# Assessment of Catch and Exploitation of Largemouth Bass Fisheries in the Lower Arkansas River: Potential Impacts of Competitive Tournaments

**Bradley V. Fontaine,** *Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 N. University, Box 4912, Pine Bluff, AR 71601*

**Clifford P. Hutt,** *Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762*

**Michael A. Eggleton,** *Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 N. University, Box 4912, Pine Bluff, AR 71601*

*Abstract*: Historically, limited information has been available for largemouth bass (*Micropterus salmoides*) fisheries in the Arkansas River downstream of Lake Dardanelle. The objectives of this research were to characterize angler effort, catch, and harvest in the lower Arkansas River for both recreational and competitive tournament anglers and to assess potential impacts of competitive tournaments on Arkansas River largemouth bass fisheries. In October 2007, a 12-month tag-reward study and bus-route creel survey were initiated to generate catch, harvest, and effort statistics for the largemouth bass fishery in Arkansas River Pool 4 (Pine Bluff). Additional surveys were conducted to assess competitive bass tournaments. Estimated angling effort for the year was 60,007 h (24.3 h/ha), of which an estimated 11.9% was associated with competitive bass tournaments. Following adjustment for tag retention, angler non-response, and tagging-associated mortality, adjusted catch and harvest rates of largemouth bass were 69.1% and 13.8%, respectively. When incorporating mortality associated with routine handling and holding of bass by tournament anglers into exploitation estimates, total exploitation in Arkansas River Pool 4 became 19.2% (95% CI, 17.7%–21.1%). In light of the relatively high recreational catch rates and presence of tournament activity, mortality associated with these factors may have the potential to impact the largemouth bass fishery in Arkansas River Pool 4.

*Key words*: largemouth bass, exploitation, catch, effort, creel surveys, tournaments

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Largemouth bass (*Micropterus salmoides*) is an extremely popular sport fish in Arkansas for both recreational and tournament anglers. In Arkansas, 655,000 resident and non-resident anglers fished about 10.8 million days, and spent almost US $420 million while fishing in 2006 (USDI 2006). Recreational angling generated a total economic impact of $812 million on the Arkansas economy in 2006 (American Sportfishing Association 2007), with about 40% of that impact created by black bass anglers. Similarly, competitive bass angling tournaments are popular throughout Arkansas. In a 1987 survey of Arkansas anglers, Arkansas Game and Fish Commission (AGFC) reported an estimated 62,000 anglers participated in at least one competitive fishing event in Arkansas (Area Marketing Research Associates 1988). Almost 48,000 (about 77%) of these anglers were bass anglers participating in bass tournaments, and almost one-third of these anglers fished more than 12 tournaments a year. Subsequent surveys estimated that competitive bass anglers represented approximately 10% of the angling public on Arkansas waters (Responsive Management 2000).

The Arkansas River supports one of the most important fisheries in Arkansas, which includes black basses (*Micropterus* spp.), crappies (*Pomoxis* spp.), and catfishes (*Ictaluridae*) (Limbird 1993). The river contains the most popular black bass fisheries in the state, and because of its location near populated cities such as Little Rock, Conway, Fort Smith, and Pine Bluff, it is the site of numerous competitive bass tournaments (Arkansas Tournament Information Program) [ATIP] 2005). In 2005, the ATIP reported that at least 24,616 anglers fished a total of 193,284 h in 445 competitive largemouth bass tournaments in Arkansas waters (ATIP 2005). Approximately one-third of these tournaments were on the Arkansas River, and almost two-thirds of those tournaments were in either Lake Dardanelle (Pool 10 at Russellville) or Pool 13 (Ft. Smith) (ATIP 2005).

Using mathematical models that simulated tournament-associated mortality impacts on largemouth bass fisheries, Allen et al. (2004) suggested that when tournament activity was high in a system (defined as tournament catches greatly exceeding recreational harvest), fisheries managers should incorporate tournament-associated mortality into management strategies. Although AGFC stated that bass tournaments were not believed to be adversely impacting bass populations in any Arkansas waters, they emphasized the need for continued monitoring of bass tournament weigh-in and release procedures and continued development of the ATIP database (AGFC 2002).

