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Angler Survey of the Connecticut River

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STATE OF CONNECTICUT

Department of Environmental Protection

Bureau of Natural Resources

Fisheries Division

Federal Aid in Sport Fish Restoration

F-57-R-29

Final Report

Grant Title: **INLAND FISHERIES RESEARCH AND MANAGEMENT**

Study 3: **Inland Fisheries Operation**

Job 3: **Angler Survey of the Connecticut River and Candlewood Lake**

Part B: **Connecticut River Angler Survey**

Period Covered: April 1, 2005 - March 31, 2011

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Table of Contents

Section **Page**

Acknowledgements…….……. i

Executive Summary……. ii

Introduction…….. 1

Objectives…….. 2

Methods……. 2
Bus Stop Survey Design……..... 2
Supplementary Surveys……... 4
Estimation of Angler Effort, Catch, and Harvest During 2008-09……..... 5
Summarizing 2008-09 Angler Attributes and Attitudes…….. 6
Comparing the 1997-98 and 2008-09 Surveys…….. 6
Assessing Validity and Performance of the Survey Design……..... 7

Work Performed/Results…….…… 8
Summary of 2008-09 Survey Operations…… 8
Angler Effort, Catch, and Harvest during 2008-09…… 9
2008-09 Angler Attributes and Attitudes..……..... 18
Comparisons of the 1997-98 and 2008-09 Surveys…… 19
Validity and Performance of the Survey Design…….…..……..... 24

Summary and Conclusions……..……. 28

Recommendations…….…… 30

References…….…… 31

Appendices…….…...…… 33

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Many Inland Fisheries Division staff members spent considerable time surveying or assisting with data analyses.

Executive Summary

Study 2: Inland Fisheries Operations
Job 3: Angler Survey of the Connecticut River and Candlewood Lake
Part B: Connecticut River Angler Survey
Federal Aid Project: F57R (Federal Aid to Sport Fish Restoration)
Segment Date: April 1, 2005 - March 31, 2010

Purposes of the Job

The Connecticut Inland Fisheries Division (IFD) often uses angler surveys to gather important information concerning the State's fisheries resources. Historically, most surveys have been performed on relatively small lakes or river sections. However, the State's two largest freshwater fishery resources, Candlewood Lake and the Connecticut River, have never been comprehensively surveyed due to their large sizes, diverse fisheries, and complex geographies. These two important resources are unique and will therefore require distinct angler surveys with customized methodologies. Thus, this project is split into two separate parts. The following covers work done on Part B, The Connecticut River, during the period April 1, 2005 to March 31, 2011.

The Connecticut River runs 70 miles through the center of Connecticut, from the Massachusetts border to Long Island Sound, and supports fisheries for freshwater, marine, and anadromous species. Significant improvements in water quality over the past 30 years have led to increased public use of the river, which may have increased fishing pressure. Increased angling activity may result in high harvest rates for some gamefish and decreased fishing quality. As such, the Inland Fisheries Division needs to document angler effort, catch and harvest throughout the Connecticut River to ensure effective conservation and management of its fishery resources. Collecting information on angler attributes (e.g. town of residence) and attitudes (e.g. about harvesting fish) will also inform management decision-making.

The purpose of Study 3 is to provide services to the angling public to ensure the proper protection and management of Connecticut's fishery resources. The purpose of Part B of this Job is to obtain information on angler use of the Connecticut River by completing an angler survey.

Objectives:

- Conduct a "bus stop" angler survey to determine current angler effort, catch, harvest, attributes, and attitudes on the portion of the Connecticut River within the State of Connecticut.
- Compare survey results to those of the 1997-98 Connecticut River angler survey to determine changes in angler effort, catch, and harvest.
- Assess the validity and performance of the 2008-09 survey design.

Methods:

- The 2008-09 Connecticut River angler survey followed a bus stop survey design almost identical to that of the 1997-98 survey:
  - The river was divided into four geographical survey Zones. Zones 1 (River mouth-Haddam), 2 (Haddam-Middletown), and 3 (Middletown-Hartford) were replicated from the 1997-98 survey; a fourth Zone (Hartford-MA border) was added to provide complete coverage of the river. Zones 3-4 were surveyed during 2008. Zones 1-2 were surveyed during 2009.

- Within Zones 1-3, the 1997-98 bus stops (defined areas of shoreline visited by survey agents during a survey day) were replicated during 2008-09. Bus stops for Zone 4 were selected based on preliminary surveys and interviews with local experts conducted during 2006-07.
- The "open-water" period (March-October) was divided into four two-month Seasons: Season 1 (March-April), Season 2 (May-June), Season 3 (July-August), and Season 4 (September-October). Each Season was stratified by day-type (weekend vs. weekday). Within day-type strata, survey days were allocated evenly between morning and afternoon start times. One weekend and two weekday survey days were conducted in each Zone during each calendar week, resources permitting.

- During a bus stop survey day, agents traveled to all the bus stops within a Zone. Upon arrival at a bus stop, agents counted all shore anglers and boat trailers (as a proxy for boat anglers, sites with boat launches only). Agents then remained at the bus stop for a pre-determined "wait time" (sites with heavier use had longer wait times), interviewing as many anglers as possible using a standardized interview form (angler interviews) and documenting arrivals/departures of shore anglers and boat trailers.
- Angler interviews garnered information on angler trip lengths, catch, harvest, attributes (e.g. gender, age, town of residence), and attitudes (e.g. attitudes towards harvesting fish from the Connecticut River).
- Two types of supplementary data were required to accurately estimate angler effort from bus stop survey data: 1) the proportion of shore angling effort within a Zone that occurred at bus stops; and 2) the proportion of boat trailers at bus stops that belonged to anglers. Two types of supplementary surveys were conducted to address these data needs:
  - During boat launch survey days, agents visited one or two bus stops with boat launches and interviewed boating parties to determine if they were anglers (launch usage interviews). Agents also obtained angler interviews from as many individual boat anglers as possible.
  - During on-water survey days, agents made two complete passes through a Zone by boat. During each pass, agents counted all shore anglers fishing inside and outside of bus stops (a shore angler count). Agents also intercepted as many boating parties as possible and obtained launch usage interviews. Angler interviews were also obtained from all boat anglers encountered.
- Whenever possible, supplementary surveys were planned to occur concurrently with a bus stop survey to bolster the numbers of boat angler interviews obtained on bus stop survey days (only angler interviews obtained during a bus stop survey day could be used for catch/harvest calculations).
- Angler effort for an entire fishing day (the entire daylight period during which a bus stop survey day took place) was estimated by applying the Time Interval Count Estimator (Pollock et al. 1994) to shore angler and boat trailer counts made during a bus stop survey day. Daily effort was estimated separately for boat and shore angling.
- Proportional correction factors derived from supplementary survey data were used to: a) correct daily shore effort estimates to account for effort occurring at non-bus-stop locations (shore angler expansion values); and b) correct daily boat effort estimates to account for the proportion of trailers at bus stops that belonged to recreational boaters (boat trailer expansion values).
- Corrected daily effort estimates were used in conjunction with daily interview data on angler catch and harvest rates to estimate daily catch and harvest of various species by shore and boat anglers.
- The stratified calculation approach of Pollock et al. (1994) was used to estimate total angler effort, catch, and harvest for each Season within each Zone as well as totals of these quantities for the entire open-water period within each Zone. Annual open-water effort, catch, and harvest for the entire river were approximated by combining Zone 3 and 4 totals from 2008 with Zone 1 and 2 totals from 2009.
- Data on angler attributes and attitudes were used to characterize the Connecticut River angler populations. Data summarized included age, gender, towns of residence, median distances traveled to reach bus stops, and attitudes about harvesting fish from the Connecticut River.

- Raw data from the 1997-98 survey were re-analyzed for this report. The following quantities were compared between surveys to assess decadal changes in fishing activity on the Connecticut River:
  - Boat and shore angler effort by Zone (all Seasons summed)
  - Boat and shore angler effort by Season within Zones
  - Mean counts of shore anglers and boat trailers at bus stops by Season/day-type
  - Percentages of anglers targeting various species by Season within each Zone
  - Directed effort for various species by Zone (all Seasons summed)
  - Catch and harvest of major fish species (all Zones/Seasons summed)
  - Catch and harvest of major fish species by Zone (all Seasons summed)
- Three important underlying assumptions of the bus stop survey design were: 1) the majority of boat anglers fishing within a Zone launch from bus stops within that Zone; 2) the majority of boat anglers launching at bus stops within a Zone remain in that Zone while fishing; and 3) the majority of shore anglers within a Zone fish at bus stops. Several lines of evidence were used to determine if these three assumptions were met for the 2008-09 survey.
- The effectiveness of concurrent supplementary surveys for bolstering boat angler interview totals was assessed, as was the relative efficiency of boat launch vs. on-water surveys for obtaining launch usage interviews.

Key Findings:

- Anglers spent an estimated 263,264 hours annually fishing on the Connecticut River during the open-water periods of 2008-09.
- Annual whole-river effort was evenly-split between boat and shore angling (131,972 boat angler-hrs vs. 131,292 shore angler-hrs). Effort was not, however, evenly distributed by boat and shore within each Zone. Shore effort was higher in Zones 1 and 3, while boat effort was higher in Zone 2. Angler effort was evenly-divided among modes in Zone 4.
- A general pattern of low angler effort during March-April, high effort during May-June, and gradually decreasing effort in July-October was evident in all Zones. This pattern was pronounced in Zone 3, where boat and shore effort during May-June of 2008 was at least double that recorded during any other Season.
- Anglers caught 35 different fish species on the Connecticut River during 2008-09. Eleven "major" fisheries (≥1,000 fish caught annually and/or relative standard errors of annual catch ≤0.50) were identified:
  - The <u>striped bass</u> fishery was the most intensive and widespread. Anglers spent an estimated 101,253 hours annually targeting striped bass during the open-water period, catching an estimated 39,699 fish (note that catch here and in the remainder of this summary refers to catch by all anglers, not just those targeting a particular species). More than half of anglers in each Zone targeted striped bass during March-June. Only 14% of striped bass caught were legal-sized under current regulations (28" minimum length limit). Anglers harvested 38% of legal-sized fish caught.
  - The <u>black bass</u> (largemouth and smallmouth bass in aggregate) fishery rivaled the striped bass fishery in terms of annual catch (39,357 fish), but attracted less than half the annual directed effort (46,797 angler-hrs). Most (80%) anglers targeting black bass were boat anglers. Fishing for black bass became popular north of Haddam as striped bass fishing tailed off in June; 30-50% of anglers targeted black bass during July-October in Zones 2-4. Very few black bass (1%) were harvested during 2008-09.
  - <u>White perch</u> attracted low annual directed effort (7,257 angler-hrs), yet annual catch was relatively high (27,298 fish) – a dynamic largely attributable to frequent catches by anglers targeting "anything". Most (88%) anglers targeting white perch fished from shore. The fishery was centered in the lower river and was most intense during spring: 15% of anglers targeted white perch in Zone 1 during March-April. White perch were harvested at a relatively high rate (39%).

- Bluefish attracted 16,521 angler-hrs of directed effort to Zone 1 during 2009, primarily during July-October. Virtually no bluefish angling occurred north of Haddam. Anglers caught 21,592 bluefish in Zone 1 during 2009; the majority (83%) were "snappers" <30 cm in length. Bluefish were harvested at a relatively high rate (24%).
- Sunfish species were primarily pursued by shore anglers (86% of anglers targeting sunfish fished from shore). Appreciable levels of directed effort and catch were only recorded in Zone 3. Anglers spent 2,377 hours targeting sunfish in Zone 3 during 2008, catching 5,553 fish. Sunfish harvest in Zone 3 was moderate (20%). No seasonal trend in the percentage of anglers targeting sunfish was apparent in any Zone.
- Fishing for American shad occurred almost entirely in Zone 4 during May-June. While brief, this fishery was relatively intense: 28% of anglers targeted shad in Zone 4 during May-June of 2008. Overall, Zone 4 anglers spent 9,252 hours targeting shad during 2008 and caught 7,347 fish, harvesting only 1%.
- Hickory shad supported a spatially disjointed fishery: directed effort and catch were limited almost exclusively to Zones 1 and 3 during 2008-09. The fishery was more intense in Zone 1 than Zone 3 (1,433 vs. 917 angler-hrs of directed effort, 4,522 vs. 1,382 fish caught). Almost all (97%) anglers targeting hickory shad fished from shore. The fishery was most popular during September-October. Harvest was moderate in Zone 1 (10%), but high in Zone 3 (65% - the second highest harvest rate for any species in any Zone).
- Catfish species supported a widespread yet low-intensity fishery that occurred over the entire open water period. Moderate totals of directed effort (1,063-5,500 angler-hrs) and catch (322-3,173 fish) were recorded in each Zone. Low percentages (<10%) of anglers targeted catfish in each Zone during almost all Seasons. The catfish fishery was relatively harvest-intensive (28% harvest rate overall).
- The black crappie fishery was limited almost exclusively to Zone 3, where anglers spent 2,579 hours targeting crappie during 2008, catching 4,145 fish. Most (85%) anglers targeting crappie fished from shore. Crappie angling was most popular in Zone 3 during September-October, when 7% of anglers targeted this species. Harvest rates were high (46%) in Zone 3.
- Yellow perch supported a small directed fishery in Zones 2-3 where anglers spent 1,433 hours annually targeting this species, catching 3,135 fish. Yellow perch angling was most popular during March–June. Low numbers of yellow perch were also caught in Zones 1 and 4 despite negligible directed effort, reflecting their relatively high rate of capture by anglers targeting "anything". The harvest rate for yellow perch varied widely among Zones (1%-51%).
- The northern pike fishery was characterized by moderate levels of directed effort and low catches. Anglers spent 14,143 hours annually targeting pike in Zones 2-4, with the majority of that effort occurring in Zone 2, but caught only 1,417 pike. The fishery was most intense during March-April in Zone 2, when 35% of anglers targeted pike. Pike harvest was minimal during 2008-09; only one harvested pike was observed by survey agents during the entirety of 2008-09 survey operations.

- Relatively high percentages (16-59%) of anglers reported that they were fishing for "anything" in each Zone/Season. "Anything" anglers were more likely to be shore anglers (77% of "anything" anglers fished from shore vs. 67% of all anglers interviewed). Boat "anything" anglers were more successful (47% caught at least one fish) than shore "anything" anglers (32% success rate). Common catches for successful boat "anything" anglers included black bass (caught by 18% of successful boat "anything" anglers), white perch (17%), yellow perch (13%), and striped bass (8%). Their shore-based counterparts frequently caught white perch (22%), striped bass (17%), sunfish (17%), bluefish (10%), and yellow perch (7%).
- Most (92%) anglers interviewed during 2008-09 were male.
- Shore angling attracted greater participation from younger anglers than boat angling. Generally, 40-50% of boat anglers in each Zone were 40-54 years old. Shore anglers were more evenly-distributed

across age brackets in each Zone, with relatively similar percentages of anglers between the ages of 20 and 49. The percentage of shore anglers younger than 20 (15%) was particularly high in Zone 4.

- The southernmost portion of the river had the widest geographical draw; Zone 1 attracted anglers from over half the towns in the State. The geographical draw of other Zones decreased in a northward fashion. The area generating trips to Zone 4 was particularly small, being limited primarily to adjacent towns.
- The distances traveled by anglers to fish at bus stops reflected the north-south disparity in geographical draw. The median distance traveled by anglers (boat and shore pooled) ranged between 30 and 40 miles for most Zone 1 bus stops, but was less than 10 miles for Zone 4 bus stops.
- A majority of Connecticut River anglers practice catch-and-release. Over 50% of anglers (all anglers and Zones pooled) indicated that they kept their target species "Rarely" or "Never"; only 31% of anglers said that they kept fish "Always" or "Most of the time". When asked "Why not?" the majority (60%) of anglers who answered "Rarely" or "Never" responded that they were "catch-and-release anglers." Similar percentages of respondents indicated that they didn't like to eat their target species (14%) or were afraid of toxins (15%).
- Estimated open-water angler effort (boat and shore combined) in Zones 1-3 declined by 29-32% between 1997-98 and 2008-09 (1997: 278,639 angler-hrs; 1998: 266,499 angler-hrs; 2008-09: 188,709 angler-hrs; note that the 2008-09 annual estimate is a combination of partial-river estimates from 2008 and 2009; also note that comparisons exclude effort in Zones 2-3 during March-April because these Zones were not surveyed during March-April of 1997-98).
- Estimated open-water shore effort in Zones 2 and 3 and boat effort in Zones 1 and 3 declined by 20-68% between 1997-98 and 2008-09. Shore effort in Zone 1 and boat effort in Zone 2 during 2008-09 fell within the range of 1997-98 estimates.
- Declines in open-water effort between 1997-98 and 2008-09 were largely the result of reduced angling activity during July-August. Declines of 41-85% in Season 3 effort were noted for boat angling in Zones 1 and 3 and shore angling in Zones 2 and 3. In addition, shore angling in Zone 2 during May-June declined by 58-66% between 1997-98 and 2008.
- Shore angler use of some bus stops declined notably between 1997-98 and 2008-09. In Zone 3, the mean number of shore anglers counted at both Charter Oak Landing and Wethersfield Cove declined substantially (45-95%) during May-August. In Zone 2, mean shore angler counts declined most substantially at Rushford Center during May-June (33-82%) and at Harbor Park during July-August (20-82%).
- Boater use of three major Zone 3 launches (Charter Oak Landing, Riverside Park, and Great River Park) also declined between 1997-98 and 2008-09. For example, the mean number of boat trailers counted at Riverside Park during July-August declined 86-95%.
- Catch of species typically targeted by shore anglers in Zones 1-3 during 1997-98 declined between 1997-98 and 2008-09 – a trend that reflects the observed declines in shore angler effort in Zones 2-3. Catches of catfish, sunfish, and white perch declined by 26-82% between 1997-98 and 2008-09; directed effort for these species declined in most Zones as well.
- Effort by anglers targeting "anything" (90% of whom fished from shore) decreased by 27-53% in Zones 2-3 between 1997-98 and 2008-09. This decline likely contributed to decreased catches of species such as catfish, sunfish, white perch, and yellow perch as these species were frequently caught by successful "anything" anglers during 1997-98.
- Harvest rates for almost all species either decreased between 1997-98 and 2008-09 or were within the range of 1997-98 estimates. For species that experienced lower harvest rates during 2008-09, the decline in absolute numbers of fish harvested was even greater than the decline in harvest rates as catches also decreased between 1997-98 and 2008-09.
- Underlying assumptions related to boat angling were met for Zones 3-4 but not Zones 1-2:
    - Concurrent counts of trailers at bus stop launches and boats on the river in Zones 3-4 during 2006 were relatively concordant. In addition, launch usage interviews collected during on-water

surveys in Zones 2-4 during 2008-09 indicated that the majority (>77%) of boat anglers within each of these Zones launched from bus stops within that Zone.
    - However, launch usage interviews collected in Zone 1 during 2009 revealed that a substantial percentage (48%) of the boat angling activity in this Zone originated from locations other than Zone 1 bus stops. In particular, a number of boat anglers launched from Zone 2 bus stops (Haddam Meadows Launch, Salmon River Launch) and then traveled to Zone 1 to fish.
    - Therefore, boat effort estimates for Zones 1 and 2 may have been biased low and high, respectively.
- Underlying assumptions related to shore angling were met for Zones 1-3 but not Zone 4.
    - Shore angler counts indicated that a majority (>50%) of shore anglers were observed at bus stops in Zones 1-3. Conversely, less than half of shore anglers were counted at bus stop sites in Zone 4 during almost all Season/day-types.
    - As shore angler expansion values for Zone 4 corrected for effort that occurred at non bus-stop locations, effort estimates were likely unbiased. However, if anglers at non bus-stop locations in Zone 4 generally targeted different species or experienced significantly different catch rates, directed effort and catch estimates for Zone 4 may have been biased.
- Both types of supplementary surveys (boat launch and on-water) made a significant contribution to the number of boat angler interviews collected. In each Zone, the number of boat angler interviews obtained during relatively infrequent concurrent supplementary surveys was greater than the number collected during all bus stop surveys combined.
- Concurrent on-water surveys were generally more effective than concurrent boat launch surveys for increasing boat angler interview totals. On-water surveys were also generally more efficient than boat launch surveys for obtaining launch usage interviews.

Conclusions:

- The 2008-09 angler survey revealed that the Connecticut River offers diverse fishing opportunities that attract substantial angler effort to the river on an annual basis. Anglers spent over 250,000 hours fishing on the Connecticut River during 2008-09, catching 35 different fish species.
- Angling activity on the Connecticut River has decreased over the last decade. Shore angler effort in Zones 2-3 and boat angler effort in Zones 1 and 3 decreased substantially between 1997-98 and 2008-09. Mean counts of anglers at many formerly high-use access points, particularly those near population centers, declined markedly between the two surveys. The generality of these declines should be investigated via comparisons to angler survey data collected on other Connecticut water bodies over the last decade.
- There was no evidence that angler impacts to Connecticut River fish populations have increased over the last decade. Overall angler effort decreased, as did overall catch and harvest of most species. Furthermore, a majority of 2008-09 Connecticut River anglers identified themselves as “catch-and-release” anglers. Given the lack of evidence for increased impacts, continuation of current CT River management practices with respect to harvest regulations is advisable.
- Open-water angler effort within Zones during 2008-09 was relatively equivalent; the geographical draw of different Zones, however, varied substantially - as did relative angler use of different access areas within Zones. Within Zones, the relative quality of access points did not explain their relative use or geographical draw. Angler motivations for use of various access points warrant further investigation.
- Under-utilized shore access locations such as Charter Oak Landing, Harbor Park, and Wethersfield Cove offer opportunities for IFD initiatives to increase angling participation by youths and urban residents. These sites are ideal because of their high-quality access, proximity to population centers, and the demonstrated attractiveness of Connecticut River shore angling to younger anglers.
- The design of the 2008-09 Connecticut River angler survey was generally appropriate and successful. Future surveys should consider incorporation of corrections for demonstrated sources of bias in Zone

1 and 2 boat effort estimates. The Zone 4 bus stop route should be altered to increase proportions of shore anglers encountered during bus stops survey days. The accuracy and precision of boat angler catch and harvest estimates from future surveys may also be improved by conducting more frequent concurrent supplementary surveys.

Recommendations:

- Conduct an angler survey on the Connecticut River again in 5-10 years using the design established for the 2008-09 survey.
- During future bus stop angler surveys on the Connecticut River and other large rivers that support significant boat angling activity, consider conducting concurrent supplementary surveys on a majority or all of bus stop survey days to improve accuracy and precision of catch and harvest estimates.
- Investigate angler motivations for using various access sites on the Connecticut River. Use this information to improve existing access and target new access areas for acquisition.
- Investigate potential marketing strategies for increasing participation in Connecticut River fishing in general and use of under-utilized access points in particular.
- Determine the generality of declines in angling activity on the Connecticut River via comparisons to angler survey data collected on other Connecticut water bodies over the last decade.
- Continue existing management of Connecticut River fisheries with respect to harvest regulations.

Introduction

The Connecticut River is perhaps the most diverse inland fishery resource in the State of Connecticut. The lower 34 km of the river is estuarine (Boyd 2004) and provides seasonal nursery and feeding grounds for marine sportfishes including bluefish (*Pomatomus saltatrix*), striped bass (*Morone saxatilis*) and summer flounder (*Paralichthys dentatus*) (Howell and Molnar 1999; Marcy 2004). The 78 km freshwater portion of the river varies greatly in gradient, depth, and riparian zone. These varied habitats foster a diverse assemblage of riverine fish species, including sportfishes such as smallmouth bass (*Micropterus dolomieu*), northern pike (*Esox lucius*), and channel catfish (*Ictalurus punctatus*) (Jacobs et al. 2004). Coves and backwaters along the river's length provide additional fishing opportunities for largemouth bass (*Micropterus salmoides*), sunfishes (*Lepomis spp.*), black crappie (*Pomoxis nigromaculatus*), and brown bullhead (*Ameiurus nebulosus*) (Jacobs et al. 2004). Finally, anadromous American shad (*Alosa sapidissima*) make annual spawning migrations into the Connecticut River that support a brief but historically important fishery (Gephard et al. 2004).

Significant improvements in water quality during 1970-90 (Mullaney 2004) created a renewed interest in recreational use of the Connecticut River (Jacobson et al. 2004). Increased recreational use presumably created increased fishing pressure, which potentially elevated harvest rates for some gamefish and concomitantly decreased fishing quality. However, except for periodic spring surveys of American shad and striped bass anglers on the river north of Hartford (Savoy and Benway 2006), no comprehensive angler survey had ever been conducted on the river.

Recognizing the need for more comprehensive data, the CTDEP conducted the first large-scale angler survey of the Connecticut River during 1997-98 (Howell and Molnar 1999). This survey employed a "bus stop" design (Jones and Robson 1991; Pollock et al. 1994) and covered the river stretch south of Hartford. The 1997-98 survey documented the intense and diverse nature of Connecticut River fisheries; anglers spent over 250,000 hours annually fishing on the river south of Hartford and caught over 400,000 fish annually of 30 different species (Howell and Molnar 1999). The 1997-98 survey also provided a valuable methodological template for future surveys.

The 1997-98 angler survey provided extensive spatial and temporal coverage but was not comprehensive. Only a limited portion of the river was surveyed during March-April, and the

river north of Hartford was not surveyed at all. The information from that survey is now also over a decade old. Accordingly, the CTDEP Inland Fisheries Division (IFD) decided to conduct an angler survey on the entire portion of the Connecticut River within the State of Connecticut during the "open-water" periods (March-October) of 2008-09. This survey was intended to provide a comprehensive and contemporary picture of the river's fisheries. It also provided an opportunity to assess decadal changes in Connecticut River fishing activity via comparisons to the 1997-98 survey.

Objectives

- Conduct an angler survey to determine current angler effort, catch, harvest, attributes, and attitudes on the portion of the Connecticut River within the State of Connecticut.
- Compare survey results to those of the 1997-98 Connecticut River angler survey to determine changes in angler effort, catch, and harvest.
- Assess the validity and performance of the 2008-09 survey design.

Methods

Bus Stop Survey Design

The 2008-09 Connecticut River angler survey used a stratified-random bus stop survey design (Pollock et al. 1994) almost identical to the 1997-98 survey design (see Appendix 1 for detailed descriptions of survey methodology, see Appendix 2 for detailed descriptions of differences between the 1997-98 and 2008-09 surveys). During a bus stop survey day, survey agents traveled along a pre-defined bus stop route, stopping for an allotted amount of time at several bus stops. Bus stops consisted of a section of shoreline with defined boundaries. Agents counted all shore anglers and boat trailers (as a proxy for boat anglers, bus stops with boat launches only) at each bus stop and then interviewed as many anglers as possible using a standardized interview form (boat/shore angler interviews; see Appendix 3 for the interview form).

The river was divided into geographical survey zones (hereafter referred to as Zones) that could be surveyed within a standard seven-hour workday. The 1997-98 Zones south of Hartford (Zones 1-3) and associated bus stop routes were replicated in 2008-09, and a fourth Zone covering the area north of Hartford was added to provide complete coverage of the river (Fig. 1;

Appendices 4-7). Pilot surveys and interviews with local experts (fishing guides, avid anglers, CTDEP staff) were conducted during 2005-07 to develop a bus stop route for Zone 4. Zones 3 and 4 were surveyed during 2008; Zones 1 and 2 were surveyed during 2009.

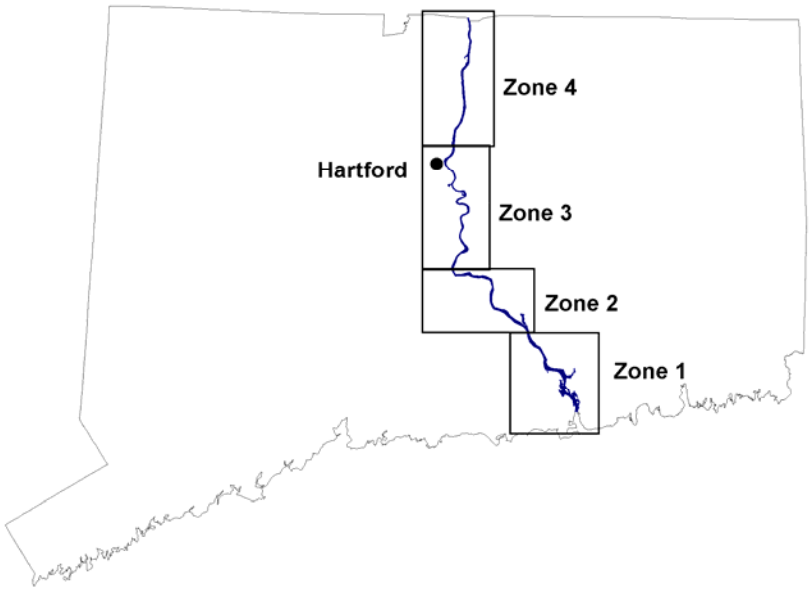

Figure 1.- Survey Zones used for the 2008-09 Connecticut River angler survey. Zone 1 extends from the mouth of the river (Old Saybrook breakwater) to the Haddam bridge; Zone 2 extends from the Haddam bridge to the Arrigoni Bridge in Middletown; Zone 3 extends from Middletown to the railroad crossing in Hartford; Zone 4 extends from Hartford to the CT/MA border in Enfield.

