Public Service
of New Hampshire

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The Northeast Utilities System

June 11, 2009

By Overnight Mail

David Webster
Office of Ecosystem Protection
United States Environmental Protection Agency
One Congress Street, Suite 1100, Mail Code CMA
Boston, MA 02114-2023

Re: Public Service Company of New Hampshire
Merrimack Station
National Pollutant Discharge Elimination System Permit No. NH0001465

Dear Mr. Webster:

Public Service Company of New Hampshire ("PSNH") is providing the enclosed report, entitled *Biocharacteristics of Yellow Perch and White Sucker Populations in Hooksett Pool of the Merrimack River*, prepared by Normandeau Associates, Inc. dated June 2009, for inclusion in the administrative record for the National Pollutant Discharge Elimination System permit for PSNH's Merrimack Station in Bow, New Hampshire (the "Permit").

This report presents the results of supplemental Clean Water Act ("CWA") §316(a) studies that Normandeau performed during 2008 with respect to two abundant Representative Important Species ("RIS") fish populations, yellow perch and white sucker, found in the Merrimack River near the Station. Normandeau sampled these populations during the spring and fall seasons in 2008, collected biological characteristics information relevant to United States Environmental Protection Agency ("EPA")-identified population-level response metrics (including length, weight, age, fecundity and incidence of disease or parasitism) and evaluated whether there was evidence of prior appreciable harm to either RIS. In short, the study's results support a finding of no prior appreciable harm from Merrimack Station's thermal discharge to the yellow perch and white sucker populations found in the river near the Station.

Please note that PSNH shortly will provide two additional reports to EPA and the New Hampshire Department of Environmental Services for inclusion in the administrative record for the Permit. The first report will provide Enercon Services, Inc.'s engineering analysis of three additional alternative cooling water intake structure ("CWIS") technologies identified by EPA this past December as requiring further study: (1) seasonal deployment of narrow slot wedgewire screens in front of the existing CWISs, (2) seasonal deployment of an aquatic filter barrier in front of the existing CWISs, and (3) installation of fine mesh traveling screens to replace the existing coarse mesh traveling screens. As you will recall, EPA specifically directed PSNH to prepare and submit this additional engineering study at our December 4, 2008 meeting, as a supplement to the technology evaluation already provided to EPA in response to the July 31, 2007 CWA §308 letter. The second forthcoming report will present Normandeau's analysis of Merrimack River ambient pH between June 2002 and May 2007.

PSNH respectfully requests EPA to review and consider each of these new reports prior to issuing a draft NPDES permit for the Station, to ensure that the draft permit is based on accurate facts and appropriately reflects and responds to fisheries conditions in a manner consistent with applicable law.

This correspondence respectfully reserves PSNH's rights to challenge any aspect of the Permit that EPA ultimately issues for the Station. Nothing herein is intended to, or should be in any way construed, as waiving PSNH's rights with respect to any pending considerations. Please feel free to call me if you have any questions.

Very truly yours,

William H. Smagula

William H. Smagula, P.E.
Director - PSNH Generation

cc: Linda T. Landis, Esq.
Elise N. Zoli, Esq.

BIOCHARACTERISTICS OF YELLOW PERCH AND WHITE SUCKER POPULATIONS IN HOOKSETT POOL OF THE MERRIMACK RIVER

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Table of Contents

Page

List of Figures

List of Tables

1.0 INTRODUCTION

Public Service of New Hampshire ("PSNH") owns and operates two separate generating units, Unit 1 and Unit 2, known together as Merrimack Station, in Bow, New Hampshire. Merrimack Station is located on the west bank of the Merrimack River adjacent to Hooksett Pool, approximately 2.9 miles upstream from the Hooksett Dam and Hydroelectric Station and about 2.9 miles downstream from the Garvin's Falls Dam. The River in Hooksett Pool is fresh water. Merrimack Station withdraws and discharges once-through cooling water from the Merrimack River subject to and with the benefits of National Pollutant Discharge Elimination System ("NPDES") Permit No. NH001465 ("Permit"), which was last renewed by Region 1 of the United States Environmental Protection Agency ("USEPA") on 25 June 1992. Unit 1, which became operational in 1960, generates at a rated capacity of 120 MW, and withdraws once-through cooling water from the waters of the Merrimack River using a cooling water intake structure ("CWIS") located in a bulkhead at the shoreline of Hooksett Pool. Unit 2, which became operational in 1968, generates at a rated capacity of 350 MW, and withdraws once-through cooling water from the Merrimack River using a separate CWIS located in a bulkhead approximately 120 feet downstream from the Unit 1 CWIS.

The Station is seeking a renewal of its existing variance under Section 316(a) of the Clean Water Act ("CWA"), 33 U.S.C. §1326(a), as part of the renewal of its existing Permit. CWA §316(a) provides that a permit applicant may demonstrate that any effluent limitation proposed for the thermal component of any discharge is more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is made. Applicants with an existing thermal discharge may demonstrate that the existing discharge is protective of the BIP by evaluating the BIP over a series of years during which the discharge occurred, and showing an absence of appreciable harm (40 C.F.R. §125.73(c); USEPA 1977). This report and certain other reports prepared by Normandeau Associates, Inc. (Normandeau) and submitted to the Merrimack Station Advisory Committee (which was established pursuant to Part I.15 of the Permit and comprises representatives of the United States Environmental Protection Agency ("USEPA"), New Hampshire Department of Environmental Services ("NHDES"), the United States Fish and Wildlife Service ("USFWS") and New Hampshire Fish and Game ("NHFG")) collectively demonstrate that the Station's past and current operations have resulted in no appreciable harm to the balanced indigenous populations of fish and other aquatic organisms in the segment of the Merrimack River receiving the Station's thermal discharge ("BIP") (Normandeau 2006; Normandeau 2007a; Normandeau 2007b).

According to draft USEPA guidance, a §316(a) demonstration may demonstrate that fish communities have not suffered appreciable harm from: (1) direct or indirect mortality from cold shocks, (2) direct or indirect mortality from excess heat, (3) reduced reproductive success or growth as a result of plant thermal discharges, (4) exclusion from unacceptably large areas, or (5) blockage of migration (USEPA 1977). Merrimack Station has a 40-year record of thermal discharge without any documented fish kills due to winter shutdown and the associated cold water temperature shock. As a result, further investigation of direct or indirect mortality from cold shocks (#1 above) is not warranted. Direct or indirect mortality from excess heat (#2 above) and reduced reproductive success or reduced growth (#3 above) as a result of Merrimack Station's thermal discharge have been examined and found to be insignificant through a comparison of trends in an index of Representative Important Species ("RIS") fish population abundance (catch per unit effort, "CPUE") among habitats in the ambient (i.e., upstream of the Station thermal discharge) and thermally influenced areas within Hooksett Pool (Normandeau 2007a). Exclusion of fish (i.e., Merrimack Station RIS) from unacceptably large areas of habitat (#4 above) as a result of Merrimack Station's thermal discharge also has been examined and found to be insignificant (Normandeau 2007a). Finally, an assessment of spring Atlantic salmon smolt passage downstream past the Station's thermal plume during 2003 and 2005 has indicated that there is no blockage of migration (#5 above) as a result of the Station's thermal discharge (Normandeau 2006).

In addition, USEPA guidance identifies five response metrics that may be relevant to the assessment of appreciable harm to fish at the RIS level (#1 through #5 below) and four response metrics that may be relevant at the community level (#6 through #9 below) (USEPA 1977): (1) reproduction (spawning habitats and fecundity), (2) life stage habitat utilization, (3) condition factors, (4) disease and parasitism, (5) age and growth, (6) general abundance of RIS, (7) relative abundance (% composition) of each species present (RIS and others), (8) association of principal groups of fish (i.e., guilds), and (9) habitat utilization maps for the indigenous fish communities. The four community-level response metrics (#6 through #9) and the RIS-level response metrics of life stage habitat utilization (#2) and condition factors (#3) were examined and found to indicate "no prior appreciable harm" to the fish community of Hooksett Pool from the Station's thermal discharge over the four-decade period (1972 through 2005) examined (Normandeau2007a). This report presents the results of the field fisheries investigations performed by Normandeau during 2008 to address the population-level response metrics identified by USEPA (USEPA 1977) as items #1, #3, #4 and #5 above.

More specifically, the objective of Normandeau's 2008 field fisheries investigations presented in this report was to examine and compare biological characteristics of two abundant RIS fish populations, yellow perch and white sucker, found among four sampling zones in the Merrimack River near Merrimack Station: (1) the thermally influenced zone of Hooksett Pool, (2) the ambient zone of Hooksett Pool, (3) an upstream reference site (Garvin's Pool), and (4) a downstream site subjected to the thoroughly mixed heated effluent from Merrimack Station (upper Amoskeag Pool). Hooksett Pool is a 5.8 mile long section of the Merrimack River that is bounded at the upstream end by the Garvins Falls Dam and at the downstream end by the Hooksett Dam. Merrimack Station's thermal discharge enters Hooksett Pool at the mid-point about 2.9 miles upstream from Hooksett Dam. Therefore, the thermally influenced zone of Hooksett Pool is found in the lower 2.9 miles of Hooksett Pool, and the thermally ambient zone is found in the upper 2.9 miles of Hooksett Pool. Garvins Pool is located upstream of the Garvins Falls Dam, and Amoskeag Pool is located downstream from Hooksett Dam. The yellow perch and white sucker populations were sampled during two seasons in 2008 (spring and fall) and evaluated to determine if there was evidence of prior appreciable harm to either RIS by obtaining and interpreting biological characteristics information that addressed population-level response metrics #1, #3, #4 and #5 (USEPA 1977), including length, weight, age, gender, sexual condition, fecundity, and incidence of disease or parasitism.

2.0 METHODS

The 2008 Merrimack River yellow perch and white sucker population studies were conducted following policies and procedures set forth in the Quality Assurance Plan and Standard Operating Procedures for field procedures (Normandeau 2008a) and laboratory procedures (Normandeau 2008b). Methodologies described in those documents are summarized below in Section 2.0 of this report.

2.1 FIELD SAMPLING

2.1.1 Sampling Design

Four sampling zones of the Merrimack River were sampled weekly during spring (14 April through 2 May) and fall (1 September through 10 October) 2008: thermally influenced Hooksett Pool, ambient Hooksett Pool, Garvin's Pool, and Amoskeag Pool (Table 2-1). Within each sampling week and sampling zone, a target number of yellow perch and white sucker was set to determine the number of samples taken to the laboratory in fresh condition for biocharacteristics analysis. Yellow perch were classified into 6 unique length groups and a target number of 30 individuals was assigned to each class (Table 2-2). White sucker were classified into 10 unique length groups and a target number of 20 individuals was assigned to each class (Table 2-3).

Quotas for each species (yellow perch or white sucker) in each week and sampling zone were filled by tallying all fish caught in each complete sampling effort (i.e., each electrofish transect or trap net set), placing each sample of fish in a container labeled with the unique sample number, placing the sample container on ice, and delivering these samples to Normandeau's Bedford, NH Biological Laboratory at the end of each sampling day. Successive whole samples of yellow perch and white sucker were retained in their entirety until the week and sampling zone length group quota was reached. Yellow perch or white sucker caught in subsequent whole samples in length groups where the week and zone quota had been reached were processed in the field and released alive. There was no subsampling of fish within each sample to satisfy an individual length group quota.

Field sampling for the collection of biocharacteristics samples was primarily conducted using boat electrofishing (see Section 2.1.2 below for a brief description of methodology), trap nets (see Section 2.1.3 below for a brief description of methodology), and baited trot lines (see Section 2.1.4 below for a brief description of methodology). Within Hooksett Pool, two zones were sampled for yellow perch and white sucker, the thermally influenced and ambient zones. These two sampling zones were identified for each sampling day based on thermal criteria that were established in the field during sampling, as described below, to account for the possibility that the size of each zone could vary in relationship to changes in river flow and Merrimack Station generating activities. The following classification scheme was used to separate sampling effort in these two zones based on the observed Merrimack River water temperature at the time of collection. The upstream ambient water temperature (measured upstream from the discharge canal, at Monitoring Station N-10) was obtained by the field sampling crew from the operations staff at Merrimack Station at the start of each sampling day and compared to the upper 95% confidence limit water temperature derived from the historical (1984-2004) daily mean water temperatures measured at Station N-10 (Normandeau 2007b) to determine the upper bound of natural variation. Measured water temperatures in lower Hooksett Pool downstream from the discharge canal (Monitoring Station S-0) that were warmer than the upper bound for the upstream ambient water temperature were considered to be in the thermally influenced portion of Hooksett Pool. For example, if the upstream ambient (N-10) temperature as measured at the start of the sampling day was 44.2°F, then the minimum temperature boundary defining the thermally influenced zone for that sample date would be 46.8°F. Accordingly, for that particular date, all sampling effort within the thermally influenced zone of Hooksett Pool would have occurred in water of a temperature equal to or greater than 46.8°F as measured at the time of sampling. There were no thermal classification schemes for either Garvin's or Amoskeag Pools because these are distinct zones physically separated from Hooksett Pool by dams.

2.1.2 Boat Electrofishing

Boat electrofishing was conducted within the Garvin's, Hooksett, and Amoskeag Pools of the Merrimack River during 2008. Electrofish sampling was conducted using a Smith-Root SR-16H electrofisher boat equipped with a 5.0 kH Generator Powered Pulsator (GPP) electrofish unit and all electrofish sampling was conducted during daylight hours, defined as between one-half hour after sunrise and one-half hour before sunset. The electrofishing equipment was operated at 4-5 amps of pulsed DC (120 pps) current and sampled 1,000 ft transects followed the shoreline from downstream to upstream. Shocking runs were restricted to depths less than 6-8 ft since previous experience indicated that scapping efficiency at greater depths may be substantially reduced. For each individual transect sampled, all stunned fish were captured by dip net and retained in a live well for processing. Upon completion of each electrofish transect, yellow perch and white sucker were enumerated and, depending on the status of the weekly quota for the particular species and sampling zone, and were either labeled and placed on ice for transport to the laboratory or processed in the field and released back into the river. All additional fish taxa caught were processed in the field and released back into the Merrimack River. Field processing included identification to species, enumeration, measuring (to the nearest mm total length; "TL"), weighing (to the nearest gram, "g"), and assessing for external parasite load. Scale samples were also collected in the field from all Merrimack Station RIS and certain other fish species that were caught, including yellow perch, white sucker, black crappie, bluegill, fallfish, largemouth bass, pumpkinseed, and smallmouth bass. Sampling parameters were recorded on the field data sheets, including sampling time, date, location, latitude and longitude, physical-chemical data, investigators, etc.

2.1.3 Trap Nets

Trap nets fished within the four sampling zones of the Merrimack River were constructed with 3-ft diameter hoops, a single 60 ft lead, and two 30 ft wings. The netting used was either tarred ¾ inch stretch mesh or 2 inch stretch mesh knotted nylon made of #43 twine. Floats were spaced every three feet and were 2.5 inch discs floats. The lead lines were anchored with 1 inch weights spaced every two feet. The net lead was secured to the shore and then pulled outward into the river so that the lead was set across the flow and perpendicular to the shoreline. Wings were set with anchors and floats at an approximately 45 to 50 degree angle off of the main lead. The cod end of the trap net was anchored in place and was retrievable by a float. After each 24-hour set, trap nets were pulled and all fish were removed from the trap and placed in a tub of water in the boat. Upon pulling each trap net sample, yellow perch and white sucker were enumerated and, depending on the status of the weekly quota for the particular species and sampling zone, were either labeled and placed on ice for transport to the laboratory or processed in the field and released back into the river. All additional fish taxa caught were processed in the field and released back into the Merrimack River. Field processing included identification to species, enumeration, measuring (to the nearest mm TL), weighing (to the nearest g), and assessing for external parasite load. Scale samples were also collected in the field from all Merrimack Station RIS and certain other fish species that were caught, including yellow perch, white sucker, black crappie, bluegill, fallfish, largemouth bass, pumpkinseed, and smallmouth bass. Sampling parameters were also recorded on the field data sheets, including sampling time, date, location, latitude and longitude, physical-chemical data, investigators, etc.

2.1.4 Trot Lines

In an attempt to increase the sample size of yellow perch, trot lines were set to capture additional yellow perch for biocharacteristics assessment in the thermally influenced and ambient zones of Hooksett Pool and Amoskeag Pool. This gear consisted of a series of hooks (size 6) baited with small (1-2 inch) golden shiners or earthworms and set for a 24 hr period. Upon checking each trot line, yellow perch were enumerated and, depending on the status of the weekly quota and sampling zone, were either labeled and placed on ice for transport to the laboratory or processed in the field and released back into the river. All additional fish taxa caught were processed in the field and released back into the Merrimack River. Field processing included identification to species, enumeration, measuring (to the nearest mm TL), weighing (to the nearest g), and assessing for external parasite load. Scale samples were also collected in the field from all Merrimack Station RIS and certain other fish species that were caught, including yellow perch, white sucker, black crappie, bluegill, fallfish, largemouth bass, pumpkinseed, and smallmouth bass. Sampling parameters were also recorded on the field data sheets, including sampling time, date, location, latitude and longitude, physical-chemical data, investigators, etc.

2.1.5 Laboratory

Yellow perch and white sucker were collected during field sampling and transferred to the laboratory where they were autopsied to gather biological information including length, weight, age, gender, sexual condition, fecundity, and incidence of disease or parasitism. All individuals were processed in fresh condition, either immediately upon delivery from the field, or refrigerated and processed within 24 hours. Once in the laboratory, total length (mm), total weight (nearest 0.1 g), gender, reproductive condition, and presence of external and internal parasites were recorded and scales were removed for age analysis. Gender was determined through an examination of the reproductive structures within each individual specimen and was recorded as male, female or undetermined. Those individuals classified as undetermined were generally juvenile fish which had not yet undergone significant development of the reproductive system. Gonad weights (nearest 0.1 g, wet weight) were determined for each individual. Reproductive condition categories included ripe, ripe and running, partially spent, spent, immature, resting, and developing (see Table 2-4 for definitions). The degree of external parasites was categorized as none, light (1-5 parasites), moderate (6-20 parasites) or heavy (>20 parasites) for each individual. Internal parasites were categorized as either present or absent. Scale samples were collected and ages were obtained following standard techniques (Normandeau 2008c).

Fecundity was assessed by enumerating the number of eggs in the gonads of ripe or ripe and running female yellow perch and white sucker using a subsample-weight extrapolation. Ovaries from yellow perch and white sucker which were determined to be in ripe or approaching ripe condition were preserved in 10% formalin for a minimum of one month. Following preservation, the total gonad weight was obtained to the nearest 0.1 g (wet weight). The right ovary (fish viewed as swimming away upright from the observer) was then cut transversely midway along the longitudinal axis and a triangular section 1-2 mm think and consisting of 1/8 of the cross section of the ovary was removed.

This subsection was weighed to the nearest 0.01 g (wet weight) and each individual egg was separated from the ovarian tissue and enumerated.