Despite the significance of largemouth bass fisheries, previous research in the Arkansas River system has been limited, especially outside of Lake Dardanelle. In 2004–2005, a comprehensive stock assessment was completed for both largemouth bass and spotted bass in all 11 pools of the Arkansas River (Batten 2008), but this

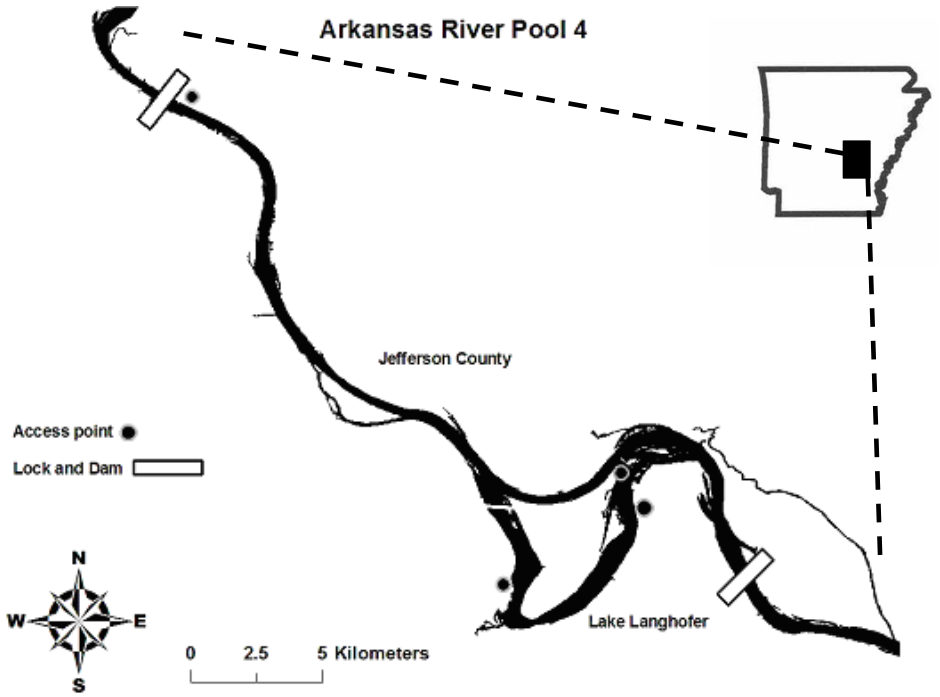


**Figure 1.** Map of Arkansas River Pool 4 with access sites marked.

study focused on the biological aspect of the fishery and not the angler aspect. Previously, there have been no evaluations characterizing angler effort, catch, and harvest of largemouth bass in the lower Arkansas River, and only one 12-month survey in Lake Dardanelle upstream. This lack of information has the potential to hinder fisheries management in that the catch and harvest aspects of the fishery are poorly understood. Thus, the objectives of this study were to (1) generate estimates of effort, catch, and harvest (exploitation) for lower Arkansas River largemouth bass fisheries, (2) apportion largemouth bass catch and angling effort between recreational and tournament anglers; and (3) assess the potential for competitive bass tournaments to impact lower Arkansas River largemouth bass fisheries. These objectives were consistent with research needs identified by AGFC in their Largemouth Bass Management Plan (AGFC 2002). Arkansas River Pool 4 was selected as a representative pool for the lower Arkansas River.

## Methods

### Study Area

Pool 4 of the Arkansas River is a typical run-of-the-river navigation pool located in the Pine Bluff area of southeastern Arkansas (Figure 1). Pool 4 has a surface area of 2,473 ha and contains 12 significant backwaters off of the main river channel and a large section of cut-off channel that is connected to the main river channel (Lake Langhofer). The Lake Langhofer region is presumed to contain the majority of the largemouth bass angling effort in this pool (AGFC, personal communication). Although uncommon, anglers can access the river in Pool 4 and lock through to other pools of the river. Since 1997, a 381-mm minimum length limit has existed for largemouth bass throughout the Arkansas portion of the Arkansas River.

