Population Characteristics of Channel Catfish in Meeker Reservoir, Oklahoma, a Small Impoundment

Graham F. Montague
Oklahoma Department of Wildlife Conservation, Oklahoma Fishery Research Laboratory, Norman, OK 73072

Richard A. Snow
Oklahoma Department of Wildlife Conservation, Oklahoma Fishery Research Laboratory, Norman, OK 73072

Alexis Whiles
Oklahoma Department of Wildlife Conservation, Oklahoma Fishery Research Laboratory, Norman, OK 73072

Abstract: Channel Catfish are a popular sportfish throughout North America and agencies often support put-grow-take fisheries for Channel Catfish in small impoundments. The Oklahoma Department of Wildlife Conservation (ODWC) stocks impoundments throughout Oklahoma with Channel Catfish to provide anglers with catfishing opportunities. Meeker Reservoir (85.8 ha) is a small impoundment located in central Oklahoma that has been historically stocked with Channel Catfish. Uniquely, Meeker Reservoir also has a naturally reproducing population of Blue Catfish that is stunted. Sampling information for Meeker Reservoir is limited and preliminary analysis suggested that Channel Catfish were also stunted. Therefore, our objective was to describe the population characteristics of Channel Catfish in Meeker Reservoir using both 25-mm and 12.5-mm mesh tandem, baited hoop net sets. The Channel Catfish in Meeker Reservoir were stunted, slow growing, dominated by stock size individuals, and had relatively low mortality. Low reservoir productivity, ODWC Channel Catfish stocking rates, and high Channel Catfish and Blue Catfish abundances may be contributing to their slow growth. Additional research should focus on examining the interspecific competition of Blue Catfish and Channel Catfish, potential environmental factors that lead to Channel Catfish recruitment, and angler dynamics of Channel Catfish in small impoundments.

Introduction

Channel Catfish, *Ictalurus punctatus*, are a popular sportfish that inhabit many impoundments throughout the United States and elevated interest in catfish angling has led to increased research and management practices over recent decades (Bodine et al. 2013; Porath et al. 2022). Channel Catfish anglers tend to be harvest oriented, while some anglers desire trophy fishing opportunities (Michaletz and Dillard 1999, Wilde and Ditton 1999, Arterburn et al. 2002, Hutt et al. 2013). Put-grow-take fisheries for Channel Catfish are popular in small impoundments throughout North America; however, due to poor natural recruitment, agencies typically rely on continual stockings for sustainable fishing opportunities (Michaletz and Dillard 1999, Michaletz 2009). In Oklahoma, Channel Catfish are the third most pursued sportfish (York 2019) and the Oklahoma Department of Wildlife Conservation (ODWC) recognizes anglers' interest by stocking impoundments statewide to create and enhance Channel Catfish fishing opportunities.

Meeker Reservoir is a small impoundment (< 100 ha) located in central Oklahoma that supports many sportfish species such as Channel Catfish, Blue Catfish *Ictalurus furcatus*, Largemouth Bass *Micropterus salmoides*, sunfish species, and White Crappie *Pomoxis annularis* to promote fishing opportunities to anglers. ODWC began stocking Meeker Reservoir with Channel Catfish in 1972 with 6,000 fingerlings. Since the initial stocking in 1972, additional Channel Catfish have been stocked (~20,000 fingerlings/year from 1981 – 1989; ~10,000-20,000 fingerlings/year from 2009 – 2013) into Meeker Reservoir in hopes to enhance the fishery (ODWC unpublished data). Prior to this study, little sampling information existed on the Channel Catfish population in Meeker Reservoir. To assess the population, ODWC biologists set tandem, baited hoop nets (25-mm mesh) in the reservoir in 2019. However, catch rates were very low and preliminary age and growth statistics suggested that the population of Channel Catfish in Meeker Reservoir consisted of primarily old fish (up to age 11) at small lengths, which is characteristic of a stunted population. These preliminary results led to further sampling efforts to better understand the Channel Catfish population. The reservoir was then resampled with 12.5-mm mesh baited hoop nets (to target smaller size classes) and age and growth analysis was conducted to reevaluate this population.

Meeker Reservoir is unique because it also contains a naturally recruiting population of Blue Catfish which is uncharacteristic of small impoundments (Waters et al. 2020a). The Blue Catfish population in Meeker Reservoir exhibits high longevity (fish aged up to 29), slow growth, low annual mortality, sexual maturity at small sizes, high abundance, and is stunted (Waters et al. 2020a). Stunted catfish populations are understudied in the literature and to our knowledge, no studies have examined the population characteristics of a Channel Catfish population residing with a stunted Blue Catfish population in a small impoundment. Additionally, Channel Catfish growth in reservoirs is variable, and stocked populations can exhibit slow growth and poor size structure in reservoirs, creating limited management options for biologists (Michaletz 2009, Tyszko et al. 2021a). Therefore, the objective of our study was to describe the population characteristics (age and size structure, condition, growth, mortality, and age and size at maturity) of Channel Catfish in Meeker Reservoir using tandem baited hoop nets.

