Wachusett Reservoir

Creel Survey Report
Survey Years 2011 and 2012

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Massachusetts Department of Conservation and Recreation
Commissioner Carol Sanchez

Division of Water Supply Protection, Office of Watershed Management
Director Jonathan Yeo

ABSTRACT

A roving creel survey of shore anglers was conducted on the Wachusett Reservoir in central Massachusetts during the 2011 and 2012 fishing seasons (April-November). Anglers were counted and interviewed to collect trip specifics and information about fish landed and harvested. A total of 2,561 anglers were surveyed across the two fishing seasons. Catch per unit effort was calculated as 0.24 fish per one hour of angling time for the 2011 season and 0.20 fish per hour in 2012. Alternatively, this is expressed as 4.1 hours of angling time to catch one fish in 2011 and 5.1 hours in 2012. Estimated totals for each fishing season include 10,977 fish caught from 16,194 angling trips in 2011 and 7,930 fish caught from 12,581 angling trips in 2012. Surveys indicate that the reservoir is used as a recreational angling resource by between eight and eleven thousand different anglers in a given fishing season, with 98% of anglers being Massachusetts residents. Smallmouth Bass and Lake Trout were the species most frequently caught by anglers; these two species accounted for nearly two-thirds of the total catch and more than half of the total harvest. The harvest rate across all species was 28%, while 44% of Lake Trout and 12% of Smallmouth Bass were harvested. Comparison of the current creel survey results to three other creel surveys conducted since 1979 show that the species most frequently caught by anglers have changed, and that this may reflect changes in the fish community composition over this time period. Further study is needed to learn more about the current population status, life history, and sustainable yield of Lake Trout in the Wachusett Reservoir. Fish are an important component of the reservoir ecosystem, and knowledge of fish population dynamics in the reservoir is important to understanding the Wachusett Reservoir food web and its impacts upon drinking water quality.

Acknowledgements:

This report was prepared by the MA Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management. The principal author is Jamie Carr, Aquatic Biologist. Review was provided by Joy Trahan-Liptak, Patricia Austin, David Worden and Larry Pistrang. External review was provided by Jason Stolarski and Richard Hartley of the MA Department of Fisheries and Wildlife and Bob Maietta of the MA Department of Environmental Protection. Cover photo: Smallmouth Bass caught in Wachusett Reservoir, photo by Jamie Carr.

Many thanks are owed to the personnel who made this study possible by performing angler counts and field surveys of anglers, including: DCR Watershed Rangers Becky Baronowski, Bruce Fant, David Wright, Derek Liimatainen, Jonathan Dudley, Keith Vicari, Matt Amadon, Tom Gonzalez, Tyler Brien and Will Anderson, DFW staff Mark Brideau and Rich Hartley, and DWSP staff Jamie Carr. Guidance on survey design and data analysis was provided by Todd Richards of the Massachusetts DFW.

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LIST OF FISH SPECIES

Common Name	Scientific Name	Common Name	Scientific Name
Banded Killifish	*Fundulus diaphanus*	Pumpkinseed	*Lepomis gibbosus*
Black Crappie	*Pomoxis nigromaculatus*	Rainbow Smelt	*Osmerus mordax*
Bluegill	*Lepomis macrochirus*	Rainbow Trout	*Oncorhynchus mykiss*
Brown Bullhead	*Ameirus nebulosus*	Rock Bass	*Ambloplites rupestris*
Brown Trout	*Salmo trutta*	Smallmouth Bass	*Micropterus dolomieu*
Chain Pickerel	*Esox niger*	White Perch	*Morone americana*
Lake Trout	*Salvelinus namaycush*	Yellow Bullhead	*Ameirus natalis*
Landlocked Salmon	*Salmo salar*	Yellow Perch	*Perca flavescens*
Largemouth Bass	*Micropterus salmoides*		

WACHUSETT RESERVOIR
CREEL SURVEY REPORT FOR SURVEY YEARS 2011-2012

1.0 INTRODUCTION

The Massachusetts Department of Conservation and Recreation (DCR), Division of Water Supply Protection (DWSP), Office of Watershed Management was established by Chapter 372 of the Acts of 1984. This division of DCR was created to manage and maintain a system of watersheds and reservoirs and provide pure water to the Massachusetts Water Resources Authority (MWRA), which in turn supplies drinking water to nearly 2.5 million people and thousands of industrial users in metropolitan Boston and Central Massachusetts. Water quality sampling and watershed monitoring make up an important part of the overall mission of the DWSP Environmental Quality Section staff at the Wachusett Reservoir in West Boylston and the Quabbin Reservoir in Belchertown.

The Wachusett Reservoir is a 4,057 surface acre, 59.7 billion gallon man made drinking water supply reservoir located in Central Massachusetts. It was completed in 1906 and is the second largest water body in the state. It is an oligotrophic reservoir with a watershed of 74,800 acres and a mean depth of 48 feet. Wachusett Reservoir also receives water from the largest body of water in the state, Quabbin Reservoir, via an aqueduct.

The open fishing season on Wachusett reservoir begins on the first Saturday in April (ice conditions permitting) and continues until the last day of November. Public boating is not allowed on the reservoir. Shore fishing is allowed for the majority of the 32.5 miles of reservoir shoreline; public access in the intake zone is prohibited (Figure 1). Fishing is permitted from dawn to dusk, and two active lines are permitted per angler.

The reservoir has historically supported an active recreational fishery, which has produced state record catches of the following 6 species: Brown Trout (1966), Smallmouth Bass (1981), White Perch (1994), Rainbow Trout (1999) and Lake Trout (2004) (DFW Freshwater Fish Records). With the exception of Rainbow Trout, all species currently inhabiting the reservoir are considered naturally reproducing and self sustaining populations. Rainbow Trout have been stocked in Wachusett Reservoir since at least the early 1990s. From 2000 through the present an average of 2,200 Rainbow Trout are stocked annually each spring by Massachusetts Division of Fish and Wildlife (DFW) staff (Mark Brideau, personal communication).

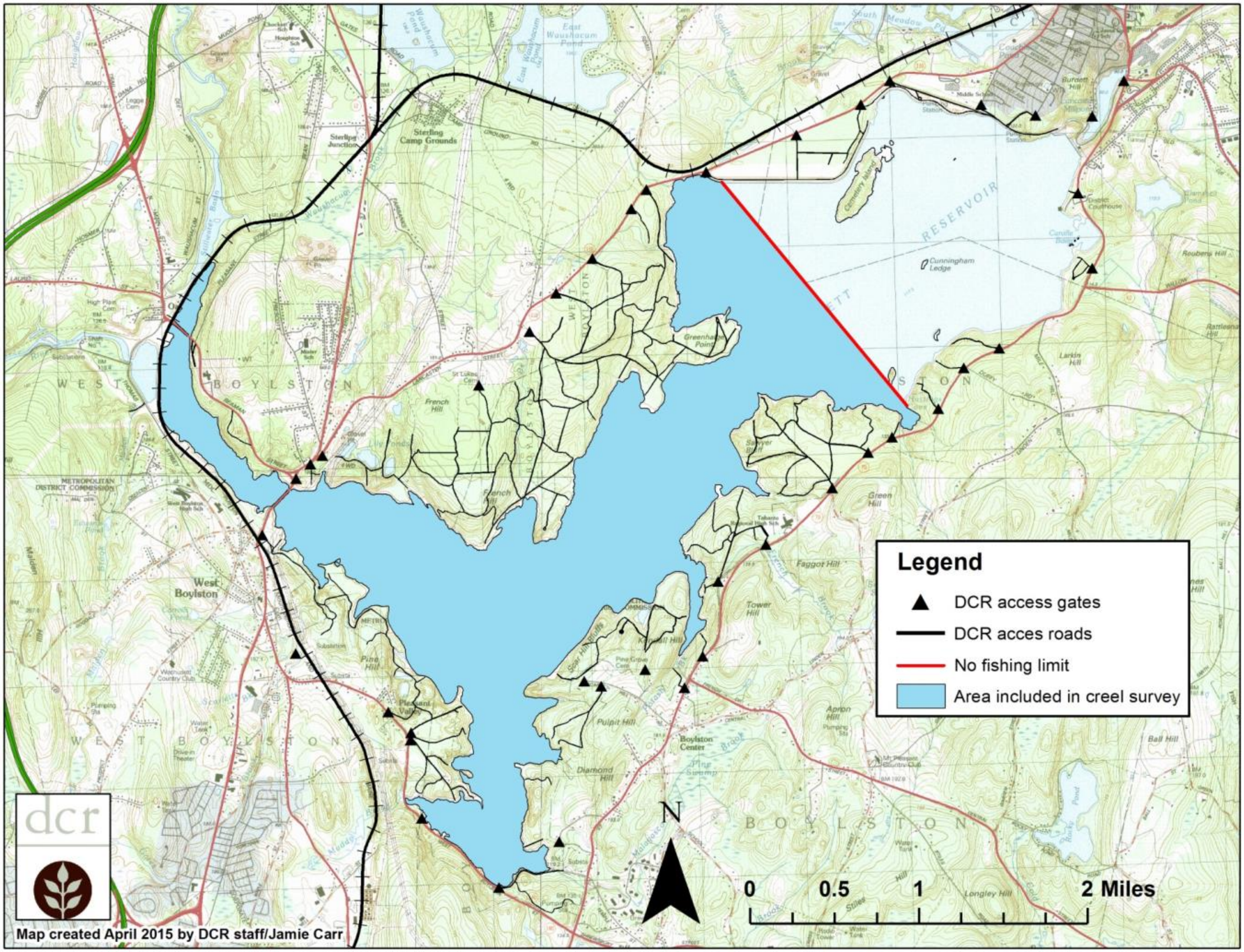
Historic fisheries data collected in the reservoir consists of net sampling and a limited amount of tagging of adult Lake Trout and Landlocked Salmon. Between 1978 and 1999, fish sampling included the setting of 24 gill nets, 3 smelt nets, one Fyke net, and one shoreline seine haul all set by DFW staff. An angler mail-in survey of 105 anglers was conducted in 1976. Angler creel surveys at Wachusett Reservoir were conducted by DFW staff in 1979, 1980, and 1998. No fisheries data was collected in Wachusett Reservoir between 1999 and 2010. Creel surveys were conducted in 2011 and 2012, and this report summarizes those activities. DWSP and DFW initiated a Lake Trout tagging study at Wachusett Reservoir in the fall of 2014.

