Characteristics of the Paddlefish Fishery at Chetopa Dam, Kansas, 1992–2006

Ben C. Neely, *Kansas Department of Wildlife, Parks and Tourism, 5089 CR 2925, Independence, KS 67301*

Susan F. Steffen, *Kansas Department of Wildlife, Parks and Tourism, 1830 Merchant, P.O. Box 1525, Emporia, KS 66801*

Sean T. Lynott, *Kansas Department of Wildlife, Parks and Tourism, 1500 W. 7th St., P.O. Box 777, Chanute, KS 66720*

Jeff D. Koch, *Kansas Department of Wildlife, Parks and Tourism, 21514 S. Yoder Rd., Pretty Prairie, KS 67570*

Abstract: Paddlefish (*Polyodon spathula*) angling is popular among Kansas anglers, but limited to a few areas in the state. The most popular fishery, both in terms of angler effort and harvest, is located at Chetopa Dam, a low-water bridge on the Neosho River in southeast Kansas. This fishery, as well as other paddlefish fisheries in Kansas, is only open to recreational angling. As such, maintaining accurate records of recreational harvest are important for management purposes. We summarized data from the Chetopa Dam fishery as part of a mandatory check system for harvested paddlefish from 1992 to 2006. A total of 8892 paddlefish were harvested by 5882 anglers during the study period. Angler participation in this fishery was predominately by Kansas residents (94.5%). Total number of harvested fish and mean length of harvested fish differed among years, but no trends were detected. However, an increasing trend in mean length of harvested fish was observed from 2001 to 2006 that may have been related to a relatively strong year class in 1995. Trends in mean length of harvested fish support the hypothesis that this population is maintained by episodic recruitment. These data provide historical reference for future comparisons of harvest both inter- and intra-state, and can be applied to assist with further development of this locally important paddlefish snag fishery.

Key words: anglers, snag fishery, harvest, mandatory check station

Journal of the Southeastern Association of Fish and Wildlife Agencies 2:15–19

Paddlefish (*Polyodon spathula*) are large-bodied fish endemic to the Mississippi River drainage and the northeastern portion of the Gulf Slope (Jennings and Zigler 2009). They have several characteristics that render them susceptible to overfishing including a long lifespan, slow maturation, inconsistent natural recruitment, and roe that is valued in the caviar market (Jennings and Zigler 2009). Habitat degradation throughout their native range has resulted in localized population declines (Jelks et al. 2008). Concerns related to overfishing in the 20th century were first widely presented in Dillard et al. (1986). However, several states initially regulated paddlefish in the late 1940s and early 1950s to prevent overexploitation (Combs 1986). There are several major problems inherent to overharvest of a recreationally important fish including reduction of populations to levels that could alter ecology of aquatic systems (Jelks et al. 2008) and reduction of a fishery's value due to reduced population size (Colvin et al. 2013). Because of related concerns, many natural resource management agencies have acknowledged the importance of maintaining paddlefish stocks and implemented monitoring approaches to conserve and enhance these important fisheries (Bettoli et al. 2009, Leone et al. 2012, Schooley et al. 2014).

Despite historically decreasing paddlefish populations, recreational fisheries for the species have developed across most of their range (Bettoli et al. 2009). Anglers participating in these fisheries often employ blind-snagging techniques in areas of suspected congregation during spawning migrations (Quinn 2009). Dams create barriers to paddlefish movements resulting in aggregations of fish; thus, tailwaters are common places for fisheries to develop. Reported harvest varies widely among these fisheries, but total mean annual harvest from recreational fisheries in the United States from 2000–2006 was estimated at 15,000 to 20,000 fish (Quinn 2009). However, evidence suggests that range-wide harvest may currently exceed these estimates. For example, an estimated 15,088 paddlefish were harvested from Grand Lake O' the Cherokees, Oklahoma, alone in 2009 (Schooley et al. 2014). The propensity of paddlefish fisheries to be overexploited, coupled with increased harvest, highlight the importance of recreational fisheries monitoring to understand fishery dynamics and promote effective management.

