**Assessment of natural movements and dispersal of tournament-displaced *Micropterus***

**species on Neely Henry Reservoir, Alabama.**

by

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**Abstract**

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**Introduction**

Black Bass *Micropterus spp.* are the most sought-after fish by anglers in the United States (Fish and Service 2009; Fish and Service 2018). In 2016, 9.6 million anglers fished a total of 117 million days targeting Black Bass (Fish and Service 2018). While the number of anglers targeting Black Bass has remained similar between 2006-2016 (Fish and Service 2009; Fish and Service 2018), the number of Black Bass tournaments is increasing, especially in the Southeastern United States (Schramm and Hunt 2007; Driscoll et al. 2012). Driscoll et al. (2012) reported that the number of competitive fishing tournaments in the Southeastern United States between 2009-2011 was 41939, a 124% increase in tournaments when compared to estimates from 2002-2004. The state of Alabama alone had an average of nearly 9000 fishing tournaments per year between 2009-2011 with more than 98% of those tournaments targeting Black Bass (Driscoll et al., 2012).

Black Bass anglers tend to be avid anglers and drivers of the sportfishing industry as a whole (Shupp, 2002). On a smaller scale, Black Bass tournaments provide immense value to local economies (Martin et al. 1982; Driscoll and Myers 2014; Snellings 2015; Boozer et al. 2019). Tournaments on Sam Rayburn in Texas were estimated to provide $23.5 million in value to the local economy between November 2007 to October 2008 (Driscoll and Myers 2014). Black Bass tournaments on Neely Henry Reservoir (the location of this study) have been estimated at $10.3 million in 2017 (Boozer et al. 2019). However, despite the economic benefits, the explosion in the number of Black Bass tournaments has raised concern among anglers and managers (Kerr and Kamke 2003; Schramm and Hunt 2007).

One of the main concerns associated with an increasing number of Black Bass tournaments is the potential for overcrowding/stockpiling of fish around popular tournament weigh in sites (Schramm et al. 1991). Overcrowding of fish at release sites has the potential to increase vulnerability to angling and create unnatural accumulations of fish, resulting in decreased body condition and reduced growth (Gilliland 1999; Bunt et al. 2002; Hunter and Maceina 2008a; Maynard et al. 2017). Additionally, because many fish are displaced from spawning areas by tournaments during the spring, reproduction of these populations may be negatively affected by tournaments (Wilde and Paulson 2003; Hanson et al. 2007; Siepker et al. 2009). Recently, some tournament organizations, the most notable being Major League Fishing, have adopted a tournament format where fish are caught, weighed, and released at the capture location (Cooke et al. 2020). This tournament format eliminates the issues associated with overcrowding at weigh in sites and mortality from long periods of time in a live well, however, this format is not yet practiced by many fishing clubs and organizations (Cooke et al. 2020).

Previous research of Black Bass dispersal following tournament capture has been mostly fixated on largemouth bass *Micropterus salmoides* and smallmouth bass *Micropterus dolomieu*. Dispersal patterns of largemouth and smallmouth bass have been variable across studies. Several studies have shown rapid dispersal of translocated largemouth and smallmouth bass and no evidence of long-term stockpiling (Huchzermeyer et al. 2013; Brown et al. 2015; Rupnik, 2018). Conversely, several studies have shown minimal dispersal of released fish from the weigh in site for 1 or more months (Bunt et al. 2002; Wilde and Paulson, 2003). Wilde (2003) summarized 12 studies for smallmouth and largemouth bass and found that 51% of largemouth and 26% of smallmouth remained within 1.6 km of release sites, indicating largemouth may be more susceptible to stockpiling. The large amount of variation in Black Bass dispersal across studies highlights the need to evaluate potential stockpiling on a waterbody-to-waterbody basis. Furthermore, many studies utilize “simulated” angling/displacement events ( Hunter and Maceina 2008a; Brown et al. 2015) or submitted fish to additional stress by preforming surgeries after fish had already gone through the capture and/or tournament weigh in process (Gilliland, 1999; Wilde and Paulson 2003; Huchzermeyer et al. 2013; Maynard et al. 2017; Rupnik 2018), which could bias results.