A creel survey is a survey of anglers to determine the number and type of fish caught by anglers in a specific water body over a specific time period. In this context, a creel survey of Wachusett Reservoir can serve as a tool to directly assess the following: adult fish populations, fishing pressure, catch rate, and harvest. Fish are an important component of a reservoir ecosystem, and knowledge of fish populations in the reservoir is important to understanding the food web of the reservoir and its impacts upon water quality. Predatory game fish in the reservoir have important top down effects on smaller fish, zooplankton, and phytoplankton, which directly impact water quality.

Basic summaries for the 2011 and 2012 creel seasons providing raw data and basic totals are available online on the MA Department of Conservation and Recreation website. They are found within their respective 2011 and 2012 Wachusett Reservoir Annual reports of monitoring activities (DCR 2011 and 2012).

The goal of this project is to document angler catches at Wachusett Reservoir during the 2011 and 2012 fishing seasons in order to compare the results to past surveys and establish a baseline for future comparison. The methods of the sampling design and analyses are described. Results for the estimated angler effort, catch per unit effort, harvest rates, and angler attributes are presented. The potential water quality impacts of angling as well as survey limitations are discussed. Finally, a comparison to historical creel surveys and future recommendations are included.

FIGURE 1. WACHUSETT RESERVOIR MAP



2.0 METHODS

2.1 SAMPLING DESIGN

A roving creel survey with a progressive count was employed. A stratified random sampling design was used to randomly select two weekdays and one weekend day each week as creel survey days. A schedule was then generated for the fishing season that assigned each survey day to a particular department. The fishing season ran from April 10th to November 30th in 2011 and from April 7th to November 30th in 2012. The Reservoir typically opens to angling on the first Saturday in April; in 2011 the opening was delayed one week due to ice cover.

Each survey day consisted of two separate loops around the reservoir: an AM loop and a PM loop. The AM loop was initiated after sunrise and typically concluded before noon. The PM loop was initiated after noon and concluded before sunset. On each assigned loop the creel clerk would make one complete trip around the reservoir, using a progressive count to determine the number of anglers for that loop. Every visible angler was counted and as many anglers as possible were surveyed while completing one trip around the reservoir. The total number of anglers counted, surveyed, and specific reasons that anglers were not surveyed were recorded on an agent sheet (Appendix C) for each loop.

A basic creel survey card was developed (Appendix A) that enabled creel clerks to quickly collect basic information from an angler or group of anglers, including: time started fishing, tackle used, and home zip code. The type, number, and length of fish caught as reported by the angler were also recorded. Creel surveys were performed by DCR Wachusett Watershed Rangers, DCR Division of Water Supply Protection staff, and Department of Fish and Wildlife staff. Training of agents and meetings were held prior to the start of each season to ensure standard data collection. Definitions for each item on the creel card were provided with an explanation of each field (Appendix B). Starting times and starting locations were not predetermined; due to the variety of personnel conducting the surveys and the various locations from which each group would begin the survey, there was not a consistent bias introduced by starting location.

The overall survey procedure for 2011 and 2012 were the same, excepting one difference. In 2012, the minimum time required for an angler to be fishing in order to be surveyed was changed to 30 minutes from the 1 hour minimum used in 2011 (Pollock 1997).

The main basin of the reservoir, Thomas basin, and Oakdale basin were included in the creel survey. The designated no fishing area near the intake and the small upper basins (Quinapoxet and Stillwater basins) north and west of the railroad trestle were not included in the survey area. Reservoir tributaries were also not included as part of the creel survey. Finally, the Lilly Ponds inside of DCR gate 28 and all small ponds not directly connected to the reservoir were also excluded.

Surveys were conducted by vehicle using the access roads. The network of access roads maintained around the reservoir makes it possible for official personnel to patrol the reservoir by vehicle; this makes it possible for creel clerks to efficiently access anglers for interviews. On occasion, surveys were conducted by boat, with 10 survey loops conducted using the boat in 2011 (5%) and 2 in 2012 (1%). The use of the boat in 2011 was primarily due to storm damage of trees in the fall of 2011 that made use of the access roads difficult during late October and early November.

Groups of anglers were often included on a single survey, provided that they had begun fishing at the same time and their method of fishing was consistent. Information for a group of anglers fishing together that had multiple start times were recorded with a separate survey for each angler start time.

Data collected from survey agent sheets and creel survey cards were entered into a Microsoft Access electronic database stored on the W: drive of the server at John Augustus Hall in West Boylston; actual creel survey cards are stored in chronological order at this location as well.

2.2 ANALYSIS AND ESTIMATIONS

The methods and formulas for analyzing the creel survey data and generating estimated results followed methods outlined in "Estimating Angling Effort and Catch from Michigan Roving and Access Site Angler Survey Data" (Lockwood et al 1999). The appropriate equations for a roving creel survey and instantaneous counts were used. An accommodation was made for this survey as both complete and incomplete trip surveys were included, where Lockwood assumes that interviews of only one type are included in analysis. As a result, the catch rates for complete and incomplete trips were computed separately, and the estimated total catch equation was modified to include the proportional catch rates from both types. The frequency and duration of angler trips can vary by day of the week and season, thus angler effort calculations were pooled by weekday/weekend strata for each month in order to calculate angler effort. The equations used to calculate the estimated daily angler hours, estimated total angler hours, and estimated total angler trips are presented below.

The daily estimated angler hours for a given count were calculated:

$$E_{dj} = F_d A_{dj} \qquad (1)$$

Where F_d is the number of fishable hours on day *d* and A_{dj} is the number of anglers counted on day *d* on count j. The fishable hours for each day were defined as the number of daylight hours on a survey day based on sunrise and sunset times, rounded to the nearest 15 minutes, as provided on the website sunrisesunset.com (SunriseSunset 2014) for the location West Boylston, Massachusetts.

The estimated total angler hours on day *d* were calculated:

$$E_d = \frac{\sum_{j=1}^{nd} E_{dj}}{n_d} \qquad (2)$$

Where *n* = the number of angler counts. On a typical day, *n* =2 given the sampling design of two survey loops per day. On survey days where only one loop was completed, the estimated hours for that day were derived from only the one count.

The total estimated angler hours were calculated:

$$E_p = \frac{D_p}{m_p}\sum_{d=1}^{m_p} E_d \tag{3}$$

Where *D* is the number of days by type in the multi-day period *p*, and m_p is the number of survey days in period *p*.

The mean length of complete angler trips was calculated:

$$\bar{t_p} = \frac{\sum_{i=1}^{k_p} t_{pi}}{k_p} \tag{4}$$

Where *t* is the length of fishing trip (in hours) and *k* is the number of anglers interviewed.

The total estimated number of angler trips was calculated:

$$\widehat{\varepsilon_p} = \frac{E_p}{\bar{t_p}} \tag{5}$$

Multiple day totals used to calculate the catch rate and estimated total catch were computed by month, disregarding day of the week. The estimated catch rate (fish per angler hour) for complete angling trips was calculated using the ratio of the means:

$$\hat{R}_p = \frac{\sum_{i=1}^{k_p} c_{pi}}{\sum_{i=1}^{k_p} h_{pi}} \tag{6}$$

Where *c* is the total catch in period *p* and *h* is the total angler hours fished in period *p*.

The estimated catch rate (fish per angler hour) for incomplete angling trips was calculated using the mean of ratios:

$$\bar{R}_p = \frac{\sum_{i=1}^{k_p}\left(\frac{c_{pi}}{h_{pi}}\right)}{k_p} \tag{7}$$

Where *c* is the total catch in period *p* and *h* is the total angler hours fished in period *p*.

The estimated total catch was calculated by adding the estimated catch from complete and incomplete trips using their associated catch rates:

$$\hat{C}_p = E_p\hat{R}_p\left(\frac{\sum_{i=1}^{kp} h_{complete}}{\sum_{i=1}^{kp} h_p}\right) + E_p\bar{R}_p\left(\frac{\sum_{i=1}^{kp} h_{incomplete}}{\sum_{i=1}^{kp} h_p}\right) \tag{8}$$

Where $h_{complete}$ is the sum of the complete trip angling hours in period p and $h_{incomplete}$ is the sum of the incomplete trip angling hours in period p.

