# Evaluation of the Relative Selectivity of Sampling Gear on Ictalurid Populations in the Neuse River

**Kent L. Nelson,** *North Carolina Wildlife Resources Commission, 512 North Salisbury Street, Raleigh, NC 27611.*

**Albert E. Little,** *North Carolina Wildlife Resources Commission, 512 North Salisbury Street, Raleigh, NC 27611.*

*Abstract:* Five techniques (electrofishers, hoop nets, gill nets, wire traps, and trotlines) were used to sample ictalurids in the Neuse River above New Bern, North Carolina, between July 1984 and May 1985. Hoop nets were the most effective of the sampling gears tested. They collected white catfish (*Ictalurus catus*), channel catfish (*I. punctatus*), blue catfish (*I. furcatus*), yellow bullhead (*I. natalis*), and margined madtom (*Noturus insignis*) and accounted for 76% of the total number of fish caught. Electrofishing (low voltage) captured white catfish, yellow bullhead, and margined madtom, which represented 14% of the total number of fish caught. White catfish, channel catfish, blue catfish, and brown bullhead (*I. nebulosus*) were caught with trotlines, but this accounted for only 8% of the total number caught. Wire traps, gill nets, and electrofishing (high voltage) were ineffective in sampling catfish in the Neuse River. White and channel catfish collected with trotlines and white catfish collected with the electroshocker were significantly larger than those captured in hoop nets. Significant differences were also indicated between the species composition of hoop nets and electrofisher samples.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 40:72–78

An accurate assessment of fish community structure is often required for effective resource monitoring and management. Selectivity of sampling gears for species and size is often an important source of bias in such assessments (Hamley 1975, Yeh 1977, Laarman and Ryckman 1982). Effectiveness of a particular gear type for a species may vary between sample locations and also seasonally. While the use of multiple gear types can often better delineate species composition, sampling programs are usually limited by time and monetary constraints to 1 or 2 specific types. Consequently, recognizing the effectiveness and limitations of sampling gear is important in selecting appropriate gear for meeting study objectives.

In a recent study, Borawa (1982) attempted to evaluate the status of ictalurid populations in the Neuse River using a telephone magneto and an electrofishing

boat with pulsed direct current output. His study was designed to document the presence of blue catfish reportedly established in the Neuse River since their introduction in 1966. White catfish, yellow bullhead, and margined madtom were collected. Blue and channel catfish, abundant in commercial catches, were not captured. Blue and channel catfish may have been less susceptible than other ictalurids to the electrofisher either as a result of differences in habitat preferences or physiological or behavioral responses to the gear. Corcoran (1979) found channel catfish less susceptible than other ictalurids to electrofishing using pulsed D.C. current. Due to its apparent selectivity, electrofishing may not be the optimum gear for the efficient collection of some species of catfish or for unbiased samples of population structure. Our objective was to determine the relative selectivity of 5 sampling techniques (hoop nets, gill nets, catfish traps, electrofishers, and trotlines) for catfish in the Neuse River.

Appreciation is extended to all Division of Boating and Inland Fisheries personnel who assisted with the field collections and manuscript review. Jacquelin Dietz, Department of Statistics, North Carolina State University assisted with data analysis. This study was funded in part through Dingell-Johnson Federal Aid in Fish Restoration, Project F-22 North Carolina.

## Methods

The Neuse River forms at the confluence of the Eno and Flat rivers in Piedmont North Carolina and flows southeasterly until it enters the Pamlico Sound near New Bern. The Neuse River is 399 km long and has a drainage area of 1,449,869 ha (5,598 miles$^2$). The freshwater portion of the river is typical of large, low gradient coastal plain rivers, with extensive floodplains and widely fluctuating flow rates.

Sampling was conducted at 10 sites located in a 17.0-km section of the Neuse River, 10.5 km upstream of New Bern. Sites were selected to represent homogenous habitat types along the main channel of the river. Each site consisted of a channel dropoff area between 1 and 3 m deep in proximity to the shoreline. Sampling was conducted twice seasonally between July 1984 and May 1985. Each sampling period consisted of 3 days during which 2 hoop nets, 2 gill nets, 2 trotlines, and 4 catfish traps (2 per site) were fished at 1 site for 2 consecutive nights. The remaining 2 sites were sampled with an electrofisher. Gears were randomly assigned to sample sites through a blind drawing.