While tournament dispersal of largemouth and smallmouth bass is well studied, movement and dispersal patterns of Alabama bass *Micropterus henshalli* is not well understood. Alabama bass are native to the Mobile River basin which encompasses parts of Alabama, Georgia, and Mississippi (Rider and Maceina 2015). Alabama bass are a popular sportfish within their native ranges and can make up are large amount of the annual catch by anglers (Rider and Maceina 2015). Ricks and Maecina (2009) found that Alabama bass made up approximately 70% of the total tournament capture on Lake Martin, Alabama. They also make up a large amount of the tournament captures throughout reservoirs on the (but not limited to) Tallapoosa, Coosa, and upper Warrior rivers (Rider and Maceina 2015). Although Alabama Bass are actively caught by anglers throughout their home range, minimal data is available regarding tournament dispersal of Alabama bass. Ricks and Maecina (2008a) found that Alabama bass dispersed at a higher rate than largemouth bass and overall high dispersal rates were observed. Hunter and Maecina (2008a) also found that all Alabama bass moved away from the weigh in site rather rapidly, with no Alabama or largemouth bass being found near the weigh in site after 2 months. Due to the high variation in dispersal for other black bass species (largemouth and smallmouth) it is unlikely that Alabama bass would disperse the same across its native range.

Seasonal movement data of fishes is also a critical part of fishery management. Movement data can inform managers of high use areas, home ranges, critical spawning grounds, overwintering locations, and areas of resource competition between species (Winter 1977; Mesing and Wicker 1986; Karchesky and Bennett 2004; Hunter and Maceina 2008b; Goclowski et al. 2013). Movement patterns of largemouth bass are well studied (Warden Jr and Lorio 1975; Winter 1977; Savitz et al. 1983; Mesing and Wicker 1986; Hunter and Maceina 2008b). However, movement data of Alabama bass in reservoirs is virtually nonexistent. Its close relative, the spotted bass *Micropterus punculatus* has been studied in rivers and streams, but it too remains understudied in reservoirs (Horton and Guy 2002; Horton et al. 2004; Goclowski et al. 2013; Edge et al. 2020). To our knowledge, only one study has utilized telemetry to evaluate Alabama bass movement within a reservoir (Hunter and Maceina 2008b). The objectives of this study are to (1) examine dispersal patterns of tournament caught largemouth and Alabama bass and (2) evaluate seasonal movements of largemouth and Alabama bass in Neely Henry Reservoir. This research should continue to build on what fishery managers already know about largemouth bass and give greater insight into Alabama bass movement and tournament dispersal on large reservoirs.

Chuchill and Bettoli have need for movement data of spotted bass.

**Study Area**

Neely Henry is a 4547-hectare reservoir located in Northeast Alabama (Figure 1). It is the second reservoir located on the Coosa River, located just below Weiss Lake and above Logan Martin Reservoir. It is shallow (mean depth = 3.3 m) and eutrophic with several of its creeks being designated as impaired in 2022 by the state of Alabama’s 303(d) impaired waterbody list. It is a high effort reservoir with an estimated 143 tournaments conducted on the reservoir during the year 2017 bringing in an estimated $10.3 million to Etowah county (Boozer et al. 2019).

**Methods**

*Sampling Design*

We captured and tagged both Alabama and largemouth bass from Neely Henry reservoir (4547 hectares) in January-February 2022, December 2022-January 2023, and May of 2023 using standardized daytime boat electrofishing with a Midwest Lake infinity shock box producing 12-15 peak amps. Sampling sites were standardized by distance instead of time. Neely Henry reservoir was divided into 1.6 km long shoreline sites. 100 of these shoreline segments were randomly selected to be sampled for both the January-February 2022 and December 2022-January 2023 field seasons. Sites that were not originally selected were utilized if sampling goals were not met after completing the initial 100 sites. For the May 2023 sampling event, only 80 shoreline sites were randomly selected to be used, and no revisiting or use of alternate sites was needed. The upper, more riverine portion of the lake (above Hokes Bluff) was not sampled for this study due to its lack of access and low catch rates.