The monthly estimated catch for each fish species was calculated by multiplying the monthly count of each species by an expansion factor for that month. The expansion factor for each month was calculated by dividing the estimated total catch for that month by the total catch for that month. The total estimated harvest for each species was calculated by multiplying the total estimated catch for that species for each month by the actual harvest rate observed for that species during that angling season.

The annual harvest rate was calculated by dividing the estimated total fish harvested each year by the surface area of the reservoir. Thus the harvest rate is expressed as fish per acre per year. The total yield simply adds a weight component to the annual harvest rate. The total estimated weight harvested for Lake Trout and Smallmouth Bass was calculated by multiplying the average length of harvested specimens of that species in a given season by the expected weight for that length by the total number of fish estimated to be harvested. The total yield is then the total estimated weight harvested divided by the reservoir surface area. Smallmouth Bass weights were calculated using the length weight ratios provided by PA fish and game (Appendix D) (Lorantis 2013). Lake Trout weights were calculated based on length and weight data of Lake Trout less than 500mm total length collected from Wachusett Reservoir by DWSP and DFW in 2014 (Appendix E) (unpublished).

3.0 RESULTS

In 2011, the creel survey was conducted on 98 of the 236 possible days within the fishing season (April 9 – November 30). In 2012, the creel survey was conducted on 98 of the 238 possible days within the fishing season (April 7 – November 30).

On an average survey loop over the two year period (each survey day consisted of one AM loop and one PM loop), the creel clerk circumnavigated the reservoir in two hours and twenty eight minutes, while counting 14 anglers and surveying 7 anglers. Due to time constraints, clerks were not expected to interview all anglers; a rough goal of interviewing half of the anglers was set. In total, creel clerks counted 5,005 anglers and surveyed 2,561 anglers (51%) during the two seasons.

3.1 ESTIMATED ANGLER EFFORT

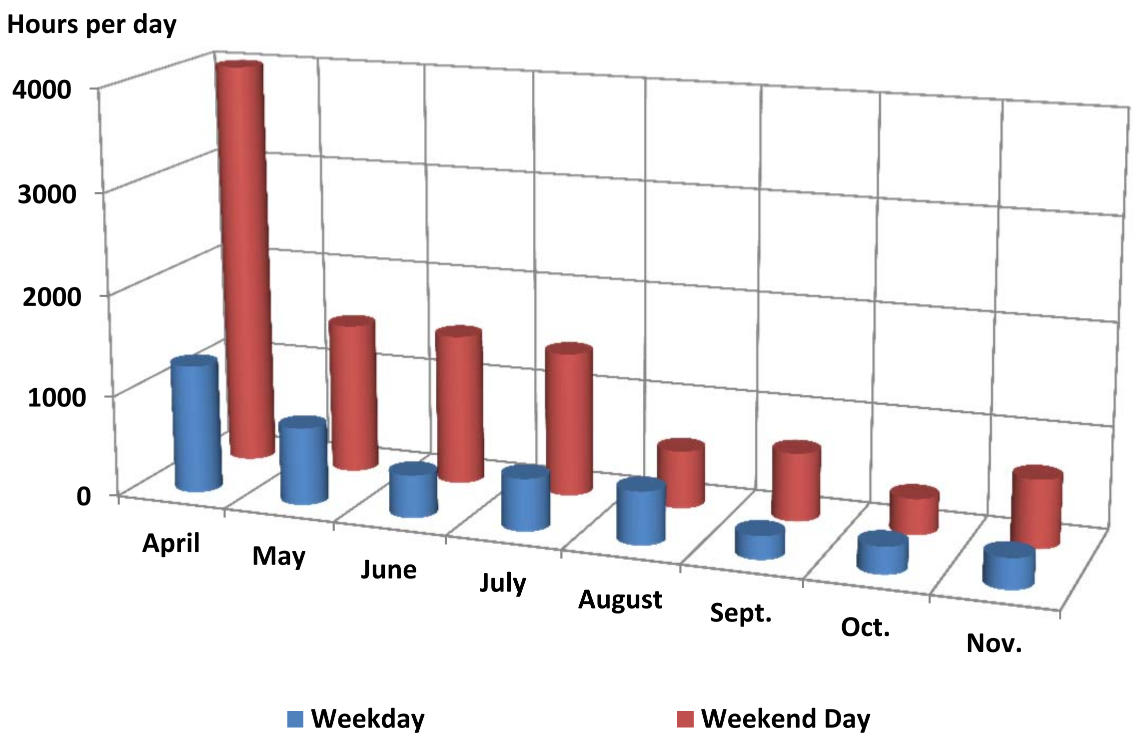
During the 2011 angling season, creel surveys revealed that an estimated 16,194 angling trips took place, with a corresponding total of 45,407 hours of angling time representing the effort for the year (Table 1). 2012 surveys show an estimated 12,581 angling trips took place during that season, with a corresponding total of 40,266 hours of angling time. Mean angling trip lengths calculated from complete trip surveys show that the average angling trip lasted 3.1 hours in 2011 and 3.5 hours in 2012.

Angler effort expended was documented to be highest early in the year, and higher on weekends than on weekdays (Figure 2). Anglers concentrated their effort on April weekend days at the opening of the fishing season, when Lake Trout and Landlocked Salmon can be found close to shore and are most accessible to anglers. Effort tapered off as the season progressed, with the minimum effort occurring in October. Effort increased in November when water temperatures decreased before the close of the season.

TABLE 1. ESTIMATED TOTALS FOR 2011 AND 2012 WACHUSETT RESERVOIR CREEL SURVEYS

	2011	2012	Total 2011 and 2012
Days in fishing season	236	238	474
Survey days	98	98	196
Anglers surveyed	1,227	1,334	2,561
Complete trips (%)	19.5	15.8	17.6
Total angling trips	16,194	12,581	28,775
Total angling hours	45,407	40,266	85,673
Mean length of angling trip (hr)	3.1	3.5	3.3
Total fish caught	10,977	7,930	18,907
Total fish harvested	3,324	2,062	5,386
Fish harvested (%)	30.3	26.0	28.5
Catch per angling hour	0.24	0.20	0.22
Time to catch one fish (hr)	4.1	5.1	4.5

FIGURE 2. AVERAGE HOURS OF ESTIMATED ANGLING EFFORT PER DAY AT WACHUSETT RESERVOIR 2011-2012



3.2 ESTIMATED TOTAL CATCH AND HARVEST

During the 2011 angling season, creel surveys show an estimated total catch of 10,977 fish, with 3,324 (30%) of those fish being harvested by anglers (Table 2). 2012 creel surveys show an estimated total catch of 7,930 fish, with 2,062 (26%) of those fish being harvested by anglers (Table 3). Smallmouth Bass were the most frequently caught species in each season, followed by Lake Trout. Collectively, these two game fish accounted for almost two-thirds of the total catch (63%) and more than half of the total harvest.

TABLE 2. ESTIMATED TOTAL FISH CAUGHT DURING 2011 FISHING SEASON

Results are reported as whole fish; rounding may result in slightly different totals by column or row.

2011 Month	Black Crappie	Brown Bullhead	Chain Pickerel	Lake Trout	Landlocked Salmon	Largemouth Bass	Rainbow Trout	Rock Bass	Smallmouth Bass	Sunfish (all species)	White Perch	Yellow Bullhead	Yellow Perch	Total Fish Caught
April				1,050	11	32	21		161		418		246	1,939
May	66			407	39	289	66		630	118	52			1,666
June	66	16	16	115	16	344	82	197	1,557	410	16		49	2,885
July				241		142	22		996	219	33			1,652
August		28	14	83		194	14		387	290	14		124	1,148
September	33			226	7	33	20		127	40	7	7	200	699
October				317			16		79				63	475
November				458			27	7	7				14	513
Total by Species	164	44	30	2,896	73	1,034	268	204	3,943	1,077	540	7	697	10,977

TABLE 3. ESTIMATED TOTAL FISH CAUGHT DURING 2012 FISHING SEASON

Results are reported as whole fish; rounding may result in slightly different totals by column or row.

2012 Month	Black Crappie	Brown Bullhead	Chain Pickerel	Lake Trout	Landlocked Salmon	Largemouth Bass	Rainbow Trout	Rock Bass	Smallmouth Bass	Sunfish (all species)	White Perch	Yellow Bullhead	Yellow Perch	Total Fish Caught
April			9	939	285	47	66		342		28			1,718
May	26		26	102	34	85	68		723	51	17			1,131
June	25	25		161		186	74	25	954	112	25		25	1,611
July				59		147	20	10	608	510	10		108	1,471
August			12	108		275	12	24	431	431	12		72	1,376
September				25		76	13		151	38	13		13	328
October				48					68		7			122
November			7	114		4	15		26		4		4	173
Total by Species	50	25	54	1,556	319	820	268	59	3,302	1,141	115	0	221	7,930

The total estimated harvest by anglers over both seasons was 5,366 fish (Table 4 and Table 5). Lake Trout were harvested the most each season, with an estimated 1,118 and 834 Lake Trout harvested 2011 and 2012, respectively. Smallmouth Bass were the second most harvested fish in each season. White Perch had the highest harvest rate (79%). Landlocked Salmon (73%) and Rainbow Trout (65%) were also frequently harvested when caught. Anglers indicated that they intended to consume the fish that they harvested 88% of the time; some smaller perch and sunfish were kept in order to be used as bait.

