Evaluation of Trapnetting for Sampling Black Crappie

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Abstract: Trap nets were evaluated as sampling gear for black crappie (*Pomoxis nigromaculatus*) in 4,900-ha Lake Wylie, North Carolina and South Carolina. Compared with a creel survey, cove sampling with rotenone, and spring electrofishing, trap nets were the most efficient and cost-effective gear used for capturing black crappie at Lake Wylie. Age and size structure of black crappie captured in trap nets were similar to that harvested by anglers during the same season. Trap net catch rates (number per net set) also appeared to reflect densities of black crappie in Lake Wylie. Biases were related to sampling season and to mesh sizes of the trap nets used. Catch rates of large (≥250 mm total length) black crappie in spring were significantly higher than those observed in fall, and catch rates of small (<250 mm total length) black crappie in fall were significantly higher than those observed in spring. Although the same size classes were captured, more large black crappie were captured in nets with 2.5-cm bar mesh than in nets with 1.9-cm bar mesh, and generally, more small black crappie were captured in nets with 1.9-cm bar mesh than in nets with 2.5-cm bar mesh.

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Trap nets, effective in capturing black crappie and white crappie (*Pomoxis annularis*) (Bennett 1971), have been extensively evaluated as sampling gear for white crappie in midwestern reservoirs (Boxrucker 1984, Willis et al. 1984, Colvin and Vasey 1986). These evaluations have shown that trap-net catches provided useful information on density, age, and size structure of white crappie populations.

Black crappie are more widespread than white crappie in the southeastern United States (Lee et al. 1980), and are more abundant than white crappie in many southeastern reservoirs (Barwick 1978; Duke Power Co., unpubl. data). Black crappie generally prefer cleaner, deeper, and cooler waters than white crappie (Lee et al. 1980), and could have different vulnerabilities to trapnetting. The objective of this study was to evaluate trap nets as sampling gear for black crappie in Lake Wylie, a

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4,900-ha cooling reservoir located on the border of North Carolina and South Carolina. Comparative capture efficiency, effects of sampling season and mesh size on age- and size-selectivity, and the ability of catch rates to reflect densities were determined.

Methods

Sample Collection

Trap nets (2 0.9 × 1.8-m steel frames, 4 0.9-m diameter hoops wrapped with either 1.9-or 2.5-cm bar mesh netting, with attached single 15.3 × 0.9-m, 1.9- or 2.5-cm bar mesh lead), were set overnight for 17 to 28 hours, including dusk and dawn, at a minimum of 15 randomly selected locations in each of 5 zones (5 to 1,670 ha) of Lake Wylie during November 1985. When necessary, additional locations were sampled within each zone until a minimum of 200 black crappie were captured. These same locations were sampled again in November 1986 and 1987. Zonation of Lake Wylie was based on differences in flow, water temperature, and nutrient concentrations. In April 1986, trap nets were set overnight at 15 to 44 randomly selected locations in the same 5 zones. At each location, nets were set off points, with the free lead tied to shore, and the nets stretched perpendicular to shore with the frame completely submerged (1 to 5 m in depth).

All black crappie and white crappie captured in each trap net were enumerated and measured (total length [TL] in millimeters). Mesh size of each net set was also recorded during each sampling period. In November, scales were taken from approximately 600 black crappie lakewide, with lengths proportional to the entire catch, and ages were determined. Ages determined from scales and otoliths of 64 black crappie (total lengths ranging from 97 to 387 mm) from Lake Wylie were in agreement. Aging was verified by comparing age frequency in 1-cm length groups and length-frequency of the entire sample (Jerald 1983).

A creel survey of all zones sampled with trap nets was conducted from December 1985 through November 1986. Methodology of this creel survey was similar to that described in Harrell (1986). Scales were removed and total lengths recorded from randomly selected black crappie, and total lengths from nearly all white crappie examined during the creel survey were also recorded. Cove rotenone sampling was conducted at 3 fixed locations during August 1985, 1986 and 1987, in a similar manner described in Davies and Shelton (1983) except the block net was set in the morning and no estimates of unrecovered fish were made. One kilometer of shoreline at 3 fixed locations were also electrofished (840 V pulsed DC; 4 amps) during April 1985, 1986 and 1987. Efforts to capture all fish observed were made.