During the open-water period, two-month seasons were designated: March-April (Season 1), May-June (Season 2), July-August (Season 3), and September-October (Season 4). Each season was stratified by day-type (weekday/weekend). Major weekday holidays (Memorial Day, 4th of July, and Labor Day) were treated as weekend days. Within day-type strata, survey days were allocated evenly between morning (7:00 AM during March and September–October, 6:00 AM or 7:00 AM during April–August) and afternoon (1:00 PM during March and September–October, 1:00 PM or 2:00 PM during April–August) start times. Afternoon survey days generally ended around nightfall (7:00 or 8:00 PM, depending on the season); no night-time surveying was done. One weekend and two weekday survey days were allocated to each Zone during each calendar week, resources permitting.

Supplementary Surveys

Two types of supplementary data were required to accurately estimate angler effort from bus stop survey data: 1) the proportion of shore angling effort within a Zone that occurred at bus stops; and 2) the proportion of boat trailers at bus stops that belonged to anglers (see *Estimation of Angler Effort, Catch, and Harvest during 2008-09*). Two types of supplementary surveys were conducted to address these data needs. During boat launch survey days, agents visited bus stops with boat launches and interviewed boating parties to determine if they were anglers. Interviews of this type are hereafter referred to as launch usage interviews (note that a launch usage interview corresponded to a boating party, not a single boat angler). Agents also interviewed as many individual boat anglers as possible using the standard bus stop survey interview form. Boat launch surveys were conducted in Zones 3-4 during May-August of 2006-07 (as part of planning for the 2008-09 survey) and during May-July of 2008. Boat launch surveys were discontinued in Zones 3-4 after July 2008 in favor of conducting more efficient on-water surveys (see below); in addition, no boat launch surveys were conducted in Zone 2 during 2009 in favor of conducting on-water surveys. Boat launch surveys were necessary, however, at the "I-95 Launch" bus stop in Zone 1 during 2009 because on-water surveys could not reliably assess the proportions of anglers/recreational boaters using launches within Zone 1 (see below). No boat launch surveys were conducted during March-April of 2008-09 because all boaters during this Season were assumed to be anglers. A limited number of boat launch surveys conducted during March-April of 2006-07, coupled with anecdotal observations made during 2008-09 Season 1 bus stop survey days, supported this assumption.

A more efficient supplementary survey design was developed and implemented in July of 2008 and was subsequently used during the remainder of 2008-09. During on-water survey days, agents made two complete passes through a Zone by boat. Start times for passes were separated by three hours; passes generally took a maximum of two hours to complete. During each pass, agents counted all shore anglers fishing inside and outside of bus stops (a shore angler count). Agents also intercepted as many boating parties as possible and obtained launch usage interviews. Boat angler interviews were also obtained from all boat anglers encountered. On-water surveys therefore provided the opportunity to concurrently obtain shore angler counts, launch usage interviews, and boat angler interviews. Additionally, unlike boat launch survey

days, on-water survey days provided launch usage interviews for multiple launches. On-water surveys also provided previously unavailable information about the proportions of boat anglers that launched from bus stops; this information was useful in assessing the validity of the underlying assumptions of the bus stop survey design (see *Assessing Validity and Performance of the Survey Design*).

Whenever possible, 2008-09 supplementary surveys were planned to occur concurrent with a bus stop survey. During 1997-98, bus stop surveys alone were inefficient for obtaining boat angler interviews (Appendices 8-9). Conducting concurrent supplementary surveys provided an opportunity to bolster the numbers of boat angler interviews obtained during bus stop survey days (only interviews obtained during bus stop survey days could be used for catch/harvest calculations, see Appendix 1). We attempted to conduct similar numbers of concurrent weekday and weekend supplementary surveys within each month. Weekdays and weekend days for concurrent supplementary surveys were randomly chosen from the bus stop survey schedule; non-concurrent supplementary surveys were conducted opportunistically as resources permitted.

On-water surveys could not effectively assess the proportion of anglers/recreational boaters using launches within Zone 1 because many boaters who launch from the I-95 Launch, the largest and most heavily-used launch in Zone 1, travel directly to nearby Long Island Sound and are therefore not likely to be intercepted by on-water survey agents. Launch usage interviews obtained during on-water surveys therefore provided unreliable estimates of boat trailer expansion values for Zone 1 (see *Estimation of Angler Effort, Catch, and Harvest during 2008-09*). Accordingly, only launch usage interviews obtained during boat launch surveys at the I-95 Launch were used to calculate boat trailer expansion values for Zone 1. The proportion of angling/recreational boating activity at the I-95 Launch was a reasonable proxy for Zone 1 as a whole because the overwhelming majority of boating activity originated from this site. Boat anglers who fished in Long Island Sound were lumped with "recreational" boaters for all expansion value calculations.

Estimation of Angler Effort, Catch, and Harvest during 2008-09

Angler effort (angler-hrs) for an entire fishing day was estimated by applying the Time Interval Count Estimator to shore angler and boat trailer counts made during the bus stop survey

day (Pollock et al. 1994). Daily effort was estimated separately for shore and boat angling. Proportional correction factors derived from supplementary survey data were used to: a) correct daily shore effort estimates to account for effort occurring at non-bus-stop locations (shore angler expansion values); and b) correct daily boat effort estimates to account for the proportion of trailers at bus stop launches that belonged to recreational boaters (boat trailer expansion values). Corrected daily effort estimates were then used in conjunction with daily interview data on angler catch and harvest rates to estimate daily catch and harvest of various species by shore and boat anglers. The stratified calculation approach of Pollock et al. (1994) was used to estimate total angler effort, catch, and harvest for each Season within each Zone as well as totals of these quantities for the entire open-water period (March-October) within each Zone. It was not possible to generate true "whole-river" annual estimates of angler effort, catch, or harvest for 2008 or 2009 because the entire river was not surveyed during either year. Accordingly, annual whole-river effort, catch, and harvest were approximated by combining Zone 3 and 4 totals from 2008 with Zone 1 and 2 totals from 2009.

A detailed description of the analytical methods used to estimate angler effort, catch, and harvest can be found in Appendix 1. See Appendix 2 for a description of differences between these methods and those used in original 1997-98 analyses.

Summarizing 2008-09 Angler Attributes and Attitudes

Data on angler attributes and attitudes collected during the 2008-09 survey were used to characterize the Connecticut River angler population (no data on angler attributes or attitudes were collected during the 1997-98 survey, so historic comparisons were not possible). Demographic summaries included age and gender of Connecticut River anglers, as well as towns of residence. The median distance (miles) traveled by anglers to reach each bus stop was also calculated. Responses to a series of questions concerning attitudes about harvesting fish from the Connecticut River were also summarized.

Comparing the 1997-98 and 2008-09 Surveys

Raw data from the 1997-98 survey were re-analyzed for this report using the methodology described in Appendix 1 - with two exceptions. Raw data from 1997-98 boat launch surveys and shore angler counts were not available; it was therefore impossible to

perform iterative chi-square testing and create pooled expansion values. Accordingly, original 1997-98 boat trailer and shore angler expansion values were used in re-analyses. The original 1997-98 wait times for the spring-summer season were also used in re-analyses. See Appendix 2 for a detailed description of differences between this report's methodology and the original 1997-98 methodology.

All comparisons between the 2008-09 and 1997-98 surveys were limited to Zones 1-3 as Zone 4 was not surveyed during 1997-98. Additionally, comparisons for Zones 2-3 were limited to May-October (these Zones were not surveyed during March-April of 1997-98). The following quantities were compared between surveys to assess decadal changes in fishing activity on the Connecticut River:

- Total boat and shore angler effort by Zone (all Seasons summed)
- Total boat and shore angler effort by Season within Zones
- Mean counts of shore anglers and boat trailers at bus stops by Season/day-type
- Percentages of anglers targeting various species by Season within each Zone
- Directed effort for various species by Zone (all Seasons summed)
- Total catch and harvest of major fish species (all Zones/Seasons summed)
- Total catch and harvest of major fish species by Zone (all Seasons summed)

Assessing Validity and Performance of the Survey Design

Three important underlying assumptions of the bus stop survey design were: 1) the majority of boat anglers fishing within a Zone launch from bus stops within that Zone; 2) the majority of boat anglers launching at bus stops within a Zone remain in that Zone while fishing; and 3) the majority of shore anglers within a Zone fish at bus stops.

Several lines of evidence were used to determine if these three assumptions were met for the 2008-09 survey. Concurrent counts of boats on the river and boat trailers at bus stop launches were made in Zones 3-4 during 2006. Launch usage interviews from on-water surveys were used to assess the proportions of boat anglers within each Zone that launched from bus stops within that Zone. Shore angler counts were used to assess the proportion of shore anglers that fished at bus stops vs. other locations within a Zone.

Bus stop surveys alone were inefficient for obtaining boat angler interviews during 1997-98 (Appendices 8-9). Concurrent supplementary surveys were conducted during 2008-09 as a

potential remedy. To assess the effectiveness of this approach, the number of boat angler interviews obtained during each survey type (bus stop, boat launch, and on-water) in each Zone was summarized. Frequency distributions of daily boat angler interview totals from bus stop only, bus stop/concurrent boat launch, and bus stop/concurrent on-water survey days in each Zone were also calculated. Finally, the relative efficiency of boat launch vs. on-water surveys for obtaining launch usage interviews was assessed by calculating mean interviews obtained per man-day of labor for each survey type.

Work Performed/Results

Summary of 2008-09 Survey Operations

A total of 360 bus stop surveys were conducted during 2008-09 (Zone 1 *n*=104; Zone 2 *n*=99; Zone 3 *n*=80; Zone 4 *n*=77; see Appendix 10). Survey effort was relatively consistent across Seasons in Zones 1-2 during 2009; fewer surveys were conducted during Seasons 1 and 4 of 2008 in Zones 3-4 due to manpower shortages (Appendix 9).

A total of 51 boat launch surveys were conducted in Zones 3-4 during 2006-08 (Zone 3 *n*=24; Zone 4 *n*=27; see Appendix 11). The majority of these surveys were conducted on weekdays during Seasons 2-3. A total of 19 boat launch surveys were conducted at the I-95 Launch in Zone 1 during 2009 (Appendix 11). The majority of 2008-09 boat launch surveys were conducted concurrently with bus stop surveys.

A total of 63 on-water surveys were conducted in Zones 1-4 during 2008-09 (Zone 1 *n*=13; Zone 2 *n*=14; Zone 3 *n*=21; Zone 4 *n*=15; see Appendix 12). Survey effort was low for some Zone/Season/day-types because of logistical issues (manpower shortages and boat breakdowns). In particular, only one on-water survey was conducted on a Zone 3/Season 2 weekday and a Zone 4/Season 2 weekend day (Appendix 12). Logistical issues also made it difficult to conduct on-water surveys and bus stop surveys on the same day; as a result, only 38 of the 63 on-water surveys were conducted concurrently with a bus stop survey. Concurrent on-water surveys were most deficient in Zones 3-4 (Appendix 12).

A total of 129 shore angler counts were obtained during on-water surveys in Zones 1-4 during 2008-09 (Appendix 13).

A total of 1,151 boating parties were interviewed during supplementary surveys in Zones 3-4 during 2006-09 and Zones 1-2 during 2009 (Zone 1 *n*=582; Zone 2 *n*=118; Zone 3 *n*=288;

Zone 4 *n*=163; see Appendices 14-15). The relative contribution of launch usage interviews from on-water surveys vs. boat launch surveys varied across Zones and years (Appendix 14). The boat launch surveys conducted in Zones 3-4 during 2006-07 as part of survey planning made a substantial contribution to launch usage interview totals (Appendix 14).

A total of 3,011 anglers were interviewed during 2008-09 survey operations (Appendix 16). The majority of interviews came from shore anglers (shore *n*=2,032 or 67%, boat *n*=979 or 33%). Only interviews obtained during either bus stop surveys or concurrent supplementary surveys were used for catch/harvest calculations (see Appendix 1); 2,755 interviews met these criteria (Zone 1 shore *n*=912, boat *n*=317; Zone 2 shore *n*=411, boat *n*=168; Zone 3 shore *n*=489, boat *n*=89; Zone 4 shore *n*=217, boat *n*=152). An additional 256 boat angler interviews were obtained during non-concurrent supplementary surveys. These interviews were not used for catch/harvest calculations, but were used to summarize angler target species, attributes, and attitudes. On-water surveys made a substantial contribution to boat angler interview totals (Appendix 17). In Zones 1-3, the number of boat angler interviews obtained during relatively infrequent on-water surveys was greater than the number obtained during all bus stop surveys combined.

Angler Effort, Catch, and Harvest during 2008-09

Iterative chi-square testing (see Appendix 1) was used to identify shore angler counts/launch usage interviews that could be pooled across day-types and/or Seasons to create fewer, more precise expansion values (chi-square testing results are not shown here for sake of brevity). The final shore angler (*S*) and boat trailer (*B*) expansion values used to correct daily effort estimates are shown in Appendices 18-19.

Plots of daily angler effort vs. river height/flow (see Appendix 1, also Appendices 20-27), as well as notes taken by survey agents, indicated that shore anglers and boat trailers were present at bus stops within Zones 1, 2 and 4 during all river stages. Within Zone 3, shore anglers were also encountered during all river stages (Appendix 25). No boat trailers, however, were counted when river height exceeded 3.7 m (12 ft.) at the USGS Hartford gauge station (Appendix 24) because all boat launches within Zone 3 were inundated and unusable at this river stage. Accordingly, days on which mean river height at Hartford exceeded 3.7 m were not used to estimate Seasonal totals of boat angler effort in Zone 3 during 1997-98 and 2008 (see

Appendix 1). River stage exceeded this threshold on 41 days during 2008 (March-April *n* = 30; May-June *n* = 4; July-August *n* = 7), and on 5 and 7 days during 1997 and 1998, respectively (all days occurred in May-June).

Anglers spent an estimated 263,264 hours annually fishing on the Connecticut River during the open-water periods of 2008-09 (Fig. 2, Appendix 28; note that this "annual" estimate is a combination of partial-river totals from 2008 and 2009). Annual whole-river effort was evenly-split between boat and shore angling (131,972 boat angler-hrs vs. 131,292 shore angler-hrs). Effort was not, however, evenly distributed among fishing modes within each Zone. Total open-water shore effort (i.e. sum of effort during Seasons 1-4) was higher in Zones 1 and 3, while total boat effort was higher in Zone 2. Total open-water effort was evenly-divided among modes in Zone 4.

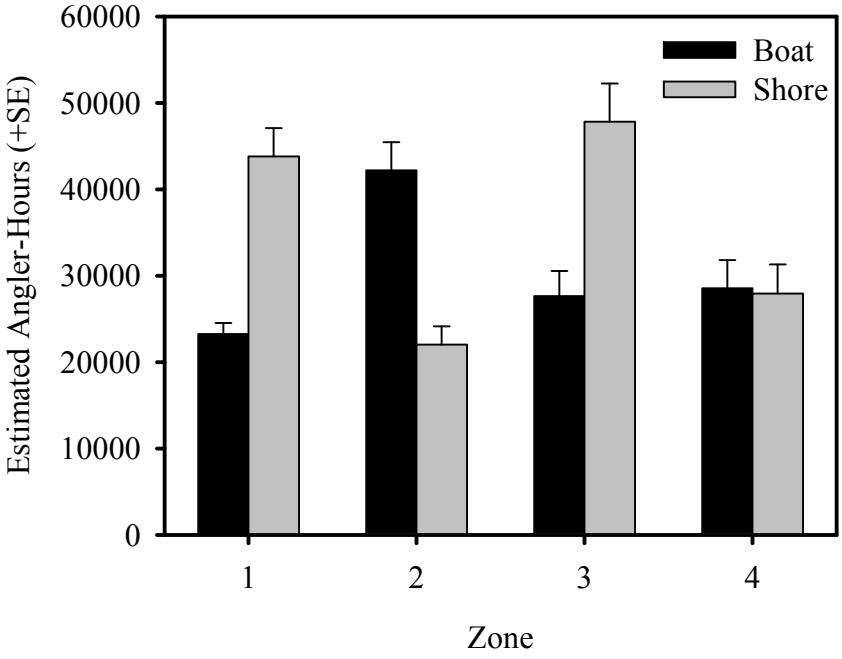

Figure 2.- Total open-water boat and shore angler effort in Zones 1-4 during 2008-09. Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009.

A general pattern of low angler effort during March-April, high effort during May-June, and gradually decreasing effort in July-October was evident in all Zones (Fig. 3, Appendix 29). This pattern was pronounced in Zone 3, where boat and shore effort during May-June of 2008 was at least double that recorded during any other Season. There were some notable deviations – for instance, boat effort remained high during July-August within Zone 2, and shore effort was actually highest during July-August within Zone 1.

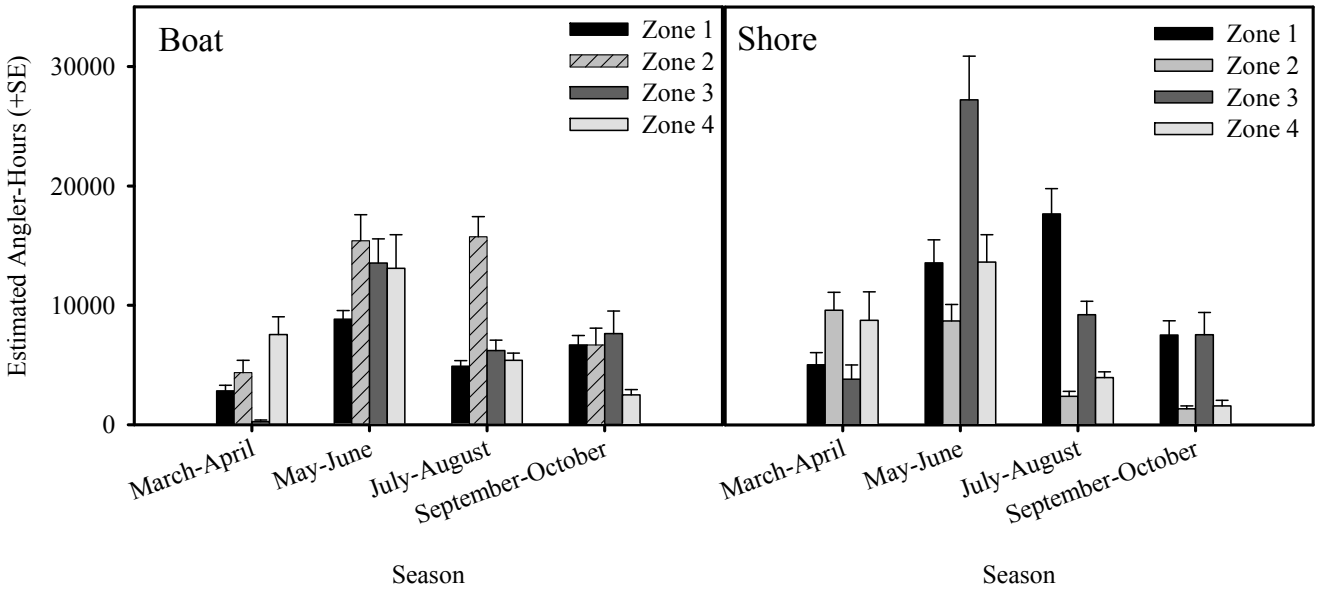

Figure 3.- Estimated boat and shore angler effort (angler-hours) by Season in Zones 1-4 during 2008-09. Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009.

Anglers caught 35 different fish species on the Connecticut River during 2008-09 (Appendix 30). The most important fisheries, both in terms of annual catch (Fig. 4-5, Appendices 30-31), percentage of anglers participating (Appendices 32-35), and directed effort (Appendix 36) were for striped bass and black bass (largemouth bass and smallmouth bass in aggregate). Nine other "major" fisheries, defined here as fisheries in which ≥1,000 fish were caught annually and/or relative standard errors (RSE) of annual catch ≤0.50, were also identified (Appendices 30-31; note that "annual" catch and effort estimates refer to combinations of partial-river totals from 2008 and 2009). Some specific notes on major fisheries:

Striped bass

The striped bass fishery was the most intensive and widespread of the major fisheries. Anglers spent an estimated 101,253 hours annually targeting striped bass during the open-water period (Appendix 36), catching an estimated 39,699 fish (Fig. 4, Appendix 30; note that catch here and in the remainder of the report refers to catch by all anglers, not just those targeting a particular species). Striped bass were targeted equally by boat and shore anglers; the distribution of striped bass anglers among fishing modes was identical to the overall interview distribution (boat=33%, shore=67%; see *Summary of 2008-09 Survey Operations*). Success (defined as catching at least one fish), however, was not equal among modes: 56% of anglers who caught a striped bass were boat anglers. Striped bass were caught by a relatively high percentage (17%) of successful "anything" shore anglers (i.e. those anglers fishing from shore, targeting "anything", who caught at least one fish of any species). Striped bass fishing was most intense in Zone 1, where anglers spent 32,757 hours during the 2009 open-water period targeting striped bass, catching 17,785 fish (Fig. 5, Appendix 31). Substantial directed effort and catch were also recorded in all other Zones. Striped bass fishing occurred primarily during March-June, when more than half of anglers in each Zone targeted this species. Participation in the fishery declined significantly during summer-fall in all Zones except Zone 1 (Appendices 32-35). The striped bass fishery was primarily catch-and-release – anglers harvested only 5% of striped bass caught during 2008-09. However, only 14% of striped bass caught were legal-sized under current regulations (28" minimum length limit). Anglers harvested 38% of legal-sized fish caught. Estimates of directed effort for and catch of striped bass were likely conservative as no surveys were conducted at night when anglers are known to pursue striped bass.

Black Bass

The black bass fishery (largemouth and smallmouth bass in aggregate) rivaled the striped bass fishery in terms of annual catch (39,357 fish, see Fig. 4, Appendix 30), but attracted less than half the annual directed effort (46,797 angler-hrs, see Appendix 36) and was not as widespread, being relatively insignificant in Zone 1 (Fig. 5, Appendices 31, 36). Black bass were unique in that 80% of anglers targeting them were boat anglers. These species were caught by a high percentage (18%) of successful "anything" boat anglers. The fishery was most intense in Zone 2, where anglers spent 18,703 hours targeting black bass during the 2009 open-water

period, catching 16,557 fish. Black bass angling became popular north of Haddam as the striped bass fishery tailed off in June; 30-50% of anglers targeted black bass during July-October in Zones 2-4 (Appendices 32-35). Very few black bass (1%) were harvested during 2008-09.

White Perch

White perch (*Morone americana*) attracted low annual directed effort (7,257 angler-hrs, see Appendix 36), yet annual catch was relatively high (27,298 fish, see Fig. 4, Appendix 30). This dynamic was largely attributable to frequent catches by "anything" anglers: 17% and 22% of successful boat and shore "anything" anglers caught white perch. The white perch fishery was largely shore-based (88% of anglers targeting white perch fished from shore), was harvest-intensive (39% harvest rate overall), and was centered in the lower river. Anglers spent 4,245 hours in Zone 1 during the 2009 open-water period targeting white perch, catching 19,127 fish (Fig. 5, Appendices 31, 36). White perch angling in Zone 1 occurred primarily during March-April when 15% of anglers targeted this species (Appendix 32). The percentages of anglers targeting white perch in all other Zones/Seasons were generally less than 5% (Appendices 32-35).

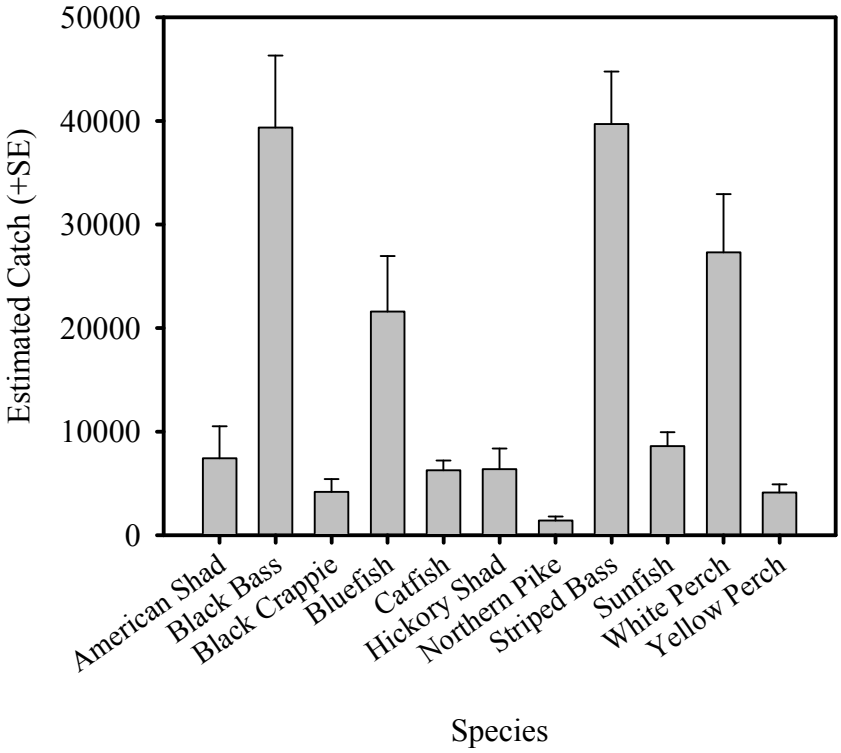

Figure 4.- Total estimated annual catch of major species in Zones 1-4 during 2008-09 (boat and shore anglers combined). "Black Bass" includes largemouth and smallmouth bass. "Catfish" includes brown bullhead, channel catfish, and white catfish. "Sunfish" includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass. This summary combines data from two years (Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009).

Bluefish

Bluefish, a marine sportfish that utilizes the Connecticut River estuary as a seasonal nursery and feeding grounds, attracted 16,521 angler-hrs of directed effort to Zone 1 during the 2009 open-water period (Appendix 36). Bluefish were targeted equally by boat and shore anglers. This species was caught by a relatively high percentage (10%) of successful "anything" shore anglers. Anglers targeted bluefish in Zone 1 primarily during July-October (Appendix 32), catching 21,592 fish; virtually no bluefish angling occurred north of Haddam (Fig. 5, Appendix 31, 36). The majority (83%) of bluefish caught were juveniles or "snappers" <30 cm in length. Bluefish were harvested at a relatively high rate (24%, see Appendix 30).

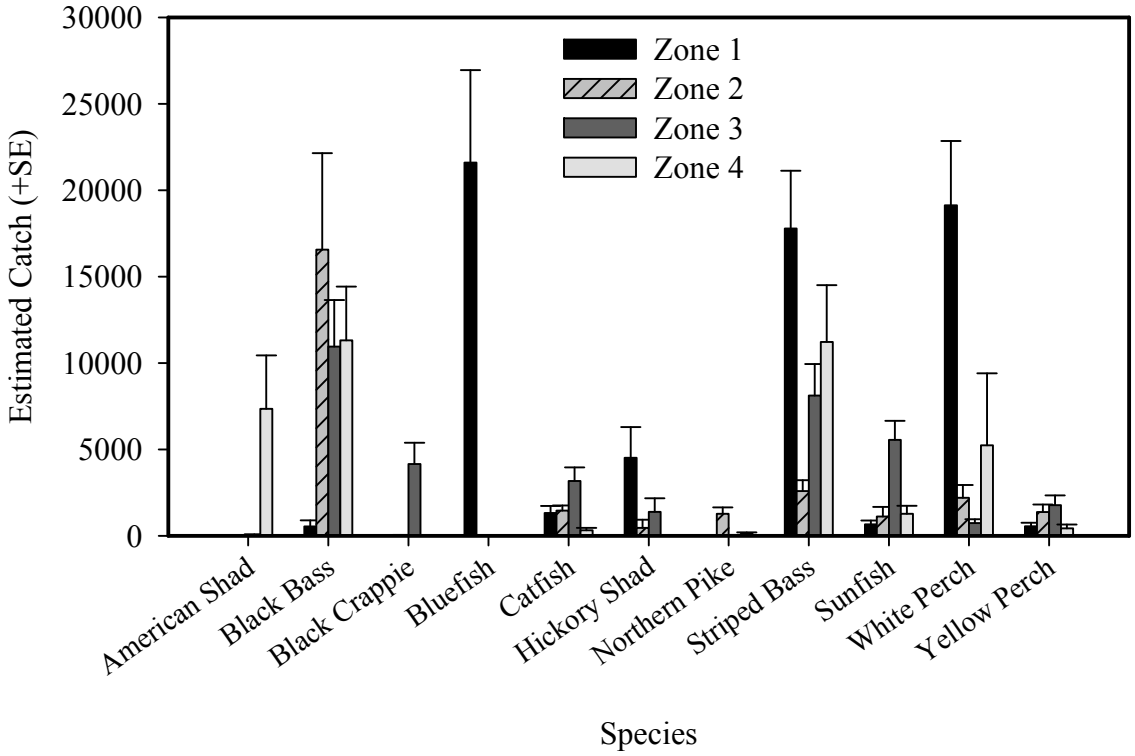

Figure 5.- Total open-water catch of major species by Zone during 2008-09 (boat and shore anglers combined). Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009.

