Evaluation of Crappie Catch Rates and Size Distributions Obtained from 3 Different Trap Nets

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Abstract: The North Carolina Wildlife Resources Commission initiated a fall crappie (*Pomoxis* spp.) trap net-based stock assessment program in 1986. Since 1986, declining catch rates have forced increased effort to meet sample size requirements. The objective of this study was to determine the effect of trap net design on crappie capture rates and size selectivity. In March and April 1998, 5 trap nets each of 3 mesh sizes (13, 19, and 25 mm bar measure) were set overnight (24 hours) for 4 consecutive nights on 3 piedmont North Carolina reservoirs. Catch rates of crappie approximately doubled with each increase in mesh size and were significantly ($P < 0.05$) different among all mesh sizes. Similar results were found for crappie <250 and ≥250 mm total length (TL). Differences in the pooled length frequencies of the catch were found among mesh sizes; however stock length fish (≥130 mm) were vulnerable to each mesh size and the size range of crappies collected appeared similar among meshes. Increasing mesh size from 13 to 25 mm appears to offer fishery managers a way to significantly increase trap net catches for stock size crappie and control sampling effort. Catch rate and size distribution information collected with the larger mesh traps will not be directly comparable to similar information collected with the smaller mesh traps.

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The North Carolina Wildlife Resources Commission (NCWRC) initiated a fall trap net-based reservoir crappie stock assessment program (Van Horn and Jones 1990) in 1986. The assessment was a modification of a system developed in Missouri by Colvin and Vasey (1986). Mesh size was standardized at 13 mm (bar measure) to enhance the vulnerability of y-o-y crappie to the trap nets (Willis et al. 1984, Colvin and Vasey 1986), From 1986 to 1995, mean annual crappie CPUE (*N* caught/net night) in North Carolina was highly variable (<1–24 fish/net night) among reservoirs, with the highest CPUE occurring prior to 1990 (NCWRC, unpubl. data). Since 1986, the combined annual mean trap net CPUE for all reservoirs sampled declined from approximately 11 to <1. The CPUE of y-o-y crappie has remained near 0 since 1986. As a result of low y-o-y catch rates, the NCWRC stock assessment model does not include a crappie y-o-y metric.

Trap net catch rates often are highly variable (Miranda et al. 1990) and can be affected by water depth (O'Brien et al. 1984), clarity (Mitzner 1981), temperature (Kelly 1953, Mitzner 1981), and net orientation (Hubert 1983, Miranda et al. 1990). None of these factors appears sufficient to explain the long term decline in NCWRC trap net catches. Concurrent increases in crappie condition and growth rates in the populations experiencing the greatest declines in CPUE (NCWRC, unpubl. data) suggest the 13-mm mesh trap net catch rates are reflecting real declines in crappie abundance.

The decline in crappie trap net catch rates has important consequences for crappie managers. Low catch rates raise the sampling effort needed to meet minimum sample size objectives and make additional changes in CPUE more difficult to detect. A trap net configuration was needed that could increase crappie catch rates while continuing to reflect trends in abundance of stock size crappie. The objective of this study was to determine the effect of trap net design on crappie capture rates and size selectivity.

Methods

Trap nets were set in 3 reservoirs in the piedmont region of North Carolina. B. E. Jordan Reservoir (5,270 ha) is a U.S. Army Corps of Engineers flood control impoundment; Lake Townsend (608 ha) and Oak Hollow Reservoir (324 ha) are water supply impoundments for the cities of Greensboro and High Point.

In March and April 1998, 5 trap nets each of 3 mesh sizes (13, 19, and 25 mm) were set overnight (24 hours) for 4 consecutive nights on each reservoir. Trap nets covered with 13-mm mesh netting had 0.9- × 1.5-m steel frames, 4 0.7-m diameter hoops, single 15.3- × 0.9-m leads, and 1 throat within a 2.2-m cod end. Trap nets covered with 19- and 25-mm mesh netting had 0.9- × 1.5-m steel frames, 6 0.8-m diameter hoops, single 15.3- × 0.9-m leads, and 2 throats within a 3.7-m cod end. Nets were set perpendicular to the shore off points. The 3 mesh size nets were set in alternating order, 1 mesh/point. The mesh size of the initial net set was chosen at random. Captured crappie were counted and individually measured (mm, TL); mesh size of capture was recorded.