In 1972, Kansas Department of Wildlife, Parks and Tourism (KDWPT) initiated the first legal paddlefish fishery in Kansas at Chetopa Dam, a low-head dam on the Neosho River in southeast Kansas (Bonislawsky 1977). Since then, eight recreational fisheries have been established in the state, including six that remained open through 2014; however, only Chetopa Dam was open annually from 1972 through 2014 (Neely et al. 2015). Chetopa Dam is a low-head dam that becomes inundated when discharge reaches approximately 227 m^3sec^{-1}. It is 61 river km (rkm) upstream of

Grand Lake O' the Cherokees, an 18,800-ha impoundment in northeast Oklahoma that supports a naturally sustaining paddlefish population. Connectivity between Chetopa Dam and Grand Lake O' the Cherokees is achieved when discharge reaches approximately 283 m^3sec^{-1} and inundates a low-head dam near Miami, Oklahoma (Figure 1). The number of times connectivity is achieved between Chetopa Dam and Grand Lake O' the Cherokees varies annually (i.e., typically less than five days but as many as 25 days during snagging season), and is positively related to harvest at the study site (Neely et al. 2014). Paddlefish in the Chetopa Dam fishery are mostly migrants from Grand Lake O' the Cherokees that are conducting spawning migrations (Bonislawsky 1977). Public access for paddlefish snagging at Chetopa Dam has historically been limited to 0.5 km of shoreline along the east side of the Neosho River immediately downstream of the dam.

Unfortunately, monitoring of the Chetopa Dam fishery has been sporadic. A creel survey conducted from 1974 to 1976 estimated annual harvest varied from 28 to 170 fish (Bonislawsky 1977). Harvest was not monitored from 1977 to 1991. Because paddlefish populations had been declining across much of their range (Dillard et al. 1986), KDWPT adopted mandatory check stations for harvested paddlefish at all legal fisheries from 1992 to 2006. These stations relied on contracting nearby businesses (e.g., gas stations and convenience stores) to tag harvested fish and collect pertinent fishery data (e.g., angler and fish information) and were not operated by KDWPT staff. Check stations existed at all fisheries, but inconsistent catch led many of them to close. However, the check station at the Chetopa Dam fishery remained open from 1992–2006 and resulted in a consistent long-term data set. During this 15-yr study period, this fishery comprised the majority (approximately 75%) of statewide paddlefish harvest and angler effort (T. Mosher, KDWPT, unpublished data). Thus, the Chetopa Dam paddlefish fishery can serve as a proxy for paddlefish angling and harvest management in Kansas. Objectives of this manuscript were to explain characteristics of paddlefish harvested from the Chetopa Dam fishery from 1992–2006 and to document spatial distribution of anglers that participated in this fishery. These data can be used as baseline information for future monitoring of this unique fishery and provide comparative data for other fisheries managers throughout the paddlefish distribution.

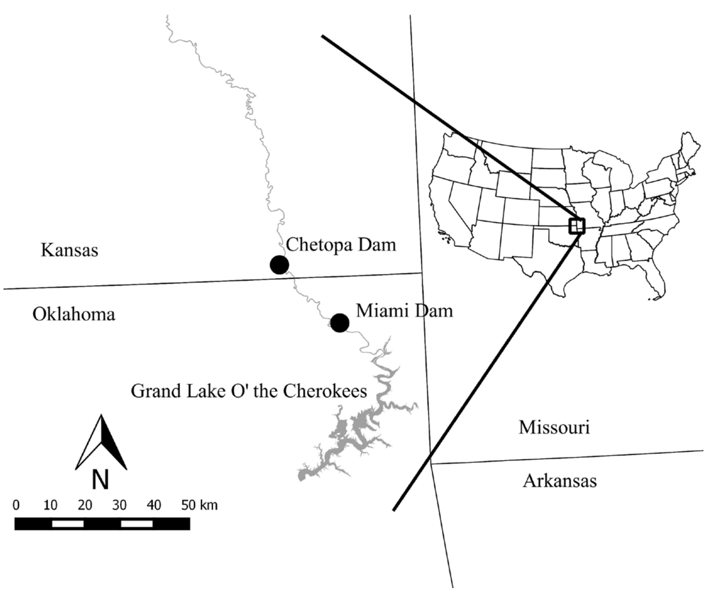

Figure 1. Map showing location of Chetopa Dam on the Neosho River, Kansas, in relation to Grand Lake O' the Cherokees, Oklahoma.