Sunfish

The sunfish species (bluegill *Lepomis macrochirus*, pumpkinseed *L. gibbosus*, redbreast sunfish *L. auritus*, green sunfish *L. cyanellus*, and rock bass *Ambloplites rupestris*) were

primarily pursued by shore anglers (86% of anglers who targeted sunfish fished from shore) and were a caught by a high percentage (17%) of successful "anything" shore anglers. All five species were caught, but the only one specifically targeted was bluegill; most anglers simply stated they were fishing for "sunfish". Sunfish only produced appreciable levels of directed effort and catch in Zone 3 (Fig. 5, Appendices 31, 36). Anglers spent 2,377 hours targeting sunfish in Zone 3 during the 2008 open-water period, catching 5,553 fish. Sunfish harvest in Zone 3 was moderate (20%). No seasonal trend in the percentage of anglers targeting sunfish was apparent in any Zone (Appendices 32-35).

American Shad

The American shad run to the Connecticut River supported the most spatially and temporally constrained of all Connecticut River fisheries during the open-water period. Shad angling occurred almost entirely in Zone 4 (Fig. 5, Appendices 31, 36) during May-June (Appendix 35). Shad were targeted equally by boat and shore anglers, yet boat anglers were more successful (54% of anglers who caught American shad fished from a boat). While brief, this fishery was relatively intense: 28% of anglers in Zone 4 during May-June of 2008 targeted American shad (Appendix 35). Overall, Zone 4 anglers spent 9,252 hours targeting shad and caught 7,347 fish, harvesting only 1%.

Hickory Shad

Hickory shad (*Alosa mediocris*), a migratory species present seasonally in the Connecticut River, supported a fishery with a disjointed spatial distribution: directed effort and catch were limited almost exclusively to Zones 1 and 3 during 2008-09 (Fig. 5, Appendix 31, 36). The fishery was more intense in Zone 1 than Zone 3 (1,433 vs. 917 angler-hrs of directed effort, 4,522 vs. 1,382 fish caught). Fishing for hickory shad occurred almost exclusively from shore: 97% of hickory shad anglers were shore anglers. The percentages of anglers targeting hickory shad were highest during September-October (Appendices 32, 34). The harvest rate for this species was moderate in Zone 1 (10%), but high in Zone 3 (65% - the second highest harvest rate for any species in any Zone, see Appendix 31). This dynamic likely reflects differences in angler motivations. Based on comments made to survey agents and postings on online fishing forums, anglers in Zone 3 commonly harvest hickory shad for use as bait.

Catfish

The catfish species (channel catfish, white catfish *Ameirus catus*, and brown bullhead) supported a widespread yet low-intensity fishery that occurred over the entire open water period. Moderate totals of directed effort (1,063-5,500 angler-hrs) and catch (322-3,173 fish) were recorded during the open-water period in each Zone (Fig. 5, Appendices 31, 36). Catfish were targeted equally by boat and shore anglers. In each Zone, low percentages (<10%) of anglers targeted catfish during almost all Seasons (Appendices 32-35). Interestingly, peak levels of directed effort, catch, and participation occurred in different Zones: total directed effort was highest in Zone 2 (Appendix 36), total catch was highest in Zone 3 (Fig. 5, Appendix 31), and the highest percentage of anglers targeting catfish was recorded during July-August in Zone 4 (Appendix 35). The catfish fishery was relatively harvest-intensive (28% harvest rate overall – see Appendix 30). Estimates of directed effort for and catch of catfish were likely conservative as no surveys were conducted at night when catfish angling is presumably most intensive.

Black Crappie

Black crappie were pursued primarily by shore anglers (85% of crappie anglers fished from shore), but boat anglers were more successful (35% of anglers who caught crappie fished from a boat). The crappie fishery was limited almost exclusively to Zone 3, presumably because there are many coves along this river stretch that contain favorable habitat for this species. Zone 3 anglers spent 2,579 hours targeting crappie during the 2008 open-water period (Appendix 36), catching 4,145 fish (Fig. 5, Appendix 31). Crappie angling was most popular in Zone 3 during September-October, when 7% of anglers targeted this species, but low percentages of anglers also targeted crappie during May-August (Appendix 34). Crappie harvest rates were high (46%) in Zone 3.

Yellow Perch

Yellow perch (*Perca flavescens*) were pursued equally by boat and shore anglers, but boat anglers were more successful: 44% of anglers who caught yellow perch fished from a boat. Yellow perch were caught by relatively high percentages of successful “anything” boat and shore anglers (13% and 7%, respectively). This species supported a small directed fishery in Zones 2-3

where anglers spent 1,433 hours annually targeting yellow perch (Appendix 36), catching 3,135 fish (Fig. 5, Appendix 31). Yellow perch angling was most popular during March–June (Appendices 33-34). Low numbers of yellow perch were also caught in Zones 1 and 4 despite negligible directed effort (Appendices 32, 35-36), reflecting their relatively high rate of capture by "anything" anglers. The harvest rate for yellow perch varied widely between Zones (1%-51%); this variation likely results from the imprecision of yellow perch catch estimates (RSE ranging from 0.32-0.52 for each Zone) and not differences in angler motivations among Zones.

Northern Pike

Northern pike were targeted equally by boat and shore anglers, but boat anglers were much more successful (72% of anglers who caught pike fished from a boat). Overall, the pike fishery was characterized by moderate levels of directed effort and low catches. Anglers spent 14,143 hours annually targeting pike in Zones 2-4, with the majority of that effort occurring in Zone 2 (Appendix 36), but caught only 1,417 pike (Fig. 4-5, Appendices 30-31). Almost all pike were caught within Zone 2. Anglers caught only 145 pike in Zones 3-4 during the open-water period of 2008 despite spending 5,593 hours targeting them. The pike fishery was most intense during March-April in Zone 2, when 35% of anglers targeted pike (Appendix 33). A secondary peak in pike fishing was evident in the fall when 20% and 10% of anglers targeted pike in Zones 2 and 4, respectively (Appendices 33, 35). Pike harvest was minimal during 2008-09; only one harvested pike was observed by survey agents during either year of the survey.

"Anything" Anglers

Relatively high percentages of anglers reported that they were fishing for "anything" in each Zone/Season (Appendices 32-35). This "fishery" ranked in the top three in terms of directed effort in each Zone (Appendix 36). "Anything" anglers were more likely to be shore anglers (77% of "anything" anglers fished from shore vs. 67% of all anglers interviewed). The majority (87%) of boat "anything" anglers fished using artificial lures; the proportion of bait (42%) and artificial lure (58%) anglers was similar among shore "anything" anglers. Boat "anything" anglers were more successful (47% caught at least one fish) than shore "anything" anglers (32% success rate). Overall, "anything" anglers caught 30 different species of fish. Common catches for successful boat "anything" anglers included black bass (caught by 18% of successful boat

"anything" anglers), white perch (17%), yellow perch (13%), and striped bass (8%). Their shore-based counterparts frequently caught white perch (22%), striped bass (17%), sunfish (17%), bluefish (10%), and yellow perch (7%).

2008-09 Angler Attributes and Attitudes

Most (92%) anglers interviewed during 2008-09 were male. Angler age structures revealed an interesting among-mode difference: shore angling attracted greater participation from younger anglers than boat angling. The age distribution of boat anglers had a distinct mode around 40-54 years of age; generally, 40-50% of boat anglers in each Zone fell within this age bracket (Appendix 37). Shore anglers were more evenly-distributed across age brackets in each Zone, with relatively similar percentages of anglers between the ages of 20 and 49 (Appendix 37). The percentage of shore anglers under the age of 20 was particularly high in Zone 4 (approx. 15%).

A clear north-south trend in the size of the geographical area generating trips to each Zone was apparent. The southernmost portion of the river had the widest geographical draw; Zone 1 attracted anglers from over half the towns in the State (Appendix 38). The geographical draw of other Zones decreased in a northward fashion (Appendices 39-41). The area generating trips to Zone 4 was particularly small, being limited primarily to adjacent towns (Appendix 41).

The distances traveled by anglers to fish at bus stops within each Zone reflected the north-south disparity in geographical draw (Appendices 42-45). The median distance traveled by anglers (boat and shore pooled) ranged between 30 and 40 miles for most Zone 1 bus stops (Appendix 42), but was less than 10 miles for Zone 4 bus stops (Appendix 45). The greater draw of Zone 1 may be partially related to its proximity to a major interstate highway (I-95); this hypothesis is supported by the relatively long distances traveled to reach sites in close proximity to I-95 (South Cove, Dock & Dine, Black Hall River, Lieutenant River, DEP Marine Headquarters, I-95 Launch; see Appendix 42). The seasonal availability of marine species such as bluefish and summer flounder may also increase the draw of these southernmost sites. Interestingly, the relative quality of access sites (i.e. factors such as roadside signage, amenities, quality and size of parking area, walking distance from parking to fishing area, length of fishable shoreline) did not appear to influence their relative attractiveness. For instance, Zone 2 sites with relatively low-quality access (Johnson Brook, Rushford Center, Paper Rock) drew anglers from

similar distances as sites with high-quality access (Harbor Park, Hurd State Park; see Appendix 43). Similarly, Charter Oak Landing, Great River Park, and Riverside Park, sites that are perhaps the most high-quality shore access locations along the entire river and are also in close proximity to a major interstate (I-84), failed to routinely attract anglers from substantial distances (Appendix 44).

As part of the standard angler interview, anglers were asked "How often do you keep (*target species*) that you catch in the Connecticut River?" (anglers who indicated that they were targeting "anything" were asked how often they kept "fish" that they caught in the Connecticut River) and were asked to choose between the responses "Always", "Most of the time", "Occasionally", "Rarely", or "Never". Anglers who responded "Rarely" of "Never" were asked a follow-up question – "Why not?" – and were then asked to choose from the responses "I don't like to eat fish", "It's too much bother to clean fish", "I'm afraid of toxins" or provide another response. The responses to these questions indicated that a majority of Connecticut River anglers practice catch-and-release. Over 50% of anglers (all anglers and Zones pooled) responded that they kept their target species "Rarely" or "Never"; only 31% of anglers responded that they kept fish "Always" or "Most of the time" (Appendix 46). When asked "Why not?", the majority (60%) of anglers who answered "Rarely" or "Never" responded, unprompted, that they were "catch-and-release anglers" (Appendix 46). Similar percentages of respondents indicated that they didn't like to eat their target species (14%) or were afraid of toxins (15%).

Comparisons of the 1997-98 and 2008-09 Surveys

Total open-water angler effort in Zones 1-3 declined by 29-32% between 1997-98 and 2008-09 (1997: 278,639 angler-hrs; 1998: 266,499 angler-hrs; 2008-09: 188,709 angler-hrs; note that the 2008-09 annual estimate is a combination of partial-river estimates from 2008 and 2009; also note that comparisons in this section exclude effort in Zones 2-3 during March-April because these Zones were not surveyed during March-April of 1997-98). Declines in total effort were evident in each Zone (Fig. 6, Appendix 47). Shore effort in Zone 2 declined most substantially, dropping three-fold from 36,427 and 39,368 angler-hrs during 1997 and 1998 to 12,440 angler-hrs during 2009. Substantial declines of 30-40% were also evident for shore effort in Zone 3 (1997: 76,363 angler-hrs; 1998: 61,587 angler-hrs; 2008: 43,995 angler-hrs) and boat effort in Zone 1 (1997: 35,555 angler-hrs; 1998: 39,043 angler-hrs; 2009: 23,247 angler-hrs).

Boat effort in Zone 3 declined by 20-35% from 34,398 and 41,357 angler-hrs during 1997 and 1998 to 27,383 angler-hrs during 2008. Both shore effort in Zone 1 (43,816 angler-hrs) and boat effort in Zone 2 (37,828 angler-hrs) during 2009 fell within the range of 1997-98 estimates.

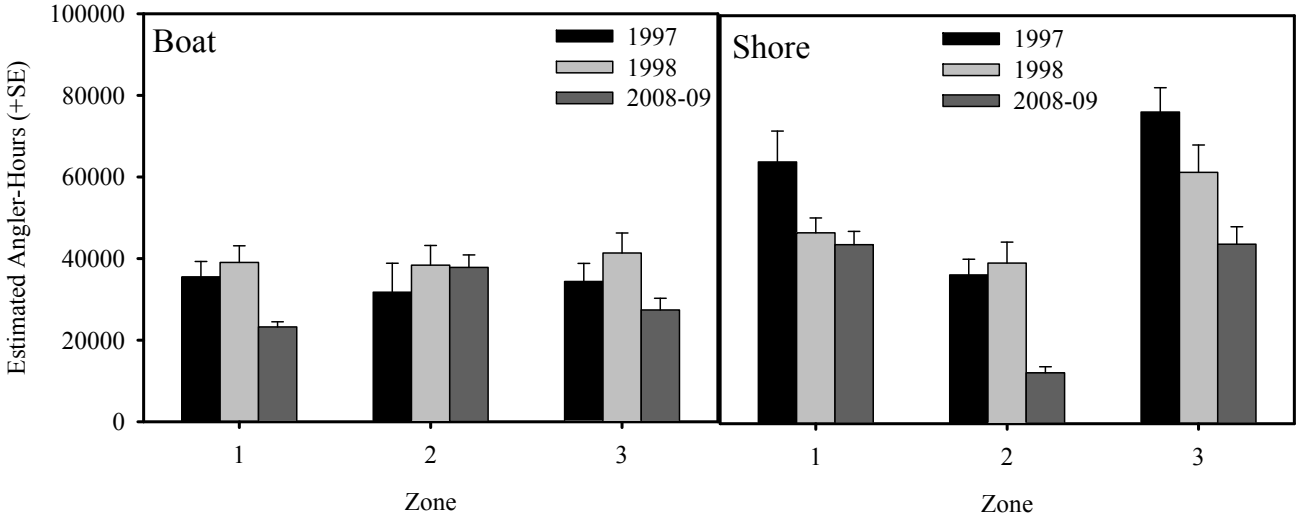

Figure 6.- Total estimated boat and shore angler effort (angler-hours) in Zones 1-3 during 1997, 1998, and 2008-09. Zone 4 was not sampled during 1997-98 and is therefore excluded here. In addition, estimates shown here for Zones 2-3 during 2008-09 exclude Season 1 (March-April) effort because Zones 2-3 were not sampled during Season 1 of 1997-98.

Declines in total open-water effort were largely the result of reduced angling activity during July-August (Fig. 7-9, Appendix 48). In Zone 1, boat effort during July-August declined three-fold, from approximately 15,000 angler-hrs during both 1997 and 1998 to 4,888 angler-hrs during 2009. In Zone 2, shore effort declined from 7,854 and 15,868 angler-hrs during July-August of 1997 and 1998 to 2,392 angler-hrs during July-August of 2009. A substantial decline in shore effort during May-June was also noted in Zone 2 (1997: 25,763 angler-hrs; 1998: 20,954 angler-hrs; 2009: 8,702 angler-hrs). Boat effort in Zone 3 during July-August of 1997 and 1998 was 10,583 and 13,988 angler-hrs with only an estimated 6,213 angler-hrs occurring in 2008. Shore effort in Zone 3 during July-August also declined, from approximately 26,000 angler-hrs during both 1997 and 1998 to 9,222 angler-hrs in 2008.

Angler use of some bus stops in Zone 3 declined notably between 1997-98 and 2008-09. The mean number of shore anglers counted during bus stop survey days at both Charter Oak Landing and Wethersfield Cove declined substantially (45-95%) during May-August on both

weekdays and weekend days. The mean number of boat trailers counted during May-June at three major Zone 3 launches (Charter Oak Landing, Riverside Park, and Great River Park) also declined, especially at Riverside Park where the mean number of boat trailers counted during Season 2 weekends declined by 88%. Declines of 86-95% in boater use were also evident at Riverside Park during July-August. Overall, it is notable that (with the exception of shore angling at Charter Oak Landing during 1997-98) angler use of Charter Oak Landing, Great River Park, and Riverside Park – three of the highest-quality angler access points along the entire river – was not substantially different than use of other Zone 3 bus stops during both surveys.

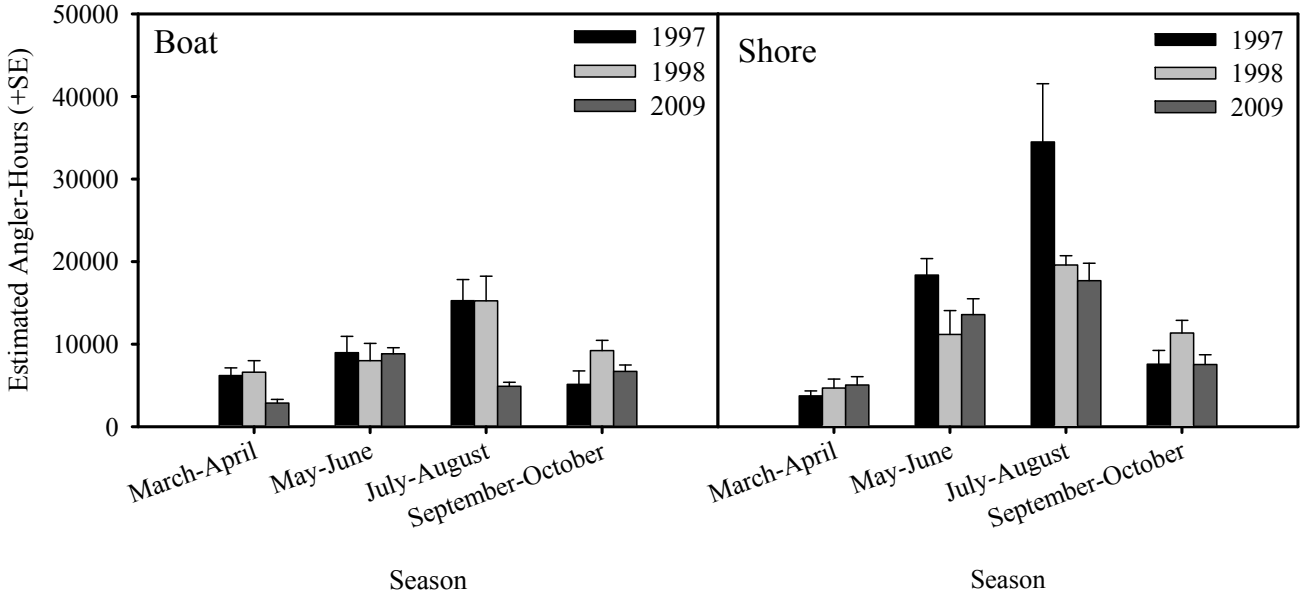

Figure 7.- Estimated boat and shore angler effort (angler-hours) by Season in Zone 1 (river mouth to Haddam) during 1997, 1998, and 2009.

Within Zone 2, the marked decline in shore angler effort during May-August was general across all five of the most heavily-used bus stops (Harbor Park, Johnson Brook, Rushford Center, Lower Haddam Marsh, and the Salmon River Launch). Mean numbers of shore anglers declined most substantially at Rushford Center during May-June (33-82%) and at Harbor Park during July-August (20-82%).

Interestingly, the mean numbers of trailers counted at the I-95 Launch in Zone 1 during July-August did not change appreciably between 1997-98 and 2008-09 despite the estimated three-fold decline in boat angler effort within this Zone/Season (this launch accounted for >90% of all trailers counted during July-August in Zone 1 during both surveys). Thus, it appears that

only use of this launch by Connecticut River boat anglers has decreased over the last decade. This dynamic is reflected in the differences between 1997-98 and 2008-09 boat trailer expansion values for Zone 1. Howell and Molnar (1999) reported that 44% and 26% of boat anglers launching in Zone 1 during 1997-98 summer weekdays and weekend days, respectively, fished in the Connecticut River; during 2009 these percentages were substantially lower (14% and 5% respectively, see Appendix 19).

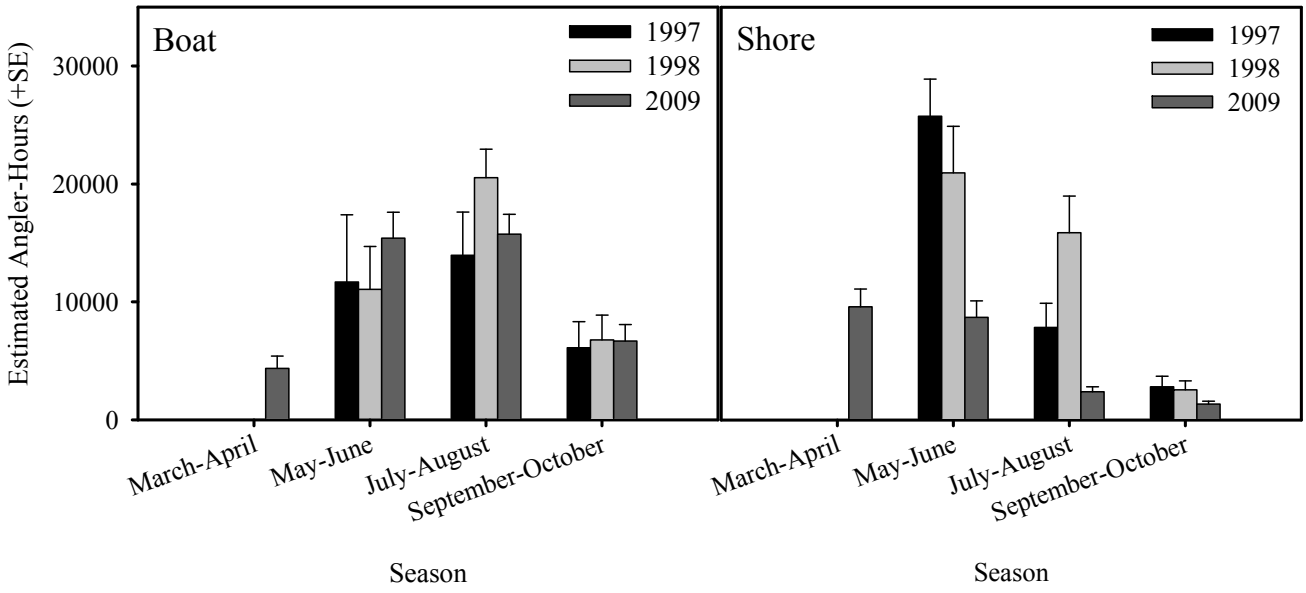

Figure 8.- Estimated boat and shore angler effort (angler-hours) by Season in Zone 2 (Haddam – Middletown) during 1997, 1998, and 2009. Zone 2 was not sampled during March-April of 1997-98.

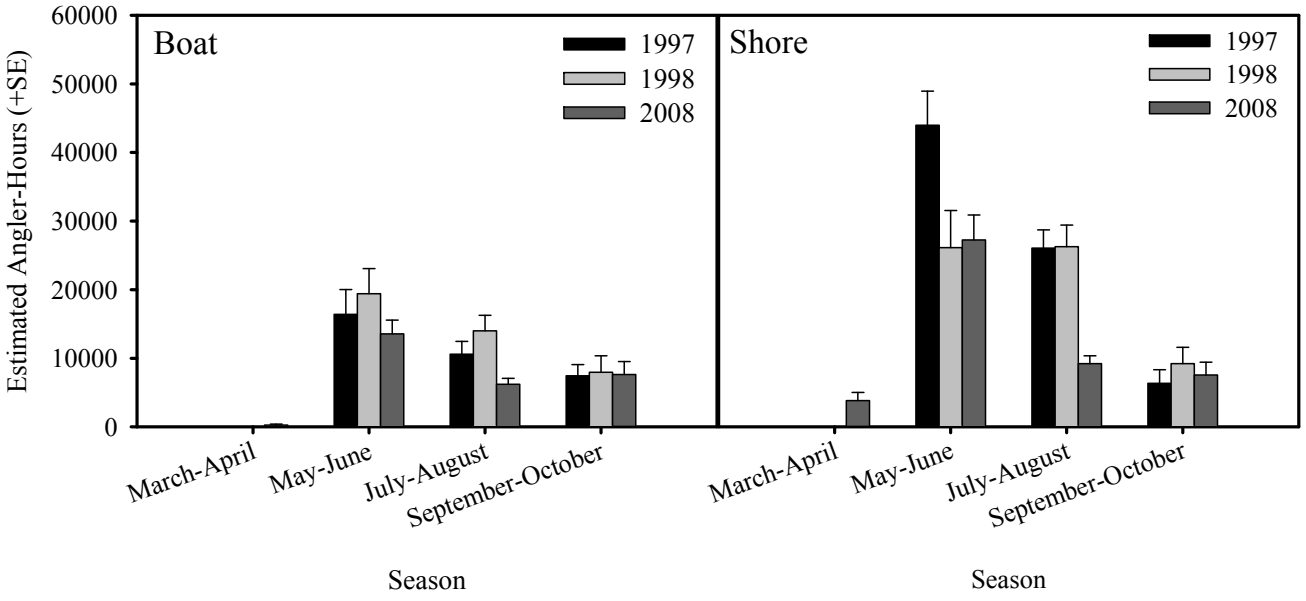

Figure 9.- Estimated boat and shore angler effort (angler-hours) by Season in Zone 3 (Middletown - Hartford) during 1997, 1998, and 2009. Zone 3 was not sampled during March-April of 1997-98.

Catch of resident species (i.e. excluding marine/migratory species such as bluefish and hickory shad) typically targeted by shore anglers in Zones 1-3 during 1997-98 declined between 1997-98 and 2008-09 – a trend that reflects the observed declines in shore angler effort in Zones 2-3. For example, most (>85%) anglers targeting catfish species fished from shore during 1997-98; overall catch of catfish declined by 78-82% between the two surveys (1997: 26,445 fish; 1998: 28,751 fish; 2008-09: 5,691 fish; see Fig. 10, Appendix 49). Within each Zone, total catfish catch declined by 68-90% (Fig. 11-13, Appendices 50-52). Lower directed effort for catfish was likely a contributing factor. Directed effort for catfish in Zones 1-2 decreased by 35-82% between 1997-98 and 2008-09 (Appendices 53-55). Similar trends were evident for sunfish species and white perch. Most (≥70%) anglers who targeted these species during 1997-98 were shore anglers. Overall sunfish catch declined by 38-52% between 1997-98 and 2008-09 (1997: 11,753 fish; 1998: 15,386 fish; 2008-09: 7,336 fish). Overall white perch catch declined by 26-67% over the same period (1997: 66,549 fish; 1998: 29,573 fish; 2008-09: 21,961 fish). Directed effort for white perch decreased in all three Zones; trends in directed effort for sunfish varied (decreased in Zone 2 but increased in Zones 1 and 3). Perhaps most importantly, "anything" effort decreased in Zones 2-3 between 1997-98 and 2008-09 (27-53% decline in "anything" angler-hrs, see Appendices 54-55). High percentages (≥90%) of "anything" anglers fished from shore during 1997 and 1998, and successful shore-bound "anything" anglers frequently caught catfish (>25% of shore "anything" anglers who caught at least one fish caught catfish), sunfish (≥17%) and white perch (≥15%) during this period. The decline in "anything" shore angling in Zones 2-3 likely contributed to decreased catches of these species; it may also have contributed to the overall decline in yellow perch catch (1997: 12,514 fish; 1998: 13,592 fish; 2008-09: 3,689 fish). Most (≥75%) anglers who targeted yellow perch during 1997-98 did so by boat, but successful shore "anything" anglers frequently caught yellow perch (>10% of successful shore "anything" anglers).

