Length, Weight, Age, and Growth of Young-of-year Shoal Bass Raised in a Southwest Georgia Hatchery Pond

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Abstract: We measured total length and weight and estimated daily age of 50 young-of-year shoal bass *(Micropterus cataractae)* collected from a hatchery pond in southwest Georgia. Daily age was estimated using otoliths and was considered the median age of ring counts from one reader who counted rings in each otolith independently three times. This sample of young-of-year shoal bass averaged 28.55 days old, 24.04 mm in total length, and 0.13 grams in weight. Daily growth rates averaged 0.85 mm day^{-1}. The length-weight relationship was described by the equation: weight = $0.0043e^{0.1399*length}$. The frequency distribution of daily ages was skewed, suggesting one main spawning period later in the season, lasting approximately 12 days, with young-of-year swim-up beginning 27 March 2003. These are among the first data on young-of-year shoal bass characteristics and we recommend further research to validate daily ring formation in otoliths of this species.

Key words: otoliths, *Micropterus cataractae,* validation, spawning duration, recruitment

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Because shoal bass *(Micropterus cataractae)* have only recently been formally described (Williams and Burgess 1999), little information exists regarding population characteristics of the species, especially for early life stages. Wheeler and Allen (2003) studied habitat and prey use of age-0 (70-mm to 200-mm TL) and adult shoal bass in the Chipola River, Florida. There, age-0 shoal bass inhabited rocky shoals, as did adults, and consumed mostly fish and mayflies (order Ephemeroptera). Earlier studies on young-of-year shoal bass considered them a "race" of redeye bass *(M. coosae)*. Wright (1967) and Hurst (1969) observed redeye (shoal) bass nests in shoals and near riffles. Ramsey and Smitherman (1972) described the color and pigmenta-

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tion development of young-of-year. Smitherman and Ramsey (1972) reported spawning behavior and young-of-year characteristics in hatchery ponds. Johnson (1977) produced a report on the culture of shoal bass in hatchery ponds in Georgia.

In 2003, Georgia Department of Natural Resources (GADNR) initiated a shoal bass stocking program in the Chattahoochee River, below Morgan Falls Dam, near Atlanta. This program provided an opportunity to collect information on young-of-year shoal bass characteristics that has largely been lacking previously. Our objective was to obtain estimates of length, weight, age, and growth for a sample of these young-of-year prior to stocking.

Methods

Thirty pairs of adult shoal bass were collected by electrofishing from North Highlands Reservoir (an impoundment of the Chattahoochee River in Muscogee County, Georgia) and were stocked into a 0.4-ha earthen pond at the Steve Cocke Fish Hatchery, Dawson, Georgia, on 10 March 2003. Natural forage of sunfish (*Lepomis* spp.) and aquatic insects was maintained in the pond prior to spawning. Based on prior experience with shoal bass culture, hatchery personnel estimated that spawning would occur 7–10 days following transfer to a spawning/rearing pond. On 29 April 2003, approximately 50,000 young-of-year shoal bass were collected from the hatchery pond.

Immediately prior to release in the wild, a sample of 50 young-of-year individuals was collected and preserved in 70% ethanol. In the lab, we measured total length (mm) and weight (g) for each individual, and removed the sagittal otoliths. Otoliths were mounted on slides with thermoplastic cement and ground in the sagittal plane until the outer and inner rings could be simultaneously viewed (Miller and Storck 1982). Otoliths were subsequently examined under a drop of mineral oil with a compound microscope at 400X and daily rings were counted blind three times by one reader who had had prior experience estimating daily ages from otoliths (DiCenzo and Bettoli 1995). The median age from the three ring counts was used to assign an age in days to each fish and we assessed the maximum difference among ring counts for each otolith as a measure of precision. We fit the length-weight data with an exponential model, transformed it into a linear form by taking the natural logarithm of weight, and performed linear regression analysis (Proc Reg, SAS 1992) to evaluate the relationship. We estimated daily growth (mm day^{-1}) for each individual by dividing the total length by assigned daily age (Isley and Noble 1987, Sammons et al. 1999, Long and Fisher 2001) and then calculated the mean and standard deviation.

