

Achieving High Survival of Tournament-caught Black Bass: Past Efforts and Future Needs and Opportunities

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Abstract: Rapid growth of black bass (*Micropterus* spp.) tournaments in the 1960s and 1970s caused concern among fisheries managers and anglers about the impacts of tournament-caused mortality on bass populations. Tournament organizers voluntarily implemented live-release events in the early 1980s. As catch-and-release practices became more common, procedures to improve the survival of tournament-caught fish were developed and have evolved. The objectives of this paper are to review education and outreach efforts to improve survival of tournament-caught black bass, suggest research needs and opportunities to achieve greater survival, and show the relevance of high survival to contemporary black bass management. Since 1985, a succession of informational products describing those techniques have been developed and distributed to anglers. Although research has confirmed the effectiveness of the recommended procedures and documented that angler and tournament organizer behavior has changed and the survival of tournament-caught black bass has increased, the impacts of the outreach efforts on tournament practices have not been quantified. Continued efforts towards increasing angler awareness of proper handling techniques may benefit from better communication, endorsement by professional anglers, and the use of incentives by state agencies to encourage better fish care.

Key words: angler education, fish care, *Micropterus*, mortality, tournament

Journal of the Southeastern Association of Fish and Wildlife Agencies 2:50–56

Black bass (*Micropterus* spp.) tournaments (hereafter, bass tournaments) originated in the southeastern United States in the 1950s. These early events generally attracted only local attention. The Bass Anglers Sportsman Society (B.A.S.S.) was founded in 1968 as a multi-faceted business that shared black bass fishing information via Bassmaster Magazine and held large tournaments throughout most of the United States. Increasing interest in bass tournaments stimulated formation of other tournament organizations and hundreds of black bass clubs (hereafter, bass clubs), many of which also held multiple tournaments each year.

Black bass fishing regulations, particularly in southern states, were relatively liberal in the 1960s and early 1970s. The increased interest in bass fishing, specifically tournaments, prompted B.A.S.S. to promote the conservation of black bass populations and fishery resources. As a result, a black bass catch-and-release movement was born. The ethic spread among bass anglers and tournament organizers and, by the early 1980s, many tournaments had become live-release events.

In this paper we provide a brief chronology of fisheries research related to survival of tournament-caught black bass and education and outreach efforts to inform anglers and tournament organizers about procedures for improving the survival of those fish. We then address three objectives: (1) to offer suggestions to improve outreach effectiveness in the future, (2) to answer why continued efforts to increase implementation of desirable fish-handling pro-

cedures can be beneficial, and (3) to suggest topics for future research that will provide information to further increase survival of tournament-caught black bass.

Early Research

Fishery managers were concerned about the potential increase in black bass mortality associated with the growing participation in tournaments (Schramm et al. 1991). Initial bass tournament studies focused on the survival of tournament-caught black bass (e.g., Archer and Loyacano 1974, Seidensticker 1974, Holbrook 1975; reviewed in Schramm et al. 1991). Welborn and Barkley (1973) and Plumb et al. (1974) were the first attempts to address the causes of tournament mortality by testing the benefit of treating tournament-caught fish for disease. Throughout the 1980s, studies evaluated relationships of environmental and livewell conditions with black bass mortality (e.g., Schramm et al. 1985, 1987) and consistently found positive correlations between water temperature and mortality. A decade later, a meta-analysis of 130 bass tournaments identified water temperature as the primary factor affecting survival of tournament-caught bass (Wilde 1998).

Despite well-established procedures for handling and transporting fish developed by public and private hatcheries, biologists and tournament organizations were slow to adopt and adapt these procedures to improve the survival of tournament-caught black bass. Carmichael et al. (1984a, 1984b) evaluated procedures for

reducing the mortality of largemouth bass (*Micropterus salmoides*) during handling and transportation. They proposed that the process of harvesting and transporting fish consisted of a series of successive stressors, and the accumulation of stress above some threshold resulted in mortality. Schramm et al. (1987) recognized that handling fish in bass tournaments (capture, livewell confinement, and handling at weigh in) was essentially the same handling sequence as harvesting and transporting fish at a hatchery and proposed that cumulative stress may cause much of the delayed mortality of tournament-caught bass.

