WARMWATER FISH POPULATION ASSESSMENTS IN NEW HAMPSHIRE (2016)

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JOB 9: Warmwater and Coolwater Fisheries Population Assessments

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INTRODUCTION

Black bass fishery resources in the State of New Hampshire are highly utilized by anglers, with Smallmouth Bass (*Micropterus dolomieui*) and Largemouth Bass (*M. salmoides*) ranking as the top two species fished for by anglers. Based on the most recent data available, anglers are the most satisfied with bass fishing than any other species in New Hampshire; 78% and 75% overall satisfaction for Largemouth Bass and Smallmouth Bass, respectively (Responsive Management 2016). 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 a general increase in the annual number of tournaments over time (Table 1).

According to the 2011 National Survey of Fishing, Hunting, and Wildlife Associated Recreation, 140,000 anglers fished 1.705 million days for warmwater and coolwater species in New Hampshire (panfish: 23,000 anglers fished 226,000 days; black bass: 110,000 anglers fished 1.434 million days; Northern Pike (*Esox lucius*) and Pickerel (*Esox niger*): 7,000 anglers fished 45,000 days) (U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2013). Since the average trip expenditure for anglers fishing in New Hampshire is $35 per day, the total estimated expenditures by anglers fishing for warmwater and coolwater species equals approximately $59.68 million per year.

As black bass populations in the state are managed solely by natural reproduction, it is necessary to conduct population assessments to monitor their status in response to existing or proposed management strategies and to ensure their continued health. Standardized assessment protocols developed and utilized in surveys conducted in 1997 (Sprankle 1998) were modified in 1998 (Sprankle 1999) to improve indices of relative abundance.

A single warmwater survey was conducted in 2016. This report includes data analysis and the summary of one assessment conducted in Region 2: Lower Beech Pond, Tuftonboro (Table 2).

Objectives of warmwater assessments in all water bodies were to determine: 1) black bass condition; 2) fish size and population structure; 3) relative abundance (black bass and community species); 4) young-of-year black bass size; 5) black bass age and growth; and 6) compare measured population parameters to statewide values and among populations. Lower Beech Pond was sampled due to concerns arising from a property owner and issues with the current access to the pond.

METHODS

Fish were collected by boat electrofishing (Smith-Root SR18) after sunset using three netters. Electrofishing equipment was adjusted according to water conductivity and observed fish behavior relative to their position in the electrode’s field. The study design incorporated timed runs of 500 or 1000 seconds (using the equipment's "on" meter time) when sampling for target species (black bass or other pre-determined species), and community runs of 500 seconds when sampling for non-target species. Past studies showed 500-second community runs were adequate to ascertain species relative abundance in New Hampshire waters (Dexter 2008; Racine and Gries 2008). Black bass were captured during both target and community runs. Typically, five runs were conducted during an evening, two of which were community runs. Timed runs permitted a measure of statistical precision (standard deviation) to be estimated for relative abundance indices, expressed in mean fish per hour (fish/hr) that were further partitioned into discrete length categories for black bass (see below).

All fish were placed in a live well upon capture. Fish were measured to the nearest millimeter, total length (TL), and weighed to the nearest gram. For aging purposes, scale samples were taken from black bass in the region below the lateral line and slightly posterior to the pectoral fin on the left side of the fish. Fish were processed shortly after capture and then released. Detailed black bass growth methodology and analyses are presented in Racine (2006a). In this report, only fish aged as ≤ 6 years of age and having scales with ageing confidence ratings of less than 3 (i.e. ± 1 year) were analyzed.

Proportional Stock Density (PSD) measures for bass were determined according to the length categories (based on total length) described in Gablehouse (1984) for Smallmouth Bass: stock 180-279 mm; quality 280-349 mm; preferred 350-429 mm; memorable 430-509 mm; and trophy > 510 mm. Largemouth Bass were similarly grouped: stock 200-299 mm; quality 300-379 mm; preferred 380-509 mm; memorable 510-629 mm; and trophy > 630 mm. Relative abundance (fish/hr) measures incorporated a < stock category, which was any bass less than stock size (juveniles and young-of-the-year (YOY)).

$$PSD = \frac{number\ \ of\ \ fish \geq quality}{number\ \ of\ \ fish \geq stock} \bullet 100$$

Confidence intervals were calculated for PSD estimates at the 80% and 95% confidence level using formulas based on Gustafson (1988). A PSD value ranging from 40 to 60 indicates a balanced fish population; a balanced fish population is defined as one that is intermediate between the extremes of a large number of small fish and a small number of large fish and indicates that rates of recruitment, growth and mortality rates may be satisfactory (Anderson and Weithman 1978). Values < 40 indicate an extreme number of small fish when compared to the number of large fish. Values > 60 indicate an extreme number of large fish when compared to the number of small fish.

Relative weight (W_r) values were derived as a measure of condition of individual fish. Relative weight values were calculated for black bass > 150 mm (TL). This index compares the actual weight of an individual (W) with a standard weight (W_s) for a fish of the same length:

$$W_r = W/W_s \cdot 100$$

The standard weight equation used for Smallmouth Bass was $\log_{10} W_s$ (g) = - 5.329 + 3.20 x $\log_{10}$ TL (mm), proposed by Kolander et al. (1993). The equation used for Largemouth Bass was $\log_{10} W_s$ (g) = -5.316 + 3.191 x $\log_{10}$ TL (mm), proposed by Wege and Anderson (1978). Relative weight values > 90 may be considered good, with values > 100 considered excellent.

Although black bass YOY data are presented, there are inherent biases associated with using this data due to the small size (generally < 70 mm, TL) of these fish during the summer sampling period. Although, the sampling crew attempts to capture YOY black bass, they can be difficult to capture and differentiate from other YOY fish. Therefore, it must be assumed that black bass YOY relative abundance data are conservative and not an accurate representation of the YOY population.

