EVALUATION OF BLACK BASS MOVEMENT AFTER BASS TOURNAMENT WEIGH-IN AT AMES FARM INN, LAKE WINNIPESAUKEE (2007 - 2008)

STATE: New Hampshire

GRANT: F-50-R-25

GRANT TITLE: Anadromous and Inland Fisheries Operational Management Investigations

JOB 10: Warmwater and Coolwater Fisheries Population Assessment

PERIOD COVERED: July 1, 2008 – June 30, 2009

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Introduction

Black bass (*Micropterus dolomieui,* smallmouth and *M. salmoides,* largemouth) fishery resources in New Hampshire are highly utilized by anglers, with smallmouth and largemouth bass ranking among the top four species fished for by anglers (Responsive Management 2004). According to the 2006 National Survey of Fishing, Hunting, and Wildlife Associated Recreation, 105,000 anglers fished 1.264 million days for black bass in New Hampshire (U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2008). This level of angler participation in black bass fishing represented 53% of New Hampshire's freshwater anglers and 46% of the total days of fishing. The economic impact from anglers fishing for black bass in New Hampshire is significant, as these anglers generated $37.92 million in fishing-related expenses during 2006 (U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2008).

Black bass tournaments have become increasingly popular during the last decade. The New Hampshire Fish and Game Department (NHFGD) requires clubs and organizations to apply for permits to hold bass tournaments and a database which tracks these permits has shown an increase in tournament pressure over time (Figure 1).

Lake Winnipesaukee is one of New Hampshire's most popular bass fisheries, for both tournament and non-tournament anglers. The number of permitted bass tournaments held on Lake Winnipesaukee from 1996-2005 was the highest of any water body in the state (704 tournaments), averaging 70 per year. Additionally, tournament effort (angler hours) was also highest for Lake Winnipesaukee, averaging 18,614 angler hours per year from 1996-2005. From 2001-2005, 39% of all smallmouth bass and 20% of all largemouth bass weighed-in during permitted bass tournaments in New Hampshire were caught in Lake Winnipesaukee.

Lake Winnipesaukee, a natural lake located in east central New Hampshire (43°23' N, 71°15' W), has a surface area of 18,043 hectares. This lake is classified as oligotrophic, has a full pool elevation of 154 m above mean sea level, a mean depth of 13.1 m, and a maximum depth of 54.9 m. Lake Winnipesaukee is managed to provide principal recreational fisheries for landlocked salmon (*Salmo salar*), black bass and lake trout (*Salvelinus namaycush*). Secondary recreational fisheries exist for rainbow trout (*Oncorhynchus mykiss*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), white perch (*Morone americana*), brown bullhead (*Ameiurus nebulosus*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), and burbot (*Lota lota*). Rainbow smelt (*Osmerus mordax*) provide the primary forage for salmonids.

Although Lake Winnipesaukee has a number of boat ramps, Ames Farm Inn (Gilford) is the facility used most frequently by bass tournaments. From 2001-2005, 48% of permitted bass tournaments on Lake Winnipesaukee launched from Ames Farm Inn. This transcribes to the Ames Farm Inn launch being used by 64% (7,426 anglers) of all tournament participants on Lake Winnipesaukee from 2001-2005. As a result of this heavy tournament use, most bass weighed-in during bass tournaments in the lake are released at or near this facility (current New Hampshire regulations specify that bass must be released at least 300 feet from the shoreline after weigh-in).

From 2001-2005, 64% (16,226) of all smallmouth bass and 64% (6,784) of all largemouth bass weighed-in during permitted bass tournaments on Lake Winnipesaukee were weighed-in at Ames Farm Inn. These values equate to 47,501 pounds of black bass (68% of total) being released at the Ames Farm Inn release site from 2001-2005.

Bass relocation via tournaments may be detrimental to bass fisheries. North American fisheries agencies surveyed in 2000-2001 reported impacts of fish relocation as one of the biological issues related to fishing tournaments (Kerr and Kamke 2003). Stang et al. (1996) suggested tournaments may negatively influence black bass populations (or individuals) by redistributing fish and that these impacts are potentially increased on popular waters hosting large numbers of tournaments that weigh-in at one or two locations. To minimize negative effects of tournament on bass fisheries, researchers have suggested releasing tournament caught bass away from weigh-in sites (Bunt et al. 2002) and other high angler use areas (Gilliland 1999, Bunt et al. 2002). Rotating weigh-in sites and releasing bass at various locations around a water body have also been recommended (Ridgway and Shuter 1996, Gilliland 1999).

Relocating large numbers of bass to Ames Farm Inn release site may negatively impact bass because many displaced bass remain in the general vicinity of weigh-in sites for days, weeks or even months after release (Stang et al. 1996, Gilliland 1999, Ridgway 2002). Wilde (2003) reviewed 12 scientific studies that examined dispersal of tournament caught black bass and reported that at the end of studies, 51% of largemouth bass and 26% of smallmouth bass had dispersed less than 1.6 km from the release site and 41% of largemouth bass had dispersed less than 0.8 km.

This potential stockpiling of bass at Ames Farm Inn release site may harm bass fisheries in a number of ways. First, angler catch and harvest rates may be higher in and around the release site than in other areas (Gilliland 1999). Two studies examining angler recapture rates of relocated bass in a river (smallmouth bass) and a lake (largemouth bass) found 50% of all recaptured bass were caught by anglers in the immediate release area with two fish being caught almost immediately after release (one within 3 hours and one within 30 minutes) (Gilliland 1999, Bunt et al. 2002). Researchers have suggested bass tournament organizers consider releasing fish near sites of original capture or in area not readily accessible to anglers in order to decrease angling vulnerability after tournaments (Gilliland 1999, Bunt et al. 2002). Second, increased bass densities can also increase competition for food and habitat resources as well as enhance opportunities for bacterial diseases (Steeger et al. 1994) and viral transmissions or outbreaks, such as Largemouth Bass Virus (Inendino et al. 2005). Finally, large numbers of dead bass near weigh-in sites can also result in negative press and public perception (Meals and Miranda 1994).

