On Improved Care of Black Bass During Live-Release Competitive Angling Events – Recent Innovations and Associated Research Needs

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On occasion, there are changes that have the potential to disrupt the *status quo* — even in the fishing world. Here we describe the emerging release-at-capture format of competitive black bass *Micropterus* spp. fishing events that is growing in popularity within the recreational fishing community and represents such a potential change. We briefly contrast this newer format with traditional weigh-in formats (where fish are retained in livewells then delivered to a central weigh-in site) with a focus on fish care. We consider various challenges and opportunities with the release-at-capture format and identify research needs to better understand how this format can potentially be rolled out more broadly (including to smaller club events) and the benefits (if any) of doing so.

Organized competitive black bass fishing events have been around since at least the 1950s (Schramm et al. 1991) although informal competitions probably extend back to the beginning of the 1900s or earlier. Today, it is almost unheard of for a black bass competitive event to intentionally harvest a fish. Indeed, most events require proof of a functional livewell (often verified by organizers at the start of each competition day) and penalize competitors for bringing in fish that are moribund. The general format for competitive bass fishing events has been rather consistent through time. During a competition day, anglers catch bass in an attempt to collect the biggest "bag" of fish by mass. In the past ~25 years, the bag limit has typically been between four and six bass per day. Captured fish, often beyond a minimum size (usually in the range of 12–15 in/30–38 cm) are held in livewells. When the angler achieves their limit they will begin to "cull," whereby they release the smallest fish and retain larger individuals. At the end of the tournament day, anglers deliver their fish to a central weigh-in site where fish are typically transferred to a heavy-duty, water-filled bag to move them to the weigh scales. Fish are then weighed (either in air or using a water weigh-in system [Tufts and Morlock 2004]) and either immediately released or held for a short period to enable processing (e.g., tagged for scientific or management purposes; stockpiled awaiting sufficient numbers of fish to transport/release) and eventually returned to the waterbody, either being released at the weigh-in location or transported to one or multiple sites away from the weigh-in site. There has been much research on how to optimize livewell conditions (Cooke et al. 2002; Suski et al. 2005, 2006; Ostrand et al. 2011) and the weigh-in procedures (Weathers and Newman 1997; Suski et al. 2004; Tufts and Morlock 2004) to benefit fish. Similarly, there has been much research on the consequences of displacing bass from their site of capture (reviewed in Wilde 2003) with some tournament organizers using live release boats or even trucks to distribute fish around the waterbody at the conclusion of the fishing day. Other work has explored how the timing of tournaments (e.g., during the spawning period) influences bass reproduction (Siepker et al. 2009).

All of these aforementioned studies, combined with angler ingenuity and the goodwill of competitive events organizers, have led to guidelines for competitive fishing events for black bass (see Schramm and Gilliland 2015). The most well-known such document was produced by the Bass Anglers Sportsman Society (B.A.S.S.) and has been updated several times, recognizing continual improvement in procedures (Schramm and Heidinger 1988; Gilliland and Schramm 2002). Despite these efforts, issues still remain that can cumulatively result in negative impacts on angled fish. For example, a failure in livewell function during a tournament can impede fish survival. On some days, water temperatures are simply too high such that even the best efforts at fish care are insufficient for survival (Wilde 1998). Temperature shock can also occur where, for example, an angler catches a smallmouth bass at depth in the morning at say 15°C and then spends the afternoon fishing for largemouth bass in a shallow bay that is 28°C. Fish captured at depth may also suffer from barotrauma with prolonged retention at the surface (i.e., in a livewell) exacerbating the condition (Morrissey et al. 2005; Gravel and Cooke 2008). Research would also suggest that some remedies used by anglers to supposedly improve holding conditions in a livewell can actually cause more harm than good if not monitored properly (i.e., excessive use of ice or chemical additives, over-oxygenation of water; Cooke et al. 2002; Suski et al. 2006; Shultz et al. 2011; Sullivan et al. 2015). There are also potential issues with disease transfer among fish given that they are held in proximity in a livewell (Steeger et al. 1994; Schramm et al. 2004; Schramm and Davis 2006), as well as physical injuries from abrasion (Steeger et al. 1994; Colotelo and Cooke 2011) or trauma (Suski et al. 2005). Finally, displacement issues remain, and, although efforts have been devoted to building communal live release boats, they do not return fish to their original site of capture, but rather serve to reduce the number of fish stock-piled at a single release site. Despite these issues, bass tournaments are regarded as having minimal negative impacts on bass populations where such studies have occurred (e.g., Driscoll et al. 2007; Hysmith et al. 2014), although there is need for more assessments on the population-level consequences of live-release tournaments (Kerns et al. 2012) and social concerns remain. Moreover, climate change may require anglers and tournament anglers to adapt to continue to achieve high rates of survival given that there is positive relationship between water temperature and both initial and delayed tournament mortality (Wilde 1998).

