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Post Tournament Release Movements of Black Bass in Lake Champlain

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Prepared by:
George A. Maynard, Timothy B. Mihuc, Mark H. Malchoff, Danielle Garneau and V. Alex Sotola
Lake Champlain Research Institute at SUNY Plattsburgh

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POST TOURNAMENT RELEASE MOVEMENTS OF BLACK BASS IN LAKE CHAMPLAIN

George A. Maynard
Timothy B. Mihuc
Mark H. Malchoff
Danielle Garneau
V. Alex Sotola

Lake Champlain Research Institute at SUNY Plattsburgh

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PROJECT SUMMARY

The popularity of black bass (*Micropterus* spp.) fishing tournaments on Lake Champlain has risen over the past few decades. Since the early 2000s, the City of Plattsburgh, NY, has hosted numerous large-scale competitive tournaments including the Wal-Mart / FLW tournament series as well as the ESPN / Bassmasters tournament series. These national circuit tournaments play an important role in the local economy. Due to the relatively recent emergence of Lake Champlain as a popular bass fishing lake, there is a need for more scientific information about the bass fishery, in particular, information is lacking as to how fish respond to relocation and release as a result of tournament activities.

Fish stress levels and dispersal patterns were assessed at nine tournaments in 2011 and 2012. Results indicated there was a positive relationship between fish stress and distance traveled in a live-well; the further fish traveled, the more likely they would become stressed. Average immediate mortality was under 5% for both species. Dispersal results showed delayed dispersal (fish leaving Cumberland Bay) using both T-bar tag return and telemetry methods. In general, it took fish at least two weeks, and often several months to disperse beyond Cumberland Bay. Many fish ultimately dispersed from Cumberland Bay with 56% of radio-tagged smallmouth bass and 44% of radio-tagged largemouth bass leaving the bay during our study. Dispersal patterns were similar for T-bar tags. As time post-release increased, higher proportions of tag returns came from outside of Cumberland Bay; however, tag returns from the bay continued throughout the study. One tagged fish and none of the radio-telemetry fish returned to their original capture locations following release in Plattsburgh. One dispersal pattern that became apparent was the tendency of fish to disperse to the northern regions of Lake Champlain. No study fish observed exhibited dispersal South of the Ausable River in NY and Winooski River in VT when released at Plattsburgh.

The data collected in this study provides a much needed starting point for further bass research on Lake Champlain. In addition, results give managers some insight into Lake Champlain bass tournaments, and their potential impacts on bass populations. This report contains detailed information on fish stress and mortality (using a method developed by the Lake Champlain Research Institute) and fish dispersal (using both T-bar tagging and telemetry). This information was used to make recommendations to improve tournament practices and for further research projects to better maintain Lake Champlain's high quality black bass fishery. Recommendations include better communication of existing scientific research to tournament organizers and anglers, moving the release point away from the Plattsburgh waterfront, and the establishment of a long-term monitoring program of the warmwater fishery in Lake Champlain. Finally, ideas for continuing research on black bass on Lake Champlain are listed.

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George A. Maynard, Timothy B. Mihuc, Mark H. Malchoff, Danielle Garneau, V. Alex Sotola
Lake Champlain Research Institute
State University of New York at Plattsburgh, Plattsburgh, NY 12901

INTRODUCTION

An emerging fishery issue is the growing interest in black bass fishing tournaments. According to the most recent report from the United States Fish and Wildlife Service, black bass are ranked as the most popular recreational freshwater fish in the United States (Cordell et al. 2008). Competitive bass fishing tournaments are now held in Mexico (Waters et al. 2005), all 48 contiguous states in the U.S., and Canada (Beamesderfer and North 1995). In New York, black bass are in the top five favorite fish for 75% of recreational anglers (Connelly and Brown 2009). Several lakes in New York are nationally renowned for bass fishing. BassMaster Magazine recently ranked Lake Erie and Lake Champlain numbers four and five respectively in their list of the top bass lakes in the United States (Hall et al. 2012).

Many amateur and professional bass tournaments are hosted each year by communities along Lake Champlain. Lake Champlain hosted 95 bass tournaments in 2005 alone (LCFTC 2009). With the recent increase in fishing tournaments, managers in the Champlain Valley have identified the need for information about bass populations including dispersal patterns following tournament events. Research conducted on smaller reservoirs and rivers (Blake 1981, Gilliland 1999, Bunt et al. 2002, Edwards et al. 2004, Gries 2009) may not address dispersal patterns in systems with the size and complexity of Lake Champlain. Black bass home ranges are typically less than 1 km in size (Ridgway and Shuter 1996, Ridgway 2002, Hunter 2006). Most studies have shown that bass are unlikely to return long distances (>8km) to capture sites post-release and are likely to remain within three to seven kilometers of the release site (Klindt and Shiavone 1991, Stang et al. 1996, Wilde 2003, Wilde and Paulson 2003). This may result in depletion of bass from localized areas that receive heavy angling pressure and a concomitant increase in abundance of bass at the release site. However, a recent study in New Hampshire suggested that dispersal distances may exceed seven kilometers for some fish (Gries 2009) raising questions about the potential for long-distance dispersal on Lake Champlain.

Black bass data for Lake Champlain are limited. In 2010, the Vermont Fish and Wildlife Department began a long-term monitoring program for black bass in the South Lake using standardized electrofishing transects. The only other available data are tournament bag weights which do not differentiate largemouth and smallmouth bass data. Both of these sources suggest that, in general, Lake Champlain contains a productive black bass fishery. However, to effectively address the concerns of stockpiling at release points and localized depletion from heavy fishing pressure, managers need a better understanding of dispersal patterns post-release.

Project Objectives:

1. Assess fish condition (stress) and mortality rates at bass tournaments.
2. Determine post-release dispersal patterns using external T-bar tags
3. Use telemetry to assess post-release black bass dispersal patterns.
4. Develop recommendations to improve tournament release practices.

Study Site and Topics:

Work was conducted on Lake Champlain (Fig. 1) which has a surface area of 1124 km^2, a maximum width of 21km, a length of 200 km, and a maximum depth of 122 m. It is bordered by New York (to the west and south), Vermont (to the east), and Quebec (to the north). The lake drains northward into the Richelieu River and is connected to the Hudson River in the south via the Champlain Canal (Myer and Gruendling 1979).

Lake Champlain contains a mix of eutrophic, mesotrophic, and oligotrophic sub-basins. Warm water, eutrophic sub-basins are dominated by largemouth bass and other centrarchids. Cool water, mesotrophic sub-basins are dominated by smallmouth bass, northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), and rock bass (*Ambloplites rupestris*). The Main Lake and Willsboro Bay are cold water, oligotrophic sub-basins dominated by lake trout (*Salvelinus namaycush*) and Atlantic salmon (*Salmo salar*) (Marsden and Langdon 2012). Due to the abundance of habitat, both species of black bass can reach weights of over 2.25 kg and lengths of over 50 cm, making the lake desirable for fishing tournaments.

Tournaments on Lake Champlain can subject fish to long-distance travel in livewells, as anglers launching out of Plattsburgh, NY, may catch and transport fish from Missisquoi Bay in the north (40 km distant) or from South Bay at the southernmost end (>110 km distant) back to Plattsburgh. Tournament activities, therefore, present both challenges and opportunities to better understand the impacts of various treatments including stress of capture, extended transport, weigh-in and confinement in release boats. Among the suite of stressors is barotrauma as fish caught at depth are brought to the surface. The resulting decrease in pressure allows internal gasses to expand with associated physiological and anatomical impacts. Barotrauma has been well studied in marine fisheries, and freshwater salmonid fisheries, but has received little attention in bass tournament studies.

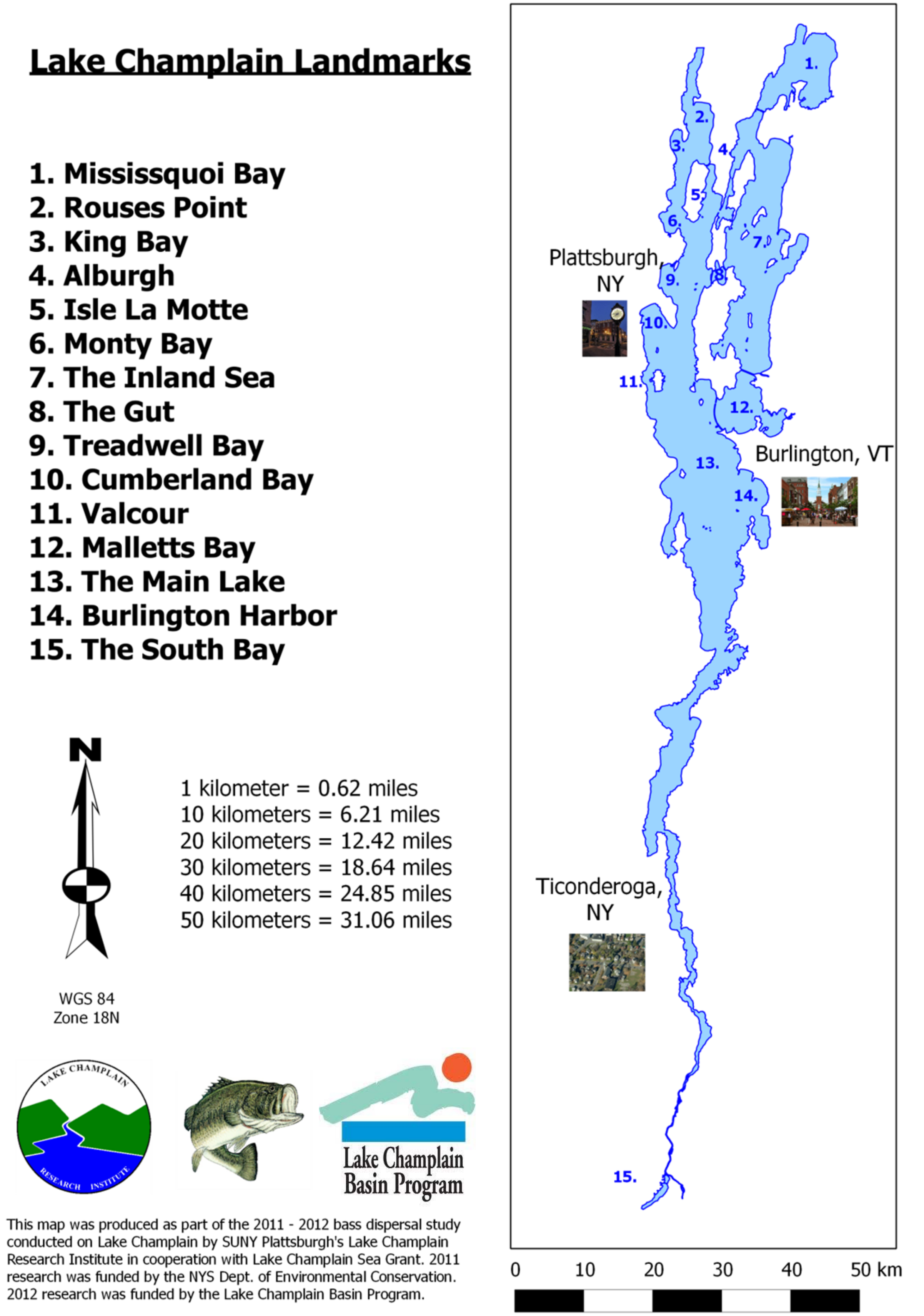

Figure 1 - Map of Lake Champlain with some landmarks labeled

METHODS

Black bass were collected from anglers at nine Plattsburgh-based tournaments in summer 2011 and 2012. The Plattsburgh weigh-in was selected for this study because it hosts the largest tournament events on Lake Champlain. Four 100 gallon holding tanks were used to process fish at each tournament (two for assessing stress, measuring, weighing, and tagging fish, and two for holding fish before and after radio transmitter implantation; Appendix 1). Each tank was filled with fresh lake water run through a chiller; five air stones bubbled air into each tank. Length and weight measurements from tournament captured fish as well as fish captured through electrofishing surveys on Lake Champlain (Maynard et al. 2012 unpublished) were used to calculate species specific length-weight regressions.

Stress Index

Using metrics adapted from Campbell et al. (2010) and Davis (2010), a subset of fish were evaluated for a battery of stress symptoms at tournaments (Table 1; Appendix 2). Most of the conditions and associated stress descriptions are self-explanatory and recognizable to biologist as well as tournament staff and anglers. Four of the conditions are symptomatic of barotrauma (tight abdomen, exopthalmia, ocular emphysema, and esophageal eversion). Each stress indicator was scored as present or absent (1 or 0). Using Quantum GIS v1.8.0 fish were assigned distances from capture location to weigh-in (e.g. any fish from Malletts Bay was assigned a “livewell travel distance” of 19km). All statistical analyses were conducted using the R Project for Statistical Computing v2.14.1 (R Development Core Team 2012). In order to reduce the skewness,distance traveled data were transformed using square root transformation (McCune and Grace 2002). Data were used to generate generalized linear models (GLMs) to depict bass stress levels as a function of distance traveled, bass length, and lake temperature.

