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Population characteristics and evidence of natural reproduction of Blue Catfish in Milford Reservoir, Kansas

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We examined trends in abundance, size and age structure, and growth rates of blue catfish, *Ictalurus furcatus*, in Milford Reservoir, Kansas. Trends in abundance and size structure were assessed using fall gill net data collected during 1990-2001. Pectoral spines were collected from fish (N=30) captured during 2001 for age and growth analysis. Catch per unit effort was less than 5 fish per net night from 1990 to 1999. Catch per unit effort in 2000 was significantly (P=0.01) higher than in previous years and samples were dominated by fish <300 mm total length (TL). Seventy-four percent of blue catfish collected in 2001 were from the 1999 and 1998 year-classes, indicating natural reproduction. Mean back-calculated lengths at age indicated that fish require approximately 3 years to reach stock length (300 mm TL) and 5 years to reach quality length (510 mm TL). Growth of blue catfish in Milford Reservoir was similar to that of other populations throughout the midwestern and southeastern U.S. These data suggest that the blue catfish population in Milford Reservoir has increased in abundance and that natural reproduction is occurring. These data provide important baseline information for future comparisons of blue catfish population characteristics in Kansas reservoirs.

Keywords: growth, size structure, reproduction, age, blue catfish, Ictalurus furcatus, Kansas, reservoir.

INTRODUCTION

The blue catfish, *Ictalurus furcatus*, is native to the Mississippi, Missouri, and Ohio river basins of the central and southern U.S. (Glodek 1980; Graham 1999). Due to their relatively fast growth, large maximum size, and importance as a sport and commercial species, blue catfish have been widely introduced throughout North America (Graham 1999). In Kansas, blue catfish were historically found in the large river systems (*e.g.* Missouri, Kansas, and Marais des Cygnes rivers) of central and eastern Kansas (Cross 1967). Blue catfish were known to occur in the Republican River when Milford Reservoir was constructed and anglers reported catching the occasional large blue catfish after impoundment. Although angler reports indicated that some fish were present upstream from the dam at the time of impoundment, no fish were captured during routine population sampling conducted by the Kansas Department of Wildlife and Parks (KDWP) during the 1960s, 1970s, or 1980s. Furthermore, small blue catfish were not present in the reservoir indicating that the remnant blue catfish population was not recruiting in sufficient numbers to be collected in a sample. In response, KDWP began a stocking program in 1990 to establish a naturally-reproducing blue catfish population in Milford Reservoir. Blue catfish were first stocked in 1990 as fingerlings (approximately 120 mm TL) and yearly stockings of fingerling and/or intermediate (approximately 210 mm TL) blue catfish continued until 1995 (Table 1). KDWP did not stock again until 2001 when larval blue catfish were stocked.

Table 1. Number of larval, fingerling (approximately 120 mm TL), and intermediate (approximately 210 mm TL) blue catfish stocked into Milford Reservoir during 1990-2001. Blue catfish were not stocked prior to 1990.

Year	Larvae	Fingerling	Intermediate
1990	0	1,775	0
1991	0	18,182	0
1992	0	0	17,627
1993	0	10,811	0
1994	0	0	27,855
1995	0	32,110	19,123
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
2001	39,182	0	0

The purpose of this study was to examine trends in relative abundance, size structure, and growth of blue catfish in Milford Reservoir. In addition, recent surveys suggest that natural reproduction may be occurring in Milford Reservoir. Therefore, we also examined age structure to determine the extent of natural reproduction.

Methods

Milford Reservoir is a 6,483 ha impoundment on the Republican River (Dickinson, Clay, and Geary counties, KS). The dam is located 17.6 km upstream from the confluence of the Republican and Smoky Hill rivers, which form the Kansas River at Junction City, Kansas. Milford Reservoir has a mean depth of 6.7 m and the shoreline is dominated by limestone cobble and boulders (Reinke 2001). White bass, *Morone chrysops*, hybrid striped bass, *M. saxatilis* x *M. chrysops*, walleye, *Stizostedion vitreum*, channel catfish, *Ictalurus punctatus*, flathead catfish, *Pylodictis olivaris*, and blue catfish are the most abundant sport fish. Similar to other Kansas reservoirs, gizzard shad, *Dorosoma cepedianum*, is the predominant prey species.

Blue catfish stocking history was assessed by examining KDWP stocking records. Trends in abundance and size structure were assessed by annually sampling six fixed sites in October or November from 1990 to 2001 using gill net compliments (4 monofilament gill nets, 30.5-m long x 1.8-m deep, with either 2.5-cm, 3.8-cm, 6.4-cm, or 10.2-cm bar measure mesh) (Fig. 1). All fish were counted and measured to the nearest millimeter (TL). During 2001, pectoral spines were removed from blue catfish for age and growth analysis using techniques described by Sneed (1951). Transverse sections (0.2 to 0.5 mm thick) were cut using a low-speed diamond saw (Buehler Isomet, Lake Bluff, IL) distal to the basal groove (Sneed 1951; Marzolf 1955). A dissecting