Of late there have been a number of new developments in competitive angling events that are worthy of consideration from the perspective of fish care, particularly in a warming world. Specifically, some events are now run in a manner whereby fish are immediately released at the site of capture, eliminating the period of livewell holding. With this format, fish are weighed (or measured) immediately after landing with digital images (either video or photographs; see Wegman 2019 for overview; Figures 1 and 2) and are then returned to the water. At more sophisticated events, there is an on-board referee/scrutineer, with data (and imagery) transmitted in real time to an event operations centre. Such information can thus be shared in real time with other participants and the broader public (e.g., via television or the internet), creating new marketing/publicity opportunities. Most notably has been the emergence of the Major League Fishing series (MLF; see https://majorleaguefishing.com/; note that MLF is in the process of merging with Fishing League Worldwide [FLW], which emphasizes that there may be additional rapid developments in the tournaments fishing world; https://www.flwfishing.com/news/2019-10-10-major-league-fishing-to-acquire-flw). In such a format, live video streams come in from fishing boats with television producers switching the feed to where the action is (when someone, especially one of the leaders, hooks a fish). Commentary is provided and there is often a large screen on a stage where the public can watch the event. This format arguably engages more individuals for longer periods than typically occur with more traditional tournament formats. Yet, there are also examples of this same general approach working for smaller events where livestreaming is not practical. Simple cellular telephone apps (e.g., http://fishproquo.com/ and http://score

Figure 1. Bass can be weighed on standardized scales. In this image a scrutineer holds the scale. Immediately afterward, the fish is weighed it is released. Video is streamed from the boat to a live TV production facility. Photo Credit: Major League Fishing.

trackerlive.com/) can be used for sharing catches, then at the end of the day the anglers meet up at an award ceremony.

From the perspective of a fish, a release-at-capture event is quite different. They are not held in a livewell. They are not exposed to other bass. They are not culled. They are not weighed in at a central location. And they are not displaced from the site of capture. This approach inherently reduces the risk of initial, short-term and delayed mortality, whether it be from equipment failure (livewell or at the weigh-in site), environmental conditions, disease, or the cumulative impact of multiple stressors experienced during an angling tournament. The fish does still have to be weighed (or measured), and this is typically done in air, although in watching a number of these events (on television and YouTube), it is rare that the total time a fish is out of water from when it was landed until when it is released (after weighing) exceeds 1 min (e.g., see examples of video from Major League Fishing; available: https://www.youtube.com/watch?v=1QotHAROFqs). There is a physiological cost to repeated handling and disturbance during a typical tournament day. For example, angling equates to exercise for fish, and results in physiological disturbances, but these disturbances will recover with 3–4 h of rest (Cooke et al. 2002; Suski et al. 2003, 2004). Livewell confinement has the potential to add subsequent stressors for fish, particularly if water quality is poor due to overcrowding,

Figure 2. Bass can be measured on a standardized board with an identification badge used for scale and to validate the catch. Immediately after the fish is measured it is released. This approach can be used on small vessels including a kayak, as in this photo. Photo Credit: Michael Cox.

thermal stress, or low oxygen. If fish are weighed in air at a central weigh-in site, a fish that may have virtually "recovered" from angling stress during livewell retention (assuming livewell conditions are adequate) is challenged physiologically immediately prior to its release by air exposure and handling (Cooke et al. 2002; Suski et al. 2003, 2004). These repeated stressors are eliminated with the release-at-capture approach as stressors resulting from livewell confinement and weigh-in procedure are removed. Moreover, displacement research has suggested that fish displaced long distances may take many months to return to their site of capture, if at all (reviewed in Wilde 2003). Neither the fitness consequences to an individual fish, nor the ecological consequences for moving about top predators are known and would be difficult to quantify. Fish that are caught from depth are also returned to the water quickly, often before the consequences of barotrauma have been fully realized such that the fish can often recompress themselves without fizzing (i.e., the use of a needle or other hollow instrument to release expanded gasses from the swim bladder; Cooke, personal observation). In addition, if tournaments are held during the reproductive period, fish are released near the site of capture rather than displaced. A fish that is displaced from a nest to a central weigh-in site would most certainly experience nest failure (Siepker et al. 2009).