TABLE 4. ESTIMATED TOTAL FISH HARVESTED DURING 2011 FISHING SEASON

Results are reported as whole fish; rounding may result in slightly different totals by column or row.

2011 Month	Black Crappie	Brown Bullhead	Chain Pickerel	Lake Trout	Landlocked Salmon	Largemouth Bass	Rainbow Trout	Rock Bass	Smallmouth Bass	Sunfish (all species)	White Perch	Yellow Bullhead	Yellow Perch	Total Harvest
Harvest Rate	0.57	-	-	0.39	0.50	0.08	0.70	-	0.09	0.32	0.90	-	0.59	0.30
April				405	5	2	15		14		375		146	587
May	37			157	20	22	46		54	38	47			504
June	37			44	8	26	57		134	132	15		29	874
July				93		11	15		86	70	29			500
August				32		15	10		33	93	12		74	348
September	19			87	3	3	14		11	13	6		118	212
October				122			11		7				37	144
November				177			19		1				8	155
Total by Species	94	0	0	1,118	37	80	186	0	339	346	485	0	412	3,324

TABLE 5. ESTIMATED TOTAL FISH HARVESTED DURING 2012 FISHING SEASON

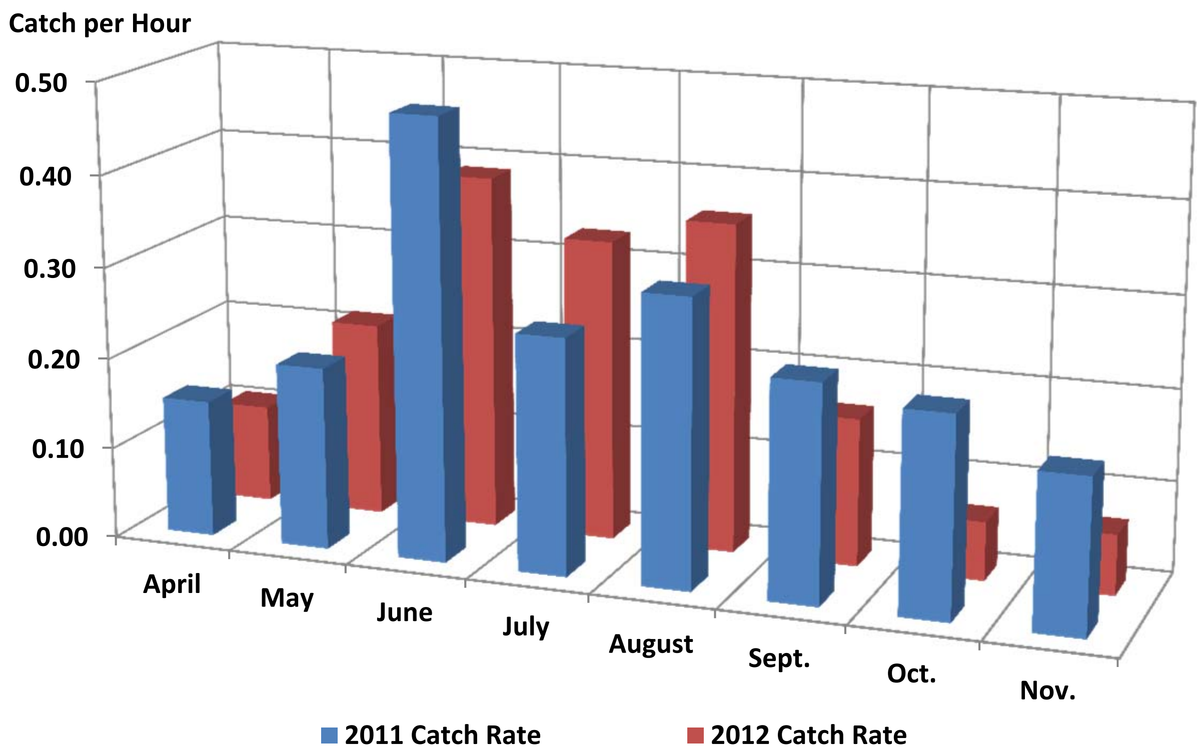
Results are reported as whole fish; rounding may result in slightly different totals by column or row.

2012 Month	Black Crappie	Brown Bullhead	Chain Pickerel	Lake Trout	Landlocked Salmon	Largemouth Bass	Rainbow Trout	Rock Bass	Smallmouth Bass	Sunfish (all species)	White Perch	Yellow Bullhead	Yellow Perch	Total Harvest
Harvest Rate	-	1.00	0.14	0.54	0.76	0.01	0.62	-	0.14	0.09	0.33	-	0.19	0.26
April			1	504	218	1	41		48		9			447
May			4	55	26	1	42		102	5	6			294
June		25		86		2	46		135	11	8		5	419
July				32		2	12		86	48	3		21	383
August			2	58		4	7		61	41	4		14	358
September				14		1	8		21	4	4		2	85
October				26					10		2			32
November			1	61			9		4		1		1	45
Total by Species	0	25	8	834	244	11	166	0	467	108	38	0	42	2,062

3.3 CATCH PER UNIT EFFORT

Catch per unit effort by anglers is a standard measure of angling success which represents the number of fish caught by anglers per a standard unit of time. Catch rate is reported here as catch per angling hour. During the 2011 angling season, creel surveys show an overall catch rate of 0.24. This rate was slightly higher than the rate of 0.20 observed for the 2012 angling season. Expressed another way, on average it took each angler 4.1 hours to catch one fish in 2011 and 5.1 hours in 2012. Catch rates were highest in the summer months of June, July, and August (Figure 3). In terms of angling success by trip over the two year period, almost exactly half of all angler trips resulted in at least one fish being caught. Slightly more than half of complete trips resulted in fish caught in 2011 (55%) and slightly less in 2012 (47%).

FIGURE 3. CATCH RATE BY MONTH FOR WACHUSETT RESERVOIR 2011-2012



3.4 HARVEST RATES AND YIELD

In 2011, it is estimated that the overall harvest rate for the Wachusett Reservoir was 0.8 fish per acre. In 2012, the harvest rate was lower at 0.5 fish per acre. Additionally, the total yield was calculated for the two most frequently caught species, Lake Trout and Smallmouth Bass.

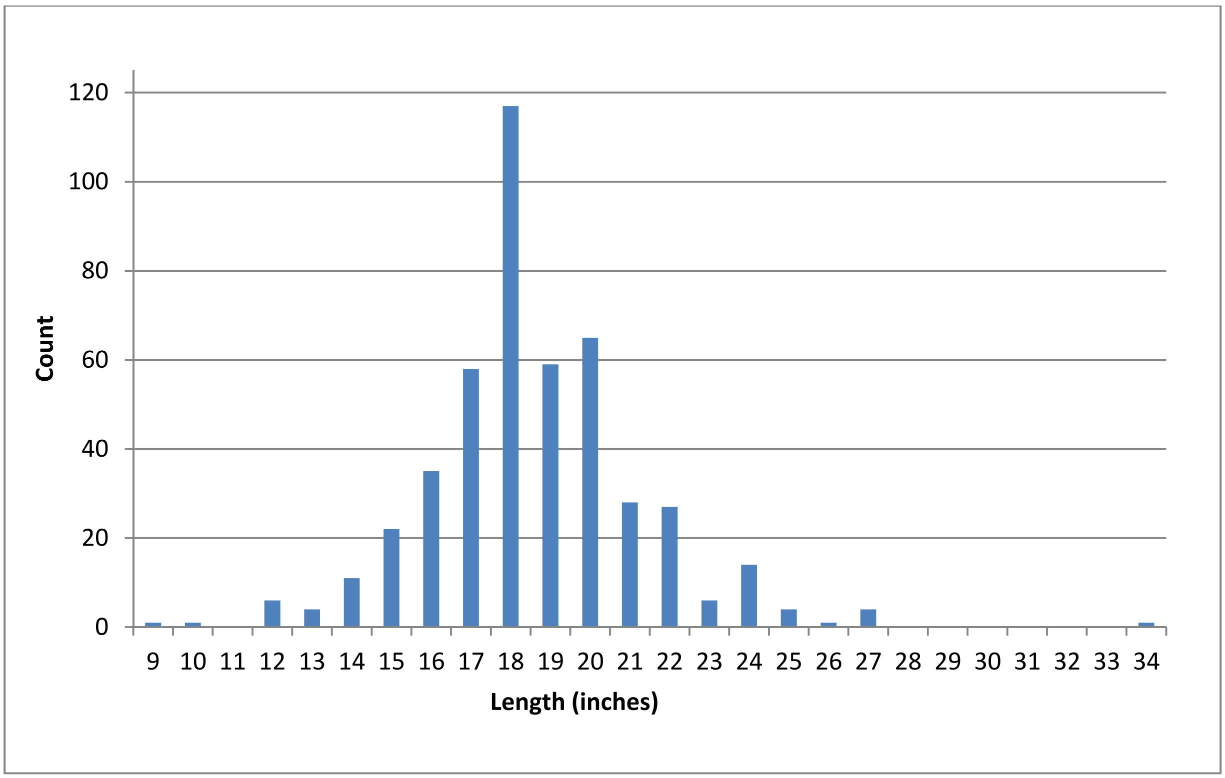
The average length of a harvested Smallmouth Bass was 15.4 inches in 2011 and 17.5 inches in 2012. The total estimated harvest in pounds for Smallmouth Bass was 610 pounds in 2011 and 1,260 pounds in 2012. The estimated yield for Smallmouth Bass was 0.15 pounds per acre in 2011 and 0.31 pounds per acre in 2012.