Hoop nets used in this study were 6.2 m long and 1.8 m in diameter with a mouth 15 cm in diameter. Nets were of 2-cm stretched mesh and consisted of 5 hoops with throats attached to the first and third hoops. A combination of cut fish and cottonseed meal was used as bait. Nets were set with the openings facing downstream. Gill nets 9.1 m long, 2.4 m deep, and with 7.6-cm stretched mesh were set parallel to the nearest bank. Trotlines with droppers 38 cm in length spaced 116 cm apart were equipped with 25 size 2/0 hooks baited with cut fish. Commercially purchased catfish traps were 1.2 m long, 38 cm in diameter and constructed of 2.5-

cm wire mesh. Traps contained 2 throats with openings 12.7 cm in diameter. Traps were baited with a combination of cottonseed meal and cut fish. Fish used as bait in the hoop nets and wire traps were primarily gizzard shad (*Dorosoma cepedianum*), suckers (*Moxostoma sp.*), and sunfish (*Lepomis sp.*). Cut American eel (*Anguilla rostrata*) was used for bait on the trotlines. Captured fish were removed from these gears and trotlines were rebaited at 24-hour intervals. The electrofishing boat utilized a Coffelt VVP-15 electrofishing unit powered by a generator to provide pulsed DC output. Each electrofishing sample site was divided into upstream and downstream sections and was sampled for 30 minutes at either low voltage (40 volts, 1 amp) or high voltage (150 – 380 volts, 3 – 3.5 amps). The sequence of either high or low voltage was determined by a coin toss, with the downstream section always being sampled first. In each of the sections, the electrofisher, accompanied by a pickup boat, proceeded upriver for 15 minutes along each bank. Conductivity and water temperature were measured with YSI Model 33 S-C-T meter prior to electrofishing. All fish captured were identified and measured for total length (mm).

Size selectivity of the various gear for white, channel, and blue catfish and yellow bullhead was evaluated with the Kruskal-Wallis Rank Sum and Wilcoxon Rank Sum tests (Hollander and Wolfe 1973). The Wilcoxon and Kruskal-Wallis tests were used when comparing 2 and 3 gear types, respectively. A $X^2$ test was used to evaluate species selectivity (Snedecor and Cochran 1967). To make valid comparisons, the $X^2$ test requires that most of the cells have an expected frequency ($F$) greater than 5. Small sample sizes result in a high proportion of low expected frequencies and therefore comparisons were limited to hoop nets vs. electrofisher and hoop nets vs. trotlines.

## Results

Utilizing 5 techniques, a total of 120 white catfish, 70 channel catfish, 12 blue catfish, 16 yellow bullhead, 1 brown bullhead, and 9 margined madtom were collected. Hoop nets were the most effective of the sampling gears tested, capturing 5 ictalurid species and 76% of the total number caught (Table 1). The brown bullhead was the only species not collected in hoop nets. Hoop nets collected the greatest number of fish per species in comparison to other gear types. The electrofisher (low voltage) captured 3 species and 14% of the total catch while trotlines collected 4 species and 8% of the total catch. Two species and 2% of the total catch were captured in the traps. No ictalurids were collected in gill nets or with the electrofisher at high voltage during the study. The $X^2$ test indicated the species composition of hoop net and electrofisher samples were significantly different ($P < 0.005$). No significant difference was detected in a comparison of species composition between hoop net and trotline samples. Tests comparing other gear types were not possible due to the small sample size.