All reported mean values include estimated standard deviations, unless otherwise noted. Linear regression was used to examine the relationship of fish total length to relative weight. The level of significance for all statistical analyses was 0.10.

RESULTS

Lower Beech Pond (Tuftonboro)

Lower Beech Pond was surveyed on June 30. Five 500 second community species runs were conducted (Table 2). A total of 89 Largemouth Bass and 73 Smallmouth Bass were sampled (Figure 1 and 2). The PSD for Largemouth Bass was 65 (lower and upper 80% CI's 48, 99, Table 3a) compared to the statewide mean of 65 (Racine 2006b). The PSD for Smallmouth Bass was 0 (lower and upper 80% CI's: 0, 11; Table 3b) compared to the statewide mean of 43 (Racine 2006b).

Mean relative weight values for Largemouth Bass and Smallmouth Bass were calculated by length category (Table 4a and 4b). Mean relative weight values for Largemouth Bass were lower for stock, quality, and preferred size fish when compared to statewide mean values (Racine 2006b). Mean relative weight values for Smallmouth Bass were lower for stock size fish when compared to statewide mean values (Racine 2006b). The relationship between Largemouth Bass total length and relative weight was significant with a negative trend ($P = 0.02$, $R^2 = 0.17$; Figure 1). The relationship between Smallmouth Bass total length and relative weight was significant with a negative trend ($P = 0.01$, $R^2 = 0.2$; Figure 2).

Mean back-calculated length at age, total number of fish aged, logarithmic trendline correlation coefficient, age at quality size, and growth categorization for Largemouth Bass are presented in Table 5a and Figure 3. Largemouth Bass growth was categorized as slow when compared to New Hampshire water bodies sampled during 1997-2005. Average length at age was below statewide values (1997-2005) for Largemouth Bass age

1-5. Largemouth Bass took an average of 4.85 years to reach quality size (300 mm) compared to the statewide average of 3.74 years (1997-2005) (Racine 2006a).
Mean back-calculated length at age, total number of fish aged, logarithmic trendline correlation coefficient, age at quality size, and growth categorization for Smallmouth Bass are presented in Table 5b and Figure 4. Smallmouth Bass growth was categorized as slow when compared to New Hampshire water bodies sampled during 1997-2005. Average length at age was above statewide values (1997-2005) for Smallmouth Bass age 1 and were below statewide values for ages 2-5. Smallmouth Bass took an average of 6.68 years to reach quality size (280 mm) compared to the statewide average of 4.47 years (1997-2005) (Racine 2006a).

Mean relative abundance estimates (fish/hr) for Largemouth Bass and Smallmouth Bass were calculated for all fish and by length category (Table 6a and 6b). Mean relative abundance estimates for Largemouth Bass were higher for all bass lengths combined, < stock, and quality but not for stock and preferred when compared to statewide mean values (Racine 2006b). Mean relative abundance estimates for Smallmouth Bass were higher for all bass lengths combined and for < stock and stock when compared to statewide mean values (Racine 2006b). Community samples produced in decreasing order of relative abundance: Yellow Perch (*Perca flavescens*), Pumpkinseed (*Lepomis gibbosus*), Black Crappie (*Pomoxis nigromaculatus*), Chain Pickerel (*Esox niger*) and Golden Shiner (*Notemigonus crysoleucas*) (tied) (Table 7). Sample size and mean TL of YOY bass are shown in Table 8.

DISCUSSION

A number of the water bodies sampled to date appear to lack cover preferred by Largemouth Bass in water 1 – 3 meters deep. Reports on cover preferences for Largemouth Bass typically cite 40 – 60% as an ideal range (Stuber and Gebhart, 1982). This range of cover has been observed occasionally at water bodies sampled to date, but the use of existing cover by Largemouth Bass when present is clear during sampling events. Future analyses of the quantity and quality of cover in relation to the population measures currently utilized should be conducted. This relationship has implications for herbicide treated waters where exotic and native vegetation removal efforts are increasing.

Lentic waters that have habitat features preferred by Smallmouth Bass are typically oligotrophic, have good water clarity, and poor conductivity. In addition to these issues, larger bass may be more heavily concentrated in deep-water habitats not possible to sample by electrofishing from the early summer through fall. This creates a difficult situation for representatively sampling and characterizing a Smallmouth Bass population by electrofishing. In these waters, the size of the field around the electrodes is often limited and bass are able to evade the field or leave the area ahead of the boat. However, YOY Smallmouth Bass appear to be effectively sampled in preferred shallow habitats in water bodies sampled to date. In contrast to the apparent habitat limitations Largemouth Bass may be faced with in waters sampled to date, Smallmouth Bass populations appear to have slightly more abundant and slightly better quality habitat types based upon habitat suitability information (Edwards and Gebhart, 1983).

A PSD value ranging from 40 to 60 indicates a structurally balanced population. Values < 40 indicate an extreme number of small fish when compared to the number of large fish. Values > 60 indicate an extreme number of large fish when compared to the number of small fish. The PSD value for Largemouth Bass in Lower Beech Pond was 65 indicating an unbalanced population skewed towards larger fish and is equal to the statewide average (Table 3a). The PSD value for Smallmouth Bass in Lower Beech Pond was 0 (no fish > quality size were captured) and is lower than the statewide average and indicates a population skewed towards smaller fish (Table 3b).