Relocating large numbers of bass to the Ames Farm Inn release site could also negatively impact bass because some tournament caught black bass never return to their capture sites after weigh-in and release (Stang et al. 1996, Ridgway 2002, Wilde 2003). Additionally, the percent of bass that do return to their site of capture is generally low, but varies with study, distance displaced, and species of interest. Wilde (2003) reviewed 12 scientific studies that examined dispersal of tournament caught black bass and reported that 14% of largemouth bass and 32% of smallmouth bass returned to their site of capture. Other studies have found return rates for black bass ranging from 10-83% (Ridgway and Shuter 1996, Stang et al. 1996, Ridgway 2002). Furthermore, it has

been suggested that largemouth bass navigate using visual landmarks (Wilde 2003) and the further black bass are displaced, the less likely they are to return to their place of capture (Ridgway 2002; Wilde 2003). Gilliland (1999) reported that 84% of tagged largemouth bass were recaptured at sites connected to a release site by a continuous shoreline while only 16% were recaptured in areas where they had to cross deep, open water.

Limited movement of bass back to their place of capture can potentially be harmful in a number of ways. Bass must use energy to find appropriate habitat in their new area and depletion of energy reserves may increase the probability for over winter mortality (Mackereth et al. 1999). Spawning success may also be influenced, as male smallmouth bass are known to exhibit spawning site fidelity from year to year (Ridgway et al. 1991). Bass may also face increased competition for resources due to increased densities. Additionally, fish placed into an unfamiliar area may be at a disadvantage for forage and habitat as compared to residents.

Bass stockpiling and movement issues may be more severe for largemouth bass than smallmouth bass. Largemouth bass move smaller distances away from release sites than do smallmouth bass (Healey 1990, Ridgway 2002, Wilde 2003) and are more likely to be recaptured near their release site (Healey 1990).

The main objective of this study was to assess movement of tournament caught black bass after weigh-in and release at Ames Farm Inn, Lake Winnipesaukee. This study also provided opportunities to examine bass harvest rates, distance bass were moved by tournament anglers, and the relationship between distance bass swam and the number of days between tagging and their first recapture.

Methods

Bass were tagged at 13 bass tournament weigh-ins held at Ames Farm Inn from June 30, 2007 through August 22, 2007 (Table 1). Larger tournaments (>20 participants) were targeted to increase sample size. Bass were identified to species, measured for TL (mm), tagged with yellow Floy tags, and then released by anglers at the Ames Farm Inn release site (a set of blacktop buoys located approximately 0.87 km from the nearest shoreline). Floy tags were individually numbered and contained instructions requesting anglers to contact the NHFGD upon catching a tagged bass.

No bass tournament weigh-ins were held at Ames Farm Inn after August 22, 2007 or during 2008 due to property use issues. Accordingly, no bass were tagged after August 22, 2007.

Data on recaptured tagged bass were collected during 2007 and 2008 with angler captures of tagged bass being the only source of recapture information. Press releases, websites and direct communication with tournament organizers were used to inform anglers of the need to report tagged fish. No rewards were offered. Data were collected via phone calls and emails from anglers and also from direct observation at bass tournament weigh-ins. During 2007 and 2008, NHFGD staff attended 43 bass tournament weigh-ins (located at various locations around the lake) to record information on tagged bass that were brought to weigh-in or that were culled by

anglers during the tournament. Larger tournaments were targeted to increase the likelihood of observing tagged bass. The following information was recorded for each recaptured bass: tag number, date of capture, species, location of capture (GPS coordinates or general location), angler name and contact information, whether bass was kept or released, release location (GPS coordinates or general location), angler type (tournament/non-tournament), and if the bass was caught during a bass tournament.

Tagged bass release and recapture locations were entered into a mapping program based on either latitude and longitude coordinates or location descriptions from anglers. In the mapping program, latitude and longitudes coordinates were assigned to recapture and release locations for all tagged bass. When calculating distance fish swam or distance anglers moved fish, the shortest straight-line over-water distance was used. While it is likely distance moved was greater than what is reported, finer detailed data were not available for these fish (i.e. such as would be collected if fish were tracked with radio tags), and it was necessary to be conservative and consistent with these values.

Results and Discussion

Tagging and Recapture

A total of 1,836 bass were tagged at 13 tournament weigh-ins at Ames Farm Inn during 2007. The majority of bass entered at weigh-ins were smallmouth bass; 64% (1,169) of bass tagged were smallmouth bass and 36% (667) were largemouth bass (Table 1). During 2007, 150 individual tagged bass were released more than once from tournament weigh-ins at Ames Farm Inn (Table 2).

During 2007 and 2008, information from tagged bass that were recaptured by anglers was collected via phone calls and emails from anglers and by direct observation at 43 tournament weigh-ins held at various locations around Lake Winnipesaukee. Recapture data were collected on 225 tagged bass for a recapture rate of 12.3%. The majority of recaptured tagged bass were largemouth bass; 22% (49) of bass recaptured were smallmouth bass and 78% (176) were largemouth bass. The 225 recaptured tagged bass were caught a total of 278 times as some tagged bass were caught more than once (Table 3). The 49 recaptured tagged smallmouth bass were caught a total of 52 times and the 176 recaptured tagged largemouth bass were caught a total of 226 times.

