NATURALLY OCCURRING HYBRIDS OF THE GENUS *DOROSOMA* IN CHEROKEE RESERVOIR

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ABSTRACT

Shad less than 100 mm were collected monthly from Cherokee reservoir during the period August 1983 to August 1984 using nightime shoreline electrofishing. Gizzard shad *(Dorosoma cepedianum),* threadfin shad *(D. petenense),* and hybrids of these two species comprised 6.2, 90.6, and 3.2 percent, respectively, of the total collection (n = 3630). Young-of-year hybrids were intermediate between young-of-year gizzard and threadfin shad in predorsal length, upper jaw length, mandible length and anal fin ray count; they exhibited the greatest values for body depth, caudal peduncle depth and dorsal filament length. Mean total length and weight of hybrids were comparable to those of gizzard shad, but greater than those of threadfin shad. In general, hybrids had a rounded snout shape similar to that of gizzard shad, but with a more terminal mouth. Hybrids also exhibited the elongated dorsal filament and yellow pigmentation in the fins characteristic of threadfin shad.

INTRODUCTION

Some of the smaller members of the herring family, Clupeidae, serve as an important source of food for many sport fishes in Tennessee reservoirs. The most common are the gizzard shad *(Dorosoma cepedianum)* and the threadfin shad *(D. petenense).* Gizzard shad are native to the Tennessee River system and provide good forage for economically important fishes until they grow too large to be consumed. Threadfin were introduced into the Tennessee River valley from Gulf coast drainages. Unlike gizzard shad, threadfin shad do not grow too large for most game species to eat; they will, however, often die of cold shock when temperatures drop below about 7 C (Griffith 1978). Hybrids between gizzard and threadfin shad have been previously noted in the wild, but published descriptions do not exist for Tennessee populations. While collecting forage fish in Cherokee Reservoir, we found substantial numbers of apparent *Dorosoma* hybrids. In the following paper we describe their abundance and morphometrics, and speculate on their management value.

MATERIALS AND METHODS

Shad were collected either monthly or bimonthly from Cherokee Reservoir during the period August 1983 through August 1984. Samples were collected by nighttime shoreline electrofishing for a 30-minute period. Only fish less than 100 mm total length (forage-sized) were retained and preserved in the field in 10% formalin. They were later soaked in water at the laboratory and transferred to 40% isopropanol.

Monthly collections were separated into gizzard, threadfin, and hybrid shad. Gizzard and threadfin shad were separated primarily by examining the shape of the snout and the length of the dorsal filament. Also of importance were the presence or absence of yellow pigmentation in the fins which survived preservation to some degree, and the number of anal fin rays. Hybrids were distinguished from the parent species by examination of a combination of physical characteristics, including the shape of the snout and head, the length of the dorsal filament and upper jaw, body shape, the incidence of black pigment on the chin and floor of the mouth, and the number of anal fin rays. The number of each kind of shad in each monthly collection was ascertained, and the percentage composition of the total collection was determined.

To determine physical differences among gizzard, threadfin, and hybrid shad, selected measurements were taken on 30 representative individuals of each kind. Predorsal length, upper jaw length, mandible length, caudal peduncle depth, dorsal filament length, and body depth were determined to 0.1 mm using dial calipers. Each measurement for an individual fish was then divided by that fish's standard length and multiplied by 1,000. Also, the number of rays in the anal fin of each of the 90 fish was counted under a dissecting microscope. Dyeing the fins in a rose bengal solution made rays more readily visible. Total length (mm) and body weight (0.01 g) were taken on 30 fish of each kind from the January and February 1984 collections. These fish were selected using a table of random numbers. Means for each physical characteristic were compared using Duncan's multiple range test.

RESULTS

The total collection consisted of 3630 shad; the percentage composition was 6.2% gizzard shad, 3.2% hybrids, and 90.6% threadfin shad (Table 1). In general, hybrids had a rounded snout shape similar to that of gizzard shad, but with a more terminal mouth (Figure 1). However, they also had the elongated dorsal filament and yellow pigmentation in the fins of live fish that are characteristic of threadfin shad.

