ESTIMATES OF POPULATION SIZE AND POTENTIAL IMPACTS OF WINTER HARVEST ON BLACK BASS IN FOUR SOUTHWESTERN NEW HAMPSHIRE WATER BODIES (2009)

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INTRODUCTION

Black bass (*Micropterus dolomieui*, smallmouth and *M. salmoides*, largemouth) fishery resources in the State of New Hampshire are highly utilized by anglers, with smallmouth and largemouth bass ranking among the top four species fished for by anglers (Responsive Management 2004). Bass anglers are the most satisfied of any angler group in New Hampshire; 87% of smallmouth bass anglers and 81% of largemouth bass anglers were either very or somewhat satisfied with their fishing experiences for these species. Strong support for special black bass management regulations was also shown in the survey: 70% supported catch and release; 68% supported special length limits; 50% supported reduced bag limits; and 47% supported artificial lures and flies only (Responsive Management 1996).

According to the 2006 National Survey of Fishing, Hunting, and Wildlife Associated Recreation, 168,000 anglers fished 1.871 million days for warmwater and coolwater species in New Hampshire (panfish: 30,000 anglers fished 339,000 days; black bass: 105,000 anglers fished 1.264 million days; northern pike and pickerel: 33,000 anglers fish 268,000 days) (U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2008). The level of angler participation in black bass fishing represented 53% of New Hampshire's freshwater anglers and 46% of the total days of fishing. Since the average trip expenditure for anglers fishing in New Hampshire is $30 per day, the total estimated expenditures by anglers fishing for warmwater species equals approximately $56.13 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. Assessments also provide opportunities to examine the need for new angling regulations in order to improve existing fisheries.

In winter 2009, staff of the New Hampshire Fish and Game Department's Warmwater Fisheries Program proposed a new management strategy for select New Hampshire water bodies. This proposed administrative rule would have created a new category for "lakes and ponds with special rules" called "Quality Bass Management Waters" which would apply to Clement Pond/Joe Silvia Lake (Hopkinton), Grassy Pond (Rindge), Warren Lake (Alstead), and Gregg Lake (Antrim). For these waters, a year-round 381-508 mm (15-20") protective slot-length limit on black bass was proposed with only one bass allowed to be kept per day that was > 508 mm (>20").

The proposed rule did not move past an internal review and more details on bass population size and impacts of harvest on bass populations were requested. Accordingly, surveys were conducted in 2009 to determine population size of black bass in the four water bodies proposed to be managed as "Quality Bass Management Waters." Catch rates (number of bass captured per hour of sampling) and bass total length (TL; mm) was also compared between angling and electrofishing samples. To further justify the proposed rule change, the impact winter harvest of larger bass may have on the proposed water body's largemouth bass populations were also examined.

In 2010, the proposed rule was revised so the 381-508 mm (15”-20”) protective slot-length limit would only be imposed from January 1 to March 31 and the daily limit for black bass during this time period would be increased from two to three fish, of which only one can be > 508 mm (>20”). The goal of this proposed rule is to increase the number of black bass ≥ 381 mm (≥ 15”) in these water bodies. This goal will be met through protection of bass within the slot-length limit and increased growth rates brought about as a result of an increased harvest of bass < 381 mm (< 15”).

Success of this regulation will in large part depend on angler’s willingness to harvest bass below the slot-length limit. Because largemouth bass is either the only bass species present or the most prevalent bass species in each of these four water bodies, regulations were conceived with a focus on largemouth bass. However, smallmouth bass populations, where present, should also benefit from these regulations.

METHODS

Each water body was sampled three times by boat electrofishing and three times by anglers (Table 1). Sampling was conducted using these two techniques to minimize any sampling technique associated size bias.

Bass collected by boat electrofishing (Smith-Root SR18) were sampled 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. Each night’s sampling was broken up into timed runs of 1000 seconds (using the equipment’s “on” meter time) and black bass were the only species collected. With the exception of Gregg and Warren Lakes, each water body’s entire shoreline was surveyed during each night’s sample; only a small portion of Gregg and Warren Lakes’ shorelines was not surveyed. All bass were placed in a live well upon capture. Bass were identified to species, checked for fin clips (see below), and measured to the nearest millimeter (TL) using the lower lobe of the caudal fin. Bass captured for the first time were marked via a slight upper caudal clip (excised fin). Fish were processed shortly after capture and then released. Bass < 152 mm (< 6”) were released without being processed.

Bass collected by anglers were caught during the day using artificial lures. Two to seven boats (four to twelve anglers) participated in each day’s survey. Catch and effort for each boat was recorded separately (boat effort = # anglers x hours angled). Bass were either processed immediately or held in live-wells until staff was available to process them (see above). Bass < 152 mm (< 6”) were released without being processed.