Anglers fishing in bass tournaments accounted for the majority of recaptures. Examing total number of times tagged bass were recaptured in 2007 and 2008, 61% of smallmouth bass and 81% of largemouth bass were recaptured during bass tournaments and 39% of smallmouth bass and 19% of largemouth bass were captured by anglers not fishing in bass tournaments.

Although 64% of fish that were tagged were smallmouth bass, this species only comprised 22% of recaptured fish. While interesting, this result is not all-together surprising due to a number of factors. First, there was likely less chance that anglers would catch tagged smallmouth bass because the smallmouth bass population is much larger than that of largemouth bass in Lake Winnipesaukee (NHFGD, unpublished data). Second, smallmouth bass typically prefer deeper colder waters than largemouth bass (Scott and Crossman 1998). Because deeper waters are more abundant in Lake

Winnipesaukee than shallower ones and smallmouth bass typically swim further distances after release than largemouth bass (Healey 1990, Ridgway 2002, Wilde 2003), tagged smallmouth bass had a better opportunity to re-distribute themselves more fully from the weigh-in site after release. Additionally, largemouth bass tend to swim using the shoreline as a landmark (Gilliland 1999, Wilde 2003), which may make it easier for anglers to target them after release.

Harvest

Anglers who caught tagged bass while not fishing during a bass tournament were divided into two groups: those that do participate in bass tournaments and those that do not participate in bass tournaments. Harvest rates of tagged bass were higher for anglers that never participate in bass tournaments and were also higher for smallmouth bass than for largemouth bass. When these two anglers groups were combined, anglers who caught tagged bass while not participating in a bass tournament harvested 15.0% of the tagged smallmouth bass they caught and 7.5% of the tagged largemouth bass they caught. When data for anglers that never participate in bass tournaments were analyzed separately, harvest rates increased slightly as anglers that do participate in bass tournaments did not harvest any tagged bass even when not fishing in a bass tournament. Anglers that never participate in bass tournaments harvested 16.7% of the tagged smallmouth bass they caught and 9.7% of the tagged largemouth bass they caught.

Although there has been an increasing trend towards catch-and-release fishing for bass in the southern United States during the open-water season (Allen et al. 2008; Myers et al. 2008), our results showed higher harvest rates of smallmouth bass in Lake Winnipesaukee than during past studies. Anglers fishing Lake Winnipesaukee during the open-water seasons in 1990 and 1991 harvested 11% and 9%, respectively, of smallmouth bass caught (New Hampshire Fish and Game Department 1991, 1992). Harvest rates of tagged bass in this tagging study are much lower than those that occur during the ice fishing season in New Hampshire (smallmouth: 28%, largemouth: 49%; Racine and Gries 2007).

A concern related to conducting bass tournament weigh-ins (and release) in the same area over time is that angler harvest rates may be higher in and around the release site than in other areas (Gilliland 1999). In two similar tagging studies, as many as 50% of all recaptured bass were caught by anglers in the immediate release area (Gilliland 1999, Bunt et al. 2002). However, data from Lake Winnipesaukee showed only 16.6% of harvested tagged bass were caught less than 1.0 km from the Ames Farm Inn release site and the average distance from Ames Farm Inn release site that a bass was caught and harvested was 8.9 km ($\pm$ 6.5).

Bass Movement

Distance bass swam between tagging and release after weigh-in at the Ames Farm Inn release site in 2007 and their first recapture was examined by species and year. On average, smallmouth bass recaptured for the first time in 2007 and 2008 had swam further (6.1 km and 10.8 km, respectively) than largemouth bass (4.8 km and 9.5 km, respectively; Table 4). However, further analysis revealed differences between distances swam by smallmouth and largemouth bass (both years combined) were not statistically significant (Two-way ANOVA; $P = 0.158$). On average, smallmouth and largemouth recaptured for the first time in 2008 swam further than bass recaptured

for the first time in 2007 (Table 4). Further analysis revealed this difference between years to be statistically significant (Two-way ANOVA; $P < 0.001$). The furthest distance a bass swam between tagging and release and their first recapture (2007 or 2008) was 19.6 km for smallmouth bass and 21.0 km for largemouth bass. The minimum distance a bass swam between tagging and release and their first capture (2007 or 2008) was 0.1 km for both smallmouth and largemouth bass (Table 4). It should be noted that some tagged bass could have transported and culled by tournament anglers and not been reported.

The number of tagged bass recaptured for the first time within a certain distance from the Ames Farm Inn release site was examined separately by species and year. Number of days between tagging and release after weigh-in and their first recapture was also investigated. In both 2007 and 2008, greater percentages of smallmouth bass were caught farther from Ames Farm Inn than were largemouth bass (Table 5a, 5b and 6a, 6b), indicating that smallmouth bass appeared to move farther from their release site than did largemouth bass. A greater percentage of smallmouth and largemouth recaptured for their first time in 2008 was caught further from Ames Farm Inn than for bass recaptured for their first time in 2007 (Table 5a, 5b and 6a, 6b), indicating that bass appeared to move farther from their release site over time.

In 2007, 33.3% of tagged smallmouth bass and 15.7% of tagged largemouth bass were recaptured < 1.6 km from the Ames Farm Inn release site, and 25.0% of smallmouth bass and 12.7% of largemouth bass were recaptured $\leq$ 0.8 km from the release site (Table 5a, 5b and 6a, 6b). In 2008, no tagged smallmouth or largemouth bass were recaptured < 1.6 km from the Ames Farm Inn release site (Table 5a, 5b and 6a, 6b). Results from 2007 are slightly higher than those found by Wilde (2003) for smallmouth bass, but much lower for largemouth bass. Wilde (2003) reviewed 12 scientific studies that examined dispersal of tournament caught black bass and reported that at the end of these studies, 51% of largemouth bass and 26% of smallmouth bass had dispersed < 1.6 km from the release site and 41% of largemouth bass had dispersed < 0.8 km. It is possible that these discrepancies may be related to available habitat in the area surrounding the Ames Farm Inn, as well as differences in methods and longevity among studies.