Table 1. Numbers of shad less than 100 mm total length collected during hybrid shad study from Cherokee Reservoir, Tennessee, August 1983 through August 1984.

Month	Gizzard	Hybrid	Threadfin	Total
Aug 83	0	0	159	159
Sep 83	15	3	18	36
Oct 83	11	3	571	585
Nov 83	0	0	0	0
Dec 83	5	9	894	908
Jan 84	22	11	1296	1329
Feb 84	111	44	12	167
Mar 84	9	1	0	10
Apr 84	3	1	0	4
May 84	0	0	0	0
Jun 84	0	0	0	0
Jul 84	—	—	—	—
Aug 84	48	43	341	432
TOTAL	224	115	3291	3630
PERCENT OF TOTAL	6.2	3.2	90.6	100.0

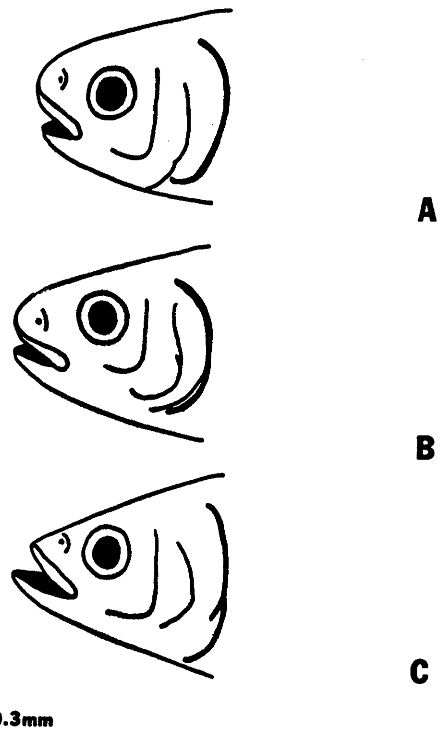

Figure 1. Representative snouts of gizzard shad (A), hybrid shad (B), and threadfin shad (C) from Cherokee Reservoir, Tennessee.

Hybrids were found to be intermediate between gizzard and threadfin shad in their predorsal length, upper jaw length, and mandible length (Table 2). Gizzard shad had the greatest predorsal length, while threadfin shad had the greatest upper jaw and mandible lengths.

Hybrids were found to have the greatest values of the three kinds of fish for caudal peduncle depth, dorsal filament length, and body depth (Table 2). There was no significant difference in caudal peduncle depth between gizzard and threadfin shad, and although hybrids had the greatest value for dorsal filament length, this value was not significantly different from that of threadfin shad. Threadfin shad had the least body depth in relation to standard length.

Table 2. Mean proportional body measurements and ranges of 30 representative specimens each of gizzard, hybrid, and threadfin shad collected from Cherokee Reservoir, Tennessee, August 1983 through August 1984. Measurements are expressed as whole numbers calculated as thousandths of standard length. Values with the same superscript are not significantly different at a significance level of 0.05 as determined by Duncan's multiple range test. Standard errors are in parentheses.

Character	Gizzard	Hybrid	Threadfin
Predorsal length	508^a (2.34) 484-547	496^a (1.47) 481-516	487^c (1.63) 471-513
Upper jaw length	92^c (0.90) 82-102	110^b (1.01) 98-122	118^a (0.69) 113-126
Mandible length	120^c (1.41) 106-138	140^b (0.81) 132-150	162^a (0.81) 154-169
Caudal peduncle depth	89^b (0.73) 80-95	93^a (0.67) 84-99	90^b (0.76) 80-103
Dorsal filament length	215^b (4.88) 175-277	330^a (3.40) 284-366	325^a (2.14) 305-348
Body length	326^b (1.36) 311-342	330^a (1.49) 311-343	311^c (1.27) 298-325

The mean anal fin ray count of hybrids was significantly different from those of the parent species ($P < 0.05$). Hybrids had an intermediate mean of 26.1 anal fin rays, standard error of 0.25, and a range of 24-29. Means, standard errors and ranges of anal fin ray counts for gizzard and threadfin shad were 31.9, 0.26, 29-34 and 22.7, 0.18, 21-25, respectively. Mean total length and body weight of hybrids collected during January and February 1984 were found to be approximately equal to those of gizzard shad, but greater than those of threadfin shad (Table 3).