Relative weight values > 90 may be considered good, with values > 100 considered excellent. All size categories of Largemouth Bass sampled in 2016 had mean Wr values < 90 (Table 4a). Observed values are acceptable from a management standpoint, as no exceptional values were documented and sample sizes were relatively small. A significant negative relationship between total length and relative weight values was observed for the Largemouth Bass population analyzed, but the variation was poorly explained. The one size category of Smallmouth Bass sampled in 2016 had a mean Wr value > 90 (Table 4b). The observed value is acceptable from a management standpoint, as no exceptional values were documented and sample sizes were relatively small. A significant negative relationship between total length and relative weight values was observed for the Smallmouth Bass population analyzed, but the variation was poorly explained.

Mean relative abundance values (fish/hr) for Largemouth Bass and Smallmouth Bass sampled in 2016 by length category were variable (Table 6a and 6b). Mean values (fish/hr) by length category may provide a means of categorizing populations by relative abundance. It is important to note again that sampled water bodies vary in the quantity and quality of bass habitat and these values should be interpreted cautiously. However, comparisons over time for a single population will provide important information on the inter-annual variability of this measure. The single greatest obstacle to the interpretation of these values within a population over time is unknown rates of harvest mortality, which is likely high in some cases and low in others.

A plot of mean relative abundance (fish/hr) by length category for Largemouth Bass assessed in 2016 revealed a shift in abundance between bass of < stock size and those ≥ stock size (Figure 5). A plot of mean relative abundance (fish/hr) by length category for all Smallmouth Bass populations assessed in 2016 revealed a shift in abundance between bass of < stock size and those ≥ stock size (Figure 4). These shifts in abundance should hypothetically correspond with the smallest size Largemouth Bass considered harvestable by anglers and can act in essence as a surrogate catch curve. However, this assumption is likely not valid for Smallmouth Bass given the difficulties in characterizing a Smallmouth Bass population based on electrofishing (see above).

Relative abundance measures for community species in assessments conducted in 2016 were variable (Table 7). Yellow Perch had the highest overall mean relative abundance (83.5 fish/hr $\pm$ 91.7).

RECOMMENDATIONS

Required sampling effort needed to produce adequate sample sizes is essential to conduct a meaningful and valid assessment (Miranda, 1993). Analysis of data and its interpretation is dependent on a level of statistical confidence and precision. Statistical precision of the measures generated by the assessment and the ability to use standard analytical methods are driven by sample size. The use of timed runs permits an estimate of precision for some estimated parameters (i.e. relative abundance), but this approach produces highly variable measures, which precludes some statistical testing.

Due to obstacles (conductivity/water clarity/deepwater habitat use) faced when trying to assess a lentic smallmouth population, it is recommended that sampling efforts target the spawning stock of Smallmouth Bass in the spring, during pre-spawn movements. Due to concerns of inadequate sample sizes from electrofishing samples, fyke nets should be used as the primary sampling gear. A program targeting selected spawning areas (fixed stations) as an index should be developed and employed in important smallmouth fisheries such as Lake Winnipesaukee. This program should be used as a tool to monitor the size/age structure and condition (Wr) of populations over time.

Significant negative relationships between total length and relative weight values may indicate a lack of forage for larger fish. Relationship between relative weight values by size category and relative abundance values of forage fish should be examined in future years. Additionally, efforts should be made to transfer appropriate forage species to specific waters where black bass populations might benefit from increased prey resources.

The NHFGD should continue to assess warmwater bass populations throughout the state and annually update the statewide black bass database. This database will allow biologists to target specific water bodies for more detailed assessments and to make well-informed management recommendations that will preserve and improve the quality of bass populations state-wide. Additionally, a survey of habitat features of assessed water bodies should be conducted to evaluate potential habitat improvements for warmwater species. Attempts should also be made to more closely examine population parameters of non-black bass species of warmwater fish. Accordingly, data analyses similar to those found in Racine (2006a and 2006b) should be performed for these species.

ACKNOWLEDGMENTS

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LITERATURE CITED

Anderson, R.O. and A.S. Weithman. 1978. The concept of balance for coolwater fish populations. American Fisheries Society Special Publication 11: 371-381.

Dexter, T. (2008). Sampling time needed to accurately determine species composition, relative abundance, length, and weight of fish in New Hampshire water bodies using a boat electroshocker. Antioch University New England. M.S. Candidate of Environmental Studies, 1-14.

Edwards, E. A. and G. Gebhart. 1983. Habitat suitability information: Smallmouth Bass. U. S. Fish and Wildlife Service FWS/OBS-82/10.36. U. S. Department of the Interior. Washington DC.

Gablehouse, D. W. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Gustafson, K. A. 1988. Approximating confidence intervals for indices of fish population size structure. North American Journal of Fisheries Management 8:139-141.

Kolander, T. D., D. W. Willis, and B. R. Murphy. 1993. Proposed revision of the standard weight equation for Smallmouth Bass. North American Journal of Fisheries Management 13: 398-400.

Miranda, L. E. 1993. Sample sizes for estimating and comparing proportion-based indices. North American Journal of Fisheries Management 13:383-386.

Racine, M. 2006a. Warmwater population assessments in New Hampshire: black bass age appendix (1997-2005). F-50-R-22 Job 10. New Hampshire Fish and Game Department. Concord, NH.

Racine, M. 2006b. Warmwater population assessments in New Hampshire: black bass trend analysis (1997-2005). F-50-R-22 Federal Aid in Sportfish Restoration Performance Report. Concord, NH.

Racine, M. and G. Gries. 2008. Warmwater fish population assessments in New Hampshire (2007). F-50-R-24. Federal Aid in Sportfish Restoration Report. Concord, NH.

Responsive Management. 2016. New Hampshire freshwater anglers' fishing participation and preferences. Responsive Management. Harrisonburg, VA.

Sprankle, K. 1999. Warmwater population assessments in southwest New Hampshire (1998). New Hampshire Fish and Game Department. Concord, NH.