As bass tournaments grew in numbers, tournament anglers and organizations evolved and fish handling procedures conducive to higher survival became more common. Weathers and Newman (1997) found bass survival in summer tournaments was greater in well-organized events that implemented “fish-friendly” procedures.

Educational Efforts

Correlations between mortality and environmental and angling variables from a study of 18 tournaments in Florida and experience rearing and transporting fish led to a University of Florida extension bulletin on care of tournament-caught black bass (Schramm 1985). The handbook included guidelines for fish handling, aeration, temperature control, and maintaining water quality (Table 1).

Three years later the Bass Research Foundation (BRF) developed a brochure that described best handling practices for tournament anglers and organizers (Table 1; Schramm and Heidinger 1988). The BRF publication was distributed to all fisheries agencies in the United States and Canada with encouragement to reprint the brochure and distribute to constituent anglers. Florida, Missouri, Iowa, Oklahoma, and Texas printed brochures.

Oklahoma Department of Wildlife Conservation (ODWC) biologists recognized that numerous smaller bass club tournaments could have a greater effect on black bass populations than conspicuous but less frequent larger events but often lacked the means to conduct “fish-friendly” weigh-ins. In 1993, ODWC developed a “weigh-in kit” that consisted of the basic components necessary to conduct a fish-friendly, small-club weigh in (Gilliland 2000). These kits and fish handling instructions were patterned after recommendations made in the 1988 BRF booklet. The concept was widely publicized through bass fishing publications and seminars. Several state agencies developed similar programs, and many incorporated the recommended protocols into tournament permit requirements. Effects of this particular effort were not measured, but it provided a visible demonstration that there were simple actions anglers and tournament organizers could take to improve the survival of released fish.

In a series of controlled studies that combined previously rec-

Table 1. Educational instruments developed help anglers and tournament organizers improve the survival of tournament-caught black bass.

	<i>Keeping Your Catch Alive, 1985</i>	<i>Live Release of Bass, 1988</i>	<i>Keeping Bass Alive, 2002</i>	<i>Keeping Bass Alive, 2009</i>	<i>Keeping Bass Alive Top 10, 2010</i>	<i>Keeping Bass Alive, 2012</i>
Publisher	University of Florida	Bass Research Foundation	B.A.S.S.	B.A.S.S.	B.A.S.S.	B.A.S.S.
Format	Print	Print	Print and Web	Web	Wallet card	Web
Length, pages	6	17	44	8		8
Content						
Biology, why bass die	Yes	Yes	Yes	Yes		Yes
Fish handling	Yes	Yes	Yes	Yes	Yes	Yes
Temperature control	Yes	Yes	Yes	Yes	Yes	Yes
Use of ice	Yes	Yes	Yes	Yes	Yes	Yes
Dissolved oxygen	Yes	Yes	Yes	Yes	Yes	Yes
Water quality, flushing	Yes	Yes	Yes	Yes	Yes	Yes
Livewell construction	Yes	Yes	Yes			
Livewell additives/chemicals	Yes	Yes	Yes	Yes		Yes
Fizzing		Yes	Yes	Yes	Yes	Yes
Weigh-in procedures		Yes	Yes	Yes		Yes
Releasing fish	Yes	Yes	Yes	Yes	Yes	Yes
Fish holding tank/life support tank		Yes	Yes	Yes		Yes
Live-release boats			Yes	Yes		Yes
Encouraging fish care/dead fish penalties		Yes	Yes	Yes		Yes
Alternative tournament formats		Yes	Yes	Yes		Yes

ommended livewell operating protocols, Gilliland (2000) confirmed mortality was higher in summer tournaments but was reduced when anglers used ice to cool livewell water, added salt, and used supplemental aeration. These results received significant exposure in national fishing publications.

Recognizing the continued need to improve fish care among a growing legion of tournament anglers and tournament organizations, B.A.S.S. published *Keeping Bass Alive, a Guidebook for Anglers and Tournament Organizers* (KBA, Table 1; Gilliland and Schramm 2002). More than 10,000 copies were distributed to state

agencies, anglers, and tournament organizers. Although the effectiveness of this educational tool and outreach effort in improving survival of tournament-caught bass cannot be measured, more than a dozen state agencies incorporated the recommendations into their publications and Internet websites and many anglers and tournament organizers have implemented the procedures.