The relationship between distance tagged bass swam and the number of days between their release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture was examined for bass captured in 2007 and 2008. For both species, the relationship between distance swam and number of days at large was significant (smallmouth: $P = 0.01$; largemouth: $P < 0.001$), indicating that the greater the number of days between release and first recapture, the more likely it was for smallmouth and largemouth bass to be further from their release site (Figure 2 and 3). However, the variation in this relationship was poorly explained for both species (smallmouth: $R^2 = 0.12$; largemouth: $R^2 = 0.11$).

Results presented above are generally consistent with findings from researchers performing similar studies in other North American water bodies. Studies have indicated largemouth bass move shorter distances away from release sites than smallmouth bass (Healey 1990, Ridgway 2002, Wilde 2003) and largemouth bass were more likely to be recaptured near their release site than smallmouth bass (Healey 1990). Studies have also shown that distance swam by black bass after release increases with time (Healey 1990, Stang et al. 1996, Richardson-Heft et al. 2000, Ridgway 2002), although in a review of twelve studies examining dispersal of tournament caught black bass, Wilde

(2003) found no relationship between study duration and distance dispersed. Results from the Lake Winnipesaukee study support the notion that distance swam by black bass after release increases with time. However, results were inconclusive as to whether smallmouth bass swam greater distances away from release sites than largemouth bass. This discrepancy is likely related to a number of factors including the lower sample size of recaptured tagged smallmouth bass vs. largemouth bass in the Lake Winnipesaukee study, larger amounts of smallmouth bass habitat in the vicinity of the Ames Farm Inn release site, differences among study methods and locations, and because distance bass moved was somewhat dependent on when a tagged bass was recaptured by an angler.

The percentage of black bass returning to their original capture location after relocation and release from a bass tournament weigh-in can vary greatly, but is generally low (Ridgway and Shuter 1996, Stang et al. 1996, Ridgway 2002, Wilde 2003). Although the Lake Winnipesaukee study was not designed to answer this question, limited data related to this question were examined. Tournament anglers knew the location of capture for nine bass prior to tagging and of these fish, three were recaptured again (two largemouth bass and one smallmouth bass). The smallmouth bass was recaptured in the general location of its original capture prior to tagging (fish had swam 19.6 km from Ames Farm Inn; original capture location was 22.5 km from Ames Farm Inn), but the two largemouth bass recapture locations were in a direction away from their original capture location (fish had swam an average of 5.5 km from Ames Farm Inn; average original capture location was 18.0 km from Ames Farm Inn). It should be noted that the smallmouth bass was at large for 319 days while the largemouth bass were only at large for 38 and 49 days, respectively.

Recapture data for tagged bass that were weighed in and released twice at Ames Farm Inn during 2007 were examined to ascertain if fish swam in the same direction each time after release and if they were recaptured in the same general area each time. Initial tagging and release at Ames Farm Inn counted as one release. Data for 23 largemouth bass were used for this evaluation and 61% (14) swam in the same direction after both releases. Of those 14 bass, 43% (6) were recaptured both times in the same general location and 43% (6) were recaptured the second time at a location where they had to travel past their first recapture location.

Examining recapture data for Lake Winnipesaukee, 78% of largemouth bass and 29% of smallmouth bass likely followed the shoreline after release from weigh-ins. This is consistent with other studies and it has been suggested that largemouth bass navigate using visual landmarks (Wilde 2003). Gilliland (1999) reported 84% of tagged largemouth bass were recaptured at sites connected to a release site by a continuous shoreline while only 16% were recaptured in areas where they had to cross deep, open water. In comparison, Ridgway and Shuter (1996) found displaced smallmouth bass equipped with radio tags returned to their home areas in relative proximity to shore. It should be noted that the proximity of tagged bass to shoreline after release in the Lake Winnipesaukee study was not quantified, but rather was inferred based upon their release and recapture location.

The distance bass were moved by tournament anglers, either by transport to a weigh-in or when bass were culled later in the fishing day, was also examined. Relocation distance is important as it has been suggested that long displacement distance may be a reason for low return rates of black bass to their capture sites (Wilde 2003). Additionally, bass relocated further distances may either

not return (Ridgway 2002) or take longer to return to their capture location (Ridgway and Shuter 1996). Recapture and release data from 2007 and 2008 were combined for all tagged bass regardless of how many times they were recaptured. Tournament anglers, utilizing various weigh-in locations on Lake Winnipesaukee, relocated smallmouth bass an average of 5.5 km (n = 31, standard deviation = 5.0, range: 0.0 – 16.5 km) and largemouth bass an average of 6.0 km (n = 182, standard deviation = 5.3, range: 0.0 to 24.0 km; Table 7). Bass caught by tournament anglers weighing in at Ames Farm Inn were relocated smaller distances than those caught by anglers weighing in at locations other than Ames Farm Inn (Table 7).

Summary

Concern over multiple bass tournament weigh-ins occurring at one location over time, such as Ames Farm Inn, stems from issues outlined above related to bass stockpiling, limited movement of bass back to their original place of capture, and increased harvest of bass in areas adjacent to the weigh-in locations. Results shown above from the bass movement study on Lake Winnipesaukee alleviate some of these concerns, but also show a need for future studies.