Table 1 – Physical indicators of fish stress

Condition	Description
Absence of Dorsal Erection	Fins do not become erect when fish is restrained
Absence of Mouth Clamp	Mouth does not clamp shut when lifted or opened
Absence of Restraint Resistance	Fish does not exhibit muscle flex for escape
Hook Wound	Wounding in or around the mouth
Bloody Fins	Hemorrhaging present in fins
Fin Damage	Fins frayed or missing parts
Lamprey Wound	Circular wounding characteristic of lamprey attack
Tight Abdomen	Abdomen swollen, feels tight to the touch
Exopthalmia	Eyes protruding out of orbit
Ocular Emphysema	Gas present in eye
Esophageal Eversion	Eversion of esophageal tissue into the buccal cavity

Immediate fish mortality was measured by collecting dead fish from cooperating release boats. Delayed fish mortality was measured by monitoring the Plattsburgh waterfront for tagged fish for the first 48 hours after each tournament and closely following radio tagged fish for that time period.

METHODS: Statistical analysis

To ensure variable independence, we tested for interactions between stress indicators (package "cor.test", R v2.14.1). No stress indicators were significantly related ($r2>0.62$; 9 df; Price 2012) so each was evaluated separately. In order to reduce the skewed nature of the distance traveled data, we used a square-root transformation to tighten the distribution (McCune et al. 2002). To determine the effects of temperature, fish length, and distance traveled in a livewell on fish stress, we used generalized linear modeling, which can be used to analyze non-normal and binary data (Zuur et al. 2009). As there was no interaction between the independent variables, we ran several models for each stress indicator (temperature, length, distance, and null models featuring interactions between variables) for each species. Following model creation, we tested the models using likelihood ratio tests (package "lmtest", R v2.14.1) to select the models with the highest likelihood. We used Mann-Whitney U tests (package "stats", R v2.14.1) to determine differences between species and between release groups. All statistical analysis was conducted using the R Project for Statistical Computing v2.14.1 (R Core Team, 2012) in the RStudio v0.97 environment (RStudio 2012).

Relative condition factor was calculated by dividing individual weight by the length-specific mean weight of tournament-caught fish (Anderson and Neumann, 1996). Regression-line-percentile (RLP) formulae were calculated for tournament-caught fish only using the formula $\log_{10}(W_s) = a' + b \times \log_{10}(L)$ where W_s is standard weight in grams and L is total length in millimeters (Murphy et al., 1991). A regression tree model was employed to compare post-tournament fish dispersal rates as a function of a suite of measured stress indicators. This model provides the first step in the development of a stress condition index for Lake Champlain tournaments.

Fish T-bar Tagging

Prior to processing, each fish was assigned an original capture location based on information collected from the anglers. All fish were measured for length, the majority of fish were assessed for the stress index, and a subset of fish were weighed. The majority of fish collected (> 1000 of each species) had T-bar tags inserted between the anterior pterygiophores using standard procedures (Murphy and Willis 1996). Each tag carried a unique identifier code, along with email and telephone contact information. T-bar tags are a low-cost method that can be used to assess dispersal distance of tournament-caught fish post-release and have been used successfully in a number of black bass dispersal studies (Blake 1981, Wilde 2003). Outreach including press releases, networking with local angling groups, contact through the NYSDEC "Field Notes" listserv, and participation in online forums was used to encourage tag returns by the Lake Champlain angling community. Additionally, distribution of handouts at subsequent tournament registrations created a resampling effort using hundreds of tournament anglers.

Fish Telemetry

A subset of T-bar tagged fish were selected for radio telemetry. These fish were anaesthetized and Lotek radio transmitters (Fig. 2; Tab. 2) were surgically implanted in the abdomen following standard procedures (Bunt et al. 2000). After being held for a post-observational period of 4-24 hours, these

Table 2 – Technical specifications for three types of Lotek transmitters used in the study

Model	Diameter x Length	Weight	Battery Life
MCFT2-3FM	11 x 59mm	11g	572 Days
CH-11-18	11 x 56mm	11g	193 Days
MCTF2-3EM	12 x 53mm	10g	342 Days

fish were released at a standard release point, which was approximately the same location used by tournament release boats based out of Plattsburgh. Radio-tagged fish were tracked using a unidirectional Yagi antenna and a Lotek SRX600 radio telemetry receiver mounted on either a boat or a plane in the weeks/months following release. Use of boat tracking facilitated accurate and efficient monitoring of fish located in the region of Lake Champlain bounded by AuSable Point, Valcour Island, and Cumberland Head. As fish left Cumberland Bay, telemetry flights were used to mark the general location (e.g. bay, river mouth, or island shoreline) of fish.

Dispersal data (both telemetry and T-bar tag) were displayed using time-sequence density heat maps (QGIS v1.8.0 “heatmap” plugin). Heat maps are a form of raster imagery that can be used to easily visualize point density data.

Figure 2 - Lotek transmitters (Dual acoustic, *above*, Radio, *below*).

Data Management

Data were managed using a Microsoft Access 2007 database. QGIS v1.8.0 “Lisboa” was used to generate maps. Graphs were produced using Microsoft Excel and the R Project for Statistical Computing v2.14.1. Statistical analyses were conducted using the R Project for Statistical Computing using the following packages; cor.test, corrgram, rms, lme4, glmmML, lmtest, and MASS.

RESULTS

Population dynamics, tournament catch data

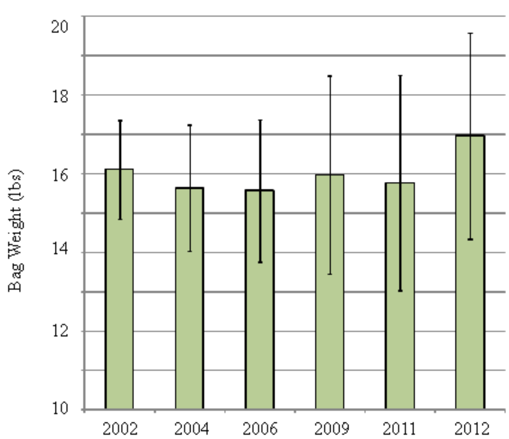

Figure 3. Average creel weight for the top 100 anglers at WalMart-FLW Tour events on Lake Champlain. The creel limit for black bass on Lake Champlain is five fish (including both largemouth and smallmouth bass).

The only information available on Black Bass populations for Lake Champlain prior to this study was Bass tournament catch data. We compiled tournament data from the WalMart FLW Tour event held in Plattsburgh several times of the past decade (Fig. 3). The data show 5-fish bag weights averaging approximately 15 lbs (approx 3 pound average per fish) that are consistent over the past decade. Similar “no trend” data have previously been compiled from the daily creel limit weights for the Top 10 anglers from each of the 8 professional-level Bassmaster tournaments held on Lake Champlain since 1997 (LCMCOOP, 2011). The FLW Tour Open data exhibit a consistent pattern over the past decade and are adequate (when combined with length/weight regression analysis) for management comparisons to other water bodies (see below). Existing tournament data suggests that the Lake Champlain bass fishery has maintained good quality (3 pound average) over the past decade. Tournament data, however, are limited because species information is lacking and data are restricted to only the largest fish in the population.

We collected length and weight information on 339 largemouth and 413 smallmouth bass during this study. Length-weight relationships appear in Figure 4. In general, the relationship shows a healthy length-weight relationship for both largemouth and smallmouth bass. At maximum length for both species (> 45-50 cm) fish show increased weight, suggesting that as fish age they are putting on mass at a higher rate than increasing length. Additionally, using data from Magron et al. 2005, we compared length-weight regressions for bass on Lake Champlain to bass in the Hudson River. The comparison showed that largemouth bass tend to be heavier at length in Lake Champlain, and smallmouth bass sizes are similar in both water bodies.

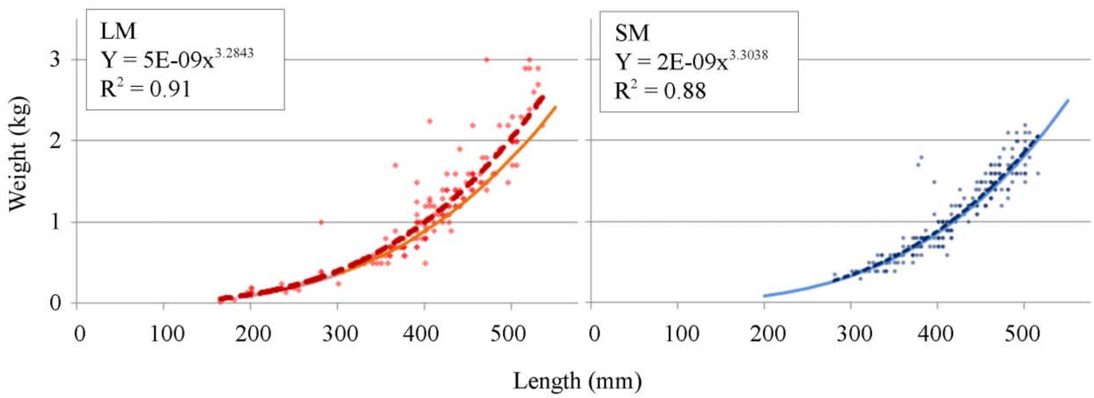

Figure 4. Length-weight regressions for Lake Champlain largemouth bass (left) and smallmouth bass (right) compared with length-weight regressions for bass from the Hudson River. Lake Champlain bass are represented by dashed lines, and Hudson River bass are represented by solid lines. Hudson River regressions were taken from Magron et al. (2005). Lake Champlain regressions were generated by a combination of data from this study as well as data collected by a fish community study conducted by the Lake Champlain Research Institute.

The mean calculated relative condition factor (K_n) for tournament-caught largemouth bass was 1.03 (C.I=0.02; p=0.05). The same value for tournament-caught smallmouth bass was 1.02 (CI=0.02; p=0.05). Length-weight regression-line-percentile (RLP) techniques produced trendlines of $Log_{10}(W) = - 5.1381 + 3.1326\ Log_{10}(L)$, ($R^2 = 0.83$; $p<0.001$); and $Log_{10}(W) = - 5.0948 + 3.0941\ Log_{10}(L)$, ($R^2 = 0.82$; $p<0.001$) for tournament-caught largemouth and smallmouth respectively.

A comparison of fish age versus length appears in Figure 4a . We utilized four different structures (otoliths, opercles, scales and dorsal spines) to age approximately 60 fish of each species (for methods see Bardach, 1955, Maraldo and MacCrimmon 1979, Long and Fisher 2001). We used four individual readers for each structure resulting in each reader completing