Table 3. Mean total lengths and weights and ranges of 30 randomly selected specimens each of gizzard, hybrid, and threadfin shad collected from Cherokee Reservoir, Tennessee, January and February 1984. Values with the same superscript are not significantly different at a significance level of 0.05 as determined by Duncan's multiple range test. Standard errors are in parentheses.

	Gizzard	Hybrid	Threadfin
Total length (mm)	71.9^a (1.77) 59-97	71.5^a (0.91) 61-81	55.0^b (0.91) 48-64
Weight (g)	2.82^a (0.21) 1.44-6.50	2.67^a (0.11) 1.38-4.02	1.14^b (0.05) 0.72-1.76

Discussion

The percentage composition of the collection made during this study was 6.2% gizzard shad, 3.2% hybrid shad, and 90.6% threadfin (Table 1). Population percentages of hybrid shad similar to this, 1.7 and 2.5%, were reported from Lake Texoma, Oklahoma (Shelton and Grinstead 1973). Bennett (1962) indicated that production of hybrids rarely exceeds 1 or 2% in natural populations. It is unknown whether the hybrids in this study were F1 hybrids or if they were possibly members of subsequent generations, since the reproductive capacity of hybrids remains in question (Shelton and Grinstead 1973; McLean et al. 1980).

During the present study, hybrid shad were intermediate between gizzard and threadfin shad in their predorsal, upper jaw, and mandible lengths (Table 2). They had the greatest caudal peduncle depth, dorsal filament length, and body depth (Table 2). Minckley and Krumholz (1960) measured physical characteristics of 6 hybrid specimens and 25 specimens each of gizzard and threadfin shad from the Ohio River Basin. Their results were similar to those of the present study; however, they did find hybrids to be intermediate in body depth between the parent species.

One of the definitive ways to separate gizzard and threadfin shad is to count their anal fin rays, since these counts for the two species are mutually exclusive, with gizzard shad usually having 29-34 rays and threadfin shad, 21-25 rays. Although the range for hybrids in this study extended into those of the parent species, anal fin ray count could sometimes serve as a valuable aid in identifying an individual hybrid if the fish's count fell between the ranges of gizzard and threadfin shad (26-28). Minckley and Krumholz (1960) reported mean anal fin ray counts similar to those of the present study. Their mean counts were 30.4 for gizzard shad, 27.2

for hybrids, and 23.2 for threadfin shad, while those from the present study were 31.9, 26.1, and 22.7, respectively.

The mean length and weight comparisons made during the present study indicated forage-sized hybrid shad were approximately equal in size to gizzard shad, but greater in size than threadfin shad. Maximum length of adult hybrids is unknown, but it appears that, like gizzard shad, they continue to surpass threadfin shad in size throughout life. Most hybrid shad collected from Lake Texoma were larger than threadfin shad and were greater than 150 mm total length (Shelton and Grinstead 1973). Mean standard length of hybrids (146.3 mm) collected by Minckley and Krumholz (1960) greatly exceeded that of threadfin shad (102.7 mm).

In situations where the shad forage base as a whole was poor, an extensive winterkill of thermally-sensitive threadfin shad during years when it was the most populous forage would substantially reduce the amount of food available to game fishes prior to and during the spawning season. In this study, 4 C water temperatures during January cold-stressed the threadfin shad making them vulnerable to collection (over 1200 were captured). This cold also resulted in large scale mortality of threadfin shad that increased the percentage of gizzard and hybrid shad in the collection the following summer. Hybrid shad made up only 3.2% of the total collection during the present study; however, Griffith (1978) stated that in the month following a severe winterkill of threadfin shad, hybrids were a significant percentage of the remaining shad forage (26.3%) as a result of their apparent greater tolerance of low water temperatures. Consequently, hybrid shad could prove to be an asset to the forage base, since the potential exists for them to become a key component of the meager food supply remaining following a harsh winter. The thermal tolerance of hybrids may offset to some degree a possible detrimental aspect of excessive growth.

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