Schnabel population estimators (multiple mark and multiple recapture) were used to estimate bass population size (Ricker 1975) and associated 95% confidence intervals. Population estimates were calculated by species for all bass ≥ 152 mm (≥ 6”) in each water body and by length categories related to the proposed rule change.

A Mann-Whitney Rank Sum test was used to compare catch rates between angling and electrofishing on each water body by species. Prior to analysis, a square root transformation was applied to catch rate (# bass captured/hour) data (Zar 1984). Catch rate data were calculated for each sample date either by electrofishing run or by boat for angling samples. A two-way ANOVA was used to compare TL of bass captured between angling and electrofishing sampling methods by species, using water body and sampling method as treatments.

A combination of data sources was used to estimate the impact winter harvest of larger bass might have on the proposed water body's largemouth bass populations; population estimate data referenced above, ice creel angler data from 2003 (Racine and Gries 2007), and age data from 2008 (Racine et al. 2009). Only largemouth bass data were used in this exercise because largemouth bass is either the only bass species present or the most prevalent bass species in these waters.

Ice angler data from 2003, averaged across four NH bass water bodies (catch rate = 0.11 bass/hour, harvest rate = 0.05 bass/hour, expanded winter angling effort = 1,642 hours; Racine and Gries 2007), were used to estimate number of largemouth bass caught and harvested on the four proposed water bodies in a typical winter from January 1 to March 31. Number of bass $\geq$ 152 mm ($\geq$ 6") caught was estimated by multiplying the average 2003 winter catch rate (0.11 bass/hour) by the expanded 2003 winter angling effort (1,642 hours). Number of bass caught by other size categories was estimated by multiplying the catch rate for that size category (number of bass of that size category caught during the 2003 winter angler survey divided by the total number of bass caught during the 2003 winter angler survey) by the estimated number of bass caught $\geq$ 152 mm ($\geq$ 6"). Number of bass $\geq$ 152 mm ($\geq$ 6") harvested was estimated by multiplying the average 2003 winter harvest rate (0.05 bass/hour) by the expanded 2003 winter angling effort (1,642 hours). Number of bass harvested by other size categories was estimated by multiplying the harvest rate for that size category (number of bass of that size category harvested during the 2003 winter angler survey divided by the number of bass of that size category caught during the 2003 winter angler survey) by the estimated number of bass caught in that size category.

Total annual mortality rates for largemouth bass were calculated for each of the four proposed water bodies using linear catch curve regressions (regression of log [N_{age}] against age; Van Den Avyle 1993). The slope of the catch curve regression (Z) was the instantaneous mortality rate and was converted to a total annual mortality rate ($A = 1\text{-}e^{-z}$). Catch curves were created using age data from the four proposed water bodies collected in 2008 (Racine et al. 2009). Lake specific data used for catch curves employed successive ages for which the best sample size existed. Ice fishing mortality rates (u) were calculated for each length category by dividing estimated number of largemouth bass harvested from January 1 to March 31 by the estimated number of bass in each water body for each respective size category. Percent of total annual mortality attributed to ice angler harvest for each length category was calculated by dividing ice fishing mortality rate (u) by total mortality rate (A) and multiplying by 100.

All reported mean values include estimated standard deviations, unless otherwise noted. The level of significance for all statistical analyses was 0.10.

RESULTS

Clement Pond (*Hopkinton*)

Clement Pond is natural water body, raised by damming, and is 119 acres. Mean depth is 6.6 m and maximum depth is 15.5 m. Fish species present include largemouth bass, smallmouth bass, yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), chain pickerel (*Esox niger*), black crappie (*Pomoxis nigromaculatus*), and yellow bullhead (*Ameiurus natalis*). Clement Pond was surveyed three times by electrofishing and three times by angling during July and August 2009 (Table 1). A total of 340 largemouth bass and 9 smallmouth bass were sampled. Population estimates were greater for largemouth bass and varied by length category (Table 2, Figure 1 and 2). Catch rates for largemouth and smallmouth bass were significantly greater during electrofishing samples than during angling samples ($P < 0.001$; Table 1, Figure 3 and 4).

Total annual mortality rate (*A*) for largemouth bass was 0.37 and largemouth bass ice fishing mortality rates (*u*) varied by length category, but were highest for bass ≥ 381 mm (≥ 15”) (Table 3). Percent of total largemouth bass mortality attributed to ice angler harvest varied by length category, but was highest (45.4%) for bass ≥ 381 mm (≥ 15”) (Table 3).