Structural (non-mesh size) differences between the small mesh and the larger mesh trap nets suggested catch rates between the 2 frame types might be influenced by differences in escapement in addition to mesh size. Five caudal fin-marked crappie per net were placed into the cod ends of a subset of trap nets of each mesh size. The trap nets were reset and the presence or absence of these marked fish was recorded the following day (24 hours later). Escapement for each net was calculated as follows: 1- (marked fish recovered live/[total marked fish—dead marked fish]). After 8 net nights, mortality rates for marked fish in the 19- and 25-mm mesh nets were near 100% and no escapement estimate could be calculated. Twenty-two net trials were conducted to estimate escapement from the 13-mm mesh nets.

Catch rates in the 13-mm mesh nets were multiplied by the inverse of the mean observed escapement to minimize any effect of the structural differences among nets before making any statistical comparisons. Comparing the escapement-adjusted catch rates of the 13-mm mesh nets with the unadjusted catch rates of the 19- and 25-mm traps reduced the probability of demonstrating significantly higher catch rates in the larger mesh nets. Untransformed mean crappie CPUEs were compared by trap net mesh size using a Mann-Whitney test ($P \leq 0.05$). Comparisons were made within each of the 3 reservoirs separately and for the pooled reservoir catch. Catch rate comparisons were then repeated for crappie <250 and ≥250 mm. Crappie length frequencies were pooled for all reservoirs and compared by trap net mesh size using a Kolmogorov-Smirnov test ($P \leq 0.05$). Crappie length frequencies were also evaluated using proportional stock density (PSD) and relative stock density (RSD_{250}) indices. The SYSTAT (1996) statistical package was used to make all comparisons.

Results and Discussion

Catch Rates

A total of 864 crappie were captured in 180 net nights during the study. In the escapement trial, 110 fish were marked, 59 live fish were recovered, and 7 dead fish were recovered from the 13-mm mesh nets. Mean escapement was 0.43 (SD = 0.36, N = 22). As a result, crappie CPUE in 13-mm mesh trap nets reported in this study are adjusted upward by the multiplier 1.76. Large numbers of sunfish (*Lepomis* spp.), common carp (*Cyprinus carpio*), white perch (*Morone americana*), and ictalurids were noted in the 19- and 25-mm mesh nets. The crowding created by the heavy bycatch and the weakened condition of the marked fish may have been responsible for the high mortality rates negating the escapement trials in the 19- and 25-mm mesh nets.

Total catch rates of all crappie for all reservoirs combined were significantly different among all mesh sizes, approximately doubling with each increase in mesh size (Table 1). Willis et al. (1984) reported no significant differences in CPUE between 13- and 25-mm mesh nets for all sizes of white crappie (*P. annularis*) in a Kansas reservoir; however, high colloidal clay turbidity may have obscured the effect of mesh size (D. W. Willis, pers. commun.). In this study, CPUEs in 25-mm mesh nets were significantly higher than in 13-mm mesh nets on all reservoirs (Table 1). McInerny (1988) reported higher crappie catch rates in 25-mm mesh than 19-mm mesh trap nets, but failed to find significant differences. In this study, catch rates in 25-mm mesh nets were consistently greater than catch rates in 19-mm mesh nets, but the differences were significant at only 1 reservoir.

Willis et al. (1984) suggested that 13-mm mesh nets might sample crappie <250 mm more effectively than the larger 25-mm mesh nets. In this study, catch

Table 1. Mean crappie CPUE (*N*/net night) for various lengths of crappie collected by 3 different trap nets from 3 piedmont North Carolina reservoirs, March–April 1998. Crappie CPUE compared within columns and crappie size groupings. Means followed by the same letter are not significantly different ($P < 0.05$).

	Townsend			Oak Hollow			B. E. Jordan			Combined		
Bar mesh	*N*	CPUE	SD	*N*	CPUE	SD	*N*	CPUE	SD	*N*	CPUE	SD
All lengths												
13 mm[a]	20	2.0	2.6	20	2.5B	3.6	20	1.8	2.8	60	2.1	3.0
19 mm	20	4.8B	4.9	20	1.3B	1.9	20	6.6B	9.2	60	4.2	6.4
25 mm	20	8.8B	12.0	20	6.4	6.6	20	11.8B	15.7	60	9.0	12.1
<250 mm												
13 mm	20	1.9	2.6	20	2.1B	3.3	20	1.1	2.3	60	1.7	2.7
19 mm	20	4.6B	4.9	20	1.1B	1.9	20	2.4B	3.3	60	2.7	3.8
25 mm	20	7.4B	9.7	20	5.9	6.6	20	3.8B	4.9	60	5.7	7.4
≥250 mm												
13 mm	20	0.1B	0.4	20	0.4	0.9	20	0.8	1.8	60	0.3	0.9
19 mm	20	0.2BC	0.4	20	0.2B	0.4	20	4.0B	6.3	60	1.5B	4.0
25 mm	20	0.5C	0.8	20	0.4B	0.9	20	7.3B	13.1	60	2.7B	8.1

a. Data corrected 76% for crappie escapement.