Methods

Meeker Reservoir is an 85.8 ha impoundment located 2.3 miles southwest of Meeker, Oklahoma in Lincoln County (35º 29′ 46.4″N, 96º 56′ 10.2″W; Waters et al. 2020a; Figure 1). Meeker Reservoir was formed in 1970 with the primary purposes being municipal water supply, flood control, and recreation. Meeker Reservoir has 8 km of shoreline, a maximum depth of 7.4 m, and a mean depth of 2.8 m (OWRB 2009). The river reservoir interface of Quapaw Creek is silted in, reducing the surface area of the lake by 21% (109.3 ha in 1970; OWRB 2009; Waters et al. 2020a). The reservoir consists mostly of open

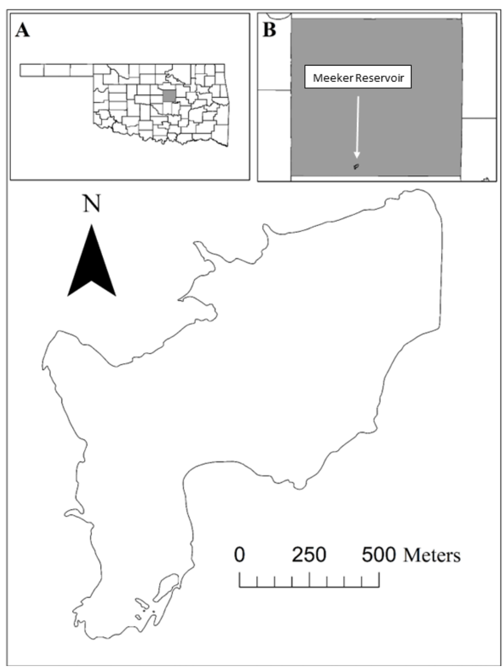

Figure 1. Map of Meeker Reservoir located in Lincoln County, Oklahoma (A) and location of the reservoir within Lincoln County (B).

water with areas of emergent aquatic vegetation, limited submerged or exposed standing timber, rock, coarse gravel, and clay or sand substrate. The reservoir is considered mesotrophic, is extremely turbid (mean secchi depth of 10 cm), has a salinity range of 0.10 to 0.11 ppt, and is neutral to slightly alkaline (7.33 - 8.37 pH; OWRB 2009).

Study Design

Channel Catfish were collected from Meeker Reservoir using tandem baited hoop nets (25-mm mesh and 12.5-mm mesh) during May and June 2020 (correlates with Channel Catfish spawning season in Oklahoma; Miller and Robison 2004). Tandem, baited hoop nets were rigged following ODWC standardized sampling protocols. Specifically, each tandem net set consisted of three 3.4-m-long hoop nets (25-mm and 12.5-mm bar mesh; Miller Net Company, Inc., Memphis, Tennessee) containing seven fiberglass hoops, with the lead hoop being about 0.8 m in diameter and each subsequent hoop gradually decreasing in diameter toward the cod end. Each net included a throat on the second hoop and a restricted throat on the fourth hoop and was baited with fish food (Sportsman's Choice Trophy Fish Feed, Multi-species Formula, Cargill Animal Nutrition, Minneapolis, MN). Nets were fished parallel to shore at depths of 1–3 m for 72 hours. Temperature (°C) and dissolved oxygen concentration (mg/L) were recorded with a YSI meter (model Pro 2030, Yellow Springs Instruments, Yellow Springs, OH) just above bottom at each net set to ensure that dissolved oxygen was ≥ 4 mg/L.

All fish were measured for total length (TL; mm) and weighed (g). Twenty Channel Catfish per 10-mm TL group were collected for age estimation and sex determination. Fish kept for age estimation and sex determination were euthanized using a 1:1 ice to water slurry (Blessing et al. 2010) and processed at the Oklahoma Fishery Research Laboratory in Norman, Oklahoma. Fish were re-measured for total length (TL; mm), weighed (g), sex determined, and lapilli otoliths were removed for age estimation.

Fish were assigned a maturity status (immature or mature) following methods of Davis and Posey (1958) and Perry and Carver (1972). Immature Channel Catfish were those showing no signs of gonadal development. The ovaries and testes of these immature fish are classified as barely distinguishable or are readily distinguishable but not developed. Fish were classified as mature female if they had well developed ovaries that contained yellowish to creamy-yellow eggs or their ovaries were spent (the eggs deposited). Males were classified as mature if their testes were enlarged and white in color.