It was difficult to determine with certainty from this study whether bass stockpiling was occurring at the Ames Farm Inn release site and if so, for how long, as a bass' recapture location depended to some degree on when fish were recaptured by anglers. However, during 2007, only 25.0% of tagged smallmouth bass and 12.7% of largemouth bass were recaptured within 0.8 km of the Ames Farm Inn release site (Table 5a, 5b and 6a, 6b). In 2008, no tagged bass of either species were recaptured within 1.6 km of the Ames Farm Inn release site (Table 5a, 5b and 6a, 6b). Additionally, data presented in this report indicate that tagged bass appear to move greater distances with the more time that passes between release and recapture. These results seem to indicate that if bass stockpiling is occurring at the Ames Farm Inn release site, it appears that it is not long-lived and fish will disperse over time.

The percent of black bass returning to their site of capture after relocation is generally low and varies with study, distance displaced, and species of interest (Ridgway and Shuter 1996, Stang et al. 1996, Ridgway 2002, Wilde 2003). The Lake Winnipesaukee study was not designed to evaluate return rates of tagged bass to their original capture location. However, very limited data presented above indicated that one of three tagged bass returned to its general capture location after relocation and release at weigh-in. Because limited movement of black bass back to their place of capture has the potential to negatively impact these fish (Mackereth et al. 1999, Ridgway et al. 1991), it is important that future studies be conducted to answer this question in New Hampshire water bodies when staff and time allows.

Releasing large numbers of bass at a single location may be cause for concern as angler harvest rates may be higher in and around the release site than in other areas (Gilliland 1999). However, data from this study showed only 16.6% of harvested tagged bass were caught less than 1.0 km from the Ames Farm Inn release site and average distance from the Ames Farm Inn release site that a tagged bass was caught and harvested was 8.9 km ($\pm$ 6.5).

Despite indications from this bass movement study of a general lack of seemingly negative impacts from bass tournaments on Lake Winnipesaukee bass, there are still many unanswered questions. Future studies should be conducted where specific objectives are to examine rates and longevity of bass stockpiling and return rates of bass to their original capture location after release from tournament weigh-ins. In the meantime, it is recommended that bass tournament organizations follow advice presented by other researchers: when possible, tournament caught bass should be released away from weigh-in sites (Bunt et al. 2002) and other high angler use areas (Gilliland 1999, Bunt et al. 2002) and weigh-in and release sites should occur at various locations around a water body (Ridgway and Shuter 1996, Gilliland 1999).

Acknowledgements

This study would not have been possible without the support and cooperation of Don Ames, the bass tournament anglers and organizations who fished Lake Winnipesaukee during 2007 and 2008, the anglers who sent in data on recaptured tagged bass, and the Ames Farm Inn staff. I would also like to thank the following staff and volunteers who ensured the success of this project: NHFGD: Mike Racine, Ben Nugent, Andy Schafermeyer, John Viar, Don Miller, Joel Bader, Scott Decker, Diane Baraby, Nick Lewis, Tim Dexter, Jason Carrier, Vikki Leonard, Mark Beauchesne, and Matt Carpenter; Volunteer: Adam Dubriske.

LITERATURE CITED:

Allen, M.S., C.J. Walters, and R. Myers. 2008. Temporal trends in largemouth bass mortality, with fishery implications. Transactions of the American Fisheries Society 28: 418-427.

Bunt, C.M., S.J. Cooke, and D.P. Philipp. 2002. Mobility of riverine smallmouth bass related to derby displacement and seasonal habitat use. Pages 545-552 in D.P. Philipp and M.S. Ridgway, editors. Black bass: ecology, conservation and management. American Fisheries Society, Symposium 31, Bethesda, Maryland.

Gilliland, E.R. 1999. Dispersal of black bass following tournament release in an Oklahoma reservoir. Proc Annu Conf Southeast Assoc Fish and Wildl Agencies 53: 144-149.

Healey, T.P. 1990. Movement and survival of tournament-caught black bass at Shasta Lake. Calif Fish and Game 76: 36-42.

Inendino, K. R., E.C. Grant, D.P. Philipp, and T.L. Goldberg. 2005. Effects of factors related to water quality and population density on the sensitivity of juvenile largemouth bass to mortality induced by viral infection. Journal of Aquatic Animal Health 17:304-314.

Kerr, S.J., and K.K. Kamke. 2003. Competitive fishing in freshwaters of North America: a survey of Canadian and U.S. jurisdictions. Fisheries 28: 26-31.

Mackereth, R.W., D.L.G. Noakes, and M.S. Ridgway. 1999. Size-based variation in somatic energy reserves and parental expenditure by male smallmouth bass, Micropterus dolomieui Environmental Biology of Fishes 56: 263-275.

Meals, K.O., and L.E. Miranda. 1994. Size-related mortality of tournament-caught largemouth bass. North American Journal of Fisheries Management 14: 460-463.

Myers, R., J. Taylor, M. Allen, and T.F. Bonyechio. 2008. Temporal trends in voluntary release of largemouth bass. North American Journal of Fisheries Management 28: 428-433.

New Hampshire Fish and Game Department. 1991. Lake Winnipesaukee bass evaluation (1990). Federal Aid Project. Concord, NH. 30 pp.

New Hampshire Fish and Game Department. 1992. Lake Winnipesaukee bass evaluation (1991). Federal Aid Project. Concord, NH. 23 pp.

Responsive Management. 2004. New Hampshire angler survey; resident anglers participation in and satisfaction with fishing and their opinions on fishing issues. Responsive Management. Harrisonburg, VA.

Racine, M.T. and G. Gries. 2007. Winter angler survey statistics from four New Hampshire warmwater lakes (2003). New Hampshire Fish and Game Department. Concord, NH. 24 pp.