The average length of a harvested Lake Trout was 18.5 inches in 2011 and 19.3 inches in 2012. The total estimated harvest in pounds for Lake Trout was 2,162 pounds in 2011 and 1,734 pounds in 2012. The estimated yield for Lake Trout was 0.53 pounds per acre in 2011 and 0.43 pounds per acre in 2012.

3.5 SIZE DISTRIBUTION OF LAKE TROUT AND SMALLMOUTH BASS

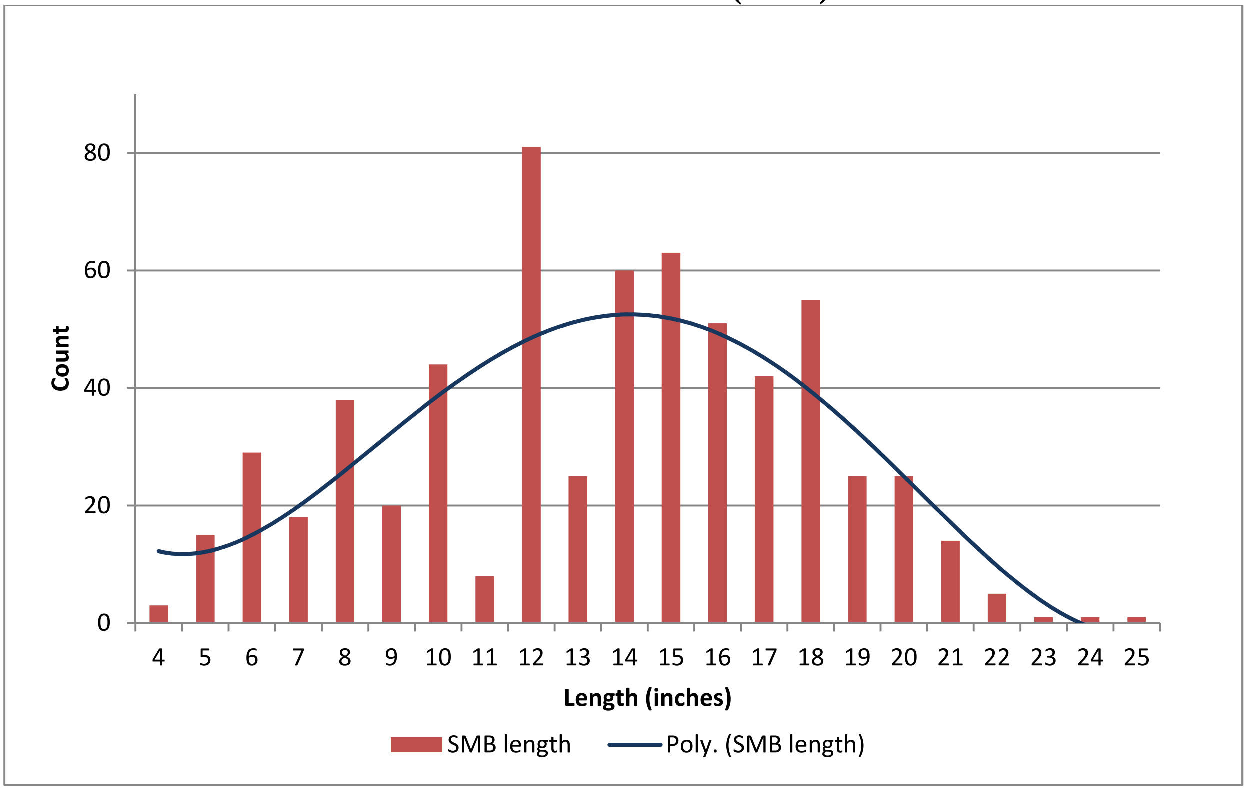
A graph of Lake Trout length distribution in the Wachusett Reservoir as reported by anglers shows that the most frequently reported Lake Trout was 18 inches in length (Figure 4), while 32% of Lake Trout caught were reported as 20 inches in length or greater.

FIGURE 4. LENGTH DISTRIBUTION OF LAKE TROUT CAUGHT IN WACHUSETT RESERVOIR 2011-2012 (n=464)



A graph of Smallmouth Bass size distribution in the Wachusett Reservoir as reported by anglers shows that the most frequently reported Smallmouth Bass was 12 inches in length (Figure 5), while 35% of Smallmouth Bass caught were reported as 16 inches in length or greater. Odd number lengths of shorter Smallmouth Bass appeared to be underreported by anglers, who appeared to report predominantly even number lengths for small fish. Due to this reporting bias, a trend line is also inserted in Figure 5.

FIGURE 5. LENGTH DISTRIBUTION OF SMALLMOUTH BASS CAUGHT IN WACHUSETT RESERVOIR 2011-2012 (n=322)

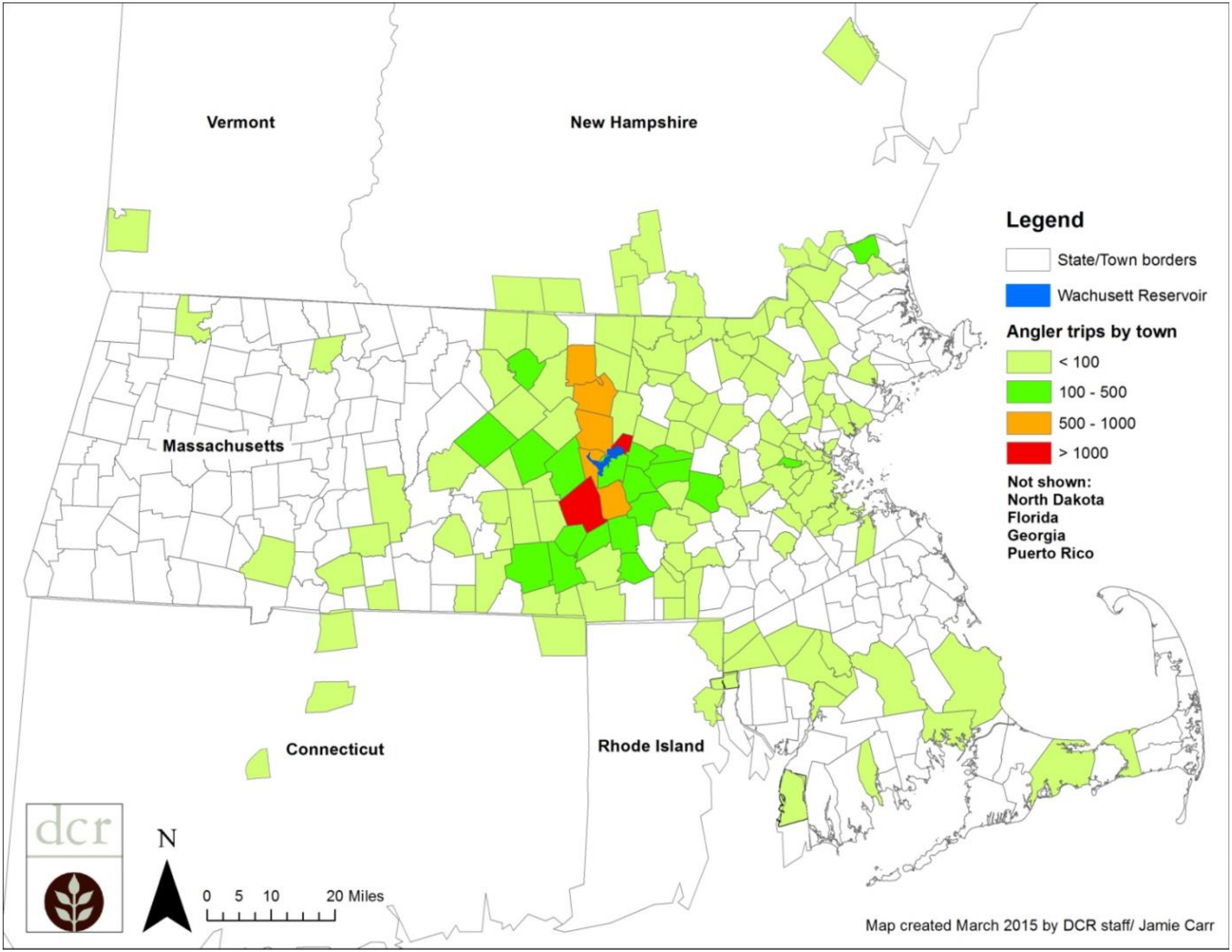


3.6 ANGLER ATTRIBUTES

Anglers were asked to provide their home zip code as part of the interview and there were 1,549 valid responses to the home zip code survey question across the two seasons (only a single zip code was often recorded by clerks when interviewing multiple anglers). 97.8% of anglers surveyed while fishing at the Wachusett Reservoir were Massachusetts residents. Angling trips originated from 126 different Massachusetts towns (Figure 6). Out of state angler trips were recorded from New Hampshire (10), Connecticut (9), Rhode Island (7), North Dakota (3), Florida (2), Vermont (1), Georgia (1) and Puerto Rico (1).