2.1.6 Statistical Methodology

2.1.6.1 Use Code

Each field sample was assigned a code by the field crew leader at the time of collection designating its use for subsequent data analysis. Samples collected without any sampling problems related to the gear or deployment were considered valid for all analytical tasks and assigned a Use Code = 1. Samples in which fish were caught but sampling problems were encountered were assigned a Use Code = 2. Sampling problems were generally related to problems with gear deployment or variance from standardized sampling effort. Use Code = 5 samples were the same as Use Code = 2 samples where no fish were caught. Use Code 5 samples were excluded from all analysis.

In the laboratory, a use code (to be referred to as an "Age Code") was assigned to each scale sample collected from yellow perch and white suckers based on physical attributes and condition of each sample to designate its use in age-related data analysis. Age Code = 1 scale samples that were clean, symmetrical and were selected from the upper body of the fish, anterior to the lateral line. These scale samples were available for use in all data analysis. Age Code = 2 samples were those in which the individual scales were asymmetric. These samples were used only for determining age of an individual and would not have been useful for back calculation of growth due to the asymmetry. Age Code = 5 samples were ones where age could not be determined, either because all scales were regenerated, or there was evidence of scales from more than one fish in the sample indicating sample contamination had occurred in the field. Age Code 5 samples were excluded from all analysis.

2.1.6.2 Bray-Curtis Index of Community Similarity

The Bray-Curtis index of community similarity was used to quantitatively compare the fish communities within the four sampling zones, Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool and Amoskeag Pool within the 2008 sample year. Unlike taxa richness or rank abundance, the Bray-Curtis index (I_{BC}) computes percent similarity among the fish taxa common in two sets of survey data (Clarke 1993). This index negates the influence of uncommon fish species that may be present within some sampling zones within the comparison. Its power of predicting similarity is based upon species present within both of the data sets being compared. The closer the Bray-Curtis value is to 100%, the more similar the two communities are.

2.1.6.3 Condition

Length-weight relationships describe the mathematical relationship between length and weight of individual fish with the objective of being able to convert one to the other. The slope from the regression equation produced by this relationship reflects the condition or robustness of the fish species for which the equation was developed. The species-specific slope value from the length-weight relationship of catch from multiple years or locations can be compared and used to detect changes in the average condition of fish. Degraded habitat conditions that might be caused by a thermal discharge would result in a decreasing slope (less weight for a given length) for a given fish species over time, indicating a reduction in quality of body condition for that population of fish.

Length-weight relationships require a sufficient catch of different sizes of yellow perch and white sucker to be sure the slope of the equation is not biased by one or two exceedingly large or small individuals that are not representative of the population being sampled. Length-weight regression equations were generated using SAS PROC GLM for yellow perch and white sucker captured during

2008 in Garvin's Pool, the thermally influenced and ambient zones of Hooksett Pool, and Amoskeag Pool. These data were not subset and analyzed separately for different sampling gears because the relationship between length, weight and fish condition was considered independent of gears. Since the 2008 sampling took place during the spawning season, gonadal development was expected to vary significantly during the sampling period depending on whether the fish were caught in pre- or post-spawning condition. Therefore, total wet weight was expected to exhibit high variability within the sampling period in direct relationship to changes in sexual condition. The regression relationship between length and somatic weight (total wet weight – gonad wet weight) was considered to be the most stable measure of condition of individual in each sampling region and was used for the 2008 cross-zone comparisons. In addition, historic fisheries data collected in Hooksett Pool from the sample years 1995, 2004 and 2005 were used to generate length-weight regression equations to compare to the length-weight regressions generated for both white sucker and yellow perch captured during 2008. As somatic weights were not recorded during previous years, between-year comparisons for yellow perch and white sucker in Hooksett Pool were calculated using total wet weights. Historic data collected during 1995, 2004 and 2005 for both fish species was subset to include only catch from the months of April, May, September and October to provide a standardized set of length and weight data from yellow perch and white sucker representative of the same months sampled in 2008.

Analysis of covariance ("ANCOVA") was used to compare differences in the length-weight relationships and condition of yellow perch and white sucker among both the four 2008 sampling zones and within Hooksett Pool (i.e., the ambient and thermally influenced zones pooled) over the four years of data. The data were first examined using scatter diagrams of $\log_{10}$ weight vs. $\log_{10}$ length to insure an adequate sample and a representative range of sizes (points not clustered). Length-weight scatter plots were also used to visually identify outliers, and the original data values were examined to determine if they were valid or in error. Erroneous values of length or weight for individual fish were corrected, if possible. Outliers with no information indicating that they were in error were retained for analysis. Regression equations were developed to represent growth curves based on total wet-weight, and ANCOVA was used to compare these growth curves among the four years of available data.

2.1.6.4 Age Determination

All scale samples collected for yellow perch and white sucker during 2008 were assigned an age through interpretation of annuli (Jearld 1983, Schneider 2001). These age data were tabulated into age-length keys representing the age-length frequency relationship for yellow perch and white sucker caught in each of the four zones (Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool). Each age-length key was based on the individual length measurements taken in the field for all fish in each sampling zone caught in Use Code = 1 samples. Age-length data in each age-length key were based on data obtained from all Age Code = 1 or Age Code = 2 scale samples analyzed in the laboratory. Back-calculated length at age was not used to expand the sample size in the creation of age-length keys to avoid the confounding effects of Lee's Phenomenon or reverse Lee's Phenomenon (Ricker 1975; Gutreuter 1987; Smale and Taylor 1987). Age-length keys developed were derived from age-length frequency distributions for sampling gears on an individual basis.

Age-frequency distributions were constructed based on CPUE by age class for both yellow perch and white sucker. Prior to calculating any mean CPUE values, the data were "zero filled" for each age class, such that each age class collected in the study is represented in every sample. Therefore, "replication" in this study is at the sample level. All zero catch samples (no fish of any species collected) were also included in this matrix. Plotted values of CPUE versus age were scaled to represent 42 samples (maximum collected for any one zone) to provide a uniform scale for comparison of distributions.

2.1.6.5 Fecundity

Fecundity was assessed by enumerating the number of eggs in weight-based subsamples taken from the gonads of ripe or ripe and running yellow perch and white sucker caught during 2008, and then using a subsample-weight extrapolation. The following formula was used to estimate the number of eggs in the entire ovary of each selected fish:

Fecundity = Number of eggs x Gonad weight (g) / Subsample weight (g)

Regression analysis was used to characterize the relationship between female length and fecundity for both yellow perch and white sucker; a regression equation for each sampling zone with an appropriate sample size was developed. The effects of degraded habitat conditions would result in finding a significantly lower fecundity for a given length of females from the thermally influenced zone compared to the ambient zone. ANCOVA was used to compare the differences in the length-fecundity relationships among the four sampling zones.

2.1.6.6 Parasites

A frequency distribution describing the occurrence of external and internal parasites was calculated on a rank scale for both external (none, low, moderate, heavy load) and internal (present, absent) parasites observed on yellow perch and white suckers during 2008. Frequency distributions for each species and sampling zones were compared with a Chi-square test of multi-contingency tables. Thermally degraded habitat conditions were hypothesized to result in more frequent infestation of external and internal parasites, indicating a reduction in the overall health and condition of the fish.

Table 2-1. Sampling effort (number of Use Code = 1 or Use Code = 2 samples) within the Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool and Amoskeag Pool sampling zones sorted by gear and calendar week for 2008. (Note: A blank cell equals no effort.)

Sampling Zone	Sampling Week		Electrofishing		Trot Line		0.75 in Trap Net		2.0 in Trap Net	
	Beginning	Ending	Use Code = 1	Use Code = 2	Use Code = 1	Use Code = 2	Use Code = 1	Use Code = 2	Use Code = 1	Use Code = 2
Garvin's Pool	14-Apr-08	18-Apr-08	10							
	21-Apr-08	25-Apr-08					4		6	
	28-Apr-08	2-May-08	5	5						
	1-Sep-08	5-Sep-08	7	2			5	1		
Hooksett Pool (Thermally influenced)	14-Apr-08	18-Apr-08	11							
	21-Apr-08	25-Apr-08	12	2			8		2	
	28-Apr-08	2-May-08	6	3	6					
	1-Sep-08	5-Sep-08	5	2			8			
	29-Sep-08	3-Oct-08		5						
	6-Oct-08	10-Oct-08	6	1						
Hooksett Pool (Upstream Ambient)	14-Apr-08	18-Apr-08	12							
	21-Apr-08	25-Apr-08	26	3			8			
	28-Apr-08	2-May-08	6	7	6					
	1-Sep-08	5-Sep-08	6	1			8			
	29-Sep-08	3-Oct-08		3						
	6-Oct-08	10-Oct-08	5							
Amoskeag Pool	14-Apr-08	18-Apr-08	7							
	21-Apr-08	25-Apr-08	21	6			4		8	
	28-Apr-08	2-May-08	2	9	4					
	8-Sep-08	12-Sep-08	8	3						

Table 2-2. Biocharacteristics quotas for yellow perch in each week and zone.

LG	Length Group (mmtl)	Quota Number
1	<101	30
2	101-150	30
3	151-200	30
4	201-250	30
5	251-300	30
6	>300	30
Total		**180**

Table 2-3. Biocharacteristics quotas for white sucker in each week and zone.

LG	Length Group (mmtl)	Quota Number
1	<101	20
2	101-150	20
3	151-200	20
4	201-250	20
5	251-300	20
6	301-350	20
7	351-400	20
8	401-450	20
9	451-500	20
10	>500	20
Total		**200**

Table 2-4. Criteria for determining sex and state of maturity of yellow perch and white sucker.

State of Maturity	Females	Males
Gravid or milting (ripe)	Ovaries full of granular eggs that are partially translucent. Eggs can be released when ovary is compressed.	Testes white, less firm in texture, and if compressed will readily milt.
Ripe and running	Adult prepared to spawn immediately; expulsion of eggs with little provocation.	Adult prepared to spawn immediately; expulsion of milt with little provocation.
Partially spent	Ovaries somewhat flaccid and convoluted, with a variable number of eggs left. Ovarian membrane somewhat vascular.	Testes whitish, somewhat flaccid and convoluted, with free flow of milt.
Spent	Ovaries flaccid, few translucent eggs left. Ovarian membrane very vascular or sac-like.	Testes brownish white, flaccid, convoluted, with no flow of milt upon compression.
Immature	Ovaries very small and stringlike, thicker than testes, somewhat opaque and gelatinous in appearance.	Testes very small and stringlike, thinner than ovaries, somewhat translucent, and extremely tender.
Not gravid or not milting (Resting)	Underdeveloped ovaries in an adult female. Ovaries larger, more firm, opaque, and relatively thick. No eggs discernible to naked eye.	Underdeveloped testes in an adult male. Testes larger, more firm, opaque, but still tender.
Semi-gravid semi-milting (developing)	Subripe females heading into spawning season. Ovaries considerably larger, yellow, granular in consistency. Eggs discernible to naked eye, but not readily released when ovary is compressed.	Subripe males heading or into spawning season. Testes considerably larger, white, firm in texture, but milt not running.

3.0 GENERAL CATCH CHARACTERISTICS

3.1 SAMPLING EFFORT

A summary of sampling effort is provided in Table 2-1 of this report.

Electrofish sampling was conducted in the four sampling zones in the Merrimack River during the spring season between the dates of 16 April and 2 May 2008 and during the fall season between the dates of 2 September to 10 September and 2 October to 8 October 2008. Sampling was conducted in Garvin's Pool on three dates (22 Use Code = 1 and 7 Use Code =2 samples), thermally influenced Hooksett Pool on nine dates (40 Use Code = 1 or 13 Use Code =2 samples), ambient Hooksett Pool on ten dates (55 Use Code = 1 or 14 Use Code =2 samples), and Amoskeag Pool on seven dates (38 Use Code = 1 or 18 Use Code =2 samples).

Trap net sampling was conducted in the four sampling zones during the spring season between the dates of 16 April and 2 May 2008 and during the fall season between the dates of 2 September and 10 September 2008. Sampling was conducted in Garvin's Pool on seven dates (15 Use Code = 1 or 1 Use Code =2 samples), thermally influenced Hooksett Pool on seven dates (16 Use Code = 1 or Use Code =2 samples), ambient Hooksett Pool on nine dates (16 Use Code = 1 samples), and Amoskeag Pool on four dates (12 Use Code = 1 samples).

Trot lines were fished from 23 April to 2 May 2008. A total of six 24-hr samples were collected from thermally influenced Hooksett Pool, six 24-hr samples from ambient Hooksett Pool and four 24-hr samples from Amoskeag Pool. Fall sampling within Amoskeag Pool was limited due to very low water levels associated with headpond draw downs for ongoing construction work at the Amoskeag Hydroelectric facility in Manchester, New Hampshire. As a result of the low water levels, both boat ramp availability and a navigable water channel were diminished.

3.2 CATCH COMPOSITION

Twenty-five fish species were captured by electrofishing during the spring and fall sampling periods in Garvin's Pool, Hooksett Pool (thermally influenced and ambient zones), and Amoskeag Pool of the Merrimack River during 2008 (Table 3-1). Taxa richness of the electrofishing catch was uniform among the four sampling zones: fifteen species in Garvin's Pool, sixteen species in the thermally influenced zone of Hooksett Pool, seventeen species within the ambient zone of Hooksett Pool, and sixteen species within Amoskeag Pool. A total of 487 individual fish were collected from Garvin's Pool, 287 by electrofishing and 200 by trap net. Total catch from thermally influenced Hooksett Pool was 545 individual fish, the majority of which (497) were collected by electrofishing. A total of 454 individual fish were collected from ambient Hooksett Pool, 400 by electrofishing, 47 by trap net and an additional 8 individuals by trot line. Total catch from Amoskeag Pool was 149 individual fish, the majority of which (146) were collected by electrofishing.

Table 3-2 presents a comparison of the fish communities sampled within Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool and Amoskeag Pool during the spring and fall sampling effort of 2008. The thermally influenced Hooksett Pool and ambient Hooksett Pool show the greatest degree of community similarity among the four sampled zones (65.5%). That is, the fish communities sampled in the two zones within Hooksett Pool were most similar, with the degree of difference unrelated to proximity to the thermal discharge from Merrimack Station. Moreover, the fish community of Garvin's Pool is most similar to that of thermally influenced Hooksett Pool (40.6%) and least similar to that of Amoskeag Pool (31.7%). The greatest differences in fish community composition were among the three Pools, which may be related to differences in the amount and types of habitats in each Pool.

3.3 BIOCHARACTERISTICS SAMPLE DESIGNATIONS

Table 3-3 presents the temporal and spatial distribution for Use Code = 1 and Use Code =2 samples within each of the four sampling zones by sampling gear. In addition, the samples selected for analysis of each of the biocharacteristics are noted. Samples selected for analysis of biocharacteristics varied for each metric and were designated based on a combination of both sample method (i.e., electrofish, trap net and trot line) and Use Code (i.e. 1 or 2). Biocharacteristics samples analyzed for length, weight, condition factor, sex ratio, fecundity and parasitic load were based on data obtained from all sample gears (electrofish, trap net and trot line) and samples classified as either a Use Code = 1 or Use Code = 2. Biocharacteristics samples analyzed for age were based on data obtained only from electrofish samples classified as either a Use Code = 1 or Use Code = 2.

Table 3-1. Common name, scientific name and total catch by sampling gear of fish species collected during the 2008 Merrimack Station evaluation of yellow perch and white sucker.

		Garvin's Pool		Hooksett Pool (Thermally influenced)			Hooksett Pool (Ambient)			Amoskeag Pool	
Common Name	Scientific Name	Electrofish	Trapnet	Electrofish	Trapnet	Trotline	Electrofish	Trapnet	Trotline	Electrofish	Trotline
Alewife	*Alosa pseudoharengus*			16							
American eel	*Anguilla rostrata*			4			4				
American shad	*Alosa sapidissima*			4						12	
Atlantic salmon	*Salmo salar*						1				
Black crappie	*Pomoxis nigromaculatus*	2	12	4	1						
Bluegill	*Lepomis macrochirus*	7	27	39	8		9	9		3	
Brook trout	*Salvelinus fontinalis*						2				2
Brown bullhead	*Ameiurus nebulosus*	2	26								
Chain pickerel	*Esox niger*	20	17	11			7			3	
Common carp	*Cyprinus carpio*			1						7	
Common shiner	*Luxilus cornutus*	1								1	
Emerald shiner	*Notropis atherinoides*						1				
Fallfish	*Semotilus corporalis*	1		21		1	71		4	5	
Golden shiner	*Notemigonus crysoleucas*			9			3			16	1
Largemouth bass	*Micropterus salmoides*	18	13	164	6		48	1	1	5	
Margined madtom	*Noturus insignis*	1									
Pumpkinseed	*Lepomis gibbosus*	17	30	4			4			3	
Rainbow trout	*Oncorhynchus mykiss*									1	
Redbreast sunfish	*Lepomis auritus*	15	1	12			8	6		7	
Rock bass	*Ambloplites rupestris*	5	2		8		1	2		4	
Smallmouth bass	*Micropterus dolomieu*	14	6	45	23		27	28		48	
Spottail shiner	*Notropis hudsonius*	6		44			38			2	
Tessellated darter	*Etheostoma olmstedi*						2				
White sucker	*Catostomus commersonii*	26	2	73			147	1		20	
Yellow perch	*Perca flavescens*	152	64	46		1	26		3	9	
Total		**287**	**200**	**497**	**46**	**2**	**399**	**47**	**8**	**146**	**3**

Table 3-2. Sampling zone (Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool) comparison of the Bray-Curtis Percent Similarity Index for the fish community sampled by all gear types during the spring and fall periods of 2008.

	Bray-Curtis Percent Similarity (%)			
Fish Communities Compared	Garvin's Pool	Hooksett Pool (Thermally influenced)	Hooksett Pool (Ambient)	Amoskeag
Garvin's Pool				
Hooksett Pool (Thermally influenced)	40.6			
Hooksett Pool (Ambient)	34.2	65.5		
Amoskeag	31.7	51	48.9	

Table 3-3. Number of Use Code = 1 and Use Code =2 samples used for analysis of biocharacteristics parameters for yellow perch and white sucke
Pool, ambient Hooksett Pool, and Amoskeag Pool of the Merrimack River by sampling week and sampling gear during 2008.