Harvest rates in the two most significant fisheries – striped bass and black bass – were equivalently low during 1997-98 and 2008-09. Anglers harvested only 3-8% of striped bass and 1-5% of black bass caught during the two survey periods (Appendix 49). Overall harvest rates for other species, most notably those typically targeted by shore anglers, declined between 1997-98 and 2008-09. Anglers harvested 81% and 59% of white perch caught in 1997 and 1998, but harvested only 28% of white perch caught in 2008-09. Harvest rates for bluefish (1997: 72%;

1998: 83%; 2008-09: 24%), catfish (1997: 61%; 1998: 59%; 2008-09: 28%), yellow perch (1997: 49%; 1998: 27%; 2008-09: 20%), and sunfish (1997: 49%; 1998: 44%; 2008-09: 16%) displayed a similar trend. The declines in actual numbers of white perch, catfish, yellow perch, and sunfish harvested by anglers were even greater, as overall catches of these species were lower during 2008-09 (Appendix 49). Overall, there is no evidence that anglers currently harvest more fish from the Connecticut River than they did a decade ago.

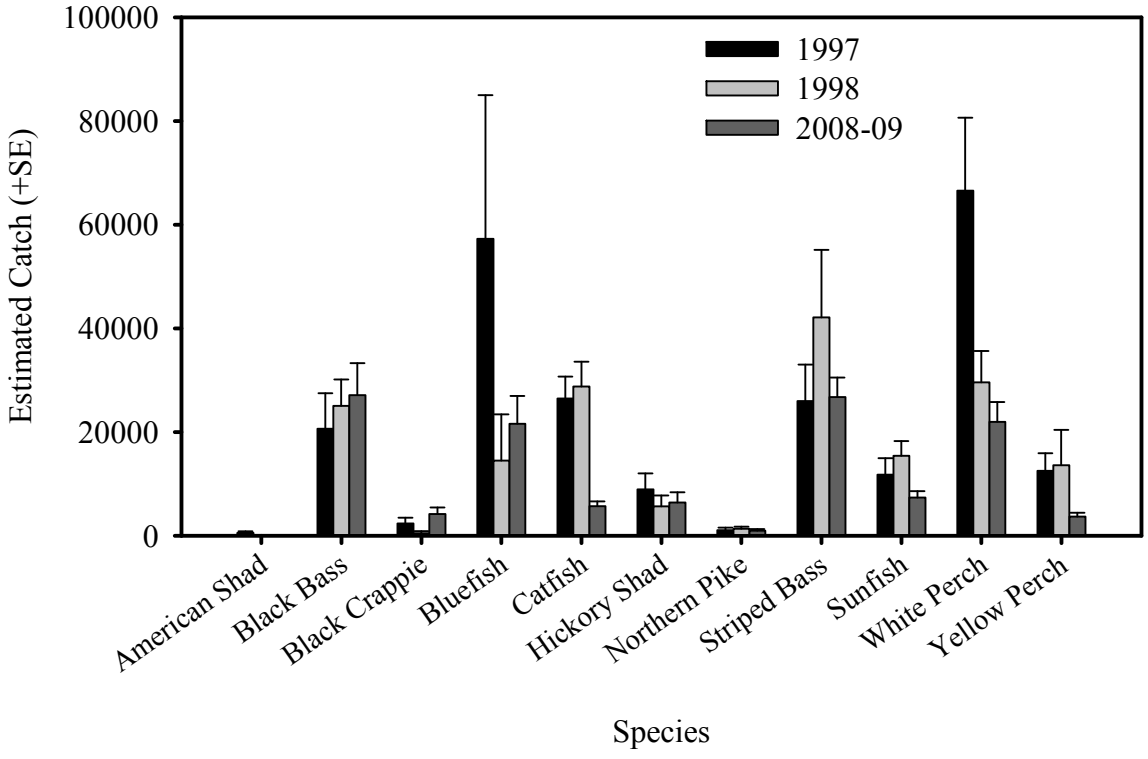

Figure 10.- Total estimated catch of major species in Zones 1-3 during 1997, 1998, and 2008-09 (boat and shore anglers combined). Zone 4 was not sampled during 1997-98 and is therefore excluded here. Estimates shown here for Zones 2-3 during 2008-09 exclude Season 1 (March-April) catch because Zones 2-3 were not sampled during Season 1 of 1997-98. Results for 2008-09 combine data from two years (Zone 3 was sampled during 2008; Zones 1-2 were sampled during 2009).

Validity and Performance of the Survey Design

Concurrent counts of trailers at bus stop launches and boats on the river in Zones 3-4 during 2006 were relatively concordant (Appendix 56), with the exception of three counts (Zone 4 on 7/23/06, both Zones 3 and 4 on 8/5/06). Launch usage interviews collected during on-water surveys in each Zone during 2008-09 indicated that for Zones 2-4, the majority (>77%) of

boat anglers within each Zone launched from bus stops within that Zone (Appendices 57-61). However, launch usage interviews collected in Zone 1 revealed that a substantial portion (48%) of the boat angling activity in this Zone originated from locations other than Zone 1 bus stops (Appendices 57, 61). In particular, a number of boat anglers launched from Zone 2 bus stops (Haddam Meadows Launch, Salmon River Launch) and then traveled to Zone 1 to fish. Therefore, boat effort estimates for Zones 1 and 2 may have been biased low and high, respectively. For Zones 3-4, however, the underlying assumptions related to boat angling (the majority of boat anglers fishing within a Zone launch from bus stops within that Zone, the majority of boat anglers launching at bus stops within a Zone remain in that Zone while fishing) were met.

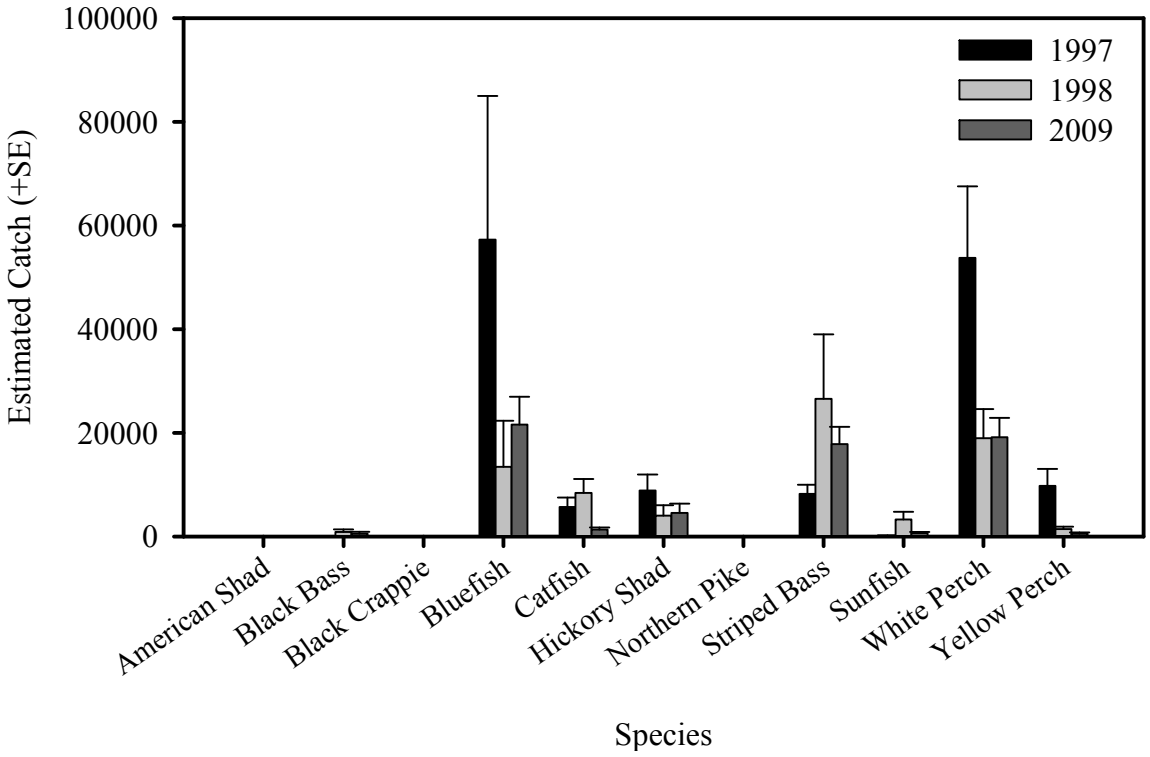

Figure 11.- Total estimated catch of major species in Zone 1 (Mouth-Haddam) during 1997, 1998, and 2009 (boat and shore anglers combined).

The proportions of shore anglers counted at bus stop sites during shore angler counts ("Prop in" in Appendix 13) indicate that a majority (>50%) of shore anglers were observed at bus stops in Zones 1-3 (with the exception of Zone 3/Season 3 weekend days). Conversely, less than half of shore anglers were counted at bus stop sites in Zone 4 during all Season/day-types

with the exception of Season 4 weekend days (Appendix 13). Therefore, the underlying assumption related to shore angling (the majority of shore anglers within a Zone fish at bus stops) was generally met for Zones 1-3 but not Zone 4. As the shore angler expansion values for Zone 4 corrected for effort that occurred at non bus-stop locations, effort estimates were likely unbiased. However, if anglers at non bus-stop locations in Zone 4 generally targeted different species or experienced significantly different catch rates, directed effort and catch estimates for Zone 4 may have been biased.

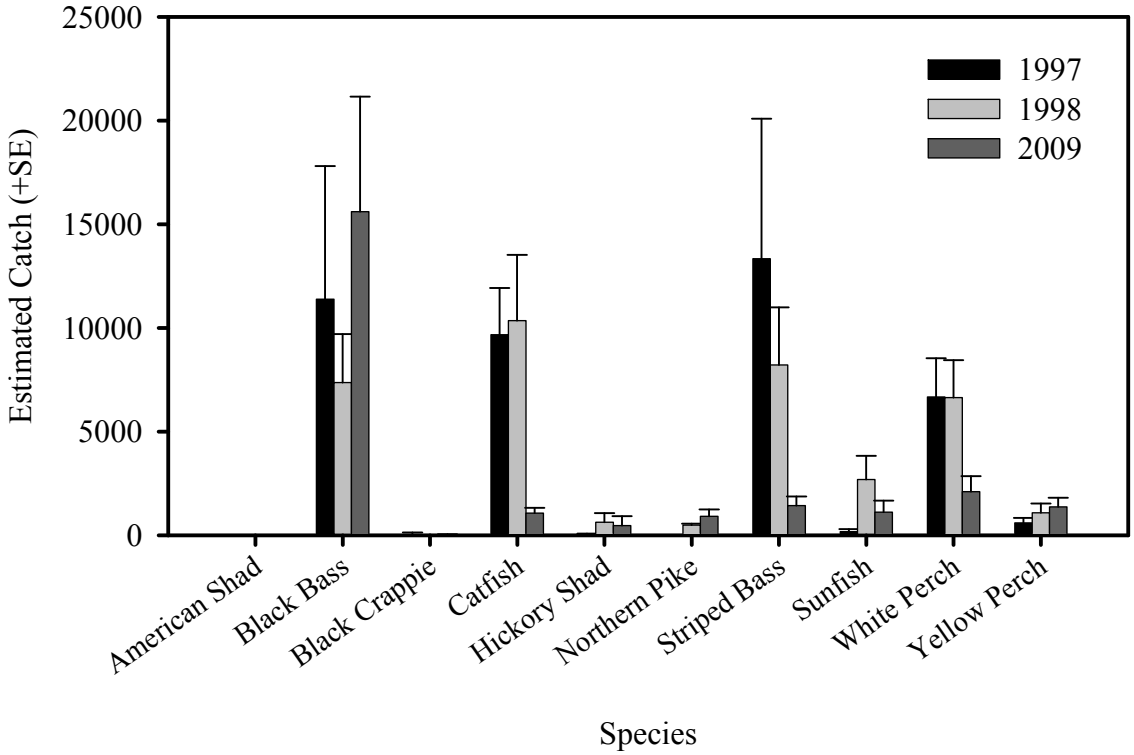

Figure 12.- Total estimated catch of major species in Zone 2 (Haddam – Middletown) during 1997, 1998, and 2009 (boat and shore anglers combined). Estimates for 2009 do not include catch during Season 1 (March – April) because Zone 2 was not sampled during Season 1 of 1997-98

Both types of supplementary surveys (boat launch and on-water) made a significant contribution to the total number of boat angler interviews collected. In each Zone, the number of boat angler interviews obtained during relatively infrequent concurrent supplementary surveys was greater than the number collected during all bus stop surveys combined (Appendix 17). Frequency distributions of the number of boat angler interviews collected on "bus stop only",

"bus stop + concurrent boat launch survey", and "bus stop + concurrent on-water survey" days indicate that, within every Zone, concurrent survey days tended to produce higher numbers of boat angler interviews (Appendices 62-65); on-water surveys generally were most effective at increasing the probability of encountering and interviewing boat anglers. On-water surveys were also generally more efficient for obtaining launch usage interviews than boat launch surveys. In Zones 3-4, on-water surveys produced an average of 6-10 launch usage interviews per man-day of labor for most Zone/day-types; boat launch surveys produced 3-4 interviews per man-day for most Zone/day-types (Appendices 66-67). However, boat launch surveys at the I-95 Launch in Zone 1 were very efficient for obtaining launch usage interviews (average of 23 and 41 interviews/man-day for weekdays and weekend days, respectively) – indicating that boat launch surveys conducted at high-use launches represent a viable alternative to more labor-intensive on-water surveys for collection of launch usage interviews.

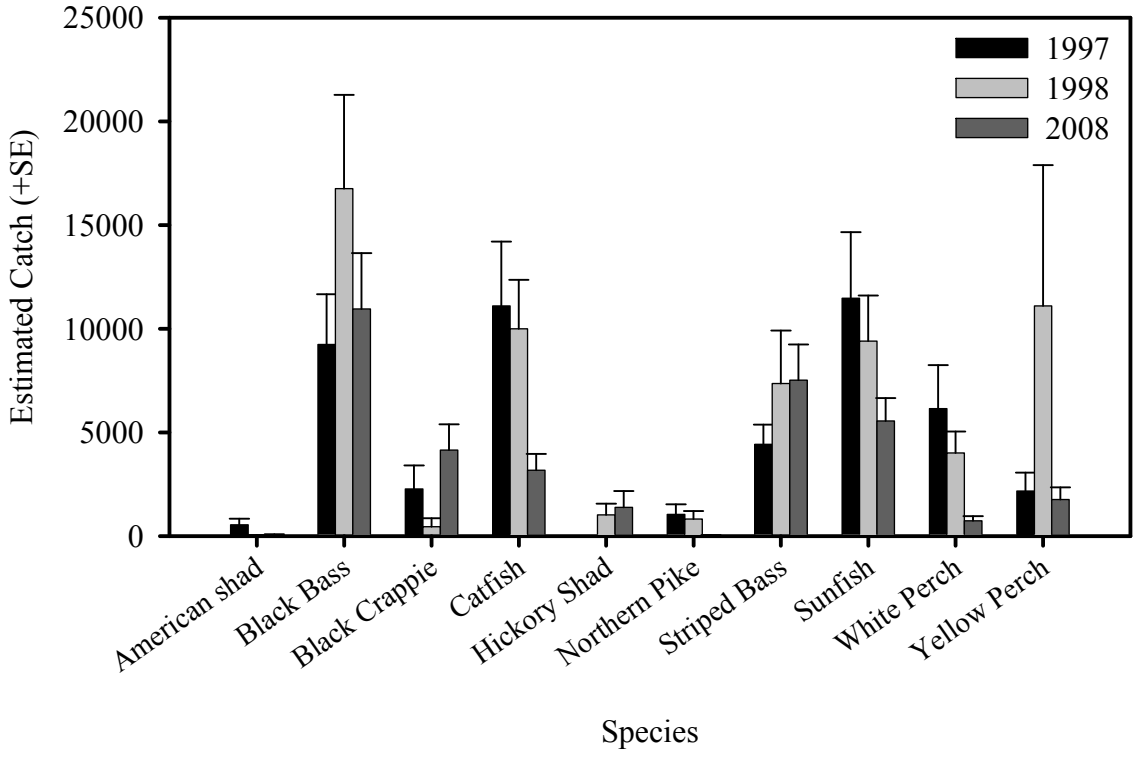

Figure 13.- Total estimated catch of major species in Zone 3 (Middletown – Hartford) during 1997, 1998, and 2008 (boat and shore anglers combined). Estimates for 2008 do not include catch during Season 1 (March – April) because Zone 3 was not sampled during Season 1 of 1997-98.

Summary and Conclusions

The 2008-09 angler survey revealed that the Connecticut River offers diverse fishing opportunities that attract considerable angler effort to the river on an annual basis. Anglers spent over 250,000 hours fishing on the Connecticut River during the open-water periods of 2008-09, catching 35 different fish species. Participation in various fisheries varied both spatially and temporally. Fishing for some species occurred during relatively narrow time windows (e.g. American shad during May-June) or was limited to certain river stretches (e.g. bluefish in Zone 1); other species were pursued over large areas for extended portions of the open-water period (e.g. striped bass and black bass). Few angler surveys have been conducted on other large rivers in Connecticut. Therefore, it is unclear to what extent the variety and characteristics of Connecticut River fisheries generalize to other rivers in the State. It is apparent, however, that fisheries in large water bodies such as the Connecticut River are likely to be complex and thus will require more specialized survey and management strategies than smaller lakes and rivers.

Angling activity on the Connecticut River during the open-water period has decreased over the last decade. Shore angler effort in Zones 2-3 and boat angler effort in Zones 1 and 3 decreased by 20-68% between 1997-98 and 2008-09. The numbers of shore anglers fishing at many formerly high-use access points, particularly those near population centers (e.g. Charter Oak Landing, Wethersfield Cove, Harbor Park, Rushford Center), declined markedly between the two survey periods. It is unclear to what degree this decline in angling activity reflects a general statewide trend or is specific to the Connecticut River. Further investigations into declines in angler effort at other Connecticut water bodies are warranted. Whatever these investigations may reveal, it is nevertheless worrisome that use of a fishery resource as dynamic and accessible as the Connecticut River has declined in recent years. The IFD should investigate strategies for marketing the many high-quality fishing opportunities the Connecticut River offers. Finally, because comparisons between the 1997-98 and 2008-09 surveys reveal substantial changes in use of a fishery resource on a decadal time scale, this may therefore be an appropriate maximum interval for periodic surveys of large water bodies such as the Connecticut River that require substantial manpower and are therefore not feasible to survey on a regular basis.

There was no evidence that angler impacts to Connecticut River fish populations have increased over the last decade. Overall angler effort decreased, as did overall catch and harvest of most species. Furthermore, a majority of 2008-09 Connecticut River anglers identified

themselves as “catch-and-release” anglers. Given the lack of evidence for increased impacts, continuation of current Connecticut River management practices with respect to harvest regulations is advisable. Some species for which harvest rates are still moderate-high (e.g. catfish, sunfish) may warrant more careful consideration; however, it will be difficult if not impossible to assess exploitation rates as quantification of population size or age structure in a water body as large as the Connecticut River requires significant manpower investments.

Total open-water angler effort within Zones during 2008-09 was relatively equivalent; the geographical draw of different Zones, however, varied substantially - as did the relative angler use of different access areas within Zones. Within Zones, the relative quality of access points did not explain their relative use or geographical draw. This finding is notable, given the considerable investments the State and many municipalities have made in acquiring and improving access points along the river. Angler motivations for use of various access points warrant further investigation. Such investigations may inform prioritization of access improvement and acquisition along the Connecticut River and other large rivers in the State.

The IFD has a long-standing interest in increasing family participation in angling (Babey et al. 2009) and has recently launched initiatives focused on angling opportunities for urban residents (Barry et al. 2011). Currently under-utilized shore access points along the Connecticut River such as Charter Oak Landing, Harbor Park, and Wethersfield Cove are well-suited for these initiatives because of their high-quality access, proximity to population centers, and the demonstrated attractiveness of Connecticut River shore angling to younger anglers. IFD staff working on these initiatives should seek to plan events at these locations and market them to families and urban anglers. Such efforts can play a role in an overall strategy to increase angling activity on the Connecticut River.

The design of the 2008-09 Connecticut River angler survey was generally appropriate and successful. The underlying assumptions related to boat angling were met for two of the four zones; assumptions related to shore angling were met for three of four zones. Future surveys should consider incorporation of corrections for demonstrated sources of bias in Zone 1 and 2 boat effort estimates. In addition, the bus stop route for Zone 4 should be redesigned in an attempt to increase the proportion of shore anglers that are encountered at bus stops. On-water surveys proved to be an efficient means of collecting multiple data types (shore angler counts, launch usage interviews, angler interviews). Concurrent on-water surveys were generally more

effective and efficient than boat launch surveys for bolstering boat angler interview totals on bus stop survey days; however, these surveys were more logistically challenging due to higher manpower requirements and the potential for boat breakdowns. Furthermore, concurrent boat launch surveys were highly effective at high-use boat launches such as the I-95 launch and were less logistically challenging. Future surveys should seek to use both types of concurrent surveys in the most effective manner for each Zone. More frequent concurrent surveys will also likely improve accuracy and precision of boat angler catch and harvest estimates – especially in light of the finding that boat anglers are often more successful in catching many species.

Recommendations

- Conduct an angler survey on the Connecticut River again in 5-10 years using the design established for the 2008-09 survey. Consider incorporating a night-time survey component to more accurately measure directed effort for and catch of species pursued by night-time anglers (catfish, striped bass).
- During future bus stop angler surveys on the Connecticut River and other large rivers that support significant boat angling activity, consider conducting concurrent supplementary surveys on a majority or all of bus stop survey days to improve accuracy and precision of catch and harvest estimates.
- Investigate angler motivations for using various access sites on the Connecticut River. Use this information to improve existing access and target new access areas for acquisition.
- Investigate potential marketing strategies for increasing participation in Connecticut River fishing in general and use of under-utilized access points in particular.
- Determine the generality of declines in angling activity on the Connecticut River via comparisons to angler survey data collected on other Connecticut water bodies over the last decade.
- Continue existing management of Connecticut River fisheries with respect to harvest regulations.

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Appendices

Appendix 1.- Detailed description of the bus stop survey design and analyses.

A bus stop survey is appropriate for fisheries such as the Connecticut River that feature multiple well-defined, but widely-dispersed access points over a large geographic area (Jones and Robson 1991). This design requires selection of multiple survey sites, or "bus stops", within a survey zone. Bus stops should include the most heavily-used public access points within the survey area as identified by a pilot study and/or expert interviews. The amount of time allocated for a daily survey sample, or "survey day", dictates the number of bus stops that can be included in the survey. On each survey day, a starting bus stop and travel direction are randomly selected. The survey agent then travels to each bus stop along a fixed route (the "bus stop route") and remains at that location for an allotted amount of time. These "wait times" are assigned using prior knowledge of the relative angler use of each site; more heavily used sites have longer wait times. Upon arrival at a bus stop, the survey agent counts all anglers at the site and then subsequently records the times of angler arrivals or departures. Cars or boat trailers may be counted as a proxy for anglers. The survey agent may also interview anglers while on-site.

During a survey day in 1997-98 and 2008-09, agents counted all shore anglers and boat trailers (as a proxy for boat anglers at bus stops with boat launches only) present upon arrival at each bus stop. The agent then recorded times of shore angler/boating angler party arrivals or departures from the site for the remainder of the wait time. The agent also interviewed as many anglers as possible using a standardized interview form ("angler interviews"). During both the 1997-98 and 2008-09 surveys, angler interviews recorded the angler's trip length, catch, and harvest. During the 2008-09 survey, interviews also garnered information on the angler's opinions (e.g. on the quality of their angling experience) and attributes (e.g. town and state they reside in). See Appendix 7 for the 2008-09 standardized angler interview form.

Counts and arrival/departure times of shore anglers at each bus stop were used to estimate shore angler effort for the entire "fishing day" (i.e. the entire 12 or 14 hour day, depending on the month, during which the six hour survey day took place) as:

$$E_s = \left[\frac{T \sum_{i=1}^{n} \frac{1}{w_i} \sum_{j=1}^{m} \frac{e_{ji}}{\pi_j}}{60} \right] / S \qquad \text{(Equation 1)}$$

where:
E_s = estimated shore angler effort for the entire fishing day (hours)
T = survey day length (= 3600 minutes)
W_i = wait time at the ith site in minutes (i = 1,2….n)
e_{ji} = total time in minutes that the jth angler is at the ith site while clerk is on-site (j = 1, 2, …m)
π_j = AM/PM period sampling probability (= 0.5, see below)
S = shore angler expansion value (see Equation 2)

The sampling probability term (π_j) corresponds to the AM/PM sampling probability. Because these periods were sampled with equal probability, this term was set to 0.5. This parameter therefore essentially doubles (by dividing by 0.5) the angler effort estimate for the six

hour survey day to create an overall estimate for a 12 hour fishing day. During April–August, when we assumed a 14 hour fishing day, E_s was divided by 0.86 (12/14) to expand the 12 hour estimate to a 14 hour fishing day; no correction was necessary during March and September–October when we assumed a 12 hour fishing day.

Shore angler effort estimates for each fishing day were corrected to account for shore angling that occurred at non-bus stop locations. Shore angler counts were used to generate shore angler expansion values:

$$S = \frac{A_s}{N_s} \qquad \text{(Equation 2)}$$

where:
S = shore angler expansion value
A_s = anglers observed fishing at bus stop sites (summed across all shore angler counts)
N_s = total anglers observed (summed across all shore angler counts)

Initially, Zone-specific shore angler expansion values were calculated for each Season/day-type (weekday/weekend). Chi-square testing (SAS v. 9.3) was then used to test for significant differences between the counts of shore anglers inside vs. outside bus stops for day-types within Seasons; in instances in which no significant difference was found, weekday and weekend shore angler counts were pooled for that Season. A second round of chi-square testing was then performed to test for significant differences between Seasons with pooled day-types; in instances in which no significant differences were found, shore angler counts for those Seasons were pooled (no data from different Zones were pooled). This testing/pooling procedure created fewer, more precise, expansion values. The appropriate shore angler expansion value (S), depending on the Zone/Season/day-type, was then used in Equation 1. Because few shore angler counts were performed during Season 1 (March–April) in any year, we applied Season 2 (May–June) shore angler expansion values to Season 1 bus stop survey days.

A modification of Equation 1 was used to estimate boat angling effort for an entire fishing day. Survey agents counted boat trailers at each bus stop launch as a proxy for boat anglers. The use of trailers as a proxy necessitated a correction for the average number of boat anglers per boating party. The average boating party size was set to 2 for all analyses (Howell and Molnar 1999). The time spent at shore-angling-only sites was also subtracted from the survey day duration, as these sites were not valid locations to assess boat angling effort (trailer counts were not possible). Boat angler effort for the entire fishing day was calculated as:

$$E_b = \left[\left[\frac{T_b \sum_{i=1}^{n} \frac{1}{w_i} \sum_{j=1}^{m} \frac{e_{ji}}{\pi_j}}{60} \right] * P \right] * B \qquad \text{(Equation 3)}$$

where:
E_b = estimated boat angler effort for the entire fishing day (hours)
T_b = survey day length, <u>not including</u> time spent at shore-angling-only sites
W_i = wait time at the ith site in minutes (i = 1,2….n)

e_{ji} = total time (minutes) that the jth trailer is at the ith site while clerk is on-site (j = 1, 2, …m)
π_j = AM/PM period sampling probability (= 0.5, see above)
P = average boating party size (= 2)
B = boat trailer expansion value (see Equation 4)

A similar adjustment to E_b as that described above for E_s was made to expand to a 12 or 14 hour fishing day (depending on the month). In this case, the adjustment was made by dividing E_b by (T_b / 12) or (T_b / 14), with T_b expressed in hours.

Boat angler effort estimates for each fishing day were corrected to account for the proportion of trailers at bus stop launches that did not belong to anglers. Launch usage interviews obtained during on-water and boat launch surveys were used to generate boat trailer expansion values:

$$B = \frac{A_b}{N_b} \qquad \text{(Equation 4)}$$

where:
B = boat trailer expansion value
A_b = boating parties interviewed during on-water surveys and/or boat launch surveys that were anglers (summed across all surveys)
N_b = total boating parties interviewed during on-water surveys and/or boat launch surveys (summed across all surveys)

Initially, Zone-specific boat trailer expansion values were calculated for each Season/day-type; a similar iterative chi-square testing procedure as that outlined above for shore angler expansion values was then used to create pooled expansion values within each Zone. Boat trailer expansion values were set to 1 for all Season 1 bus stop survey days as all boating activity was assumed to be attributable to angling.