To be clear, innovations in competitive angling events to date have collectively reduced the biological consequences, both improving welfare of individual fish and reducing mortality to the presumed benefit of fish populations. In other words, the "traditional" approach with livewell retention and weigh-in at a central site has benefited from science-based attempts to improve fish outcomes (i.e., the science that was used to generate guidance such as that shared in Gilliland and Schramm [2002] and Tufts and Morlock [2004]). But, compared to the more novel release-at-capture approach, a traditional retention and weigh-in at a central site is inherently more risky for individual fish (perhaps less so for the population based on science to date as per above; e.g., Driscoll et al. 2007) than when they are captured and released immediately. A study of initial mortality (fish dead at weigh-in) of bass entered in professional B.A.S.S. tournaments revealed that mortality (which was overall quite low at <5%) was correlated with bag size, mean fish weight per angler, and number of fish per angler (Wilde et al. 2002), emphasizing how the novel release-at-boat approach has the potential to address all of these issues and lower mortality even further. It is also important to recognize that organizations like B.A.S.S. and FLW have been doing this for decades and have expertise in fish care that may not exist at all tournaments such that the mortality rates, more broadly, are presumably higher than characterized in the Wilde et al. (2002) study.

To our knowledge, while there has yet to be a specific study comparing the outcomes of both event formats, there are some lessons that can be drawn from the non-tournament studies that simply assess capture and immediate release of bass following air exposure. In general, it is known that bass recover physiologically within several hours, even when briefly (~1 min) exposed to air (Gustaveson et al. 1991; Cooke et al. 2003; Thompson et al. 2008; White et al. 2008). In other words, there is no reason to think that the immediate capture, weighing, and releasing of fish at the boat should lead to mortality aside from the usual, but rather minor (for black bass) issues with hooking mortality arising from hooking injury (often 1–2% for black bass; Clapp and Clark 1989; Cooke et al. 2003; Wilde and Pope 2008). Nonetheless, research that directly contrasts different event formats is needed (See Table 1),

particularly to understand their outcomes in future climate scenarios. Similarly, there may be more room for innovation for on-boat events. For example, a transparent, water-filled trough or container could be used to reduce air exposure on boats. Fish could also be measured in a water filled trough (as per Cooke et al. 2005) or clear holding chambers often used for fish photography (so-called "fish viewers;" http://www.dynamicaqua.com/handling_files/fishviewerPic.jpg) by ichthyologists (Howe 1996), or even by some fishing guides in their effort to #keepemwet (Danylchuk et al. 2018). Just like boat manufacturers have incorporated livewells into modern boat designs, there is no reason why additional design features could not be added that would make it easier/better for fish handling for the release-at-capture-site style of tournament. There may also be need to investigate instances of fish being dropped (on boat carpet, which can cause abrasion; Colotelo and Cooke 2011; note that in MLF a penalty is assigned if fish are dropped) and ensure that optimal weigh procedures (e.g., how fish are attached from the scale) do negligible damage to the fish.

Table 1. List of research needs related to the release-at-capture tournament model with a focus on black bass *Micropterus* spp.

Research Needs Related to Release-At-Capture Fishing Tournament Model
• Quantify the energetic and potential fitness costs of the release-at-capture model relative to the traditional weigh-in model across a range of relevant temperatures (including future climate scenarios).
• Understand how multiple-capture events compound over the course of a season or multiple years if some of the largest bass in a waterbody are repeatedly captured for different tournament formats.
• Determine what on-board innovations could help to improve fish care during the weigh/measure process (e.g., potential for on-deck holding).
• Evaluate the consequences of dropping fish or weighing them in air on fish health, condition and survival in release-at-capture events.
• Determine if fish in release-at-capture events benefit from short-term livewell retention—and if so, in what circumstances (e.g., only if unable to maintain equilibrium, only above a given water temperature),
• Evaluate the extent to which the release-at-capture model will reduce mortality at warm water temperatures (now and future temperature scenarios).
• Determine in what, if any scenarios the release-at-capture model is needed to prevent declines in fish populations (i.e., where this becomes a relevant component of fishing mortality).
• Determine if there are particular aspects of tournaments (e.g., waterbody size/depth, weather conditions, time of year/season, size of the competitor pool) for which the release-at-capture method is particularly effective at improving fish condition and survival.
• Determine the extent to which the release-at-capture model could be adopted for competitive events targeting other species to the benefit of the fish (e.g., Walleye *Sander vitreus*).
• Consider gains (e.g., could get size/catch data on a wider range of individuals—not just the biggest fish) and losses (e.g., loss of tagging or aging structure collect opportunities) in terms of fish population monitoring that comes with fish not being delivered to a central weigh-in site.
• Characterize relevant stakeholder (e.g., anglers, sponsors, fans, other waterbody users) perspectives and threat perceptions regarding the release-at-capture tournament model.
• Identify barriers to adoption of the release-at-capture model.
• Determine if the release-at-capture model addresses concerns regarding fish care (relative to convention weigh-in format) among relevant stakeholders and the broader community thus maintaining social license to operate.
• Quantify economic benefits of the release-at-capture model relative to other event styles.
• Determine whether anglers and fans have a preference for using weights or lengths.
• Identify what aspects of event management enable sponsors to achieve their goals while also enabling optimal fish care.