Methods

Fishery Characteristics and Operation

Paddlefish snagging at Chetopa Dam was allowed from 15 March to 15 May each year from 1992 to 2006. Season extensions were enacted in 1996 and 2002 that prolonged the season until 22 May and 30 May, respectively, to encompass active migrations and increase harvest. Daily creel limit during the study period was two fish, and harvest of all landed fish was required, excluding 2006 when the daily creel limit was one fish and an 86-cm minimum eye-fork length (EFL) limit was enacted. In all other years, there were no length restrictions for paddlefish at Chetopa Dam. During the study period, anglers were required to take harvested fish to a mandatory check station located near the snagging area where angler information (i.e., name, address, fishing license number, hours spent fishing) and EFL of harvested fish were collected. Once these data were collected, a clerk placed a tag on the fish and it was considered legally harvested.

Data Analyses

We analyzed several metrics, including total catch, length of harvested fish, and home state of successful anglers. Total catch was calculated by totaling the number of fish checked. Angler residency was examined across all years combined. Linear regression was used to assess annual trends in total catch and mean length of harvested fish during the study period. The goal of these tests was to determine if characteristics of harvested fish consistently changed through time. Analysis of variance was used to evaluate differences in mean length of harvested fish between years. Statistical significance was determined at $P \leq 0.05$.

Results

A total of 8892 harvested fish were documented at the Chetopa Dam check station from 1992 to 2006. Annual total catch varied substantially among years (annual mean = 593 fish; minimum = 38

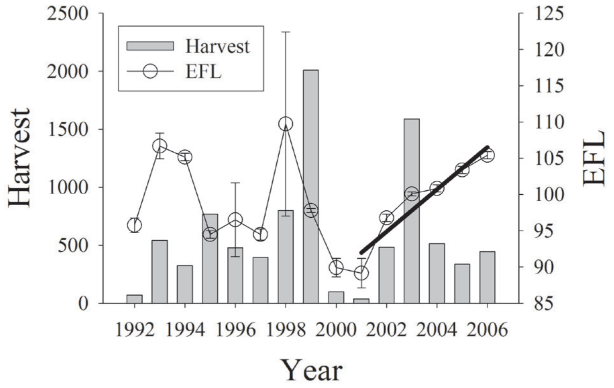

Figure 2. Annual paddlefish harvest and mean eye-fork length (EFL) of harvested fish (with standard error) from the Chetopa Dam fishery on the Neosho River, Kansas, from 1992 to 2006. The linear relationship between mean EFL and year from 2001 to 2006 is represented by a solid line.

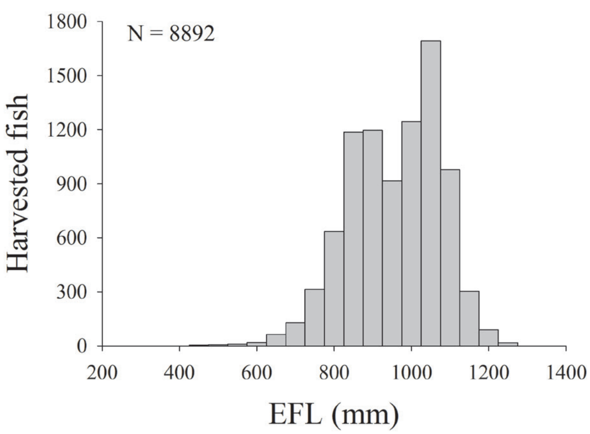

Figure 3. Length frequency of paddlefish harvested from the Chetopa Dam fishery on the Neosho River, Kansas, from 1992 to 2006.

fish; maximum = 2010 fish; Figure 2), but there was no linear temporal trend in harvest (linear regression; $P = 0.66$; $r^2 = 0.02$). Mean length of harvested fish differed between years and varied annually from 89 to 110 cm EFL (ANOVA; F 14,8798 = 56.06; $P < 0.01$). There was no long-term linear trend in mean length (linear regression; $P = 0.86$; $r^2 = 0.01$), but there was a positive trend in mean length from 2001 through 2006 (linear regression; $P < 0.01$; $r^2 = 0.89$; Figure 2). Length of harvested fish varied from 250 to 1270 mm EFL (Figure 3). Harvested fish were checked by 5882 anglers that lived in 18 different states. Kansas residents comprised the majority of these anglers (94.5%) followed by residents of Missouri (3.0%), Oklahoma (1.4%), Arkansas (0.3%) and Nebraska (0.3%).