Estimates of total angler catch and harvest of each species for an entire fishing day were derived using a two-step calculation. In the first step, catch-per-hour and harvest-per-hour of each species was calculated for each angling mode (boat or shore) using interview data. Only interviews from bus stop surveys or supplementary surveys (boat launch, on-water) that were conducted concurrently with a bus stop survey were used for catch and harvest calculations. In the second step, catch-per-hour and harvest-per-hour of each species for each angling mode was multiplied by the estimated effort for that mode (E_s or E_b from Equations 1 or 3) to produce an estimate of total catch and harvest of each species for that fishing day. Estimates of boat and shore angler catch-per-hour for each species were derived from interview data using the ratio-of-means estimator (Pollock et al. 1994):

$$C = \frac{\bar{c}}{\bar{L}} \qquad \text{(Equation 5)}$$

where:
C = catch-per-hour
$\bar{c}$ = mean boat or shore angler catch of a species (across all boat or shore angler interviews obtained on that survey day)

$\overline{L}$ = mean trip length (across all boat or shore angler interviews obtained on that survey day)

Once catch-per-hour for a given species was estimated for each mode on a fishing day, total catch of that species for each mode on that fishing day was calculated as (Pollock et al. 1994):

$$\hat{C} = \hat{E}C \qquad \text{(Equation 6)}$$

where:
$\hat{C}$ = estimate of total catch by shore or boat anglers for an entire fishing day
$\hat{E}$ = estimated total angler effort (E_s, Equation 1, for shore angling; E_b, Equation 3, for boat angling)
C = estimate of catch-per-hour (Equation 5)

Survey days on which no effort was recorded for a mode (i.e. E_s or $E_b = 0$) were treated as "zero" catch days for all species ($\hat{C} = 0$ for all species). Survey days on which catch of a species was not recorded in any interviews for a mode and angler effort was non-zero for that mode (i.e. E_s or $E_b > 0$) were treated as "zero" catch days for that species ($\hat{C} = 0$ for that species). Survey days on which effort was recorded for a mode (i.e. E_s or $E_b > 0$), but no usable interviews were obtained for that mode (either no interviews or only interviews of boat anglers who were just launching/shore anglers who had just arrived on-site) were treated as "missing values"; these days were dropped from subsequent calculations of total angler catch and harvest for a Season (see below).

Harvest-per-hour and total harvest estimates for a fishing day were derived using the same analytical framework, with the exception that mean harvest (mean number of a species caught but not released across all boat or shore anglers interviewed on a survey day) was substituted for mean catch in Equation 5.

The stratified calculation approach of Pollock et al. (1994) was used to estimate total angler effort, catch, and harvest for each Season within each Zone. The calculation was stratified by day-type (weekday vs. weekend). Stratification most effectively reduces the variance associated with an estimate of a population mean or total when strata are more homogenous internally than the population as a whole (Pollock et al. 1994). Based on the 1997-98 survey and angler surveys conducted on other Connecticut waters, significantly different levels of angler effort and catch were expected on weekends relative to weekdays; stratifying by day-types therefore minimized within-stratum variance and thus reduced the variance associated with overall estimates of catch and effort. These calculations were performed separately for each angling mode (shore or boat). A stratified mean of each variable (effort, catch, or harvest) was calculated for each Zone/Season/mode:

$$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h \qquad \text{(Equation 7)}$$

where:
$\bar{y}_{st}$ = stratified mean of angler effort (E_s, E_b from Equation 1 or 3), catch ($\hat{C}$ from Equation 6), or harvest

W_h = weighting factor for day-type stratum h = (N_h / N), where N_h = number of days in day-type stratum h and N = number of days in the Season
$\bar{y}_h$ = sample mean of angler effort, catch, or harvest for day-type stratum h

The variance of the stratified mean was estimated as:

$$Var(\bar{y}_{st}) = \sum_{h=1}^{L} W_h^{\,2} \frac{S^2{}_h}{n_h}\left(\frac{N_h - n_h}{N_h}\right) \qquad \text{(Equation 8)}$$

where:
$Var(\bar{y}_{st})$ = variance of the stratified mean of angler effort, catch, or harvest
W_h = weighting factor for day-type stratum h (see Equation 7)
$S^2{}_h$ = sample variance of angler effort, catch, or harvest for day-type stratum h
n_h = number of days sampled in day-type stratum h
N_h = number of days in day-type stratum h

Total angler effort, catch, or harvest for the Season was then calculated as:

$$\hat{Y}_{st} = N * \bar{y}_{st} \qquad \text{(Equation 9)}$$

where:
$\hat{Y}_{st}$ = estimate of total angler effort, catch, or harvest for the Season
N = number of days in the Season
$\bar{y}_{st}$ = stratified mean of angler effort, catch, or harvest (Equation 7)

The variance of total angler effort, catch, or harvest for the Season was calculated as:

$$Var(\hat{Y}_{st}) = N^2 Var(\bar{y}_{st}) \qquad \text{(Equation 10)}$$

where:
$Var(\hat{Y}_{st})$ = variance of total angler effort, catch, or harvest for the Season
N = number of days in the Season
$Var(\bar{y}_{st})$ = variance of the stratified mean of angler effort, catch, or harvest (Equation 8)

Precision of total angler effort, catch, or harvest for the Season was expressed as the relative standard error (RSE):

$$RSE(\hat{Y}_{st}) = \frac{\sqrt{Var(\hat{Y}_{st})}}{\hat{Y}_{st}} \qquad \text{(Equation 11)}$$

where:

$RSE(\hat{Y}_{st})$ = relative standard error of total angler effort, catch, or harvest for the Season
$Var(\hat{Y}_{st})$ = variance of total angler effort, catch, or harvest for the Season (Equation 10)
$\hat{Y}_{st}$ = estimate of total angler effort, catch, or harvest for the Season (Equation 9)

Total angler effort, catch, or harvest for an entire survey year within a Zone was estimated by summing $\hat{Y}_{st}$ across all Seasons. The relative standard errors of whole-year angler effort, catch, or harvest estimates for a Zone were calculated as:

$$RSE(\hat{Y}_{st,annual}) = \frac{\sqrt{\sum_i Var(\hat{Y}_{st,i})}}{\sum_i \hat{Y}_{st,i}} \qquad \text{(Equation 12)}$$

where:
$RSE(\hat{Y}_{st,annual})$ = relative standard error of whole-year angler effort, catch, or harvest estimate
$Var(\hat{Y}_{st,i})$ = variance of total angler effort, catch, or harvest for Season *i* (Equation 10)
$\hat{Y}_{st,i}$ = estimate of total angler effort, catch, or harvest for Season *i* (Equation 9)

It was not possible to generate true "whole-river" estimates of angler effort, catch, or harvest for 2008 or 2009 because the entire river was not surveyed in either year. An approximation of a whole-river estimate was obtained by combining whole-year estimates from each Zone (i.e. combining 2008 data from Zones 3-4 with 2009 data from Zones 1-2). Whole-river estimates were calculated using an analogous estimation scheme to the one described above for whole-year estimates within a Zone: whole-year estimates of total angler effort, catch, and harvest within each Zone were summed to estimate whole-river quantities, variances of these estimates were summed and a square root of this sum was taken to estimate standard errors of whole-river quantities, and relative standard errors of whole-river quantities were estimated by dividing standard errors by whole-river quantities.

Periodic flooding events affect angler access at many locations along the Connecticut River. Daily effort estimates for both modes (E_b, E_s from Equations 1 and 3) within each Zone were plotted against daily means of river height/flow obtained from United States Geological Survey (USGS) gauge stations to assess the effect of flood events on angler effort. These plots, along with notes taken by survey agents on-site during flood events, were used to identify Zone-specific flood thresholds above which all access for shore and/or boat anglers within a Zone was eliminated (i.e. E_b and/or $E_s = 0$ because anglers could not access the river). Days during which river flood stage exceeded these thresholds were eliminated from the number of possible fishing days within a Zone/Season (N in Equations 9-10) to improve accuracy of total angler effort estimates for a Zone. Appropriate adjustments were also made to weighting factors (W_h) in Equations 7–8.

Appendix 2.- Differences between the original 1997-98 Connecticut River angler survey design and data analyses and those of the recent 2008-09 survey. Raw data from the 1997-98 survey were re-analyzed for this report using 2008-09 methods (see Appendix 1) except where noted in the report body.

Survey Design

1. During 1997-98, Zones 1-3 were surveyed in both years except that they were not surveyed during March–April of either year. During 2008-09, we: a) surveyed a fourth Zone north of Hartford; and b) surveyed each Zone for the duration of the open water period (March – October). Surveying all four Zones in each year was not feasible during 2008-09 given available manpower; we therefore chose to survey Zones 3-4 during 2008 and Zones 1-2 during 2009. This decision was made after considering the tradeoff between the desirability of sampling all Zones during both years (obtaining a "whole-river" picture of angling activity during each year) and the necessary reduction of within-Zone sampling effort (and concomitant loss of precision in survey results) that such comprehensive sampling would require.

2. The 1997-98 "CT Yankee" bus stop in Zone 2 is no longer open to the public. We therefore removed this bus stop from the Zone 2 bus stop route and adjusted wait times at the remaining sites accordingly.

3. The 1997-98 survey assumed a 14 hour fishing day during spring-summer (March–August) and a 12 hour fishing day during fall (September–October). As a result, survey planners used two different survey-day lengths: a seven-hour survey day during spring-summer, followed by a reduced six-hour survey day during fall. Different sets of wait times were accordingly used for each bus stop route during spring-summer vs. fall. We chose to use a six-hour survey day for the entire sampling season during 2008-09 because: a) it allowed survey agents to complete a survey within a standard seven-hour workday; and b) it was mathematically simple to expand effort estimates from a six-hour survey day to either a 12 or 14 hour fishing day. We therefore used the 1997-98 fall wait times (corresponding to a six hour survey day) for Zones 1-3. Based on observations made during survey operations, we also chose to depart from the 1997-98 methodology by assuming a 12 hour fishing day in March.

4. The 2008-09 survey effort (i.e. number of bus stop survey days conducted in each Zone/Season) was 45–75% higher than that of the 1997-98 survey. The 2008-09 levels of survey effort were designed to obtain estimates of Seasonal angler effort with RSE $\leq$ 0.25, based on *post-hoc* analyses of 1997-98 survey data that examined the relationship of survey effort to expected precision of angler effort estimates (see Davis et al. 2008).

5. The 1997-98 survey used only boat launch surveys to obtain launch usage interviews. On-water surveys were not conducted during 1997-98 (i.e. all launch usage interviews used to calculate boat trailer expansion values came from boat launch surveys). Boat launch survey agents traveled to one launch/day during 1997-98 (and 2006-07); boat launch survey agents traveled to two launches/day during 2008 (3 hrs per launch). Boat

launch surveys at the I-95 Launch during 2009 were full-day (6 hr) surveys. Additionally, during 1997-98, shore angler counts were conducted in two Zones per day (as opposed to twice in the same Zone per day during 2008-09).

Data Analyses

1. During both surveys, bus stop survey agents counted boat trailers at bus stops with boat launches as a proxy for boat anglers. Because not all bus stops had boat launches (and were therefore not valid survey sites to assess boat angler effort), we made a correction to the survey day length when calculating estimates of boat angler effort: time spent at shore-angling-only sites was subtracted from the survey day duration. The original 1997-98 survey methodology recorded trailer counts of 0 at all shore-angling-only sites and used the entire survey day to estimate boat angler effort.

2. The stratified calculation scheme and associated formulas for stratified means and variances (Pollock et al. 1994) used for 2008-09 data analyses were not used in the original 1997-98 data analyses. Originally, 1997-98 angler effort, catch, and harvest were estimated individually for each Zone/Season/day-type "cell" as the product of the sample mean for and the total number of days within that Zone/season/day-type cell; these quantities were summed across all Season/day-type cells within a Zone to estimate whole-year effort, catch, and harvest for that Zone. Relative standard errors of whole-year effort, catch, and harvest were estimated by: a) calculating sample standard errors for each Zone/Season/day-type cell; b) summing sample standard errors across all Season/day-type cells within a Zone; and c) dividing the sum of sample standard errors by the estimated whole-year effort, catch, or harvest for that Zone.

3. For the original 1997-98 data analyses, all survey days during which no catch events of a given species were recorded in angler interviews from either boat or shore anglers were treated as "missing values" for that mode – i.e. these days were dropped from subsequent estimation of total catch/harvest for that mode within a Season/day-type cell. Accordingly, only days on which catch of a given species was >0 were used to estimate means/variances/standard errors of catch/harvest within a Season/day-type cell. Similarly, survey days on which no angler effort was observed for a mode (E_s or $E_b = 0$) were treated as missing values (rather than being treated as zero catch days for all species).

4. The numbers of possible fishing days within a Zone/Season were not adjusted in 1997-98 to account for flood events that prevented angler access to bus stop locations.

Connecticut River Creel Survey Interview Form

ID:

Date:	Route:	Site:	# of Anglers:

Multiple Anglers - Use Letters

Fishing From: Boat Shore	Time Started:	Time Now:

What are you fishing for?	Bait Used: Lures Flies Minnows Worms
	Other Bait:

How would you rate your fishing success today?
Terrible Poor Average Good Excellent Can't tell yet

(boat anglers only) **Were you fishing in the CT River or LIS today?** (boundary = Saybrook breakwater)
CT River LIS Percent Breakdown (if not one or the other):

Are you fishing in a tournament today?
Yes No

What town/state are you from?

How many times do you go fishing in an average year?

Of those trips, how many on average are on the CT River?

How often do you keep (target species) **that you catch in the CT River?** (striped bass - say "legal-sized")
Always Most of the time (>50%) Occasionally (<50%) Rarely (<10%) Never

(If rarely or never) **Why not?**
Don't like to eat fish Afraid of toxins Too much bother Other:

Have you been interviewed on the CT River yet this year? Yes No

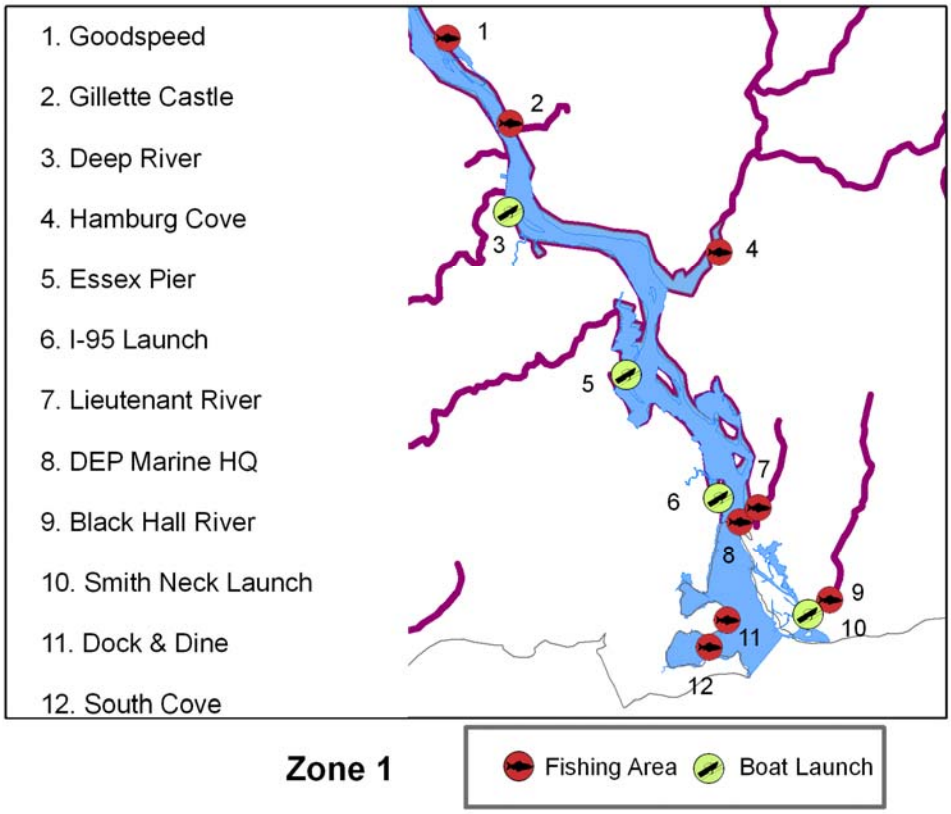
Age (ask):
Sex: M F

Boat Angler Checklist
Length of Boat:
Motor Horsepower:
Type of Boat:
bass boat center console open canoe kayak other:
Hull Material: fiberglass aluminum plastic other:
Number of Rods:

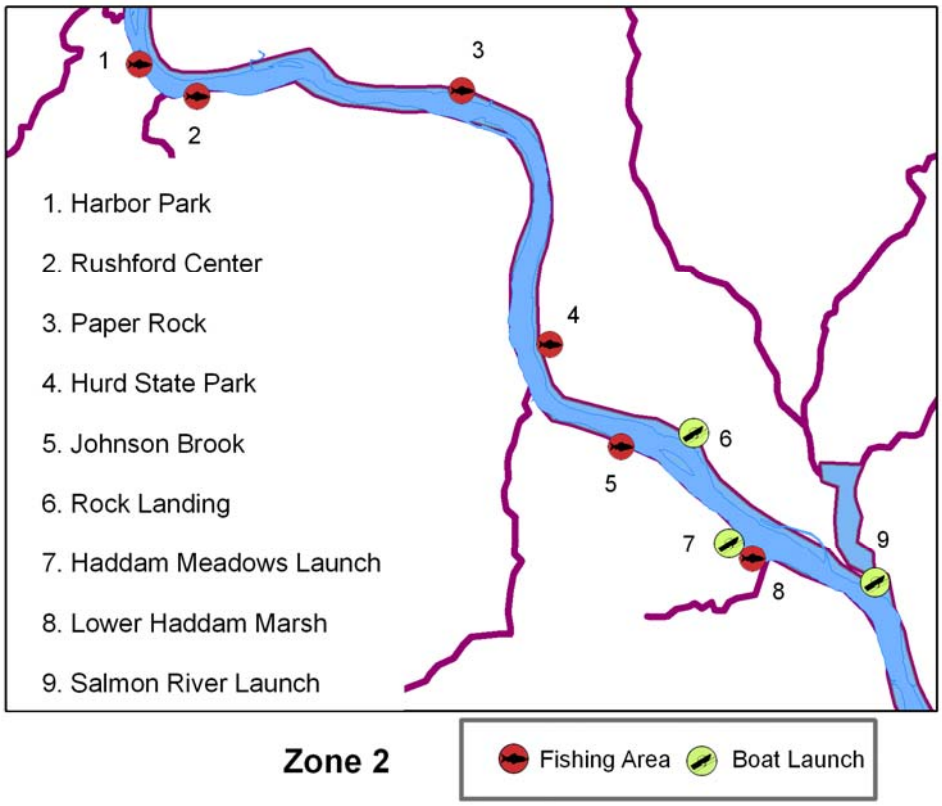
Are there any additional comments you would like to make about the Connecticut River?

Species	Lengths	**Kept Fish (cm)**	Species	Lengths	**Released Fish (inches)**

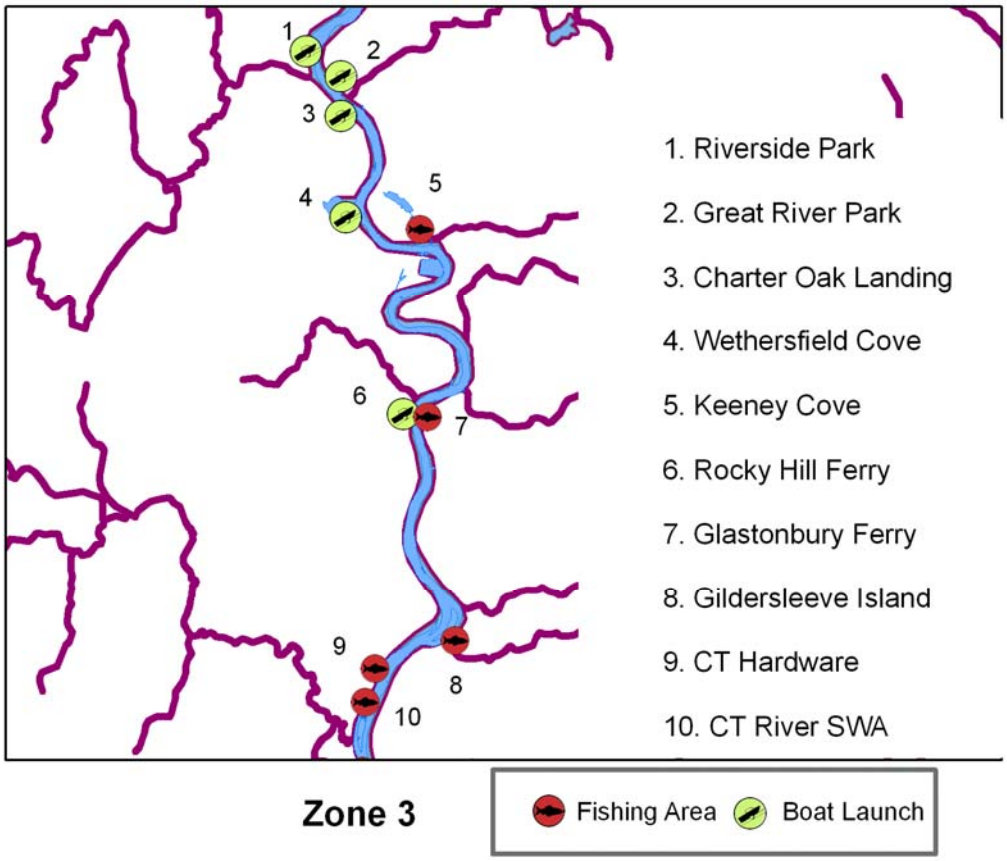
Appendix 3.- Standardized interview form used during 2008-09 survey operations to obtain boat and shore angler interviews.



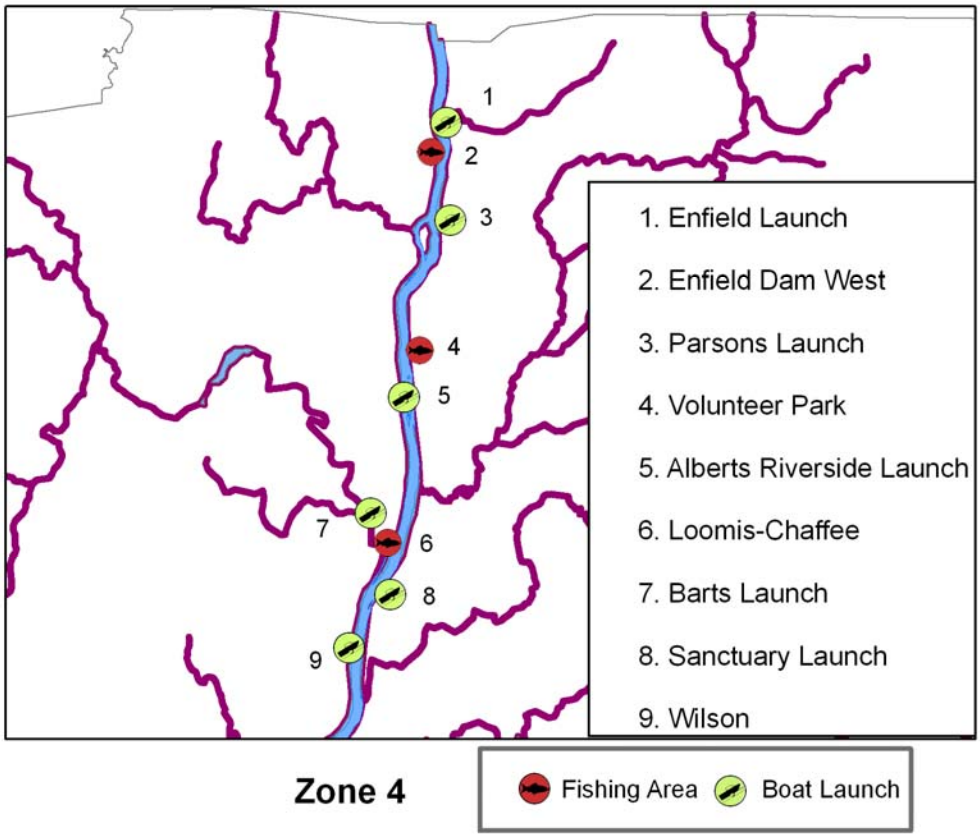
Appendix 4.- Bus stop locations in Zone 1 (River mouth - Haddam). Areas designated as "Fishing Areas" are shore-fishing-only locations.



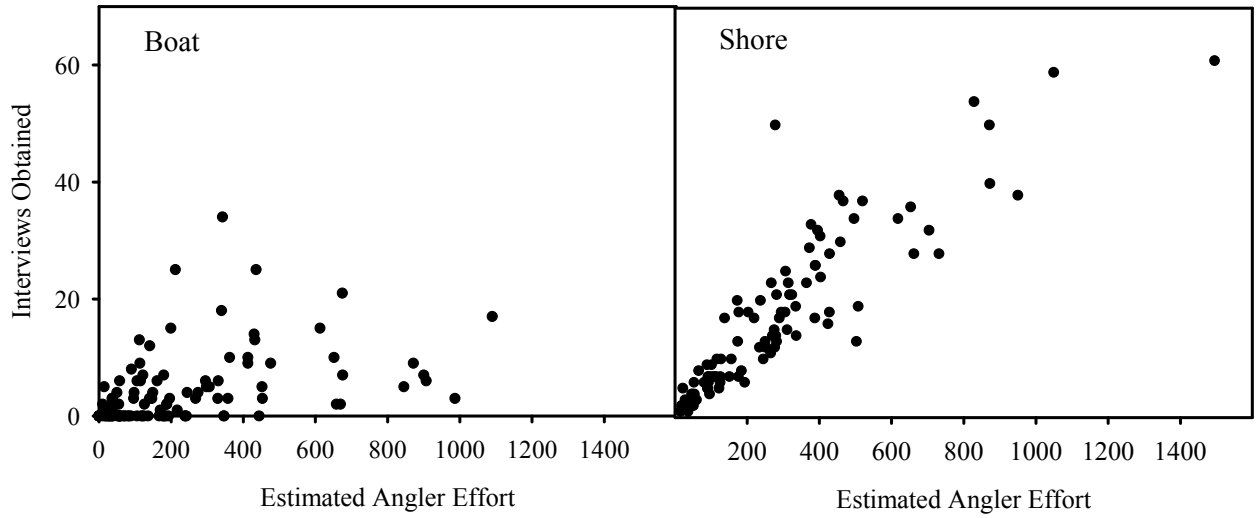
Appendix 5.- Bus stop locations in Zone 2 (Haddam - Middletown). Areas designated as "Fishing Areas" are shore-fishing-only locations.



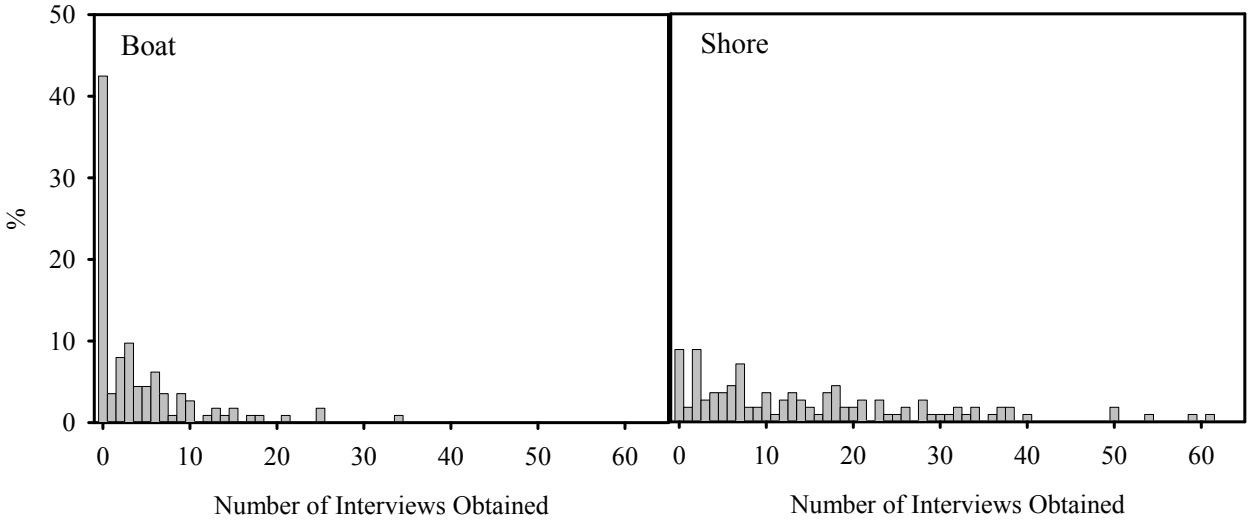
Appendix 6.- Bus stop locations in Zone 3 (Middletown - Hartford). Areas designated as "Fishing Areas" are shore-fishing-only locations (State Wildlife Area abbreviated as "SWA").