*Reward Tagging*

When collecting fish from selected sites, Alabama and largemouth bass greater than 300 mm from each site were collected and put into the live-well on our electrofishing vessel. We tried to avoid tagging more than 10 of each species per site to ensure proper spread of tags across the entirety of the reservoir, however, this was violated on some occasions. Additionally, for both species, we attempted to tag 66 fish in six 50 mm length groups ranging from 300-600 mm. Once a desired length bin was completed, future collected fish within that length bin were released, and thus not tagged. However, due to some size bins not being able to be filled, some 50 mm length groups have more than the initially targeted 66 fish in order to reach the targeted tag amount of 400 tags per species per year. Fish selected for tagging were affixed with an external dart tag manufactured by Hallprint Inc. (model: PDAT; length: 120 mm; color: yellow). Every third fish for the January-February 2022 and December 2022-January 2023 field seasons were “double tagged” with an additional dart tag of the same reward value, however, anglers were still only paid on a per fish basis, i.e., a double tagged fish did not carry double the reward. Fish tagged during the May 2023 were only single tagged to try and minimize the tagging stress of being tagged during the higher water temperatures that occur in May.

When applying tags, both dart tags and the tag application tool were first sterilized in a 2% chlorhexidine solution before inserting the reward tag between the dorsal pterygiophores at a lateral and diagonal angle. Once inserted into the fish, the tag was rotated 90 degrees to ensure the tag was locked into place between the dorsal pterygiophores. Each external reward tag had a unique tag number, the reward amount ($100, $200, or $300), and a phone number for the angler to call and report their capture of the fish printed on the tag. Additionally, the tag instructed anglers to clip/cut the tag off the fish so it can be sent to us in the mail as proof that they caught the given fish. Upon calling the tag in, a short survey was administered by Auburn fisheries staff. Information obtained from the survey included basic information such as: capture date, capture location, whether the fish was kept or released, and whether the fish was weighed in at a tournament. If weighed in at a tournament, the boat ramp where the fish was released after weigh-in was obtained from the angler

TABLE OF TAGGING SUMMARY (SPECIES, TAG LEVELS, TAGGING EVENT? LINK TO MAPS THAT I CREATED (FIGURE 2-6)).

*Telemetry Tagging*

A subset of the external dart tagged fish in both the January-February 2022 and December 2022-January 2023 periods were also surgically implanted with radio-telemetry transmitters. Only fish with a total length (TL) greater than 350 mm were eligible for implantation of a radio telemetry transmitter. For January-February 2022, 50 Alabama (mean TL = 431 mm, range = 358-527 mm) and 50 largemouth bass (mean TL = 438 mm, range = 355-532 mm) were implanted with a F-185 transmitter manufactured by Advanced Telemetry Systems (Isanti, Minnesota) with a 24-hour mortality switch. In the December 2022-January 2023 field season 75 Alabama (mean TL = 420 mm, range = 350-514 mm) and 75 largemouth bass (mean TL = 440 mm, range = 344-532 mm) were implanted F-185 radio transmitters manufactured by Advanced Telemetry Systems (Isanti, Minnesota) with an 8-hour mortality switch. The mortality switch allows the tag to send a mortality signal if no motion of the tag is detected. If motion is detected within the time interval of the mortality switch the tag will begin coding “alive” again. The change to a shorter mortality switch interval for the December 2022-January 2023 field season occurred due to several fish from the first tagging event appearing dead (based on tracking surveys) but continuously coded alive. TAGGING DISTRIBUTION MAPS