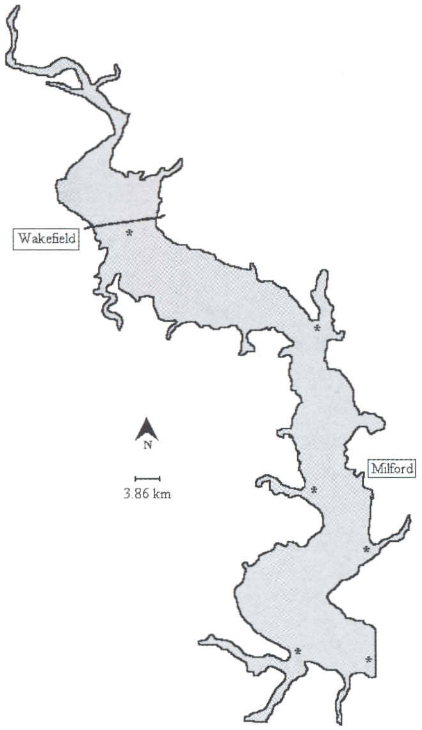

Figure 1. Map of the six fixed net locations (asterisks) on Milford Reservoir, Kansas.

microscope coupled with an image analysis system was used to mark annular growth rings.

Catch per unit effort (CPUE) was calculated as the number of fish collected per gill net compliment night (NCN). Differences in CPUE among years were assessed using a mixed-model repeated measures analysis of variance (ANOVA; Littell, Milliken *et al.* 1996) using the Kenward-Roger (Kenward and Roger 1997) approximation for degrees of freedom and a compound symmetric variance-covariance structure. Multiple comparisons were conducted using least-squares means. Size structure was assessed using proportional stock density (PSD) and incremental stock density (RSD; Gabelhouse 1984; Anderson and Neumann 1996) of stock-to quality- (S-Q; 300-509 mm), quality- to preferred- (Q-P; 510-759 mm), and preferred- to memorable-length (P-M; 760-889 mm) blue catfish. We used the direct proportion method to estimate mean back-calculated length-at-age to facilitate comparison with previous studies. Mean back-calculated length at age estimates were weighted by sample size within each year-class to decrease the influence of older and rarer individuals in the analysis. Growth of blue catfish in Milford Reservoir was compared to populations reported in Graham (1999). All analyses were conducted using SAS (Littell et al. 1996) and $a = 0.05$.

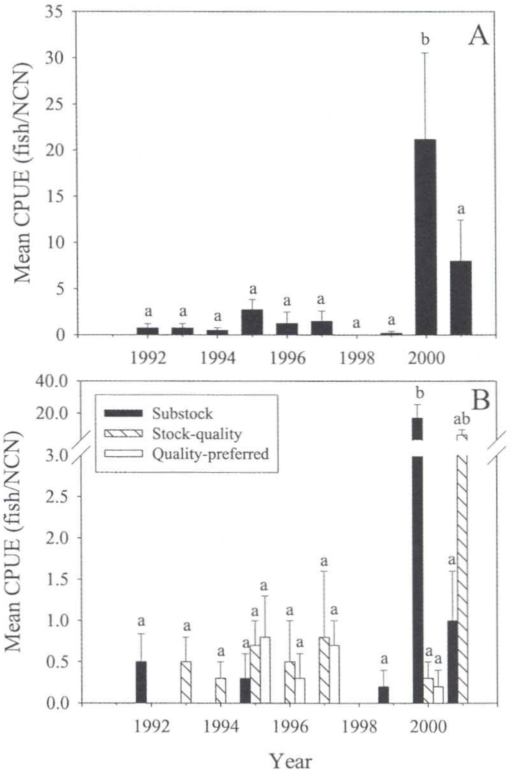

Figure 2. Mean catch per unit effort (CPUE = number of fish / gill net compliment night [NCN]) for all fish (A) and by length category (B) for blue catfish collected from Milford Reservoir, Kansas, during 1992-2001. Length categories represent substock (< 300 mm), stock- to quality-length (300-509 mm), and quality- to preferred-length (510-759 mm). Error bars represent one standard error, and bars with different letters indicate a significant difference (P < 0.05).

Table 2. Proportional stock density (PSD) and relative stock density of stock- to quality- (S-Q; 300-509 mm), quality- to preferred- (Q-P; 510-759 mm), and preferred- to memorable-length (P-M; 760-889 mm) blue catfish collected from Milford Reservoir during 1992 to 2001. Blue catfish were not captured prior to 1992.

Year	N	PSD	S-Q	Q-P	P-M
1992[a]	3	0	0	0	0
1993	3	0	100	0	0
1994	2	0	100	0	0
1995	11	33	67	33	0
1996	5	40	60	40	0
1997	9	44	56	44	0
1998[a]	0	0	0	0	0
1999[a]	1	0	0	0	0
2000	106	33	67	33	0
2001	49	5	95	0	5

[a] All collected blue catfish were less than stock length.