In an effort to recruit professional anglers as spokespersons for proper fish care, competitors in the 2001, 2002, and 2003 Bassmaster Classic tournaments (an annual event in which only limited contestants are invited to participate based on performance in multiple professional tournaments held throughout the preceding year) were briefed on the benefits of proper livewell management procedures described in KBA. Ice was provided to competitors each morning to be used to control livewell temperature, and water temperature and dissolved oxygen levels were measured in the boat livewells at the end of each fishing day. Although these data were not collected as part of a controlled experiment, the effort offered an opportunity to alert and inform professional anglers. It also provided insight into boat livewell design and aeration equipment inadequacies that were later communicated to boat manufacturers.

In 2004–2005, the effectiveness of KBA procedures on the survival of largemouth bass caught in summer tournaments was tested at 12 events throughout the southeastern United States (Schramm et al. 2006). At each tournament, consenting anglers followed the temperature and water quality management procedures recommended in KBA while other anglers followed their usual livewell-management practices. Unfortunately, largemouth bass virus compromised the study and precluded measurement of 5-day post-release mortality. Nevertheless, the study demonstrated that cooling livewell water significantly reduced initial mortality, and several hundred anglers witnessed the benefits of simple livewell management procedures (fish were more vigorous and had better color and thicker mucus layer). The results of the research were summarized in two-page handouts that were provided to tournament organizers who participated in the study. Unfortunately, measuring the long-term effect of the outreach effort was not possible.

In 2009, a second edition of KBA was produced. This version was shorter and published on the B.A.S.S. website, *www.Bassmaster.com*. The procedures recommended in Schramm and Heidinger (1988) and the first edition of KBA were formulated largely on fish physiology and accepted procedures used by aquaculturists for holding and transporting fish. With confirmation that these procedures improved bass survival, it was now possible to make more definitive recommendations for fish handling. Thus, the second edition of KBA retained the “what to do” and deleted much of the bio-

logical and physiological background for “why do it” (Table 1). The graphics were enhanced to make the content more appealing to the reader.

In 2010, the content of KBA was distilled to 10 tips for bass care that was printed on a plastic card the size of a credit card. B.A.S.S. distributed 10,000 of these cards at numerous tournaments, outdoor shows, and the Bassmaster Classic. In 2012, modifications were made to KBA on the B.A.S.S. web site that further pared the content while retaining essential information (Table 1). Plans for the future include the addition of photographs and video clips to better illustrate the KBA procedures.

Most recently, researchers have examined specific topics related to tournament fish care and produced educational outreach materials for the Internet. Texas Parks and Wildlife Department, for example, produced videos on the use of compressed oxygen in livewell management, relieving barotrauma by “fizzing,” and cautions against the use of hydrogen peroxide to temporarily boost livewell oxygen levels (R. Myers, TPWD, personal communication). The Maryland Department of Natural Resources created a special Tidal Bass Home Page with tournament fish care tips (J. Love, MDNR, personal communication)

Conclusions And The Future

There is no simple way to evaluate the impact of any of these educational efforts. Tournament fish care has come a long way in 40 years. Black bass are no longer brought to weigh in on stringers and filleted afterwards. Many anglers and tournament organizers may be more conscious of the need to do what they can to keep fish healthy for live release. However, our conversations with anglers and observations of tournament weigh ins suggest that there are “patches” of well-informed anglers and tournament organizers who make significant efforts to maximize the survival of their catch; but there are many more that are not inclined to change procedures, possibly because they do not see a need. Similarly, some tournament organizations are not willing to risk loss of participation by imposing what they may see as excessive or unnecessary rules or restrictions on anglers. These observations apply to amateur as well as professional anglers and the organizations that host their tournaments.

The reluctance to change is understandable. Stressors, such as low dissolved oxygen or chemical wastes, and essential physiological functions, such as osmoregulation and metabolic recovery, are invisible to anglers. Further, and perhaps more important, anglers do not see the mortality that occurs one to several days after the tournament has ended, so the concept of delayed mortality is very much out of sight and out of mind.

