Examination of the Current Oklahoma State Record Smallmouth Buffalo

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Abstract: Smallmouth Buffalo (*Ictiobus bubalus*) is found predominately in eastern Oklahoma and recognized as a non-game species by the Oklahoma Department of Wildlife Conservation. The designation of non-game allows the species to be recreationally caught or harvested using any legal method and without limits. We examined the current state record (restricted division: allowing recreational harvest with no restriction) Smallmouth Buffalo caught using rod and reel on May 3, 2019 from Broken Bow Reservoir. The lapilli otoliths were removed from this specimen to estimate age, back calculate length-at-age (growth rates), and back calculate spawning year. The final estimated age of this fish was 62 years old. The growth curve using back-calculated length-at-age suggested this Smallmouth Buffalo initially grew rapidly (80% of total length within first 17 years), but the growth increments constricted with increasing age. Based on the estimated age of this fish, the state record Smallmouth Buffalo was spawned in 1957, indicating this fish was spawned prior to impoundment of Broken Bow Reservoir. Further, the hatch year of this fish corresponds with flooding, after a prolonged drought, demonstrating the importance of river flow to successful spawning of this species. Although this study is limited to a single specimen, it improves our knowledge of a long-lived, understudied species in Oklahoma.

Introduction

Smallmouth Buffalo (*Ictiobus bubalus*) is a widely distributed, non-game species, once commercially harvested in Oklahoma waters. Smallmouth Buffalo is the most common of the 3 *Ictiobus* spp. in Oklahoma reservoirs and rivers (Miller and Robison 2004). This species is widely distributed throughout the Mississippi River basin from the Gulf of Mexico north to Ohio and west to the Dakotas (Miller and Robison 2004). Within Oklahoma, Smallmouth Buffalo are predominately found in the eastern part of the state (Miller and Robison 2004). *Ictiobus* spp. are commercially important in North America (Love et al. 2019) and were commercially harvested in Oklahoma from the 1930's to the mid 1980's (Houser 1957, ODWC unpublished data). Although records are limited, *Ictiobus* spp. comprised 44% (131,926 kg) of total annual commercial fish harvest from reservoirs between 1957 – 1969 (Elkin Jr. 1958, Jones 1961, Mensinger 1971). Currently, Smallmouth Buffalo are not commercially fished and are managed as a non-game species, which allows this species to be recreationally pursued via any legal methods with no regulated harvest (ODWC 2019).

Our current understanding of Smallmouth

Buffalo is limited to information obtained on smaller specimens through standard fish surveys. The Oklahoma Department of Wildlife Conservation (ODWC) currently has no management objectives for this species, but when these fish are encountered during standardized surveys (typically during fall gillnetting), they are enumerated, weighed and measured. However, the size of Smallmouth Buffalo sampled with the standard experimental gillnet is dictated by the mesh size (largest mesh size = 64 mm), so these samples are heavily biased to the capture of smaller Smallmouth Buffalo (mean TL = 428 mm, ranging 159 – 699 mm TL; ODWC unpublished data). This constricted size structure provides no insight into the growth potential or maximum size of Smallmouth Buffalo in these systems, which can be quite large (> 800 mm TL; Edwards and Twomey 1982, Miller and Robison 2004, Love et al. 2019). Regardless of sampling gear, encounters with large Smallmouth Buffalo are rare, but large fish are occasionally reported via angler reports when they believe they caught a state record. Collection and examination of these large, angler-caught specimens is a means to gain information on an otherwise understudied fish species.

On May 3, 2019, a new state record (1,015 mm TL, 30.1 kg) Smallmouth Buffalo was caught from Broken Bow Reservoir, Oklahoma. The fish exceeded the weight of the previous Smallmouth Buffalo record by 9.98 kg. Due to the anomalous size of this fish and the potential for individuals in this genus to reach very old ages (Bigmouth Buffalo *Ictiobus cyprinellus*, 112 years old; Lackmann et al. 2019), ODWC requested to obtain this fish for examination. Our objective was to examine the new state record Smallmouth Buffalo to estimate age, evaluate growth rate through back calculated length-at-age, and estimate hatch year (i.e., back calculated) to better understand environmental conditions that contributed to production of this fish. We realize this assessment is limited to a single individual but felt the opportunity to examine a large specimen would benefit future evaluations.