Lapilli otoliths were extracted from each fish (Long and Stewart 2010) and placed into an individually numbered envelope and allowed to dry for ≥ 24 h prior to processing (Secor et al. 1992, Hull et al. 2022). Once dried, otoliths were processed following methods from Buckmeier et al. (2002) and Waters et al. (2020b). After processing, otoliths were viewed using a stereo microscope (capable of 130x magnification) with a fiber optic filament attached to an external light source to illuminate annuli (Buckmeier et al. 2002, Waters et al. 2020b). Each otolith was estimated in concert by two readers, however if the readers disagreed on the age of the fish, then that otolith was put aside and later viewed again (Hoff et al. 1997). If an otolith was unreadable, the second otolith's age was estimated, however if that otolith was also unreadable, the fish was removed from the study. Each otolith was evaluated in random order with no reference of TL, weight, or sex (Hoff et al. 1997).

Analysis

Size structure of the Meeker Reservoir Channel Catfish population was described with 20-mm bin length frequency histograms of all fish captured and proportional size distribution (PSD, stock ≥ 280mm, quality ≥410 mm, preferred ≥610; Gabelhouse 1984). PSDs were calculated using psdcalc function in the Fisheries Stock Analysis (FSA) package (Ogle 2022) in R (R Core Team 2022, version 1.4.1103). A simple linear regression was used to describe the relationship between log10(weight):log10(length). The relationship of Channel Catfish length to weight was also used to evaluate fish condition by calculating relative weight (Wr) using the wrAdd function in Ogle's FSA package (2022) in R (R Core Team 2022, version 1.4.1103). Separate length-frequency histograms were created for each hoop net mesh size (12.5-mm and 25-mm) using 20-mm length bins. A Fisher's exact test using the fisher.test() function in R (R Core Team 2022, version 1.4.1103) was used to determine if 20-mm bin length frequencies from each hoop net mesh size differed (P value of ≤ 0.05 was considered significant).

A logistic regression model was used to determine the relationship between maturity at age for male and female Channel Catfish using binary variables (0 = immature, 1 = mature). Mean length at age was calculated for male and female Channel Catfish. These data were then log transformed to linearize the relationship, and differences in growth between sexes were tested using analysis of covariance (ANCOVA) with the aov() function in R (R Core Team 2022, version 1.4.1103). Because prior analysis of growth between sexes was similar ($F_1 = 1.19, P = 0.28$), all fish were combined to estimate growth rates using a von Beralanffy growth model.

Growth trajectories and instantaneous mortality rates for Channel Catfish were estimated using a von Betalanffy growth model fit to total length and age estimates using the FSA package (Ogle 2022) in R (R Core Team 2022, version 1.4.1103). Instantaneous mortality rates (Z) were estimated via a weighted catch curve fit to estimated ages using the catchCurve() function in the FSA package (Ogle 2022) in R (R Core Team 2022, version 1.4.1103). Total annual mortality (A) was also estimated for each structure using $1\text{-}e^{-z}$ (Ricker 1975). Channel Catfish < age-2 were not fully recruited to the sampling gear and were removed from catch-curve analysis.

Results

Of the 850 Channel Catfish collected, 298 fish were kept for age estimation and population assessment (Figure 2). Fish used for age analysis ranged from age 1- to age-11 and 70 - 456 mm TL. Male (51%) add female (49%) fish were similarly represented in the sample, with male Channel Catfish reaching 100% maturity by age-8 and female by age-10 (Figure 3). The earliest that male Channel Catfish reached maturity was age-2, 50-75% of all male fish reached maturity