Before radio transmitters were implanted, fish were anesthetized in 250-ppm carbon dioxide solution created by mixing acetic acid and sodium bicarbonate until loss of equilibrium occurred (MARKING AND MEYER 1985). Once loss of equilibrium was evident, fish were removed and placed into a padded surgical trough, ventral side up, making sure to flush gills with lake water via a small bilge pump. Transmitters, and all tools used during implantation were all sterilized in 2% chlorhexidine solution prior to each implantation. A small incision of approximately 20-mm was made on the ventral surface of the fish, anterior to the urogenital pore. A transmitter was then placed into the body cavity. A hypodermic needle was utilized to puncture the body cavity of the fish posterior to the incision. The antenna of the transmitter was then threaded into the needle and the needle was subsequently withdrawn, thus threading the transmitter wire through the small puncture created by the needle. The incision was then closed up by 2 sutures of 3-0 ethilon poyamide 6 non-absorbing sutures manufactured by Ethicon LLC fed through the fish by a 30-mm 3/8c reverse cutting needle. Once sutures were in place, VetOne was spread on both the incision site and the puncture site. Fish were then allowed to recover in an oxygenated recovery tank. After full recovery, fish were released at their capture site.

*Tracking Transmitter Fish*

Alabama and largemouth bass implanted with transmitters during the December 2022-January 2023 field season were designated to be a part of the upper or lower halves of the lake depending on their initial tagging location. A random subsample of 20 telemetered largemouth and 20 telemetered Alabama bass from both the upper and lower lake (n=80) was attempted to be completed in March of 2023 in order to ensure tracked fish were representative of the entire reservoir and spread throughout. Fish that had already coded dead or had been reported to be caught in tournaments or harvested prior to the beginning of April 2023 were not included in this random selection. I was able to fill 3 of the 4 groups with 20 individuals, however, only 18 Alabama bass from the upper lake met the grouping requirements due to low catch rates. Only 18 Alabama bass from the upper lake met the requirements, thus making the initial tracking sample size n=78 instead of the original goal of n=80. As fish died or disappeared, they were subsequently replaced by fish that were not originally selected in order to keep a higher sample size to calculate seasonal movement patterns.

Fish were tracked with a 3-element Yagi antenna and R4500C receiver manufactured by Advanced Telemetry Systems Inc. on a biweekly basis. The best location for each fish was marked with a Garmin E-trex 22x handheld GPS, which is accurate to within 3 m. The best location was defined as when the gain on the receiver was minimized, the tag sound was omnidirectional under the boat and the “signal-strength” on the receiver was maximized. Fish were removed from the tracking regimen and location acquisition ceased if they coded dead on more than one occasion and no discernable movement occurred between each dead-code.

Some of the telemetered fish were caught and released in tournaments by anglers. We were notified of such an event by anglers voluntarily calling the phone number on the external dart tag or by Auburn fisheries staff who were present at tournament weigh-ins. The date and location of release of these tournament-caught fish was recorded and they were subsequently added to the tracking regimen. Tournament-released fish were tracked in an identical manner as the original 78 fish on the same biweekly basis, however, they tracked indefinitely instead of being removed from the rotation after coding dead.

*Movement Analysis*

*Simulation Analysis*

Dividing lake into sections (probability of moving sections based on state)

Utilizing receiver data to assign sections to non-tracked fish.

ASSESS DEPLETION, loading of fish.

WHAT TO DO WITH NATURAL MOVEMENT DATA (HOME RANGE) MOVEMENT SPEEDS, ETC. seasonal based movement (monthly)

HOW TO OBTAIN DISTANCE VALUES (Least cost distance on Neely Henry). Shapefile-raster, loop over time step and tag number.

Home range sizes of both Alabama and Largemouth Bass will be constructed for both species for this study. Differences in movement between species, between seasons, and between tournament-released and non-tournament released fish will also be assessed. Additionally, a multi-state model will be constructed to evaluate the spatial redistribution of fish in the lake by tournaments, and if dispersal rates of fish is cancelling out their accumulation around release sites.

**Results**

**Discussion**

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**Figures**



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