### Estimation of Angling Effort

A 12-month creel survey was initiated on Pool 4 in October 2007. Surveys were conducted with a bus-route design (Pollock et al. 1994), which is unique to angler creel surveys and provides for more precise estimates when angling effort is widely distributed among multiple access points (Soupir et al. 2006). This bus route utilized three of the four access sites available in Pool 4 (Figure 1). One access site located at the north end of the pool just below the upstream lock and dam was excluded from the bus route because pilot surveys conducted there during 2007 indicated almost no use of this access point and none by bass anglers. The lack of use of this access site was likely due to its remote location away from main highways and primary bass habitats utilized by anglers downstream.

The bus-route design used a two-stage stratified random sampling design following Malvestuto (1996), with days (weekends / weekdays) as the primary sampling unit and shifts (morning / afternoon) as the secondary sampling unit. All sampling units were

sampled with equal probabilities following Pollock et al. (1994). Four creel shifts—two weekday and two weekend—were randomly selected per two-week interval throughout the year. Shifts were 6 h in length from March through October and 5 h in length from November through February. Prior to the survey, multiple pilot counts were conducted along the bus route in spring and summer 2007 to determine exact travel times between access sites, and conduct counts of boat trailers at each site to rank access sites by their level of use. Access site rankings and travel times were then used to generate the bus-route schedule to ensure the creel clerk spent appropriately more time at access sites receiving the greatest angler use (Pollock et al. 1994). Daily shift schedules were determined by randomly selecting a starting point within the shift (minute) along the cumulative route time. The creel clerk began each shift at the randomly assigned starting minute and completed the entire loop of the bus-route schedule from that point forward. This scheme ensured that the creel clerk could be at any access point along the bus route at any time during a given shift. At each stop along the bus route, instantaneous and cumulative trailer counts were conducted. Anglers were surveyed as they ended their angling trips in order to quantify mean daily party size, length of completed trip, total bass catch, and total bass harvest. These estimates were expanded to estimate mean daily catch per unit effort (CPUE), catch, and harvest statistics following Pollock et al. (1994).

## Recreational Catch and Harvest

In September 2007, a 12-month tag-reward study was initiated concurrent with the creel survey to generate estimates of largemouth bass catch and harvest as percentage of fish caught or harvested. During a 3-week period in September 2007, 845 largemouth bass 330-mm total length and greater were captured during daytime with boat-mounted electrofishing and tagged with a white 76-mm Floy T-bar anchor tag. Individuals between 330 and 381 mm total length (TL) were below the legal length limit for the Arkansas River. These represented 47% of the individuals tagged, but many were expected to grow into the legal size range during the tag-reward study based on growth modeling conducted by Batten (2008). This modeling indicated that Pool 4 bass were on average aged 2.3 years at 330 mm TL and 3.2 years at 381 mm TL, which corresponded with bass at 330 mm TL growing into the legal size range in approximately 0.9 years (about 10.8 months) on average. Thus, a significant proportion of the sub-legal sized bass were expected to become legal-sized during the course of the survey given even average growth. Captured bass were measured for total length and held in live wells (aerated as needed), tagged just below the back dorsal fin on the left side within 30 minutes of capture, and released in the vicinity of where they were captured. Bass were usually captured, tagged, and released in batches of 5–10 individuals.

The T-bar anchor tags were coded with a unique number, notation of "REWARD," and a 1-800 phone number to the AGFC Monticello field office. Upon calling the number, anglers were asked to report the tag number, approximate fish length, capture date, approximate capture location, whether they were bank or boat anglers, whether they harvested or released the bass, and whether the angler was participating in a competitive tournament. Anglers were then instructed where to mail the tag to obtain the cash reward. Tag rewards ranged from $10 to $100 and were paid for every tag returned in the mail. Cash rewards were allocated as $10 (49% of the tags at large), $20 (48%), $50 (2%), and $100 (1%). The tag-reward study was announced with signs posted at all access points, marinas, and area bait shops, and short articles in the local newspaper and on the AGFC website. Signs at access points were replaced throughout the year as needed. These announcements were meant to inform anglers of the purpose of the tags when recovered, but were not done at such a high level so as to bias effort with anglers seeking cash rewards (e.g., Murphy and Taylor 1991). Anglers became aware of the actual amount of their cash rewards when they received their reward check in the mail. Access point signs informed anglers only of the overall range of the cash rewards, and when calling in tags to AGFC, anglers were told by the dispatcher that rewards were randomly assigned later. These measures were used to minimize non-responses by anglers that knew in advance they would receive a smaller cash reward.