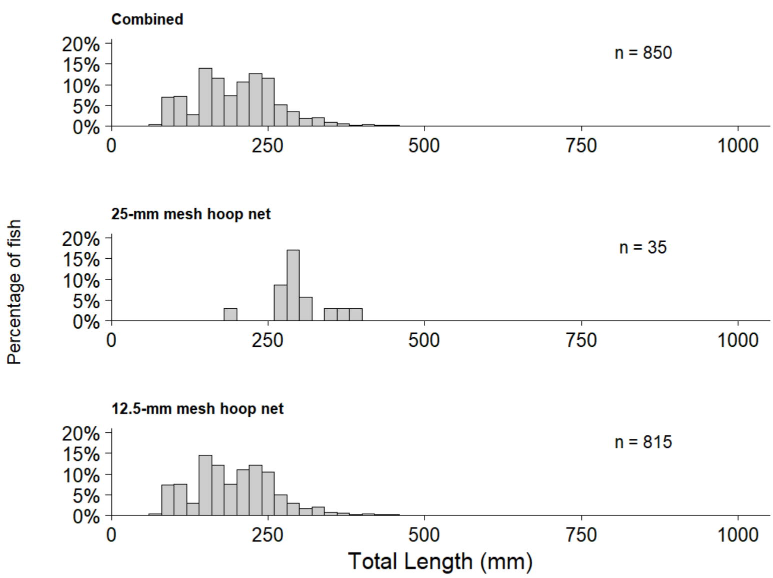

Figure 2. Length Frequency histogram using 20-mm bins of Channel Catfish from Meeker Reservoir, Oklahoma caught using tandem baited hoop nets with 25-mm and 12.5-mm mesh.

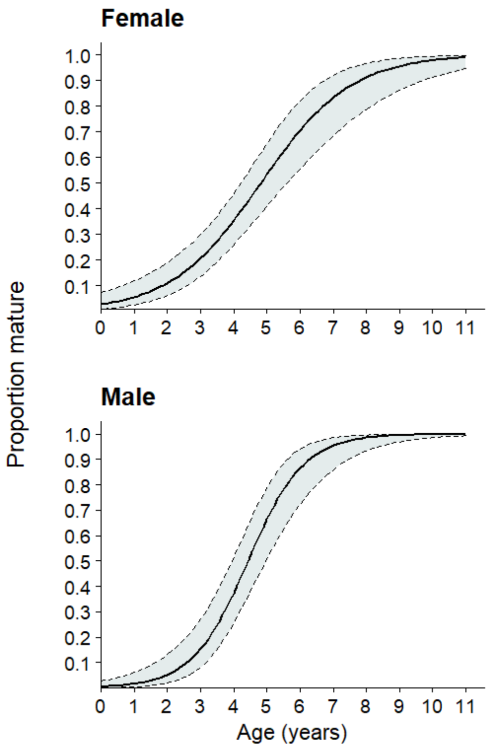

Figure 3. Results of logistic regression analysis displaying the proportion of mature female (top) and male (bottom) Channel Catfish by age. Grey dashed lines represent 95% confidence intervals.

by age-5, and 100% by age-8. The earliest that female Channel Catfish reached maturity was age-2, 50% of all female fish reached maturity by age-5, 75% by age-6, and 100% by age-10.

This population was dominated by sub-stock (90.2%) and stock (9.3%) sized Channel Catfish (Table 1). As a result, PSD was low (PSD-Q = 2), and no fish exceeded PSD-Q size (>410mm). Stock length fish had a mean age of 7, and quality length fish had a mean age of 8.25 (Table 1). The weight-length relationship ($\log_{10}(W) = 3.32(\log_{10}(TL)) - 13.66$) was significant ($r^2 = 0.98$, $P < 0.01$; Figure 4). This relationship resulted in a mean Wr of 93.23 (range of 93-96) (Table 1), which is average (near the 75th percentile) for Channel Catfish in Oklahoma. Length frequencies derived from the catch rates of 25-mm and 12.5-mm hoop net mesh sizes differed significantly (Fisher's exact P value ≤ 0.01).

The Von Bertalanffy growth model indicates that Channel Catfish approach L_∞ ($L_\infty = 393.7$ mm TL; predicted maximum total length) slowly ($k = 0.21$), with individuals in the population reaching approximately 50% of the L_∞ by age-3 and 75% of L_∞ by age-7 (Figure 5). The estimated instantaneous mortality was 0.32 and the total annual mortality rate was 27.2% (Figure 6).

Discussion

Channel Catfish in Meeker Reservoir exhibit slow growth and have dense populations of sub-stock size (< 280mm fish) individuals. Our results are consistent with Tyszko et al. (2021a), where they found that Channel Catfish growth was slow in small reservoirs <101 ha. The Channel Catfish population in Meeker Reservoir is exceptionally slow growing compared to other reservoirs throughout Oklahoma. For example, the predicted maximum length for Channel Catfish (393.7 mm) in Meeker Reservoir are in the 5th percentile (451 mm) compared to other Oklahoma reservoirs (OFAA 2022). Additionally, lengths in Meeker Reservoir

Table 1. Proportional size distribution (PSD; 95% confidence interval (CI)), mean age (range), and relative weight (Wr; 95% CI) of Channel Catfish by size class collected from Meeker Reservoir, Oklahoma.