Data Analyses

Catch rates of black crappie (the more abundant species of crappie in Lake Wylie) were defined as the number of fish in an overnight net set. Expressions of catches to a defined unit of time (i.e. number/24 hours) were not calculated because no significant relationship existed between the duration of net sets and the number of black crappie caught (r^2 = 0.05, N = 78 and r^2 = −0.08, N = 110 in November 1985 and April 1986 samples, respectively). Black crappie are apparently inactive during day, but active during dusk, dawn, and night (Helfman 1981); consequently, vulnerability to capture in trap nets would not be constant over time. Length-frequency histograms (1-cm length groups) for black crappie captured in 1.9- and 2.5-cm trap nets were constructed. Age frequency histograms by 1-cm length groups for black crappie captured in trap nets (all mesh sizes) set in November and for black crappie examined in the creel surveys in spring (December 1985 through April 1986) and fall (October and November 1986) were also constructed.

Significant differences ($P \leq 0.05$) between mean catch rates were determined with ANOVA and Tukey's Studentized Range tests. Significant differences between length-frequency distributions were determined with the Chi-square test for homogeneity. A modified Schoener index (α) (Wallace 1981) to determine similarities between length-frequencies was also used. If α = 1, the length-frequency distributions are exactly the same, and if α = 0, the length-frequency distributions were completely dissimilar. Relative Stock Density (RSD) (Anderson 1980) of black crappie ≥250 mm in trap nets and the creel were also calculated and compared.

Results and Discussion

Capture Efficiency

Trap nets were efficient and cost-effective gear for capturing black crappie at Lake Wylie. An average of 1,433 black crappie were captured in an average of 98 trap nets set during each sampling period. Trapnetting (15 net sets/day) captured an average of 90 black crappie per person-day expended; the number of black crappie examined during the creel survey averaged 27 per day. In comparison, cove rotenone sampling (2 days, 12 people/day) captured black crappie at a rate ranging from 0 to 2 fish per person-day expended, and the capture efficiency during spring electrofishing (3 km of shoreline/day) ranged from 0 to 8 fish per person-day expended (Duke Power Co., unpubl. data). Bennett (1971) also reported that trapnetting and angling were the most efficient methods that captured black crappie.

Seasonal Effects

Trap net catches of black crappie in Lake Wylie between seasons were apparently different even though the same year classes were available for capture. Although catch rates and standard deviations of catch rates of all sizes of black crappie in November 1985 and April 1986 were similar (Table 1), length distributions of the catches (Fig. 1) were significantly different (Table 1). Catch rates of black crappie <250 mm in November 1985 were significantly higher than catch rates of black crappie <250 mm in April 1986, and catch rates of black crappie ≥250 mm in November 1985 were significantly lower than those observed in April 1986 (Table 1). Relative Stock Density (RSD) was also considerably lower in November 1985

Table 1. Mean (with standard deviation) catch rates (number/net set) of black crappie of all lengths, <250 mm TL and ≧250 mm TL, and length distribution[a] characteristics of black crappie captured in trap nets set in November 1985 and April 1986 at Lake Wylie.

Season	Catch rates: All fish	Catch rates: <250	Catch rates: ≧250	*N* net sets	Length distribution: RSD	Length distribution: α	Length distribution: χ^2
Fall 1985	12.7 ± 16.2	10.8 ± 14.4	1.9 ± 2.9	81	14	0.45	$P < 0.001$
Spring 1986	12.3 ± 15.7	6.2 ± 8.6[b]	6.1 ± 8.8[b]	131	48		

[a]Relative Stock Density 250, Schoener index (α), and Chi-square probabilities (χ^2) indicated that length distributions in November and April catches were the same.
[b]Significant difference between spring and fall: $P < 0.05$.