Biocharacteristic	Sampling Week		Electrofishing								Trot line						
			Garvin's		Thermal		Ambient		Amoskeag		Garvin's		Thermal		Ambient		Amosk
	Beginning	Ending	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1
All Samples Available	14-Apr-08	18-Apr-08	**10**		**11**		**12**		**7**								
	21-Apr-08	25-Apr-08			**12**	**2**	**26**	**3**	**21**	**6**							
	28-Apr-08	2-May-08	**5**	**5**	**6**	**3**	**6**	**7**	**2**	**9**			**6**		**6**		**4**
	1-Sep-08	5-Sep-08	**7**	**2**	**5**	**2**	**6**	**1**									
	8-Sep-08	12-Sep-08							**8**	**3**							
	29-Sep-08	3-Oct-08				**5**		**3**									
	6-Oct-08	10-Oct-08			**6**	**1**	**5**										
Length (mmTL)	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9			6		6		4
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										
Weight (g)	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9			6		6		4
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										
Length-weight (Condition)	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9			6		6		4
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										
Age-Length	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9							
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										
Sex Ratio	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9			6		6		4
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										

used for analysis of biocharacteristics parameters for yellow perch and white sucker caught within Garvin's Pool, thermally influenced Hooksett
f the Merrimack River by sampling week and sampling gear during 2008.

lectrofishing					Trot line								Trap net							
	Ambient		Amoskeag		Garvin's		Thermal		Ambient		Amoskeag		Garvin's		Thermal		Ambient		Amoskeag	
.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2
	12		7																	
2	26	3	21	6																
3	6	7	2	9			6		6		4		10		10		8		12	
2	6	1																		
			8	3									5	1	8		8			
5		3																		
	5																			
	12		7																	
:	26	3	21	6																
	6	7	2	9			6		6		4		10		10		8		12	
	6	1																		
			8	3									5	1	8		8			
		3																		
	5																			
	12		7																	
	26	3	21	6																
	6	7	2	9			6		6		4		10		10		8		12	
	6	1																		
			8	3									5	1	8		8			
		3																		
	5																			
	12		7																	
	26	3	21	6																
	6	7	2	9			6		6		4		10		10		8		12	
	6	1																		
			8	3									5	1	8		8			
		3																		
	5																			
	12		7																	
	26	3	21	6																
	6	7	2	9																
	6	1																		
			8	3																
		3																		
	5																			
	12		7																	
	26	3	21	6																
	6	7	[illegible]	[illegible]									10		10		[illegible]		[illegible]	

Table 3-3. (Continued)

Biocharacteristic	Sampling Week		Electrofishing								Trot line						
			Garvin's		Thermal		Ambient		Amoskeag		Garvin's		Thermal		Ambient		A
	Beginning	Ending	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C
Fecundity	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9			6		6		4
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										
Parasitism	14-Apr-08	18-Apr-08	10		11		12		7								
	21-Apr-08	25-Apr-08			12	2	26	3	21	6							
	28-Apr-08	2-May-08	5	5	6	3	6	7	2	9			6		6		4
	1-Sep-08	5-Sep-08	7	2	5	2	6	1									
	8-Sep-08	12-Sep-08							8	3							
	29-Sep-08	3-Oct-08				5		3									
	6-Oct-08	10-Oct-08			6	1	5										

t line				Trap net							
Ambient		Amoskeag		Garvin's		Thermal		Ambient		Amoskeag	
U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2	U.C. 1	U.C. 2
				10		10		8		12	
6		4									
				5	1	8		8			
				10		10		8		12	
6		4									
				5	1	8		8			

4.0 YELLOW PERCH RESULTS AND DISCUSSION

4.1 LENGTH

Yellow perch collected from field sampling during spring and fall 2008 (combined) were taken to the laboratory for analysis of biocharacteristics parameters (see Section 2.1.5 of this report), allowing comparison of these parameters when adequate samples (number of fish) were obtained among sampling zones. Table 4-1 presents the total catch, minimum TL, maximum TL, and mean TL (mm) for yellow perch captured within each of the four sampling zones (Garvin's Pool, the ambient zone of Hooksett Pool, the thermally influenced zone of Hooksett Pool and Amoskeag Pool). Detailed catch information for each yellow perch collected from each of the four sampling zones is provided in Appendix A of this report.

When pooled among gear types used for sampling during 2008, total length for yellow perch ranged from 64 to 338 mm TL in Garvin's Pool, 66 to 323 mm TL in ambient Hooksett Pool, 67 to 278 mm TL in thermally influenced Hooksett Pool,and 46 to 118 mm TL in Amoskeag Pool. Mean total lengths ranged from a high of 203 mm TL in the thermally influenced zone of Hooksett Pool to a low of 72 mm TL in the Amoskeag Pool.

?

4.2 WEIGHT

The minimum, maximum, and mean total weight (g) and the minimum, maximum, and mean somatic weight (g) for yellow perch captured within each of the four sampling zones (Garvin's Pool, the ambient zone of Hooksett Pool, the thermally influenced zone of Hooksett Pool and Amoskeag Pool) are presented in Table 4-1.

?

When pooled among gear types used for sampling during 2008, total weight for yellow perch ranged from 1 to 436 g in Garvin's Pool, 1 to 332 g in ambient Hooksett Pool, 2 to 265 g in thermally influenced Hooksett Pool and 1 to 16 g in Amoskeag Pool. Mean total weight ranged from a high of 115 g in Garvin's Pool to a low of 5 g in Amoskeag Pool. When pooled among gear types used for sampling during 2008, somatic weight for yellow perch ranged from 5 to 415 g in Garvin's Pool, 11 to 323 g in ambient Hooksett Pool, 16 to 256 g in thermally influenced Hooksett Pool and 4 to 16 g in Amoskeag Pool. Mean somatic weight ranged from a high of 115 g in Garvin's Pool to a low of 9 g in Amoskeag Pool.

4.3 LENGTH VS WEIGHT (CONDITION)

The total length-somatic weight relationships for yellow perch collected among the four sampling zones during 2008 are presented numerically in Table 4-2 and graphically in Figure 4-1. There were no significant differences (ANCOVA; $p > 0.05$) in the slope or intercept parameters for the total length-somatic weight regressions for yellow perch (Figure 4-3; Table 4-14) when examined by sampling zone.

Length-weight regressions derived from historic fisheries data collected for yellow perch in Hooksett Pool from the sample years 1995, 2004 and 2005, along with data collected during the current sampling year (2008), are presented numerically in Table 4-3 and graphically in Figure 4-2. To present comparable data, these regressions are based on total length and total wet weight for yellow perch taken from samples representing the entire Hooksett Pool (ambient and thermally-influenced zones combined), pooled for fish collected during the months of April, May, September, and October. The magnitude of the slope in the regression equation reflects the condition or robustness of the fish; a higher slope indicates a greater weight relative to a constant increase in length. Since juveniles usually have a lower length-weight slope than older individuals, variation in the length-weight slope may also result from changes in the age composition of the samples. For yellow perch, there were no significant differences (ANCOVA; $p > 0.05$) for the slope and y-intercept parameters for fish collected during the months of April, May, September, and October during the years 1995, 2004, 2005 and 2008 (Figure 3-5; Table 3-15). The lack of significant differences in slopes and y-intercepts indicate that yellow perch sampled during each of the four years were equally robust (weight at a given length).

Assessment of the condition of yellow perch through comparison of the length-somatic weight relationships indicated there were no significant differences for individuals captured during 2008 within Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool and Amoskeag Pool. Degraded habitat conditions that might be caused by a thermal discharge would have resulted in a decreasing slope (less somatic weight for a given length) for the species over time, indicating a reduction in quality of body condition for the yellow perch population in the vicinity of Merrimack Station. As a result, the analysis of the length-weight condition relationships supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the yellow perch population of thermally influenced Hooksett Pool. In addition, comparisons of the length-weight relationships for historic (1995, 2004, and 2005) Hooksett Pool (thermally influenced and ambient zones pooled) sampling versus 2008 suggested the length-weight relation has remained constant. The lack of significant change in condition through time also supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the yellow perch population of Hooksett Pool.

4.4 AGE-LENGTH

Age was determined for scale samples obtained from all yellow perch caught by boat electrofishing, ¾ inch trap net, 2 inch trap net, and trot line during spring and fall 2008. However, age-length keys were constructed for yellow perch captured only by boat electrofishing for each sampling zone during 2008 to avoid problems associated with gear selectivity. By using age-length data from the single sampling gear providing the largest catch, and the gear considered to be the least size-selective sampling method (Hubert 1996, Reynolds 1996), the age-length keys developed for comparison among the four zones would not be confounded by different combinations of gear and effort among the zones (Table 2-1).

Figure 4-3 presents the standardized (42 samples) age frequency distributions developed from the electrofishing catch of yellow perch in Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool and Amoskeag Pool during spring and fall 2008. Age distribution of yellow perch sampled by electrofishing ranged from Age 0 to Age 11 in Garvin's Pool, Age 0 to Age 4 in ambient Hooksett Pool, Age 0 to Age 9 in thermally influenced Hooksett Pool and Age 1 to Age 2 in Amoskeag Pool. Age distribution of yellow perch in Garvin's Pool appeared to have a bimodal distribution with peaks in catch of fish classified as Age 3 and Age 7. Yellow perch captured during fall sampling were predominantly younger than those captured during the spring sampling, most likely a result of effort to collect spawning age fish for fecundity samples during the appropriate time of the year (spring). Likewise, yellow perch within thermally influenced Hooksett Pool displayed peaks in catch of fish classified as Age 1 through Age 3 as well as Age 7 along with a similar pattern of a greater number of younger fish captured during fall sampling and a greater number of older yellow perch captured during the spring sampling. Yellow perch collected from both ambient Hooksett Pool and Amoskeag Pool were predominantly Age 1 individuals. The majority of yellow perch captured in ambient Hooksett Pool were collected during the fall sampling while all yellow perch collected in Amoskeag Pool were captured during the spring sampling.

Mean length at age was determined for yellow perch collected by electrofishing from each sampling zone during 2008; Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool and Amoskeag Pool. Table 4-4 presents the mean length at age for yellow perch in each Merrimack River sampling zone. Sufficient age and length data were available to compare the estimated length at age for yellow perch among all four sampling zones for only the 2007 cohort (Age 1) caught during 2008. Mean length at age for Age 1 yellow perch was 108 mm TL in Garvin's Pool, 99 mm TL in ambient Hooksett Pool, 116 mm TL in thermally influenced Hooksett Pool and 69 mm TL in Amoskeag Pool. Length at age did not differ, as indicated by overlapping 95% confidence limits, for Age 1 yellow perch found in Garvin's Pool and in thermally influenced Hooksett Pool or ambient Hooksett Pool. Age 1 yellow perch in Amoskeag Pool were smaller than Age 1 individuals from either Garvin's Pool or Hooksett Pool, as indicated by non-overlapping 95% confidence limits.

Sufficient age and length data were available to compare the mean length at age for each of three cohorts of yellow perch caught during 2008 (the 2004 Age 4 cohort, the 2005 Age 3 cohort, and the 2006 Age 2 cohort) among the following three zones: Garvin's Pool, the ambient Hooksett and thermally influenced Hooksett sampling zones. Although there were no significant differences as indicated by overlapping 95% confidence limits for the 2004 or 2005 cohorts among these three zones, mean length at age for yellow perch from the 2006 cohort was greater in thermally influenced Hooksett Pool than either Garvin's or ambient Hooksett Pool.

Sufficient age and length data were available to compare the mean length at age for each of three older cohorts of yellow perch caught during 2008 (the 2001 Age 7 cohort, the 2002 Age 6 cohort, and the 2003 Age 5 cohort) among the following two zones: Garvin's Pool and the thermally influenced Hooksett sampling zones. There were no significant differences as indicated by overlapping 95% confidence limits for the 2001 or 2003 cohorts, but mean length at age for yellow perch from the 2002 cohort was greater in thermally influenced Hooksett Pool than Garvin's Pool.

There were no significant differences in mean length at age as indicated by overlapping 95% confidence intervals for yellow perch from the 2008 cohort (young-of-year) captured from thermally influenced Hooksett Pool or ambient Hooksett Pool.

Statistical analysis of mean length at age for eight different cohorts of yellow perch caught during 2008 in the vicinity of Merrimack Station supports a finding of "no prior appreciable harm" from the Station's thermal discharge. It was hypothesized that degraded habitat conditions that might be caused by continued exposure to Merrimack Station's thermal discharge would result in lower mean length at age for a population of fish due to a reduction in growth rates associated with thermal stress (USEPA 1977). No incidences of smaller length yellow perch at age were observed within the thermally influenced zone of Hooksett Pool among eight different cohorts of yellow perch compared to one or more of the ambient zones.

4.5 SEX RATIO

Table 4-5 presents the sex ratio (M:F) for yellow perch collected for biocharacteristics assessment from each of the four sampling zones during 2008. These ratios ranged from a high of 2.8 males per female within Garvin's Pool to a low of 0.8 males to female in ambient Hooksett Pool for yellow perch. The percentage of male yellow perch captured, assuming that catch of undetermined sex was in the same proportion, was 71.3% in Garvin's Pool, 17.2% in the ambient zone of Hooksett Pool, 34.0% in the thermally influenced zone of Hooksett Pool and 22.2% in Amoskeag Pool. Yellow perch collection for assessment of fecundity took place during late April of 2009 in an effort to target spawning condition individuals. Sampling during this early-spring period focused on finding preferred spawning habitat for yellow perch such as sheltered coves and backwaters with flooded terrestrial vegetation or beds of submerged aquatic vegetation. Field crews operating within Garvin's Pool were able to take advantage of more abundant backwater habitat with large areas of flooded terrestrial vegetation and reduced water velocities for effective sampling of yellow perch. Spawning aggregations, described for this species to consist of 15 to 25 males following a single female (Scarola 1987), were present within these backwater areas and may explain the greater percentage of male yellow perch captured within Garvin's Pool.

4.6 FECUNDITY

Ripe or ripe and running ovaries were collected from a small sample size of just six yellow perch during spring 2008 sampling. Five ripe yellow perch were collected from Garvin's Pool and one was collected from the ambient zone of Hooksett Pool (Table 4-6). There were no ripe or ripe and running female yellow perch collected from either the thermally influenced zone of Hooksett Pool or Amoskeag Pool during the spring of 2008. The mean total length for ripe female yellow perch collected from Garvin's Pool was 263 mm (range = 245 to 303 mm) and the mean fecundity was 14,217 eggs (range = 4,192 to 22,056 eggs) per female. The total length of the single female yellow perch collected within ambient Hooksett Pool was 230 mm and had a fecundity value of 28,405 eggs.

The length-fecundity relationship for yellow perch within Garvin's Pool is presented in Table 4-7. Length-fecundity relationships were not developed for yellow perch from either sampling zone within Hooksett Pool or Amoskeag Pool due to a lack of an adequate number of samples (Table 4-7).

Degraded habitat conditions that might be caused by a thermal discharge would result in lower fecundity at a given length for a population of fish. Although regression parameters for the total length- fecundity relationship could not be calculated for ambient Hooksett Pool, thermally influenced Hooksett Pool or Amoskeag Pool, a regression equation was developed for yellow perch in Garvin's Pool. With future collection of spawning condition yellow perch from Hooksett and Amoskeag Pools, analysis of regression parameters allows for the determination of "no prior appreciable harm" from the Station's thermal discharge to the yellow perch populations of Hooksett and Amoskeag Pools.

4.7 PARASITES

4.7.1 Internal Parasites

Figure 4-4 presents the presence and absence frequency of occurrence of internal parasites observed in yellow perch captured during the spring and fall 2008. There were no yellow perch determined to have internal parasites present in samples collected from ambient Hooksett Pool, thermally influenced

Hooksett Pool or Amoskeag Pool. A total of 16.7% of yellow perch from Garvin's Pool did have internal parasites present. Frequency distributions for Garvin's Pool differed significantly from those observed at all other sampling locations for yellow perch ($p = <0.0001$) when assessed using Chi-square multi-contingency tables. Internal parasites were detected within a greater proportion of yellow perch sampled from Garvin's Pool than either thermally influenced or ambient Hooksett Pool or Amoskeag Pool.

4.7.2 External Parasites

Figure 4-5 presents the frequency of occurrence of external parasites observed in yellow perch captured during the spring and fall 2008 assessed on a rank scale from absent to heavy. The largest proportion of yellow perch were classified as having a light external parasitic load (1-5 visible parasites) within Garvin's Pool (49.1%), ambient Hooksett Pool (62.1%) and thermally influenced Hooksett Pool (51.1%). Within Amoskeag Pool, the majority of yellow perch (77.8%) were categorized as having no external parasitic load. The frequency distributions for each of the four sampling areas were compared using a Chi-square multi-contingency table to test for differences in the distributions. The distribution of external parasite load for yellow perch within Amoskeag Pool differed significantly from that in Garvin's Pool ($p = <0.0001$), ambient Hooksett Pool ($p = <0.0001$) and thermally influenced Hooksett Pool ($p = <0.0001$). Visual examination of the distributions in Figure 4-5 suggests that a greater proportion of yellow perch in Amoskeag were absent of external parasites than other sampling locations. External parasite load for yellow perch within Garvin's Pool, ambient Hooksett Pool and thermally influenced Hooksett Pool showed no significant difference in the occurrence of external parasites ($p > 0.05$).

4.7.3 Discussion of Parasitism

Statistical analysis of the occurrence of internal and external parasites in yellow perch caught within each of the four Merrimack River sampling zones during spring and fall 2008 supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the yellow perch population of Hooksett Pool. Thermally degraded habitat conditions are hypothesized to result in more frequent infestation of internal and external parasites, indicating a reduction in the overall health and conditions of the fish (USEPA 1977 draft). Internal parasitic loads were significantly greater for yellow perch found within Garvin's Pool than those observed in either Hooksett or Amoskeag Pools. While there were no significant differences in frequency distribution for incidence of external parasites in yellow perch between yellow perch collected from the ambient and thermally influenced zones of Hooksett Pool, the external parasite loads were significantly higher in Garvin's Pool compared to the thermally influenced zone of Hooksett Pool. Anecdotal observations of yellow perch collected among the four sampling zones and assessed in the laboratory during the spring and fall of 2008 noted that the dominant external parasite was black spot. The black spots are caused by pigment that the fish deposits around the larval stage of a parasitic digenetic trematode, usually a *Neascus* spp. In general, the presence of the black spot parasite does not affect the growth or the longevity of the infected fish; however, massive infections in young fish may cause fish mortality (Hoffman 1967).

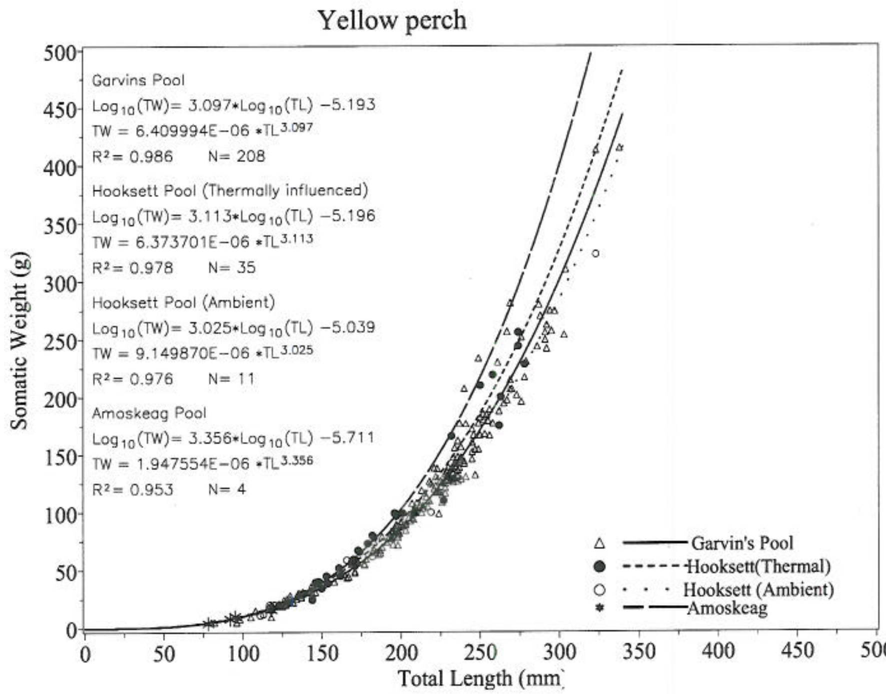

Figure 4-1. Length-somatic weight relationship for yellow perch captured from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during the spring and fall 2008.