Zip code information is known for roughly 60% of the angler population surveyed, allowing for the town of origin to be assigned to 17,022 of the estimated 28,775 angler trips over the two fishing seasons. This information is presented visually in Figure 6. The most angler trips originated from Worcester, which accounted for 27% of all angling trips with an estimated 4,775 trips. Other towns with at least 500 estimated trips included Clinton (1,708), Leominster (843), Shrewsbury (775), West Boylston (652), Sterling (618) and Fitchburg (551). As the zip code is not known for close to 40% of anglers, these numbers underestimate the actual totals.

FIGURE 6. ESTIMATED NUMBER OF WACHUSETT RESERVOIR ANGLING TRIPS BY TOWN OF ORIGIN



During the course of the 2011 angling season, 70% (856) of anglers surveyed can be classified as "unique" anglers as they indicated they had not been surveyed before during that fishing season, while 30% had been surveyed previously. During the course of the 2012 angling season, 66% (884) of anglers surveyed were unique anglers, while 34% were repeat anglers that had been surveyed previously during the 2012 fishing season. It is estimated that 11,336 anglers utilized the Wachusett Reservoir as a recreational fishery during the 2011 fishing season (making a total of 16,194 trips), while 8,304 anglers visited during the 2012 season (making a total of 12,581 trips).

4.0 DISCUSSION

4.1 SURVEY RESULTS

The Wachusett Reservoir is used primarily by Massachusetts anglers. It is utilized most heavily by local anglers but many anglers travel a significant distance from within the state, as well as from other states to make use of the fishery. Despite the relatively low catch rates, anglers are drawn to the fishery for the chance to catch a trophy fish in an undeveloped setting. The reservoir is used primarily as a recreational fishery, as over 70% of the fish caught are released. Those fish that are harvested are typically consumed by the angler.

Anglers were very cooperative with the survey and many were genuinely interested in the creel survey and its results. Several of the 7 anglers who did not cooperate over the course of the survey (0.01%) were encountered while in a rush to use the bathroom. Compliance with angling laws and watershed regulations by anglers at the reservoir is high; 99% of anglers encountered in the course of the survey were in compliance with applicable regulations. The Wachusett Watershed Rangers patrol the reservoir frequently and have contacted and educated many anglers, which facilitated executing the creel survey and factors into the high compliance rate with regard to regulations.

Overall, the creel survey process and effort from creel clerks was extremely consistent from year to year. Overall angler effort and catch totals did vary from year to year, with angler effort and total catch totals lower in 2012 than 2011. Wachusett Reservoir is exclusively a shoreline fishery due to regulations; as a result angler catch rates and angler effort are likely susceptible to the influence of seasonal weather conditions and water temperatures from year to year. Of note is that weather conditions were different in the two years surveyed. In 2011, ice out was very near to the opening day of fishing in April after an extended freeze 3 months in duration, while in 2012 the reservoir did not freeze over and there was no ice. Consequently, the average water temperature for the month of April was 5.7˚C in 2011, far colder than the average of 8.5˚C in April of 2012 (MWRA 2015).

Seasonal variation in weather and water temperatures influences the availability of cold water species to shore anglers. If the most desirable species such as Lake Trout and Landlocked Salmon are less available to shore anglers, then both the catch rate and the angler effort could be negatively influenced; these are compounding factors that would lead to a lower total catch result. Presumably, anglers alter their behavior and fish more frequently and plan longer trips when they have experienced angling success themselves or have heard positive reports from other anglers. The adverse effect is also presumably true.

4.2 LINK BETWEEN FISH AND WATER QUALITY

It is well established that changes to the fish community can impact the biology and water chemistry of a reservoir system. Predatory fish are at the top of the reservoir food chain, and have top down effects that influence populations of smaller fish, zooplankton, and phytoplankton. Changes in the fish community, whether from angling, climate change, or other factors have the potential to impact water quality. Therefore, it is important to maintain a basic understanding of the fish community in the reservoir.

At this time, the overall annual harvest rate of fish by anglers appears fairly low, as harvest rates for the two seasons ranged between 0.5 and 0.8 fish per acre. This is the effect of the relatively low overall catch rate combined with the fact that most fish that anglers catch are released. The total harvest is also limited by the fact that anglers are only able to access the fishery from the shoreline and are also unable to fish a significant area around the intake. It is likely that these factors are directly related to the quality of the fishery and the presence of large game fish and state record catches. Although the overall impact of angling to the fish community of Wachusett Reservoir as a whole appears likely to be minimal, it is not known what impact anglers may have on the population of Lake Trout, the most frequently harvested fish.

There is very little data about the density, growth rates, or overall health of the Lake Trout population in the Wachusett Reservoir (DWSP and DFW initiated a Lake Trout tagging study at Wachusett in 2014). Lake Trout are a slow growing member of the char family that typically inhabits very cold, highly oxygenated water found within oligotrophic water bodies, and they occur at a low density relative to other species in terms of fish per acre. Lake Trout reach sexual maturity at a late age and have a lower reproductive potential compared to other fish. Studies have shown that many Lake Trout fisheries can only support very low harvest rates and that this species is very vulnerable to overexploitation by anglers (Burr 2006).

The harvest rate and estimated total yield of 0.43-0.53 pounds of Lake Trout per acre per year documented in this creel survey for 2011/2012 is surprisingly quite close to the level of 0.45 discussed as a potential cutoff in the literature for jeopardizing naturally reproducing populations (Johnson 2001). Depending upon a number of variables (available habitat, water body size, available forage, growth rates, age class structure), an appropriate yield for Wachusett Reservoir may be higher or lower. This merits further research.

Finally, there is also evidence that changes in water quality may impact fish. For example, increases in water temperature due to climatic changes are believed to negatively impact Lake Trout by reducing the volume of available cold water habitat (Plumb 2006). Compounding this problem is that increases in water temperature typically favor other species that can negatively impact Lake Trout, particularly Smallmouth Bass (Jackson 2007). This could mean that the fishery may not support the same harvest rate of Lake Trout in the future as it does at present or has in the past. In the case of the Wachusett Reservoir, the shoreline access and restricted no fishing zone in this unique fishery play a role in limiting angler exploitation of this species simply by limiting angler access to the fish. Further study is needed to learn more about the current state of the Lake Trout population and to monitor their trends in the future.

4.3 SURVEY LIMITATIONS

Bias is introduced in any attempt to survey recreational anglers. This creel survey was designed in an effort to limit obvious sources of bias. The size of the Wachusett Reservoir and network of access roads allows a survey agent to travel completely around it, view the fishable shoreline and interview anglers in less time than an average complete angling trip. This lends credibility to the progressive counts; however, time spent stopping to interview anglers means that the progressive counts are biased low and angling effort is likely underestimated. Given the personnel, logistics, and time constraints, the roving creel survey design with a progressive count was the only possible fit for the situation. Also, the survey was limited to the area of the reservoir that is open to fishing and does not include the no fishing area of the reservoir.

Anglers are able to target specific types of fish habitats, specific species, and even sizes of fish. Rainbow Smelt and Banded Killifish are important forage fish in the reservoir, but are not caught by rod and line and thus they are not represented in the creel survey. The results provided by a creel survey are not unbiased or random, and can be skewed by angler attitudes towards what is a desirable fish. Anglers targeting large Lake Trout and Smallmouth Bass expect a lower catch rate as a tradeoff for having a greater chance at a trophy catch. The catch rate results are influenced by angler attitudes and would likely be higher if more anglers focused more effort on catching readily available, albeit smaller, fish.

Anglers were asked to identify their "target species" and creel clerks were instructed to select one response. However, many anglers reported fishing for more than one species, and the same fishing methods often do result in the catches of different species of fish. As a result, the analysis for the angler effort directed by target species was not presented in this report. It can be generally stated that some combination of Lake Trout and/or Smallmouth Bass are the target species for more than 70% of anglers, and that no other species outside of these two accounts for more than 5% of the angler effort.

Reducing the minimum time required for an angler to have spent fishing in order to be surveyed from one hour to 30 minutes between seasons resulted in a slight increase in the percentage of anglers being interviewed. The percentage of anglers seen that were surveyed also rose slightly from 2011 to 2012 (48% to 55%).