From the tag return data, exploitation of largemouth bass was determined as:

$$\mu = R / M$$

where $\mu$ = exploitation rate (as % of total bass tagged), R = total number of tag returns from harvested bass, and M = total number of tagged bass in the river (Slipke and Maceina 2006). The resulting exploitation estimate was adjusted for tag retention, angler non-response, and tagging-associated mortality. Approximately 15% of the bass were double-tagged to assess tag retention rates. Tag retention was calculated as one minus the number of single-tag returns from double-tagged bass divided by the total number of double-tagged bass (Muoneke 1992, Miranda et al. 2002). Angler non-response was determined as the number of tags observed during routine surveys that were *not* returned by anglers to AGFC for reward divided by the total number of tags observed during surveys. Tagging-associated mortality was assessed by returning 56 randomly collected bass to the laboratory (half tagged, half not, all ≥330-mm TL) and holding them in freshwater recirculating tanks for a period of six days. Untagged bass were held in tanks to assess whether mortality resulted from tagging (which included

**Table 1.** Monthly total angling effort and total largemouth bass (LMB) angling effort with effort densities derived from creel surveys (n = 411) in Arkansas River Pool 4, 2007–2008.

| Month | Effort (95% CI) (h) | Effort density (95% CI) (h/ha) | % LMB effort | LMB effort (95% CI) (h) | LMB effort density (95% CI) (h/ha) |
|---|---|---|---|---|---|
| Oct 07 | 3,204 (1,759–4,649) | 1.30 (0.71–1.88) | 0.43 | 1,377 (756–1,999) | 0.56 (0.31–0.81) |
| Nov 07 | 1,044 (216–1,872) | 0.42 (0.09–0.76) | 0.20 | 209 (43–375) | 0.08 (0.02–0.15) |
| Dec 07 | 1,287 (–86–2,260) | 0.52 (–0.03–1.08) | 0.53 | 682 (–46–1,410) | 0.28 (–0.02–0.57) |
| Jan 08 | 1,143 (302–1,984) | 0.46 (0.12–0.80) | 0.76 | 869 (230–1,508) | 0.35 (0.09–0.61) |
| Feb 08 | 1,650 (–87–3,387) | 0.67 (–0.04–1.37) | 0.90 | 1,485 (–78–3,048) | 0.60 (–0.03–1.23) |
| Mar 08 | 5,061 (3,205–6,918) | 2.05 (1.30–2.80) | 0.70 | 3,543 (2,243–4,842) | 1.43 (0.91–1.96) |
| Apr 08 | 2,563 (–109–5,234) | 1.04 (–0.04–2.12) | 0.26 | 666 (–28–1,361) | 0.27 (–0.01–0.55) |
| May 08 | 12,680 (6,911–19,196) | 5.13 (2.49–7.76) | 0.39 | 4,945 (2,404–7,487) | 2.00 (0.97–3.03) |
| Jun 08 | 11,785 (6,164–16,658) | 4.77 (2.79–6.74) | 0.55 | 6,482 (3,801–9,162) | 2.62 (1.54–3.70) |
| Jul 08 | 10,707 (6,726–14,687) | 4.33 (2.72–5.94) | 0.55 | 5,889 (3,699–8,078) | 2.38 (1.50–3.27) |
| Aug 08 | 6,055 (3,484–8,627) | 2.45 (1.41–3.49) | 0.53 | 3,209 (1,847–4,572) | 1.30 (0.75–1.85) |
| Sep 08 | 2,829 (1,490–4,168) | 1.14 (0.60–1.69) | 0.56 | 1,584 (835–2,334) | 0.64 (0.34–0.94) |
| Totals | 60,007 (29,975–90,400) | 24.3 (12.12–36.41) | 0.53 (mean) | 30,940 (15,706–46,175) | 12.5 (6.35–18.67) |
| Tournament totals | | | 1.00 | 7,116 | 2.88 |