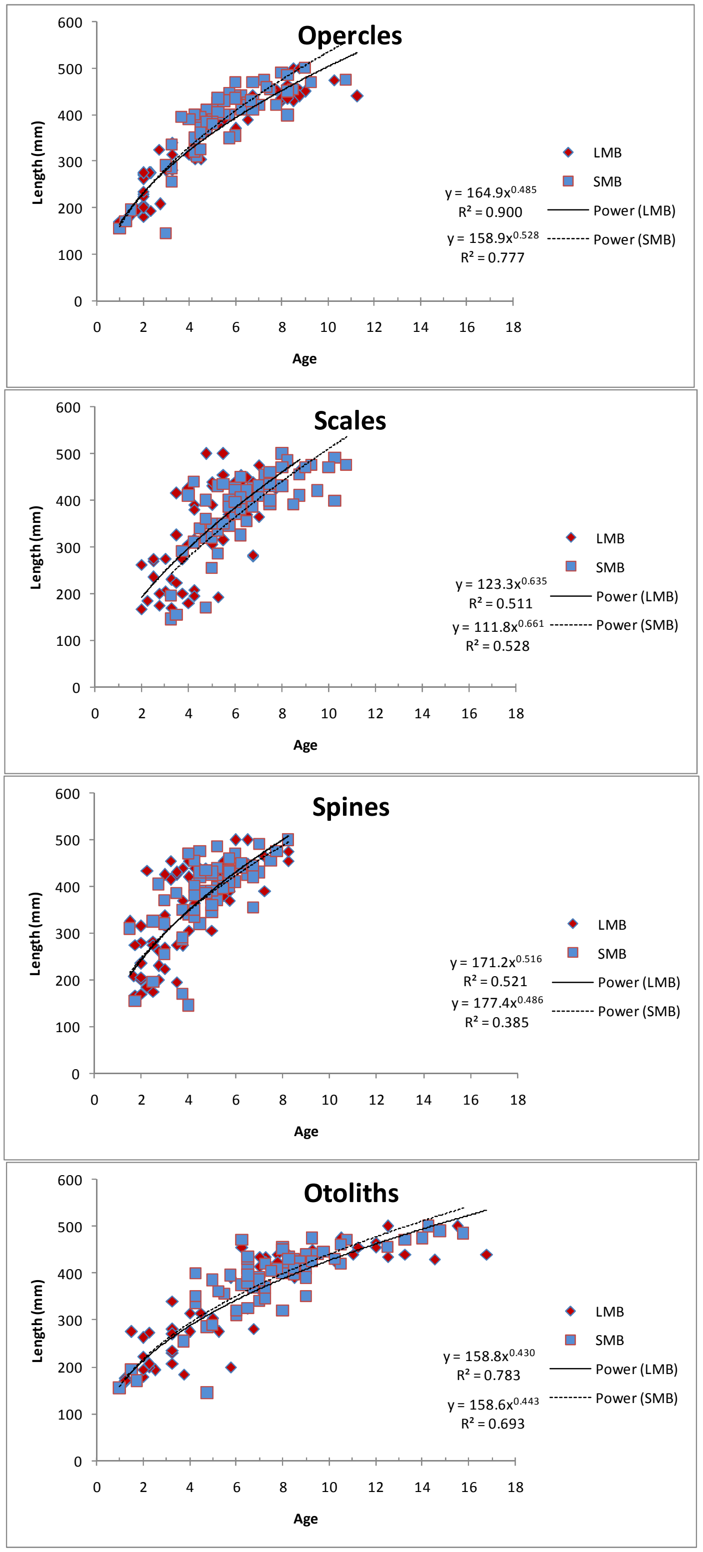

Figure 4a . Length versus mean age for LMB (n=60) and SMB (n=61) using four different aging methods. Regression lines and R^2 values for each species approx 240 age estimates per species . In order to obtain more accurate information across a broad range of ages we collected fish in size classes below the tournament-legal limit (<300mm) as well. Several methods were used to age Lake Champlain bass which required sacrificing the fish (fish over 300 mm were obtained from tournament release boats as mortality fish and did not required us to sacrifice any live fish). Results indicate the use of spines or scales are less useful to age LMB or SMB in Lake Champlain due to poor length vs age relationships in both species and possible age underestimates for older fish by spines (the very fish we need more accurate age information on to manage the fishery). Aging black bass using scales has been cautioned by several investigators (Besler 1999, Maceina et al. 2007, Taylor and Weyl 2012) due to asymmetrical growth patterns which result in high variation in scale reader errors. The two methods that yielded the best relationship with fish length were otoliths and opercles. It appears that otoliths may overestimate the oldest fish in the population given that other similar lakes typically contain SMB with a maximum age of 10-11 (Lake Erie, Lake Nipissing) or <13 years for LMB (Lake Ontario) (Scott and Crossman 1973). We obtained ages using otoliths up to 17 yrs in Lake Champlain while no other structure resulted in an age estimate over 11 years for the same Lake Champlain fish. Opercles had the the tightest age to length relationship and appear to more accurately estimate older aged fish and are likely the most suitable structure for aging Lake Champlain black bass.

Angler Capture Location

In total, 3,870 bass (1,987 largemouth, herein referred to as LM, and 1,883 smallmouth, herein referred to as SM) were processed over nine tournaments (thirteen sample days; Table 3; Appendix 3). Lengths of tournament-caught smallmouth bass ranged from the legal limit of 300 mm to a maximum of 535 mm. Smallmouth bass weights ranged from 0.1 kg to 2.2 kg. The average smallmouth bass length and weight was 421 mm (16.5 in) and 1.1 kg (2 lbs, 6 oz.). Lengths of tournament-caught largemouth bass ranged from 305 mm to a maximum of 535 mm. Largemouth bass weights ranged from 0.4 kg to 3.0 kg. The average largemouth bass length and weight was 414 mm (16.3 in) and 1.3 kg (2 lbs, 14 oz; Fig. 4), respectively.

Largemouth bass were generally captured further from Plattsburgh than smallmouth bass. Capture information is for general lake areas (individual bays, etc.) as reported by anglers. Over half of all largemouth bass were originally captured greater than 40 km from Plattsburgh (Fig. 5; Fig. 6). The South Lake (Ticonderoga) represented >40% of all largemouth bass caught by tournament anglers during this study. The vast majority of smallmouth bass were captured within 40 km of Plattsburgh in the North Lake or the Inland Sea. The Main Lake (a deep, oligotrophic zone) produced a very small proportion of tournament-caught bass in this study (Fig. 6).

Table 3 – Number of black bass processed at all tournaments attended in 2011and 2012. "LM" refers to largemouth bass. "SM" refers to smallmouth bass. T-bar refers to fish implanted with T-bar tags. Transmitter refers to fish implanted with telemetry transmitters, and M/S no tag refers to fish evaluated for stress without being tagged. N/A indicates no tag returns occurred. Appendix 4 provides detailed information about each tournament (e.g. weather conditions, number of anglers).

	LM				SM				
Date	**T-bar**	**Transmitter**	**M/S no tag**	**Returns**	**T-bar**	**Transmitter**	**M/S no tag**	**Returns**	**Funding**
6/11/2011	49	1	10	10	80	1	36	7	DEC
6/18/2011	59	3	8	11	89	3	38	10	Both
6/23/2011	1235	3	26	29	91	4	27	7	LCBP
6/24/2011	156	0	14	26	97	0	16	5	
7/30/2011	33	5	3	0	36	5	7	0	
9/15/2011	116	5	14	7	179	5	17	6	
9/16/2011	108	4	10	4	162	8	31	7	
6/16/2012	95	4	2	9	117	8	3	1	
6/28/2012	207	3	20	22	121	9	13	3	
6/29/2012	205	4	52	9	143	3	32	5	
7/19/2012	7	4	277	1	26	5	117	0	
7/20/2012	0	0	300	N/A	0	0	197	N/A	
9/15/2012	0	2	53	N/A	0	2	155	N/A	
LCBP Totals	**738**	**26**	**728**	**52***	**748**	**40**	**565**	**22***	
Totals	1160	38	789	128*	1141	53	689	51*	

*tag return numbers do not include multiple recaptures (i.e. each fish only counts once)

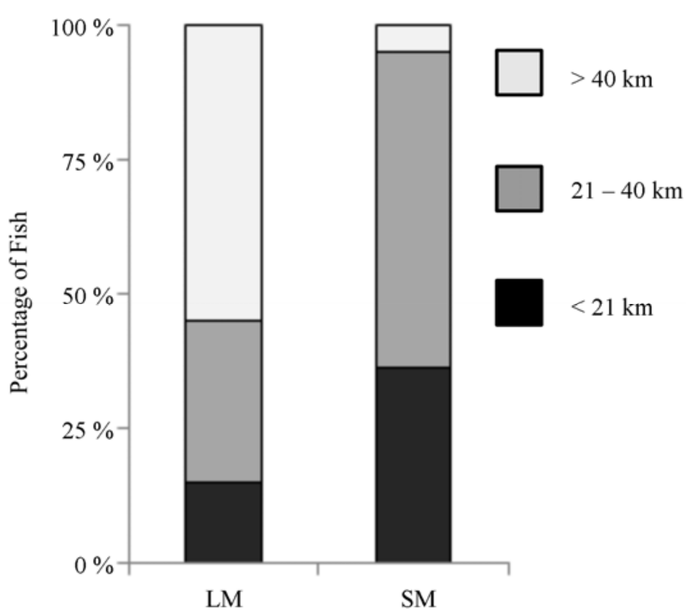

Figure 5 - Distance from initial capture to weigh-in for each species.

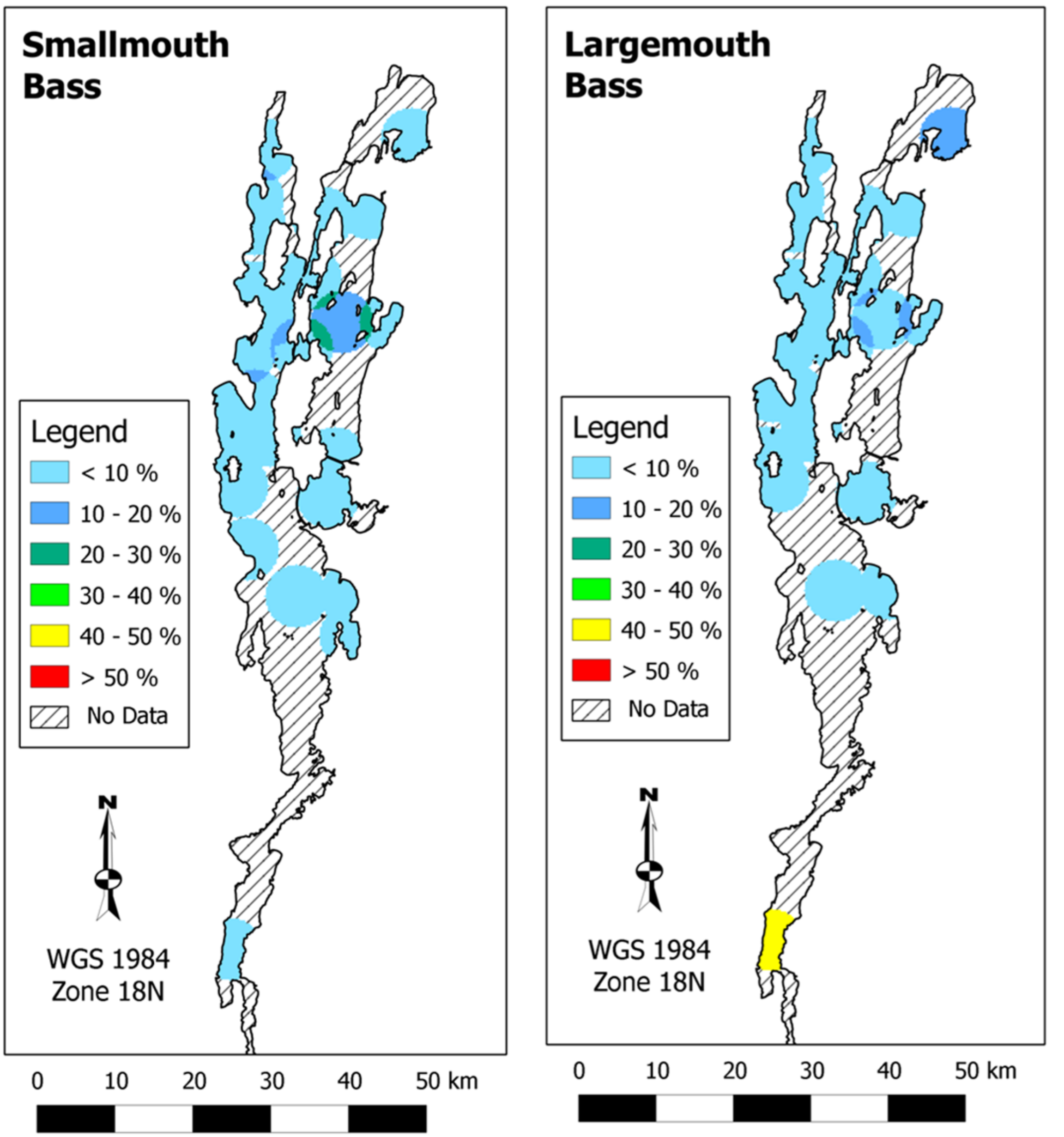

Figure 6. Observed density that a randomly selected fish at a 2011 bass tournament in Plattsburgh would be from any area of the lake generated through density estimation. Largemouth bass were most commonly captured in the South Lake, the Inland Sea, the Alburgh Passage, the Gut, and Missisquoi Bay. Smallmouth bass were most commonly captured in the Inland Sea.

Fish Stress

Stress index results indicate the presence of bloody fins (>50% occurrence) in both species (Fig. 7). Rates of other indicators of stress were also high, with over 50% of largemouth bass and over 30% of smallmouth bass exhibiting fin damage. Over 40% of both species exhibited an absence of dorsal erection. Less than 20% of smallmouth and 40% of largemouth exhibited hook wounds, and less than 5% of individuals exhibited lamprey wounds.