Discussion

Annual paddlefish harvest from the Chetopa Dam fishery was highly variable. Approximately 40% of harvest during the 15-yr study period occurred in the two years with greatest harvest, 1999 and 2003, while only 1% of harvest during the study period occurred in the two years with the lowest harvest, 1992 and 2001. Intuitively, total catch would be related to population density. However, variation in total catch in this fishery is likely attributed more to environmental conditions than population density (Lewin et al. 2006, Gordon 2009, Quinn 2009, Neely et al. 2014). Another major limitation of using total catch to estimate relative abundance of this population is lack of an effort estimate. The data collection procedure for this study only recorded effort of successful anglers, which may have hindered our efforts to translate total catch into a measure of population abundance. Ideal conditions for paddlefish harvest from the Chetopa Dam fishery include a combination of increases in discharge and sustained high flows to create connectivity between the study site and Grand Lake O' the Cherokees (Neely et al. 2014). Superficially, we might reason that increased harvest in this fishery is indicative of reproductive success because of long-range movements and spawning migrations paddlefish are known to exhibit (Jennings and Zigler 2009, Pracheil et al. 2012). This reasoning is corroborated by the large cohort naturally spawned and recruited in the Neosho River basin in 1999, the year with greatest harvest at Chetopa Dam (Scarnecchia et al. 2011, Schooley et al. 2014). However, the second greatest harvest at Chetopa Dam in 2003 does not align with a naturally produced cohort in the Neosho River Basin (Scarnecchia et al. 2011, Schooley et al. 2014). These differences suggest that total catch might serve as a proxy for quantifying large-river fish conducting spawning migrations; however, a separate suite of hydrologic conditions must likely be met to promote recruitment (Zeug and Winemiller 2008, Pracheil et al. 2009). Despite limitations of total harvest to describe a recreational fishery, consistent monitoring provides a measure of angler-induced mortality, and possibly reproduction, that can be used to identify critical gaps in natural reproduction and recruitment of paddlefish in this system.

Variation in mean length of harvested fish existed between years, which might partially be attributed to males arriving at the study area before females. Male spawning migrations often preceded female spawning migrations in the Missouri River system (Stancill et al. 2002) and may occur in the Neosho River system as well. Favorable environmental conditions could have persisted longer in other years and elicited migratory behaviors from both sexes, thus influencing mean length of harvested fish. For example, in years when optimal river hydrology events (sustained discharge >283 m3 sec-1 and increasing discharge; Neely et al. 2014) were rare, harvest might have been dominated by smaller males that were eager to spawn. In years when optimal river hydrology occurred more frequently, harvest was likely increased and comprised of both early-arriving males and females. This would result in a more representative sample of the breeding population and result in greater mean EFL of harvested fish because anglers harvested more, generally larger, females. Sex of harvested fish was not determined in this study, but collection of these data would be beneficial in further harvest evaluations to verify suspected sex disparities in migration habits of fish in this population. The lack of a linear trend in mean length of harvested fish from 1992 to 2000 suggests that there was not a single strong cohort supporting harvest during this time period. However, there was an increasing trend in length of harvested fish observed from 2001–2006. Because male paddlefish in this system mature at age 6 to age 7 and females at age 8 to age 9 (Scarnecchia et al. 2011), there may have been strong year classes produced in 1995 and 1996. This is corroborated by an increased number of age 8 to age 10 fish sampled from Grand Lake O' the Cherokees in 2004 (Scarnecchia et al. 2011). The apparent lack of strong cohorts followed by evidence of successful recruitment from the 1995 and 1996 year class also corroborates previous findings that episodic recruitment is driving this fishery (Scarnecchia et al. 2011, Schooley et al. 2014).