Size Category	*n*	PSD Value	Mean Age (range)	W_r (95% CI)
Sub-Stock (≤ 280 mm)	767	N/A	2.8 (1 - 11)	93 (92.9-93.1)
Stock (≥ 280 mm)	79	95 (88 – 99)	7 (4 -10)	94.5 (94.4 - 94.6)
Quality (≥ 410 mm)	4	5 (1 - 12)	8.3 (7 -10)	95.2 (95 - 95.4)
Overall	850	-	3.8 (1 -11)	93.23

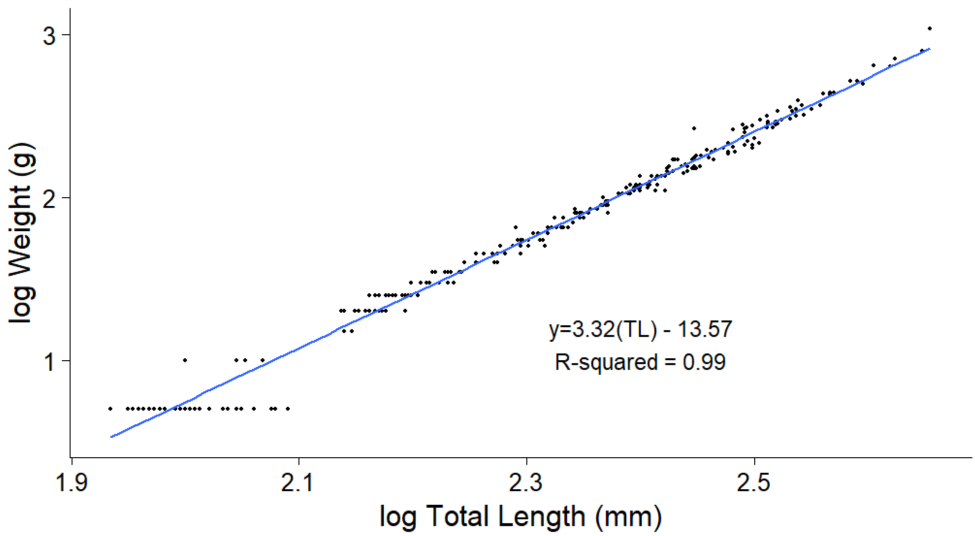

Figure 4. Weight-length relationship for 287 Channel Catfish collected from Meeker Reservoir, Oklahoma. The logarithmically transformed weight-length equation is log10 (W) = 3.32(log10 TL) – 13.57.

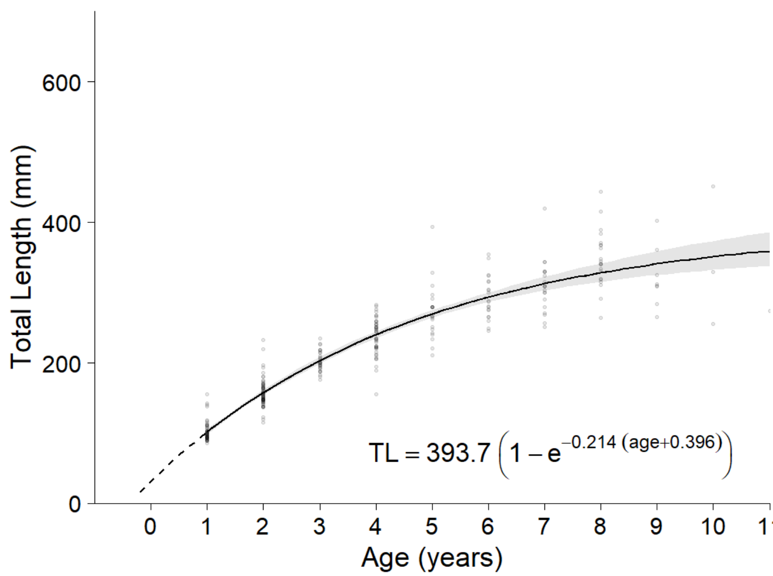

Figure 5. Von Bertalaffy growth curve calculated from 276 lapilli otolith age estimates for Channel Catfish collected from Meeker Reservoir, Oklahoma using tandem baited hoop nets.

generally fall between the 5th and 10th percentile of mean lengths from North American Channel Catfish populations up to 10 years of age (Hubert 1999). Other states have shown variable growth and population densities across regions (Tyszko et al 2021a). Therefore, a more comprehensive understanding of the growth rates of Channel Catfish across Oklahoma would be beneficial for managing populations statewide.