Sprankle, K. 1998. Black bass population assessments in selected New Hampshire waters (1997). New Hampshire Fish and Game Department. Concord, NH.

Stuber, R. J. and G. Gebhard. 1982. Habitat suitability index models: Largemouth Bass. U. S. Fish and Wildlife Service FWS/OBS-82/10.16. U. S. Department of the Interior. Washington DC.

U. S. Department of Interior, Fish and Wildlife Service, and U. S. Department of Commerce, U.S. Bureau of the Census. 2013. 2011 National survey of fishing, hunting, and wildlife- associated recreation – New Hampshire.

Wege, G. J. and R. O. Anderson. 1978. Relative weight: a new index of condition for Largemouth Bass. New approaches to the management of small impoundments. Special publication 5., North Central Division, American Fisheries Society. Washington, D.C.

Table 1. Number of bass fishing tournament permits issued by the NHFGD (1992 - 2016).

Year	Number of Permits Issued
1992	303
1993	352
1994	404
1995	389
1996	475
1997	459
1998	426
1999	421
2000	476
2001	487
2002	468
2003	496
2004	493
2005	508
2006	502
2007	490
2008	465
2009	481
2010	518
2011	557
2012	513
2013	528
2014	486
2015	509
2016	523

Table 2. Summary of warmwater fish population assessments performed in 2016.

Sample Date	Water body	Region	Acreage	Town	County	Fishery	Sampling Method	Sample Type	Targeted Species[a]	Number of Runs	Run Times (seconds)
6/30/2016	Lower Beech Pond	2	160	Tuftonboro	Carroll	Warmwater, Coldwater	Electrofish	Community	All	5	500

[a] BLB - black bass.

Table 3a. Proportional Stock Density (95% and 80% confidence intervals) of Largemouth Bass populations assessed in 2016 by electrofishing.

Water body	Sample Date	Lower CI 95%	Lower CI 80%	PSD	Upper CI 80%	Upper CI 95%	≥ Quality Size	≥ Stock Size
Lower Beech Pond	6/30/2016	41	48	65	79	85	13	20
Statewide average[a]	1997-2005	-	-	65	-	-	-	-

[a.] Reprinted from Racine (2006b).

Table 3b. Proportional Stock Density (95% and 80% confidence intervals) of Smallmouth Bass populations assessed in 2016 by electrofishing.

Water body	Sample Date	Lower CI 95%	Lower CI 80%	PSD	Upper CI 80%	Upper CI 95%	≥ Quality Size	≥ Stock Size
Lower Beech Pond	6/30/2016	0	0	0	11	18	0	19
Statewide average[a]	1997-2005	-	-	43	-	-	-	-

[a.] Reprinted from Racine (2006b).

Table 4a. Sample size, mean relative weight value, and one standard deviation by length category for Largemouth Bass populations assessed in 2016 by electrofishing.

		Total Length Interval (mm)											
		Stock 200-299			Quality 300-379			Preferred 380-509			Memorable 510-629		
Water body	Sample Date	*n*	Wr	SD	*n*	Wr	SD	*n*	Wr	SD	*n*	Wr	SD
Lower Beech Pond	6/30/2016	7	85.1	18.6	11	84.2	10.1	2	66.1	27.6	-	-	-
Mean Wr			85.1			84.2			66.1			-	
Std Dev Wr			-			-			-			-	
Statewide average[a]	1997-2005	115[b]	99.1	12.4	118[b]	93.2	8.2	112[b]	93.4	8.5	40[b]	97.3	12.4

a. Reprinted from Racine (2006b).
b. *n* represents the number of waterbodies.

Table 4b. Sample size, mean relative weight value, and one standard deviation by length category for Smallmouth Bass populations assessed in 2016 by electrofishing.

		Total Length Interval (mm)											
		Stock 180-279			Quality 280-349			Preferred 350-429			Memorable 430-509		
Water body	Sample Date	*n*	Wr	SD	*n*	Wr	SD	*n*	Wr	SD	*n*	Wr	SD
Lower Beech Pond	6/30/2016	18	94.3	4.6	-	-	-	-	-	-	-	-	-
Mean Wr			94.3			-			-			-	
Std Dev Wr			-			-			-			-	
Statewide average[a]	1997-2005	48[b]	96.2	8.6	41[b]	90.1	9.2	34[b]	86.9	7.7	14[b]	86.9	8.6

a. Reprinted from Racine (2006b).
b. *n* represents the number of waterbodies.

Table 5a. Mean back-calculated length at age, total number of fish aged, logarithmic trendline correlation coefficient, age at quality size, and growth categorization for Largemouth Bass by water body.

Water body	Town	Sample Year(s)	Species	Maximum Age ≤ 6 with CR < 4[a]	Maximum age used for back-calculations	Mean back-calculated length (mm) at age: 1	2	3	4	5	6	Number of fish aged: ≥1	5-6	R^{2c}	Age at quality size 300 mm	Growth Categorization
Lower Beech Pond	Tuftonboro	2016	LMB	5	5	70	137	209	273	323	-	13	1	0.96	4.85	Slow
Statewide average[b]		1997-2005	LMB			83	185	265	320	357	387				3.74	

a. Oldest fish aged with a confidence rating of 1 to 3.
b. Reprinted from Racine (2006a).
c. Correlation coefficient for logarithmic trendline.

Table 5b. Mean back-calculated length at age, total number of fish aged, logarithmic trendline correlation coefficient, age at quality size, and growth categorization for Smallmouth Bass by water body.