handling and holding), or handling and holding alone (Dunning et al. 1987). This trial was conducted during two weeks in May 2008, when ambient laboratory water temperatures (24 C) were nearly identical (± 1 C) to Arkansas River water temperatures both during the tagging event (September 2007) and the tagging mortality trial (May 2008). All other aspects of the tagging and handling between the mortality trial and the actual tagging event were as identical as possible. Largemouth bass catch statistics were generated identically as above, other than bass caught was used instead of bass harvested in computations.

### Tournament Effort and Catch

Competitive bass tournaments could not be effectively surveyed using the bus-route design. Bus-route surveys did on occasion coincide with tournament weigh-ins, but these occurrences were rare. Tournaments did not take place randomly throughout the week and year, and larger tournaments (e.g., >20 boats) were exclusive to weekends and always at the same access point. Therefore, competitive tournaments were surveyed through an additional set of non-random surveys that were conducted primarily on Saturday and Sunday afternoons from 1500–1700 hours. This time interval corresponded to the principal weigh-in times for Pool 4 tournaments during the 2008 season.

Surveys were completed for all tournaments that could be learned about in advance. Initially, contacts were made with local organizers, bass clubs, and other individuals, and a tentative schedule of Pool 4 tournaments was developed for the entire year. All of these tournaments were surveyed. However, there were still several smaller tournaments (e.g., 5–10 boats) that were less organized, not announced in advance or publicized, and occurred on irregular schedules. These tournaments typically occurred on weekday evenings, and lasted no more than 3 h. Few of these tournaments were surveyed. Thus, because it was not possible to generate an advance schedule containing all Pool 4 bass tournaments for the entire year and because they were non-randomly sampled, resulting estimates of tournament effort and catch are underestimates. However, because it is highly likely that the tournaments surveyed encompassed the vast majority of tournaments and tournament effort, and included all of the larger, more organized, and widely publicized tournaments, the underestimates were expected to be small.

At each tournament, as many anglers were surveyed as possible (50% of participants at least). Anglers reported the number of bass they caught during the tournament, including bass that were weighed in and those caught and released during the day's angling. Tournament organizers provided the total number of boats and angler participants for each tournament. Tournament effort was calculated as the number of angler participants multiplied by the length of the tournament in hours. Tournament catch was calculated as the sum of all bass caught by tournament anglers during the tournament hours. Using the estimates of tournament effort and catch collected as described above, the percentage that both contributed to total angling effort and total bass catch in Pool 4 were determined for the 12-month survey period.

## Results

Creel surveys conducted during 2007–2008 surveyed 411 recreational anglers during 98 shifts. Based on the trailer counts and

**Table 2.** Monthly total largemouth bass (LMB) catch, catch density, harvest, and angler catch per unit effort (CPUE) derived from creel surveys ($n = 411$) in Arkansas River Pool 4, 2007–2008.

| Month | LMB Catch (95%CI) (*n* bass) | LMB Catch density (*n* bass/ha) | LMB Harvest (95% CI) (*n* bass) | CPUE (*n* bass/h) |
|---|---|---|---|---|
| Oct 07 | 280 (154–406) | 0.11 | 39 (21–56) | 0.203 |
| Nov 07 | 4 (1–8) | 0.00 | 1 (0–1) | 0.021 |
| Dec 07 | 697 (–47–1,441) | 0.28 | 96 (–6–199) | 1.022 |
| Jan 08 | 604 (160–1,048) | 0.24 | 83 (22–145) | 0.695 |
| Feb 08 | 2,127 (–112–4,365) | 0.86 | 293 (–15–602) | 1.432 |
| Mar 08 | 1,428 (904–1,952) | 0.58 | 197 (125–269) | 0.403 |
| Apr 08 | 100 (–4–204) | 0.04 | 14 (0–28) | 0.150 |
| May 08 | 653 (317–988) | 0.26 | 90 (44–136) | 0.132 |
| Jun 08 | 1,257 (738–1,777) | 0.51 | 174 (102–245) | 0.194 |
| Jul 08 | 3,645 (2,290–5,000) | 1.47 | 503 (316–690) | 0.619 |
| Aug 08 | 1,589 (914–2,263) | 0.64 | 219 (126–312) | 0.495 |
| Sep 08 | 825 (435–1,216) | 0.33 | 114 (60–168) | 0.521 |
| Totals | 13,208 (5,749–20,668) | 5.34 | 1,823 (793–2,852) | 0.29 (mean) |
| Tournament totals | 7,241 | 2.93 | N/A | 0.57 (mean) |