The slow growth of Meeker Reservoir Channel Catfish may be driven by various factors including low reservoir productivity. Meeker Reservoir is classified as mesotrophic

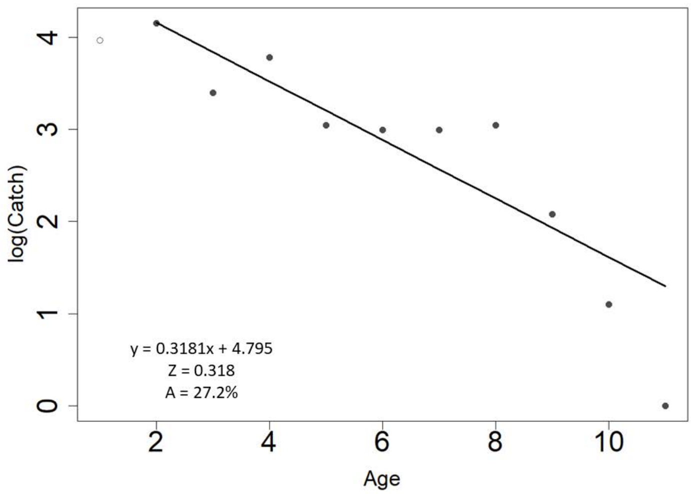

Figure 6. Weighted catch curve regression used to estimate total annual mortality (A) for Channel Catfish collected from Meeker Reservoir, Oklahoma. Age-1 fish are excluded from the catch curve regression. Z = instantaneous total mortality and S = total annual survival.

(OWRB 2009), having low to moderate productivity. The competition for food could be higher in less productive reservoirs because of decreased food availability, likely negatively impact on Channel Catfish growth rates (Shoup et al. 2007, Michaletz 2009). For example, in Missouri reservoirs, Michaletz (2009) found that Channel Catfish growth was slow when lake productivity (indexed by chlorophyll-a concentration) was low. In Illinois reservoirs, Shoup et al. (2007) noted that Channel Catfish growth was positively correlated with available forage abundances (i.e., the more productive a reservoir, the higher abundance of forage present). Also, in Ohio reservoirs, Channel Catfish growth generally decreased as reservoir productivity decreased, but the effect of productivity was less clear in describing the precision of variability in Channel Catfish growth models (Tyszko et al. 2021a). Future research should examine how lake productivity and forage abundance impacts Channel Catfish growth and size structure in impoundments throughout Oklahoma. Additionally, their slow growth may also be driven by interspecific competition between high abundances of both Channel and Blue Catfish, resulting in density-dependent processes attributing to slow Channel Catfish growth (Michaletz 2009; Flammang et al. 2011, Waters et al. 2020a). Future research should examine forage competition and energetic requirements of Blue Catfish and Channel Catfish in small impoundments.

Additionally, ODWC stocking rates may have been too high in Meeker Reservoir, artificially inflating densities leading to slow growth of Channel Catfish (Michaletz 2009). Furthermore, Tyszko et al. (2021a) found that larger reservoirs (≥ 406 ha) were more suited to support preferable-sized Channel Catfish to anglers (i.e., populations with fast growth and larger size structure), citing that smaller reservoirs (< 101 ha) may be unsuitable for sustaining fishable Channel Catfish populations through continued agency stocking. Therefore, ODWC biologists should consider reexamining stocking rates in Meeker Reservoir and develop alternative protocols for future stockings throughout Oklahoma. The reevaluation of stocking rates across Oklahoma will not only benefit put-grow-take fisheries and create higher quality fishing opportunities but will also improve the allocation of hatchery resources and efficiency (i.e., less time and money spent on Channel Catfish). Additional research that identifies more effective stocking rates for small impoundments will be prudent for agencies in the future.

Habitat and environmental variables that affect reproduction and recruitment may also be affecting the high population densities of Channel Catfish in Meeker Reservoir. Waters et al. (2020a), noted that Blue Catfish are successfully reproducing in Meeker Reservoir, likely leading to high Blue Catfish densities. The increased density of Channel Catfish in Meeker Reservoir may in part be attributed to successful utilization of available spawning habitat leading to increased recruitment. Stocking has not occurred in Meeker Reservoir since 2013 and the presence of 1-year old fish in the reservoir suggests that natural reproduction is occurring. The successful spawning and recruitment of both species in the reservoir is a likely culprit of increased densities and competition, perhaps leading to small size structures. Tyszko et al. (2021a) found that Channel Catfish densities were highest where natural recruitment and reproduction occurs, and stocking does not. However, catfish recruitment in small impoundments is understudied and additional research on environmental factors such as available habitat, annual temperatures, and hydrology are needed to better understand their effect on catfish densities.