Anglers are known to travel from neighboring states to participate in paddlefish fisheries (Bettoli 2011, Morgan et al. 2012, Schooley et al. 2014). However, out-of-state anglers constituted a small portion of successful anglers at the Chetopa Dam fishery (5.5% of harvest). The propensity of this fishery to cater to in-state anglers contrasts findings elsewhere where non-residents comprised 15% of total anglers in a Missouri fishery (Morgan et al. 2012), 33% of total anglers in a Tennessee fishery (Bettoli 2011), 37% of survey respondents in Montana (Scarnecchia et al. 1996), and 19%–28% of paddlefish permit sales in Oklahoma (Schooley et al. 2014). Of particular interest is the relatively low numbers of successful anglers from Missouri (3.0%) and Oklahoma (1.4%) participating in the Chetopa Dam fishery, despite its proximity (<40 km) to either state. Based on distances traveled by anglers to participate in other paddlefish fisheries, we would expect the 'drawing-range' of the Chetopa Dam fishery to extend well into Missouri and Oklahoma (Bettoli 2011, Morgan et al. 2012). Reasons for relatively limited non-resident participation could be attributed to Missouri and Oklahoma having higher-quality paddlefish fisheries (Morgan et al. 2012, Schooley et al. 2013). For example, the Grand Lake O' the Cherokees fishery immediately downstream of the Chetopa Dam fishery produced estimated average harvest of 10,276 paddlefish per year from 2008–2013 (Schooley et al. 2014). This estimate is over five times greater than the greatest annual harvest from the Chetopa Dam fishery. Additionally, the Grand Lake O' the Cherokees fishery is within 60 km driving distance from Chetopa Dam. The combination of increased harvest and close proximity of the Grand Lake O' the Cherokees fishery to Chetopa Dam likely results in many Oklahoma residents choosing to stay in their home state. Increased non-resident participation in the Chetopa Dam fishery might financially benefit both KDWPT and the local economy. Non-resident anglers generally spend more money per trip than resident anglers (Hunt and Grado 2010). However, Kansas has not historically been a destination state for anglers (Ditton et al. 2002). The propensity of some paddlefish fisheries to draw non-resident anglers suggests that a similar phenomenon is possible with the Chetopa Dam fishery. Results presented herein provide justification for a marketing campaign to promote this unique fishery both to residents and non-residents.

The paddlefish fishery at Chetopa Dam has both the greatest participation and harvest among paddlefish fisheries in Kansas (Neely et al. 2015). Additionally, it contributed 3%–4% of total recreational harvest of paddlefish in the United States from 2000–2006 (Quinn 2009). As such, it is important to understand dynamics of this this fishery. Data presented herein provide a census of legally-harvested paddlefish from the Chetopa Dam fishery from 1992 to 2006 and afford insight into harvest patterns, size of fish harvested from this fishery, and spatial distribution of successful anglers. Unfortunately, fish check stations to monitor harvest were discontinued following the 2006 snagging season. The predominant issue that forced termination of this program was location of willing contractors to collect information from harvested fish. Beginning in 2007, KDWPT implemented a mail-out survey system to monitor paddlefish fisheries in the state. However, a formal evaluation of this sampling procedure is needed to determine if data quality are similar to those collected with the census procedure. Additionally, data such as sex of harvested fish and effort of all anglers, successful or not, should be collected to fill information gaps exposed in this study. Regardless of how data are collected, continued monitoring will be necessary to ensure that best management practices and suitable conservation measures are applied to protect and enhance this unique fishery.

Acknowledgments

We extend thanks to R. Friggeri for initiating the check station procedure at Chetopa Dam and T. Kyle and T. Stewart for entering data. Comments from G. Mestl, J. Goeckler, T. Mosher, and Q. Phelps, three anonymous reviewers, and the editor (S. Sammons) improved this manuscript.

Literature Cited

Bettoli, P. W. 2011. The recreational snag fishery for paddlefish in Cherokee Lake, Tennessee. Proceedings of the Annual Conference of the Southeastern Association of Fisheries and Wildlife Agencies 65:125–130.

_____, J. A. Kerns, and G. D. Scholten. 2009. Status of paddlefish in the United States. Pages 23–38 *in* C. P. Paukert and G. D. Scholten, editors. Paddlefish management, propagation, and conservation in the 21st century: building from 20 years of research and management. American Fisheries Society, Symposium 66, Bethesda, Maryland.

Bonislawsky, P. 1977. Paddlefish investigation. Kansas Forestry, Fish, and Game Commission, Federal Aid in Sportfish Restoration Project F-15-R-30 Final Report, Topeka, Kansas.

Colvin, M. E., P. W. Bettoli, and G. D. Scholten. 2013. Predicting paddlefish roe yields using an extension of the Beverton-Holt equilibrium yield-per-recruit model. North American Journal of Fisheries Management 33:940–949

Combs, D. L. 1986. The role of regulations in managing paddlefish populations. Pages 68–76 *in* J. G. Dillard, L. K. Graham, and T. R. Russell, editors. The paddlefish: status, management, and propagation. American Fisheries Society, North Central Division, Special Publication No. 7, Bethesda, Maryland.

Dillard, J. G., L. K. Graham, and T. R. Russell, editors. 1986. The paddlefish: status, management, and propagation. American Fisheries Society, North Central Division, Special Publication No. 7, Bethesda, Maryland.