creel surveys, total annual fishing effort (with 95% confidence intervals) in Arkansas River Pool 4 during the period October 2007–September 2008 was 60,007 h (29,975–90,040) (Table 1). Effort density by anglers averaged 24.3 h/ha (12.1–36.4) (Table 1). Angler effort was lowest during November–February period (mean 1,281 h/m) and peaked during the May–July period (mean 11,724 h/m/month) (Table 1). Largemouth bass anglers accounted on average for 53% of all angling effort on Pool 4, which translated to 30,940 h (15,706–46,175) or about 12.5 h/ha (6.4–18.7) of intended effort (Table 1). Total annual largemouth bass catch was 13,208 (5,749–20,668) bass (Table 2); annual bass harvest was estimated to be 1,823 (793–2,852) bass (Table 2). Mean monthly bass catches ranged from a low of 4 bass (0.9–7.9) in November to 3,645 bass (2,290–5,000) in July (Table 2). The November 2007 estimate was believed to be biased low because of the low number of anglers surveyed that month and the low bass catch rates of the anglers surveyed. Unusually low effort and bass catches in April 2008 were due to extreme flood conditions in the lower Arkansas River during that month, which kept small-craft advisories in effect and access points closed for much of the month. For recreational anglers, mean party CPUE for bass was 0.49 bass/h and mean angler CPUE for bass was 0.29 fish/h (Table 2).

From the tag-reward study, 240 of the 845 (28.4%) tagged largemouth bass were reported as caught by anglers. Of the 240 bass, 48 were harvested by anglers, which equated to an exploitation rate of 5.7%. Catch and exploitation rates of bass that were legal-sized at the time of tagging (i.e., legal sized during the entire 12-month study) were similar at 27.0% and 6.6%, respectively. Correction factors for angler non-response, tag retention, and tagging-associated mortality were applied to the original estimates derived from the entire sample of 845 tagged bass. Angler non-response was calculated at 42.1%, as 8 of 19 tags observed during regular creel surveys were not returned by anglers. Tag retention rate was calculated as 71.0%, as 22 of 31 double-tagged fish returned by anglers contained two tags. Laboratory trials indicated tagging-associated mortality to be 0%, with no tags lost during these trials. After corrections were applied, annual catch rate of largemouth bass was estimated to be 69.1%, with annual exploitation estimated to be 13.8%.

Surveys of tournament anglers included 212 anglers surveyed from 12 tournaments on Pool 4 during the period October 2007–September 2008. During this period, an estimated 910 anglers fished 7,116 h in competitive bass tournaments on Pool 4 (Table 1). Of the 910 tournament anglers, 348 of these participated in a major 3-d tournament known as the "Arkansas Big Bass Bonanza," which had over 1,000 anglers participating throughout the river. For tournament anglers, mean party CPUE was 1.02 bass/h and mean angler CPUE was 0.57 bass/h from the tournaments surveyed. Tournament anglers caught an estimated 7,241 bass in Pool 4 during tournaments throughout the year, with 1,929 (27%) being legal-sized fish and 1,516 (21%) bass being weighed in.