Total annual mortality was relatively low for the Meeker Channel Catfish population (27.2%), possibly due to low angler exploitation and harvest rates. Angler exploitation is typically correlated with increased annual mortality (Parrett et al. 1999). However, there may be low angler exploitation and harvest in Meeker Reservoir due to small size structure and resulting angler disinterest (Hutt et al. 2013). Previous studies have documented a decrease in Channel Catfish angling effort and exploitation in general (Parrett 1999, Michaletz et al. 2008, Tyszko et al. 2021a). Creel surveys and exploitation studies would be beneficial for managers to meet angler's preferences and better understand the harvest of Channel Catfish in small impoundments throughout Oklahoma. Therefore, additional information regarding the exploitation and harvest of stunted Channel Catfish populations is warranted.

We found that the number of Channel Catfish caught using standardized tandem baited hoop nets (25.4-mm mesh) differed from the number caught using smaller-sized mesh tandem baited hoop nets (12.5-mm; Figure 2). We were able to sample smaller size classes (< 170 mm) and catch more individuals using the 12.5-mm sized mesh. Tandem, baited hoop nets efficiently sample Channel Catfish (Bodine et al. 2013); however, underrepresentation of smaller size classes of fish have also been documented in the literature. For example, Buckmeier and Schlechte (2009) observed underrepresentation of fish ≤ 250 mm in 25.4-mm mesh tandem hoop nets. Tyszko et al. (2021b) found that juvenile fish (< 400 mm) in tandem baited hoop nets with 25-mm mesh did not fully recruit to the gear. Additional research should incorporate and develop a standardized sampling protocol using tandem baited hoop nets with smaller mesh sizes for sampling juvenile and smaller size structures of Channel Catfish. Understanding juvenile catfish population characteristics such as recruitment, reproduction, and size structure will allow managers to better develop strategies to manage these populations.

Put-grow-take fisheries are popular in Oklahoma and provide valuable catfish angling opportunities (York 2019). However, it is imperative for management agencies to optimize stocking practices and create fisheries that are valued by catfish anglers. Therefore, developing a standardized approach for stocking small impoundments is essential for managing quality catfishing opportunities for anglers. Additional research should focus on developing standards to assess stocked Channel Catfish populations and the variables that influence their population characteristics. Furthermore, understanding angler dynamics in small impoundments will be beneficial to managers trying to develop management strategies that match angler preference and behavior to provide quality fishing experiences. Identifying and understanding variables that attribute to stunted populations will allow for more effective fisheries management on small impoundments that support Channel Catfish populations.

Acknowledgments

We thank Shelby Jeter, Michael Porta, Jory Bartnicki, and Michael Hollie for assisting in field sampling and lab work for this project. We thank Austin Griffin, and J. Bartnicki for reviewing an earlier draft of this manuscript. Financial support for this publication was provided by the Sport Fish Restoration Program grant [F-50-R-25] and [F-86-D-1] to the Oklahoma Department of Wildlife Conservation.

References

Arterburn, J., D. Kirby, and C. Berry. 2002. A survey of angler attitudes and biologist opinions regarding trophy catfish and their management. Fisheries 27:10-21.

Blessing J., J.C. Marshall, and S. Balcombe. 2010. Humane killing of fish for scientific research: a comparison of two methods. Journal of Fish Biology 76:2571-2577.

Bodine, K. A., D. E. Shoup, J. Olive, Z. L. Ford, R. Krogman, and T. J. Stubbs. 2013. Catfish sampling techniques: where we are now and where we should go. Fisheries 38:529-546.

Buckmeier, D.L., E. R. Irwin, R. K. Betsill, and J. A. Prentice. 2002. Validity of otoliths and pectorals pines for estimating ages of Channel Catfish. North American Journal of Fisheries Management 22:934-942.

Buckmeier, D. L., and J. W. Schlechte. 2009. Capture efficiency and size selectivity of Channel Catfish and Blue Catfish sampling gears. North American Journal of Fisheries Management 29:404-416.

Davis, J. T., and L. E. Posey. 1958. Length at maturity of channel catfish in Louisiana. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 12:72-75.

Flammang, M. K., R. D. Schultz, and D. N. Cashatt. 2011. Utility of tandem hoop nets for indexing Channel Catfish structure and growth. Pages 545-555 in P. H. Michaletz and V. H. Travnichek, editors. Conservation, ecology, and management of catfish: the second international symposium. American Fisheries Society, Symposium 77, Bethesda, Maryland.

Gabelhouse, D. W. Jr. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Hoff, G. R., D. J. Logen, and M. F. Douglas. 1997. Otolith morphology and increment validation in young Lost River and Shortnose Suckers. Transactions of the American Fisheries Society 126:488-494.

Hubert, W. A. 1999. Standards for assessment of age and growth data for Channel Catfish. Journal of Freshwater Ecology 14:313-326.

Hull, J. N., C. M. Olson, R. A. Snow, M. J. Porta. 2022. Using pectoral spines and otoliths for estimating ages of channel catfish and effects on estimating population parameters. Journal of the Southeastern Association of Fish and Wildlife Agencies 9:39-46.