Richardson-Heft, C.A., A.A. Heft, L. Fewlass, and S.B. Brandt. 2000. Movement of largemouth bass in northern Chesapeake Bay: relevance to sportsfishing tournaments. North American Journal of Fisheries Management 20: 493-501.

Ridgway, M.S. 2002. Movements, home range, and survival estimation of largemouth bass following displacement. Pages 525-534 in D.P. Philipp and M.S. Ridgway, editors. Black bass: ecology, conservation and management. American Fisheries Society, Symposium 31, Bethesda, Maryland.

Ridgway, M.S, and B.J. Shuter. 1996. Effects of displacement on the seasonal movements and home range characteristics of smallmouth bass in Lake Opeongo. North American Journal of Fisheries Management 16: 371-377.

Ridgway, M.S., J.A. MacLean, and J.C. MacLeod. 1991. Nest-site fidelity in a centrarchid fish, the smallmouth bass (Micropterus dolomieui). Canadian Journal of Zoology 69: 3103-3105.

Scott, W.B. and E.J. Crossman. 1998. Freshwater fishes of Canada. Galt House Publications Ltd. Ontario, Canada. 966 pp.

Stang, D.L., D.M. Green, R.M. Klindt, T.L. Chiotti, and W.W. Miller. 1996. Black bass movements after release from fishing tournaments in four New York waters. American Fisheries Society Symposium 16: 163-171.

Steeger, T.M., J.M. Grizzle, K. Weathers, and M. Newman. 1994. Bacterial diseases and mortality of angler-caught largemouth bass released after tournaments on Walter F. George Reservoir, Alabama-Georgia. North American Journal of Fisheries Management 14: 435-441.

U. S. Department of Interior, Fish and Wildlife Service, and U. S. Department of Commerce, U.S. Bureau of the Census. 2008. 2006 National survey of fishing, hunting, and wildlife associated recreation.

Wilde G.R. 2003. Dispersal of tournament-caught black bass. Fisheries 28: 10-17.

Table 1. Date and number of smallmouth and largemouth bass tagged at bass tournament weigh-ins at Ames Farm Inn during 2007.

Date	Number Bass Tagged	Number Smallmouth Tagged	Number Largemouth Tagged
6/30/2007	95	34	61
7/1/2007	198	153	45
7/8/2007	281	182	99
7/11/2007	156	76	80
7/21/2007	168	101	67
7/22/2007	215	163	52
7/25/2007	161	90	71
8/4/2007	81	57	24
8/5/2007	137	98	39
8/11/2007	18	14	4
8/12/2007	62	32	30
8/18/2007	116	68	48
8/22/2007	148	101	47
Total	1836	1169 (64%)	667 (36%)

Table 2. Number of times individual tagged smallmouth and largemouth bass were weighed in and released at Ames Farm Inn during 2007 bass tournaments. Initial weigh-in and release when bass tagging occurred was counted as one release.

	Number of Times Released at Ames Farm Inn			
Species	1	2	3	4
Smallmouth Bass	1169	15	0	0
Largemouth Bass	667	116	19	0

Table 3. Number of times individual tagged smallmouth and largemouth bass were recaptured by anglers during 2007 and 2008.

	Number of Times Recaptured			
Species	1	2	3	4
Smallmouth Bass	46	3	0	0
Largemouth Bass	132	39	4	1

Table 4. Sample size (*n*) and average distance (km) tagged bass swam between release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture in 2007 or 2008.

Year	Species	*n*	Average	Stdev	Minimum	Maximum
2007	Smallmouth	36	6.1	5.2	0.1	18.9
2007	Largemouth	165	4.8	3.4	0.1	21.0
2008	Smallmouth	13	10.8	4.9	3.2	19.6
2008	Largemouth	11	9.5	4.8	2.4	18.8

Table 5a. Number and percentage of tagged smallmouth bass recaptured for the first time in 2007 and number of days between release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture by distance (km) bass swam.

	Distance (km)							
2007	≤ 0.8	>0.8 to 1.6	>1.6 to 3.2	>3.2 to 4.8	>4.8 to 6.4	>6.4 to 8.0	>8.0 to 16.0	>16.0
Number bass	9	3	3	2	1	4	13	1
% of bass	25.0	8.3	8.3	5.6	2.8	11.1	36.1	2.8
Average number days	25	33	22	43	18	19	34	42
Standard Deviation	28	43	17	33	-	4	22	-
Minimum number days	7	6	5	20	18	16	11	42
Maximum number days	97	82	38	66	18	25	88	42

Table 5b. Number and percentage of tagged smallmouth bass recaptured for the first time in 2008 and number of days between release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture by distance (km) bass swam.

	Distance (km)							
2008	≤ 0.8	>0.8 to 1.6	>1.6 to 3.2	>3.2 to 4.8	>4.8 to 6.4	>6.4 to 8.0	>8.0 to 16.0	>16.0
Number bass	0	0	1	0	1	3	5	3
% of bass	0.0	0.0	7.7	0.0	7.7	23.1	38.5	23.1
Average number days	-	-	458	-	266	428	345	321
Standard Deviation	-	-	-	-	-	32	53	30
Minimum number days	-	-	458	-	266	392	297	292
Maximum number days	-	-	458	-	266	448	434	351

Table 6a. Number and percentage of tagged largemouth bass recaptured for the first time in 2007 and number of days between release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture by distance (km) bass swam.

