Observations of Spatial Heterogeneity in the Age Distribution of Black Crappie in B. E. Jordan Reservoir

Shari L. Bryant, *North Carolina Wildlife Resources Commission, P.O. Box 129, Sedalia, NC 27342–0129*

Scott L. Van Horn, *North Carolina Wildlife Resources Commission, 1142 I-85 Service Rd., Creedmoor, NC 27522*

Douglas A. Besler, *North Carolina Wildlife Resources Commission, Route 6, Box 685, Marion, NC 28752*

Ronald J. Small, *North Carolina Wildlife Resources Commission, 109 S. Elam Avenue, Greenboro, NC 27403*

Abstract: In October 1997, apparent spatial heterogeneity in the black crappie *(Pomoxis nigromaculatus)* age distribution was observed in B.E. Jordan Reservoir. The number of age groups for black crappie increased from downlake to uplake. The objective of this study was to verify this spatial heterogeneity. Trap nets were used to collect black crappie in 4 sections of the reservoir. Black crappie ages ranged from 1 to 17 years, and fish $\geq$10 years were found only in the upper 2 sections of the reservoir. Significant ($P<0.05$) differences in the black crappie age distribution were found between most reservoir sections in April 1998. However, only the lower most section and upper most section were significantly different in November 1998. There were no differences between sections in April 1999. The reason this spatial heterogeneity existed in the black crappie age distribution remains unclear; however, it is likely that the otolith sample sizes were too low to detect spatial differences in age distribution prior to 1997. Age distribution data is an important component in the development of management recommendations for crappie fisheries. Failure to assume that spatial heterogeneity may exist in crappie age distributions when designing age sampling schemes may result in poor management decisions.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 53:66–72

The North Carolina Wildlife Resources Commission began collecting data on black crappie in B.E. Jordan Reservoir in 1986. The crappie stock assessment program on the reservoir was based on stock assessment techniques developed by the Missouri Department of Conservation (Colvin and Vasey 1986). Since 1986, crappie

were collected annually using 13-mm bar mesh trap nets in October and November. Abundance (crappie/net night), size structure (percent crappie >200-mm), growth (mean length-at-capture for age 2 crappie), and age structure (percent crappie ≥ age 3) were used to evaluate the crappie population.

Impounded in September 1981, B.E. Jordan Reservoir is a 5,560-ha U.S. Army Corps of Engineers project located approximately 32 km west of Raleigh, North Carolina. The dam is located at the confluence of the Haw River and New Hope Creek. The reservoir was constructed to provide flood control for the Cape Fear River and is also used for municipal water supply and recreational activities such as fishing, hunting, boating, water skiing, and swimming.

Between 1986 and 1996, a general decline was observed in the percentage of black crappie ≥ age 3 in the reservoir (Fig. 1). A sampling scheme of 4 otoliths/10-mm size group (Van Horn and Jones 1990, Hammers and Miranda 1991) was used for the reservoir and 2 otoliths/10-mm size group were removed from black crappie in each half of the reservoir.

In October 1997, a gill net survey was conducted on the New Hope Creek section of the reservoir. Length, weight, and otoliths were taken from every black crappie caught in the gill nets to complement the 1997 trap net data. Fifty-four percent of the black crappie were ≥age 3 including a total of 13 black crappie between ages 10 and 16. Most of the older black crappie in the gill nets were collected in the upper section of the reservoir.

In the October 1997 trap net survey, otoliths were removed from every black crappie. Forty percent of the black crappie were ≥age 3 including a total of 4 black crappie between ages 10 and 12 years. Again, most of the older fish were collected in the upper section of the reservoir. By comparison, only 9% of the black crappie were ≥age 3 in the 1996 trap net survey.

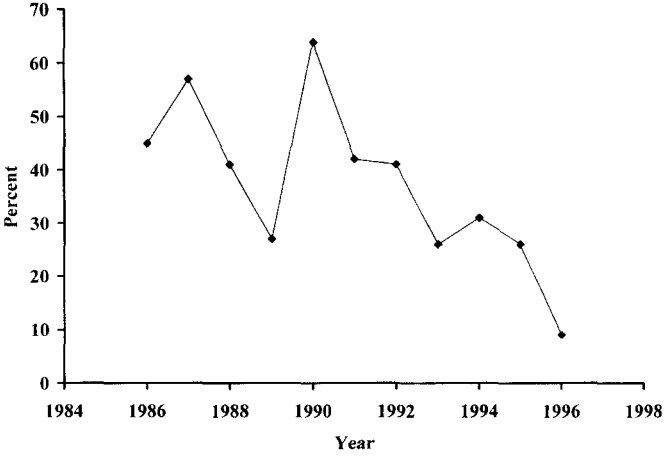

Figure 1. Percentage of black crappie ≥age 3 collected from B.E. Jordan Reservoir using 13-mm bar mesh trap nets in the fall, 1986–1996.