Grassy Pond (*Rindge*)

Grassy Pond is natural water body, and is 99 acres. Mean depth is 1.1 m and maximum depth is 2.3 m. Fish species present include largemouth bass, yellow perch, pumpkinseed (*Lepomis gibbosus*), golden shiner (*Notemigonus crysoleucas*), chain pickerel, and creek chubsucker (*Erimyzon oblongus*). Grassy Pond was surveyed three times by electrofishing and three times by angling during July and August 2009 (Table 1). A total of 157 largemouth bass were sampled. Population estimates varied by length category (Table 2, Figure 1). Catch rates for largemouth bass were significantly greater during electrofishing samples than during angling samples ($P < 0.001$; Table 1, Figure 3).

Total annual mortality rate (*A*) for largemouth bass was 0.42 and largemouth bass ice fishing mortality rates (*u*) varied by length category, but were highest for bass ≥ 381 mm (≥ 15”) (Table 3). Percent of total largemouth bass mortality attributed to ice angler harvest varied by length category, but was highest (56.5%) for bass ≥ 381 mm (≥ 15”) (Table 3).

Gregg Lake (*Antrim*)

Gregg Lake is natural water body, raised by damming, and is 195 acres. Mean depth is 5.3 m and maximum depth is 11.0 m. Fish species present include largemouth bass, smallmouth bass, yellow perch, chain pickerel, redbreast sunfish (*Lepomis auritus*), pumpkinseed, and golden shiner. Gregg Lake was surveyed three times by electrofishing and three times by angling during July and August 2009 (Table 1). A total of 261 largemouth bass and 95 smallmouth bass were sampled. Population estimates were greater for largemouth bass and varied by length category (Table 2, Figure 1 and 2). Catch rates for largemouth and smallmouth bass were significantly greater during electrofishing samples than during angling samples ($P < 0.001$; Table 1, Figure 3 and 4).

Total annual mortality rate (*A*) for largemouth bass was 0.36 and largemouth bass ice fishing mortality rates (*u*) varied by length category, but were highest for bass $\geq$ 381 mm ($\geq$ 15") (Table 3). Percent of total largemouth bass mortality attributed to ice angler harvest varied by length category, but was highest (41.9%) for bass $\geq$ 381 mm ($\geq$ 15") (Table 3).

Warren Lake (*Alstead*)

Warren Lake is natural water body, raised by damming, and is 186 acres. Mean depth is 2.0 m and maximum depth is 4.2 m. Fish species present include largemouth bass, smallmouth bass, yellow perch, pumpkinseed, golden shiner, chain pickerel, and bluegill. Warren Lake was surveyed three times by electrofishing and three times by angling during July and August 2009 (Table 1). A total of 453 largemouth bass and 9 smallmouth bass were sampled. Population estimates were greater for largemouth bass and varied by length category (Table 2, Figure 1 and 2). Catch rates for largemouth and smallmouth bass were significantly greater during electrofishing samples than during angling samples ($P < 0.001$; Table 1, Figure 3 and 4).

Total annual mortality rate (*A*) for largemouth bass was 0.36 and largemouth bass ice fishing mortality rates (*u*) varied by length category, but were highest for bass $\geq$ 381 mm ($\geq$ 15") (Table 3). Percent of total largemouth bass mortality attributed to ice angler harvest varied by length category, but was highest (31.1%) for bass $\geq$ 381 mm ($\geq$ 15") (Table 3).

Comparison of TL of bass captured by angling and electrofishing:

The TL of largemouth bass captured differed significantly among water bodies and between sampling methods ($P < 0.001$; Figure 5). Post-hoc comparisons showed that angling captured significantly longer largemouth bass than did electrofishing ($P < 0.001$). Electrofishing captured a greater range of sizes than did angling and also captured a greater number of smaller length largemouth bass (Figure 5).

The TL of smallmouth bass captured differed significantly among water bodies ($P = 0.003$), but not between sampling methods ($P = 0.56$; Figure 6). Additionally, there was a significant interaction between water body and sampling method ($P = 0.02$). Although not significant, angling captured slightly longer smallmouth bass than did electrofishing and electrofishing captured a slightly greater range of sizes than did angling (Figure 6).

DISCUSSION

Population estimates of largemouth bass in the four proposed water bodies were greater than expected and provide new and needed information about bass population size in southwestern New Hampshire waters (Table 2). Populations estimates of smallmouth bass were much lower than those for largemouth bass in all water bodies sampled. With the exception of Gregg Lake, smallmouth bass population estimates were poor due to low sample sizes (Table 2).

While it was not surprising that catch rates for black bass were significantly greater during electrofishing than angling samples (Table 1, Figure 3 and 4), the TL of largemouth bass captured differed significantly between sampling methods (Figure 5). Anglers captured significantly longer largemouth bass and electrofishing captured a greater size range, indicating the importance of using more than one sampling method when performing bass population estimates. The TL of smallmouth bass captured did not differ significantly between sampling methods (Figure 6), likely due either to the low number of smallmouth bass captured or because their size distribution was smaller than that of largemouth bass in these water bodies.