5.0 COMPARISON TO HISTORICAL CREEL SURVEYS

The first attempt to estimate the number of anglers using the Wachusett Reservoir fishery was conducted in 1976. Although "manpower and funding limitations precluded a thorough investigation of fish population dynamics," an indirect approach was used where a mail survey questionnaire was sent to 105 Wachusett-Sudbury fishing permit holders (DFW 1976). Survey results generated an estimated population of 6,000 anglers, who would each make 13 trips per year. With an average trip length of 3 hours, the total angling hours were estimated to be 234,000. No estimates of catch rate or total catch from this mail survey were present in the files. Subsequent efforts 3 years later appear to provide more refined and much lower estimates of angling effort, therefore the 1976 mail survey results are not included in Table 6 below.

A more intensive creel survey effort began 3 years later in 1979 and was repeated in 1980. These surveys concentrated on interviews of anglers fishing at the reservoir throughout the fishing season and appear to utilize a similar approach to recent surveys (although documentation is limited). Summary tables with the expanded results of each creel survey are available in the fish and wildlife archives (DFW 1979 and 1980) and are presented in Table 6. Another creel survey conducted in 1998 documented a similar number of angling trips to the survey 18 years prior but indicated more angling hours of effort. Detailed methods are available for the survey design (DFW 1998), and an expanded summary table of estimated results is presented. However, there is no documentation for the number of anglers actually surveyed or the methods used to analyze the data, and the catch rate is unknown.

TABLE 6. HISTORIC ANGLER SURVEYS AT WACHUSETT RESERVOIR

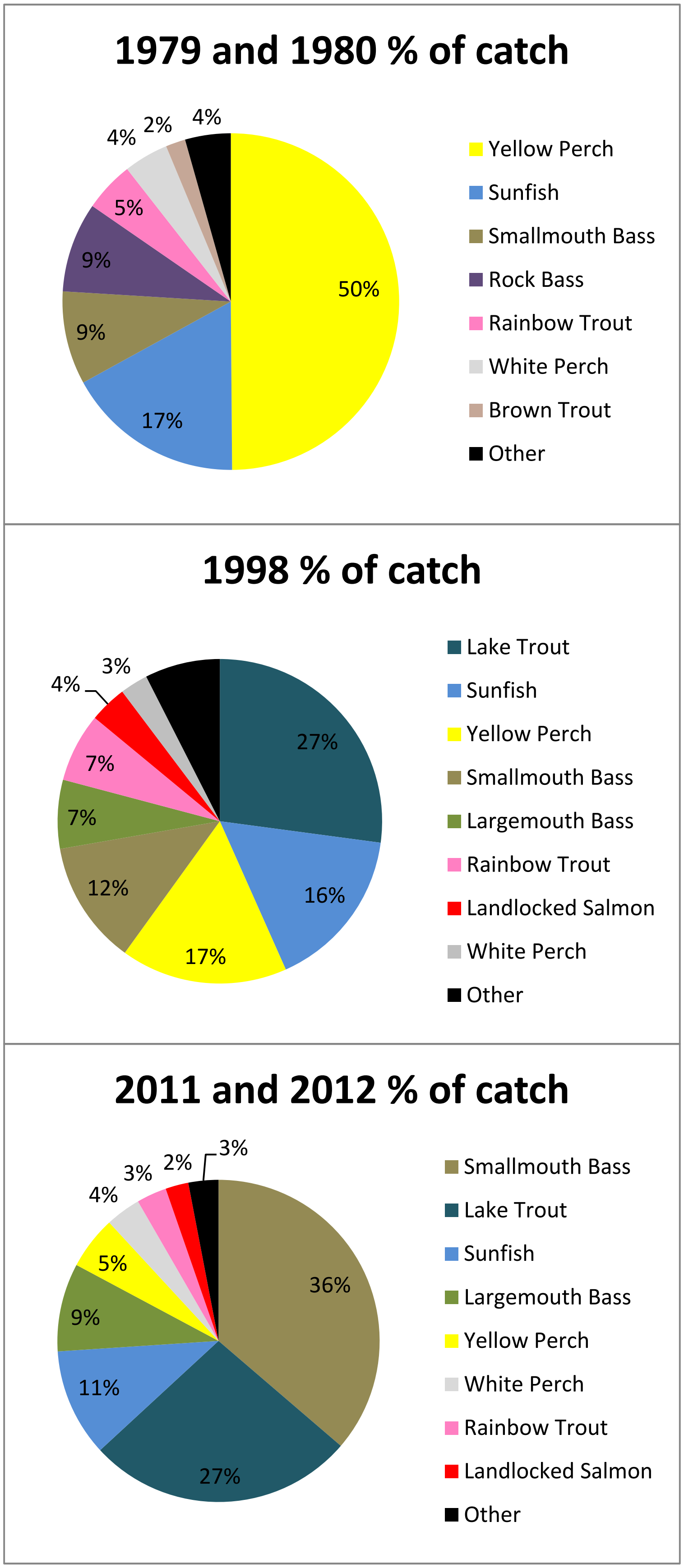
	Anglers Surveyed	Avg. Trip Length (hours)	Angling Trips	Angling Hours	Catch/Hour	Catch/Angler
1979 Creel Survey	1,761	2.1	22,029	53,989	0.41	1.00
1980 Creel Survey	1,974	2.3	26,770	63,534	0.56	1.33
1998 Creel Survey	?	?	26,907	83,144	?	?
2011 Creel Survey	1,227	3.1	16,194	45,407	0.24	0.76
2012 Creel Survey	1,334	3.5	12,581	40,266	0.20	0.60

As the result of limited documentation, it is difficult to directly compare the results of creel surveys conducted sporadically over the past 35 years. In general terms, it does appear that there may be fewer angling trips annually now than in the past, and anglers are fishing for a longer period of time when they do fish. Higher catch rates reported in the 1979/1980 creel surveys could be related to the types of fish that were most frequently caught (Yellow Perch and Sunfish) as opposed to the most recent creel surveys where larger game fish (Smallmouth Bass and Lake Trout) comprised the majority of the catch. It may be plausible that a change in the fish community composition could alter angling behavior by leading to lower catch rates and thus less frequent angling trips, but also longer trip lengths on average as more anglers may extend their trip until they catch a fish.

Raw data of the actual fish caught by anglers is available for each of the creel surveys. Thus, the proportion of each species caught is comparable across the different surveys and provides some interesting insights into changes in the fish species caught by anglers over the past 35 years. Yellow Perch accounted for 50% of the total catch in the 1979/1980 time period, but declined to 17% in 1998 and declined further to only 5% in 2011/2012 (Figure 7). The proportion of sunfish species and White Perch caught has remained relatively stable, while Largemouth Bass were rare in the earliest creel surveys but have increased incrementally in subsequent surveys. Smallmouth Bass accounted for only 9% of the total catch in 1979/1980, but increased to 12% in 1998 and accounted for 36% of the total catch in 2011/2012. These results indicate that changes to the reservoir fish community may have occurred over the past 35 years.

Finally, one of the goals of the 1979/1980 creel surveys was to determine how many Lake Trout anglers were catching at Wachusett Reservoir. Results show that less than 20 Lake Trout were caught by anglers surveyed in the entire two year period. Since that time, this species has become the primary cold water fish species targeted and caught by anglers. Again, creel surveys are not a random sample of the fish population, and fish caught by anglers are only the fish that are large enough to be caught. Anglers considering a species desirable and targeting those species increases the odds of catching them.

FIGURE 7. PERCENTAGE OF TOTAL CREEL CATCH BY SPECIES



6.0 RECOMMENDATIONS

Future creel surveys should utilize the angler effort data collected in this survey to more closely align survey effort and angling effort. Now that the dominant patterns of angler effort have been determined, more survey effort can be concentrated on the time periods that see the heaviest angling pressure (April, May, weekends) and less survey effort can be allocated to periods with the lowest angling effort and harvest (September, October, weekdays).

Repeating the creel survey in the future at regular intervals would be useful to observe changes over time in the proportion of each species of fish caught by anglers. Much of the limitation of comparing the current survey to past surveys is due to the large time gaps in between surveys. Conducting a creel survey at regular intervals, such as 5 years apart, would allow for a timeline of survey results to corroborate each other and more clearly elucidate trends in fish caught by anglers.

Further study is needed to learn more about the current population status, life history, and sustainable yield of Lake Trout in the Wachusett Reservoir. Additional creel surveys and research are needed to explore and establish an appropriate maximum sustainable yield for this naturally reproducing Lake Trout fishery. In the meantime, a conservative approach would seek to maintain a harvest rate that does not exceed 0.5 pounds of Lake Trout per acre per year as suggested in Maine's proposed management targets (Johnson 2001).

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Appendix A: Creel Survey Form (Front and Back)

Wachusett Reservoir 2012 Creel Survey Form

Time started fishing:_______ AM/PM Interview Time:________ AM/PM Fishing trip completed? Y /N

anglers in party:___ # lines in water:___ Primary Fishing Type: Baitfish/Bait /Lures /Flies/ Bait and Lures

Target species (choose one):_________________ Surveyed before in 2012? Y /N Home zip code? _________

Please list the fish species you have caught today, their length, and whether kept or released:

	Fish Species	Length (inches)	
1			Kept / Released
2			Kept / Released
3			Kept / Released
4			Kept / Released
5			Kept / Released
6			Kept / Released
7			Kept / Released
8			Kept / Released
9			Kept / Released
10			Kept / Released

If fish were kept, do you plan to eat the fish that you kept? Y /N

Prevent aquatic hitchhikers! Don't dump bait buckets!