	Distance (km)							
2007	≤ 0.8	>0.8 to 1.6	>1.6 to 3.2	>3.2 to 4.8	>4.8 to 6.4	>6.4 to 8.0	>8.0 to 16.0	>16.0
Number bass	21	5	27	53	8	30	20	1
% of bass	12.7	3.0	16.4	32.1	4.8	18.2	12.1	0.6
Average number days	18	16	23	35	25	32	33	96
Standard Deviation	15	14	16	26	17	17	19	-
Minimum number days	1	2	8	7	10	6	8	95
Maximum number days	52	35	87	97	64	66	77	95

Table 6b. Number and percentage of tagged largemouth bass recaptured for the first time in 2008 and number of days between release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture by distance (km) bass swam.

	Distance (km)							
2008	≤ 0.8	>0.8 to 1.6	>1.6 to 3.2	>3.2 to 4.8	>4.8 to 6.4	>6.4 to 8.0	>8.0 to 16.0	>16.0
Number bass	0	0	1	1	1	0	7	1
% of bass	0.0	0.0	9.1	9.1	9.1	0.0	63.6	9.1
Average number days	-	-	444	456	416	-	361	416
Standard Deviation	-	-	-	-	-	-	26	-
Minimum number days	-	-	444	456	416	-	320	416
Maximum number days	-	-	444	456	416	-	382	416

Table 7. Sample size (*n*) and distance (km) tagged bass were relocated by tournament anglers via culling or transport to weigh-in during 2007 and 2008.

				Distance (km)			
Year	Weigh-in Location	Species	*n*	Average	Stdev	Minimum	Maximum
2007	Ames Farm Inn	Smallmouth	19	3.3	3.9	0.0	9.9
2007	Ames Farm Inn	Largemouth	139	4.7	3.7	0.0	21.0
2007+2008	Not at Ames Farm Inn	Smallmouth	12	9.0	4.6	2.9	16.5
2007+2008	Not at Ames Farm Inn	Largemouth	43	10.0	7.3	0.0	24.0
2007+2008	All Locations	Smallmouth	31	5.5	5.0	0.0	16.5
2007+2008	All Locations	Largemouth	182	6.0	5.3	0.0	24.0

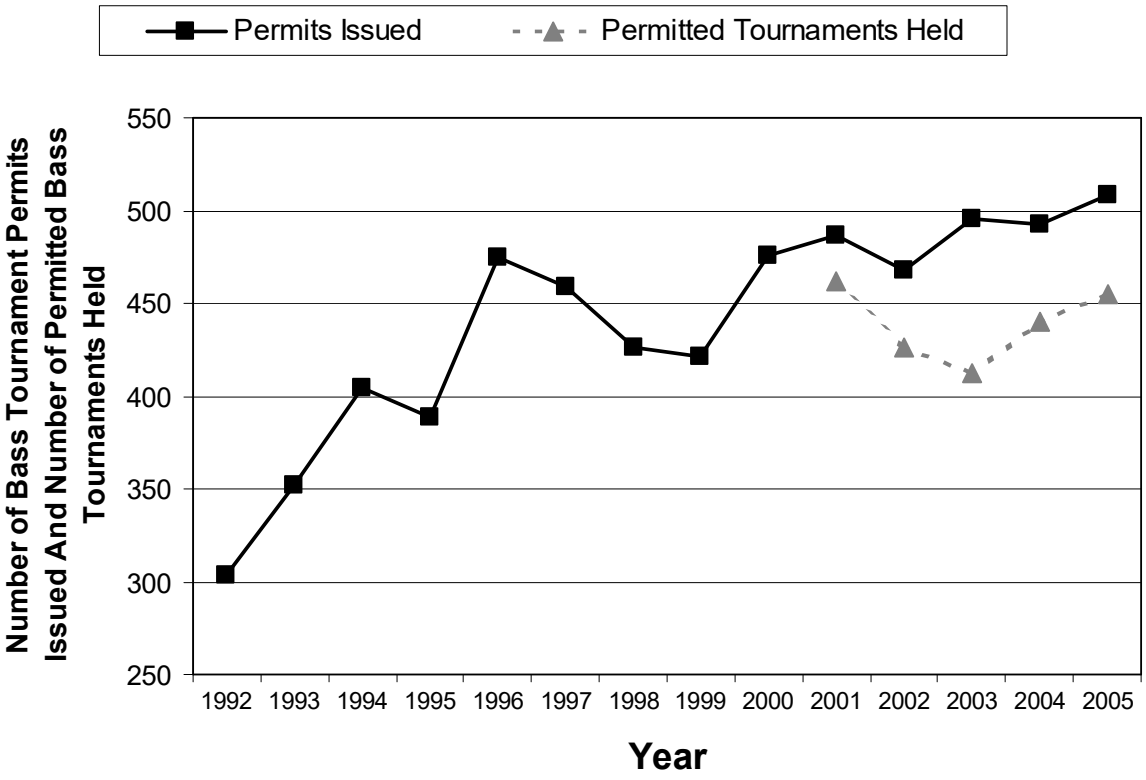

Figure 1. Number of bass tournament permits issued from 1992 – 2005 in New Hampshire (does not account for tournaments that were later cancelled) and number of permitted bass tournaments held from 2001 – 2005 (accounts for tournaments that were cancelled).