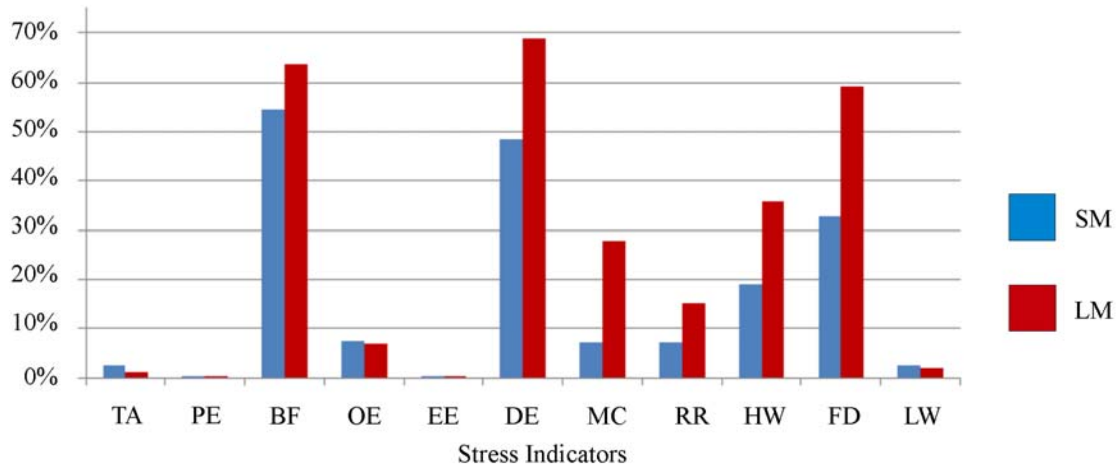

Figure 7 - Percent occurrence (y-axis) of different stress indicators by species including tight abdomen (TA), popeye (PE), bloody fins (BF), ocular emphysema (OE), esophageal eversion (EE), absence of dorsal erection (DE), absence of mouth clamp (MC), absence of restraint resistance (RR), hook wounds (HW), fin damage (FD), and lamprey wounds (LW).

Generalized linear modeling shows that the probability of fish experiencing fin damage increased (SM p=0.002, LM p<0.001) the greater the distance fish were transported in a livewell (Fig. 8).

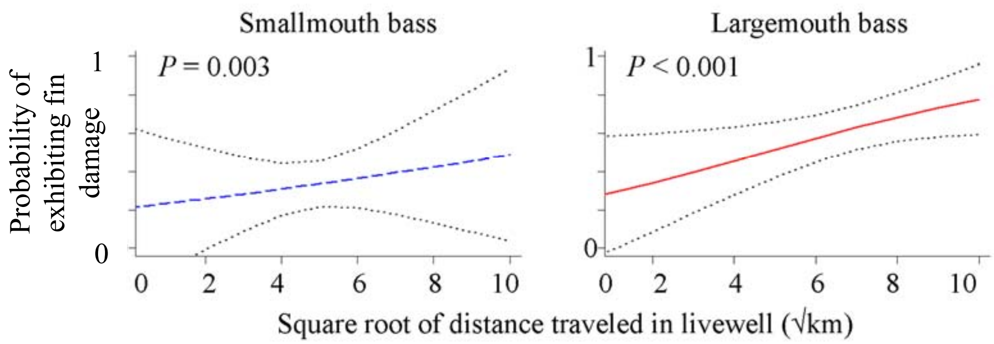

Figure 8 – Probability of a fish exhibiting fin damage (y-axis) as a function of the square root of distance traveled in a livewell (km, x-axis). Smallmouth bass are represented by the blue line on the left, and largemouth bass are represented by the red line on the right. Dotted lines show 95% confidence intervals.

Both species were more likely to exhibit bloody fins (SM p=0.003, LM p<0.001) and fail to exhibit dorsal erection (SM p=0.002, LM p<0.001), the greater the distance traveled in a livewell. Larger fish also had a higher probability of exhibiting bloody fins (SM p<0.001, LM p<0.001; Fig. 9) and fin damage (SM p<0.001, LM p<0.001).

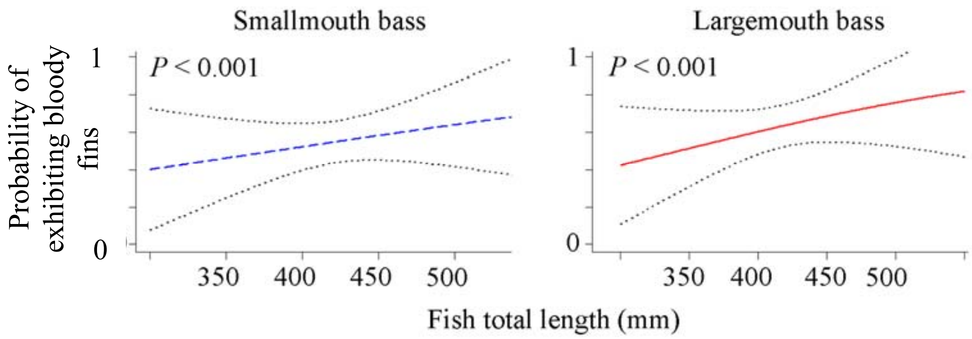

Figure 9 –Probability of a fish exhibiting bloody fins (y-axis) as a function of total length (mm, x-axis). Smallmouth bass are represented by the blue line on the left, and largemouth bass are represented by the red line on the right. Dotted lines show 95% confidence intervals.

The relationship between temperature and certain types of stress was also evident. Largemouth bass were more likely to exhibit an absence of restraint resistance ($p=0.020$), and both species were more likely to exhibit an absence of dorsal erection ($p<0.001$ for both species; Fig. 10). Higher temperatures also led to both species being more likely to exhibit bloody fins (SM $p=0.009$, LM $p<0.001$) and fin damage (SM $p=0.018$, LM $p<0.001$).

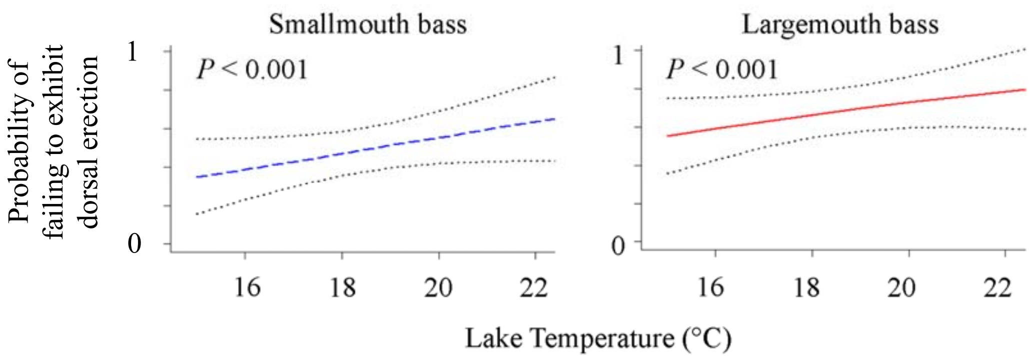

Figure 10 - Probability of a fish exhibiting absence of dorsal erection (y-axis) as a function of water temperature (°C, x-axis). Smallmouth bass are represented by the blue line on the left, and largemouth bass are represented by the red line on the right. Dotted lines show 95% confidence intervals.

Hook wounds, lamprey wounds, barotraumas indicators (tight abdomen, popeye, esophageal eversion, ocular emphysema) were not related with distance traveled, fish size, or water temperature.

Dispersal and stress

Bass dispersal modeled as a function of stress indicator presence/absence confirmed the importance these indicators (Fig. 11) model. The model was given by the formula, Rate ~ Length+TA+BF+OE+DE+MC+RR+HW+FD+LW. Model terms followed the same labeling convention as presented in Fig. 7. In the case of smallmouth bass, the analysis revealed that:

- Big fish disperse at a moderate rate, regardless of stress levels (likely due to the small number of stressed smallmouths observed).
- Smaller fish that resist restraint disperse the most quickly.
- Small fish that fail to resist restraint disperse the slowest.

In the case of largemouth bass:

- Fish with many indicators of stress (regardless of size) disperse the slowest
- Small fish with fin damage but no other indicators disperse moderately quickly
- Medium fish with few indicators (not including bloody fins) disperse moderately quickly
- Small fish with no indicators and large fish with only bloody fins or RR disperse quickly

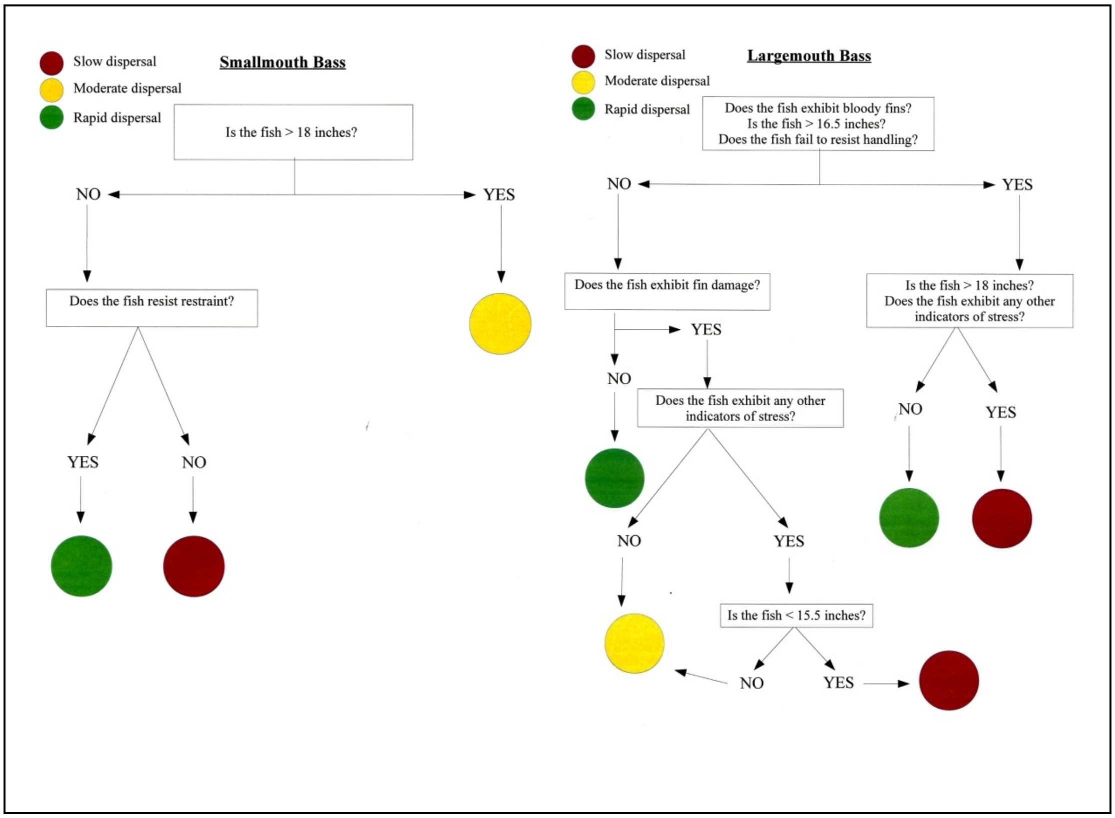

Figure 11. Regression tree analysis of dispersal rate predictions as a function of selected stress indicators.

Short-term Mortality

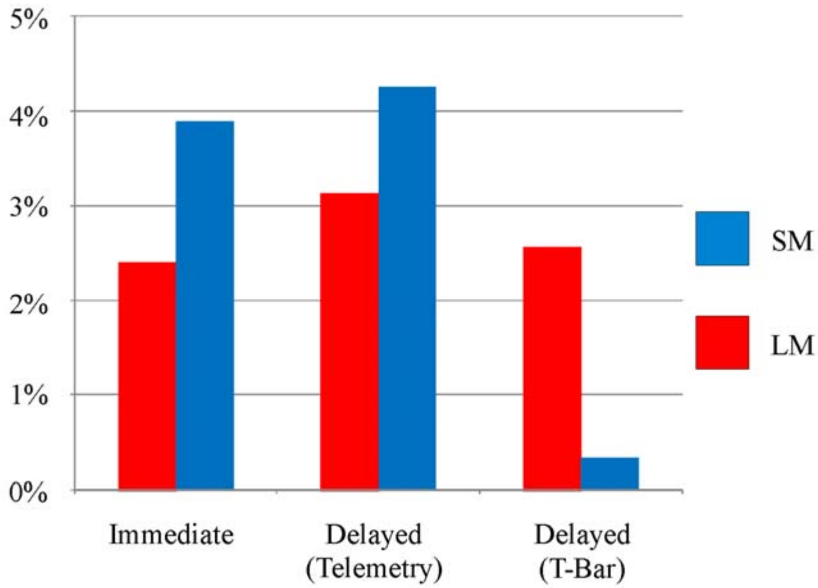

Figure 12 – Percent post-tournament mortality for both species evaluated using three methods.