rates of crappie <250 mm consistently increased with mesh size at 2 reservoirs and failed to increase from the 13- to 19-mm mesh nets in the third reservoir. Pooled reservoir catch rates of crappie <250 mm were significantly different among all mesh sizes, increasing with increasing mesh size (Table 1). Catch rates of crappie ≥250 mm were consistently greater in the 19- and 25-mm mesh trap nets in 2 of the 3 study reservoirs and pooled reservoir catch rates were significantly greater in the larger meshes than catch rates in the 13-mm mesh trap nets (Table 1). Differences in catch rates of crappie ≥250 mm among the 19- and 25-mm mesh nets were not significant. McInerny (1988) also reported similar results for catch rates of crappie ≥250 mm in 19- and 25-mm mesh trap nets.

Length Frequencies

Too few crappie were captured in the small mesh nets to permit within-reservoir comparisons of crappie size structure by mesh size. Significant differences in crappie length frequencies pooled for all reservoirs were found among all 3 mesh sizes (Fig. 1). Wide disparities in sample sizes and the sensitivity of the tests to the high sample sizes collected in the larger mesh sizes contributed to the positive tests for significance. The range of crappie lengths appeared similar among the 3 mesh sizes. Pooled reservoir PSD values for the 13-, 19-, and 25-mm mesh nets were 37%, 25%, and 24%. Pooled reservoir RSD_{250} values for the 13-, 19-, and 25-mm mesh nets were 10%, 6%, and 6%. Both the PSD and RSD_{250} indices suggest the 13-mm mesh nets caught fewer small crappie than the larger meshes. None of the 3 mesh sizes effectively sampled y-o-y crappie (<130 mm) (Fig. 1).

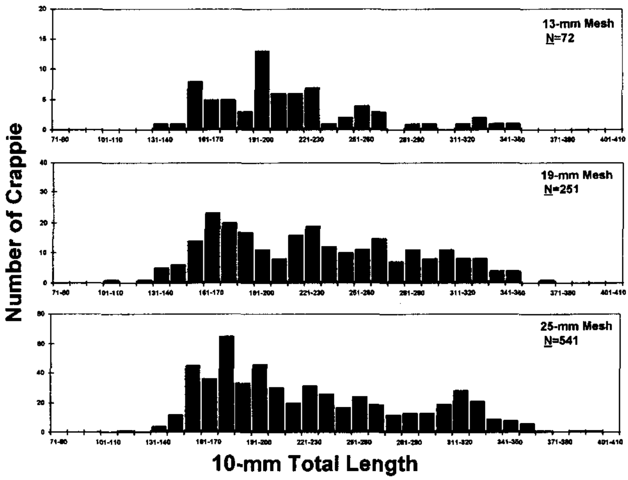

Figure 1. *Length frequency distributions of crappie captured in* 13-, 19-, *and* 25-mm *bar mesh trap nets from* 3 *Piedmont North Carolina reservoirs, March–April* 1998.

The size distributions, PSD, and RSD_{250} all suggest larger crappie are better represented in the 19- and 25-mm mesh net catches. The differences in mesh-based size selectivity suggests the larger mesh nets may be a more effective gear for assessing stocks of crappie >225 mm. Selectivity differences would preclude between-gear comparisons of size distributions collected for stock assessment purposes by the smaller and larger nets.

Conclusions

All stock size crappie were vulnerable to all 3 mesh sizes. Catch rates of stock size crappie were highest in the larger mesh nets. Increasing trap net mesh size from 13 to 25 mm appears to offer fishery managers a way to increase trap net catches for stock size crappie and control sampling effort. None of the 3 trap net designs sampled y-o-y crappie effectively; therefore, some alternative gear would be needed if managers need to collect y-o-y crappie. Also, previous data obtained from trap nets with mesh sizes other than 25 mm will not be directly comparable to similar information collected with the smaller mesh nets.

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