Results

We were able to estimate daily age for 47 out of the 50 individual fish whose otoliths were examined (three were destroyed during preparation). The maximum difference among ring counts for each otolith varied from 0 to 5 (Fig. 1). However,

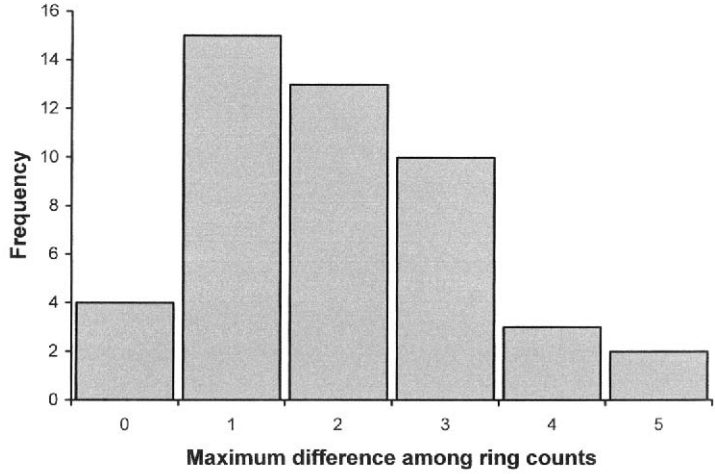

Figure 1. Frequency distribution of the maximum difference among ring counts for each otolith of young-of-year shoal bass raised in hatchery ponds in southwest Georgia ($N = 47$).

Table 1. Length, weight, age, and growth of young-of-year shoal bass raised in a hatchery pond in southwest Georgia.

Variable	*N*	Minimum	Maximum	Mean	Standard deviation
Length (mm)	50	19.6	27.1	24.05	1.52
Weight (g)	50	0.1	0.2	0.13	0.03
Age (days)	47	23	34	28.55	2.45
Growth (mm day^{-1})	47	0.70	1.03	0.85	0.07

most differences among ring counts were minor (1 or fewer) and 89% of ring counts were within three days of each other suggesting high precision. The distribution of daily ages was skewed over a 12-day period, with a peak at 30 days, suggesting one main spawning period for adult shoal bass held in the hatchery pond (Fig. 2). These shoal bass averaged 28.55 days in age, 24.05 mm in total length, 0.13 grams in weight, and grew an average of 0.85 mm day^{-1} (Table 1). The length-weight relation was significant ($F_{1, 48} = 396.53$, $P < 0.001$, $r^2 = 0.89$; Fig. 3) and was described by the equation: weight = $0.0043e^{0.1399*length}$.

Discussion

These are among the first data on age and growth of young-of-year shoal bass. Because daily growth rings in otoliths have not been validated for this species, we

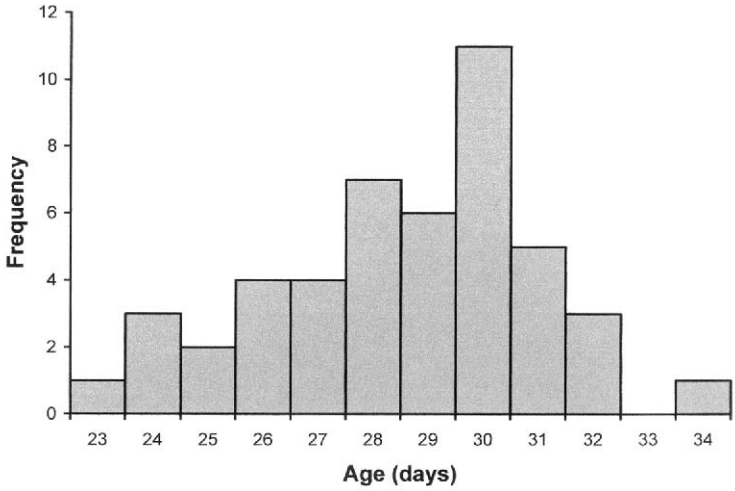

Figure 2. Frequency of age estimates of young-of-year shoal bass raised in hatchery ponds in southwest Georgia ($N = 47$).