Appendix 7.- Bus stop locations in Zone 4 (Hartford – CT/MA border). Areas designated as "Fishing Areas" are shore-fishing-only locations.



Appendix 8.- Estimated angler effort vs. number of interviews obtained for boat and shore anglers on bus stop survey days during 1998 (all Zones/Seasons combined). The relationship for boat anglers reflects a low probability of encounter between survey agents and boat anglers (survey agents were only able to interview boating anglers when they were launching or returning); boat angler interview totals remained relatively low even on high boating effort days.



Appendix 9.- Frequency distribution of the number of interviews obtained from boat and shore anglers on bus stop survey days during 1998 (all Zones/Seasons combined; including only days on which estimated angler effort >0). No boat angler interviews were obtained on >40% of bus stop survey days; more than 10 boat angler interviews were obtained on <10% of survey days.

Appendix 10.- Summary of bus stop angler surveys conducted in Zones 1-4 during 2008-09. Entries in the cells represent the number of bus stop surveys conducted during each month/day-type.

		2009						**2008**					
		Zone 1 (Mouth – Haddam)			**Zone 2 (Haddam – Middletown)**			**Zone 3 (Middletown - Hartford)**			**Zone 4 (Hartford - MA)**		
Season	**Month**	Weekday	Weekend	**SUM**	Weekday	Weekend	**SUM**	Weekday	Weekend	**SUM**	Weekday	Weekend	**SUM**
1	March	7	4	**11**	7	3	**10**	3	2	**5**	3	0	**3**
	April	9	5	**14**	8	3	**11**	3	2	**5**	5	4	**9**
2	May	8	5	**13**	9	5	**14**	9	4	**13**	6	4	**10**
	June	9	4	**13**	9	4	**13**	8	5	**13**	6	4	**10**
3	July	10	3	**13**	9	4	**13**	7	5	**12**	9	4	**13**
	August	8	5	**13**	8	5	**13**	8	5	**13**	9	5	**14**
4	September	9	4	**13**	7	5	**12**	6	4	**10**	6	4	**10**
	October	9	5	**14**	9	4	**13**	8	1	**9**	6	2	**8**
	SUMS			**104**			**99**			**80**			**77**

Appendix 11.- Summary of boat launch surveys conducted in Zones 1-4 during 2006-09. Entries in the cells represent the number of boat launch surveys conducted during each Season/day-type (see Appendix 56 for more details on locations of surveys). No boat launch surveys were conducted in Zone 2 (Haddam–Middletown) during any year. Numbers of non-concurrent surveys (those not conducted concurrently with a bus stop survey) are indicated; boat angler interviews obtained during these surveys were not used in catch/harvest calculations, but were used to summarize boat angler target species, attributes, and attitudes.

Season	Weekday	Weekend
Zone 1 (Mouth – Haddam): 2009		
May – June (2)	1	1
July – August (3)[a]	7	4
September – October (4)	3	3
Zone 3 (Middletown – Hartford): 2006-07[b]		
May – June (2)	4	1
July – August (3)	3	3
September – October (4)	0	0
Zone 3 (Middletown – Hartford): 2008		
May – June (2)[c]	6	3
July – August (3)	3	1
September – October (4)	0	0
Zone 4 (Hartford – MA): 2006-07[b]		
May – June (2)	5	3
July – August (3)	1	1
September – October (4)	0	0
Zone 4 (Hartford – MA): 2008[d]		
May – June (2)	5	3
July – August (3)	6	2
September – October (4)	1	0

[a]Two weekday surveys were non-concurrent.
[b]All 2006-07 surveys were non-concurrent as no bus stop surveys were conducted in 2006-07.
[c]Three weekday surveys were non-concurrent.
[d]An additional five boat launch surveys (4 weekday, 1 weekend) were conducted in Zone 4 during Season 1 in 2006. Interviews from these surveys were not used to estimate angler effort (all boating activity in Season 1 was assumed to be attributable to angling).

Appendix 12.- Summary of on-water surveys conducted in Zones 1-4 during 2008-09. Entries in the cells represent the number of on-water surveys conducted during each Season/day-type. Numbers of non-concurrent surveys (those not conducted concurrently with a bus stop survey) are indicated; boat angler interviews obtained during these surveys were not used in catch/harvest calculations but were used to summarize boat angler target species, attributes, and attitudes.

Season	Weekday	Weekend
Zone 1 (Mouth – Haddam): 2009		
May – June (2)[a]	2	2
July – August (3)	3	2
September – October (4)	2	2
Zone 2 (Haddam – Middletown): 2009		
May – June (2)	2	2
July – August (3)	3	3
September – October (4)	2	2
Zone 3 (Middletown – Hartford): 2008		
May – June (2)	0	0
July – August (3)[b]	3	4
September – October (4)[c]	1	2
Zone 3 (Middletown – Hartford): 2009[d]		
May – June (2)	1	3
July – August (3)	1	0
September – October (4)	3	3
Zone 4 (Hartford – MA): 2008		
May – June (2)	0	0
July – August (3)[e]	4	3
September – October (4)[f]	1	2
Zone 4 (Hartford – MA): 2009[d]		
May – June (2)	2	1
July – August (3)	0	0
September – October (4)	1	1

[a]One weekday survey was non-concurrent.
[b]One weekday and one weekend survey were non-concurrent.
[c]One weekday and one weekend survey were non-concurrent.
[d]All Zone 3-4 surveys during 2009 were non-concurrent because bus stop surveys were not conducted in these Zones during 2009.
[e]One weekday survey was non-concurrent.
[f]All surveys were non-concurrent.

Appendix 13.- Summary of shore angler counts conducted in Zones 1-4 during 2008-09. Shore angler counts were performed during on-water surveys (generally 2 counts per on-water survey day, with some exceptions due to boat breakdowns and different survey design in early 2008). Clerks counted the total number of shore anglers fishing within the Zone ("Total Anglers") and the number of these anglers fishing at bus stops ("Anglers in"). The proportions of shore anglers fishing at bus stops shown here ("Prop In") represent the "un-pooled" shore angler expansion values (*S*) – i.e. prior to pooling across seasons and day-types after iterative chi-square testing.

	Weekdays				Weekends			
Season	**Counts**	**Total Anglers**	**Anglers In**	**Prop In**	**Counts**	**Total Anglers**	**Anglers In**	**Prop In**
Zone 1 (Mouth – Haddam)								
May-June (2)	6	83	74	0.89	4	164	135	0.82
July – August (3)	6	108	83	0.77	4	130	98	0.75
September-October (4)	4	72	61	0.85	4	68	62	0.91
Zone 2 (Haddam – Middletown)								
May-June (2)	6	64	45	0.70	4	147	87	0.59
July – August (3)	6	20	13	0.65	6	44	33	0.75
September-October (4)	4	3	3	1.00	4	18	18	1.00
Zone 3 (Middletown – Hartford)								
May-June (2)	4	150	83	0.55	9	569	295	0.52
July – August (3)	5	87	48	0.55	7	235	92	0.39
September-October (4)	6	71	42	0.59	10	149	89	0.60
Zone 4 (Hartford – MA)								
May-June (2)	6	50	15	0.30	3	47	17	0.36
July – August (3)	7	48	23	0.48	4	30	14	0.47
September-October (4)	4	9	3	0.33	6	28	21	0.75

Appendix 14.- Summary of launch usage interviews, by source, used to calculate boat trailer expansion values for Zones 1-4 during 2008-09. The column labeled "Interviews" indicates the number of launch usage interviews obtained from each survey type/year. Only launch usage interviews obtained during boat launch surveys conducted at the I-95 boat launch during 2009 were used to estimate boat trailer expansion values for Zone 1 (the majority of boating activity in Zone 1 originated at the I-95 Launch; launch usage interviews from on-water surveys were unreliable for assessing boating activity at this launch as many boaters traveled to Long Island Sound).

	Weekdays		Weekends	
Season	**Survey Type (Year)**	**Interviews**	**Survey Type (Year)**	**Total Interviews**
		Zone 1 (Mouth – Haddam)		
May – June (2)	Boat Launch (2009)	18	Boat Launch (2009)	23
July – August (3)	Boat Launch (2009)	219	Boat Launch (2009)	254
September – October (4)	Boat Launch (2009)	18	Boat Launch (2009)	50
Daytype Sums		**255**		**327**
Zone Sum	**582**			
		Zone 2 (Haddam – Middletown)		
May – June (2)	On-Water (2009)	5	On-Water (2009)	21
July – August (3)	On-Water (2009)	30	On-Water (2009)	44
September – October (4)	On-Water (2009)	7	On-Water (2009)	11
Daytype Sums		**42**		**76**
Zone Sum	**118**			
		Zone 3 (Middletown – Hartford)		
May – June (2)	Boat Launch (2006)	9	Boat Launch (2006)	10
	Boat Launch (2008)	21	Boat Launch (2008)	9
	On-Water (2009)	4	On-Water (2009)	46
July – August (3)	Boat Launch (2007)	7	Boat Launch (2006)	19
	Boat Launch (2008)	20	Boat Launch (2007)	17
	On-Water (2008)	17	Boat Launch (2008)	4
			On-Water (2008)	56
September – October (4)	Boat Launch (2007)	2	On-Water (2008)	22
	On-Water (2008)	5	On-Water (2009)	15
	On-Water (2009)	5		
Daytype Sums		**90**		**198**
Zone Sum	**288**			

Appendix 14 continued

		Zone 4 (Hartford – MA)		
May – June (2)	Boat Launch (2006)	28	Boat Launch (2006)	27
	Boat Launch (2008)	17	Boat Launch (2008)	10
	On-Water (2009)	8	On-Water (2009)	2
July – August (3)	Boat Launch (2007)	5	Boat Launch (2006)	5
	Boat Launch (2008)	1	Boat Launch (2007)	2
	On-Water (2008)	12	Boat Launch (2008)	4
			On-Water (2008)	21
September – October (4)	On-Water (2008)	1	On-Water (2008)	8
	On-Water (2009)	2	On-Water (2009)	10
Daytype Sums		**74**		**89**
Zone Sum	**163**			

Appendix 15.- Summary of launch usage interviews used to calculate boat trailer expansion values for Zones 1-4 during 2008-09. The number of launch usage interviews ("Interviews") are reported, as are the number of those interviews that were from angling boat parties ("Anglers"). The proportions of angling parties ("Prop Anglers") represent the "un-pooled" boat trailer expansion values (*B*) – i.e. prior to pooling across seasons and day-types after iterative chi-square testing. All interviews shown here for Zone 1 were obtained during boat launch surveys conducted at the I-95 Launch during 2009; interviewees that launched from this location but traveled to Long Island Sound were lumped in with "recreational" boaters.

	Weekdays			Weekends		
Season	**Interviews**	**Anglers**	**Prop Anglers**	**Interviews**	**Anglers**	**Prop Anglers**
Zone 1 (Mouth – Haddam)						
May - June (2)	18	6	0.33	23	7	0.30
July – August (3)	219	30	0.14	254	13	0.05
September - October (4)	18	8	0.44	50	6	0.12
Zone 2 (Haddam – Middletown)						
May - June (2)	5	5	1.00	21	18	0.86
July – August (3)	30	9	0.30	44	27	0.61
September - October (4)	7	1	0.14	11	9	0.82
Zone 3 (Middletown – Hartford)						
May - June (2)	34	18	0.53	65	48	0.74
July – August (3)	44	10	0.23	96	28	0.29
September - October (4)	12	11	0.92	37	20	0.54
Zone 4 (Hartford – MA)						
May - June (2)	53	45	0.85	39	26	0.67
July – August (3)	18	14	0.78	32	20	0.63
September - October (4)	3	3	1.00	18	15	0.83

Appendix 16.- Angler interviews used for estimation of total angler catch and harvest in Zones 1-4 during 2008-09 (n = 2,755)[1]. Interviews were obtained during bus stop surveys; additional boat angler interviews were obtained during concurrent supplementary surveys (boat angler interviews obtained during non-concurrent supplementary surveys were not used in catch/harvest calculations but were used to summarize angler target species, attributes, and attitudes).

		Shore Anglers				Boat Anglers			
Season	**Month**	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**
1	March	31	50	6	4	3	5	2	0
	April	109	91	22	35	10	7	0	34
2	May	152	126	194	69	56	35	36	54
	June	129	38	95	26	58	35	3	9
3	July	160	16	44	37	88	40	3	18
	August	173	37	45	21	47	29	34	37
4	September	106	31	49	17	33	15	9	0
	October	52	22	34	8	22	2	2	0
	SUM	**912**	**411**	**489**	**217**	**317**	**168**	**89**	**152**

[1]Additional boat angler interviews that were not used in catch/harvest calculations (i.e. were obtained during non-concurrent supplementary surveys): 177 interviews obtained during 2009 on-water surveys in Zone 3 (n = 147) and Zone 4 (n = 30), 38 interviews obtained during 2008 boat launch surveys and on-water surveys in Zone 3 (n = 19) and Zone 4 (n = 19), and 41 interviews obtained during 2009 boat launch surveys and on-water surveys in Zone 1.

Appendix 17.- Summary of sources for boat angler interviews used in catch/harvest calculations for Zones 1-4 during 2008-09. Entries in each cell represent the number of boat angler interviews obtained from each survey type (bus stop survey, boat launch survey, on-water survey) during each Season. Zones/Seasons during which a type of survey was not performed are indicated with a dash.

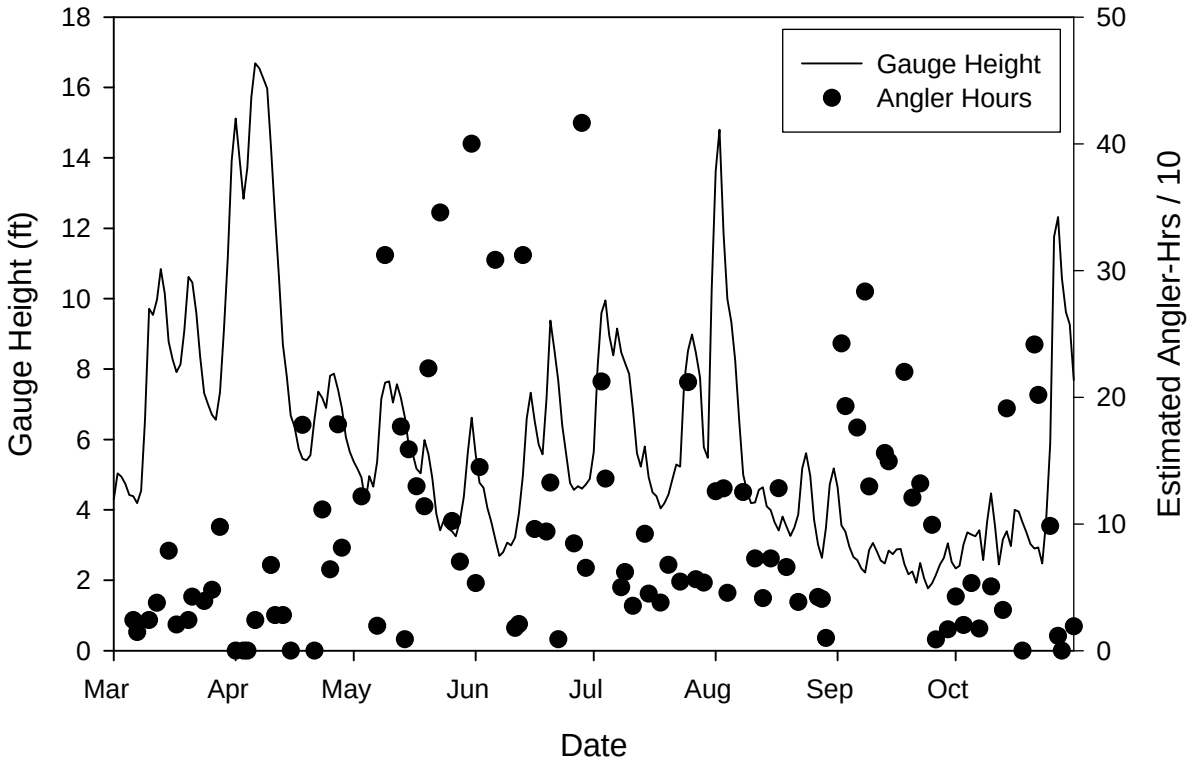
Season	Bus Stop	Boat Launch	On-Water
Zone 1 (Mouth – Haddam)			
March – April (1)	13	-	-
May – June (2)	24	27	63
July – August (3)	34	53	48
September – October (4)	11	16	28
SUMS	**82**	**96**	**139**
Zone 2 (Haddam – Middletown)			
March – April (1)	10	-	2
May – June (2)	37	-	33
July – August (3)	24	-	45
September – October (4)	4	-	13
SUMS	**75**		**93**
Zone 3 (Middletown – Hartford)			
March – April (1)	2	-	-
May – June (2)	32	7	-
July – August (3)	2	1	34
September – October (4)	3	-	8
SUMS	**39**	**8**	**42**
Zone 4 (Hartford – MA)			
March – April (1)	34	-	-
May – June (2)	53	10	-
July – August (3)	5	2	48
September – October (4)	0	-	0
SUMS	**92**	**12**	**48**

Appendix 18.- Shore angler expansion values used to correct daily shore angler effort estimates in Zones 1-4 during 2008-09. Expansion values were initially calculated for each Season/day-type within each Zone (see Appendix 13); an iterative chi-square testing procedure was then used to identify day-types and Seasons that could be "pooled" within a Zone. This table shows the pooled expansion values; the number of anglers counted ("Total Anglers"), number of those anglers that were fishing at bus stops ("Anglers In"), and the resulting proportional correction factor for shore angler effort (*S*) are shown for each Zone/Season/day-type for which a unique expansion value was used in angler effort calculations. Entries of "both" in the "Day-type" column indicate that the same expansion value was used to correct both weekday and weekend shore angler effort within that Zone/Season.

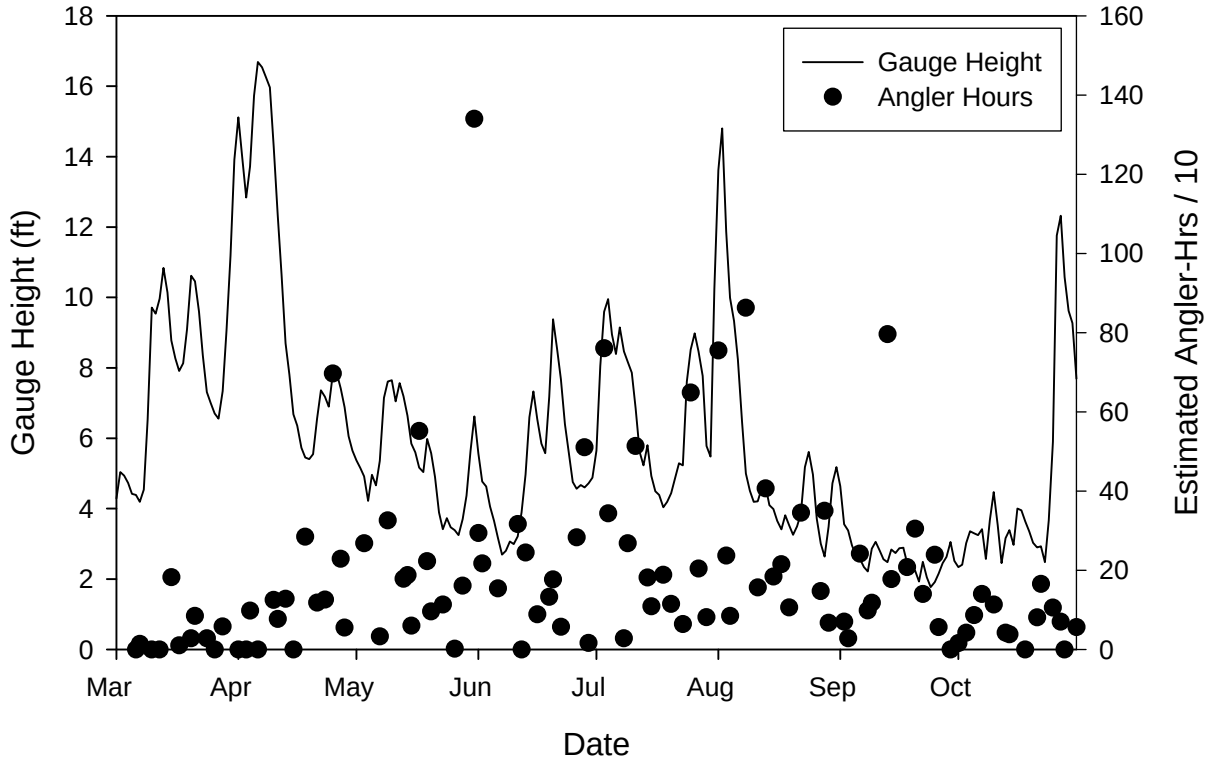
Season	Day-type	Total Anglers	Anglers In	*S*
Zone 1 (Mouth – Haddam)				
May – June (2) **&** September – October (4)	both	387	332	0.86
July – August (3)	both	238	181	0.76
Zone 2 (Haddam – Middletown)				
May – June (2) **&** July – August (3)	both	275	178	0.65
September – October (4)	both	21	21	1.00
Zone 3 (Middletown – Hartford)				
May – June (2) **&** September – October (4)	both	939	509	0.54
July – August (3)	weekday	87	48	0.55
July – August (3)	weekend	235	92	0.39
Zone 4 (Hartford – MA)				
May – June (2)	both	97	32	0.33
July – August (3) **&** September – October (4)	both	115	61	0.53

Appendix 19.- Boat trailer expansion values used to correct daily trailer counts at bus stops in Zones 1-4 during 2008-09. Expansion values were initially calculated for each Season/day-type within each Zone (see Appendix 15); an iterative chi-square testing procedure was then used to identify day-types and Seasons that could be "pooled" within a Zone. This table shows the "pooled" expansion values; the number of launch usage interviews ("Interviews"), number of interviews from boat angling parties ("Anglers"), and the resulting proportional correction factor for trailer counts (*B*) are shown for each Zone/Season/day-type for which a unique expansion value was used in angler effort calculations. Entries of "both" in the "Day-type" column indicate that the same expansion value was used to correct both weekday and weekend trailer counts within that Zone/Season.

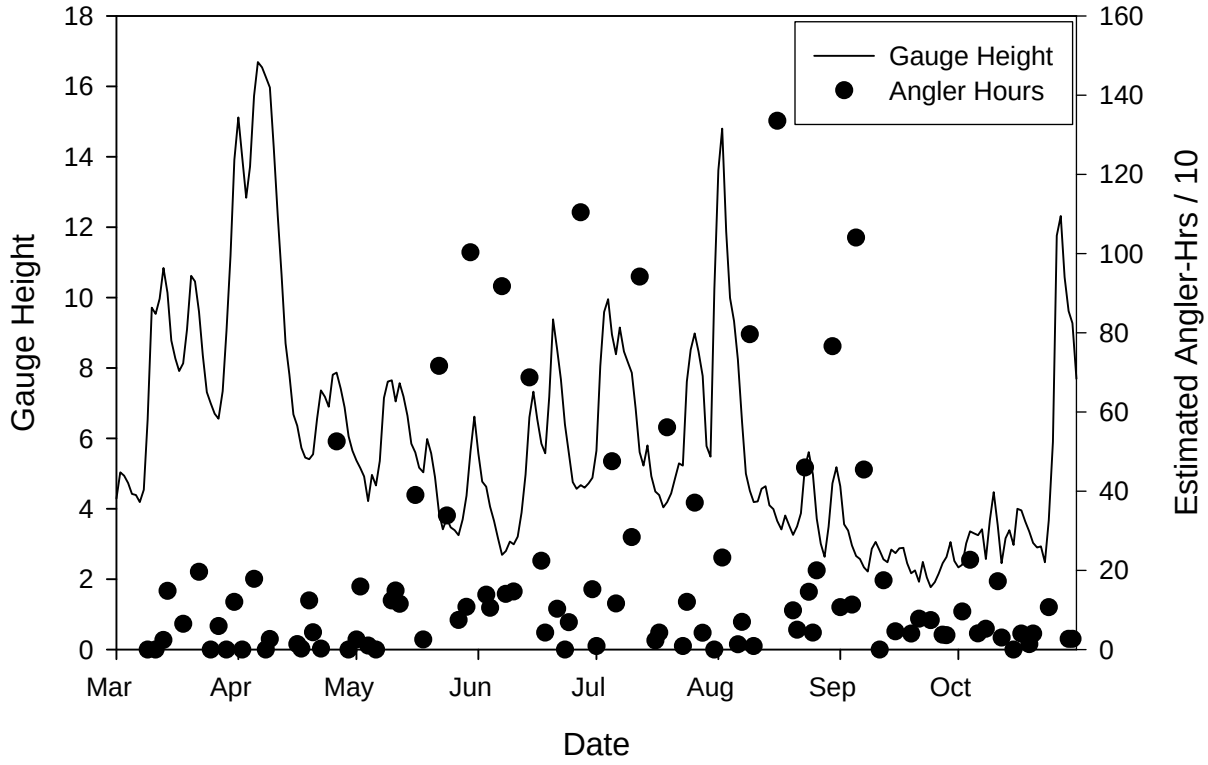
Season	Day-type	Interviews	Anglers	*B*
Zone 1 (Mouth – Haddam)				
May – June (2)	both	41	13	0.32
July – August (3)	weekday	219	30	0.14
July – August (3)	weekend	254	13	0.05
September – October (4)	weekday	18	8	0.44
September – October (4)	weekend	50	6	0.12
Zone 2 (Haddam – Middletown)				
May – June (2)	both	26	23	0.88
July – August (3)	weekday	30	9	0.30
July – August (3)	weekend	44	27	0.61
September – October (4)	both	18	10	0.56
Zone 3 (Middletown – Hartford)				
May – June (2)	weekday	34	18	0.53
May – June (2)	weekend	65	48	0.74
July – August (3)	both	140	38	0.27
September – October (4)	weekday	12	11	0.92
September – October (4)	weekend	37	20	0.54
Zone 4 (Hartford – MA)				
May – June (2)	weekday	53	45	0.85
May – June (2)	weekend	39	26	0.67
July – August (3) **&** September – October (4)	both	71	52	0.73



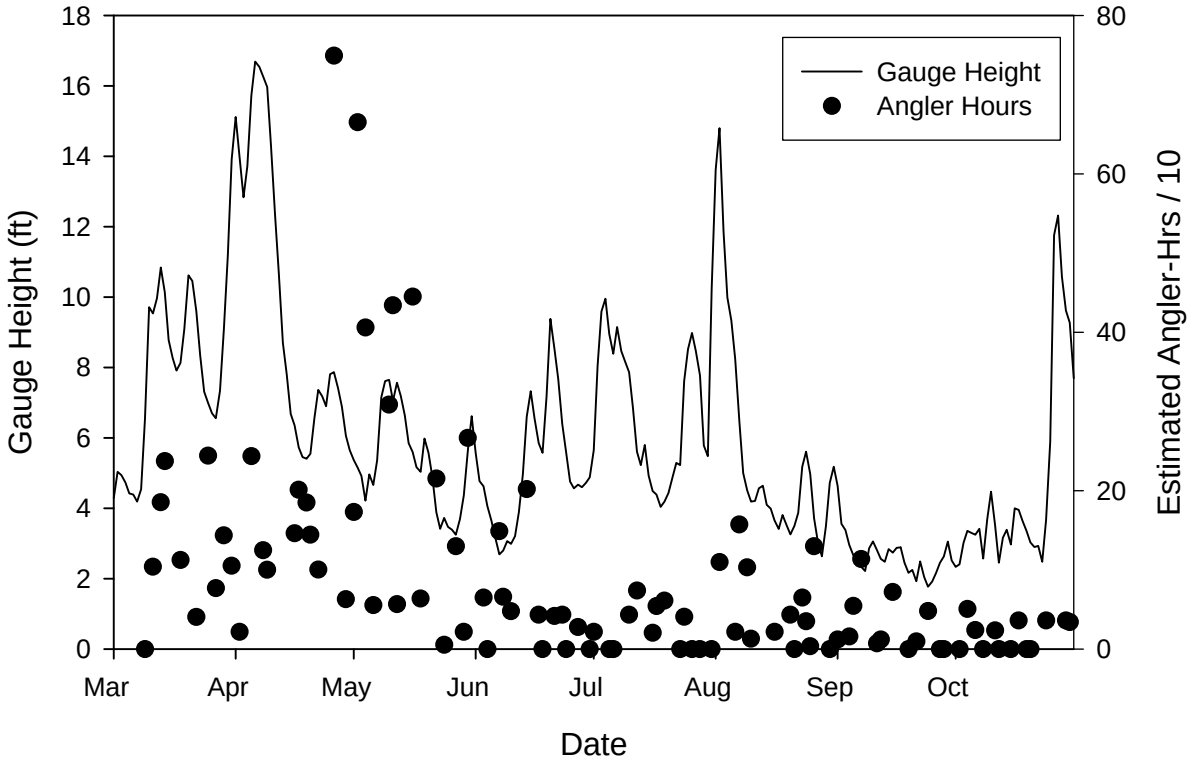
Appendix 20.- Daily estimates of boat angler effort in Zone 1 (River mouth-Haddam) during 2009 vs. USGS Hartford gauge height.