Immediate tournament mortalities were tallied at tournament release boats. Percent of total was calculated by dividing the number of release boat mortalities by the number of fish captured at tournaments. Delayed tournament mortalities (0-48 h) were tallied by combining call-ins of dead fish found ashore with a T-bar tag from the public as well as those found during our monitoring of the waterfront. Delayed mortality was also tallied by counting fish that were tracked and found dead via telemetry from 0-48 hours of release. Percent of total was calculated using number of total fish tagged with T-bar tags or radio transmitters respectively.

Mortalities for largemouth from the release boat (2.41%), delayed T-bar tags (2.57%), and delayed telemetry fish (3.13%) were low (Fig. 11). This indicates that Plattsburgh, NY tournaments had a low largemouth bass mortality rate.

Mortalities for smallmouth bass for the release boat (3.89%), delayed T-bar tags (0.34%), and delayed telemetry fish (4.26%) were also low (Fig. 11). This demonstrates a low tournament mortality rate for smallmouth bass.

We compared temperature ranges at LCRI holding tanks, tournament holding tanks (where fish are kept between the livewell and weigh-in), and holding tanks on the release boat (where fish are kept after weigh-in) on four tournament days in 2012 (Fig. 11a). The tournament holding tanks were treated with ice on the three warmest days (July 19-20 and Sept. 15, 2012). Temperatures of LCRI tanks were similar to release boat temperatures on all four days. The temperatures of the tournament holding tanks were lower than those of the release boat and LCRI tanks on July 19-20 and Sept. 15.

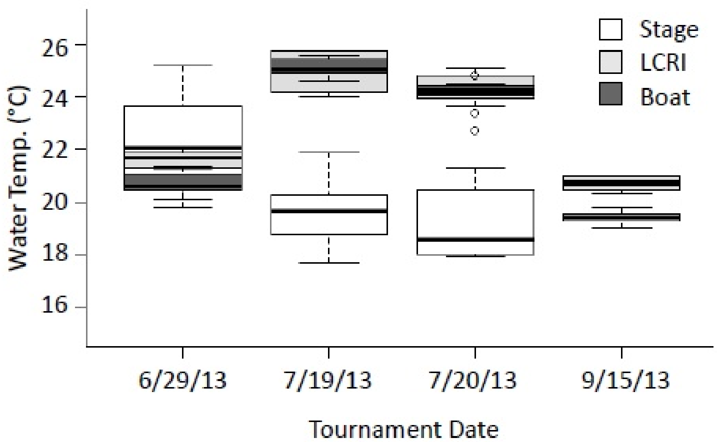

Figure 13 – Range of water temperatures of tournament infrastructure at four tournament days in 2012. Stage tanks are those tanks used to hold fish between livewell confinement and weigh-in. LCRI tanks are those tanks used to hold fish while they were measured and assessed for stress levels. Boat tanks are those tanks used to hold fish prior to mass release from a release boat.

Post–Release Dispersal in Lake Champlain

Of the 53 smallmouth bass implanted with transmitters, 34 were successfully tracked for longer than two weeks. The remaining 19 SM were not tracked beyond two weeks. Of the 38 largemouth bass implanted with transmitters, 19 were successfully tracked for longer than two weeks, four were caught and killed by anglers, and one was found dead within 48 hours of surgery. The remaining 14 LM were not tracked beyond two weeks.

The majority of radio-tagged fish remained in Cumberland Bay for several weeks post-release. Of the fish tracked for more than two weeks (SM n=32 ; LM n=19), 56% of smallmouth bass and 44% of largemouth bass eventually left Cumberland Bay (Fig. 12). Most fish of both species initially moved along the shoreline during dispersal. No smallmouth bass and only two largemouth bass crossed deep (≈200 ft) regions of the lake during dispersal. No radio-tagged bass returned to their original capture location.

A total of 2,301 fish (1160 LM and 1141 SM) were fitted with T-bar tags. Of these, 264 fish (11.5%) were recaptured and reported (185 LM and 79 SM). Of the recaptured fish, 66% of largemouth bass were recaptured within the first month following release, and 52% of smallmouth bass were recaptured within the first month. Over half (55%) of the largemouth bass recaptured in the first month were recaptured within two weeks of release compared with only 32% of recaptured smallmouth bass in the same time period. One T-bar tagged smallmouth bass (SMB 1127) returned to its proximate original capture location after four months at liberty (originally captured in the Inland Sea on 9/16/2011, and was recaptured in the Inland Sea on 5/16/2012 by an angler).

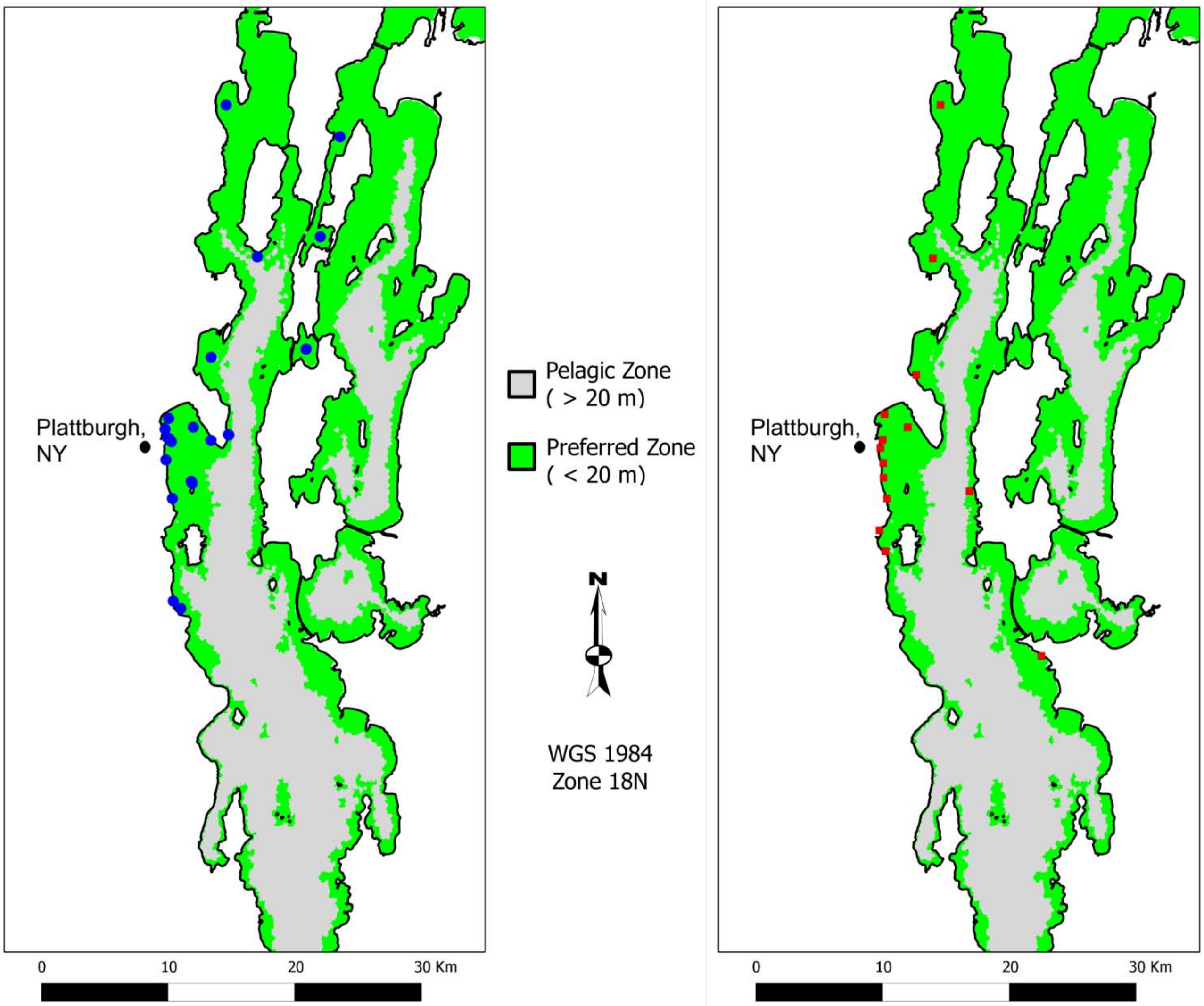

Figure 14 – Maximum distance from Plattsburgh reached by all radio tagged fish tracked for more than two weeks. Smallmouth bass are represented by blue circles (left), and largemouth bass are represented by red squares (right). Locations are overlaid onto a bathymetry map of Lake Champlain. Using habitat models produced by Edwards et al. 1983, habitat shallower than 20 m was classified as "preferred" bass habitat, and habitat deeper than 20 m was classified as pelagic (undesirable) habitat.

Maximum dispersal distance varied by species and days at liberty (Fig. 15). Smallmouth bass dispersed greater distances than largemouth bass following release. Generally, fish of both species took over 60 days to leave Cumberland Bay.

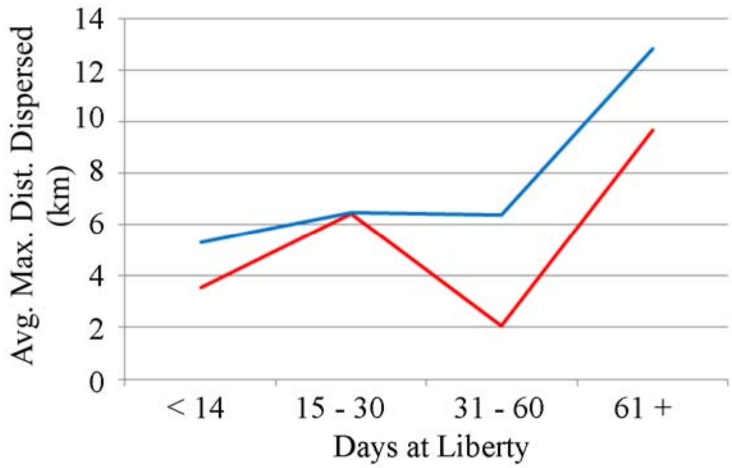

Figure 15 – Average maximum dispersal distance over a time series for each species.

Density maps generated from telemetry resightings and T-bar tag recaptures (Fig. 16, 17) show a high observed density (> 50 % chance) of encountering tagged fish near the Plattsburgh waterfront for the duration of the study. After several weeks, however, the maps show an increased observed density of encountering fish longer distances from Plattsburgh and outside of Cumberland Bay. In the 2-4 week post release period, largemouth bass dispersal was more likely out of Cumberland Bay than during the first two weeks. Smallmouth bass remained in Cumberland Bay for several months with long distance dispersal more likely after 2 months.

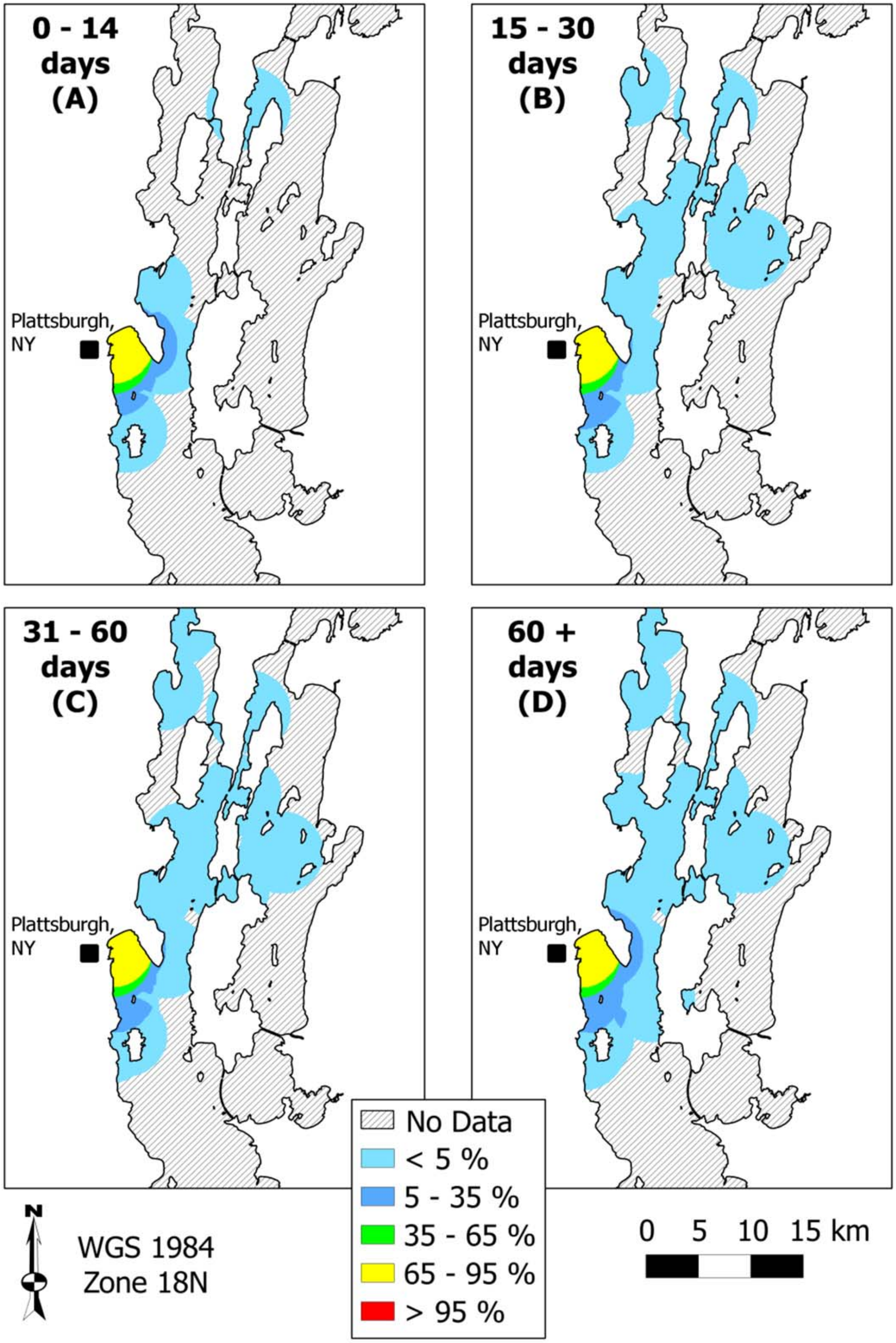

Figure 16 – Maps showing the densities of recaptures of tagged (radio or T-bar) largemouth bass post-release.