Methods

On 3 May 2019, ODWC southeast region fisheries staff weighed (using a large-capacity certified scale, Salter Brecknell Scale model 3255, Avery Weigh-Tronix, LLC, Fairmont, MN) and measured (TL and girth; mm) the potential new state record Smallmouth Buffalo. Meristic counts of lateral line scales, dorsal fin rays, anal rays, pectoral rays, pelvic rays, and gill rakers were taken to ensure species identification (Pflieger 1997, Miller and Robison 2004). Following inspection, this fish was verified as the new state record Smallmouth Buffalo.

Once certified, the fish was brought to the Oklahoma Fishery Research Laboratory (OFRL) in Norman, Oklahoma where the fish was dissected to remove the lapilli otoliths. Lapilli otoliths were cleaned of organic material and placed into an envelope to dry for a period > 24 hrs. After drying, lapilli otoliths were browned at 104°C on a hot plate to increase contrast between accretion and discontinuous zones (Secor et al.1992, Long and Snow 2016). After browning, otoliths were processed following methods described by Love et al. (2019), where otoliths were ground in a plane transverse to the nucleus using a rotary tool fixed with a grinding bit (#85422, Dremel, Racine WI). The rotary tool was held in a vice, and forceps coated in plastic tool dip (Plasti Dip International, Blaine MN) were used to securely hold the posterior portion of the otolith during the grinding process. Following grinding, otoliths were polished using wet 2000 grit wet/dry sandpaper.

To estimate age, the otolith was stood polished-side up in a dish containing modeling clay (aid in viewing), immersed in water (to reduce glare), and viewed with a variable-power stereomicroscope (capable of 130× magnification; aids in interpreting compressed annuli) using a fiber-optic filament (enables the reader to manipulate light angle to enhance annuli) attached to an external light source. Annuli, which appeared as dark rings on a light background, were counted to assign an age estimate. Otoliths were evaluated by two independent readers and if estimates were not

the same a concert reading was conducted to finalize an age estimate (Hoff et al. 1997). Once age estimates were finalized, the Dahl-Lea method was used to back-calculate length-at-ages to describe growth (mm; Quist et al 2012) and the final age estimate was subtracted from the capture year to estimate hatch year.

Results and Discussion

The new state record Smallmouth Buffalo was a female that measured 1,015 mm TL, had a girth of 974 mm, and weighed 30.31kg. The two independent readers estimated the age of this fish as 60 and 62 yrs old, respectively. The consensus age of this fish was 62 yrs old (Figure 1). This is the greatest longevity reported for Smallmouth Buffalo, although longevity information for this species is limited. However, Love et al. (2019) reported longevity of 39 yrs (majority of fish were 12 to 24 yrs old) for Smallmouth Buffalo from the middle Mississippi River. The oldest