## Discussion

The annual exploitation rate of 13.8% for largemouth bass for Arkansas River Pool 4 was comparable to other estimates in the contemporary literature. Historically, largemouth bass fisheries nationwide have been more harvest oriented, but harvests have been declining nationally for 25 years (Noble 2002). Allen et al. (1998) compiled 35 estimates of largemouth bass exploitation (μ) collected from 1953 to 1989 that ranged from 9% to 72% and averaged 35%. More recently, Allen et al. (2008) compiled 32 estimates of μ collected since 1976, and reported that mean exploitation from these studies had declined from 35% during 1976–1989 to 18% during 1990–2003. O'Bara et al. (1999) reported 16%–23% exploitation for largemouth bass in Norris Reservoir, Tennessee. Slipke et al. (2003) reported spring and early summer exploitation rates to be 10%–15% for largemouth bass in Wheeler Reservoir, Alabama. Keefer (1988) reported 14%–25% exploitation of largemouth bass in several Georgia lakes in the early 1980s. Allen et al. (2008) further surmised that exploitation rates in most current-day largemouth bass fisheries ranges between 15% and 25%. Thus, the annual exploitation rate of 13.8% estimated for Pool 4 was comparable to national trends. The estimate also was consistent with goals in AGFC's Largemouth Bass Management Plan, which aims for an exploitation of <25% for Arkansas' black bass fisheries.

The annual largemouth bass catch rate of 69.1% was high compared to estimates from other impounded river systems, which

ranged 20%–57% (Novinger 1987, Renfro et al. 1997, O'Bara et al. 1999). This result suggested that although a modest proportion of bass are being harvested each year from Pool 4, a relatively high proportion of bass population is susceptible to being caught by anglers which necessitates additional handling and holding stresses and hooking wounds for bass (Wilde 1998). During warmer months of the year, these stresses could add significant angling-related mortality to the fishery in addition to harvest.

Adjustments applied to rates of catch and exploitation can lead to uncertainty in estimates. Angler non-response rate (42%) was greater than expected in Pool 4 and based on a small sample ($n = 19$), but the estimate was consistent with previous studies. Larson et al. (1991) reported angler non-response rates of 40%–45% in three Georgia reservoirs from a crappie exploitation study. In a sauger study in Alabama, two different calculation methods resulted in non-response rates of 15% and 73% (Maceina et al. 1998). Generally, angler non-response rates in the 20%–50% range are not uncommon with sport fisheries (see studies cited in Slipke et al. 2003).

Tag retention rates are often reported in the literature as tag loss rates. Tag loss rates for fishes have been reported as time dependent. Slipke et al. (2003) reported T-bar anchor tag loss rates for largemouth bass of 40% after one month and 61% after eight months in Wheeler Reservoir, Alabama. Muoneke (1992) reported 31% after one year for white bass (25% loss of one tag plus a 6% loss of two tags) in Texas. Other studies (e.g., Farman et al. 1982) have assumed tag loss to be negligible. Tag loss rates of 29% reported herein for the lower Arkansas River largemouth bass were not considered excessive and in the middle of the reported range from previous studies.

The effects of competitive bass tournaments on Arkansas River bass fisheries has been a concern for AGFC for two decades but have not been researched to any large degree outside of the creation of the ATIP database. Because competitive live-release tournaments have increased in popularity over the last 30 years (Schramm et al. 1991, Kerr and Kamke 2003), managers have become increasingly concerned that tournament-associated mortality could be affecting largemouth bass fisheries (see reviews in Schramm et al. 1987, Hayes et al. 1995, Wilde 1998). Based on the tournaments surveyed, tournament angler effort comprised at least 11.9% of the total angling effort in Arkansas River Pool 4. This estimate is only slightly greater than estimates from previous AGFC surveys, which indicated that competitive anglers were about 10% of the fishing public in Arkansas. However, although bass weighed in during competitive tournaments comprised only about 11% of the total bass catch for the entire year in Arkansas River Pool 4, actual catches by tournament anglers, which included sub-legal bass that were caught and released and legal-sized bass that were culled, constituted 55% of the total bass catch in Pool 4 during 2007–2008. Thus, tournament angling has the potential to impact the Pool 4 largemouth bass fishery given that tournament anglers catch bass at greater rates than purely recreational anglers (tournament angler CPUE 0.57 bass/h vs. recreational angler CPUE 0.29 bass/h). This impact may be exacerbated in tournaments where handling and weigh-in procedures are less than ideal.