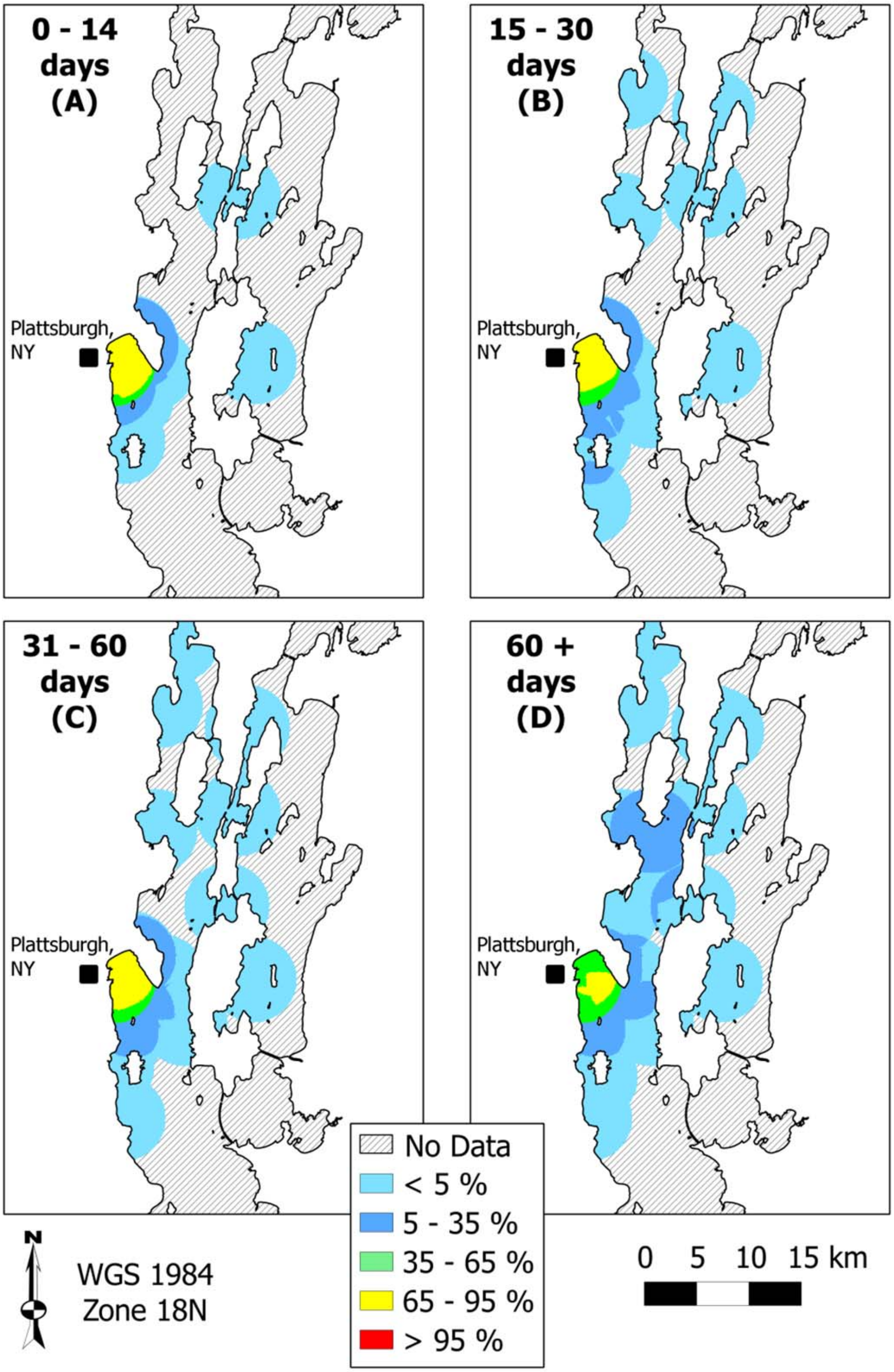

Figure 17 – Maps showing the densities of recaptures of tagged (radio or T-bar) smallmouth bass post-release.

DISCUSSION

Relative condition, tournament stress and mortality

The mean calculated relative condition factor (K_n) for tournament caught largemouth exceeded 1.0, which generally equals or exceeds published values across similar length categories (Swingle and Shell, 1971 *IN* Anderson and Neumann, 1996). This suggests that largemouth bass collected by tournament anglers are at or above average condition compared to tournament fish collected from other lakes. Similar values for smallmouth suggest that this species is also doing well. The RLP-derived trendlines reinforce these conclusions. The trendline intercepts and slopes of Lake Champlain bass are similar to published values for both species, including smallmouth populations in several New York water bodies including the Mohawk River, Findley Lake, Hudson River, and St. Lawrence River (Murphy et al., 1991; Kolandar et al., 1993).

Largemouth bass were generally transported greater distances to Plattsburgh weigh-in events than were smallmouth bass. This is probably due to the fact that habitats proximate to Plattsburgh are better suited to smallmouth bass. Habitats preferred by smallmouth bass include channels, islands, and river mouths with current, wave action, and rocky bottoms. These areas abound in the north-central region of Lake Champlain (e.g. Valcour Island, Crab Island, the Saranac River, Carry Bay, and the Gut). Data collected from tournament anglers corroborates these habitat preferences as a majority of smallmouth bass were originally captured within 40km of Plattsburgh. Largemouth bass, on the other hand, are generally found in areas with heavy cover such as vegetation and sunken timber. Additionally, they are more tolerant of eutrophic waters. Thus, areas such as King Bay, Missisquoi Bay, and the South Lake are more likely to harbor largemouth bass.

Instances of bloody fins and fin damage increased with distance traveled in livewells. Several studies have shown that livewells can be stressful environments (e.g., low oxygen, increased temperature stresses) for fish (Suski et al. 2005; Ostrand et al. 2011). Carmichael et al. (1984) found that it can take bass up to 28 days to recover from stress associated with confinement and hauling distances. Bass exhibited delayed dispersal from Plattsburgh, lending further credence to the assertion that livewell confinement can be stressful, and fish need time to recover. Some reflex impairment (absence of dorsal erection in both species, absence of restraint resistance in largemouth) were also significantly related to distance traveled in a livewell.

Research on bass stress in relation to temperature corroborates our findings that certain types of stress increase as water temperature increases. Although higher temperatures do not directly cause bloody fins, higher temperatures can exacerbate fish stress by decreasing the amount of oxygen available in the water (Thorstad et al. 2003). Researchers have also found that higher temperatures during hauling contribute to higher stress levels in fish (Carmichael et al. 1984), and that higher temperatures during handling can lead to higher instances of delayed mortality because of stress (Wilde 1998). Researchers observed temperature differences between the *in situ* lake temperature, livewell temperature, and tournament infrastructure (holding tanks on the stage and at the release boat). Variation in temperature is usually exacerbated on warmer days. Such variation can cause increases in stress due to temperature shocks, necessitating a longer recovery period post-release (Suski et al. 2006).

There is also a relationship between fish size and stress levels. Longer largemouth bass have higher oxygen requirements than their smaller counterparts (Burleson et al. 2001). Thus, any hypoxic conditions likely affect longer bass, resulting in more stress (bloody fins, reflex impairment) manifestations in those fish. Other research has also found small largemouth bass are more resilient to angling-related stress (Ostrand et al. 2011), and longer striped bass (*Morone saxatilis*) experience higher rates of angling-stress mortality than shorter striped bass do (Hysmith et al. 1992).

Barotrauma indicators (tight abdomen, esophageal eversion, ocular emphysema, and popeye), hook wounds, and lamprey wounds were not related to temperature, distance traveled in a livewell, or fish length. They are all present or absent before the fish goes into the livewell.

Estimated immediate and delayed mortality rates for both species on Lake Champlain were much lower than estimated immediate and delayed mortality rate based on a survey of 130 tournaments in the 1990s (Wilde 1998; Table 4). Improvements in tournament release practices since the 1970s have significantly reduced immediate mortality at tournament events. Because of its northern latitude and short water residence time, Lake Champlain is generally cooler than many reservoirs in the southern and midwest United States. Given the results from our stress models that show higher levels of stress at higher temperatures, it would make sense that Lake Champlain would show lower levels of delayed mortality than the national average.

Table 4 – Immediate and delayed mortality estimated for 6 tournaments on Lake Champlain (2011 – 2012) and 130 tournaments across the USA from 1972-1996 (Wilde 1998).

	Immediate	Delayed
Lake Champlain	3.2 %	2.6 %
Wilde 1998	6.5%	23.3%

Fish Dispersal

Field observations revealed that fish cued in on structures in Plattsburgh (e.g. docks, moored boats, the Plattsburgh breakwall) and remained there for a time period ranging from several days to several months. After this time, many fish began exploring the New York shoreline, using different structures (i.e., Crab Island, pilings from the old US Air Force fuel docks, downed trees) potentially for both navigation and shelter. In several cases fish returned to previous shoreline locations, suggesting they were using structures for navigation (Wilde 2003).

One noticeable difference in dispersal from 2011 to 2012 was largemouth bass dispersal out of Cumberland Bay. In 2011, 50% of largemouth eventually left the bay. In 2012, however, only 6% of largemouth eventually left the bay. We speculate that this difference may be linked to variation in annual lake levels. . In 2011, Lake Champlain reached its highest-ever flood levels, while in 2012, water levels were slightly below normal. While much largemouth bass preferred habitat occurs within Cumberland Bay, the near-shore zone in a “normal” year is characterized by rocky substrate and wave action, neither of which are desirable habitat for largemouth bass (Oster 1983; Blaser and Eades 2006). Cumberland Bay itself contains structures including reed beds, docks, and old industrial infrastructure that provide plenty of suitable habitat for largemouth bass (Fig. 14). Abnormally high lake levels in 2011, may have created more suitable vegetated near-shore habitat zones, thereby offering additional migration routes along the shoreline and avenues for fish to exit out of Cumberland Bay proper.

Both largemouth bass and smallmouth bass gradually dispersed from Plattsburgh following release from tournaments. In the initial two to three weeks post-release, both T-bar tags and telemetry show fish remained within 6 km (3.72 miles) of the release point. By the end of the first month, fish began dispersing along the New York shoreline, and after several months, fish were spread along the New York shoreline as well as the western shoreline of Alburgh and the Champlain Islands (Isle La Motte, North Hero, and South Hero). Although there are some "sedentary" fish that remained in Cumberland Bay for the duration of the observational period, the majority of both species ultimately dispersed from the Bay with largemouth dispersal probability increasing after 2-4 weeks and smallmouth dispersal after 1-2 months post-release. Such delayed dispersal has been documented in other research (Healey 1990; Bunt et al. 2000; Ridgway 2002; Ricks 2006; Gries 2009), including previous research in New York (Stang et al. 1996). Smallmouth bass have been documented remaining in close proximity to the release point for up to 30 days on a small lake (5.8 km^2; Ridgeway and Shuter 1996). A majority of largemouth bass on a small lake (21.65 km^2) remained within 1.8 km of the release point for up to 18 months (Gillilland 1999). However, on a moderately sized lake (178 km^2) largemouth bass dispersed beyond 2 km of the release point after three months (Hunter 2006). With this in mind, long-term stockpiling in the vicinity of the release point does not appear to be a major concern after tournaments, though short-term stockpiling (i.e. delayed dispersal) was evident in both species in both years.