Total annual mortality rates (*A*) for all largemouth bass $\geq$ 152 mm ($\geq$ 6") in the four proposed water bodies ranged from 0.36 to 0.42 with a mean of 0.38 (Table 3). Allen et al. (2008) examined published estimates of total annual mortality rates (*A*) for largemouth bass from studies conducted during 1953-2003 in 11 U.S. states. Over this time period, total annual mortality rates (*A*) averaged 0.57 with a range from 0.24 to 0.91. In a more comparable study, due to its proximity to New Hampshire, Edwards et al. (2004) calculated total mortality rates (*A*) of 0.38 and 0.41 for largemouth bass in two Connecticut lakes during 2001-2002.

Estimated ice fishing mortality rates (*u*) during a typical winter (January 1 to March 31) for all largemouth bass $\geq$ 152 mm ($\geq$ 6") in the four proposed water bodies ranged from 0.05 to 0.14 with a mean of 0.08 (Table 3). Allen et al. (2008) examined published annual fishing mortality rates (*u*) for largemouth bass from studies conducted during 1953-2003 in 11 U.S. states. Annual fishing mortality rates (*u*) from 1990-2003 averaged 0.18; annual fishing mortality rates (*u*) calculated in Allen et al. (2008) were for the entire year and were not calculated for only winter as in our study. In a more comparable study, due to its proximity to New Hampshire, Edwards et al. (2004) calculated annual fishing mortality rates (*u*) for largemouth bass in two Connecticut lakes during 2001 and 2002. Annual fishing mortality rates (*u*) in 2001 and 2002 at Mansfield Hollow Reservoir were 0.15 and 0.16, respectively. Annual fishing mortality rates (*u*) in 2001 and 2002 at Gardner Lake were 0.47 and 0.13, respectively; annual fishing mortality rates (*u*) calculated in Edwards et al. (2004) were for the entire year and were not calculated for only winter as in our study, although the authors attribute the higher annual fishing mortality rate (*u*) at Gardner Lake in 2001 to a higher ice harvest during that year, likely as a result of approximately a 4.5 times higher ice angler effort in 2001 vs. 2002.

Estimated percent of total annual mortality (*A*) of all largemouth bass ≥ 152 mm (≥ 6”) attributed to ice anglers in a typical winter (January 1 to March 31) in the four proposed water bodies averaged 21.4% and ranged from 13.8% to 32.3% (Table 3). In two Connecticut lakes, estimated percent of total annual mortality (*A*) of all largemouth bass attributed to ice anglers averaged 38.3% and ranged from 11.0% to 61.2% during 2001 and 2002 (Edwards et al. 2004).

The percent of the largemouth bass population from 381-508 mm (15-20”) estimated to be harvested during a typical winter (January 1 to March 31) from the four proposed water bodies can be as great as 22.3% (range: 10.6% to 22.3%) (Table 1). While it may appear that harvest of this size category is relatively minimal, harvest is concentrated during the ice fishing season, with up to 53.1% (range: 29.4% to 53.1%) of the total annual mortality of this size category attributed to ice anglers (Table 1); the majority of remaining total mortality for the year would be attributed to natural mortality as open-water bass harvest is low (Allen et al. 2008; Myers et al. 2008). Additionally, research has shown fishing and natural mortality of largemouth bass is additive, indicating that decreasing fishing mortality will decrease total annual mortality (Allen et al. 2008). Accordingly, decreasing the ice harvest of 381-508 mm (15-20”) bass will decrease the total mortality rate for this size category by approximately 30% to 53%, setting into motion the benefits of this proposed management rule.

Based on the data presented in this report, we propose that a new category for “lakes and ponds with special rules” be created in 2012 called “Quality Bass Management Waters.” This category would apply to Clement Pond/Joe Silvia Lake (Hopkinton), Grassy Pond (Rindge), Warren Lake (Alstead), and Gregg Lake (Antrim). For these waters, a 381-508 mm (15”-20”) protective slot-length limit would be imposed from January 1 to March 31 and the daily limit for black bass during this time period would be three fish, of which only one can be > 508 mm (>20”).

If proposed rules are adopted, future sampling efforts will be made on these four proposed water bodies to evaluate whether the stated goal is being met. If the stated goal is not met within five years (2017) from date of inception, these new regulations will revert back to general state black bass regulations for lakes and ponds.

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Table 1. Effort, number of bass captured, sample size, and mean bass catch rate (# bass captured/hour) by water body and sampling method.