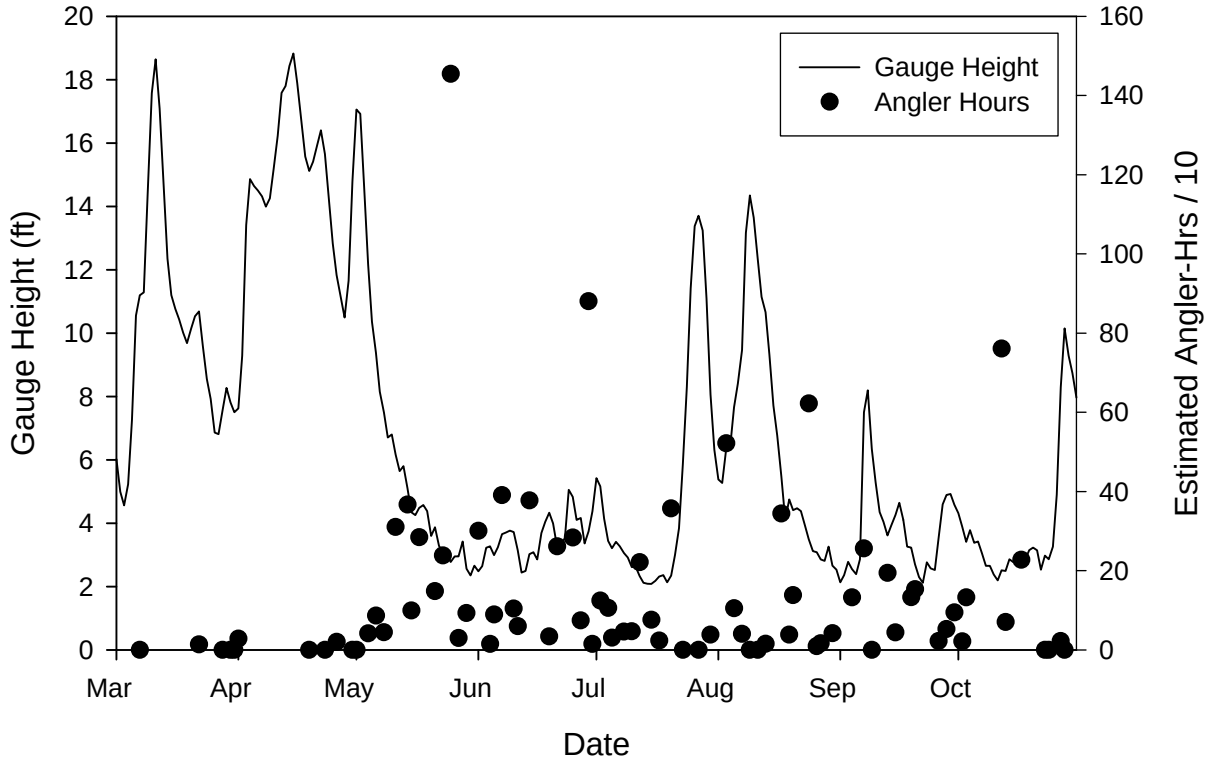
Appendix 21.- Daily estimates of shore angler effort in Zone 1 (River mouth-Haddam) during 2009 vs. USGS Hartford gauge height.



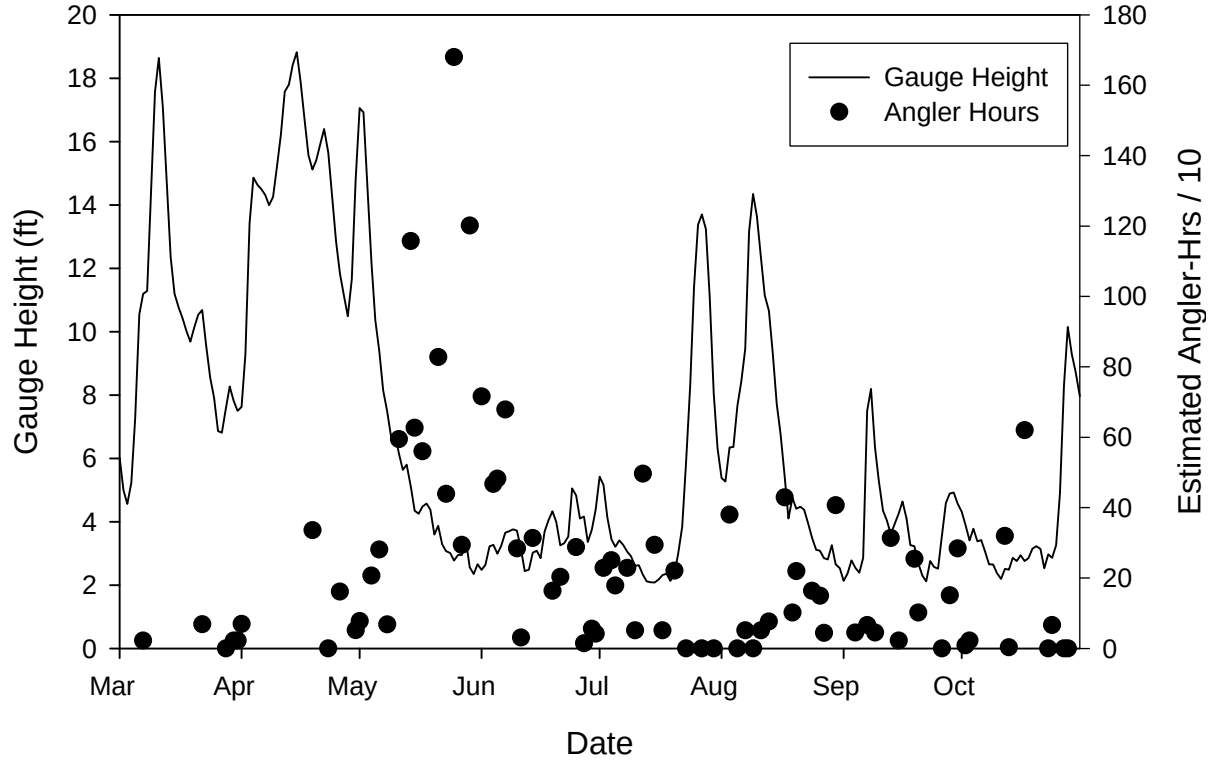
Appendix 22.- Daily estimates of boat angler effort in Zone 2 (Haddam-Middletown) during 2009 vs. USGS Hartford gauge height.



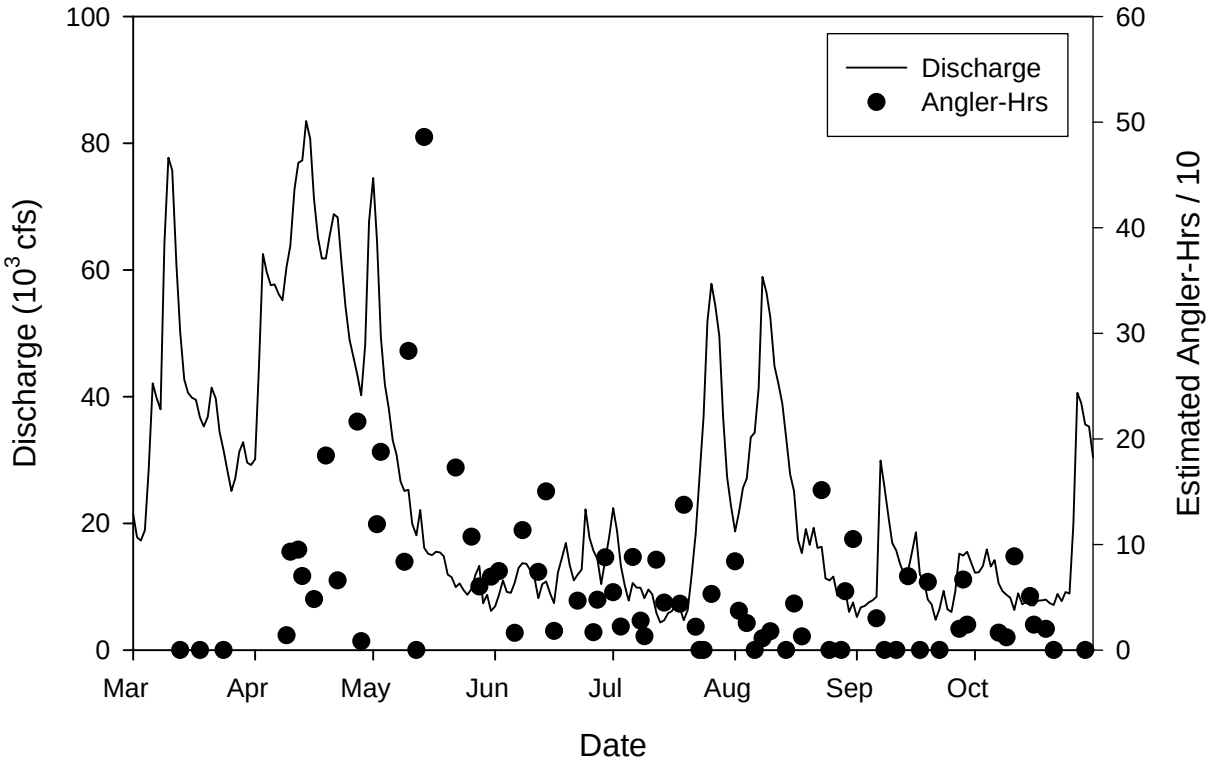
Appendix 23.- Daily estimates of shore angler effort in Zone 2 (Haddam-Middletown) during 2009 vs. USGS Hartford gauge height.



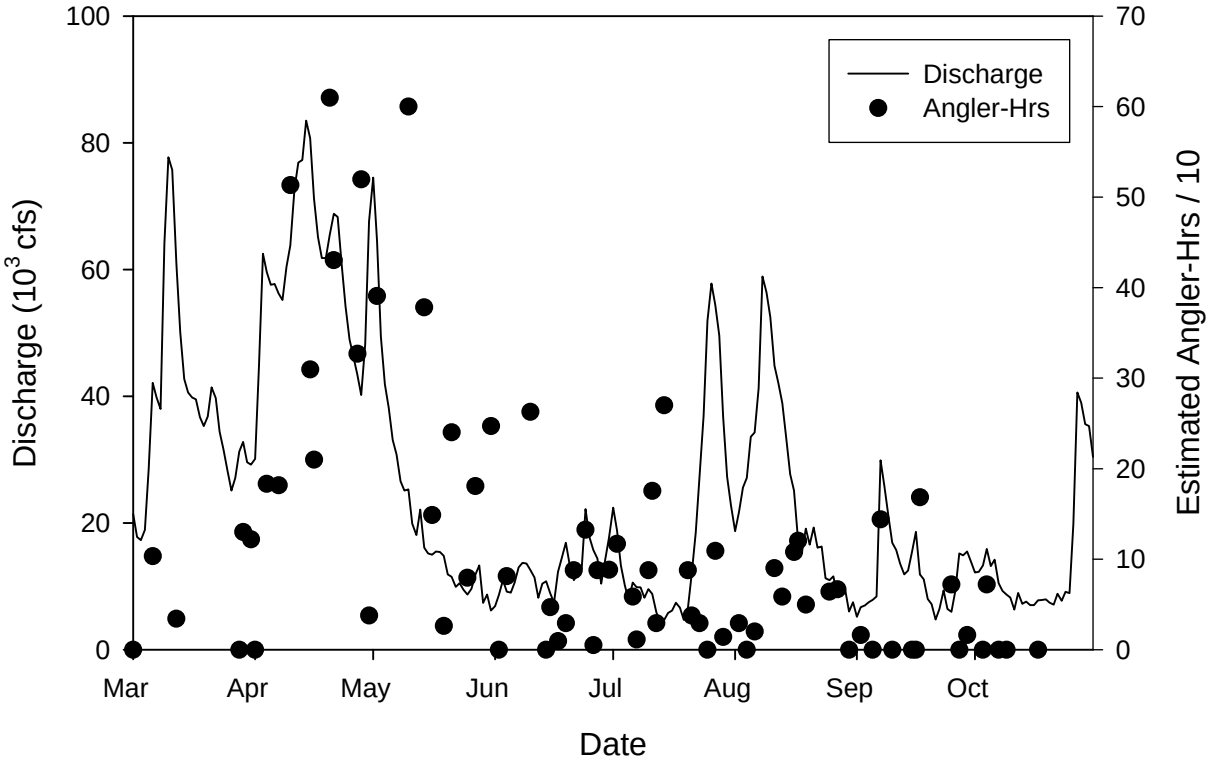
Appendix 24.- Daily estimates of boat angler effort in Zone 3 (Middletown-Hartford) during 2008 vs. USGS Hartford gauge height.



Appendix 25.- Daily estimates of shore angler effort in Zone 3 (Middletown-Hartford) during 2008 vs. USGS Hartford gauge height.



Appendix 26.- Daily estimates of boat angler effort in Zone 4 (Hartford-MA border) during 2008 vs. discharge at USGS Thompsonville gauge.



Appendix 27.- Daily estimates of shore angler effort in Zone 4 (Hartford-MA border) during 2008 vs. discharge at USGS Thompsonville gauge.

Appendix 28.- Total estimated boat and shore angler effort (angler-hours) in Zones 1-4 during 2008-09. Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009. Relative standard errors (RSE) of angler effort estimates are reported in parentheses.

Zone	2008	2009
Boat Anglers		
Mouth – Haddam (1)	-	23,247 (0.05)
Haddam – Middletown (2)	-	42,189 (0.08)
Middletown – Hartford (3)	27,644 (0.11)	-
Hartford – MA (4)	28,552 (0.11)	-
Shore Anglers		
Mouth – Haddam (1)	-	43,816 (0.07)
Haddam – Middletown (2)	-	22,040 (0.10)
Middletown – Hartford (3)	47,823 (0.09)	-
Hartford – MA (4)	27,953 (0.12)	-

Appendix 29.- Estimated boat and shore angler effort (angler-hours) by Season in Zones 1-4 during 2008-09. Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009. The column labeled "RSE" contains relative standard errors of angler effort estimates.

	Boat Anglers		Shore Anglers	
	Angler-Hours	**RSE**	**Angler-Hours**	**RSE**
Season 1 (March – April)				
Zone 1	2,839	0.16	5,041	0.20
Zone 2	4,361	0.24	9,600	0.16
Zone 3	262	0.53	3,828	0.31
Zone 4	7,553	0.20	8,761	0.27
Season 2 (May – June)				
Zone 1	8,832	0.08	13,568	0.14
Zone 2	15,406	0.14	8,702	0.16
Zone 3	13,539	0.15	27,228	0.13
Zone 4	13,104	0.21	13,642	0.17
Season 3 (July – August)				
Zone 1	4,888	0.10	17,681	0.12
Zone 2	15,747	0.11	2,392	0.18
Zone 3	6,213	0.14	9,222	0.12
Zone 4	5,394	0.11	3,960	0.12
Season 4 (September – October)				
Zone 1	6,688	0.12	7,527	0.16
Zone 2	6,676	0.21	1,347	0.17
Zone 3	7,631	0.25	7,545	0.25
Zone 4	2,501	0.18	1,590	0.29

Appendix 30.- Total estimated catch and harvest of major species[1] in Zones 1-4 during 2008-09 (boat and shore anglers combined). Species are sorted in order of descending total catch. The column labeled "Catch RSE" contains relative standard errors (RSE) of total catch estimates. This summary combines data from two years (Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009).

Species	Total Catch	Catch RSE	Total Harvest	% Harvested
Striped Bass	39,699	0.13	1,996	5
Black Bass[2]	39,357	0.18	447	1
White Perch	27,298	0.21	10,662	39
Bluefish	21,592	0.25	5,135	24
Sunfish[3]	8,604	0.15	1,175	14
American Shad	7,409	0.42	77	1
Hickory Shad	6,371	0.31	1,352	21
Catfish[4]	6,276	0.15	1,753	28
Black Crappie	4,169	0.30	1,900	46
Yellow Perch	4,113	0.19	965	23
Northern Pike	1,421	0.27	62	4

[1] Includes species for which total estimated catch ≥ 1,000 fish and/or RSE ≤ 0.50. Species also caught: river herring (alewife and blueback herring), common carp, chain pickerel, summer flounder, scup, Atlantic salmon, white sucker, American eel, brook trout, brown trout, golden shiner, fallfish, Atlantic tomcod, walleye, black sea bass, sea robin, and sturgeon.
[2] Includes largemouth bass and smallmouth bass.
[3] Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass.
[4] Includes brown bullhead, channel catfish, and white catfish.

Appendix 31.- Total estimated catch and harvest of major species[1] by Zone in Zones 1-4 during 2008-09 (boat and shore anglers combined). Species are sorted in alphabetic order. Zones 3-4 were sampled during 2008; Zones 1-2 were sampled during 2009. Columns labeled "RSE" contain relative standard errors (RSE) of catch estimates; columns labeled "% Harv" contain the estimated percentages of caught fish that were harvested.

	Zone 1			Zone 2			Zone 3			Zone 4		
Species	**Catch**	**RSE**	**% Harv**	**Catch**	**RSE**	**% Harv**	**Catch**	**RSE**	**% Harv**	**Catch**	**RSE**	**% Harv**
American Shad	19	0.84	0	0	-	-	43	0.93	0	7,347	0.42	1
Black Bass[2]	542	0.65	0	16,557	0.34	0	10,950	0.25	3	11,308	0.28	0
Black Crappie	0	-	-	24	0.98	0	4,145	0.30	46	0	-	-
Bluefish	21,592	0.25	24	0	-	-	0	-	-	0	-	-
Catfish[3]	1,319	0.31	29	1,461	0.20	37	3,173	0.25	26	322	0.42	0
Hickory Shad	4,522	0.39	10	466	0.98	0	1,382	0.57	65	0	-	-
Northern Pike	4	0.69	0	1,272	0.29	0	25	0.96	0	120	0.65	51
Striped Bass	17,785	0.19	3	2,580	0.25	3	8,114	0.22	15	11,220	0.29	2
Sunfish[4]	663	0.33	5	1,120	0.49	3	5,553	0.20	20	1,268	0.37	0
White Perch	19,127	0.19	29	2,190	0.34	18	738	0.30	22	5,243	0.79	87
Yellow Perch	554	0.36	28	1,368	0.32	1	1,767	0.33	32	424	0.52	51

[1] Major species as defined in Appendix 30, see Appendix 30 for other species caught during 2008-09.
[2] Includes largemouth bass and smallmouth bass
[3] Includes brown bullhead, channel catfish, and white catfish
[4] Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass.

Appendix 32.- Percentages of interviewed anglers targeting various species in Zone 1 (River mouth-Haddam) during 1997, 1998, and 2009. Target percentages are summarized by Season. Blank entries indicate that no anglers reported targeting that species during that year/Season. Percentages for 2009 within a Season sum to more than 100 because the survey interview form allowed anglers to report multiple target species; percentages in 1997 and 1998 sum to 100 because only one target species per angler was recorded.

Species	1997	1998	2009
March – April (Season 1)			
"Anything"	8.1	17.4	16.9
American Eel	0.6		
Black Bass[1]	1.8	3.1	1.2
Catfish[2]	11.2	9.9	3.8
Common Carp			1.9
Northern Pike	0.3		2.6
Striped Bass	25.5	43.5	64.3
White Perch	29.2	21.7	15.5
Winter Flounder	13.4	4.3	1.3
Yellow Perch	9.9		0.6
May – June (Season 2)			
"Anything"	24.3	28.7	22.4
American Shad	0.3		
Black Bass[1]	0.3	3.5	1.4
Bluefish	4.3	6.4	9.8
Catfish[2]	8.0	5.8	2.1
Chain Pickerel			0.2
Common Carp			0.5
Hickory Shad	1.0	0.6	1.2
Striped Bass	38.7	39.8	68.3
Summer Flounder	5.7	2.9	2.1
Sunfish[3]		0.6	
White Perch	13.3	8.2	6.2
Winter Flounder	3.0	3.5	0.5
Yellow Perch	1.0		0.5
July – August (Season 3)			
"Anything"	22.6	28.2	38.8
Black Bass[1]		0.9	5.9
Bluefish	44.7	21.1	27.7
Catfish[2]	4.7	4.6	1.3
Common Carp			0.2
Hickory Shad	4.3	2.8	1.0
Scup			1.3
Striped Bass	14.3	28.2	33.3
Summer Flounder	4.0	8.0	10.2
Sunfish[3]			0.6
White Perch	5.4	5.9	4.6
Yellow Perch		0.3	

Appendix 32 continued

September – October (Season 4)			
"Anything"	4.0	44.9	31.5
Bluefish	41.4	18.5	56.8
Catfish[2]	1.0	5.6	
Common Carp			0.5
False Albacore			1.9
Hickory Shad	10.1	7.3	6.6
Striped Bass	28.3	10.1	34.3
Summer Flounder	7.1		
Tautog			0.9
White Perch	8.1	13.5	4.2

[1]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[2]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for “sunfish”.

Appendix 33.- Percentages of interviewed anglers targeting various species in Zone 2 (Haddam-Middletown) during 1997, 1998, and 2009. Target percentages are summarized by Season. Blank entries indicate that no anglers reported targeting that species during that year/Season. Percentages for 2009 within a Season sum to more than 100 because the survey interview form allowed anglers to report multiple target species; percentages in 1997 and 1998 sum to 100 because only one target species per angler was recorded. Zone 2 was not surveyed during Season 1 of 1997-98.

Species	1997	1998	2009
March – April (Season 1)			
"Anything"	-	-	16.6
Black Bass[1]	-	-	7.3
Catfish[2]	-	-	6.0
Northern Pike	-	-	35.1
Striped Bass	-	-	45.7
White Perch	-	-	0.7
Yellow Perch	-	-	0.7
May – June (Season 2)			
"Anything"	34.2	33.0	26.9
Black Bass[1]	8.9	13.0	22.2
Black Crappie			0.4
Catfish[2]	7.2	5.0	5.6
Common Carp			1.7
Northern Pike	0.7		6.0
Striped Bass	36.2	38.0	52.6
Sunfish[3]		0.5	
White Perch	11.8	10.5	3.4
Yellow Perch	1.0		1.3
July – August (Season 3)			
"Anything"	36.2	63.5	44.3
Black Bass[1]	19.7	9.6	54.1
Bluefish		1.0	0.8
Catfish[2]	31.5	15.4	10.7
Northern Pike		0.5	3.3
Striped Bass	1.6	4.3	7.4
Sunfish[3]	4.7	1.0	1.6
White Perch	6.3	4.8	3.3
Yellow Perch			0.8
September – October (Season 4)			
"Anything"	34.1	40.5	40.0
Black Bass[1]	6.8	37.8	31.4
Bluefish	2.3		
Catfish[2]	9.1		17.1
Hickory Shad		2.7	
Northern Pike	6.8	8.1	20.0
Striped Bass		5.4	7.1
White Perch	20.5	5.4	1.4

[1]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.

Appendix 33 continued

[2]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.

[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for "sunfish".

Appendix 34.- Percentages of interviewed anglers targeting various species in Zone 3 (Middletown-Hartford) during 1997, 1998, and 2008. Target percentages are summarized by Season. Blank entries indicate that no anglers reported targeting that species in that year/Season. Percentages for 2008 within a Season sum to more than 100 because the survey interview form allowed anglers to report multiple target species; percentages in 1997 and 1998 sum to 100 because only one target species per angler was recorded. Zone 3 was not surveyed during Season 1 of 1997-98.

Species	1997	1998	2008
March – April (Season 1)			
"Anything"	-	-	20.0
American Shad	-	-	6.7
Black Bass[1]	-	-	6.7
Catfish[2]	-	-	6.7
Common Carp	-	-	3.3
Northern Pike	-	-	6.7
Striped Bass	-	-	53.3
Sunfish[3]	-	-	6.7
Yellow Perch	-	-	3.3
May – June (Season 2)			
"Anything"	34.5	32.3	27.9
American Shad	1.1	0.2	1.4
Black Bass[1]	14.5	12.3	9.5
Black Crappie	0.2	0.2	2.7
Catfish[2]	8.0	1.9	4.5
Common Carp			0.9
Hickory Shad	0.2	0.5	
Northern Pike	1.7	0.7	2.7
River Herring[4]	5.5	10.4	
Striped Bass	31.4	38.7	52.6
Sunfish[3]		0.2	2.9
Trout[5]	0.4		0.2
White Perch	2.5	2.3	1.1
Yellow Perch		0.2	1.0
July – August (Season 3)			
"Anything"	58.1	67.7	58.6
Black Bass[1]	21.5	21.9	27.9
Black Crappie	2.0		2.3
Catfish[2]	11.5	4.8	5.3
Common Carp			3.0
Hickory Shad		1.3	2.3
Northern Pike	2.0	1.9	5.3
Striped Bass	2.3	0.5	
Sunfish[3]	0.3	1.9	3.8
White Perch	2.3		
September – October (Season 4)			
"Anything"	58.9	48.7	41.2
Black Bass[1]	23.2	38.5	33.1
Black Crappie			7.4

Appendix 34 continued

Catfish[2]	1.8	3.9	5.9
Common Carp			15.4
Hickory Shad		1.3	3.7
Northern Pike	5.4	2.6	8.8
Striped Bass	5.4		2.2
Sunfish[3]	5.4	5.2	2.2
Yellow Perch			2.2

[1]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[2]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for "sunfish".
[4]Includes alewife and blueback herring; the taking of these species was prohibited during 2008 due to an emergency fishery closure that was initiated in 2002.
[5]Anglers were not specific about which species of trout they were targeting.

Appendix 35.- Percentages of interviewed anglers targeting various species in Zone 4 (Hartford-MA) during 2008 (Zone 4 was not surveyed during 1997-98). Target percentages are summarized by Season. Blank entries indicate that no anglers reported targeting that species during that Season. Percentages within a Season sum to more than 100 because the survey interview form allowed anglers to report multiple target species.