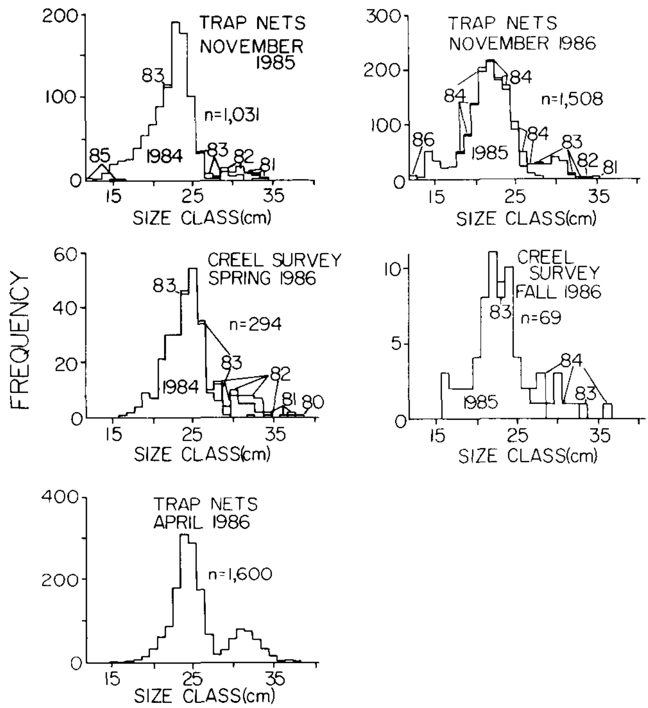

Figure 1. Length- and year-class distribution of black crappie captured in trap nets (all mesh sizes) set in November 1985, April 1986, and November 1986, and of black crappie examined during creel surveys in spring and fall 1986 at Lake Wylie, North Carolina/South Carolina. (Ages of fish collected in trap nets set in April were not determined.)

than in April 1986. The 1981 through 1984 year classes were likely captured during both seasons; however, additional older year classes were probably captured in April, indicated by capture of 360 to 380 mm fish (1980–1982 year classes) (Fig. 1). Boxrucker (1984) reported that larger and older white crappie were caught at higher rates in trap nets set in spring than in nets set in fall.

Although fall trapnetting can reasonably predict which year classes of black crappie are vulnerable to anglers during the following spring (Fig. 1), age and size structure of the angler harvest is apparently more accurately predicted when trapnetting is conducted during the season of interest. Length distributions of black crappie captured in trap nets set in April 1986 were more similar to length distributions in the spring 1986 creel than were length distributions in trap nets set in November 1985 (Fig. 1, Table 2). Additionally, the RSD of black crappie in April trap nets was more similar to the RSD in the spring creel (RSD's = 48 and 40, respectively) than the RSD in trap nets set in November (RSD = 14). Length distributions in trap nets in November 1986 and creel in fall 1986 were not significantly different (Table 2), and RSD's were similar (17 and 25, respectively).

The above data indicated similar seasonal vulnerabilities to capture in trap nets and in the creel; consequently, it was impossible to determine which season was best for sampling. Biases probably occurred during both seasons. During spring, spawning behavior probably increased capture vulnerability of larger (≥250 mm TL) fish (Boxrucker 1984); however, larger black crappie could be less vulnerable to cap-

Table 2. Schoener indices (α) and chi-square probabilities (χ^2) that length-distribution of black crappie in trap nets (all mesh sizes, 1.9-cm, or 2.5-cm mesh) and black crappie harvested by anglers in spring 1986 or fall 1986 at Lake Wylie, North Carolina/South Carolina are the same.

Comparison	α	χ^2
Nov 1985 trap net (1.9-cm) Spring 1986 creel	0.76	$P < 0.001$
Nov 1985 trap net (2.5-cm) Spring 1986 creel	0.70	$P < 0.001$
Nov 1985 trap net (all meshes) Spring 1986 creel	0.71	$P < 0.001$
Apr 1986 trap net (1.9-cm) Spring 1986 creel	0.89	$P = 0.797$
Apr 1986 trap net (2.5-cm) Spring 1986 creel	0.78	$P = 0.001$
Apr 1986 trap net (all meshes) Spring 1986 creel	0.83	$P = 0.010$
Nov 1986 trap net (1.9-cm) Fall 1986 creel	0.77	$P = 0.006$
Nov 1986 trap net (2.5-cm) Fall 1986 creel	0.79	$P = 0.604$
Nov 1986 trap net (all meshes) Fall 1986 creel	0.79	$P = 0.253$

ture, relative to smaller black crappie, during fall because they could be in deeper water than the nets. Grinstead (1969) reported that white crappie ≥250 mm TL preferred deeper water than white crappie <250 mm TL; similar behavior could be occurring with black crappie in Lake Wylie.