Smallmouth bass that left Cumberland Bay traveled in several directions. Some moved along the New York shoreline as far south as AuSable Point (13.25 km). Others moved north along the New York shoreline to Treadwell Bay (12.67 km) and King Bay (34 km). Some fish crossed into the Vermont islands region after reaching the northern end of the lake. The three telemetry- tagged smallmouth bass that crossed to the islands did so in the north lake near Isle La Motte, where water depth is between 15-24 m. This pattern seems to suggest that deep, pelagic zones and anthropogenic modifications (i.e. causeways) present barriers to fish dispersal that prevent fish from returning to the Inland Sea or the South Lake following release in Plattsburgh. These results support findings by Gilliland (1999) that show 84% of tournament-released bass traveling along continuous shoreline and only 16% crossing deep, open water.

RECOMMENDATIONS

General issues of stress

Many studies have documented the need to better manage oxygen, temperature, water quality, and fish handling procedures at tournaments. Two publications geared towards non-scientists that may be helpful are "Keeping Bass Alive: A Guidebook for Anglers and Tournament Organizers" (Gilliland and Schramm 2002) and "The Shimano Water Weigh-In System: A 'Fish-Friendly' Guide" (Tufts and Morlock 2004). Despite the plethora of research results, our experience suggests that tournament operators may not be familiar with much of the literature, especially those studies published since the mid-1990s. We recommend that tournament organizers and anglers be briefed on or provided with lay-audience friendly versions of selected publications dealing with the topics of oxygen, temperature, and water quality management.

Tournament stress index

In addition to the existing outreach information, the dispersal/stress index model results (Fig. 11) may serve as a useful tool for managers, anglers and tournament organizers. As result of the model run, we plan to advise tournament staff to consider monitoring fish length as well as three key TSI indicators – bloody fins, absence of restraint resistance, and fin damage (Figs. 7 and 11). The monitoring could conceivably be done by tournament staff at the "bump" tank, just prior to the weighing of fish or on the release boat. Fish exhibiting those indices are likely to generate a "yellow" or "red" dispersal pattern could be held aside, or perhaps be given special treatment (i.e. longer recovery times) in dedicated tanks. At a minimum, the TSI could allow stakeholders to gain some predictive abilities, thereby enabling comparisons between tournament events in different locales, or over a given span of time.

Dispersal, release sites

The lag time between release and dispersal presents a problem for using a release site close to Plattsburgh due to the heavy angling pressure western Cumberland Bay experiences. In the City of Plattsburgh, there are several popular fishing areas and boat launches (Fig. 18). We observed heavy angling harvest in Plattsburgh. Additionally, research on other water bodies has shown that the more times a fish is caught, the higher its stress levels and the lower its chance for survival (Hasler and Wisby 1958; Philipp et al. 1997; Gilliland 1999; Edwards et al. 2004; Siepker et al. 2006; Siepker et al. 2007). Because the fish are released so close to the New York shoreline, they tend to remain in these areas of localized heavy fishing pressure for several weeks post-release, thus decreasing their chances for survival. With this in mind, we recommend locating the release point further offshore and suggesting that tournaments use one of two designated release zones (Fig. 18) approximately 3-4 km from the Plattsburgh waterfront. However, we recognize this may not be logistically possible due to weather conditions; therefore, we also recommend there be a secondary release zone designated as a "foul-weather release." Moving the release point farther away from areas of heavy shore-based angling has been successful for reducing bass capture vulnerability post-release (Healey 1990; Gilliland 1999; Bunt et al. 2000).

Currently, fish are released near the Dock

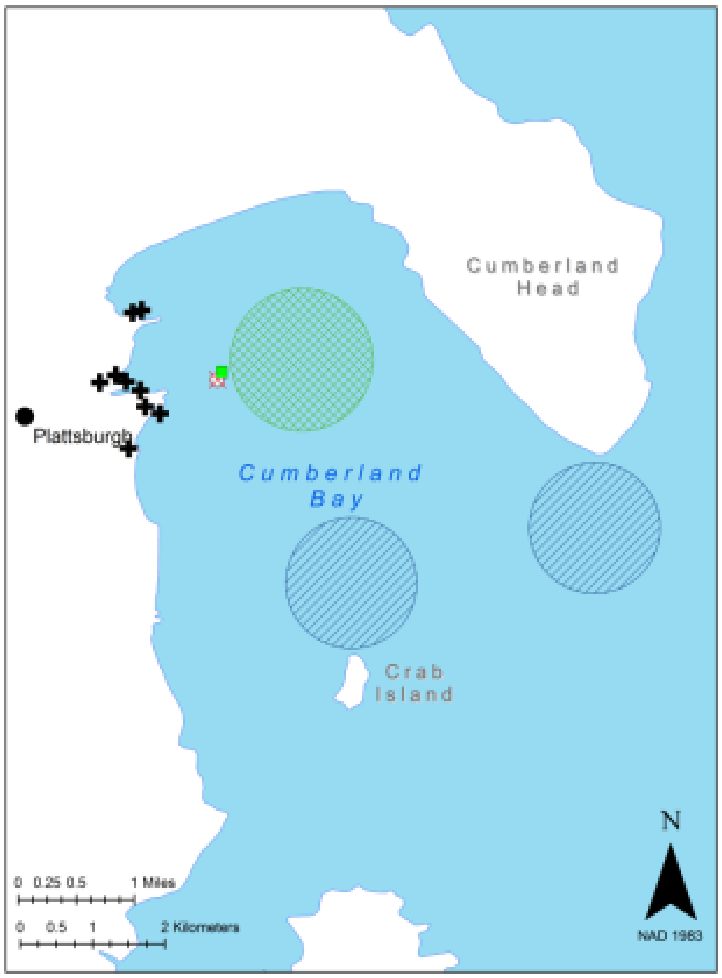

Figure 18 -- Locations of recommended release zones at Crab Island and Cumberland Head (blue hatched circles) with foul weather release (green cross-hatched circle) located east of Plattsburgh Buoy 1 (green square). Popular public fishing areas and boat ramps are represented by black crosses. The current release location is marked by a red X through a circle.

Street Landing weigh-in, just east of Plattsburgh, NY. Much of the area around the landing is flat, publicly accessible, and popular for fishing. South of Plattsburgh (Crab Island release zone), much of the shoreline is comprised of cliffs or privately owned land. There is less fishing pressure in that area. The same is true heading east of Plattsburgh (Cumberland Head release zone). Because of heavy waves that occur when southerly winds blow on Lake Champlain, we also recommend having a designated "foul weather release zone" that would limit the distance the release boat travels. For this zone, we recommend anywhere in Cumberland Bay east of Plattsburgh Buoy 1 (Fig. 16). By moving the release point to that site (instead of where it currently is, west of the buoy), the fish would be released in deeper water and have other shoreline and habitat structure options besides Plattsburgh during the initial few weeks following release. The northern shore of Cumberland Bay is comprised of public swimming beaches; fishing is not popular in this area. Our results suggests that moving the release point to the outer edge of Cumberland Bay would help alleviate the short-term stockpiling of tournament-released fish at the Plattsburgh waterfront.

According to the 2007 New York Statewide Angler Survey (NYSAS; Connelly and Brown 2009), fishing pressure on Lake Champlain increased from 1996 to 2007. As Lake Champlain continues to gain popularity (rated a 3.7 out of a possible 5 by the NYS Angler Survey and ranked as the 5th best bass fishing lake in the nation by BassMaster Magazine;Hall et al. 2012), fishing pressure will increase, making angler attitudes an important concern for designing management practices. In order to assess both angler attitudes and impact of shoreline fishing on tournament fish post-release, we recommend a roving creel survey of boat ramps and popular shoreline fishing areas in Plattsburgh.

We also recommend establishing a long-term monitoring program for warmwater and coolwater fisheries in the north lake to complement Vermont's efforts in the south lake. Additionally, long term monitoring would add to the bass database currently under construction by the NYSDEC and the NY Cooperative Fish and Wildlife Research Unit and has the potential to provide information about other fish populations in the lake such as walleye, yellow perch, bullhead, and northern pike.

Future Research

We summarize below an outline of possible avenues for future research related to black bass in Lake Champlain. These ideas are by no means comprehensive and represent our suggested avenues of study to follow up on this project.

Stress Index

- Blood chemistry analysis to evaluate the efficacy of relying on exterior stress indicators as a field method for determining fish stress.
- A field experiment using angling for black bass followed by livewell confinement under controlled situations would help to isolate the most influential variables on fish stress during transport in livewells (e.g. boat speed, duration of confinement, oxygen levels, water temperature, wave height).
- More information on specific causes of stress and levels of stress that cause mortality could help managers and tournament organizers better control fish health at tournaments, increasing post-release survival.

Dispersal

- If release points are changed, another season or two of T-bar tagging to assess these release points would show if changing the location of release could reduce vulnerability of tournament released black bass to angling induced mortality in Cumberland Bay.
- T-bar tag recovery studies are often hampered by low tag return rates. In conjunction with T-bar tagging efforts to assess changes in release point location, roving creel surveys along the Plattsburgh waterfront would give managers a better estimate of black bass recapture rates post-release.

Population / Community

- If hundreds or even thousands of black bass remain in Cumberland Bay for several weeks following tournaments, it stands to reason there may be some effect on the local fish community. Fish surveys of Cumberland Bay along the shoreline pre- and post-tournaments would elucidate the results of introducing so many top predators into the ecosystem, if even for a short time. Control sites could be established using non-impacted sites (e.g. the Rouses Point breakwall as a control for the Plattsburgh breakwall).
- More monitoring of long-term population trends is necessary in order to properly manage the black bass population of Lake Champlain. New York should consider establishing standard electrofishing monitoring sites in the north lake to mirror Vermont’s efforts in the south lake.

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APPENDIX A: EDUCATION & OUTREACH PUBLICATION DEVELOPED FOR BASS TOURNAMENT ORGANIZERS

Lake Champlain Bass Tournaments

Practices that Increase Survival and Dispersal Rates

Background and rationale

The catch-and-release bass tournament industry in North America has a track record of research and management practices designed to maximize fish survival, and minimize impacts to largemouth and smallmouth populations.

Despite this history, some questions regarding dispersal of bass in large northern lakes have remained unanswered. Recent research activities on Lake Champlain have uncovered some intriguing aspects of bass behavior and responses to stress associated with angling, transport and weigh-in at tournaments in Plattsburgh, NY. This fact sheet summarizes the findings of research conducted by LCRI staff in 2011-2012, and offers recommendations to improve tournament release practices.

Stress management

Fish subjected to angling may encounter a host of physiological challenges. Subsequent capture, transport (e.g. live wells), handling (at tournament site) and holding (tournament site and release boat), may exacerbate such physiological challenges. These challenges may produce a suite of symptoms and signs (i.e. stress responses). The resulting internal and external responses are well documented, and some are easily observed. A major driver of fish stress is low oxygen levels and/or poor water quality, both of which can be mediated (or exacerbated) by temperature.

We suggest that club-level, regional amateur and professional tournament organizers pay close attention to earlier publications supported by the tournament industry. Two publications geared towards non-scientists that may be helpful are "Keeping Bass Alive: A Guidebook for Anglers and Tournament Organizers" (Gilliland and et al 2002) and "The Shimano Water Weigh-In System: A 'Fish-Friendly' Guide" (Tufts and Morlock 2004). At a minimum, these two publications serve as excellent documents for participants and tournament organizers to review prior to each tournament season.

Since longer livewell transport distances increase stress responses, any measures to promote shorter livewell transport distances will reduce stress to fish brought to weigh-in events. Water temperature has long been known as a key to fish stress and survival, and observations at Plattsburgh-based tournaments corroborated many earlier studies. Both largemouth and smallmouth bass were less likely to exhibit dorsal fin erection as temperatures rose from 16° C (61° F) to 22° C (72° F). Tournament organizers, biologists, and anglers recognize that higher water temperatures (typically found in summer) are associated with lower dissolved oxygen levels. This may pose challenges to fish that are unable to find cooler temperatures due to confinement in livewells, staging tanks, and release boat tanks. Though most tournament organizers already attempt to manage water temperatures and associated dissolved oxygen levels, vigilant attention to these water quality parameters could further reduce stress and subsequent mortality.