Water body	Town	Sample Year(s)	Species	Maximum Age ≤ 6 with CR < 4[a]	Maximum age used for back-calculations	Mean back-calculated length (mm) at age: 1	2	3	4	5	6	Number of fish aged: ≥1	5-6	R^{2c}	Age at quality size 280 mm	Growth Categorization
Lower Beech Pond	Tuftonboro	2016	SMB	5	5	94	145	197	234	252	-	12	1	0.99	6.68	Slow
Statewide average[b]		1997-2005	SMB			85	148	217	277	322	364				4.47	

a. Oldest fish aged with a confidence rating of 1 to 3.
b. Reprinted from Racine (2006a).
c. Correlation coefficient for logarithmic trendline.

Table 6a. Sample size, mean relative abundance estimate (fish/hour), and one standard deviation by length category for Largemouth Bass captured by electrofishing in 2016. *n* = number of electrofishing runs.

Waterbody	Sample Date	*n*	All Lengths #fish	All Lengths f/h	All Lengths SD	< Stock (YOY & Juvenile) #fish	< Stock f/h	< Stock SD	Stock 200-299 #fish	Stock f/h	Stock SD	Quality 300-379 #fish	Quality f/h	Quality SD	Preferred 380-509 #fish	Preferred f/h	Preferred SD	Memorable 510-629 #fish	Memorable f/h	Memorable SD
Lower Beech Pond	6/30/2016	5	89	128.2	66.7	69	99.4	43.6	7	10.1	10.9	11	15.8	12.9	2	2.9	3.9	0	0.0	0.0
Mean f/h				128.2			99.4			10.1			15.8			2.9			0.0	
CV for f/h				-			-			-			-			-			-	
Statewide average[a]	1997-2005		126[b]	49.6	50.8	126[b]	23.2	36.1	126[b]	10.5	16.6	126[b]	10.5	14.4	126[b]	4.7	5.2	126[b]	0.5	1.3

Total Length Interval (mm) applies to the length category columns.

a. Reprinted from Racine (2006b).
b. Represents the number of waterbodies.

Table 6b. Sample size, mean relative abundance estimate (fish/hour), and one standard deviation by length category for Smallmouth Bass captured by electrofishing in 2016. *n* = number of electrofishing runs.

Water body	Sample Date	*n*	All Lengths #fish	All Lengths f/h	All Lengths SD	< Stock (YOY & Juvenile) #fish	< Stock f/h	< Stock SD	Stock 180-279 #fish	Stock f/h	Stock SD	Quality 280-349 #fish	Quality f/h	Quality SD	Preferred 350-429 #fish	Preferred f/h	Preferred SD	Memorable 430-509 #fish	Memorable f/h	Memorable SD
Lower Beech Pond	6/30/2016	5	73	105.1	79.0	54	77.8	64.3	19	27.4	23.6	0	0.0	-	0	0	-	0	0.0	-
Mean f/h				105.1			77.8			27.4			0.0			0.0			0.0	
CV for f/h				-			-			-			-			-			-	
Statewide average[a]	1997-2005		61[b]	26.3	32.8	61[b]	19.0	27.1	61[b]	5.1	6.7	61[b]	1.5	2.4	61[b]	0.9	1.4	61[b]	0.2	0.5

Total Length Interval (mm) applies to the length category columns.

a. Reprinted from Racine (2006b).
b. *n* represents the number of waterbodies.

Table 7. Mean relative abundance estimate (fish/hour) and one standard deviation for non-target species captured during community electrofishing runs in 2016. *n* = number of runs.

Water body	Sample Date	*n*	Black Crappie	Pumpkinseed	Chain Pickerel	Golden Shiner	Yellow Perch
Lower Beech Pond	06/30/16	5	2.9 ± 6.4	72.0 ± 36.7	1.4 ± 3.2	1.4 ± 3.2	83.5 ± 91.7
Mean f/hr			2.9	72.0	1.4	1.4	83.5
Stdev of f/hr			-	-	-	-	-

Table 8. Sample size, mean total length and one standard deviation of YOY black bass captured by electrofishing during 2016.

		Largemouth			Smallmouth		
Water body	Date	*n*	Mean total length	SD	*n*	Mean total length	SD
Lower Beech Pond	6/30/2016	4	28	4	2	30	1
Mean			28			30	
Stdev			-			-	