Ictalurids were captured by hoop nets and trotlines during all seasons (Table 1). Traps caught at least 1 catfish during all but the summer samples. Ictalurids were

**Table 1.** Number of catfish captured from the Neuse River, 1984–1985.

| Gear[a] | Sample period | White catfish | Channel catfish | Blue catfish | Yellow bullhead | Brown bullhead | Margined madtom | Total |
|---|---|---|---|---|---|---|---|---|
| Hoop Net | Summer | 30 | 1 | 8 | 5 | | 1 | 45 |
| | Fall | 27 | 42 | | 4 | | | 73 |
| | Winter | 22 | 14 | 1 | | | 6 | 43 |
| | Spring | 2 | 9 | | | | 1 | 12 |
| Electrofisher (low voltage) | Summer | 23 | | | 3 | | 1 | 27 |
| | Fall | | | | | | | |
| | Winter | | | | | | | |
| | Spring | 4 | | | | | | 4 |
| Trotline | Summer | 1 | | 1 | | | | 2 |
| | Fall | 6 | 2 | | | | | 8 |
| | Winter | 1 | | | | 1 | | 2 |
| | Spring | 3 | 2 | 2 | | | | 7 |
| Trap | Summer | | | | | | | |
| | Fall | | | | 3 | | | 3 |
| | Winter | | | | 1 | | | 1 |
| | Spring | 1 | | | | | | 1 |
| TOTAL | | 120 | 70 | 12 | 16 | 1 | 9 | 228 |

[a]No fish were caught in gill nets or electrofishing at high voltage.

captured with the electrofisher only during the spring and summer when water temperatures exceeded 22° C.

Hoop nets caught a higher proportion of small size white catfish in comparison to other gears (Table 2). The Kruskal-Wallis Rank Sum test indicated that white catfish captured by electrofishing and trotlines were significantly larger ($P < 0.06$) than those captured by hoop nets. No significant differences ($P > 0.14$) were detected between the size of white catfish captured by electrofishing and trotlines.

The largest white, channel and blue catfish were captured on trotlines during the study. Channel catfish collected by trotlines were significantly larger ($P < 0.0005$, Wilcoxon Rank Sum test) than those captured by hoop nets. Blue catfish caught by hoop nets and trotlines were not significantly different in size ($P > 0.36$). No channel or blue catfish were captured by electrofishing during the sampling. Sizes of yellow bullhead captured by hoop nets, electrofisher and traps were not significantly different.

## Discussion

Differences were observed in the effectiveness of sampling gears for collecting ictalurids in the Neuse River. Of the 5 gears used during 1984 and 1985, hoop nets captured the most species and the greatest number. The electrofisher and trotlines were of intermediate success, while traps and gill nets were generally ineffective. Effectiveness of hoop nets for capturing ictalurids in the Neuse River supports that reported by Pierce et al. (1981) and Yeh (1977).

**Table 2.** Number of catfish by size group captured from the Neuse River by species and gear type, 1984–1985.

| Gear / Species | Total length (cm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3–6 | 7–10 | 11–14 | 15–18 | 19–22 | 23–26 | 27–30 | 31–34 | 35–38 | 39–42 | 43–46 | ≥47 |
| Hoop net | | | | | | | | | | | | |
| White catfish | 3 | 52 | 11 | 9 | | 4 | | 1 | 1 | | | |
| Channel catfish | 1 | 34 | 14 | 7 | 6 | 3 | | | 1 | | | |
| Blue catfish | | | | | 2 | 6 | | 1 | | | | |
| Yellow bullhead | | | | | 3 | 1 | 2 | 3 | | | | |
| Margined madtom | | | 6 | 2 | | | | | | | | |
| Electrofisher (low voltage) | | | | | | | | | | | | |
| White catfish | | 3 | 1 | 1 | | 4 | 3 | 8 | 4 | 2 | 1 | |
| Yellow bullhead | | | | | | 3 | | | | | | |
| Margined madtom | | 1 | | | | | | | | | | |
| Trotline | | | | | | | | | | | | |
| White catfish | | | | | | | | | 2 | 2 | 6 | 1 |
| Channel catfish | | | | | | | | | 2 | | | 2 |
| Blue catfish | | | | | | | | | | 1 | | 2 |
| Brown bullhead | | | | | | | | | | 1 | | |
| Trap | | | | | | | | | | | | |
| White catfish | | | | 1 | | | | | | | | |
| Yellow bullhead | | | | | | 1 | 2 | 1 | | | | |

The hoop nets used in this study collected more small catfish (<24 cm) regardless of species, than did the other gear types. This was likely a result of the small mesh (2-cm stretched) of the hoop nets. Larger fish (>24 cm) in greater numbers were collected with the electrofisher (white catfish) and trotlines (white, channel, and blue catfish). The failure of hoop nets to capture larger specimens may be related to the small diameter opening (15 cm) of the first throat or mesh size. Large white, channel, and blue catfish are routinely captured in hoop nets with larger mouths and mesh size by commercial fishermen in the study area. The presence or absence of bait and type of bait may also influence catch rates and species composition of hoop nets (Pierce et al. 1981).