Despite the likely biological (especially for individual fish; i.e., welfare) benefits of release-at-capture events, we acknowledge a number of obstacles that need to be overcome before they experience widespread adoption. For example, weigh-ins at high-profile competitive events can draw large crowds and can serve as the focal point for viewers, with thousands of spectators in stadiums, many of whom presumably come to see live fish and experience the suspense and surprise of a live weigh-in. In many instances, these weigh-ins serve as a way for members of the angling industry, as well as government agencies and NGOs to engage with the public, and can be coupled with booths/exhibits, and other outreach activities. Live weigh-in events can be a boon for sponsors and organizers, resulting in revenues that support the industry, generate advertising dollars, and help sustain competitive events. The ability of a release-at-capture event to generate similar interest would need to be explored. Furthermore, owing to the magnitude of angling events and the potential financial rewards, there is the potential for cheating in any tournament, but this may be exacerbated in release-at-capture events if no scrutineers or observers are on board (see recent example where an angler cut the tail off of one fish and used it to artificially extend the tail region of another in a photo at a measure-photo-release event; https://www.dailymail.co.uk/news/article-6811011/Angler-faces-felony-fraud-charges-allegedly-cheating-10-000-freshwater-bass-tournament.html); eliminating a weigh-in also eliminates the "proof" that an angler caught a fish unless it is streamed live (e.g., on the internet or television). As such there is also need for human dimensions research (Table 1), of which some is presumably being undertaken by marketing experts associated with groups such as MLF. With sufficient interest and motivation, however, we are confident that the angling community can develop creative and meaningful solutions to these problems as the format of a tournament can evolve over time.

Although issues related to welfare of sublethal effects may not be the primary care of fisheries managers (who manage populations and require knowledge of fishing mortality; Cooke and Schramm 2007), it is increasingly important to the competitive angling events community. There is a social license associated with competitive fishing whereby the broader public (including anglers who do not engage in competitive fishing) and—ergo, sponsors—want to know that reasonable efforts are being undertaken to improve the care of captured fish. As scientists and anglers, it is encouraging to see the continual commitment of tournament organizers and participants to both responsible and sustainable recreational fishing. The new approach has the potential to further reduce conflict between competitive bass fishing events and other users of freshwater fisheries resources (Arlinghaus 2005) and is consistent with the concept of developing environmental standards for competitive fishing events (Diggles et al. 2011). It also has the potential to provide tournament organizers with options for adapting to climate change given that warmer water temperatures and other pressures are certain (Elmer et al. 2017).

Despite the potential benefits to at-boat release tournaments, there are a number of possible avenues for research that can benefit individual fish and fish populations. For example, there continues to be the need for research in the area of fish care and livewell design. All angling circuits will not have the resources, capacity, or interest in an at-boat release format, and livewells

likely will be around for the foreseeable future. Unfortunately, the design of livewells has changed very little despite several decades of use, and so we can try to improve those with research related to questions such as livewell placement, dimensions, thermal control, and improved aeration. In fact, even with catch–weigh–release models, there may be value in holding bass for short periods of time (e.g., 15 min) to enable partial recovery from the stress of capture and air exposure during measurement. It also may be possible to use a hybrid approach where some tournaments (e.g., those during the warmest periods of the summer or during the spawn) are the release-at-capture format while during other times of the year, more traditional weigh-ins are used (see https://lakerecord.net/2018/07/19/the-possibility-of-bass-and-flw-moving-to-catch-weigh-release-tournaments/). In other words, there is potential for creativity in how these tools are applied such that it is not necessarily an "all or nothing" approach. The ingenuity of anglers and the popularity of competitive fishing, coupled with engagement of the scientific community, will overcome potential challenges that exist with the release-at-capture approach, and can help this format to grow. This is an exciting time for competitive bass fishing events, and an exciting time for our resource, and we feel that the adoption of at-capture weighing procedures may help to protect valuable fisheries now and in the future.

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