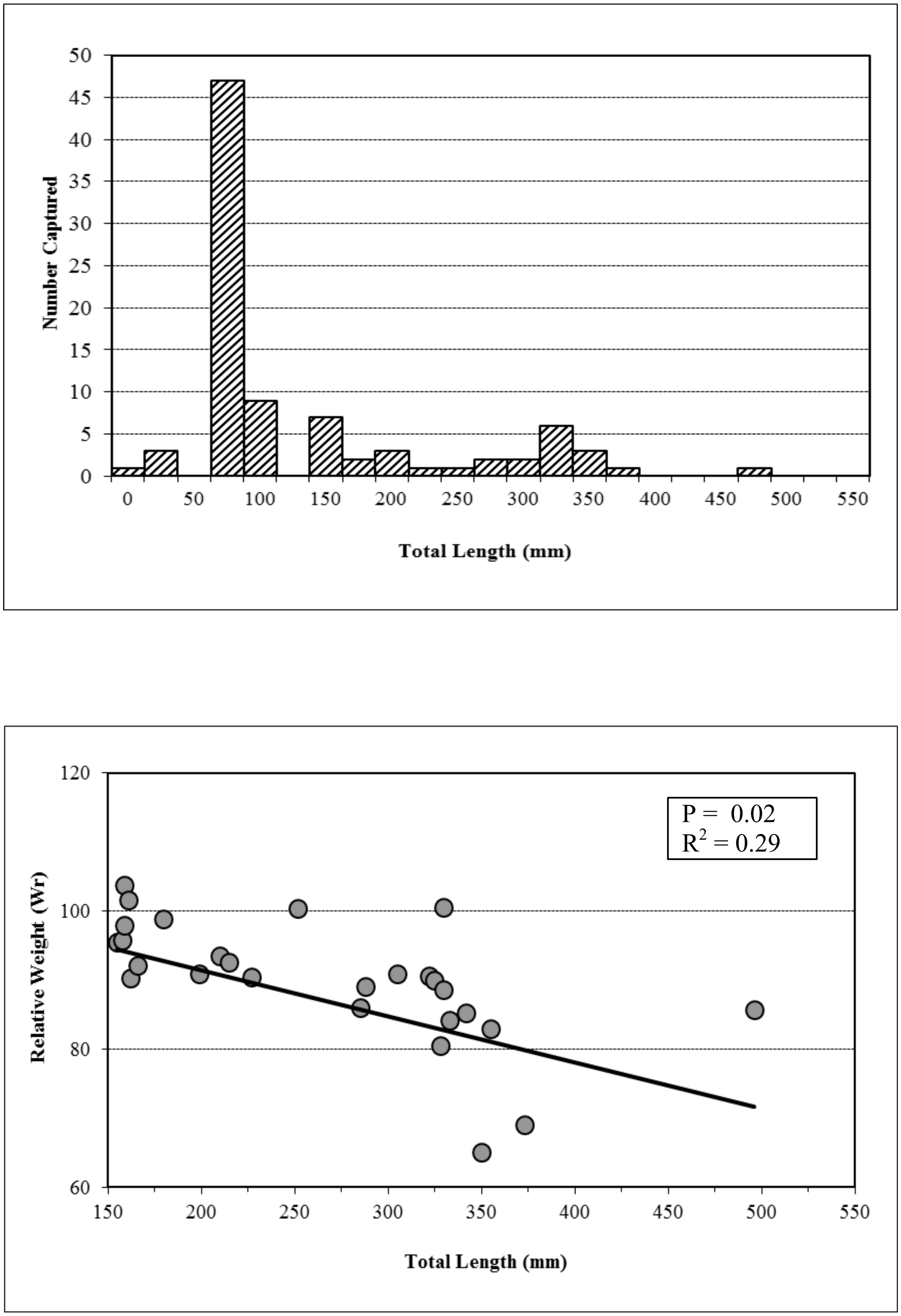
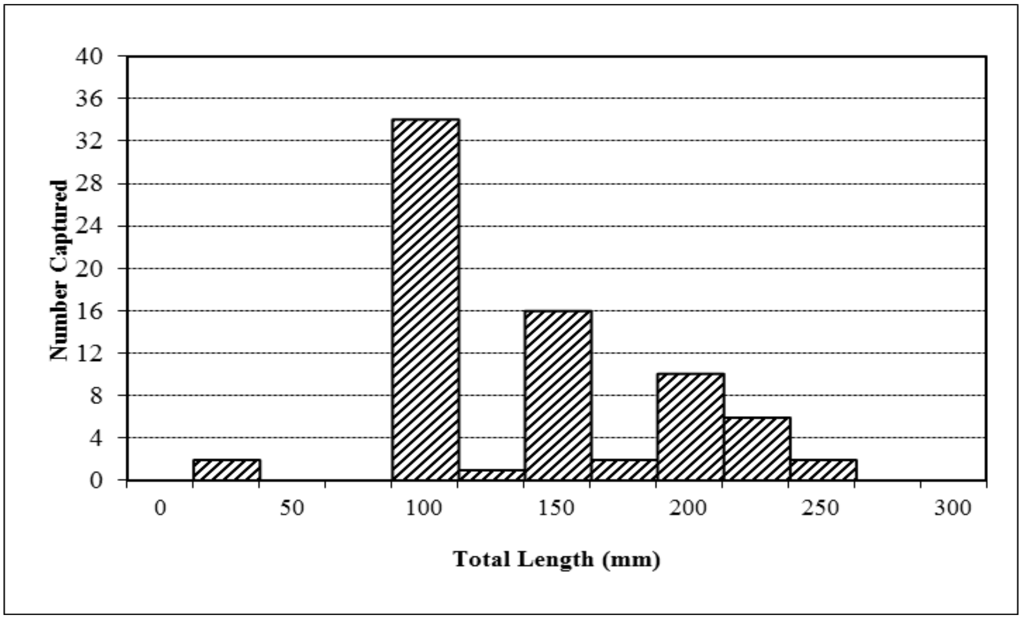


Figure 1. Length-frequency distribution (*n* = 89) and relationship of total length to relative weight (Wr; *n* = 29) for Largemouth Bass captured in Lower Beech Pond (Tuftonboro) during 2016.