Water body	Sampling Method	Effort (hours)	Number largemouth bass captured (# recaptures; inclusive)	Number smallmouth bass captured (# recaptures; inclusive)	*n* (# boats angling or # electrofishing runs)	Mean largemouth bass catch rate (± 1 SD)	Mean smallmouth bass catch rate (± 1 SD)
Clement Pond	Angling	96.50	117 (14)	2 (0)	7	1.1 (+ 1.0)	0.02 (+ 0.03)
Clement Pond	Electrofishing	6.06	223 (25)	7 (1)	21	36.4 (+ 22.4)	1.1 (+ 2.3)
Grassy Pond	Angling	100.05	43 (5)	-	10	0.5 (+ 0.3)	-
Grassy Pond	Electrofishing	7.43	114 (10)	-	27	15.3 (± 17.7)	-
Gregg Lake	Angling	117.00	89 (9)	38 (4)	10	0.8 (± 0.3)	0.3 (± 0.3)
Gregg Lake	Electrofishing	6.81	172 (7)	57 (8)	25	25.2 (± 12.0)	8.3 (± 5.9)
Warren Lake	Angling	92.08	110 (23)	3 (1)	12	1.2 (± 0.5)	0.1 (± 0.1)
Warren Lake	Electrofishing	6.31	343 (39)	6 (1)	23	54.0 (± 22.3)	0.9 (± 1.6)
Total	Angling	405.63	359 (51)	43(5)	39	0.9 (± 0.6)	0.1 (± 0.2)
Total	Electrofishing	26.61	852 (81)	70(10)	96	31.7 (± 23.6)	3.7 (± 5.2)

Table 2. Bass population estimates (Schnabel estimator), 95% confidence intervals, and number of bass per acre by water body and total length category.

Water body	Total length category (inches)	Total length category (mm)	Largemouth bass population estimate	95% Confidence Interval	Smallmouth bass population estimate	95% Confidence Interval	Largemouth bass per acre	Smallmouth bass per acre
Clement Pond	> 6 "	> 152 mm	1107	843, 1614	29	10, -	9	0.24
Clement Pond	6 - <15"	152 - 380 mm	747	548, 1175	15	5, -	6	0.13
Clement Pond	15-20"	381 - 508 mm	359	222, 944	2	-	3	0.02
Clement Pond	> 20"	> 508 mm	1	-	0	-	0.01	0.00
Grassy Pond	≥ 6 "	≥ 152 mm	604	401, 1224	-	-	6	-
Grassy Pond	6 - <15"	152 - 380 mm	390	208, 3156	-	-	4	-
Grassy Pond	15-20"	381 - 508 mm	255	157, 670	-	-	3	-
Grassy Pond	> 20"	> 508 mm	0	-	-	-	0.00	-
Gregg Lake	≥ 6 "	≥ 152 mm	1645	1104, 3225	290	185, 669	8	1
Gregg Lake	6 - <15"	152 - 380 mm	1209	783, 2648	290	185, 669	6	1
Gregg Lake	15-20"	381 - 508 mm	400	188, -	0	-	2	0.00
Gregg Lake	> 20"	> 508 mm	1	-	0	-	0.01	0.00
Warren Lake	≥ 6 "	≥ 152 mm	1170	937, 1558	12	5, -	6	0.06
Warren Lake	6 - <15"	152 - 380 mm	623	470, 925	4	-	3	0.02
Warren Lake	15-20"	381 - 508 mm	537	385, 883	3	1, -	3	0.02
Warren Lake	> 20"	> 508 mm	4	1, -	0	-	0.02	0.00

Table 3. Population estimates, catch and harvest estimates, and mortality rate estimates for largemouth bass from four southwestern NH water bodies. Population estimates were performed on these waters in summer 2009. Number of bass caught, harvested, and percent harvested estimated using average effort, catch and harvest data from four NH water bodies during the winter of 2003 (catch rate = 0.11 bass/hour, harvest rate = 0.05 bass/hour, expanded winter angling effort = 1,642 hours; Racine and Gries 2007). Mortality rates calculated using sampling data from these water bodies in summer 2008. Estimates of catch, harvest and mortality are for the period from January 1 to March 31.