Although potential overharvest was an initial fear among fish-

eries managers (Schramm et al. 1991), no declines in black bass populations have been attributed to tournaments. Results from several studies suggested that tournament-related mortality was <20% of annual fishing mortality (Kwak and Henry 1995, Neal and Clayton-Lopez 2001, Edwards et al. 2004). Driscoll et al. (2007) found largemouth bass exploitation resulting from tournaments was less than exploitation by catch-and-release bass anglers or harvest-oriented anglers on Lake Sam Rayburn, Texas, a reservoir that supports more than 300 bass tournaments annually. Population modeling studies predict little impact of tournament mortality on black bass populations at present levels of tournament fishing effort (Hayes et al. 1995, Allen et al. 2004), and surveys of fisheries administrators nationwide (Schramm and Hunt 2007) and in southeastern U.S. states (Driscoll et al. 2012) revealed that fish population impacts were the lowest-ranking concern about tournaments. However, Allen et al. (2004) indicated that greater tournament effort or high mortality of tournament-caught fish could impact largemouth bass populations, and Highsmith et al. (2014) attributed reduction of largemouth bass >356 mm to mortality resulting from high annual tournament angling effort at Amon G. Carter Reservoir (17.1 h ha⁻¹ compared to 3.2 h ha⁻¹ at Lake Sam Rayburn).

It is apparent that bass tournaments, at least in their present formats and frequencies, do not threaten most black bass populations. Those that may be at risk are unlikely to attract bass tournaments, and managers can restrict or close these waters to tournaments if necessary. Because there is little concern that tournament mortality causes overharvest, there is no compelling biological need to improve bass survival. And since many anglers and tournament organizers are reluctant to put forth additional effort, it is reasonable to question whether agencies should expend resources on additional research, education, and outreach. In addition, tournament anglers and organizations frequently oppose biologically and socially justified harvest regulations if they are perceived to interfere with the numbers of fish brought to weigh in at conventional weigh-in tournaments (Schramm and Hunt 2007, Driscoll et al. 2012). This is particularly true for regulations such as protected slot limits and maximum length limits intended to provide tournament and non-tournament anglers with larger black bass, regulations that restructure black bass population size structure to make fisheries attractive to tournaments. If live-release tournaments can achieve higher survival of tournament-caught bass, exemptions from regulations may be reasonable and justifiable (see Future Efforts). Thus, efforts to achieve higher survival of protected-size fish and simultaneously develop communication channels and rapport between fisheries management agencies and the tournament sector can pay dividends in the future.

Reasons for attempting to change angler and tournament-organizer behavior and improve survival of tournament-caught bass also has a social component. High mortality should be a concern of fisheries management agencies because the agency will be implicated for allowing poorly organized and run events. However, the benefits of high survival also accrue to tournament anglers and tournament organizations. Tournaments that kill high numbers of fish risk being denied permits in the states that have a permit system. They also risk being banned from access sites by local or municipal leaders and are likely to find local merchants uncooperative. This would be disastrous to large tournament organizations that rely on local citizenry, businesses, and government financial support, lodging and special facilities, and attracting spectators that sponsors expect to see at weigh-ins.

The economic impact of tournament fishing is still another important consideration when imposing procedures to attain high survival of tournament-caught black bass. A single professional-level tournament can generate over \$1 million in economic impacts to a local economy (M. Mulone, B.A.S.S., personal communication). Lower-tier tournaments also are economically significant. Total tournament-related angler expenditures were 74% of total angler annual expenditures of \$32 million on Lake Sam Rayburn, Texas (Driscoll and Myers 2014). Agencies are caught in a quandary. How do they encourage or regulate tournaments to minimize bass mortality without forcing tournament organizers to take their events elsewhere, thus hurting local economies?

Future Efforts

A question that remains is how to ensure that educational efforts are effective in achieving higher survival so both tournaments and fisheries managers can minimize negative public sentiment and black bass resources can benefit. We suggest that there are three choices, and they are not mutually exclusive: (1) make it the right thing to do (i.e., rely on peer pressure), (2) impose regulations, and (3) provide incentives.