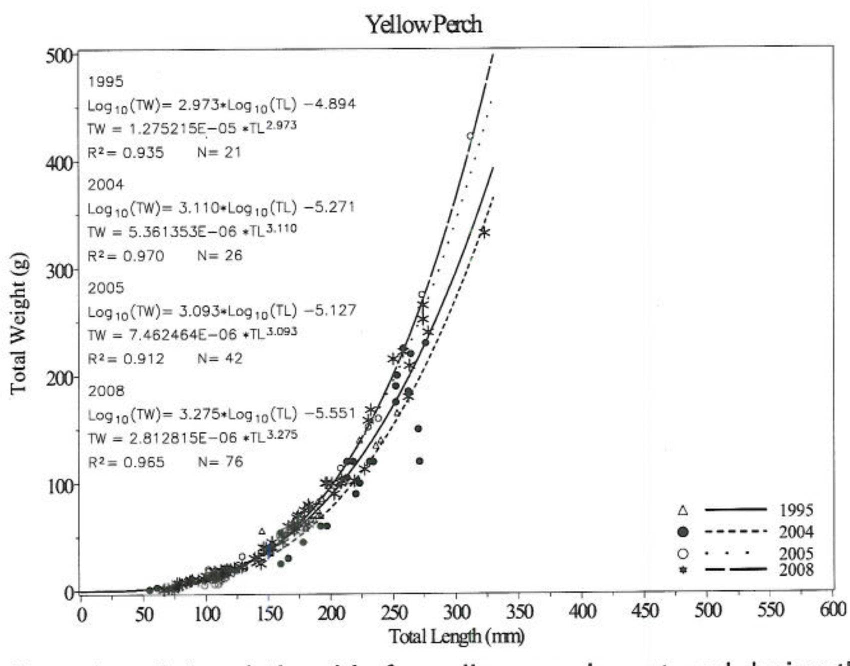

Figure 4-2. Length-weight relationship for yellow perch captured during the months of April, May, September and October of 1995, 2004, 2005, and 2008 from Hooksett Pool (ambient and thermally-influenced zones combined).

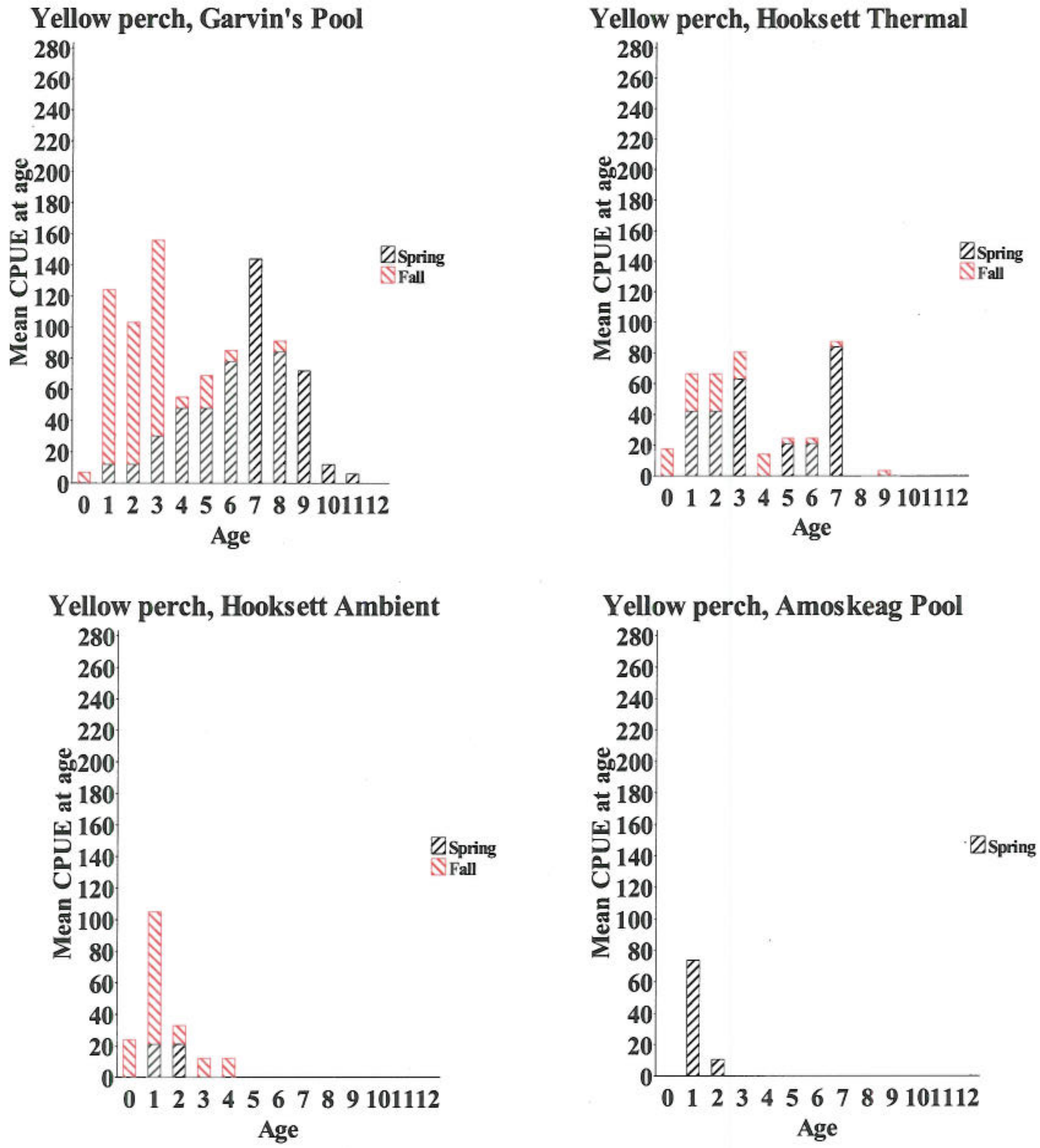

Figure 4-3. Age structure for the total catch of yellow perch captured by electrofishing from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008 based on the mean CPUE per age class.

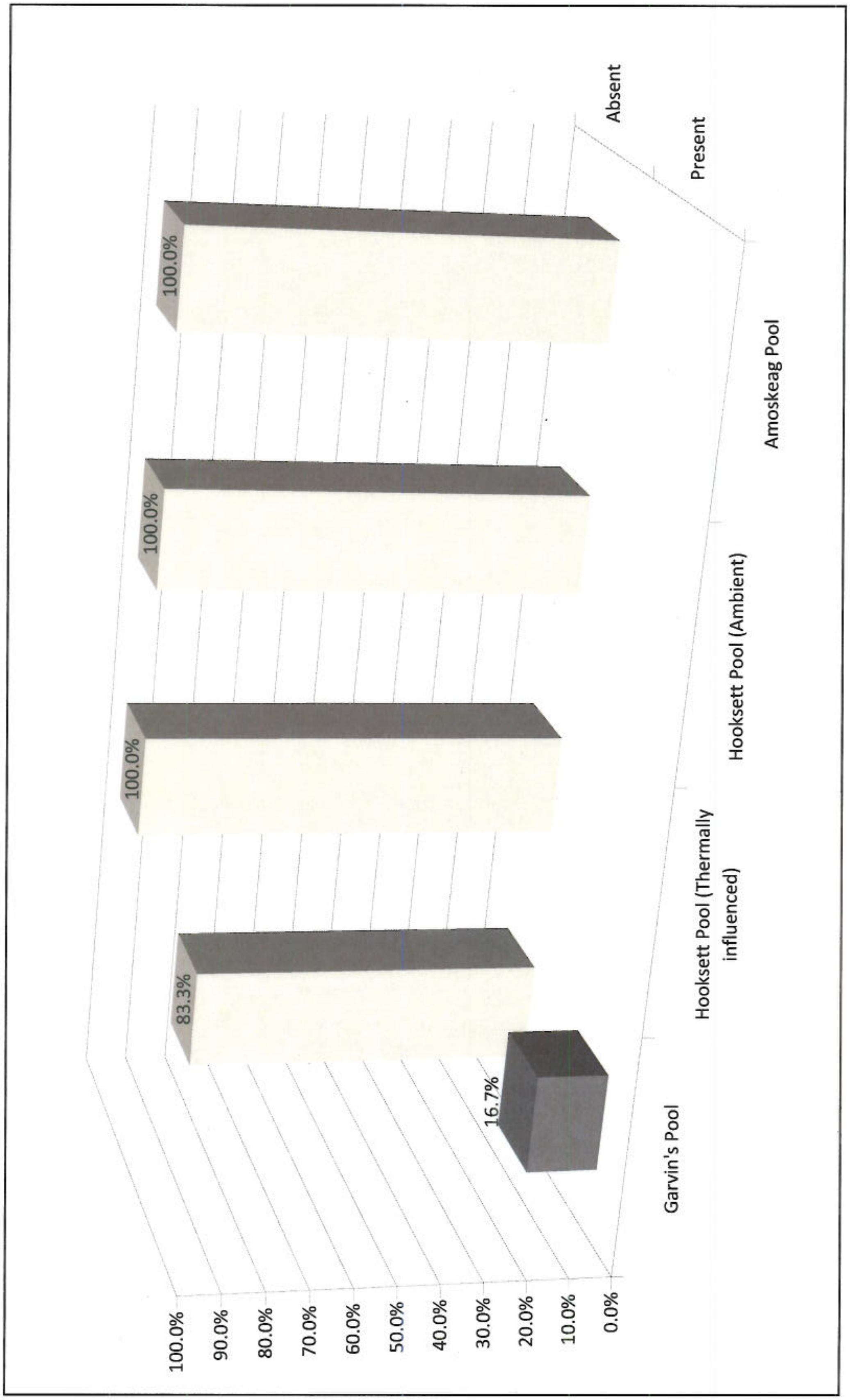

Figure 4-4. Frequency distribution of internal parasite load for yellow perch captured from Garvin's Pool (N = 216), thermally influenced Hooksett Pool (N = 47), ambient Hooksett Pool (N = 29), and Amoskeag Pool (N = 9) during spring and fall 2008.

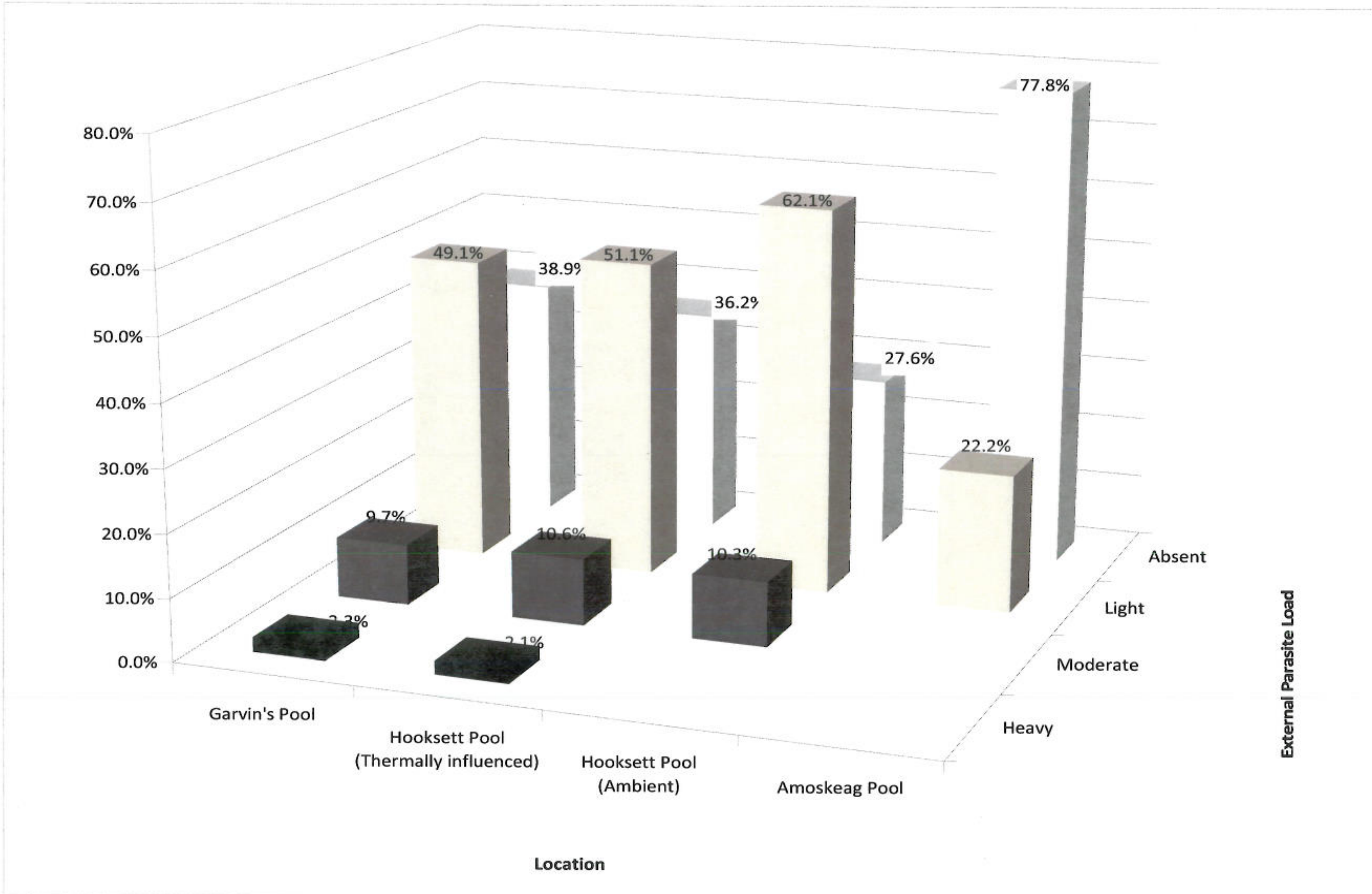

Figure 4-5. Frequency distribution of external parasite load for yellow perch captured from Garvin's Pool (N = 216), thermally influenced Hooksett Pool (N = 47), ambient Hooksett Pool (N = 29), and Amoskeag Pool (N = 9) during spring and fall 2008.

Table 4-1. Total number of fish (N), minimum (Min.), maximum (Max.), mean (Mean), and standard deviation (STD) of the mean total length in millimeters, total weight in grams, and somatic weight in grams for yellow perch and by gear type for Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008.

Species	Sampling Zone	Sampling Method	N	Total Length (mm)				Total Weight (g)				Somatic Weight (g)			
				Min.	Max.	Mean	STD	Min.	Max.	Mean	STD	Min.	Max.	Mean	STD
Yellow perch	Garvin's Pool	Electrofish	152	64	338	197	61	1	436	109	83	5	415	109	78
		Trapnet	64	90	323	218	40	8	420	129	74	8	413	129	72
		Total	216	64	338	203	56	1	436	115	81	5	415	115	76
	Hooksett Pool (Thermally influenced)	Electrofish	46	67	278	168	59	2	265	78	75	16	256	97	72
		Trotline	1	171	171	171		59	59	59		59	59	59	
		Total	47	67	278	168	58	2	265	77	74	16	256	96	71
	Hooksett Pool (Ambient)	Electrofish	26	66	219	109	35	1	102	19	23	11	100	40	31
		Trotline	3	182	323	236	76	62	332	161	148	62	323	158	144
		Total	29	66	323	122	56	1	332	34	63	11	323	72	89
	Amoskeag Pool	Electrofish	9	46	118	72	25	1	16	5	5	4	16	9	5
		Total	9	46	118	72	25	1	16	5	5	4	16	9	5

Table 4-2. Regression statistics for total length (mm) vs. somatic weight (g) of yellow perch from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during the spring and fall 2008.

Species	Sampling Zone	N	Log_{10} Slope	Log_{10} Intercept	R^2	ANCOVA test for differences in length vs. weight equations[1]							
						Slope				Intercept			
						Garvin's	Hooksett Thermal	Hooksett Ambient	Amoskeag	Garvin's	Hooksett Thermal	Hooksett Ambient	Amoskeag
Yellow perch	Garvin's	208	3.097	-5.193	0.99								
	Hooksett Thermal	35	3.113	-5.196	0.98	NS				NS			
	Hooksett Ambient	11	3.025	-5.039	0.98	NS	NS			NS	NS		
	Amoskeag	4	3.356	-5.711	0.95	NS	NS	NS		NS	NS	NS	

[1]Test results symbols for probability (p) levels of significance:
* = $p < 0.05$
** = $p < 0.01$
*** = $p < 0.001$
**** = $p < 0.0001$
NS = not significant, $p > 0.05$

Table 4-3. Regression statistics for total length (mm) vs. total weight (g) of yellow perch sampled during the months of April, May, September, and October 1995, 2004, 2005, and 2008 from Hooksett Pool (ambient and thermally-influenced zones combined).

Species	Sampling Year	N	Log_{10} Slope	Log_{10} Intercept	R^2	ANCOVA test for differences in length vs. weight equations[1]							
						Slope				Intercept			
						1995	2004	2005	2008	1995	2004	2005	2008
Yellow perch	1995	21	2.973	-4.894	0.94								
	2004	26	3.110	-5.271	0.97	NS				NS			
	2005	42	3.093	-5.127	0.92	NS	NS			NS	NS		
	2008	76	3.275	-5.551	0.97	NS	NS	NS		NS	NS	NS	

[1]Test results symbols for probability (p) levels of significance:
* = $p < 0.05$
** = $p < 0.01$
*** = $p < 0.001$
**** = $p < 0.0001$
NS = not significant, $p > 0.05$

Table 4-4. Mean total length at age for yellow perch captured by electrofishing from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during 2008.

Sampling Zone	Cohort	Age	# Fish	Lower 95% Confidence Limit	Mean Total Length (mm)	Upper 95% Confidence Limit
Garvin's Pool	1997	11	1		292	
	1998	10	3	246	291	336
	1999	9	15	242	253	264
	2000	8	22	243	252	261
	2001	7	33	233	242^{NS}	251
	2002	6	27	211	218**	225
	2003	5	23	209	217^{NS}	226
	2004	4	22	187	195^{NS}	202
	2005	3	26	142	151^{NS}	160
	2006	2	15	122	126**	131
	2007	1	20	99	108****	118
	2008	0	1		64	
Hooksett Pool (Thermally influenced)	1999	9	1		274	
	2001	7	5	231	253^{NS}	275
	2002	6	2	237	264*	291
	2003	5	2	196	220^{NS}	244
	2004	4	4	186	194^{NS}	202
	2005	3	8	156	174^{NS}	193
	2006	2	9	143	152*, ***	161
	2007	1	9	109	116****	124
	2008	0	5	71	76^{NS}	82
Hooksett Pool (Ambient)	2004	4	2	146	195^{NS}	243
	2005	3	2	145	159^{NS}	173
	2006	2	3	113	117**	121
	2007	1	15	92	99****	106
	2008	0	4	65	70^{NS}	76
Amoskeag Pool	2006	2	1		118	
	2007	1	7	54	69*, **, ***	83

Shading indicates samples were not available for a cross sampling zone comparison for a particular cohort
"NS" indicates there were no significant differences in mean length at age from other sampling zones for a particular cohort
"*" indicates that mean length at age differed significantly from Garvin's Pool for a particular cohort
"**" indicates that mean length at age differed significantly from thermally influenced Hooksett Pool for a particular cohort
"***" indicates that mean length at age differed significantly from ambient Hooksett Pool for a particular cohort
"****" indicates that mean length at age differed significantly from Amoskeag Pool for a particular cohort

Table 4-5. Sex composition, percent male, and sex ratio for yellow perch from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008.