Hutt, C. P., K. M. Hunt, J. W. Schlechte, and D. L. Buckmeier. 2013. Effects of catfish angler catch-related attitudes on fishing trip preferences. North American Journal of Fisheries Management 33:965-976.

Long, J. M., and D. R. Stewart. 2010. Verification of otolith identity used by fisheries scientists for aging Channel Catfish. Transactions of the American Fisheries Society 139:1775-1779.

Michaletz, P. H. 2009. Variable responses of channel catfish populations to stocking rate: Density-dependent and lake productivity effects. North American Journal of Fisheries Management 29:177-188.

Michaletz, P. H., and J. G. Dillard. 1999. A survey of catfish management in the United Statesand Canada. Fisheries 24:8-11.

Michaletz, P. H., M. J. Wallendorf, and D. M. Nicks. 2008. Effects of stocking rate, stocking size, and angler catch inequality on exploitation of stocked Channel Catfish in small Missouri impoundments. North American Journal of Fisheries Management 28:1486-1497.

Miller, R. J., and H. W. Robison. 2004. Fishes of Oklahoma. University of Oklahoma Press, Norman, Oklahoma.

Ogle, D.H., J.C. Doll, P. Wheeler, and A. Dinno. 2022. FSA: Fisheries Stock Analysis. R package version 0.9.3 https://github.com/fishR-Core-Team/FSA.

Oklahoma Fisheries Analysis Application. 2022. Version 2.0. Oklahoma Department of Wildlife Conservation.

Oklahoma Water Resources Board (OWRB). 2009. Hydrographic survey of Meeker Lake. Final Report. Oklahoma City, OK.

Parrett, T. P., J. A. Marshall, and D. J. Bright. 1999a. A comparison of daytime and nighttime Channel Catfish fisheries at two Ohio impoundments. Pages 391-394 R.in Irwin, E., W. A. Hubert, C. F. Rabeni, H. L. Schramm Jr., and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Perry Jr, W. G., and D. C. Carver. 1972. Length at maturity and total length-collarbone length conversions for Channel Catfish, *Ictalurus punctatus*, and Blue Catfish, *Ictalurus furcatus*, collected from the marshes of southwest Louisiana. Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners 26:541-553.

Porath, M. T., T. J. Kwak, B. C. Neely, and D. E. Shoup. 2021. Catfish 2020, A clear vision of the future. North American Journal of Fisheries Management. 41:1-S10.

R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Ricker, W. E. 1975. Computation and interpretation of biological statistics in fish populations. Fisheries Research Board of Canada, Bulletin 191.

Secor, D. H., J. M. Dean, and E. H. Laban. 1992. Otolith removal and preparation for microstructural examination. Pages 19-57 In D. K. Stevenson and S. E. Campana, editors. Otolith microstructure examination and analysis. Canadian Special Publication of Fisheries and Aquatic Sciences 117.

Shoup, D. E., S. P. Callahan, D. H. Wahl, and C. L. Pierce. 2007. Size specific growth of Bluegill, Largemouth Bass, and Channel Catfish in relation to prey availability and limnological variables. Journal of Fish Biology 70:21-34.

Tyszko, S. M., J. J. Pritt, and J. D. Conroy. 2021a. Explaining Channel Catfish population characteristics in Ohio reservoirs. North American Journal of Fisheries Management. 41:334-344.

Tyszko, S. M., J. J. Pritt, and J. D. Conroy. 2021b. Indexing reservoir Channel Catfish population density and size structure with tandem, baited hoop nets. North American Journal of Fisheries Management. 41:406-414.

Wilde, G. R. and R. B. Ditton. 1999. Differences in attitudes and fishing motives among Texas catfish anglers. Pages 395-405 in E. R. Irwin, W. A. Hubert, C. F. Rabeni, H. L. Schramm, Jr., and T. Coon, editors. Catfish 2000: proceedings of the international ictalurid symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Waters, M. J., R. A. Snow, and M. J. Porta. 2020a. Population dynamics of a stunted Blue Catfish population in a small Oklahoma impoundment. Proceedings of the Oklahoma Academy of Science 100:38-50.

Waters, M. J., R. A. Snow, and M. J. Porta. 2020b. Comparison of browned and standard otolith preparation methods for estimating age of catfish in Oklahoma. Journal of the Southeastern Association of Fish and Wildlife Agencies 7:64-71.

York, C. A. 2019. Oklahoma Department of Wildlife Conservation 2019 Oklahoma angler survey. Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma. Pages 14-15.

Submitted August 15, 2022 Accepted November 12, 2022