Peer pressure is a powerful force, particularly among anglers; indeed, this is how the strong catch-and-release ethic developed among bass anglers and tournaments. A group of iconic professional anglers promoting good fish care and speaking out against poorly-organized tournaments may stimulate action, creating a snowball effect and affecting change.

Hunters have to take a hunter education course to purchase ammunition. These courses are designed for human safety reasons, but they also provide opportunities to instill conservation ethics and respect for public and private resources. Tournament anglers could be encouraged or required to take an angler education course to participate in a tournament. This could be encouraged

or required by the state or, more appropriately, by the tournament organizations. Similarly, tournament organizers could be encouraged to take a tournament organizer course. A problem with this approach is that enforcement will be necessary if the training is required; strategies to stimulate participation will be necessary if the educational efforts are merely encouraged. In either scenario, taking a course on fish handling does not guarantee that fish care and survival will improve in tournaments; but at least the angler or tournament organizer would be exposed to the information that they may have avoided or overlooked.

Incentives are a far more attractive option than regulations. Most state fisheries agencies have been approached by tournament organizations seeking exemptions from current fisheries regulations, and many agencies grant them (Schramm and Hunt 2007, Driscoll et al. 2012). Our own survey of state fishery agencies found 16 agencies provide exemptions from a regulation or rule to tournament anglers or permitted tournaments. Benefits include exemption from daily bag-limits when using live-release boats or trailers, exemption from culling restrictions, or allowing participants to retain fish within or below a protected size limit until weighed and released.

One example of an exemption is the Bass Pass offered by the Kansas Department of Wildlife, Parks and Tourism. This annual permit can be purchased by individual anglers for \$12.50 and allows anglers participating in live-release tournaments from September 1 through June 15 to cull fish and to retain up to two fish above the statewide 15-inch minimum length limit but within a protected length limit. This and similar incentives, many of which could require the tournament anglers and organizers to follow effective fish care protocols or to take angler or tournament organizer courses, establish communication between fishery agencies and the tournament sector. Incentives require follow-up enforcement, but they also provide opportunities to educate anglers and monitor trends in mortality of tournament-caught fish.

Research Needs

Whether high survival is accomplished by peer pressure, regulations, or incentives, a performance standard is needed. What is a reasonable maximum acceptable level of mortality in a bass tournament? And further, how can that level be pre-determined in such a way that agencies can use the information to manage tournaments? Several decades of studies measuring mortality of tournament-caught black bass have demonstrated that mortality increases with temperature (e.g., Wilde 1998), so a single standard for a maximum allowable mortality may not be reasonable for bass tournaments conducted throughout a year. Further, studies by Gilliland (2000) and Schramm et al. (2006) have demonstrated that mortality can be reduced by anglers implementing simple livewell management pro-

cedures during summer tournaments; thus high water temperature is not an excuse for high mortality, and best-case survival should be considered in setting allowable mortality standards.

We cannot address what is reasonable maximum mortality. That is a management agency decision and would be determined by multiple interacting factors. Population models can be used to specify a biologically acceptable maximum mortality for individual or groups of biologically similar black bass fisheries (e.g., Allen et al. 2004), but adverse population effects of bass tournaments are not a conspicuous problem. Societal concerns and perceptions will probably dominate determination of reasonable maximum mortality, and some creative team building will be in order, possibly supported by human dimensions research.

Despite more than three decades of research on mortality of tournament-caught black bass, information about factors affecting mortality needed to provide a basis for establishing reasonable maximum mortality is lacking. Recent research on mortality of tournament-caught walleye (*Sander vitreum*) may serve as a model. As is the case with black bass, various factors have been suggested or found to be associated with walleye mortality, but water temperature is dominant. A threshold temperature (18 C) was identified above which walleye mortality was high despite proactive livewell management (Schramm et al. 2010, Loomis et al. 2013). Managers in Minnesota and South Dakota have used these data to set maximum acceptable mortality thresholds and do not allow live-release walleye tournaments during summer months. Tournaments are allowed, but all fish must be harvested. As there is no biological evidence that the harvest adversely affects walleye populations, the burden of social concerns transfers from the state fisheries agency to the tournament organization. Similar data are needed for black bass populations to provide a basis for reasonable maximum mortality and to better identify, and possibly simplify, livewell management and tournament organization procedures.