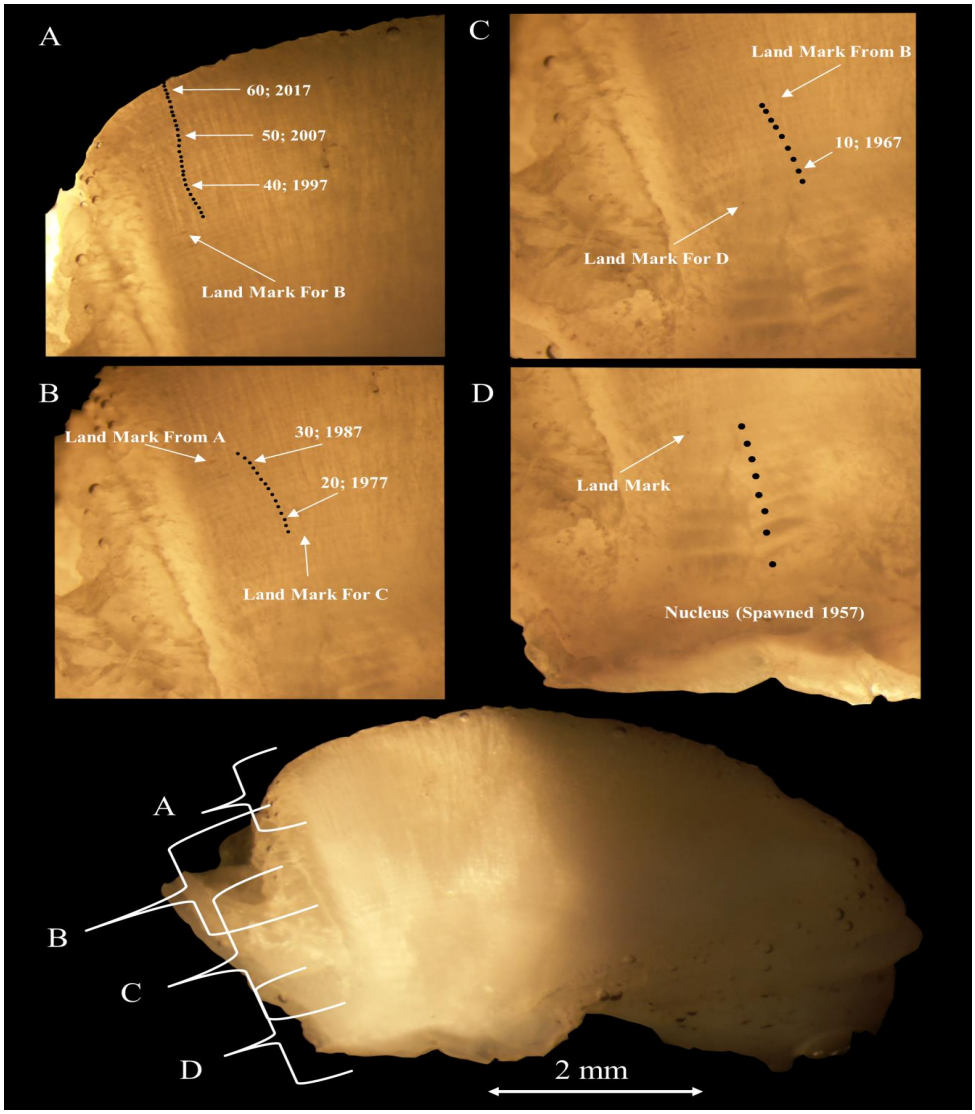

Figure 1. Photograph of a sectioned lapilli otolith from the current state record Smallmouth Buffalo (age 62) caught on 3 May 2019. ● = indicate annuli that reflect the age and year (age; year) on photographs A through D.

age reported for Smallmouth Buffalo using scale-derived age estimates was 18 yrs old (Martian et al. 1964, Jestor 1973). However, scale-derived ages are shown to underestimate the ages of catostomid species (Quist et al 2007, Muir et al. 2008, Grabowski et al. 2012). We cannot assess accuracy of this age estimate because no age validation studies using Smallmouth Buffalo otoliths have been conducted. However, the high precision between readers (within two years) for our specimen and validation of otoliths for other catostomid species (Paukert and Long 1999, Spurgeon et al. 2015), suggests this age estimate is reasonable.

Our evaluation is one of the few to present growth information for Smallmouth Buffalo. Using back-calculated length-at-age, we found that the state record Smallmouth Buffalo initially grew rapidly (attained 50% of TL in 6 years and 80% of TL by age 17), slowing with increasing age over the remainder of life (Figure 2). Our results are similar to Love et al. (2019) that found Smallmouth Buffalo growth to be rapid through the first 4 years of life (growing to 50% of their maximum TL). However, after age 10 (when they had achieved 71% of TL) Smallmouth Buffalo growth slowed drastically with increasing age (Love et al 2019).Similar growth patterns were observed with Blue Suckers (*Cycleptus elongates*) from both the Kiamichi and Red River in Oklahoma (Brewer and Dyer 2018) and three catostomid species from the Apalachicola River, Florida (Grabowski et al. 2012).