Species	Sampling Zone	N	Males	Females	Undeter mined	% Male	Sex Ratio (M:F)
Yellow perch	Garvin's Pool	216	154	54	7	71.3	2.8 : 1
	Hooksett Pool (Thermally influenced)	47	16	19	12	34.0	0.9 : 1
	Hooksett Pool (Ambient)	29	5	6	18	17.2	0.8 : 1
	Amoskeag Pool	9	2	2	5	22.2	1 : 1

Table 4-6. Total length (mm), total weight (g), fecundity, age, and cohort for yellow perch females from Garvin's Pool and ambient Hooksett Pool during spring 2008.

Sampling Zone	Total Length (mm)	Total Weight (g)	Fecundity	Age	Cohort
Hooksett Pool (Ambient)	230	158	28,405	3	2005
Garvin's Pool	245	178	12,862	5	2003
Garvin's Pool	247	169	4,192	6	2002
Garvin's Pool	245	211	22,056	7	2001
Garvin's Pool	273	232	10,440	9	1999
Garvin's Pool	303	310	21,534	10	1998

Table 4-7. Regression statistics for total length (mm) vs. fecundity of yellow perch females from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring 2008.

Species	Sampling Zone	N	Log_{10} Slope	Log_{10} Intercept	R^2
Yellow perch	Garvin's	5	2.717	-2.484	0.14
	Hooksett Thermal	0	-	-	-
	Hooksett Ambient	1	-	-	-
	Amoskeag	0	-	-	-

5.0 WHITE SUCKER RESULTS AND DISCUSSION

5.1 LENGTH

White sucker collected from field sampling during spring and fall 2008 (combined) were taken to the laboratory for analysis of biocharacteristics parameters (see Section 2.1.5 of this report), allowing comparison of these parameters when adequate samples (number of fish) were obtained among sampling zones. Table 5-1 presents the total catch, minimum TL, maximum TL, and mean TL (mm) for white sucker captured within each of the four sampling zones; Garvin's Pool, the ambient zone of Hooksett Pool, the thermally influenced zone of Hooksett Pool, and Amoskeag Pool. Detailed catch information for each white sucker collected from each of the four sampling zones is provided in Appendix A of this report.

When pooled among gear types used for sampling during 2008, total length white sucker ranged from 177 to 507 mm TL in Garvin's Pool, 73 to 527 mm TL in ambient Hooksett Pool, 176 to 542 mm TL in thermally influenced Hooksett Pool, and 122 to 554 mm TL in Amoskeag Pool. When pooled by gear, mean total length for white sucker ranged from a high of 433 mm TL in the thermally influenced zone of Hooksett Pool to a low of 290 mm TL in the ambient zone of Hooksett Pool.

5.2 WEIGHT

The minimum, maximum, and mean total weight (g) and the minimum, maximum and mean somatic weight (g) for white sucker captured within each of the four sampling zones; Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool, and Amoskeag Pool are presented in Table 5-1.

When pooled among gear types used for sampling during 2008, total weight for white sucker ranged from 65 to 1,695 g in Garvin's Pool, 4 to 1,705 g in ambient Hooksett Pool, 68 to 1,790 g in thermally influenced Hooksett Pool, and 16 to 2,110 g in Amoskeag Pool. Mean total weight ranged from a high of 1,055 g in the thermally influenced zone of Hooksett Pool to a low of 548 g in Garvin's Pool. When pooled among gear types used for sampling during 2008, somatic weight for white sucker ranged from 65 to 1,506 g in Garvin's Pool, 4 to 1,683 g in ambient Hooksett Pool, 68 to 1,776 g in thermally influenced Hooksett Pool, and 16 to 1,921 g in Amoskeag Pool. Mean somatic weight ranged from a high of 1,034 g in the thermally influenced zone of Hooksett Pool to a low of 527 g in Garvin's Pool.

5.3 LENGTH VS WEIGHT (CONDITION)

The total length-somatic weight relationships for white sucker collected among the four sampling zones during 2008 are presented numerically in Table 5-2 and graphically in Figure 5-1. There were no significant differences (ANCOVA; $p > 0.05$) in the slope or intercept parameters for the total length-somatic weight regressions for white sucker (Figure 5-1; Table 5-2) when examined by sampling zone.

Length-weight regressions derived from historic fisheries data collected in Hooksett Pool from the sample years 1995, 2004 and 2005 along with data collected during the current sampling year (2008) are presented numerically in Table 5-3 and graphically in Figure 5-2. To present comparable data, these regressions are based on total length and total wet weight taken from samples representing the entire Hooksett Pool (ambient and thermally-influenced zones combined), pooled for fish collected during the months of April, May, September, and October. The magnitude of the slope in the regression equation reflects the condition or robustness of the fish; a higher slope indicates a greater weight relative to a constant increase in length. Since juveniles usually have a lower length-weight slope than older individuals, variation in the length-weight slope may also result from changes in the age composition of the samples. White sucker slopes and y-intercepts were significantly different between 2004 and all other years of sampling (1995, 2005 and 2008) (Figure 5-2; Table 5-3). These significant differences in y-intercepts indicate that white sucker sampled during 1995, 2005, 2008 were more robust (heavier for a given length) than those sampled during 2004.

Assessment of the condition of white sucker through comparison of the length-somatic weight relationships indicated there were no significant differences for individuals captured during 2008 within Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool, and Amoskeag Pool. Degraded habitat conditions that might be caused by a thermal discharge would have resulted in a decreasing slope (less somatic weight for a given length) for a given fish species over time, indicating a reduction in quality of body condition for that population of fish. As a result, the analysis of the length-weight condition relationships supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the white sucker population of thermally influenced Hooksett Pool. In addition, comparisons of the length-weight relationships for historic (1995, 2004, and 2005) Hooksett Pool (thermally influenced and ambient zones pooled) sampling versus 2008 suggested that white sucker captured during 2008 were either more robust (i.e. greater body weight at a given length, 2004) or as robust (1995, 2005). This lack of significant change in condition through time also supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the white sucker population of Hooksett Pool.

5.4 AGE-LENGTH

Age was determined for scale samples obtained from all yellow perch caught by boat electrofishing, ¾ inch trap net, 2 inch trap net, and trot line during spring and fall 2008. However, age-length keys were constructed for white sucker captured only by boat electrofishing for each sampling zone during 2008 to avoid problems associated with gear selectivity. By using age-length data from the single sampling gear providing the largest catch, and the gear considered to be the least size-selective sampling method (Hubert 1996, Reynolds 1996), the age-length keys developed for comparison among the four zones would not be confounded by different combinations of gear and effort among the regions (Table 2-1).

Figure 5-3 presents the standardized (42 samples) age frequency distributions developed from the electrofishing catch of white sucker in Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool, and Amoskeag Pool. Age distribution of white sucker sampled by electrofishing ranged from Age 2 to Age 8 in Garvin's Pool, Age 1 to Age 12 in ambient Hooksett Pool, Age 1 to Age 12 in thermally influenced Hooksett Pool, and Age 1 to Age 12 in Amoskeag Pool. Within Garvin's Pool, white sucker abundance peaked for individuals of Age 3. Within Hooksett Pool, the peak of the age distribution for white sucker in the thermally influenced zone was at Age 8 while for white sucker in the ambient zone, this peak occurred at Age 2. Similar to the thermally influenced Hooksett Pool, white sucker in Amoskeag Pool displayed an older peak in age distribution at Age 7. Electrofishing catch of younger age classes within Garvin's Pool, ambient Hooksett Pool and thermally influenced Hooksett Pool predominantly occurred during the fall seasonal sampling while older sucker tended to be collected during the spring sampling. White sucker in Amoskeag Pool were only collected during the spring sampling.

Mean length at age was determined for white sucker collected by electrofishing from each sampling zone; Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool, and Amoskeag Pool. Table 5-4 presents the mean length at age for white sucker in each Merrimack River sampling zone. Sufficient age and length data was available to compare the mean length at age for each of four cohorts of white sucker caught during 2008 (the 2000 Age 8 cohort, the 2001 Age 7 cohort, the 2002 Age 6 cohort, and the 2003 Age 5 cohort) among the four sampling zones; Garvin's Pool, ambient Hooksett Pool thermally influenced Hooksett Pool and Amoskeag Pool. There were no significant differences as indicated by overlapping 95% confidence limits for the mean length at age of white sucker among these four sampling zones for those cohorts.

Sufficient age and length data were available to compare the mean length at age for white sucker for each of two younger cohorts of white sucker caught during 2008 (the 2005 Age 3 cohort and the 2006 Age 2 cohort) among three sampling zones; Garvin's Pool, ambient Hooksett Pool and thermally influenced Hooksett Pool. There was no significant difference, as indicated by overlapping 95% confidence limits, for the 2005 cohort but mean length at age for white sucker from the 2006 cohort was smaller in ambient Hooksett Pool than either Garvin's Pool or thermally influenced Hooksett Pool. There were no significant differences in mean length at age as indicated by overlapping 95% confidence intervals for white sucker from the 2006 cohort captured from thermally influenced Hooksett Pool or Garvin's Pool.

Sufficient age and length data were available to compare the mean length at age for white sucker for a single cohort caught during 2008 (the 2004 Age 4 cohort) among three sampling zones; Garvin's Pool, ambient Hooksett Pool, and Amoskeag Pool. No significant difference, as indicated by overlapping 95% confidence limits, was detected for mean length at age for the 2004 cohort.

No significant differences in mean length at age were detected for white sucker from the 1999 cohort (Age 9) between thermally influenced Hooksett Pool and Amoskeag Pool or for the 1998 cohort (Age 10) between thermally influenced Hooksett Pool and ambient Hooksett Pool.

Statistical analysis of mean length at age for nine different cohorts of white sucker caught during 2008 in the vicinity of Merrimack Station supports a finding of "no prior appreciable harm" from the Station's thermal discharge. It was hypothesized that degraded habitat conditions that might be caused by continued exposure to Merrimack Station's thermal discharge would result in lower mean length at age for a population of fish due to a reduction in growth rates associated with thermal stress (USEPA 1977). No incidences of smaller length white sucker at age were observed within the thermally influenced zone of Hooksett Pool among nine different cohorts of white sucker compared to one or more of the ambient zones.

5.5 SEX RATIO

Table 5-5 presents the sex ratio (M:F) for white sucker collected for biocharacteristics assessment from each of the four sampling zones during 2008. These ratios ranged from a high of 1.8 males per female in Garvin's Pool to 0.4 males per female in thermally influenced and ambient Hooksett Pool for white sucker. The percentage of male white sucker captured, assuming that catch of undetermined sex was in the same proportion, was 64.3% in Garvin's Pool, 20.3% in the ambient zone of Hooksett Pool, 27.4% in the thermally influenced zone of Hooksett Pool, and 40.0% in Amoskeag Pool.

5.6 FECUNDITY

A total of 23 female white sucker (three from Garvin's Pool, seven from the ambient zone of Hooksett Pool, five from the thermally influenced zone of Hooksett Pool, and eight from Amoskeag Pool) with ovaries classified as ripe or ripe and running were collected during spring 2008 sampling. The mean total lengths for ripe female white suckers collected in each of the four sampling zones were: 474 mm in Garvin's Pool, 469 mm in thermally influenced Hooksett Pool, 485 mm in ambient Hooksett Pool, and 445 mm in Amoskeag Pool (Table 5-6). Mean fecundity egg count values for white suckers ranged from a high of 47,643 eggs per female within the ambient zone of Hooksett Pool to a low of 32,754 eggs per female in Garvin's Pool (Table 5-6).

The length-fecundity relationship for white sucker is presented numerically in Table 5-7. The magnitude of the slope in the regression equation reflects the magnitude of fecundity; a higher slope indicates higher fecundity relative to a constant increase in length. For white sucker, the slopes and y-intercepts were significantly different between the ambient zone of Hooksett Pool and all other sampling locations (Table 5-7). Fecundity for white sucker from the ambient zone of Hooksett Pool appeared to be lower for individuals of greater total length. There were no significant differences detected between the slope and y-intercept parameters of the regression equations developed for Garvin's Pool, thermally influenced Hooksett Pool, and Amoskeag Pool indicating no difference in level of fecundity relative to increases in total length.

Degraded habitat conditions that might be caused by a thermal discharge would result in lower fecundity at a given length for a population of fish. Regression slope and y-intercept parameters for white sucker fecundity versus total length were not significantly different between Garvin's Pool, thermally influenced Hooksett Pool, or Amoskeag Pool. Significantly lower fecundity was observed for ambient Hooksett Pool white sucker at a given length compared to the other female white suckers collected among the three other sampling zones. However, the ambient zone is not influenced by Merrimack Stations thermal discharge, therefore this analysis of the fecundity-length relationships supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the white sucker population of thermally influenced Hooksett Pool.

5.7 PARASITES

5.7.1 Internal Parasitism

Figure 5-4 presents the presence and absence frequency of occurrence of internal parasites observed in white sucker captured during the spring and fall of 2008. There were no white sucker determined to have internal parasites present in samples collected from Amoskeag, the thermally influenced Hooksett Pool or ambient Hooksett Pool. A total of 3.6% of the white sucker from Garvin's Pool did have internal parasites present. Frequency distributions for Garvin's Pool differed significantly from those observed at all other sampling locations for white sucker ($p = 0.0434$) when assessed using Chi-square multi-contingency tables. Internal parasites were detected within a greater proportion of white sucker sampled from Garvin's Pool than either thermally influenced or ambient Hooksett Pool or Amoskeag Pool.

5.7.2 External Parasitism

Figure 5-5 presents the frequency of occurrence of external parasites observed in white sucker captured during the spring and fall of 2008 assessed on a rank scale from absent to heavy. The majority of white sucker were predominantly absent of parasites within Garvin's Pool (96.4%), thermally influenced Hooksett Pool (97.3%), ambient Hooksett Pool (80.4%), and Amoskeag Pool (100.0%). The frequency distributions for each of the four sampling areas were compared using a Chi-square multi-contingency table to test for differences in the distributions. When assessed using Chi-square multi-contingency tables, the distributions of external parasite load for white sucker differed significantly among most combinations of sampling locations. Only the thermally influenced Hooksett Pool and Amoskeag Pool distributions of external parasite load were statistically similar ($p = 0.0810$). However, visual assessment of the distributions in Figure 5-5 reveals that greater than 95% of the white suckers in Garvin's Pool, thermally influenced Hooksett Pool and Amoskeag Pool were classified as not having any external parasites.

5.7.3 Discussion of Parasitism

Statistical analysis of the occurrence of internal and external parasites in white sucker caught within each of the four Merrimack River sampling zones during spring and fall 2008 supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the white sucker population of Hooksett Pool. Thermally degraded habitat conditions are hypothesized to result in more frequent infestation of internal and external parasites indicating a reduction in the overall health and conditions of the fish (USEPA 1977 draft). Internal parasitic loads were significantly greater for white sucker found within Garvin's Pool than those observed in either Hooksett or Amoskeag Pools. In addition, a greater proportion of white sucker in Garvin's Pool were classified as having heavier external parasite loads than those observed for white sucker in thermally influenced Hooksett Pool. Anecdotal observations of white sucker assessed in the laboratory during the spring and fall of 2008 noted that the dominant external parasite was black spot. The black spots are caused by pigment that the fish deposits around the larval stage of a parasitic digenetic trematode, usually a *Neascus* spp. In general, the presence of the black spot parasite does not affect the growth or the longevity of the infected fish; however massive infections in young fish may cause fish mortality (Hoffman 1967).

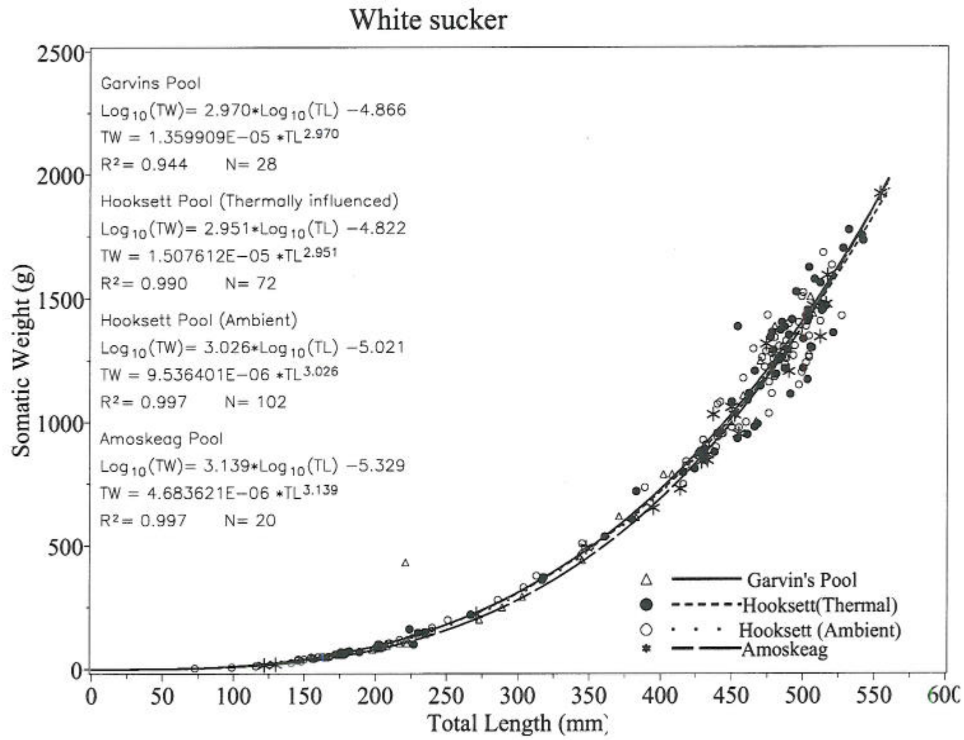

Figure 5-1. Length-somatic weight relationship for white sucker captured from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during the spring and fall 2008.