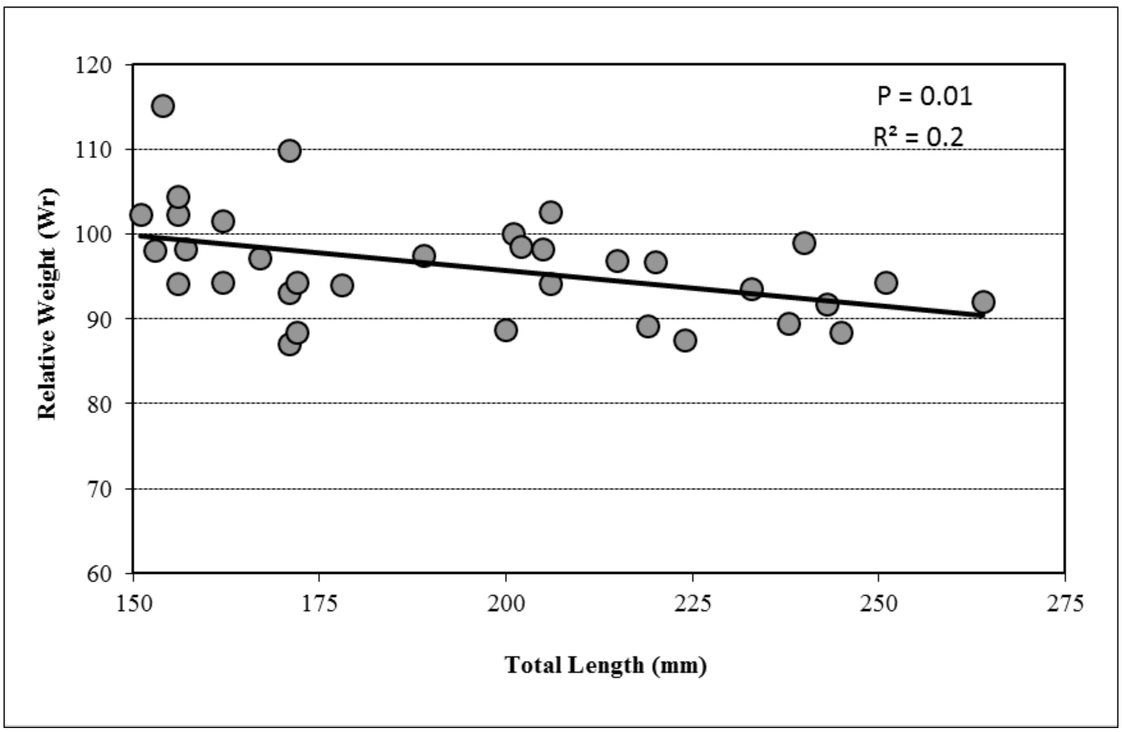


Figure 2. Length-frequency distribution (n = 73) and relationship of total length to relative weight (Wr; n = 34) for Smallmouth Bass captured in Lower Beech Pond (Tuftonboro) during 2016.

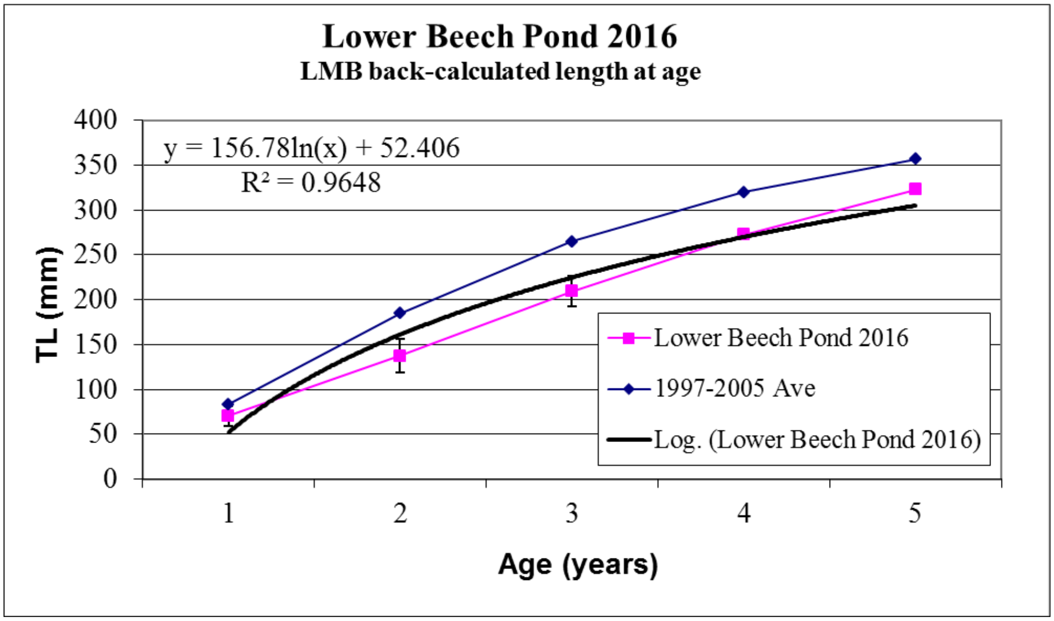


Figure 3. Average back-calculated length at age for Largemouth Bass from Lower Beech Pond (Tuftonboro) sampled in 2016 (+ 1 SD), corresponding logarithmic trendline and equation, and statewide average back-calculated length at age for Largemouth Bass from 1997-2005 (from Racine 2006a).