Water body	Length Category (inches)	Length Category (mm)	Schnabel Pop. Est.	Estimated # bass caught	Estimated # bass harvested	Estimated % of length category harvested	Total annual mortality rate (A)	Estimated ice fishing mortality rate (u)	Estimated % of total annual mortality attributed to ice anglers
Clement Pond	≥ 6	≥ 152	1107	181	82	7.4	0.37	0.07	20.0
Clement Pond	6 - <15	152 - 380	747	105	28	3.8	0.37	0.04	10.2
Clement Pond	15 - 20	381 - 508	359	72	57	15.9	0.37	0.16	42.8
Clement Pond	≥ 15	≥ 381	360	76	61	16.9	0.37	0.17	45.4
Clement Pond	> 20	> 508	1	4	4	100.0	0.37	1.00	
Grassy Pond	≥ 6	≥ 152	604	181	82	13.6	0.42	0.14	32.3
Grassy Pond	6 - <15	152 - 380	349	105	28	8.1	0.42	0.08	19.2
Grassy Pond	15 - 20	381 - 508	255	72	57	22.3	0.42	0.22	53.1
Grassy Pond	≥ 15	≥ 381	255	76	61	23.7	0.42	0.24	56.5
Grassy Pond	> 20	> 508	0	4	4	100.0	0.42	1.00	
Gregg Lake	≥ 6	≥ 152	1645	181	82	5.0	0.36	0.05	13.8
Gregg Lake	6 - <15	152 - 380	1244	105	28	2.3	0.36	0.02	6.3
Gregg Lake	15 - 20	381 - 508	400	72	57	14.2	0.36	0.14	39.5
Gregg Lake	≥ 15	≥ 381	401	76	61	15.1	0.36	0.15	41.9
Gregg Lake	> 20	> 508	1	4	4	100.0	0.36	1.00	
Warren Lake	> 6	> 152	1170	181	82	7.0	0.36	0.07	19.4
Warren Lake	6 - <15	152 - 380	629	105	28	4.5	0.36	0.04	12.5
Warren Lake	15 - 20	381 - 508	537	72	57	10.6	0.36	0.11	29.4
Warren Lake	≥ 15	≥ 381	541	76	61	11.2	0.36	0.11	31.1
Warren Lake	> 20	> 508	4	4	4	100.0	0.36	1.00	

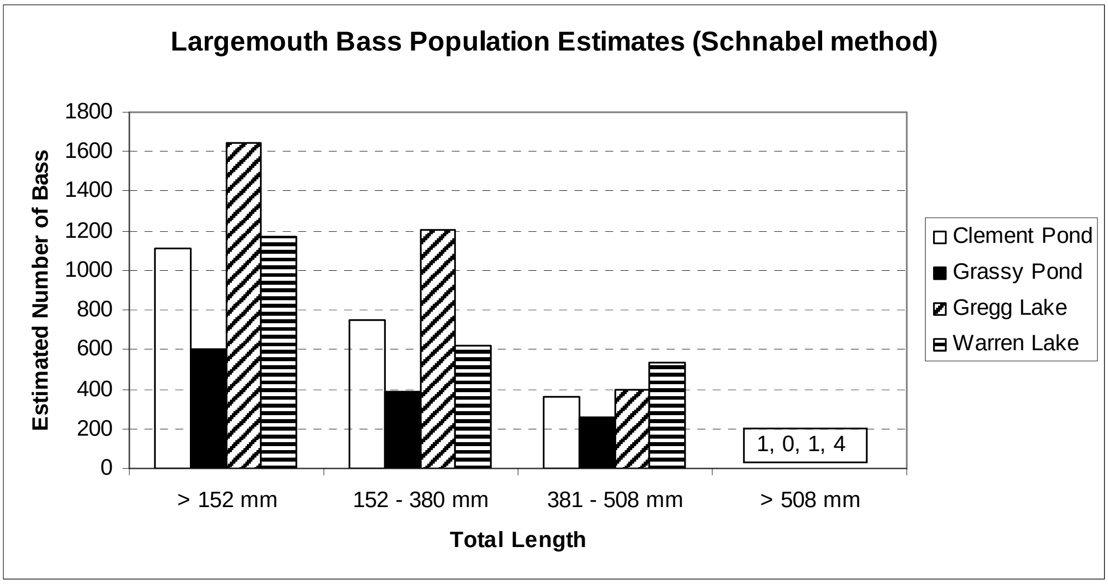

Figure 1. Largemouth bass population estimates by water body and total length category (mm).

