shown that both cyprinids and centrarchids come to the surface swimming erratically, demonstrating a decided loss of equilibrium. They often remain on or near the surface for a long time, thereby increasing the probability of capture by dip and block nets. Approximately 87 percent of the

TABLE 2
Number of species collected at each station by dip net and block net

	Station									
	1	2	3	4	5	6	7	8	9	All Stations Combined
Dip Net	8	15	14	8	11	9	14	4	6	28
Block Net	16	22	18	16	20	17	18	7	14	34
Total	17	22	18	17	21	17	19	8	14	36

TABLE 3
Percent of the total number of specimens taken at each station by dip net and lock net

	Station									
	1	2	3	4	5	6	7	8	9	All Stations Combined
Dip Net	13	7	16	38	25	13	17	33	14	14
Block Net	87	93	84	62	75	87	83	67	86	86

total number of cyprinids and 63 percent of the centrarchids were taken by the block net. The higher percentage of cyprinids captured by the block net was probably because:

1. The great number of cyprinids present in the treated area resulted in many specimens drifting by the personnel using the dip nets;
2. The bias of the personnel using dip nets to collect large specimens or new taxa, primarily centrarchids, resulted in fewer affected centrarchids in the block net; and
3. Centrarchidae, as well as other large fish, can probably tolerate a higher concentration of the ichthyocide and, therefore, may revive to swim out of the net to avoid capture. However, capture is assured by dip net.

Three families, Catostomidae, Cottidae and Ictaluridae, exhibited different capture rates. Their low frequency of occurrence in the samples (less than four percent of all specimens collected) and their discontinuous distribution would not allow meaningful conclusions.

The conditions of fish collected with dip nets and with the block net differed. Specimens collected by the block net were in poor condition because they were subjected for a relatively long period to various stresses associated with impingement and asphyxiation. Dip-netted specimens, however, were almost immediately preserved to avoid loss from the dip net and are therefore more suitable for taxonomic purposes.

Conclusions

The data suggest (1) that the block net captures more fish and more taxa in a given time period than six trained biologists employing dip nets and (2) that specimens in certain families, e.g., Percidae, may be lost when only dip netting is performed after ichthyocide application.

If a realistic qualitative and perhaps even quantitative picture of the fish community is to be gained by the use of rotenone in stream investigations, the authors recommend that (1) a block net should always be used and (2) the number of personnel employed should depend on the difficulty of setting, cleaning and removing the block net, rather than on the collection of specimens with dip nets. However, dip netting should be performed since some taxa may not be collected by block net alone, and specimens collected in dip nets are better for taxonomic purposes.

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