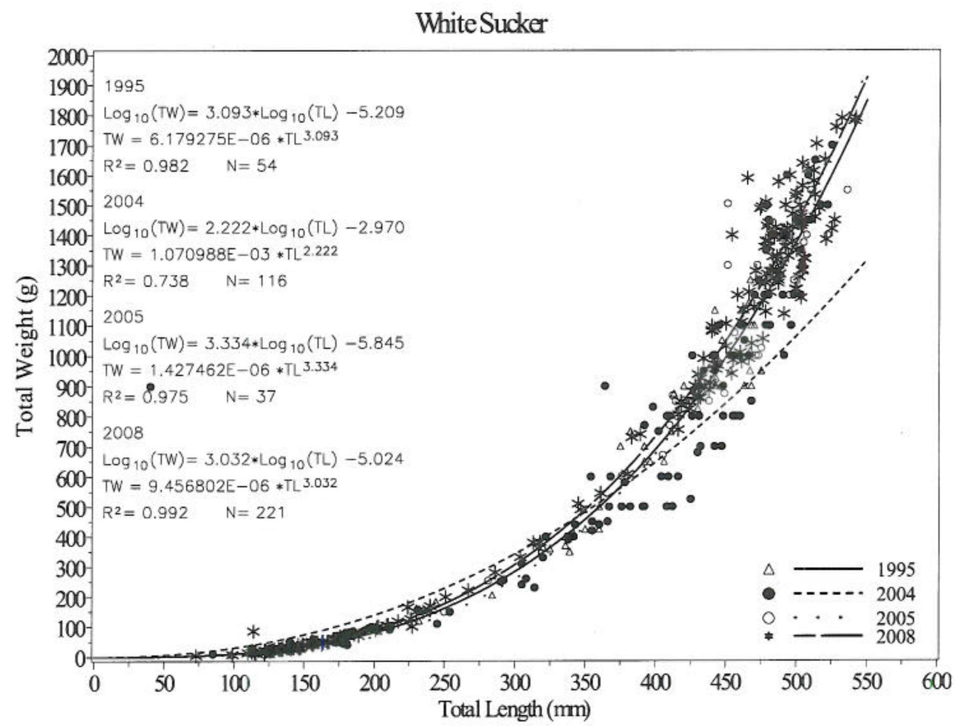

Figure 5-2. Length-weight relationship for white sucker captured during the months of April, May, September, and October of 1995, 2004, 2005, and 2008 from Hooksett Pool (ambient and thermally-influenced zones combined).

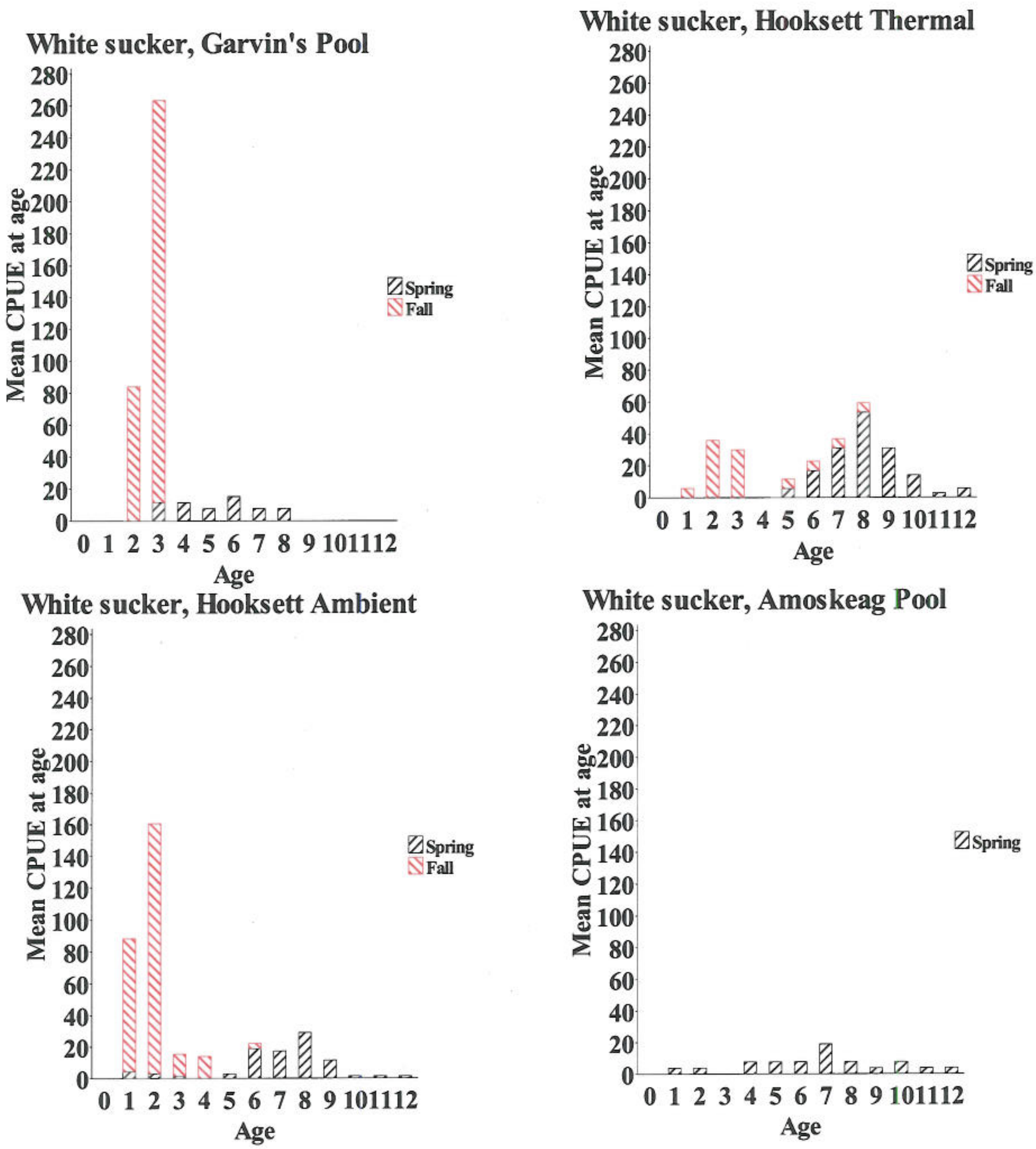

Figure 5-3. Age structure for the total catch of white sucker captured by electrofishing from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008 based on the mean CPUE per age class.

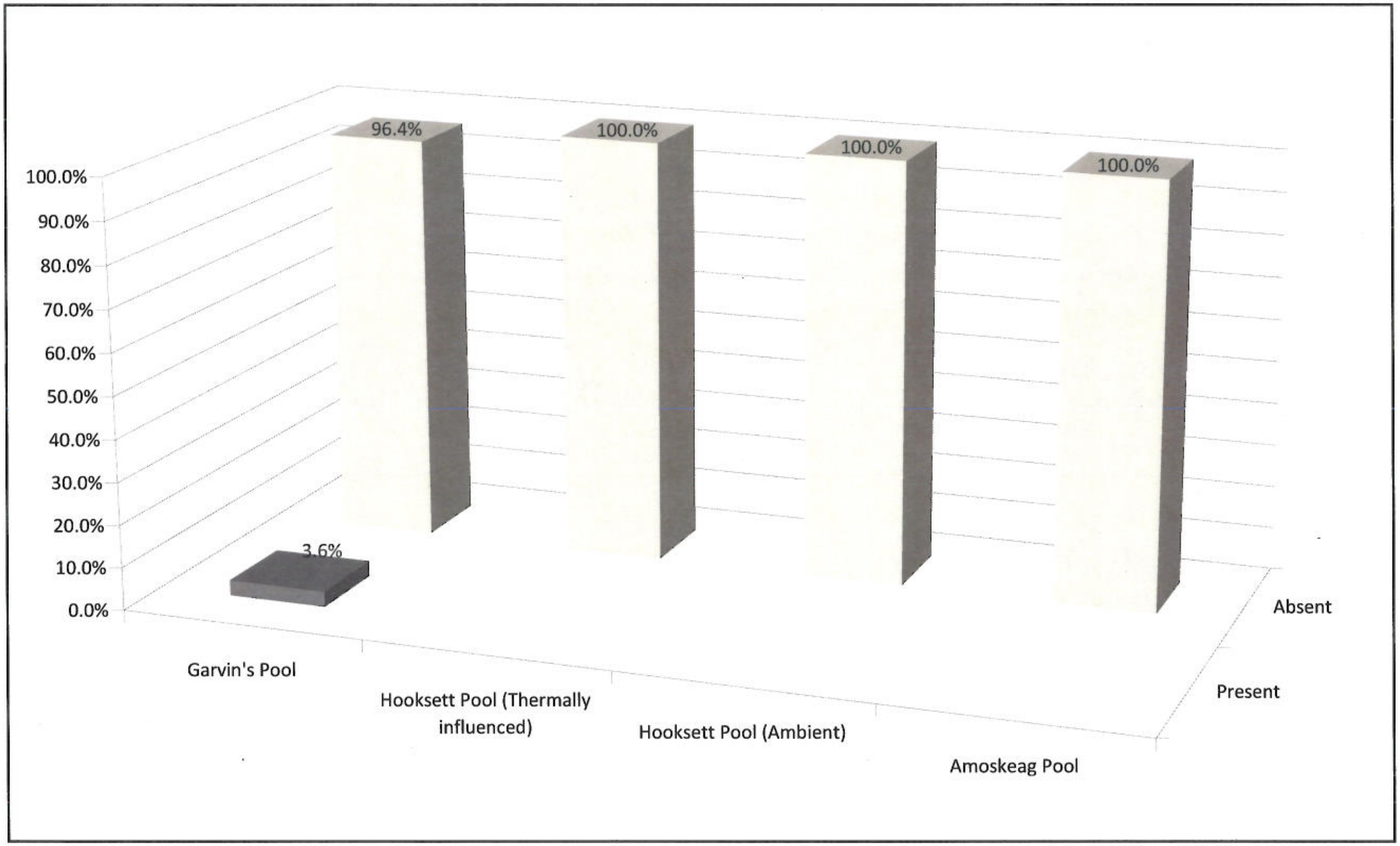

Figure 5-4. Frequency distribution of internal parasite load for white sucker captured from Garvin's Pool (N = 28), thermally influenced Hooksett Pool (N = 73), ambient Hooksett Pool (N = 148), and Amoskeag Pool (N = 20) during spring and fall 2008.

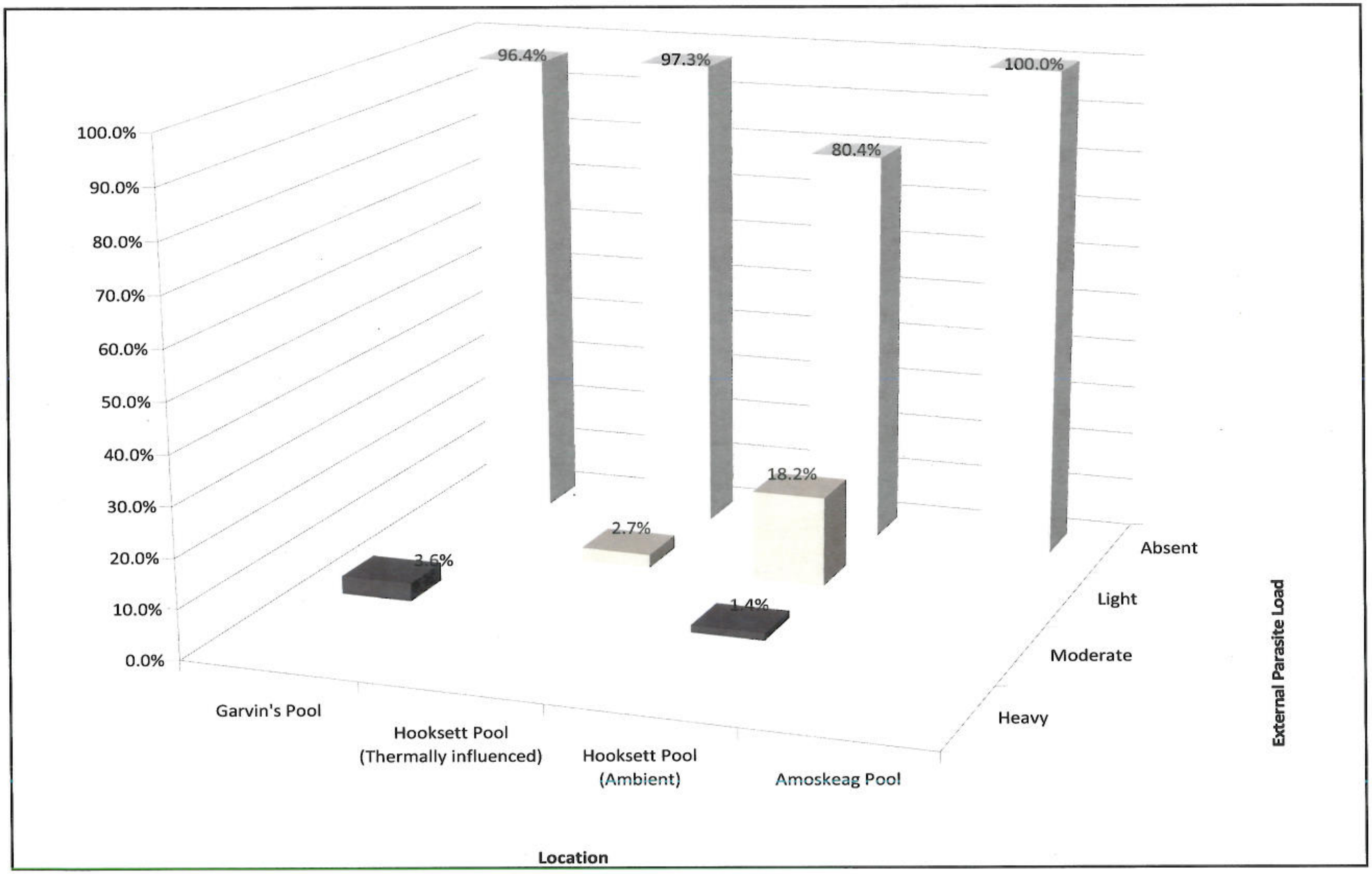

Figure 5-5. Frequency distribution of external parasite load for white sucker captured from Garvin's Pool (N = 28), thermally influenced Hooksett Pool (N = 73), ambient Hooksett Pool (N = 148), and Amoskeag Pool (N = 20) during spring and fall 2008.

Table 5-1. Total number of fish (N), minimum (Min.), maximum (Max.), mean (Mean), and standard deviation (STD) of the mean total length in millimeters, total weight in grams, and somatic weight in grams by species, and gear type for Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008.

Species	Sampling Zone	Sampling Method	N	Total Length (mm)				Total Weight (g)				Somatic Weight (g)			
				Min.	Max.	Mean	STD	Min.	Max.	Mean	STD	Min.	Max.	Mean	STD
White sucker	Garvin's Pool	Electrofish	26	177	507	315	112	65	1,695	523	518	65	1,506	506	488
		Trapnet	2	383	467	425	59	650	1,100	875	318	612	1,003	807	276
		Total	**28**	**177**	**507**	**323**	**112**	**65**	**1,695**	**548**	**511**	**65**	**1,506**	**527**	**479**
	Hooksett Pool (Thermally influenced)	Electrofish	73	176	542	433	104	68	1,790	1,064	504	68	1,776	1,034	491
		Total	**73**	**176**	**542**	**433**	**104**	**68**	**1,790**	**1,064**	**504**	**68**	**1,776**	**1,034**	**491**
	Hooksett Pool (Ambient)	Electrofish	147	73	527	288	159	4	1,705	547	611	4	1,683	739	579
		Trapnet	1	476	476	476		1,055	1,055	1,055		1,034	1,034	1,034	
		Total	**148**	**73**	**527**	**290**	**159**	**4**	**1,705**	**550**	**611**	**4**	**1,683**	**742**	**577**
	Amoskeag Pool	Electrofish	20	122	554	417	118	16	2,110	1,050	574	16	1,921	953	509
		Total	**20**	**122**	**554**	**417**	**118**	**16**	**2,110**	**1,050**	**574**	**16**	**1,921**	**953**	**509**

Table 5-2. Regression statistics for total length (mm) vs. somatic weight (g) of yellow perch and white sucker from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008.

						ANCOVA test for differences in length vs. weight equations[1]							
						Slope				Intercept			
Species	Sampling Zone	N	Log_{10} Slope	Log_{10} Intercept	R^2	Garvin's	Hooksett Thermal	Hooksett Ambient	Amoskeag	Garvin's	Hooksett Thermal	Hooksett Ambient	Amoskeag
White sucker	Garvin's	28	2.970	-4.866	0.94								
	Hooksett Thermal	72	2.951	-4.822	0.99	NS				NS			
	Hooksett Ambient	102	3.026	-5.021	0.99	NS	NS			NS	NS		
	Amoskeag	20	3.139	-5.329	0.99	NS	NS	NS		NS	NS	NS	

[1]Test results symbols for probability (p) levels of significance:
* = p < 0.05
** = p < 0.01
*** = p < 0.001
**** = p < 0.0001
NS = not significant, p > 0.05

Table 5-3. Regression statistics for total length (mm) vs. weight (g) of yellow perch and white sucker sampled during the months of April, May, September, and October 1995, 2004, 2005, and 2008 from Hooksett Pool (ambient and thermally-influenced zones combined).

Species	Sampling Year	N	Log_{10} Slope	Log_{10} Intercept	R^2	ANCOVA test for differences in length vs. weight equations[1]							
						Slope				Intercept			
						1995	2004	2005	2008	1995	2004	2005	2008
White sucker	1995	54	3.093	-5.209	0.98								
	2004	116	2.222	-2.970	0.73	****				****			
	2005	37	3.334	-5.845	0.98	NS	****			NS	****		
	2008	221	3.032	-5.024	0.99	NS	****	NS		NS	****	NS	

[1]Test results symbols for probability (p) levels of significance:
* = $p < 0.05$
** = $p < 0.01$
*** = $p < 0.001$
**** = $p < 0.0001$
NS = not significant, $p > 0.05$

Table 5-4. Mean total length at age for white sucker captured by electrofishing from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008.

Sampling Zone	Cohort	Age	# Fish	Lower 95% Confidence Limit	Mean Total Length (mm)	Upper 95% Confidence Limit
Garvin's Pool	2000	8	3	467	493 NS	519
	2001	7	2	439	460 NS	480
	2002	6	4	364	423 NS	482
	2003	5	2	356	387 NS	417
	2004	4	4	222	300 NS	378
	2005	3	9	207	235 NS	264
	2006	2	2	191	212***	232
Hooksett Pool (Thermally influenced)	1996	12	2	521	535	549
	1997	11	1		532	
	1998	10	5	504	516 NS	529
	1999	9	11	488	500 NS	512
	2000	8	20	475	483 NS	492
	2001	7	12	450	463 NS	476
	2002	6	7	394	420 NS	446
	2003	5	3	315	371 NS	427
	2005	3	5	209	248 NS	288
	2006	2	6	189	206***	223
	2007	1	1		176	
Hooksett Pool (Ambient)	1996	12	1		514	
	1997	11	1		504	
	1998	10	1		520	
	1999	9	8	491	499 NS	507
	2000	8	20	475	484 NS	494
	2001	7	12	459	471 NS	483
	2002	6	15	429	442 NS	456
	2003	5	2	280	413 NS	545
	2004	4	4	195	243 NS	291
	2005	3	5	178	232 NS	285
	2006	2	47	154	160*, **	167
	2007	1	27	121	129	137
Amoskeag Pool	1996	12	1		512	
	1997	11	1		516	
	1998	10	2	499	536 NS	572
	1999	9	1		507	
	2000	8	2	412	464 NS	515
	2001	7	5	434	449 NS	464
	2002	6	2	397	432 NS	467
	2003	5	2	379	412 NS	445
	2004	4	2	234	310 NS	385
	2006	2	1		130	
	2007	1	1		122	

Shading indicates samples were not available for a cross sampling zone comparison for a particular cohort
"NS" indicates there were no significant differences in mean length at age from other sampling zones for a particular cohort
"*" indicates that mean length at age differed significantly from Garvin's Pool for a particular cohort
"**" indicates that mean length at age differed significantly from thermally influenced Hooksett Pool for a particular cohort
"***" indicates that mean length at age differed significantly from ambient Hooksett Pool for a particular cohort
"****" indicates that mean length at age differed significantly from Amoskeag Pool for a particular cohort

Table 5-5. Sex composition, percent male, and sex ratio for white sucker from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring and fall 2008.