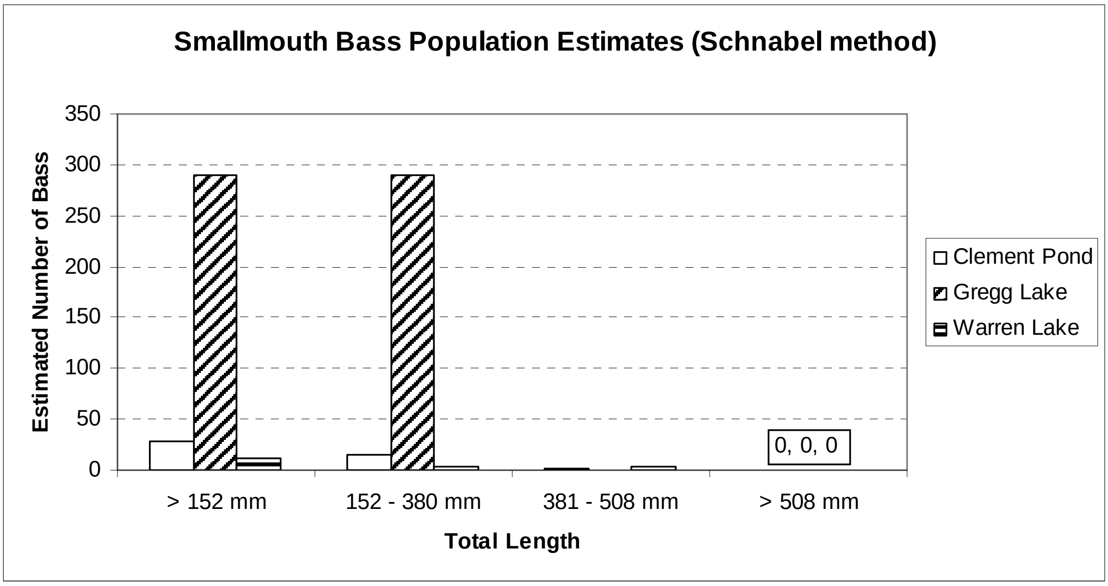

Figure 2. Smallmouth bass population estimates by water body and total length category (mm).

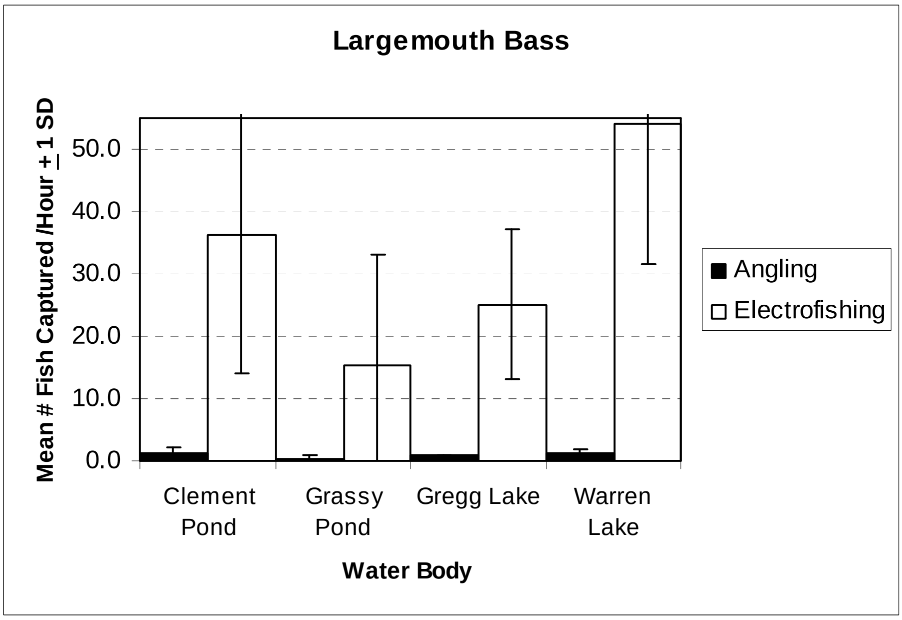

Figure 3. Mean catch rates (fish captured per hour) by water body for largemouth bass sampled by angling and electrofishing.

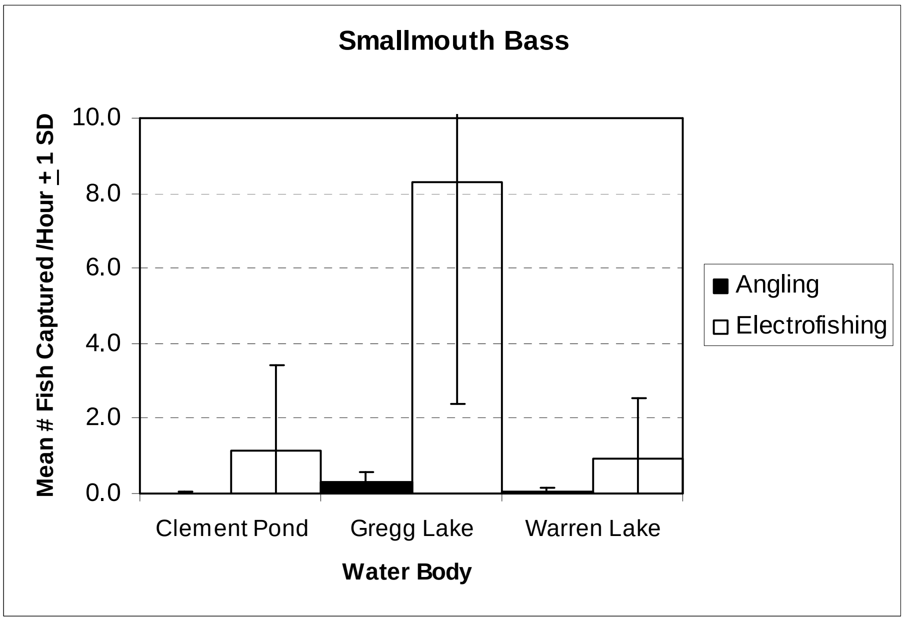

Figure 4. Mean catch rates (fish captured per hour) by water body for smallmouth bass sampled by angling and electrofishing.