Species-specific research is needed to determine factors affecting survival and the effectiveness of current state-of-the-art fish care procedures across the genus. Most studies have focused on largemouth bass, but many tournaments are held in areas where other species of black bass are caught. The few studies that have examined mortality of other black bass species have provided sobering results. Assessment of mortality of tournament-caught black bass in Lake Martin, Alabama, found mortality of Alabama bass (*Micropterus henshalli*; 62%) was twice as high as largemouth bass (Ricks 2006). Results from studies in the northeastern United States estimated tournament mortality of smallmouth bass (*Micropterus dolomieu*) was twice that of largemouth bass (Hartley and Moring 1995, Edwards et al. 2004). These studies were done in the northern part of this species' range. Mortality could be

more severe in the southern portion of the smallmouth bass' range where water temperatures are higher.

Biologists have long been concerned with the concentration of black bass near tournament release sites (stockpiling) that could result in reduced growth and increased vulnerability to capture by anglers less inclined to release fish (Schramm et al. 1991). Studies of dispersal of tournament-caught black bass have indicated variation among species and among populations within species (Wilde 2003, Ricks and Maceina 2008); but, in general, released fish are slow to disperse. Supporting contentions of suppressed growth from stockpiling, relative weight was lower for Alabama bass and largemouth bass and growth rate of spotted bass was lower in the vicinity of a tournament release site where black bass accumulated in Lake Martin, Alabama (Ricks and Maceina 2008). Supporting contentions of higher fishing mortality, Gilliland (1999) found higher black bass harvest rates in the vicinity of a weigh-in site at Lake Thunderbird, Oklahoma (Gilliland 1994). Additional information about conditions that lead to stockpiling are needed to develop guidelines for how tournament organizers release fish.

Tournament anglers are often quick to adopt products and procedures that increase their efficiency and the survival of fish. Numerous livewell additives are available to anglers. Commonly used devices used for identifying individual fish ("culling clips") use a wire clip that is inserted through gular membranes leaving a large hole or tear than may interfere with feeding or ventilation (breathing). As an alternative to fizzing to relieve barotrauma symptoms (hyperbuoyancy), anglers may use weighted clips attached to the anal fin of fish exhibiting hyperbuoyancy with the idea being that the weight will keep the fish in an upright position in the livewell, thus reducing stress and making the fish more likely to be able to swim back to depth after release. Despite marketing claims, scientific evidence is lacking about the actual effect on survival of these and other products and procedures, and studies are warranted so fisheries agencies can make authoritative statements about their suitability for improving the survival of angler-caught fish.

Fears that bass tournaments might jeopardize black bass fisheries have largely been dismissed by research and the test of time. Indeed, many fishery managers recognize benefits of bass tournaments to their agency and to fishery management (Schramm and Hunt 2007, Driscoll et al. 2012). Although there are fisheries where high adverse effects of high tournament effort could be reduced by reducing mortality of tournament-caught bass, it appears that black bass mortality in most present-day bass tournaments is sufficiently low to reduce or even eliminate the need for management from a biological perspective. However, engagement by agencies in some form of tournament management and continued efforts to achieve the highest possible survival of tournament-caught bass

provides positive reinforcement of conservation efforts to other anglers, to the sportfishing industry, and to the larger public. Conservation of black bass resources provides an excellent opportunity for fisheries managers and anglers to work together for a common and mutually beneficial goal. Partnerships and communication channels that result can benefit future fisheries management efforts in many ways, including establishment of harvest regulations intended to improve the size of black bass available to anglers.

Acknowledgments

We thank Todd Driscoll, Wes Porak, and three anonymous reviewers for constructive comments on previous versions of this manuscript. Funding for this study was provided by the U.S. Geological Survey Mississippi Cooperative Fish and Wildlife Research Unit; the Mississippi Department of Wildlife, Fisheries, and Parks; Mississippi State University; and B.A.S.S., LLC. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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