Ditton, R. B., S. M. Holland, and D. K. Anderson. 2002. Recreational fishing as tourism. Fisheries 27:17–24.

Gordon, B. 2009. Paddlefish harvest in Oklahoma. Pages 223–233 *in* C. P. Paukert and G. D. Scholten, editors. Paddlefish management, propagation, and conservation in the 21st century: building from 20 years of research and management. American Fisheries Society, Symposium 66, Bethesda, Maryland.

Hunt, K. M. and S. C. Grado. 2010. Use of social and economic information in fisheries assessments. Pages 425–427 *in* W. A. Hubert and M. C. Quist, editors. Inland fisheries management in North America, 3rd edition. American Fisheries Society, Bethesda, Maryland.

Jennings, C. A. and S. J. Zigler. 2009. Biology and life history of paddlefish in North America: an update. Pages 1–22 *in* C. P. Paukert and G. D. Scholten, editors. Paddlefish management, propagation, and conservation in the 21st century: building from 20 years of research and management. American Fisheries Society, Symposium 66, Bethesda, Maryland.

Jelks, H. L., S. J. Walsh, N. M. Burkhead, S. Contreras-Balderas, E. Díaz-Pardo, D. A. Hendrickson, J. Lyons, N. E. Mandrak, F. McCormick, J. S. Nelson, S. P. Platania, B. A. Porter, C. B. Renaud, J. J. Schmitter-Soto, E B. Taylor, m L. and Warren, Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33:372–407.

Leone, F. J., J. N. Stoeckel, and J. W. Quinn. 2012. Differences in paddlefish populations among impoundments of the Arkansas River, Arkansas. North American Journal of Fisheries Management 32:731–744.

Lewin, W. C., R. Arlinghaus, and T. Mehner. 2006. Documented and potential biological impacts of recreational fishing: insights for management and conservation. Reviews in Fisheries Science 14:305–367.

Morgan, M. R. Hayden, and R. Pierce II. 2012. Social and cultural aspects of paddlefish anglers at Lake of the Ozarks, Missouri. Proceedings of the Annual Conference of the Southeastern Association of Fisheries and Wildlife Agencies 66:42–48.

Neely, B. C., B. M. Pracheil, and S. T. Lynott. 2014. Influence of river discharge on recreational harvest of paddlefish. Fisheries Management and Ecology 21:259–263.

_____, S. F. Steffen, S. T. Lynott, and J. D. Koch. 2015. Review of paddlefish management in Kansas from 1972 to 2013 and implications for future conservation. Journal of the Southeastern Association of Fish and Wildlife Agencies 2:20–27.

Pracheil, B. P., M. A. Pegg, and G. E. Mestl. 2009. Tributaries influence recruitment of fish in large rivers. Ecology of Freshwater Fish 18:603–609.

_____, _____, L. A. Powell, and G. E. Mestl. 2012. Swimways: protecting paddlefish through movement-centered management. Fisheries 37:449–457.

Quinn, J. W. 2009. Harvest of paddlefish in North America. Pages 203–221 *in* C. P. Paukert and G. D. Scholten, editors. Paddlefish management, propagation, and conservation in the 21st century: building from 20 years of research and management. American Fisheries Society, Symposium 66, Bethesda, Maryland.

Scarnecchia, D. L., B. D. Gordon, J. D. Schooley, L. F. Ryckman, B. J. Schmitz, S. E. Miller, and Y. Lim. 2011. Southern and northern Great Plains (United States) paddlefish stocks within frameworks of Acipenseriform life history and the metabolic theory of ecology. Reviews in Fisheries Science 19:279–298.

_____, P. A. Stewart, and Y. Lim. 1996. Profile of recreational paddlefish snaggers on the Lower Yellowstone River, Montana. North American Journal of Fisheries Management 16:872–879.

Schooley, J. D., D. L. Scarnecchia, and A. Crews. 2013. Harvest management regulation options for Oklahoma's Grand Lake stock of paddlefish. Journal of the Southeastern Association of Fish and Wildlife Agencies 1:89–97.

Stancill, W. G., G. R. Jordan, and C. P. Paukert. 2002. Seasonal migration patterns and site fidelity of adult paddlefish in Lake Francis Case, Missouri River. North American Journal of Fisheries Management 22:815–824.

Zeug, S. C. and K. O. Winemiller. 2008. Relationships between hydrology, spatial heterogeneity, and fish recruitment dynamics in a temperate floodplain river. River Research and Applications 24:90–102.