Mesh Size Effects

Biases of catch rates of black crappie in Lake Wylie were also related to mesh size; however, these biases were relatively small. Catch rates of all sizes of black crappie in nets with 2.5-cm mesh were slightly, but not significantly, higher than catch rates in nets with 1.9-cm mesh (Table 3). Catches of black crappie <250 mm TL were similar in both types of nets; however, catches of black crappie ≥250 mm TL were always higher in the nets with 2.5-cm mesh, but differences were usually not significant (Table 3). Relative Stock Densities were usually higher in nets with 2.5-cm mesh (Table 3), but the same length-classes were captured in both types of nets (Fig. 2). Schoener indices were fairly high for all sample periods, but length-distributions were significantly different except in 1987 (Table 3). Black crappie <120 mm TL (age 0) were not effectively captured in nets of either mesh size, but black crappie ≥120 mm TL (age 1 and older) appeared vulnerable to capture in nets of either mesh size (Figs. 1 and 2). Length distribution of black crappie in nets with 1.9-cm mesh set in April 1986 were more similar to the length-distribution of black crappie caught by anglers in spring 1986 than the length distribution in nets with 2.5-cm mesh (Table 2). Conversely, length-distribution in nets with 2.5-cm mesh set in November 1986 was more similar to the length-distribution of harvested crappie in the fall 1986 than the length-distribution in nets with 1.9-cm mesh.

Similar biases were observed in catch rates of white crappie in trap nets with

Table 3. Mean (with standard deviation) catch rates (number/net set) of black crappie of all lengths, <250 mm TL, and ⩾ mm TL, and length-distribution[a] characteristics of black crappie captured in 1.9- and 2.5-cm mesh trap nets set in November 1985, April 1986, November 1986, and November 1987 at Lake Wylie, North Carolina/South Carolina.

Month	Mesh	*N* net sets	Catch rates			Length distribution		
			All fish	<250 mm	⩾250mm	RSD	α	χ^2
Nov	1.9	26	13.3 ± 19.8	11.3 ± 17.9	2.0 ± 2.6	15	0.84	$P = 0.001$
1985	2.5	45	13.8 ± 15.1	11.7 ± 13.0	2.1 ± 3.3	14		
Apr	1.9	46	11.7 ± 13.6	7.4 ± 10.0	4.3 ± 6.1	35	0.83	$P < 0.001$
1986	2.5	45	11.8 ± 14.8	5.6 ± 6.9	6.2 ± 8.0	51		
Nov	1.9	41	16.5 ± 15.6	14.1 ± 13.6	2.4 ± 2.6	8	0.77	$P < 0.001$
1986	2.5	47	17.7 ± 18.7	13.8 ± 15.1	3.9 ± 5.7	16		
Nov	1.9	18	13.7 ± 16.2	10.6 ± 13.6	3.1 ± 3.6	21	0.85	$P = 0.133$
1987	2.5	30	22.2 ± 20.3	14.4 ± 13.8	7.8 ± 7.9*	33		

[a]Relative Stock Density 250, Schoener indices (α), and Chi-square probabilities (χ^2) indicated that length-distribution in 1.9- and 2.5-cm mesh nets were equal.
[b]Significant difference between mesh sizes and within sampling period: $P < 0.05$.