Based on the 1997 gill net and trap net data, there appeared to be spatial heterogeneity in the age distribution of black crappie in B.E. Jordan Reservoir. Black crappie in the downlake section appeared to be represented by fewer age groups than black crappie in the uplake section. However, crappie sample sizes for both of these surveys were relatively small (N=119 and 129). The objective of this study was to verify the spatial heterogeneity in the black crappie distribution in B.E. Jordan Reservoir.

Methods

B.E. Jordan Reservoir was divided into 4 sections (Fig. 2). Each section was bounded arbitrarily by a physical aspect in the reservoir (i.e., a river confluence and bridge crossings). The sections included the Haw River (Haw), Lower New Hope Creek (Lower), Middle New Hope Creek (Middle), and Upper New Hope Creek (Upper).

Black crappie were sampled with trap nets in April and November 1998 and April 1999. In April 1998, 15 trap nets, 5 each of 13-, 19- and 25-mm bar mesh size, were fished for 2 consecutive nights at 30 sites for a total of 60 net nights. Net sites were partitioned by section as follows: 8 sites in the Haw section, 7 sites in the Lower section, 9 sites in the Middle section and 6 sites in the Upper section. The age distribution data for this study were collected concurrently with a study that evaluated the effectiveness of 3 different bar mesh trap nets (13, 19 and 25 mm) on crappie catch rates (Besler et al. 1998).

The November 1998 crappie survey was conducted using 25-mm bar mesh trap nets. A total of 12 25-mm bar mesh trap nets were fished for 2 consecutive nights at 12 sites for a total of 24 net nights. Three sites in each section were selected at random

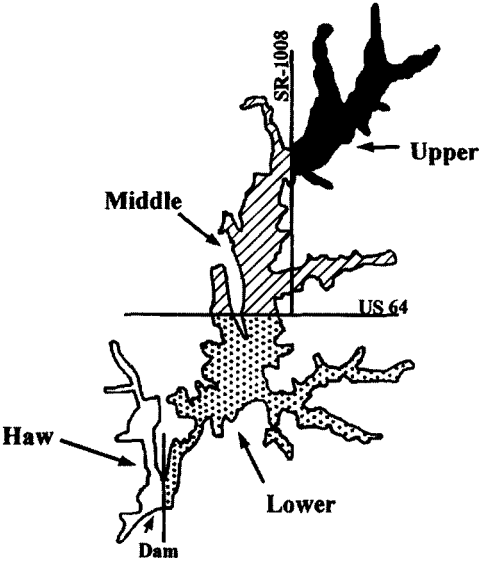

Figure 2. Map of B.E. Jordan Reservoir.

from the sites used in April 1998. The 25-mm bar mesh trap net was used following a change in the standardized trap net configuration from 13-mm to 25-mm. The total number of sites and net nights were reduced due to the high catch rates of crappie in the 25-mm bar mesh nets.

In April 1999, a total of 9 25-mm bar mesh trap nets were fished for 1 night in the Haw, Lower and Middle sections and 3 25-mm bar mesh trap nets were fished for 2 nights in the Upper section. Sites were the same as those used in November 1998.

All trap nets were set off points perpendicular to the shore. Total length (mm) was measured on all captured black crappie. A minimum of 6 otoliths were taken from each 10-mm size group in each of the 4 sections of the reservoir.

Age distributions were constructed for each section of the reservoir for April and November 1998 and April 1999 and were compared among sections within each season and year using a Kolmogorov-Smirnov test ($P \leq 0.05$). The SYSTAT statistical package (1998) was used to make all comparisons.

Results

A total of 280, 360, and 286 black crappie were aged from the April and November 1998 and April 1999 surveys. Black crappie ranged in age from 1 to 17 years, and fish ≥ 10 years were found only in the Middle and Upper sections. The total number of black crappie age groups generally increased from the Haw to the Upper section (Fig. 3).

In April 1998, significant differences in age distribution were found between most sections of the reservoir (Table 1). In November 1998, only the Haw and Upper sections of the reservoir were significantly different (Table 1). In April 1999, no significant differences were found between any of the reservoir sections (Table 1).

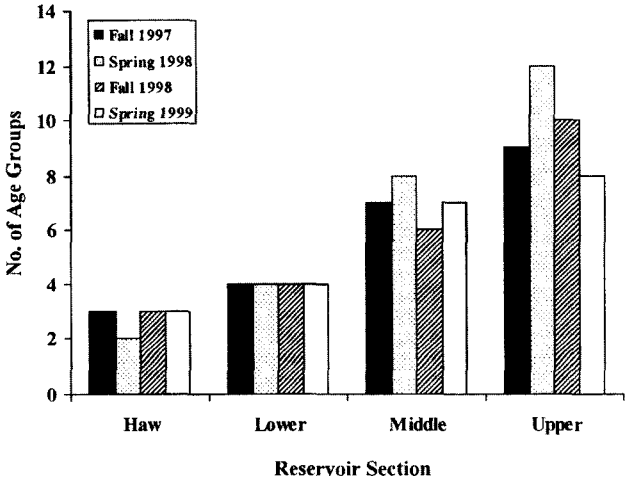

Figure 3. Number of age groups reported for Haw, Lower, Middle and Upper sections of B.E. Jordan Reservoir, 1997–1999.