We were able to back-calculate the hatch year of this fish using the age estimate from annuli counts, which revealed that the state record Smallmouth Buffalo was spawned in 1957 (Figure 1). In that year, heavy precipitation and severe flooding impacted the region (Arkansas, Kansas, Missouri, Oklahoma, and Texas) during April through June (Kutschenreuter 1958). This flooding event ended the extended drought that began in 1952 (Kutschenreuter 1958, Nace

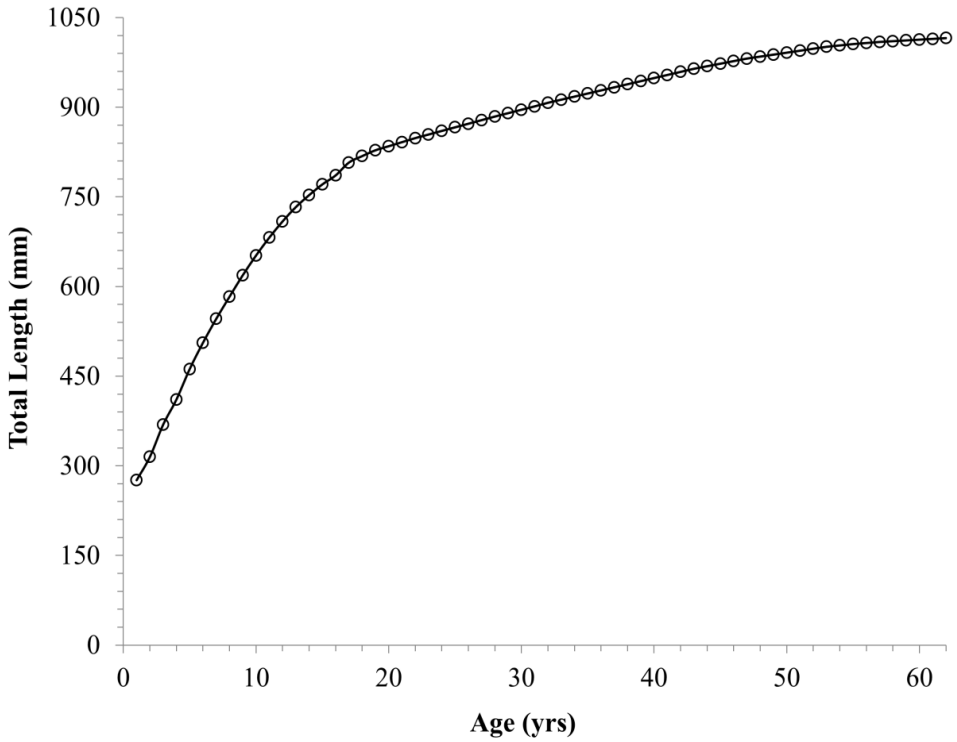

Figure 2. Back-calculated total length-at-age (mm) for the state record Smallmouth Buffalo captured in Oklahoma.

and Pluhowski 1965). In general, herbaceous terrestrial vegetation would have populated the river margins during extended drought conditions, which create spawning habitat and nursery areas for Smallmouth Buffalo when water levels rise following heavy rainfall (Etnier and Starnes 1993). It appears Smallmouth Buffalo were able to take advantage of the timing and magnitude of this flood event due to the spawning period for this species (April to early June; Becker 1983, Miller and Robison 2004). Catostomids, including *Ictiobus* spp., are cued to migrate up rivers and streams to spawn by inflow events where they spawn on inundated vegetation in the flood plain or in sloughs having shallow, vegetated shorelines (Martin et al. 1964, Hoyt and Flynn 1979, Becker 1983, Adams and Parsons 1998). It appears this extended flooding event (> 60 days) created conditions that resulted in successful spawning and recruitment of Smallmouth Buffalo to produce this state record fish 62 years ago.

Although this study is limited to a single fish, it provides considerably higher longevity estimates than previously described for Smallmouth Buffalo, and describes rarely-documented growth of this species. Additionally, large Smallmouth Buffalo are not encountered during typical fisheries assessments, so evaluating angler-caught specimens (even when it is a single fish) is important for understanding aspects of the life history of this species. An interesting finding from this evaluation was that this fish was spawned prior to impoundment of Broken Bow Reservoir. Therefore, this fish resided in Mountain Fork River, Oklahoma or migrated up stream prior to the completion of the Broken Bow Reservoir dam in 1968. This evaluation builds on our understanding of Smallmouth Buffalo biology and natural history, which is important for the conservation and management of this species.

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