Although the potential for competitive bass tournaments to impact the Pool 4 bass fishery exists, current information does not suggest the impact is significant at present. To simulate the effects of tournament-associated mortality on largemouth bass populations, Allen et al. (2004) used the ratio of tournament catch (i.e., weigh in catch) to total bass harvest (TC / HARV) as an index of tournament-associated mortality. Their modeling results suggested that when TC/HARV ratios exceeded 3.0 for a system, tournament-associated mortality (TM) rates of 20%–30% could induce a 5%–12% declines in the abundance of stock-size (300 mm total length or greater) largemouth bass and a decrease in population size structure. Alternatively, regardless of rate, TM had little effect on bass populations when TC/HARV ratios were <1.0. The computed TC/HARV ratio from Arkansas River Pool 4 during 2007–2008 was 0.83, which fell below the range where significant impacts might exist as suggested by Allen et al. (2004). When examining the 95% confidence limits of HARV in Pool 4 (793–2,852), potential TC/HARV ratios ranged from 0.53 to 1.91. Therefore, if the tag-reward study overestimated HARV, effects of TM could be more significant on the Pool 4 largemouth bass fishery, as TC/HARV ratio would equal 1.9. Results would warrant a closer examination of tournament-associated effects on the largemouth bass population in Pool 4. Alternatively, if HARV were accurate or underestimated, tournament-associated mortality effects on bass abundance and size structure were unlikely in Pool 4 and would be difficult to detect due to statistical power issues discussed by Allen et al. (2004). However, if all bass caught and handled by tournament anglers (including caught and released sub-legal bass and legal-sized bass that were culled) are considered instead of only those weighed-in in the computation of TC, the resulting TC/HARV ratio for Pool 4 was 3.97. This value is at the upper end of the range of values reported by Allen et al. (2004). Thus, if these bass are considered as a component of tournament catches, TM rates could be significantly affecting the Pool 4 bass fishery.

Tournament-associated mortality estimates are common in the literature, though the effects on the fishery have been less frequently attempted. Wilde (1998) reviewed many studies and reported a generalized range of 26%–28%, which included pre- and post-release mortality combined. Holt (2009) reported mean total mortality associated with bass tournaments to be 28% (22%–35%)

from holding cage trials conducted at 57 tournaments in Arkansas during 2002–2003. Half of these trials were conducted for Arkansas River bass tournaments in Lake Dardanelle. If these mortality estimates are applied to tournament catch data from this study, an estimated 2,035 (1,571–2,498) bass died as a result of Pool 4 tournaments during October 2007–September 2008. When incorporating this tournament-associated mortality into the exploitation estimate reported previously (13.8%) as recommended by Allen et al. (2004), exploitation adjusted for tournament catches in Pool 4 becomes 19.2% (17.7%–21.1%), with an average of 28% of the angling-related mortality being attributed to competitive bass tournaments. This figure is still less than the 25% recommended in AGFC's Largemouth Bass Management Plan (AGFC 2002), but it gives a clearer picture of what true angling-related mortality of largemouth bass may be on the lower Arkansas River. An additional consideration is that since legal harvests in the Arkansas River are restricted to largemouth bass ≥381 mm TL, exploitation of larger bass could be greater in some pools with greater angling effort and/or harvest tendencies. However, there was no evidence of this found in Pool 4 as catch and exploitation rates were similar between bass that were legal-sized at the time of tagging (i.e., throughout the entire year) and the entire sample of tagged bass (i.e., including legal-sized and sub-legal individuals).

In summary, largemouth bass fisheries in the lower Arkansas River could be impacted by competitive bass tournaments. Using Pool 4 as a sample study area, exploitation rates were not excessive, but approached 20% when incorporating standard corrections and estimates of tournament-associated mortality from prior research. Although calculations and corrections contain some degree of uncertainty, the observed catch rate suggested that mortality associated with these stresses could be significant for the largemouth bass fishery, especially if tournament activity increases in Pool 4 in the future.

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