Table 1. Comparisons between black crappie age distributions for 4 section of B. E. Jordan Reservoir using a Kolmogorov-Smirnov test.

Sample	Comparison	D	*P*
Apr 98	Haw–Lower	0.164	0.692
	Haw–Middle	0.732	<0.001
	Haw–Upper	0.770	<0.001
	Lower–Middle	0.568	<0.001
	Lower–Upper	0.606	<0.001
	Middle–Upper	0.261	<0.001
Nov 98	Haw–Lower	0.120	0.626
	Haw–Middle	0.104	0.757
	Haw–Upper	0.236	0.013
	Lower–Middle	0.129	0.467
	Lower–Upper	0.200	0.051
	Middle–Upper	0.133	0.355
Apr 99	Haw–Lower	0.068	1.000
	Haw–Middle	0.198	0.363
	Haw–Upper	0.151	0.698
	Lower–Middle	0.131	0.456
	Lower–Upper	0.106	0.703
	Middle–Upper	0.047	1.000

Discussion

The spatial heterogeneity observed in black crappie age distributions in April 1998 was not as pronounced in November 1998 and April 1999. There were no changes in the statistical differences observed between the sections in April 1998 when only data from the 25-mm bar mesh trap nets data was used. Therefore, it is unlikely that the differences in trap net mesh sizes influenced results between the sample taken in April 1998 and those taken in November 1998 and April 1999.

The spatial heterogeneity may have gone undetected prior to 1997 because otolith sample sizes were too low. A sampling scheme of 4 otoliths/10-mm size group (Van Horn and Jones 1990, Hammers and Miranda 1991) was used for the reservoir and 2 otoliths/10-mm size group were removed from black crappie in each half of the reservoir. A review of the data collected between 1986 and 1996 showed that otolith samples sizes were distributed fairly evenly among each of the 4 reservoir sections. By comparison, in 1998 and 1999 a sampling scheme of 24 otoliths/10-mm size group was used for the reservoir and 6 otoliths/10-mm size group were removed from black crappie in each of the 4 sections of the reservoir.

Initially, there was no reason to suspect that the age sampling scheme was inadequate. Between 1986 and 1992 the data showed that black crappie in the Upper section were collected at or near the maximum age for crappie in the reservoir (Table 2). The maximum age was an arbitrary age based on impoundment of the reservoir in 1981. Between 1992 and 1996 there was a divergence between the oldest fish collected in the Upper section and the maximum age for black crappie in the reservoir (Table 2). This was not considered to be a sampling problem because black

Table 2. Summary of age data collected from the Upper section of B.E. Jordan between 1986 and 1999. All samples are collected in October or November unless otherwise indicated.

Year	*N* Otoliths aged	Oldest fish	Maximum possible age
1986	0	4[a]	4
1987	32	5	5
1988	30	6	6
1989	65	7	7
1990	20	7	8
1991	17	9	9
1992	15	9	10
1993	7	7	11
1994	20	5	12
1995	19	8	13
1996		6[a]	14
1997	42	12	15
1998[b]	141	16	16
1998	107	16	16
1999[b]	83	17	17

a. Oldest fish collected in the reservoir.

b. April sample.

c. Maximum possible age based on impoundment in 1981.

crappie >age 10 were not expected to be in the population. The cause of the spatial heterogeneity observed in the black crappie age distribution in B.E. Jordan Reservoir has not been identified.

Age distribution information is an important component in developing crappie management strategies. The spatial heterogeneity observed in the black crappie age distribution in B.E. Jordan Reservoir has important consequences for fisheries managers designing crappie age sampling schemes. If crappie age groups are not randomly distributed within a reservoir, even a stratified sampling approach may prove unsatisfactory if sample sizes are too small or strata are poorly chosen. Therefore, in the initial surveys, it may be necessary to implement an age sampling scheme that is comprehensive in terms of otolith sample size and distribution of the sample throughout the reservoir. Failure to assume that spatial heterogeneity may exist when designing age sampling schemes may result in poor management decisions.

Literature Cited

Besler, D. A., S. L. Bryant, and S. L. Van Horn. 1998. Evaluation of crappie catch rates and size distributions obtained from 3 different trap nets. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 52:119–124.

Colvin, M. A. and F. W. Vasey. 1986. A method of quantitatively assessing white crappie populations in Missouri reservoirs. Pages 79–85 *in* G. E. Hall and M. J. Van Den Avyle, eds. Reservoir fisheries management: strategies for the 80's. Reservoir Comm. South. Div., Am. Fish. Soc., Bethesda, Md.

Hammers, B. E. and L. E. Miranda. 1991. Comparison of methods for estimating age, growth and related population characteristics of white crappie. North Am. J. Fish. Manage. 11:492–498.

SYSTAT. 1998. Statistics. Chicago, Ill. 751pp.

Van Horn, S. L. and R. I. Jones. 1990. Characteristics of North Carolina crappie populations and a proposed stock assessment model. North Carolina Wildl. Res. Comm. Final Rep., Fed. Proj. F-23-S. Raleigh. 59pp.