Date: __________ Day of the week: MO TU WE TH FR SA SU Location: ______________________________

Survey #: 1901 Survey agent: ______________________

MA DCR and MA Fish and Wildlife are cooperating on a creel survey to learn more about the fish in the Wachusett Reservoir. Do you mind answering a few quick questions about your fishing today?

Game Fish likely to be found in the Wachusett Reservoir:

- Brown Trout (BT)
- Rainbow Trout (RT)
- Lake Trout (LT)
- Brook Trout (BkT)
- Landlocked Salmon (LLS)
- Largemouth Bass (LMB)
- Smallmouth Bass (SMB)
- Yellow Perch (YP)
- White Perch (WP)
- Chain Pickerel (CP)
- Rock Bass (RB)
- Black Crappie (Calico Bass) (BC)
- Brown Bullhead (BB)
- Yellow Bullhead (YB)
- Catfish/horned pout
- Pumpkinseed Sunfish (PS)
- Bluegill Sunfish (BG)
- Sunfish

	Fish Species (cont'd)	Length (inches)	
11			Kept / Released
12			Kept / Released
13			Kept / Released
14			Kept / Released
15			Kept / Released
16			Kept / Released
17			Kept / Released
18			Kept / Released
19			Kept / Released
20			Kept / Released
21			Kept / Released
22			Kept / Released
23			Kept / Released
24			Kept / Released
25			Kept / Released

Survey Notes: ____

____

____

Appendix B: Creel Survey Form Explanation of Fields

Wachusett Reservoir Creel Survey Form explanation of fields

Time started fishing:_______ AM/PM The time the angler or party started fishing.
Interview Time:________ AM/PM The time the creel survey interview is conducted. The interview time needs to be <u>at least 30 minutes</u> after the time started fishing for the survey to be valid. If the fishing time is less than 30 minutes, do not fill out the survey. You could come back to that fisherman at a later time. If you are coming back to an angler you surveyed earlier in the day who is still fishing, you can update the interview time, update any new fish caught since the last survey, and leave the rest of the survey the same.
Fishing trip completed? Y /N It is important to get completed fishing trips in order to get an estimate of the average length of time that trips last to make total fishing time estimates at the end of the year. You can survey anglers who are walking out, or arriving at their vehicles after a fishing trip. These surveys will be helpful to capture completed fishing trips.
 # anglers in party:___ This can allow multiple anglers to be included in one survey. However, if anglers started fishing at different times, or are using different fishing methods, a separate survey needs to be completed for that angler.
 # lines in water:___ This would be the total number of lines in the water for the angler or party the survey covers. It is legal for each angler to have up to two lines in the water at one time.
Primary Fishing Type: Baitfish/Bait /Lures /Flies/ Bait and Lures Baitfish includes live or dead fish. Bait includes worms, nightcrawlers, dough, corn, in general anything natural that can be put on a bare hook to catch fish. A lure is something artificial, usually made of wood, plastic, or metal. A rubber or plastic worm is considered a lure. Flies should represent people fly fishing with a fly rod and fly line using an artificial "fly", however if they are doing something odd and have a fly rod and are using bait then it should be counted as "bait". If they use two different types of fishing during one trip, ask for the one they spent the most time using. Bait and lures can be circled if their method of fishing is two methods at once- ie a shiner cast out to sit while casting with a lure on a second rod.
Target species (choose one):__________ This is the primary fish species that that person is trying to catch on that fishing trip. If they use two different types of fishing to target different species, ask for the one they spent the most time using. If there is confusion about what fish name the angler uses please use the freshwater fish of MA pamphlet to point to a picture or agree upon an accepted name for that species. Please try to be as specific, ie record "Largemouth bass" and not "bass."
Surveyed before in 2012? Y /N
Home zip code? _________
Prevent aquatic hitchhikers! Don't dump bait buckets! Just a reminder to the survey agent to remind or educate anglers about preventing the spread of aquatic invasive species.
Date: __________
Day of the week: MO TU WE TH FR SA SU
Location: _________________________________ Please describe the general location where the survey took place or the person has fished, as appropriate. Sample descriptions might include: "Greenhalge Point", "Rainbow Cove", "RR trestle in Oakdale Basin", "Old Stone Church", "near Gate 17 in South Basin", or " shore east of Gates Cove". <u>Anyone fishing the Lilly ponds is not considered to be fishing the reservoir and should not be surveyed.</u>
Survey #: 124 This will be a unique number for each survey automatically filled in for each survey when it is printed out.
Survey agent: ________________________ The person who is completing the creel survey.

Please list the fish species you have caught today , their length, and whether kept or released: The goal of this question/chart is to record information to represent each fish caught by the angler or anglers on the day of the survey and the approximate length in inches of each fish. “Caught” means they brought the fish in to shore and released it. If there is confusion about what fish name the angler uses please use the freshwater fish of MA pamphlet to point to a picture or agree upon an accepted name for that species. If the angler says “

I’ve caught 4 smallies that were 7-10 inches, I let them all go” Then write down smallmouth bass for lines 1-4, and tell him “Ok, I’m going to write down one 7 inch fish, one 8 inch, one 9 inch, and one 10 inch fish. Does that sound about right?” Also, if an angler gives length estimates for fish that are kept and are easily visible, use your own size estimate as opposed to the angler size estimate if there is a disparity. If the best you can get is something general like “catfish” then that is what will have to be recorded.

	Fish Species	**Length (inches)**	
1			Kept / Released
2			Kept / Released
3			Kept / Released
4			Kept / Released

If fish were kept, do you plan to eat the fish that you kept? Y /N

Survey Notes: This section is for any additional notes the creel survey agent may have that make that survey unique, or adds additional information that may be useful.

Other survey issues:

Language Barrier: If the survey is attempted but cannot be completed due to a language barrier, then note information such as the number of anglers and lines and complete as much of the survey as possible. Make a note in the survey notes section that some/all fields could not be completed due to a language barrier.

Appendix C: Creel Survey Agent Sheet

Wachusett Reservoir Creel Survey Agent Sheet

This form should be completed by each survey agent on the day that they are surveying anglers.

Survey agent:______________________ Date: __________ Day of the week: MO TU WE TH FR SA SU

Reservoir Loop started looking/surveying at: _______ AM/PM Finished: _______ AM/PM

Weather ______________________ Loop Direction: Clockwise/Counterclockwise/Two Ranger split

Were there any areas of the reservoir open to fishing that you did not cover? Y /N

If so, where? ____

How many anglers did you survey? ___________________

How many anglers did you see? ______________________ Loop: #

Reasons Anglers Not Surveyed	Count
I saw them fishing but they were not there when I reached their location	
I saw them fishing but I did not go to their location	
The angler would not cooperate with the survey	
They had been fishing for less than 1 hour	
Fishing Illegally/Violation of DCR rules	
There were too many anglers to survey every one	

Notes: ____

Appendix D: Length and Weight Ratios of Smallmouth Bass collected in Pennsylvania

Table 1. Average weight and average age of Smallmouth bass (March-June) Lorantis 2013

	Smallmouth bass	
Inches	*Pounds*	*Years*
4	0.1	0.1
4.5	0.1	0.3
5	0.1	0.5
5.5	0.1	0.7
6	0.1	0.9
6.5	0.1	1.2
7	0.2	1.4
7.5	0.2	1.7
8	0.2	1.9
8.5	0.3	2.2
9	0.3	2.4
9.5	0.4	2.7
10	0.5	3
10.5	0.5	3.3
11	0.6	3.6
11.5	0.7	3.9
12	0.8	4.2
12.5	0.9	4.5
13	1.1	4.9
13.5	1.2	5.3
14	1.3	5.6
14.5	1.5	6
15	1.7	6.4
15.5	1.8	6.8
16	2	7.3
16.5	2.2	7.7
17	2.4	8.2
17.5	2.7	8.8
18	2.9	9.3
18.5	3.2	9.9
19	3.5	10.5
19.5	3.8	11.2
20	4.1	11.9
20.5	4.4	12.7
21	4.7	13.5
21.5	5.1	14.4
22	5.5	15.5
22.5	5.9	16.6
23	6.3	> 16.6
23.5	6.7	> 16.6
24	7.2	> 16.6

Appendix E: Length and Weight Ratios of Lake Trout

Date	Species	Length (mm)	Weight (kg)	Length (in)	Weight (lbs)
11/5/2014	LT	500	1.00	19.7	2.2
11/12/2014	LT	498	0.69	19.6	1.5
11/10/2014	LT	495	1.07	19.5	2.4
11/12/2014	LT	488	0.99	19.2	2.2
11/5/2014	LT	487	1.10	19.2	2.4
10/21/2014	LT	473	0.88	18.6	1.9
10/29/2014	LT	464	0.98	18.3	2.2
11/5/2014	LT	450	0.94	17.7	2.1
11/5/2014	LT	450	0.74	17.7	1.6
10/29/2014	LT	430	0.70	16.9	1.5

Lake Trout <500mm total length collected by MA DWSP and MA DFW in fall of 2014