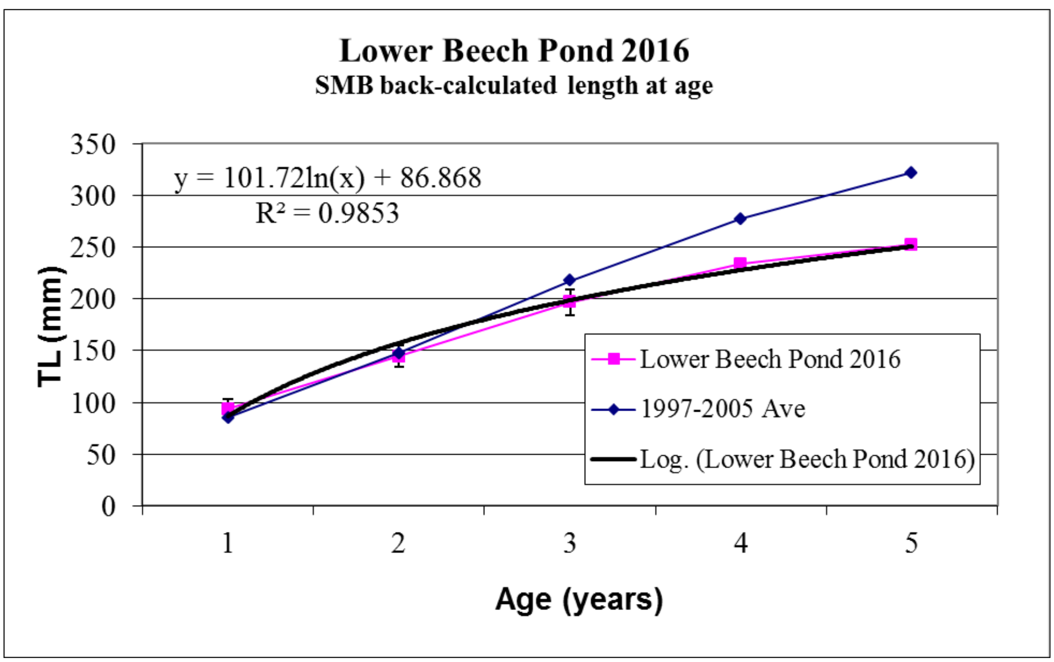
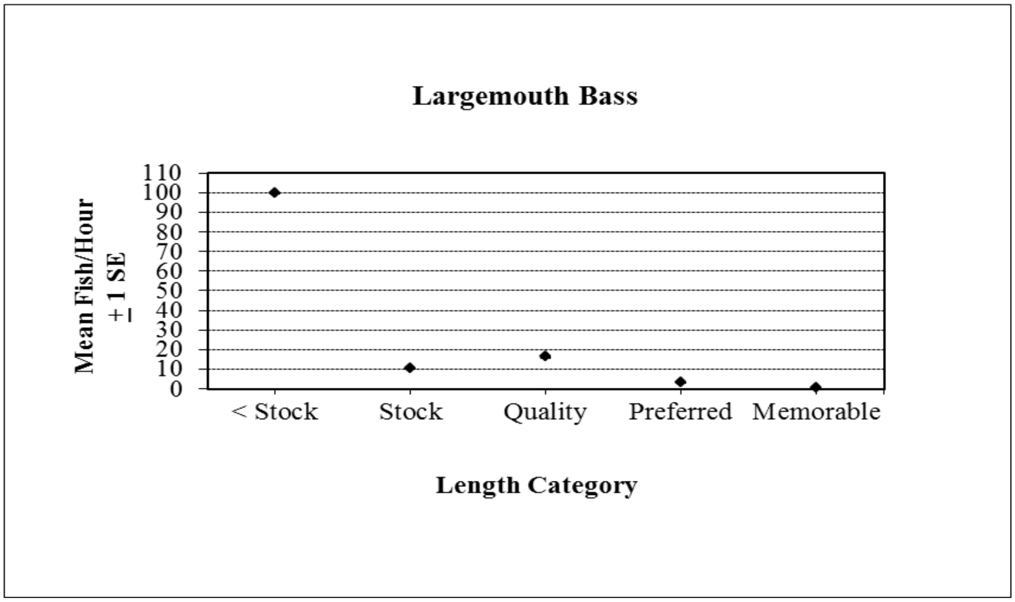


Figure 4. Average back-calculated length at age for Smallmouth Bass from Lower Beech Pond (Tuftonboro) sampled in 2016 (+ 1 SD), corresponding logarithmic trendline and equation, and statewide average back-calculated length at age for Smallmouth Bass from 1997-2005 (from Racine 2006a).



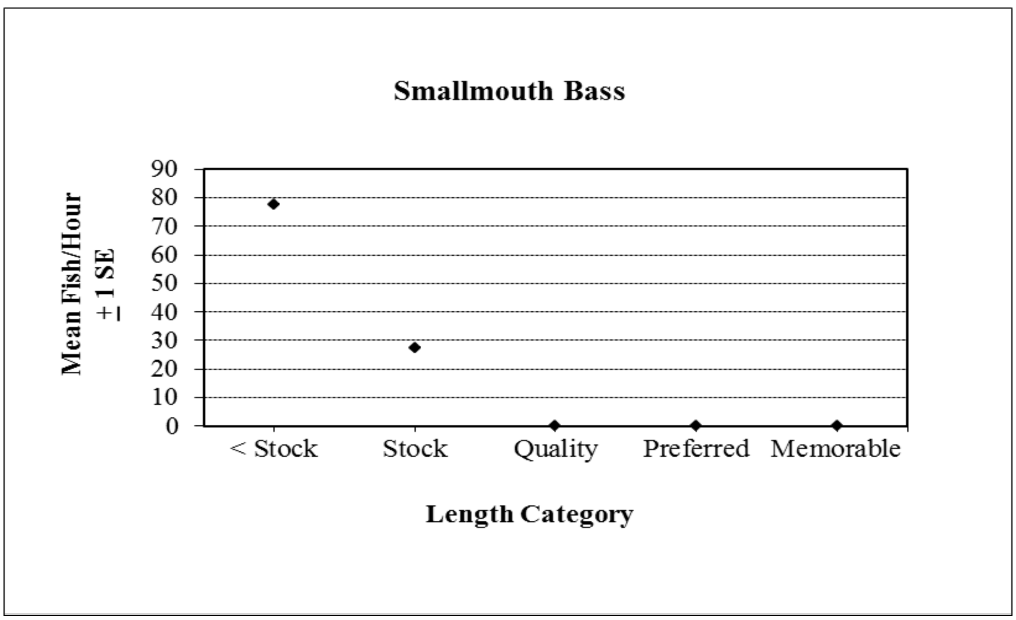


Figure 5. Mean relative abundance values (fish/hour) for Largemouth Bass and Smallmouth Bass captured in Lower Beech Pond in 2016 by length category (refer to Table 6).