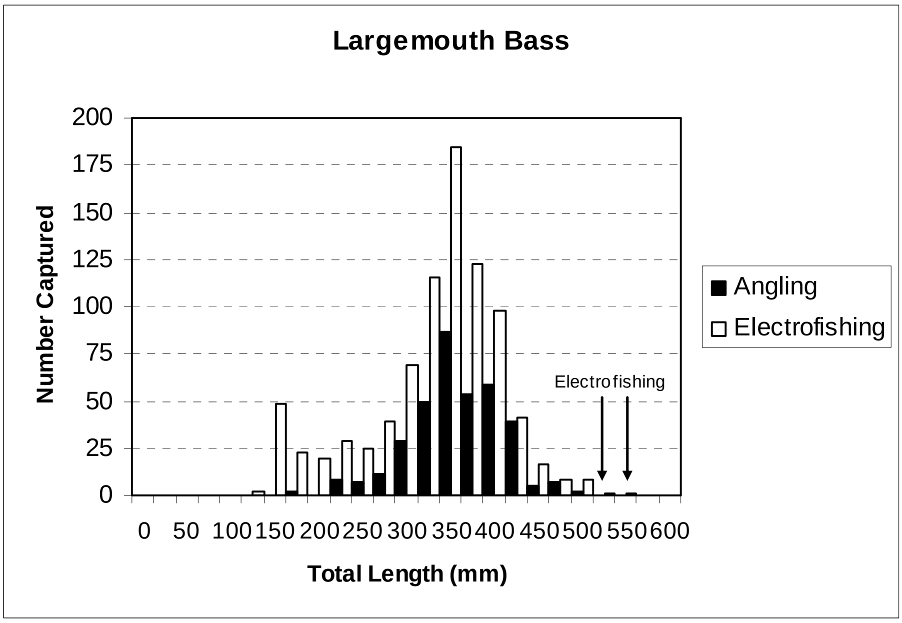

Figure 5. Number of largemouth bass captured by total length and sampling method. Data for all lakes combined.

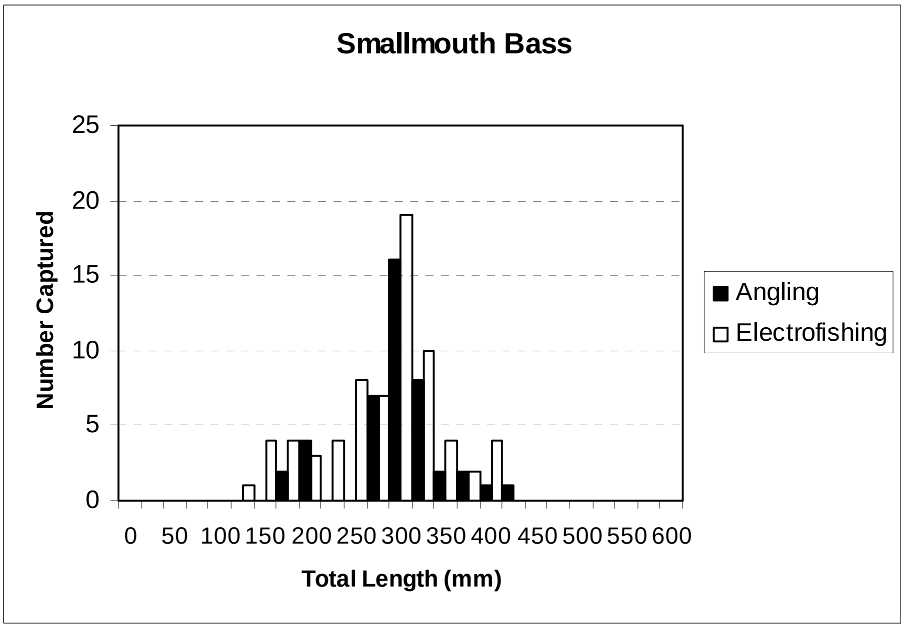

Figure 6. Number of smallmouth bass captured by total length and sampling method. Data for all lakes combined.