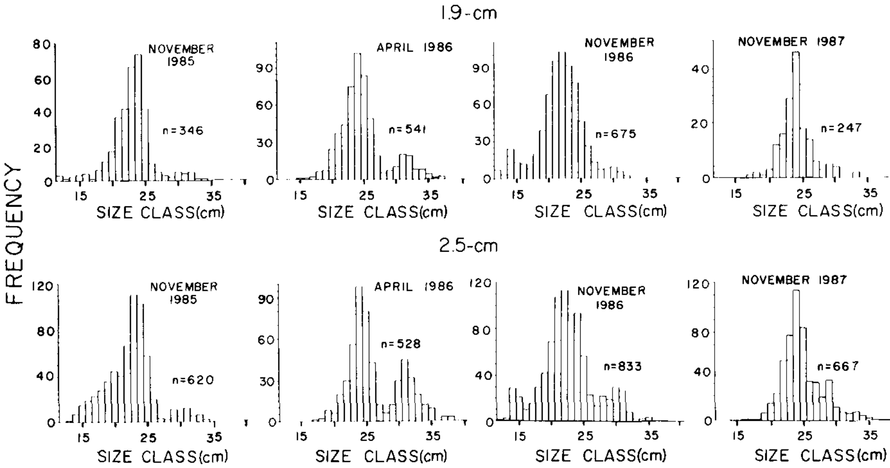

Figure 2. Length-distributions of black crappie captured in trap nets with either 1.9-cm or 2.5-cm mesh set in November 1985, April 1986, November 1986, and November 1987 at Lake Wylie, North Carolina/South Carolina.

either 1.2- or 2.5-cm mesh. Willis et. al (1984) reported higher, but not significant, catch rates of white crappie ≥120 mm and <250 mm TL in nets with 1.2-cm mesh than in nets with 2.5-cm mesh, and lower, non-significant catches of white crappie ≥250 mm TL in nets with 1.2-cm mesh than in nets with 2.5-cm mesh set in Melvern Reservoir, Kansas. Willis et al. (1984) also reported that trap nets with 1.2-cm effectively sampled white crappie 60 to 120 mm TL and that nets with 2.5-cm mesh did not.

Because year-class strength of black crappie is apparently set during their first year of life (Mitzner 1981), information gained on age 0 fish is important. The absence or low catches of black crappie <120 mm TL in trap nets set at Lake Wylie (Fig. 1) could be related to mesh size, but could also be related to spatial distribution, net design, and the method used to set trap nets. None of the 96 black crappie captured in nets with 1.2-cm mesh set in April 1986 were less than 200 mm TL (Duke Power Co., unpubl. data); however, Boxrucker (1984) reported that white crappie <120 mm TL in some Oklahoma reservoirs were vulnerable to capture in 1.2-cm mesh nets set in spring and fall. During November sampling at Lake Wylie, larger age 0 (90 to 120 mm TL) black crappie were caught and held in trap nets with 1.9-cm mesh, but catches of these fish were sporadic. Age 0 white crappie in some midwestern reservoirs were generally found in limnetic habitat (Grinstead 1969, O'Brien et al. 1984), which could be the case for age 0 black crappie in Lake Wylie. Boxrucker (1984) found that trap nets, with 1.2-cm mesh and a single 19.9 m lead and set offshore, captured white crappie <120 mm TL. The longer lead (19.8 compared to 15.2 m) and offshore sets could have increased capture efficiency of white crappie <120 mm TL.

Density Estimation

Trapnet catch rates of black crappie apparently reflect densities. Catch-per-unit-effort (number/angler hour) of black crappie in each zone during spring (March, April, May) 1986 by boat-anglers correlated well ($r = 0.92$, $N = 4$, $P < 0.1$) with trap net catches in April 1986. Annual catch-per-unit-effort of black crappie by boat-anglers in each zone correlated significantly ($r = 0.92$, $N = 5$, $P < 0.05$) with trap net catches in each zone during November 1986. Significant correlations between trap net catch rates of white crappie and harvest were also noted at Pomme de Terre Lake and Big Sac Arm of Stockton Lake, Missouri (Mo. Dep. Conserv., unpubl. data). Ratios of black crappie to white crappie in trap nets set in April 1986, November 1986, and harvested by anglers during the creel survey (107:1, 126:1, and 118:1, respectively) were similar. Because both of these independent methods show similar results, it is likely that either method can be used as an indicator of density of these crappie species.

Conclusion

Trap nets are an efficient and cost-effective gear for sampling black crappie in Lake Wylie. The age and size structure of black crappie in trap nets were similar to that harvested by anglers, and catch rates of black crappie appear to reflect actual densities. These results indicate that trapnetting provides useful data for management of black crappie. Relative to the total catch, more large black crappie ≥250 mm TL were captured in trap nets during spring, and more small (<250 mm TL) black crappie were captured during the fall. Trap nets with 1.9-cm mesh and higher catch rates of smaller fish and trap nets with 2.5-cm mesh captured larger fish more readily, but these differences were not significant. The use of trap nets of the same mesh size or the use of the same combination of nets of different mesh sizes along with sampling during the same season will reduce mesh-size and season-related biases.

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