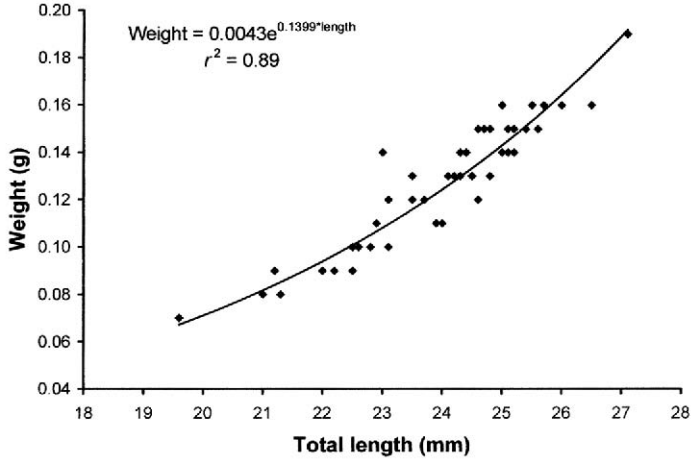

Figure 3. Length-weight relationship of young-of-year shoal bass raised in hatchery ponds in southwest Georgia ($N = 50$).

can only assume that they were formed daily as in other *Micropterus* species (Miller and Storck 1982, Graham and Orth 1987, and DiCenzo and Bettoli 1995). Further investigations of daily ring formation in shoal bass otoliths are needed to validate these findings.

Assuming the rings we observed were formed daily, the earliest swim-up date was 27 March 2003. Based on the closely-related spotted bass that takes four days to swim-up from hatch (DiCenzo and Bettoli 1995), the earliest hatch date was 23 March 2003. This date roughly corresponds to hatchery personnel's spawning date estimate of 17–20 March 2003 and is consistent with our belief that the rings are formed daily. However, these calculations should be scrutinized because they are based on a surrogate species due to the lack of shoal bass-specific data.

Our observation of a 12-day spawning duration for shoal bass is shorter than for other *Micropterus* species. Largemouth bass spawning duration has been reported to range from 60 days to 71 days in Mississippi reservoirs (Goodgame and Miranda 1993) and lasted for 45 days in Lake Shelbyville, Illinois (Miller and Storck 1984). In Alabama and Tennessee reservoirs, largemouth bass typically exhibited longer spawning durations than spotted bass; 25 to 59 days for largemouth bass and 22 to 45 for spotted bass in Alabama (Greene and Maceina 2000) and 35 to 68 days for largemouth bass and 26 to 42 days for spotted bass in Tennessee (Sammons et al. 1999). The spawning duration of smallmouth bass in a Virginia river ranged from 126 days to 136 days (Sabo and Orth 1995). Whether our observation of a short spawning duration is a sampling artifact, an artifact of spawning in hatchery ponds, or a characteristic of the species is unknown and in need of further research.

Growth rates of young-of-year shoal bass in this study were similar to those observed in other studies and for other *Micropterus* species. Smitherman and Ramsey (1972) found that young-of-year shoal bass (identified as Apalachicola race of redeye bass) at 21 to 22 days old grew 0.95 to 1.14 mm day^{-1} in hatchery ponds. Additionally, their data showed that growth during the first 100 days was linear. Daily growth rates of young-of-year largemouth bass have ranged from 0.54 mm day^{-1} (Isely and Noble 1987) to 1.14 mm day^{-1} (Long and Fisher 2001). Young-of-year spotted bass have ranged in daily growth from 0.58 mm day^{-1} (Greene and Maceina 2000) to 0.75 mm day^{-1} (Sammons et al. 1999).

Given the restricted range of shoal bass and their recent description (Williams and Burgess 1999), a paucity of information exists on life history characteristics. Shoal bass are listed as rare to threatened in different states, with habitat loss contributing heavily to their current status (Williams and Burgess 1999). Additional studies of the biology and culture of shoal bass are needed for effective conservation and management.

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