Specific recommendations for holding tanks

At a minimum, weigh-in and release boat tank systems should include:

- shading
- thermometers
- water pumps
- air pumps
- plastic tubing for air delivery
- air stones
- air chilling system (see below) or ice during summer months

Lake Champlain Research Institute
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Lake Champlain Basin Program

Weigh-in tank systems should include provisions to keep water temperature similar to that of lake temperature. While ice is commonly added to holding tanks, homemade air chillers may be more effective at controlling tank temperatures. This system offsets the heat gain of pumped air systems, and allows for more even cooling than may be achieved by adding bags of ice to weigh-in tanks. Chillers can be made of ice chests modified by adding 1.5 inch entrance and exit holes. Garden hose can then be routed in, coiled, and then routed out of the chest. During weigh-in setup (and as necessary during the event), the cooler is filled with ice and air pumps positioned to pump air through the chilled hose coil, to deliver chilled air through the air stones in the holding tanks.

Anglers and staging tanks at tournament weigh-in

Observable indicators of stress

Even with good management of dissolved oxygen levels and water temperatures, fish may still exhibit internal or external signs of stress. We recorded the presence or absence of a suite of stress indicators that could be readily observed by anglers and tournament managers. These conditions and associated descriptions are given in Table 1 (see back page).

Three of these indicators were positively correlated with other tournament variables. The probability of fish exhibiting fin damage increased with the distance fish traveled in a livewell, and the likelihood of bloody fins increased with fish length. Similarly, the likelihood of fish failing to exhibit dorsal fin erection was linked to higher lake temperatures. The presence of these stress indicators provides indirect predictions of post tournament mortality. As such, tournament managers should monitor these indicators and consider ways to minimize stress during tournament operations.

Dispersal and release sites

The lag time between release and bass dispersal presents a problem for using a release site close to the tournament weigh-in site. In Plattsburgh, we observed heavy angling harvest associated with several popular fishing areas and boat launches in western Cumberland Bay, adjacent to the tournament release site (Fig. 1). Research on other water bodies has shown that the more times a fish is caught, the higher its stress levels and the lower its chance for survival. Because the fish are released so close to the New York shoreline, they tend to remain in these areas of localized heavy fishing pressure for several weeks post-release, thus decreasing their chances for survival. Moving the release point farther away from areas of heavy shore-based angling has been successful for reducing bass capture vulnerability post-release at other venues. With this in mind, we recommend locating the release point further offshore and suggest that tournaments use one of two designated release zones approximately 3-4 km from the Plattsburgh waterfront (Fig. 1). However, we recognize this may not be logistically possible due to weather conditions; therefore, we also recommend there be a secondary release zone designated as a "foul-weather release site." (Note: additional discussion of release site recommendations may be found in the LCBP Technical Report #77).

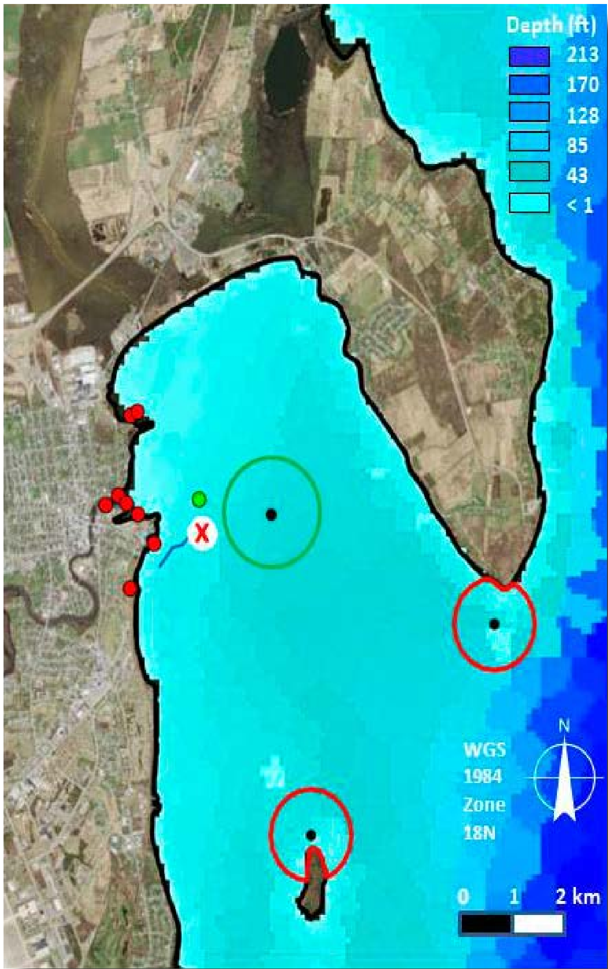


Figure 1: Dispersal and release sites. Locations of recommended release zones at Crab Island and Cumberland Head (red circles) with foul weather release (green circle) located east of Plattsburgh Buoy 1 (green dot). Popular public fishing areas and boat ramps are represented by red dots. The current release location is marked by a red X through a circle.

To read LCBP's full report, please visit the LCBP's publications database at http://www.lcbp.org/wp-content/uploads/2013/11/77_PostTournamentMovements_BlackBass.pdf

Fizzing/Barotrauma

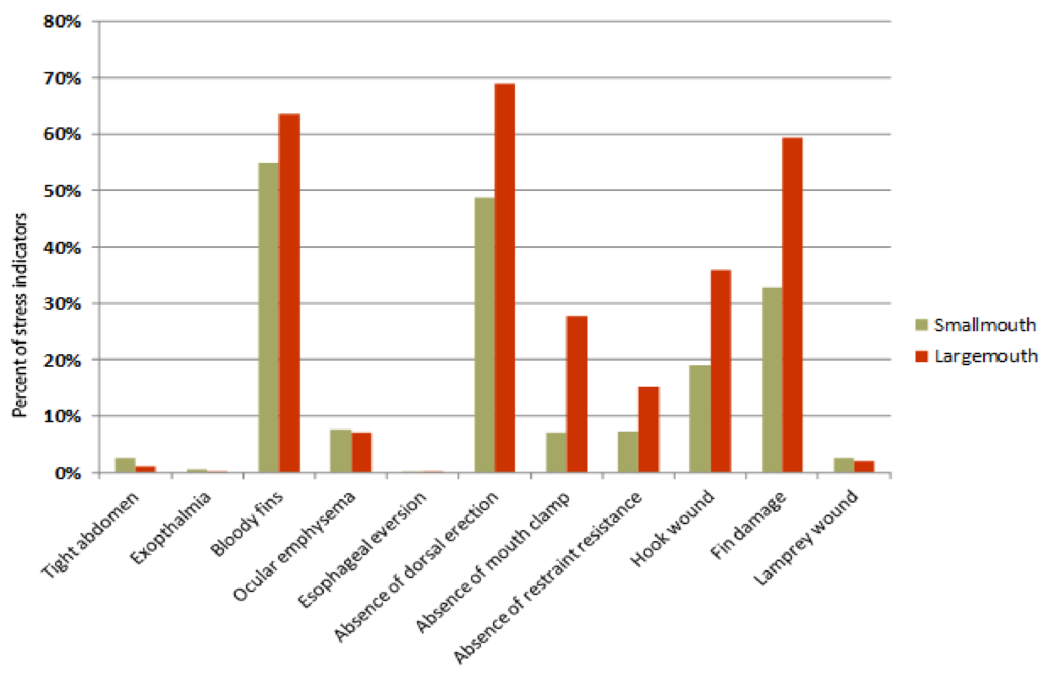


Figure 2: Percent occurrence of stress indicators observed at Plattsburgh-based bass tournaments

Four stress indicators recorded by LCRI staff were indicative of barotrauma – the rapid depressurization of blood gasses and swimbladder brought on by retrieval of fish caught at depth. These indicators were tight abdomen (TA), exopthalmia or "pop-eye,"(PE), ocular emphysema, or "clouded eye" (OE), and esophageal eversion (EE). The occurrence of this suite of indicators was relatively rare in Plattsburgh-based bass tournaments (Figure 2). This is not surprising given that most tournament fish are caught in relatively shallow waters.

Given the relatively low occurrence of barotrauma, we caution against the routine use of a "fizzing" technique whereby swimbladders are deflated by release-boat tournament staff. Fishery biologists management agencies are divided on the utility of fizzing as a treatment for barotrauma.

Fishery management agencies in New York, Vermont, and Quebec do not advocate fizzing. Fizzing should be viewed as a measure of "last resort" for fish unable to submerge.

Our recommendations based on post-tournament release observations and research are as follows:

• Don't confuse a fish's inability to maintain equilibrium with barotrauma. Signs of barotrauma include bloating, along with hemorraghing inside the mouth, on the body surface, or within the dorsal, caudal, anal, pelvic, and pectoral fins.

• Use hollow needle devices and sterilize devices prior to reuse in succeeding fishes.

• Carefully locate the insertion point. First view an imaginary line connecting the notch between the spiny/soft-ray portion of the dorsal fin, downward to the anus. Position the needle on the imaginary line, 3-5 scale rows below the lateral line. Carefully lift a scale and insert the needle through the body wall into the swimbladder

• Do NOT attempt to access the swimbladder through the mouth (Figure 3a). Such improper technique may well damage the esophagus, yet still leave the swimbladder distended. The correct technique is demonstrated in Figure 3b.

Figure 3a. Incorrect method to deflate swimbladder

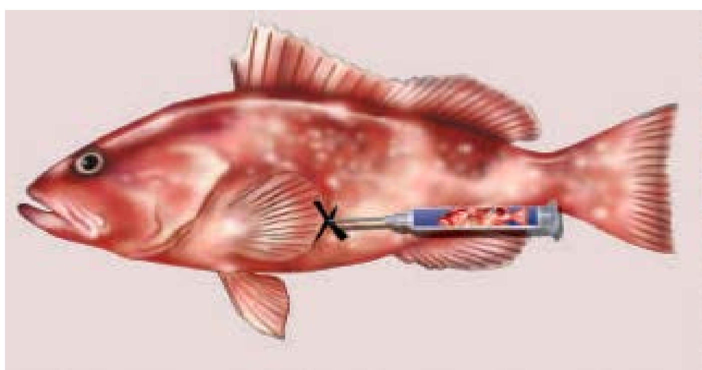
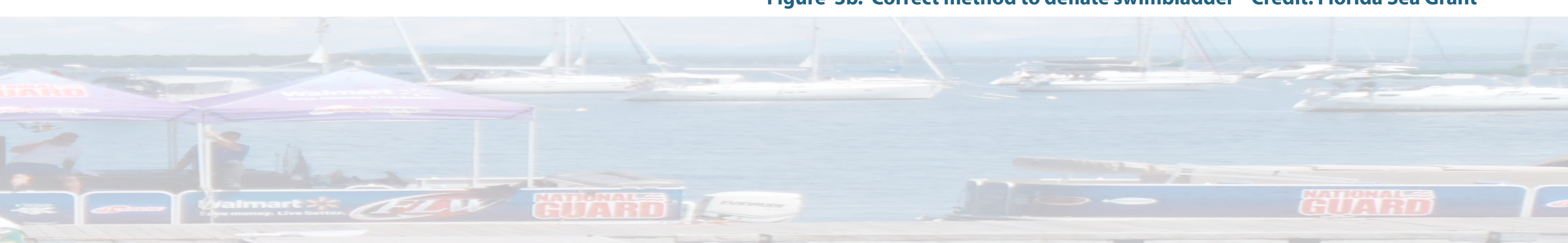


Figure 3b. Correct method to deflate swimbladder Credit: Florida Sea Grant



Condition	Description	Abbreviation
Tight abdomen	Abdomen swollen, feels tight when touched	TA
Exopthalmia	Eyes protruding out of orbit	PE
Bloody Fins	Hemorrhaging present in fins	BF
Ocular Emphysema	Gas present in eye	OE
Esophageal Eversion	Eversion of esophageal tissue into the buccal cavity	EE
Absence of Dorsal Erection	Fins do not become erect when fish is restrained	DE
Absence of Mouth Clamp	Mouth does not clamp shut when lifted or opened	MC
Absence of Restraint Resistance	Fish does not exhibit muscle flex for escape	RR
Hook Wound	Wounding in or around the mouth	HW
Fin Damage	Fins frayed or missing parts	FD
Lamprey wound	Noticeable circular wounding from lamprey	LW

Table 1. Physical indicators of fish stress

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Additional information about catch-and-release bass tournament recommendations is available from:

Mark Malchoff
Lake Champlain Sea Grant & LCRI
136B Hudson Hall
Phone: 518-564-3037

Plattsburgh State University of NY
101 Broad Street
Plattsburgh, NY 12901-2681
E-mail: mark.malchoff@plattsburgh.edu

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