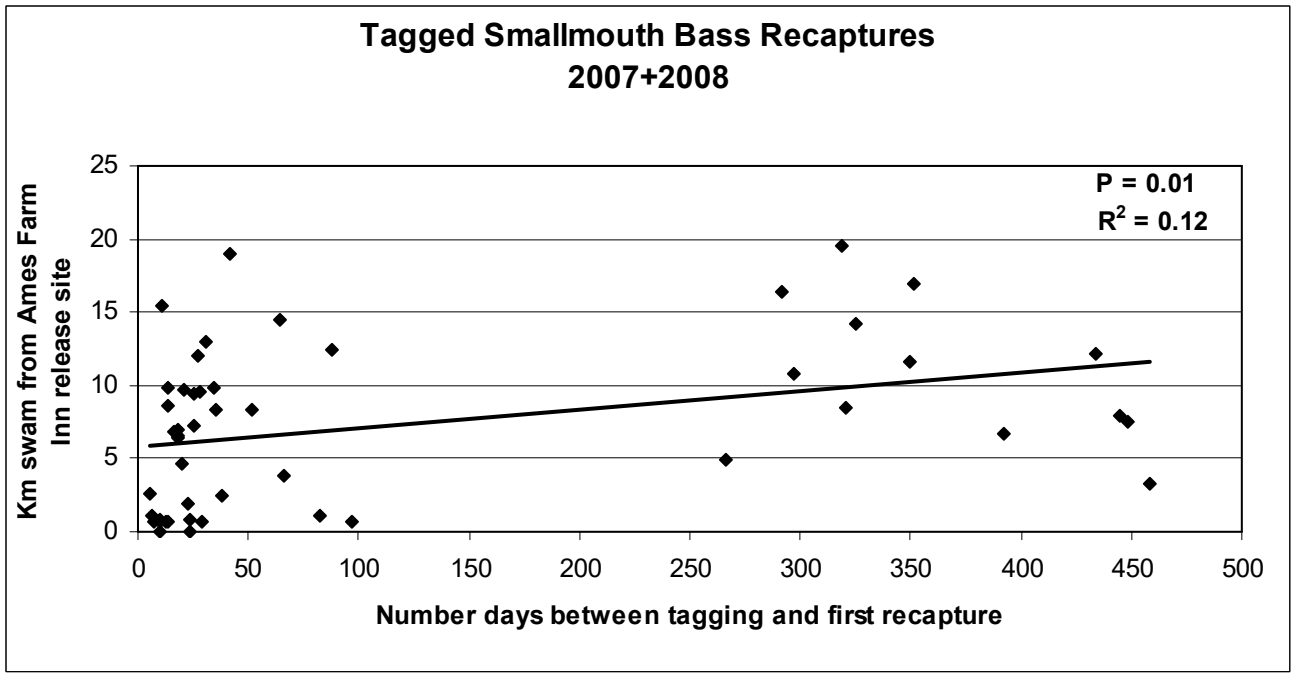

Figure 2. Relationship between distance (km) tagged smallmouth bass swam and number of days between their release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture in 2007 or 2008.

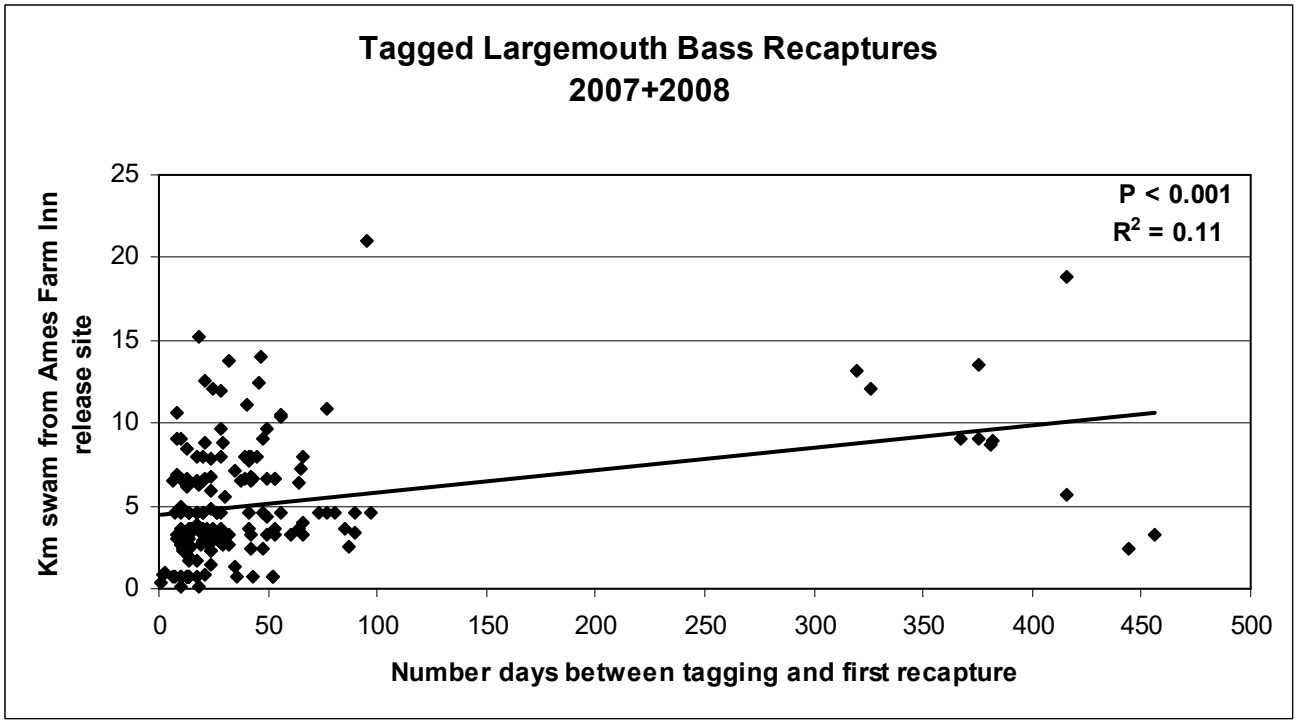

Figure 3. Relationship between distance (km) tagged largemouth bass swam and number of days between their release after tagging and weigh-in at Ames Farm Inn in 2007 and their first recapture in 2007 or 2008.