Species	Sampling Zone	N	Males	Females	Undetermined	% Male	Sex Ratio (M:F)
White sucker	Garvin's Pool	28	18	10	0	64.3	1.8 : 1
	Hooksett Pool (Thermally influenced)	73	20	52	1	27.4	0.4 : 1
	Hooksett Pool (Ambient)	148	30	71	47	20.3	0.4 : 1
	Amoskeag Pool	20	8	12	0	40.0	0.7 : 1

Table 5-6. Mean total length and mean fecundity for white sucker females from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring 2008.

Sampling Zone	Total Length	Weight	Fecundity	Age	Cohort
Garvin's Pool	449	1,110	32,805	7	2001
Garvin's Pool	467	1,100	24,967	8	2000
Garvin's Pool	507	1,695	40,491	8	2000
Hooksett Pool (Thermally influenced)	440	1,098	32,734	6	2002
Hooksett Pool (Thermally influenced)	440	1,084	30,750	7	2001
Hooksett Pool (Thermally influenced)	497	1,470	48,075	8	2000
Hooksett Pool (Thermally influenced)	487	1,578	46,033	8	2000
Hooksett Pool (Thermally influenced)	483	1,410	35,224	9	1999
Hooksett Pool (Ambient)	480	1,380	43,361	5	2003
Hooksett Pool (Ambient)	474	1,488	43,237	6	2002
Hooksett Pool (Ambient)	480	1,440	49,577	7	2001
Hooksett Pool (Ambient)	504	1,564	36,050	8	2000
Hooksett Pool (Ambient)	478	1,510	51,596	8	2000
Hooksett Pool (Ambient)	465	1,690	67,333	8	2000
Hooksett Pool (Ambient)	516	1,615	42,348	9	1999
Amoskeag Pool	348	550	18,124	4	2004
Amoskeag Pool	395	730	22,255	5	2003
Amoskeag Pool	414	850	26,343	6	2002
Amoskeag Pool	455	1,100	27,492	7	2001
Amoskeag Pool	452	1,180	34,378	7	2001
Amoskeag Pool	474	1,648	57,984	7	2001
Amoskeag Pool	507	1,790	53,901	9	1999
Amoskeag Pool	512	1,635	59,416	12	1996

Table 5-7. Regression statistics for total length (mm) vs. fecundity of white sucker females from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during spring 2008.

						ANCOVA test for differences in length vs. fecundity equations[1]							
						Slope				Intercept			
Species	Sampling Zone	N	Log_{10} Slope	Log_{10} Intercept	R^2	Garvin's	Hooksett Thermal	Hooksett Ambient	Amoskeag	Garvin's	Hooksett Thermal	Hooksett Ambient	Amoskeag
White sucker	Garvin's	3	2.367	-1.826	0.37								
	Hooksett Thermal	5	3.020	-3.488	0.76	NS				NS			
	Hooksett Ambient	7	-4.232	16.033	0.54	*	*			*	*		
	Amoskeag	8	3.243	-4.042	0.85	NS	NS	**		NS	NS	**	

[1]Test results symbols for probability (p) levels of significance:
* = $p < 0.05$
** = $p < 0.01$
*** = $p < 0.001$
**** = $p < 0.0001$
NS = not significant, $p > 0.05$

6.0 SUMMARY

USEPA guidance (USEPA 1997) identifies five response metrics of individual RIS fish populations and four response metrics of fish communities that may be relevant to the assessment of appreciable harm to a receiving water body caused by a thermal discharge such as the discharge from Merrimack Station to the Merrimack River: (1) reproduction (spawning habitats and fecundity), (2) life stage habitat utilization, (3) condition factors, (4) disease and parasitism, (5) age and growth, (6) general abundance of RIS, (7) relative abundance (% composition) of each species present (RIS and others), (8) association of principal groups of fish (i.e., guilds), and (9) habitat utilization maps for the indigenous fish communities.

The four community-level response metrics (#6 through #9) and the RIS-level response metrics of life stage habitat utilization (#2) and condition factors (#3) were previously examined in an analysis of Merrimack Station fisheries survey data from 1967 through 2005, which supports a finding of no prior appreciable harm from the Station's thermal discharge to the Merrimack Station RIS (Normandeau 2007a). Specific observations of the relationship between the Merrimack Station thermal discharge and potential sub-lethal effects on reproduction (#1), disease and parasitism (#4), were first made in this report, and additional analysis was presented to address condition factors (#3) and age and growth (#5) for two Merrimack Station RIS, yellow perch and white sucker.

The objective of the 2008 field fisheries investigations was to examine and compare biological characteristics of two abundant RIS fish populations, yellow perch and white sucker, found among four sampling zones in the Merrimack River near Merrimack Station: (1) the thermally influenced zone of Hooksett Pool, (2) the ambient zone of Hooksett Pool, (3) an upstream reference site (Garvin's Pool), and (4) a downstream site subjected to the thoroughly mixed heated effluent from Merrimack Station (Amoskeag Pool). The yellow perch and white sucker populations were sampled during two seasons in 2008 (spring and fall) and evaluated to determine if there was evidence of prior appreciable harm to either of these RIS by obtaining and interpreting biological characteristics information that addressed these population-level response metrics, including length, weight, age, gender, sexual condition, fecundity, and incidence of disease or parasitism.

The relative abundance, size distribution, age structure, mean length at age, sex ratio, fecundity, condition (weight at a given length), and incidence of disease and parasitism were evaluated for yellow perch and white sucker populations sampled during spring and fall 2008 within the four sampling zones. Comparison of these metrics among the four sampling zones allowed an assessment of prior appreciable harm from Merrimack Station's thermal discharge to yellow perch and white sucker populations inhabiting these zones.

The analysis of the fecundity-length relationships supports a finding of "no prior appreciable harm" from the Station's thermal discharge to the white sucker population of the thermally influenced zone in Hooksett Pool. While lower fecundity was observed for ambient Hooksett Pool white sucker at a given length compared to female white suckers collected in the three other sampling zones, the ambient zone of Hooksett Pool is not influenced by Merrimack Station's thermal discharge. An insufficient sample size was obtained for yellow perch to compare fecundity relationships among zones.

Assessment of the condition of yellow perch and white sucker populations through comparison of the length-somatic weight relationships indicated there were no significant differences for these species captured during 2008 within Garvin's Pool, ambient Hooksett Pool, thermally influenced Hooksett Pool, and Amoskeag Pool. Degraded habitat conditions that might be caused by a thermal discharge would have resulted in a decreased slope (less somatic weight for a given length) for a given fish species over time, indicating a reduction in quality of body condition for that population of fish. Therefore, this analysis of the length-weight condition relationships supports a finding of "no prior appreciable harm" from Merrimack Station's thermal discharge to the yellow perch and white sucker populations of thermally influenced Hooksett Pool. In addition, comparisons of the length-weight relationships observed during 2008 to the comparable data from 1995, 2004, and 2005 between the two zones of Hooksett Pool (thermally influenced and ambient zones combined) revealed that yellow perch and white sucker captured during 2008 were either more robust (i.e. greater body weight at a given length) or as robust as observed in previous years. This lack of significant decrease in condition through time also supports a finding of "no prior appreciable harm" from Merrimack Station's thermal discharge to the yellow perch and white sucker populations of Hooksett Pool.

The occurrence of internal and external parasites in yellow perch and white sucker caught within each of the four Merrimack River sampling zones during spring and fall 2008 supports a finding of "no prior appreciable harm" from the Station's thermal discharge. Thermally degraded habitat conditions are hypothesized to result in more frequent infestation of internal and external parasites, indicating a reduction in the overall health and conditions of the fish (USEPA 1977). Internal and external parasitic loads for yellow perch and white sucker found upstream within Garvin's Pool were either the same as, or were significantly greater than, internal and external parasitic loads for yellow perch and white sucker observed in either zone of Hooksett Pool (thermally influenced or ambient) or in Amoskeag Pool.

Statistical analysis of mean length at age for eight different cohorts (age classes) of yellow perch and for nine different cohorts of white sucker caught during 2008 in the four sampling zones supports a finding of "no prior appreciable harm" from the Station's thermal discharge. It was hypothesized that degraded habitat conditions that might be caused by continued exposure to Merrimack Station's thermal discharge would result in lower mean length at age for a population of fish due to a reduction in growth rates associated with thermal stress (USEPA 1977). No incidences of smaller length yellow perch or white sucker at age were observed within the thermally influenced zone of Hooksett Pool compared to ambient Hooksett Pool, Garvin's Pool or Amoskeag Pool.

In sum, results from the 2008 study support a finding of no prior appreciable harm from Merrimack Station's thermal discharge to the yellow perch and white sucker populations found in the receiving water body. Degraded habitat conditions that might be caused by a thermal discharge would result in lower fecundity, reduced condition, increased incidence of parasitism, and lower length at age for the yellow perch and white sucker populations found within the thermally influenced zone of Hooksett Pool compared to the other three sampling zones. Analysis of the yellow perch and white sucker populations in the Merrimack River near Merrimack Station found no evidence of degraded habitat conditions due to the thermal discharge affecting the population level parameters identified by USEPA as indicative of prior appreciable harm (USEPA 1977).

7.0 REFERENCES

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APPENDIX A

Total length (mm) and total weight (g) of yellow perch and white sucker captured by electrofishing, trap net, and trot line from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during the spring and fall 2008.

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	203	85
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	408	792
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	371	620
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	449	1,110
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	273	200
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	221	432
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	507	1,695
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	271	220
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	289	250
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	345	442
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	343	460
White sucker	Garvin's Pool	4/18/2008	Boat Electrofish	303	292
White sucker	Garvin's Pool	4/24/2008	2.0" mesh trap net	467	1,100
White sucker	Garvin's Pool	5/1/2008	Boat Electrofish	470	1,285
White sucker	Garvin's Pool	5/1/2008	Boat Electrofish	505	1,520
White sucker	Garvin's Pool	5/1/2008	Boat Electrofish	458	1,120
White sucker	Garvin's Pool	5/1/2008	Boat Electrofish	480	1,390
White sucker	Garvin's Pool	5/1/2008	Boat Electrofish	402	790
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	222	120
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	217	105
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	177	65
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	235	142
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	205	90
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	198	80
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	222	105
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	208	95
White sucker	Garvin's Pool	9/3/2008	Boat Electrofish	201	90
White sucker	Garvin's Pool	9/4/2008	0.75" mesh trap net	383	650
White sucker	Hooksett Pool (Thermally influenced)	4/21/2008	Boat Electrofish	541	1,781
White sucker	Hooksett Pool (Thermally influenced)	4/21/2008	Boat Electrofish	380	609
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	424	824
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	428	900
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	450	1,105
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	478	1,380
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	487	1,578
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	461	1,110
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	440	1,084
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	503	1,190
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	491	1,138

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	503	1,432
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	525	1,420
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	485	1,425
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	513	1,535
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	483	1,278
White sucker	Hooksett Pool (Thermally influenced)	4/23/2008	Boat Electrofish	505	1,325
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	512	1,580
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	500	1,350
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	454	1,400
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	490	1,390
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	504	1,450
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	478	1,240
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	506	1,320
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	466	1,210
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	508	1,620
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	477	1,360
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	431	895
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	468	1,040
White sucker	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	454	940
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	542	1,790
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	466	990
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	461	980
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	528	1,760
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	513	1,460
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	503	1,470
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	484	1,392
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	427	880
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	485	1,275
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	479	1,430
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	470	1,160
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	383	730
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	462	1,150
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	516	1,490
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	430	860
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	416	805
White sucker	Hooksett Pool (Thermally influenced)	4/30/2008	Boat Electrofish	504	1,640
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	489	1,308
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	438	885
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	521	1,385
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	502	1,440

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	487	1,240
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	532	1,790
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	481	1,210
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	500	1,220
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	483	1,410
White sucker	Hooksett Pool (Thermally influenced)	5/2/2008	Boat Electrofish	442	970
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	202	99
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	189	70
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	201	90
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	235	150
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	176	68
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	182	72
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	318	382
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	361	545
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	230	150
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	224	165
White sucker	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	203	100
White sucker	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	267	221
White sucker	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	227	100
White sucker	Hooksett Pool (Thermally influenced)	10/3/2008	Boat Electrofish	495	1,600
White sucker	Hooksett Pool (Thermally influenced)	10/3/2008	Boat Electrofish	317	361
White sucker	Hooksett Pool (Thermally influenced)	10/3/2008	Boat Electrofish	492	1,500
White sucker	Hooksett Pool (Ambient)	4/16/2008	Boat Electrofish	116	13
White sucker	Hooksett Pool (Ambient)	4/16/2008	Boat Electrofish	141	25
White sucker	Hooksett Pool (Ambient)	4/21/2008	Boat Electrofish	455	985
White sucker	Hooksett Pool (Ambient)	4/21/2008	Boat Electrofish	480	1,380
White sucker	Hooksett Pool (Ambient)	4/21/2008	Boat Electrofish	450	1,030
White sucker	Hooksett Pool (Ambient)	4/21/2008	Boat Electrofish	504	1,285
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	483	1,328
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	493	1,421
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	474	1,488
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	516	1,615
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	432	924
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	488	1,400
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	486	1,328
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	478	1,145
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	497	1,428
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	504	1,564
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	499	1,530
White sucker	Hooksett Pool (Ambient)	4/23/2008	Boat Electrofish	440	1,098

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	478	1,510
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	443	955
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	497	1,380
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	432	860
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	494	1,330
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	527	1,450
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	504	1,280
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	499	1,220
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	465	1,690
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	503	1,440
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	460	1,010
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	418	835
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	418	848
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	502	1,500
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	440	1,080
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	481	1,280
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	500	1,540
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	487	1,250
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	504	1,440
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	430	938
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	471	1,280
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	492	1,360
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	488	1,270
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	487	1,280
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	479	1,270
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	497	1,470
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	148	32
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	286	280
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	73	4
White sucker	Hooksett Pool (Ambient)	4/24/2008	Boat Electrofish	99	8
White sucker	Hooksett Pool (Ambient)	4/28/2008	Boat Electrofish	442	1,088
White sucker	Hooksett Pool (Ambient)	4/28/2008	Boat Electrofish	480	1,440
White sucker	Hooksett Pool (Ambient)	4/28/2008	Boat Electrofish	458	1,200
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	347	490
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	514	1,705
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	389	740
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	416	755
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	439	910
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	473	1,240
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	490	1,410

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	345	510
White sucker	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	480	1,360
White sucker	Hooksett Pool (Ambient)	5/2/2008	Boat Electrofish	476	1,182
White sucker	Hooksett Pool (Ambient)	5/2/2008	Boat Electrofish	520	1,652
White sucker	Hooksett Pool (Ambient)	5/2/2008	Boat Electrofish	503	1,460
White sucker	Hooksett Pool (Ambient)	5/2/2008	Boat Electrofish	444	968
White sucker	Hooksett Pool (Ambient)	5/2/2008	Boat Electrofish	475	1,495
White sucker	Hooksett Pool (Ambient)	5/2/2008	Boat Electrofish	502	1,260
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	167	49
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	146	40
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	163	50
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	177	60
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	173	58
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	164	48
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	176	58
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	155	48
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	138	30
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	146	32
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	140	30
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	134	25
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	133	25
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	123	21
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	128	20
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	168	50
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	174	60
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	174	59
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	175	60
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	179	62
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	115	14
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	113	15
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	127	21
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	126	19
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	129	21
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	123	21
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	125	20
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	164	50
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	143	30
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	142	31
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	158	49
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	149	40

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	149	39
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	143	30
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	135	29
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	143	30
White sucker	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	128	22
White sucker	Hooksett Pool (Ambient)	9/4/2008	0.75" mesh trap net	476	1,055
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	172	60
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	178	58
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	160	49
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	135	25
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	147	28
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	150	40
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	157	41
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	143	30
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	140	30
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	134	27
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	146	35
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	178	60
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	210	105
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	209	105
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	176	60
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	180	70
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	164	48
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	179	62
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	167	50
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	156	42
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	313	380
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	240	155
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	217	118
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	122	20
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	123	21
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	132	25
White sucker	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	156	45
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	114	85
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	139	31
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	434	990
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	251	199
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	240	169
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	186	76
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	202	97

Common Name	Zone	Collection Date	Method	Length	Weight
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	304	331
White sucker	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	226	126
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	129	25
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	122	12
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	171	59
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	163	42
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	138	30
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	156	51
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	122	21
White sucker	Hooksett Pool (Ambient)	10/7/2008	Boat Electrofish	110	14
White sucker	Amoskeag Pool	4/17/2008	Boat Electrofish	122	16
White sucker	Amoskeag Pool	4/22/2008	Boat Electrofish	516	1,500
White sucker	Amoskeag Pool	4/22/2008	Boat Electrofish	271	222
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	554	2,110
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	433	900
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	490	1,240
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	130	20
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	452	1,180
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	414	850
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	455	1,100
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	517	1,620
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	395	730
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	348	550
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	433	875
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	450	1,100
White sucker	Amoskeag Pool	4/25/2008	Boat Electrofish	429	850
White sucker	Amoskeag Pool	4/28/2008	Boat Electrofish	474	1,648
White sucker	Amoskeag Pool	5/1/2008	Boat Electrofish	507	1,790
White sucker	Amoskeag Pool	5/1/2008	Boat Electrofish	437	1,060
White sucker	Amoskeag Pool	5/2/2008	Boat Electrofish	512	1,635
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	96	5
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	202	190
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	245	211
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	137	28
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	144	30
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	208	94
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	234	135
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	247	137
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	269	210
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	240	148

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	229	130
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	228	123
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	221	125
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	210	110
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	195	74
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	258	230
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	297	283
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	291	255
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	295	262
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	267	200
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	247	169
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	223	120
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	252	190
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	236	165
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	238	150
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	229	135
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	224	120
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	218	112
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	194	80
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	201	90
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	171	50
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	177	56
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	164	48
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	130	23
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	278	222
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	286	250
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	249	180
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	303	310
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	338	436
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	234	142
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	240	148
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	236	140
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	304	320
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	229	141
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	228	138
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	228	123
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	203	90
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	238	158
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	178	60
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	255	180

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	269	222
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	245	163
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	232	140
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	265	202
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	213	105
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	217	110
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	292	270
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	225	130
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	221	143
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	235	150
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	105	10
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	276	220
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	276	262
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	231	132
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	273	232
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	238	130
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	249	155
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	245	148
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	234	132
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	253	172
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	256	170
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	236	155
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	230	141
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	167	49
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	233	135
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	226	110
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	234	165
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	237	150
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	219	125
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	256	195
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	216	115
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	292	255
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	236	136
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	233	135
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	237	180
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	246	170
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	213	122
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	229	140
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	237	140
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	226	131