Significant differences in species composition between hoop nets and the electrofisher and the failure of the electrofisher to collect channel and blue catfish suggest that electrofishing is selective for certain species of ictalurids. Channel and blue catfish comprised 36% of the total number of ictalurids collected by all gear types combined in the study, which indicates that they were relatively abundant and available for capture. A previous electrofishing survey of Neuse River ictalurids (Borawa 1982) also failed to detect these species.

Hook and line sampling is generally selective for size and species (Swingle et al. 1965). During this study, trotlines tended to collect only the species with larger size individuals (white, channel, and blue catfish). The use of smaller size hooks (<2/0) may improve the catch rate of trotlines for yellow bullhead and margined madtom, as well as smaller specimens of all species.

Wire catfish traps and gill nets were ineffective in capturing ictalurids in the Neuse River during the study. The traps, while much smaller than the hoop nets, were constructed of a larger mesh. As a result, smaller sizes of catfishes retained by the hoop nets likely passed through the traps. The small dimensions and throat configuration of the traps were apparently not attractive to larger catfish, although they are used for the commercial harvest of catfish in some areas. The failure of gill nets to capture ictalurids was likely a function of site selection. High water velocities in the main river channel required that the nets be set parallel to the nearest bank. Cross current sets may have increased capture rates. However, during the fall to spring period, gill nets were often obstructed with detritus, leaves, and branches or coated with dead algae, reducing their effectiveness. Sampling backwater areas and sloughs would likely improve their catch efficiency.

In summary, hoop nets were found to be the most effective of the 5 gear types used in the Neuse River for number of species and number of catfish captured, although they were selective for smaller size fish. Based on our results, we recommend the use of hoop nets to sample riverine ictalurid populations. Results indicate that electrofishing is species selective and is not an appropriate sampling technique for evaluating ictalurid community structure. Trotlines were selective for larger fish and captured relatively few catfish. Within the constraints of the study design, gill nets and traps were not effective gear types for collecting ictalurids. The effectiveness of these gears would likely differ from those observed in this study if different habitat types were sampled.

## Literature Cited

Borawa, J. C. 1982. Evaluation of ictalurid fish populations of the Northeast Cape Fear, Neuse and Tar Rivers. Final Rep. F-22-6. N.C. Wildl. Resour. Comm., Raleigh. 12pp.

Corcoran, M. R. 1979. Electrofishing for catfish: use of low-frequency pulsed direct current. Prog. Fish-Cult. 41:200–201

Hamley, J. M. 1975. Review of gill net selectivity. J. Fish. Res. Board Can. 32:1943–1969.

Hollander, M. and D. A. Wolfe. 1973. Nonparametric statistical methods. John Wiley and Sons, New York. 503pp.

Laarman, P. W. and J. R. Ryckman. 1982. Relative size selectivity of trap nets for eight species of fish. North Am. J. Fish. Manage. 2:33–37.

Pierce, R. B., D. W. Coble, and S. Corley. 1981. Fish catches in baited and unbaited hoop nets in the Upper Mississippi River. North Am. J. Fish. Manage. 2:204–206.

Snedecor, G. W. and W. C. Cochran. 1967. Statistical methods. Iowa State Univ. Press, Ames. 593pp.

Swingle, W. E., R. O. Smitherman, and S. L. Spencer. 1965. Estimation of bass numbers in a farm pond prior to draining with electroshocking and angling. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 19:246–253.

Yeh, C. F. 1977. Relative selectivity of fishing gear used in a large reservoir in Texas. Trans. Am. Fish. Soc. 106:309–313.