Results

Catch per unit effort of blue catfish was less than 5 fish/NCN during 1992-1999 (Fig. 2). Mean CPUE was significantly higher in 2000 (P <0.01) and was due to high catch rates of substock-length (*i.e.* <300 mm) fish (Fig. 2). Although mean CPUE of S-Q length blue catfish in 2001 was nearly double the CPUE of S-Q length fish during 1992-1999, this difference was not statistically significant (P >0.05). Size structure was highly variable among years (Table 2). Most fish in our samples were S-Q length. The first year that quality-length fish were collected was five years after the initial stocking. Preferred-length fish were only captured in 2001 and no fish >890 mm have been collected.

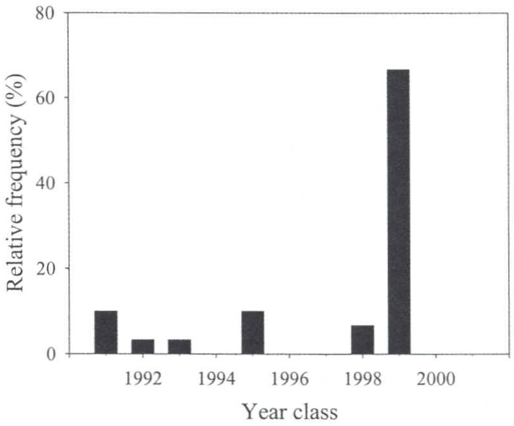

Figure 3. Relative frequency of blue catfish by year-class collected from Milford Reservoir, Kansas, during 2001 (N=30).

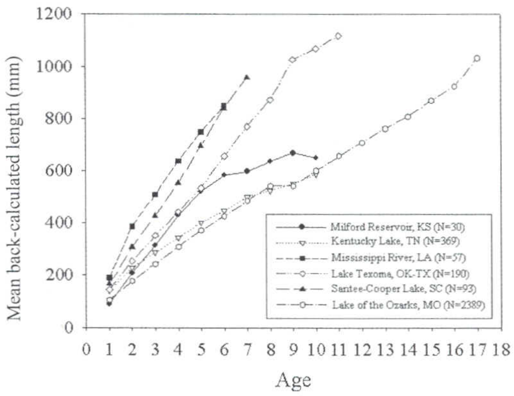

Figure 4. Mean back-calculated total length at age (mm) for blue catfish populations throughout the midwestern and southern U.S. Mean back-calculated lengths at age for Milford Reservoir, Kansas, represent data collected during 2001. Data for the other populations are from Graham (1999).

We conducted age and growth analysis on 30 fish from the 2001 sample. Seventy-four percent of the fish collected in 2001 were from the 1998 and 1999 year-classes (Fig. 3). Similar to our analysis of size structure (Table 2), mean back-calculated lengths at age indicated that blue catfish require approximately 3 years to reach stock length and 5 years to attain quality length in Milford Reservoir (Figure 4). Although mean back-calculated lengths at age of blue catfish in Milford Reservoir were similar to other populations until age-6, growth rates were lower for age-7 to age-10 fish (Fig. 4).

Discussion

Our results suggest that strong blue catfish year-classes were produced during 1998 and 1999. Blue catfish generally reach sexual maturity at age 6-7 (Graham 1999; Graham and DeiSanti 1999); therefore, fish stocked in the early 1990s would not have reached sexual maturity until 1996 or 1997. Although the 1998 and 1999 year-classes undoubtedly resulted from natural reproduction, it is unknown whether fish collected during 1992-1999 were from stocking efforts or natural reproduction.

The results of our growth analysis indicate that growth of blue catfish in Milford Reservoir was similar to that of other midwestern and southern populations up to age-6. Reduced growth rate after age-6 was likely due to a low sample size of large individuals. Although few large fish were sampled during this study, large blue catfish (>800 mm) are commonly caught by anglers, suggesting that our sampling design was inefficient for sampling large individuals. Gale, Graham *et al.* (1999) evaluated several gill nets in the tailwaters of Harry S. Truman Dam and suggested that gill nets with mesh >76 mm were best for large blue catfish. The gill nets used in this study included nets with 10.2 cm mesh, suggesting that large blue catfish should have been susceptible to our gear. Fischer, Eder and Aragon (1999) found that blue catfish in Pony Express Lake, Missouri, moved to the deeper parts of the reservoir during the fall and were confined to the deepest areas throughout winter. In addition, they also found that movement rates were much lower during the fall and winter than during summer. Similar results were reported in a movement study conducted by Timmons (1999) for a blue catfish population in Kentucky. In our study, most sampling sites were near the shoreline. Thus, low catch rates may have been due to the spatial distribution of fish, reduced movement, or low population density.

Although our age and growth analysis was based on relatively few individuals, our results provide evidence of natural reproduction and provide a baseline and direction for future research on blue catfish populations in Kansas reservoirs. Blue catfish are an important sport fish in Milford Reservoir; therefore, future investigations should focus on the contribution of stocked fish and factors influencing recruitment dynamics. Furthermore, we suggest that future investigations are needed to determine the best gear and sampling time for evaluating blue catfish populations in Kansas. Effective monitoring of blue catfish populations will be increasingly important in Kansas because several reservoirs were stocked with blue catfish in 2002 or will be stocked within the next several years.

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