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	214	112
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	214	106
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	197	90
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	194	78
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	187	70
Yellow perch	Garvin's Pool	4/18/2008	Boat Electrofish	173	58
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	200	92
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	195	85
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	199	83
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	177	54
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	191	76
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	171	48
Yellow perch	Garvin's Pool	4/21/2008	0.75" mesh trap net	166	44
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	254	187
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	294	276
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	236	128
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	233	149
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	222	126
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	206	93
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	221	121
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	241	133
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	212	108
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	203	84
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	233	126
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	209	108
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	228	125
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	222	118
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	198	83
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	207	100
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	205	96
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	199	87
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	198	71
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	196	84
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	188	73
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	182	65
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	184	66
Yellow perch	Garvin's Pool	4/21/2008	2.0" mesh trap net	186	63
Yellow perch	Garvin's Pool	4/22/2008	2.0" mesh trap net	279	232
Yellow perch	Garvin's Pool	4/22/2008	2.0" mesh trap net	226	117
Yellow perch	Garvin's Pool	4/22/2008	2.0" mesh trap net	236	132

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Garvin's Pool	4/22/2008	2.0" mesh trap net	207	110
Yellow perch	Garvin's Pool	4/22/2008	2.0" mesh trap net	198	81
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	238	150
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	240	210
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	223	140
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	98	8
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	192	75
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	197	90
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	188	79
Yellow perch	Garvin's Pool	4/23/2008	0.75" mesh trap net	198	80
Yellow perch	Garvin's Pool	4/23/2008	2.0" mesh trap net	249	238
Yellow perch	Garvin's Pool	4/23/2008	2.0" mesh trap net	222	125
Yellow perch	Garvin's Pool	4/23/2008	2.0" mesh trap net	224	100
Yellow perch	Garvin's Pool	4/23/2008	2.0" mesh trap net	245	178
Yellow perch	Garvin's Pool	4/24/2008	0.75" mesh trap net	250	170
Yellow perch	Garvin's Pool	4/24/2008	0.75" mesh trap net	291	260
Yellow perch	Garvin's Pool	4/24/2008	0.75" mesh trap net	234	145
Yellow perch	Garvin's Pool	4/24/2008	0.75" mesh trap net	222	135
Yellow perch	Garvin's Pool	4/24/2008	0.75" mesh trap net	183	68
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	288	288
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	267	260
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	323	420
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	250	185
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	269	285
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	270	210
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	230	140
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	208	100
Yellow perch	Garvin's Pool	4/24/2008	2.0" mesh trap net	195	85
Yellow perch	Garvin's Pool	5/1/2008	Boat Electrofish	183	75
Yellow perch	Garvin's Pool	5/1/2008	Boat Electrofish	194	85
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	241	179
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	215	118
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	187	65
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	137	28
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	126	21
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	127	21
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	127	20
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	123	19
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	130	25
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	125	20

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	118	20
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	80	5
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	82	5
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	64	2
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	150	39
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	78	3
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	142	31
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	125	19
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	119	19
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	80	5
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	261	230
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	287	285
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	233	131
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	218	128
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	118	98
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	169	55
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	73	3
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	144	35
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	134	25
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	118	20
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	126	21
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	127	20
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	158	40
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	144	30
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	127	21
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	108	15
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	123	21
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	123	19
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	130	28
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	138	31
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	143	35
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	126	24
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	136	30
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	132	22
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	135	30
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	132	22
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	146	31
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	126	21
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	128	22
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	136	28

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	116	18
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	128	25
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	118	18
Yellow perch	Garvin's Pool	9/3/2008	Boat Electrofish	115	14
Yellow perch	Garvin's Pool	9/3/2008	0.75" mesh trap net	252	190
Yellow perch	Garvin's Pool	9/3/2008	0.75" mesh trap net	90	8
Yellow perch	Hooksett Pool (Thermally influenced)	4/16/2008	Boat Electrofish	263	209
Yellow perch	Hooksett Pool (Thermally influenced)	4/16/2008	Boat Electrofish	230	158
Yellow perch	Hooksett Pool (Thermally influenced)	4/16/2008	Boat Electrofish	154	40
Yellow perch	Hooksett Pool (Thermally influenced)	4/16/2008	Boat Electrofish	129	22
Yellow perch	Hooksett Pool (Thermally influenced)	4/16/2008	Boat Electrofish	118	16
Yellow perch	Hooksett Pool (Thermally influenced)	4/21/2008	Boat Electrofish	227	113
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	274	272
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	262	180
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	278	240
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	208	100
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	209	102
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	150	35
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	144	25
Yellow perch	Hooksett Pool (Thermally influenced)	4/24/2008	Boat Electrofish	123	20
Yellow perch	Hooksett Pool (Thermally influenced)	4/29/2008	Trot line	171	59
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	232	168
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	148	40
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	182	80
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	196	100
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	201	100
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	183	78
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	179	75
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	146	40
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	174	70
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	169	60
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	153	45
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	113	18
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	109	15
Yellow perch	Hooksett Pool (Thermally influenced)	9/4/2008	Boat Electrofish	106	13
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	107	18
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	161	52
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	173	68
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	197	100
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	250	215

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	139	50
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	162	45
Yellow perch	Hooksett Pool (Thermally influenced)	9/5/2008	Boat Electrofish	258	222
Yellow perch	Hooksett Pool (Thermally influenced)	10/3/2008	Boat Electrofish	171	56
Yellow perch	Hooksett Pool (Thermally influenced)	10/3/2008	Boat Electrofish	142	31
Yellow perch	Hooksett Pool (Thermally influenced)	10/3/2008	Boat Electrofish	118	16
Yellow perch	Hooksett Pool (Thermally influenced)	10/7/2008	Boat Electrofish	274	265
Yellow perch	Hooksett Pool (Thermally influenced)	10/7/2008	Boat Electrofish	75	3
Yellow perch	Hooksett Pool (Thermally influenced)	10/8/2008	Boat Electrofish	112	19
Yellow perch	Hooksett Pool (Thermally influenced)	10/8/2008	Boat Electrofish	84	8
Yellow perch	Hooksett Pool (Thermally influenced)	10/8/2008	Boat Electrofish	67	2
Yellow perch	Hooksett Pool (Thermally influenced)	10/8/2008	Boat Electrofish	79	7
Yellow perch	Hooksett Pool (Thermally influenced)	10/8/2008	Boat Electrofish	77	7
Yellow perch	Hooksett Pool (Ambient)	4/29/2008	Trot line	323	332
Yellow perch	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	111	11
Yellow perch	Hooksett Pool (Ambient)	4/30/2008	Boat Electrofish	113	12
Yellow perch	Hooksett Pool (Ambient)	4/30/2008	Trot line	203	90
Yellow perch	Hooksett Pool (Ambient)	4/30/2008	Trot line	182	62
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	113	15
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	78	4
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	81	6
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	94	10
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	99	11
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	87	9
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	100	14
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	120	20
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	117	20
Yellow perch	Hooksett Pool (Ambient)	9/4/2008	Boat Electrofish	219	102
Yellow perch	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	88	9
Yellow perch	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	89	10
Yellow perch	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	70	2
Yellow perch	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	170	62
Yellow perch	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	166	60
Yellow perch	Hooksett Pool (Ambient)	9/5/2008	Boat Electrofish	152	40
Yellow perch	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	105	13
Yellow perch	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	114	17
Yellow perch	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	107	13
Yellow perch	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	123	21
Yellow perch	Hooksett Pool (Ambient)	10/2/2008	Boat Electrofish	107	14
Yellow perch	Hooksett Pool (Ambient)	10/8/2008	Boat Electrofish	66	1

Common Name	Zone	Collection Date	Method	Length	Weight
Yellow perch	Hooksett Pool (Ambient)	10/8/2008	Boat Electrofish	73	2
Yellow perch	Hooksett Pool (Ambient)	10/8/2008	Boat Electrofish	67	1
Yellow perch	Amoskeag Pool	4/17/2008	Boat Electrofish	118	15
Yellow perch	Amoskeag Pool	4/22/2008	Boat Electrofish	61	2
Yellow perch	Amoskeag Pool	4/22/2008	Boat Electrofish	46	1
Yellow perch	Amoskeag Pool	4/25/2008	Boat Electrofish	95	10
Yellow perch	Amoskeag Pool	4/25/2008	Boat Electrofish	92	8
Yellow perch	Amoskeag Pool	4/25/2008	Boat Electrofish	78	4
Yellow perch	Amoskeag Pool	4/28/2008	Boat Electrofish	55	1
Yellow perch	Amoskeag Pool	4/28/2008	Boat Electrofish	55	1
Yellow perch	Amoskeag Pool	4/28/2008	Boat Electrofish	52	1

APPENDIX B

Age-length keys constructed for yellow perch and white sucker captured by electrofishing from Garvin's Pool, thermally influenced Hooksett Pool, ambient Hooksett Pool, and Amoskeag Pool during the spring and fall 2008.

Electrofishing, White sucker, Garvin's Pool

Total Length Class (mm)	Total Measured Fish	Age of Fish														Aged	
		2		3		4		5		6		7		8			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
170-179	1			1	11.11											1	4.17
190-199	1			1	11.11											1	4.17
200-209	3	1	50	1	11.11	1	33.33									3	12.5
210-219	1			1	11.11											1	4.17
220-229	2	1	50	1	11.11											2	8.33
230-239	1			1	11.11											1	4.17
270-279	2			1	11.11	1	33.33									2	8.33
280-289	1			1	11.11											1	4.17
300-309	1			1	11.11											1	4.17
340-349	2					1	33.33			1	25					2	8.33
370-379	1							1	50							1	4.17
400-409	2							1	50	1	25					2	8.33
440-449	1											1	50			1	4.17
450-459	1									1	25					1	4.17
470-479	1											1	50			1	4.17
480-489	1									1	25					1	4.17
500-509	2													2	100	2	8.33
Total	**24**	**2**	**100**	**9**	**100**	**3**	**100**	**2**	**100**	**4**	**100**	**2**	**100**	**2**	**100**	**24**	**100**

Electrofishing, White sucker, Hooksett Pool (Thermally influenced)

Total Length Class (mm)	Total Measured Fish	Age of Fish																						Aged	
		1		2		3		5		6		7		8		9		10		11		12			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
170-179	1	1	100																					1	1.37
180-189	2			2	33.33																			2	2.74
200-209	3			2	33.33	1	20																	3	4.11
220-229	2			1	16.67	1	20																	2	2.74
230-239	2			1	16.67	1	20																	2	2.74
260-269	1					1	20																	1	1.37
310-319	2					1	20	1	33.33															2	2.74
360-369	1									1	14.29													1	1.37
380-389	2							1	33.33	1	14.29													2	2.74
410-419	1							1	33.33															1	1.37
420-429	3									1	14.29	1	8.33	1	5									3	4.11
430-439	3									2	28.57	1	8.33											3	4.11
440-449	2									1	14.29	1	8.33											2	2.74
450-459	3											2	16.67	1	5									3	4.11
460-469	6									1	14.29	2	16.67	2	10	1	9.09							6	8.22
470-479	5											2	16.67	2	10	1	9.09							5	6.85
480-489	9											2	16.67	6	30	1	9.09							9	12.33
490-499	4											1	8.33	3	15									4	5.48
500-509	11													5	25	5	45.45	1	20					11	15.07
510-519	4															1	9.09	3	60					4	5.48
520-529	3															2	18.18					1	50	3	4.11
530-539	1																			1	100			1	1.37
540-549	2																	1	20			1	50	2	2.74
Total	**73**	**1**	**100**	**6**	**100**	**5**	**100**	**3**	**100**	**7**	**100**	**12**	**100**	**20**	**100**	**11**	**100**	**5**	**100**	**1**	**100**	**2**	**100**	**73**	**100**

Electrofishing, White sucker, Hooksett Pool (Ambient)

Total Length Class (mm)	Total Measured Fish	Age of Fish																								Aged	
		1		2		3		4		5		6		7		8		9		10		11		12			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
70-79	1	1	3.7																							1	0.7
90-99	1	1	3.7																							1	0.7
110-119	4	4	14.81																							4	2.82
120-129	13	10	37.04	3	6.38																					13	9.15
130-139	9	5	18.52	4	8.51																					9	6.34
140-149	14	4	14.81	10	21.28																					14	9.86
150-159	7			7	14.89																					7	4.93
160-169	9	1	3.7	8	17.02																					9	6.34
170-179	13			12	25.53	1	20																			13	9.15
180-189	2	1	3.7			1	20																			2	1.41
200-209	2			1	2.13			1	25																	2	1.41
210-219	2					1	20	1	25																	2	1.41
220-229	1			1	2.13																					1	0.7
240-249	2			1	2.13			1	25																	2	1.41
280-289	1					1	20																			1	0.7
300-309	1					1	20																			1	0.7
310-319	1							1	25																	1	0.7
340-349	1									1	50															1	0.7
380-389	1											1	7.14													1	0.7
410-419	3											3	21.43													3	2.11
430-439	5											3	21.43	1	8.33	1	5									5	3.52
440-449	5											3	21.43	1	8.33	1	5									5	3.52
450-459	3													3	25											3	2.11
460-469	2											1	7.14			1	5									2	1.41
470-479	8											2	14.29	1	8.33	4	20	1	12.5							8	5.63
480-489	10									1	50	1	7.14	3	25	5	25									10	7.04
490-499	9													3	25	4	20	2	25							9	6.34
500-509	8															3	15	4	50			1	100			8	5.63
510-519	2																	1	12.5					1	100	2	1.41
520-529	2															1	5			1	100					2	1.41
Total	142	27	100	47	100	5	100	4	100	2	100	14	100	12	100	20	100	8	100	1	100	1	100	1	100	142	100

Electrofishing, White sucker, Amoskeag Pool

Total Length Class (mm)	Total Measured Fish	Age of Fish																						Aged	
		1		2		4		5		6		7		8		9		10		11		12			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
120-129	1	1	100																					1	5
130-139	1			1	100																			1	5
270-279	1					1	50																	1	5
340-349	1					1	50																	1	5
390-399	1							1	50															1	5
410-419	1									1	50													1	5
420-429	1							1	50															1	5
430-439	3											2	40	1	50									3	15
450-459	3									1	50	2	40											3	15
470-479	1											1	20											1	5
490-499	1													1	50									1	5
500-509	1															1	100							1	5
510-519	3																	1	50	1	100	1	100	3	15
550-559	1																	1	50					1	5
Total	20	1	100	1	100	2	100	2	100	2	100	5	100	2	100	1	100	2	100	1	100	1	100	20	100

Electrofishing, Yellow perch, Garvin's Pool

Total Length Class (mm)	Total Measured Fish	Age of Fish 0		1		2		3		4		5		6		7		8		9		10		11		Aged	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
60-69	1	1	100																							1	0.69
70-79	2			2	11.11																					2	1.38
80-89	3			3	16.67																					3	2.07
90-99	1			1	5.56																					1	0.69
100-109	2			2	11.11																					2	1.38
110-119	7			1	5.56	5	33.33	1	4.35																	7	4.83
120-129	15			6	33.33	6	40	3	13.04																	15	10.34
130-139	12			3	16.67	1	6.67	8	34.78																	12	8.28
140-149	6					3	20	3	13.04																	6	4.14
150-159	2							2	8.7																	2	1.38
160-169	3							3	13.04																	3	2.07
170-179	4							1	4.35	3	33.33															4	2.76
180-189	3							1	4.35	1	11.11			1	7.14											3	2.07
190-199	5									1	11.11	2	18.18	2	14.29											5	3.45
200-209	4							1	4.35	1	11.11					1	4.17	1	6.67							4	2.76
210-219	11									3	33.33	5	45.45	2	14.29	1	4.17									11	7.59
220-229	13											2	18.18	4	28.57	4	16.67	1	6.67	2	16.67					13	8.97
230-239	20											1	9.09	3	21.43	9	37.5	5	33.33	2	16.67					20	13.79
240-249	11													2	14.29	3	12.5	2	13.33	3	25	1	50			11	7.59
250-259	5															2	8.33	1	6.67	2	16.67					5	3.45
260-269	4															1	4.17	2	13.33	1	8.33					4	2.76
270-279	3																	2	13.33	1	8.33					3	2.07
280-289	2											1	9.09					1	6.67							2	1.38
290-299	4															2	8.33			1	8.33			1	100	4	2.76
300-309	2															1	4.17					1	50			2	1.38
Total	145	1	100	18	100	15	100	23	100	9	100	11	100	14	100	24	100	15	100	12	100	2	100	1	100	145	100

Electrofishing, Yellow perch, Hooksett Pool (Thermally influenced)

Total Length Class (mm)	Total Measured Fish	Age of Fish																		Aged	
		0		1		2		3		4		5		6		7		9			
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
60-69	1	1	20																	1	2.22
70-79	3	3	60																	3	6.67
80-89	1	1	20																	1	2.22
100-109	3			3	33.33															3	6.67
110-119	4			4	44.44															4	8.89
120-129	2			1	11.11	1	11.11													2	4.44
130-139	1					1	11.11													1	2.22
140-149	4			1	11.11	2	22.22	1	12.5											4	8.89
150-159	3					2	22.22	1	12.5											3	6.67
160-169	3					2	22.22	1	12.5											3	6.67
170-179	4					1	11.11	3	37.5											4	8.89
180-189	2							1	12.5	1	25									2	4.44
190-199	2									2	50									2	4.44
200-209	3									1	25	1	50			1	20			3	6.67
230-239	2							1	12.5			1	50							2	4.44
250-259	2													1	50	1	20			2	4.44
260-269	2															2	40			2	4.44
270-279	3													1	50	1	20	1	100	3	6.67
Total	**45**	**5**	**100**	**9**	**100**	**9**	**100**	**8**	**100**	**4**	**100**	**2**	**100**	**2**	**100**	**5**	**100**	**1**	**100**	**45**	**100**

Electrofishing, Yellow perch, Hooksett Pool (Ambient)

Total Length Class (mm)	Total Measured Fish	Age of Fish										Aged	
		0		1		2		3		4			
		N	%	N	%	N	%	N	%	N	%	N	%
60-69	2	2	50									2	7.69
70-79	3	2	50	1	6.67							3	11.54
80-89	4			4	26.67							4	15.38
90-99	2			2	13.33							2	7.69
100-109	4			4	26.67							4	15.38
110-119	5			3	20	2	66.67					5	19.23
120-129	2			1	6.67	1	33.33					2	7.69
150-159	1							1	50			1	3.85
160-169	1							1	50			1	3.85
170-179	1									1	50	1	3.85
210-219	1									1	50	1	3.85
Total	26	**4**	**100**	**15**	**100**	**3**	**100**	**2**	**100**	**2**	**100**	**26**	**100**

Electrofishing, Yellow perch, Amoskeag Pool

Total Length Class (mm)	Total Measured Fish	Age of Fish				Aged	
		1		2			
		N	%	N	%	N	%
40-49	1	1	14.29			1	12.5
50-59	2	2	28.57			2	25
60-69	1	1	14.29			1	12.5
70-79	1	1	14.29			1	12.5
90-99	2	2	28.57			2	25
110-119	1			1	100	1	12.5
Total	**8**	7	**100**	**1**	**100**	**8**	**100**