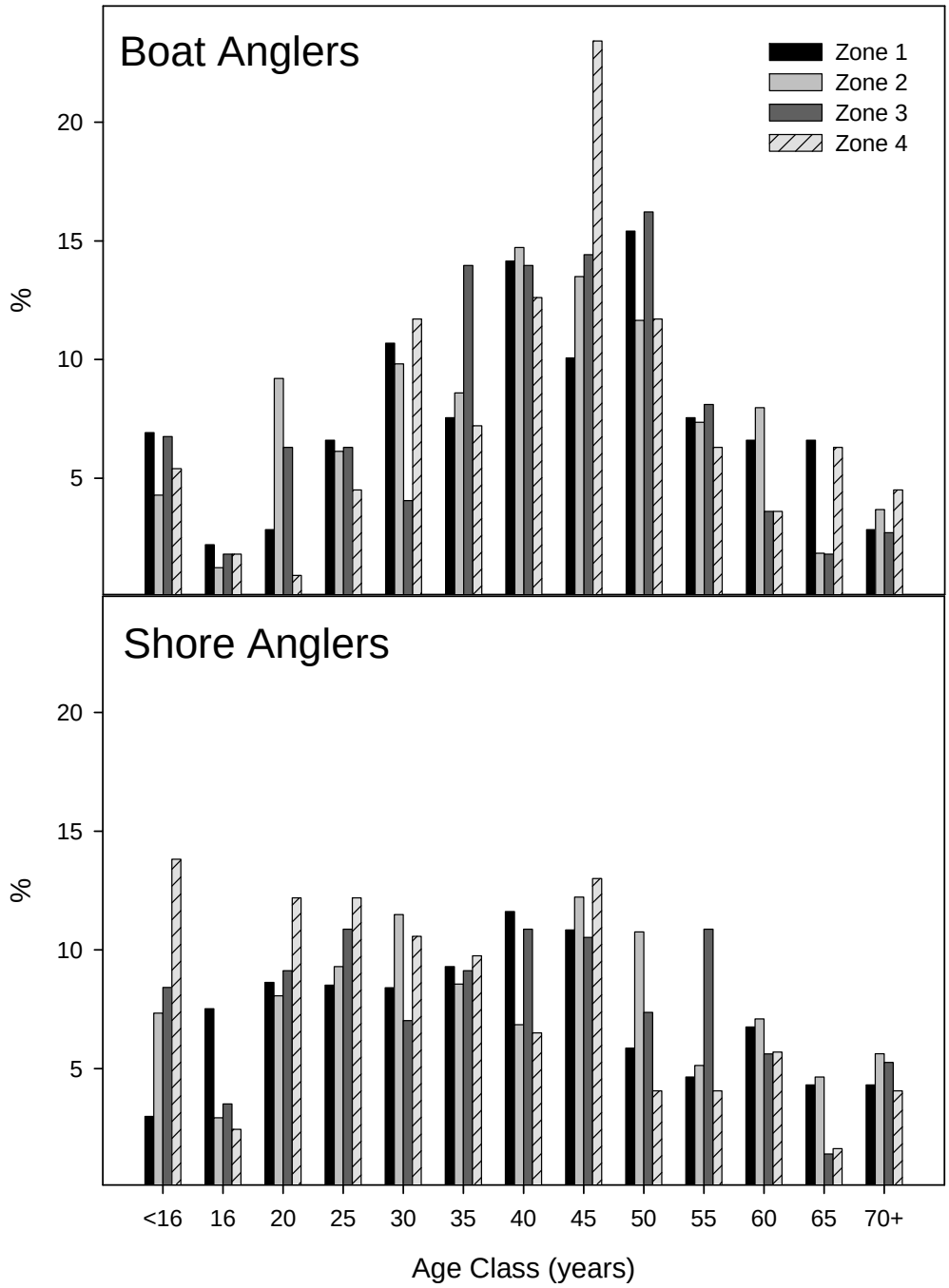
Species	March – April	May – June	July – August	Sept. – Oct.
"Anything"	15.5	16.5	37.1	53.4
American Eel			0.9	
American Shad	11.3	27.7		
Black Bass[1]	8.4	21.8	39.6	48.2
Catfish[2]		3.6	24.1	8.6
Common Carp		2.4	6.0	1.7
Northern Pike	5.6		7.8	10.3
Striped Bass	57.7	39.4	0.9	
Sunfish[3]		1.2	0.9	
Trout[4]	2.8		1.7	
White Perch		3.5		

[1]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[2]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for “sunfish”.
[4]Anglers were not specific about which species of trout they were targeting

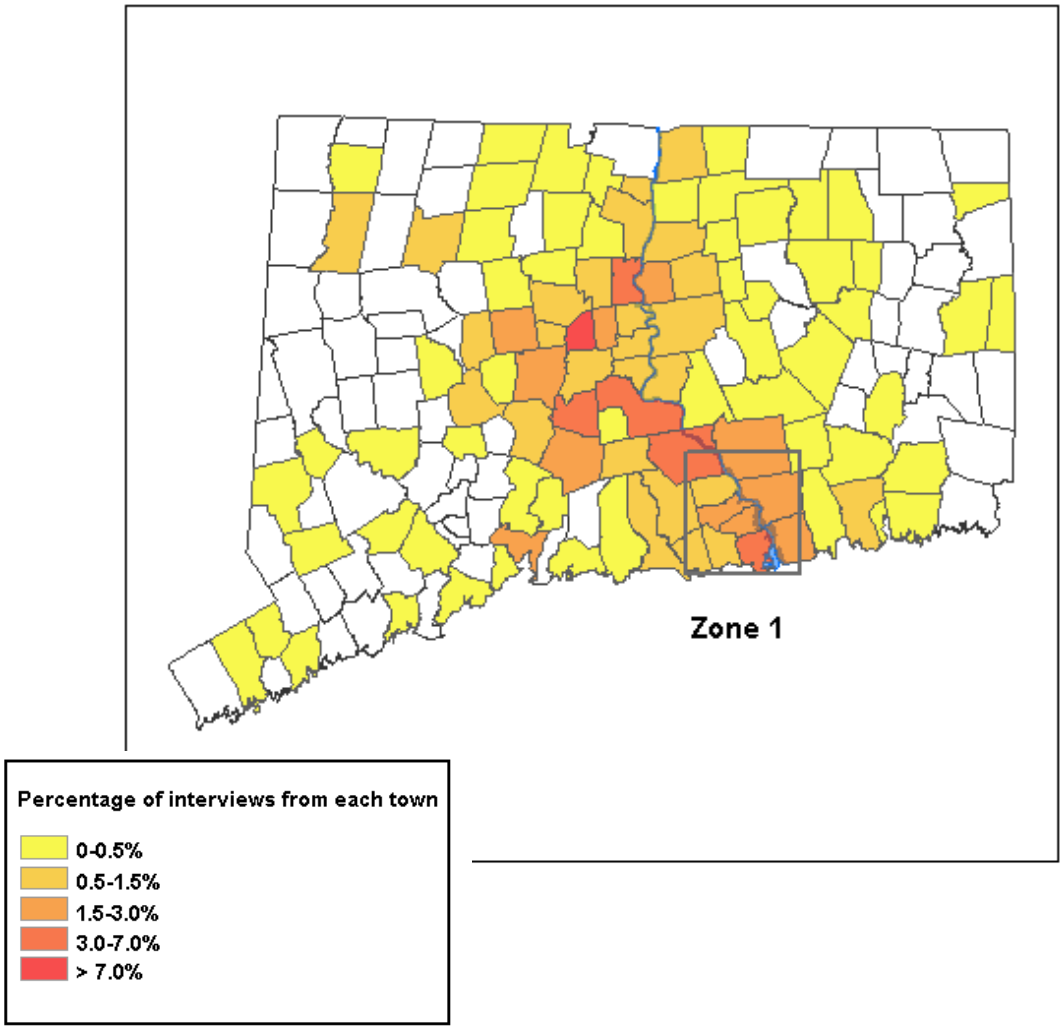
Appendix 36.- Directed angler effort (angler-hrs) by target species in Zones 1-2 during 2009 and Zones 3-4 during 2008 (shore anglers and boat anglers combined, all Seasons combined). Directed effort for each Zone was calculated by applying the Zone/Season target species percentages shown in Appendices 32-35 to sums of shore and boat angler effort within Zones/Seasons (Appendix 29) and then summing across Seasons within each Zone. Sums of directed effort are greater than sums of angler effort shown in Appendix 28 because angler target percentages summed to greater than 100 (see Appendices 32-35).

Zone 1 (Mouth – Haddam)		Zone 2 (Haddam – Middletown)		Zone 3 (Middletown – Hartford)		Zone 4 (Hartford – MA)	
Species	**Effort**	**Species**	**Effort**	**Species**	**Effort**	**Species**	**Effort**
Striped Bass	32,757	Striped Bass	20,972	"Anything"	27,489	Striped Bass	20,035
"Anything"	19,584	"Anything"	20,047	Striped Bass	23,957	Black Bass[1]	12,877
Bluefish	16,521	Black Bass[1]	18,703	Black Bass[1]	13,477	"Anything"	12,597
White Perch	4,245	Northern Pike	8,550	Catfish[2]	3,822	American Shad	9,252
Summer Flounder	2,772	Catfish[2]	5,500	Northern Pike	3,528	Catfish[2]	3,569
Black Bass[1]	1,740	White Perch	1,628	Common Carp	3,302	Northern Pike	2,065
Hickory Shad	1,433	Yellow Perch	556	Black Crappie	2,579	Common Carp	1,273
Catfish[2]	1,063	Common Carp	410	Sunfish[3]	2,377	White Perch	936
Common Carp	378	Sunfish[3]	290	Hickory Shad	917	Trout[4]	616
Scup	293	Bluefish	145	Yellow Perch	877	Sunfish[3]	405
False Albacore	270	Black Crappie	96	American Shad	845	American Eel	84
Winter Flounder	214			White Perch	448		
Northern Pike	205			Trout[4]	82		
Yellow Perch	159						
Sunfish[3]	135						
Tautog	128						
American Eel	47						
Chain Pickerel	45						

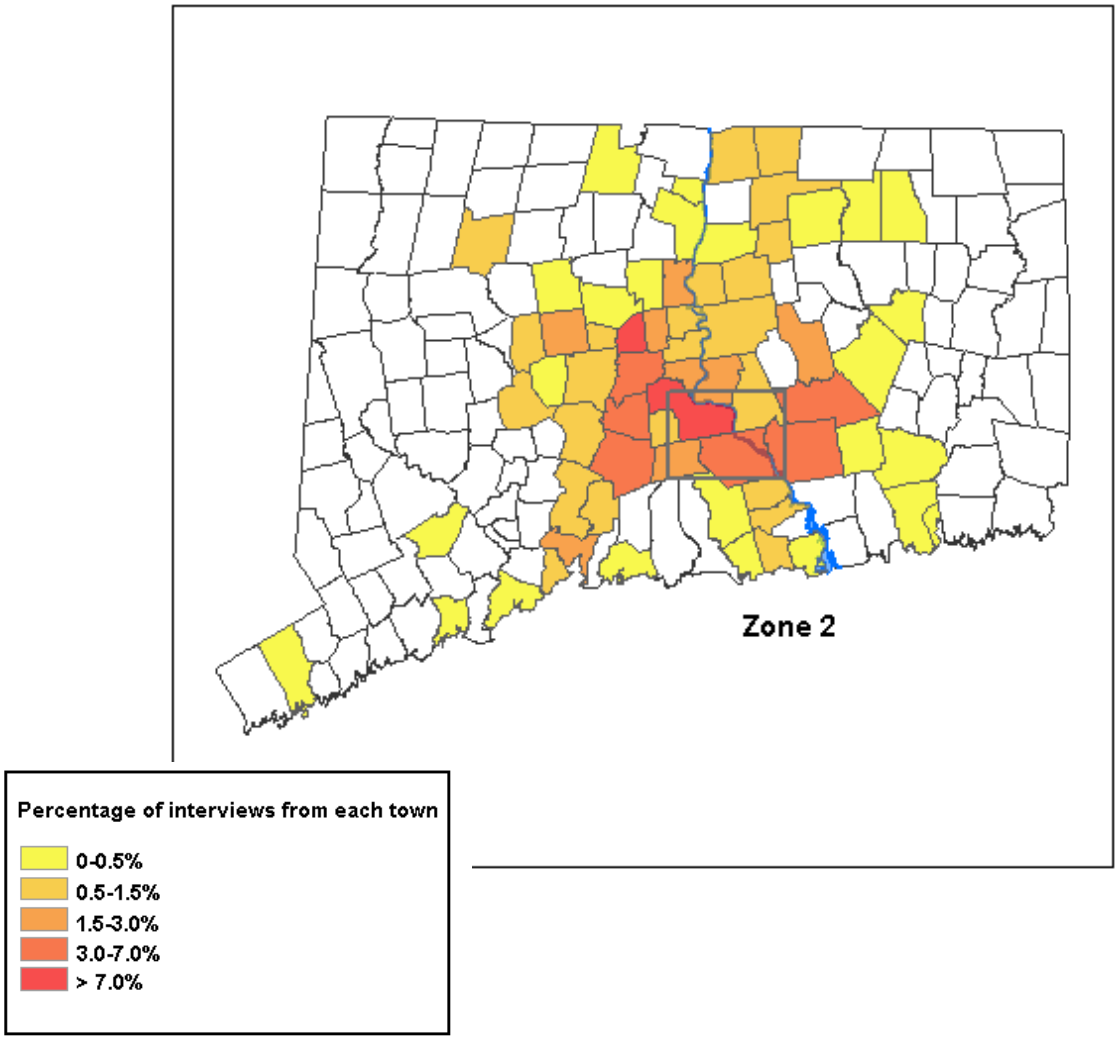
[1]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[2]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for "sunfish".
[4]Anglers were not specific about which species of trout they were targeting.



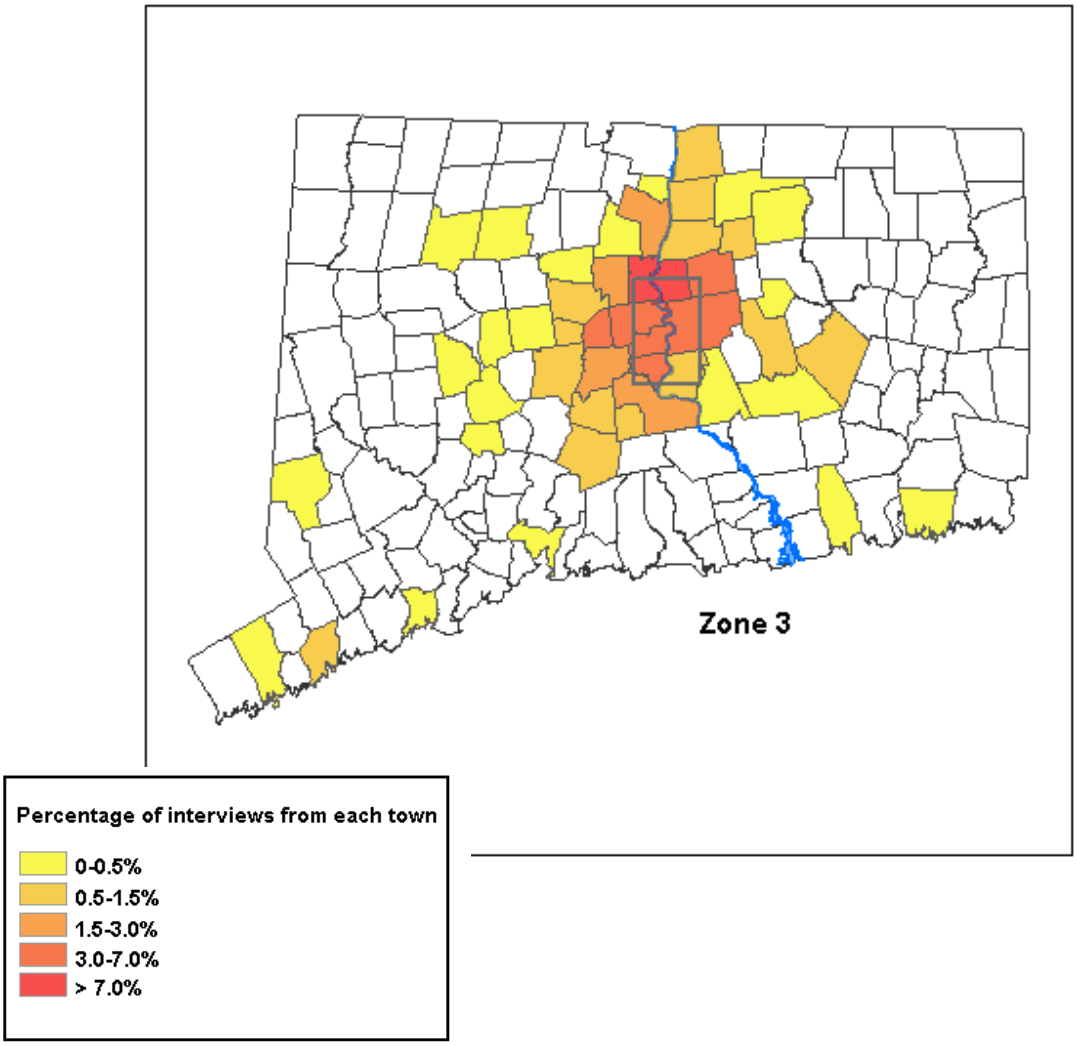
Appendix 37.- Age structure of boat and shore anglers interviewed in Zones 1-4 during 2008-09.



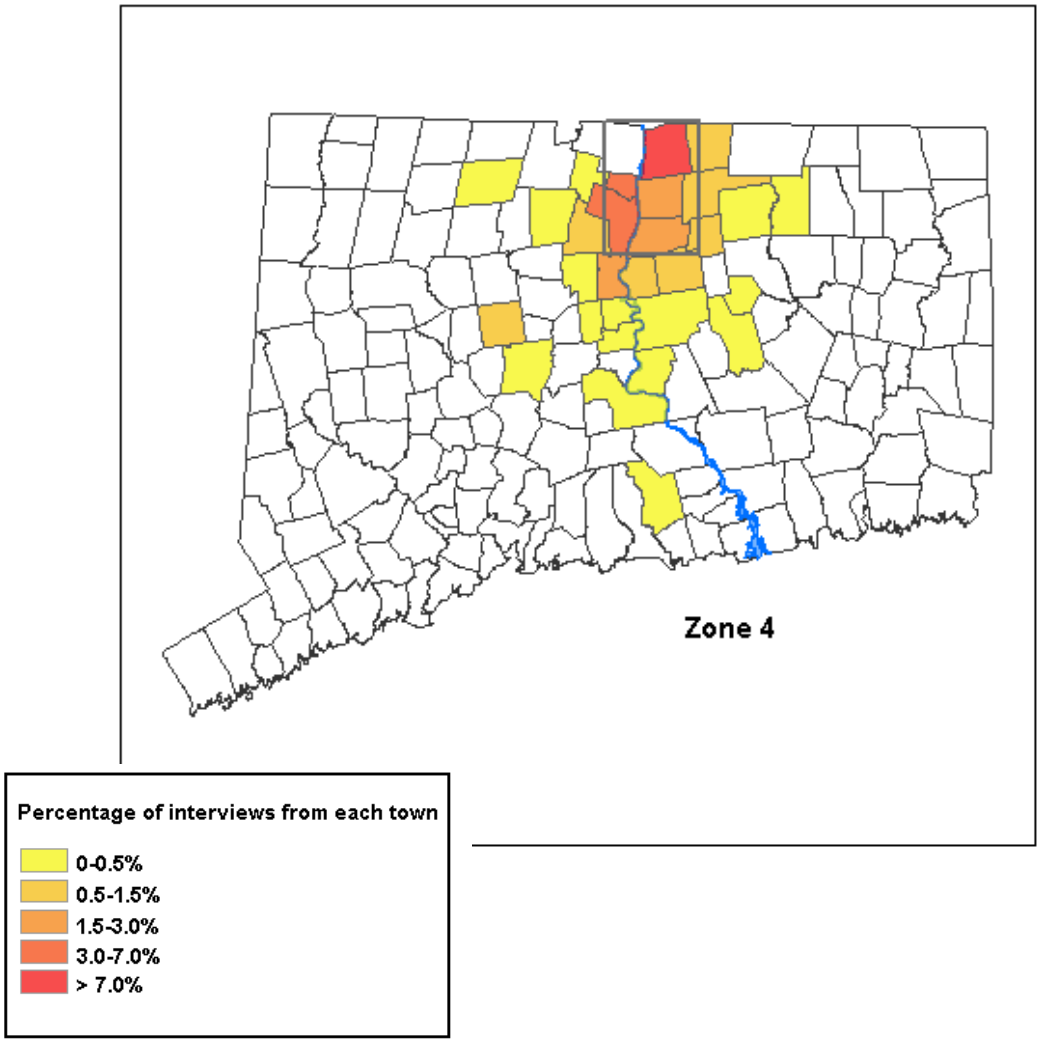
Appendix 38.- Towns of residence for anglers (all boat and shore interviews combined) interviewed in Zone 1 (River mouth-Haddam) during 2009.



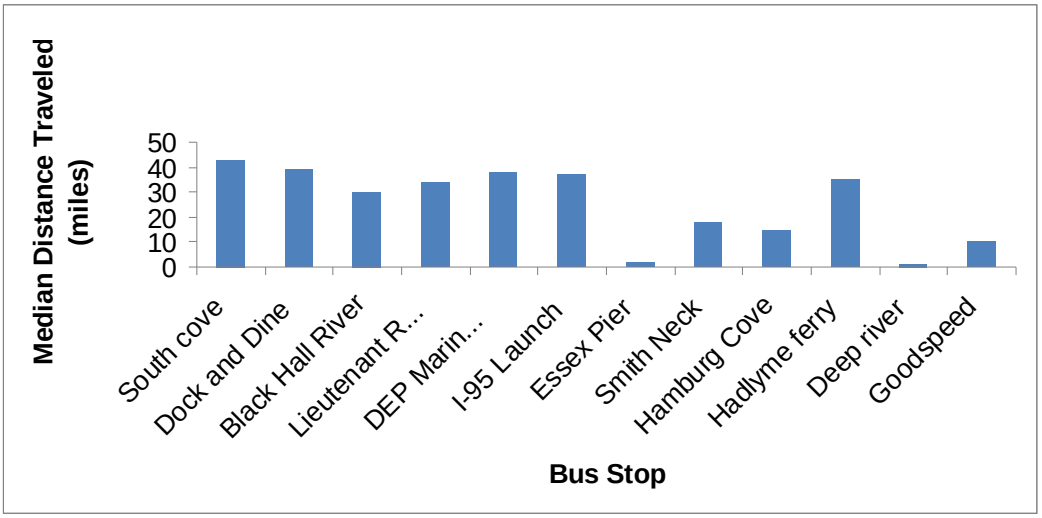
Appendix 39.- Towns of residence for anglers (all boat and shore interviews combined) interviewed in Zone 2 (Haddam-Middletown) during 2009.



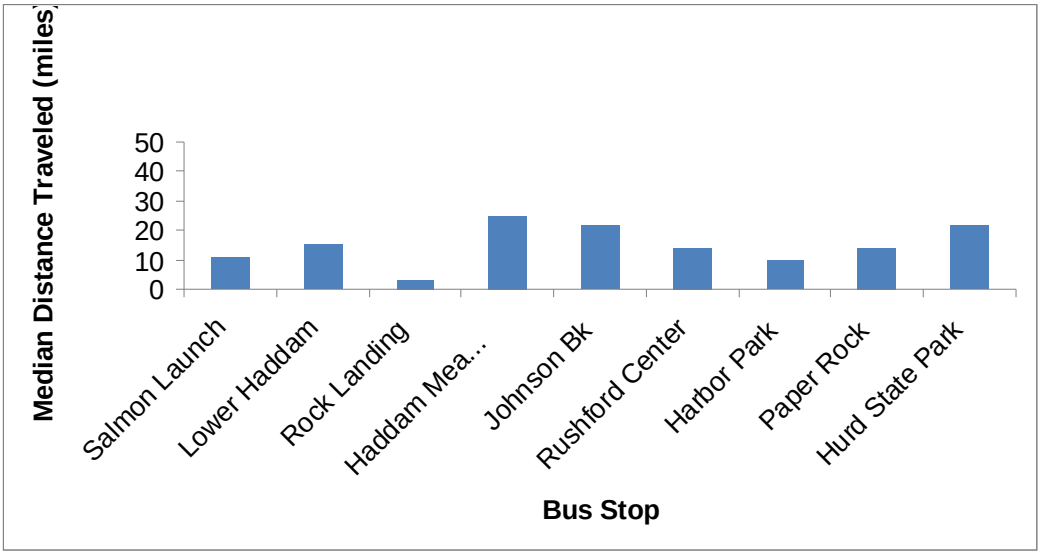
Appendix 40.- Towns of residence for anglers (all boat and shore interviews combined) interviewed in Zone 3 (Middletown-Hartford) during 2008-09.



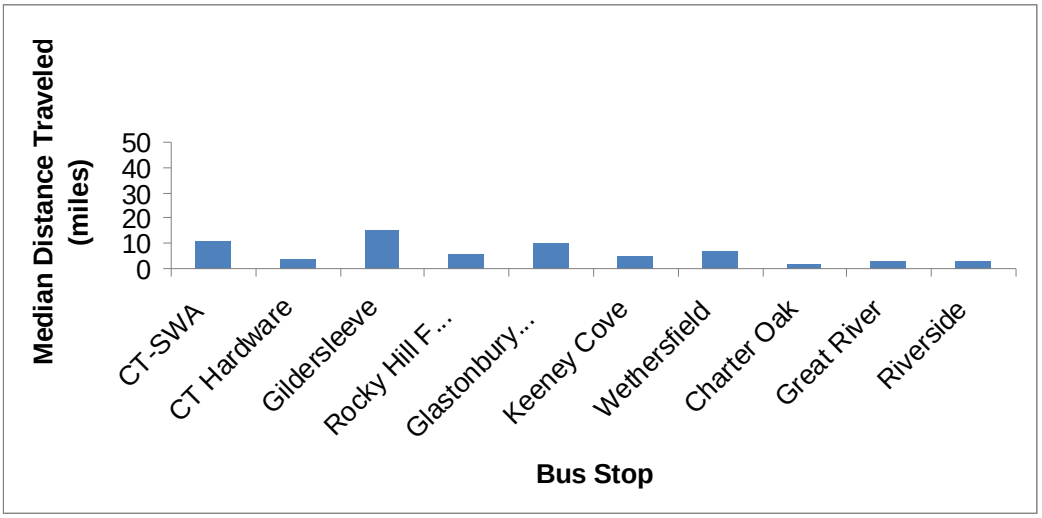
Appendix 41.- Towns of residence for anglers (all boat and shore interviews combined) interviewed in Zone 4 (Hartford-MA border) during 2008-09.



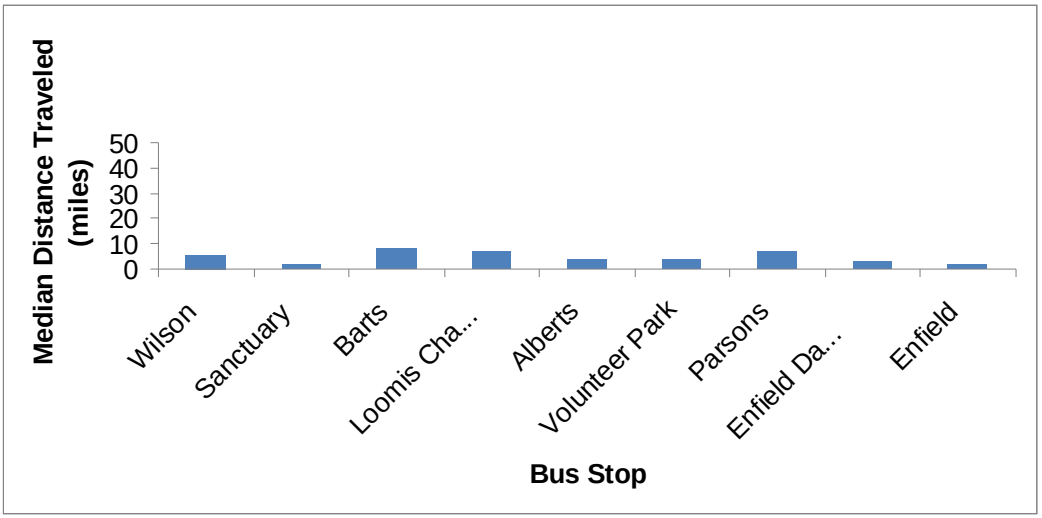
Appendix 42.- Median distance traveled (miles) by anglers (boat and shore combined) fishing at bus stops in Zone 1 (River mouth–Haddam) during 2009.



Appendix 43.- Median distance traveled (miles) by anglers (boat and shore combined) fishing at bus stops in Zone 2 (Haddam-Middletown) during 2009.



Appendix 44.- Median distance traveled (miles) by anglers (boat and shore combined) fishing at bus stops in Zone 3 (Middletown-Hartford) during 2008.



Appendix 45.- Median distance traveled (miles) by anglers (boat and shore combined) fishing at bus stops in Zone 4 (Hartford-MA border) during 2008.

Appendix 46.- Summary of angler attitudes about harvesting fish from the Connecticut River during 2008-09 (all angler interviews combined). Anglers were asked how often they kept the species that they were targeting and were asked to choose from the options shown in the column labeled "Response". Anglers who answered "Rarely" or "Never" were asked a follow-up question ("Why not?") and were asked to choose from the first three responses shown or provide an alternate reason. A majority of anglers responded, unprompted, that they were "catch-and-release anglers" (in some fashion) to this follow-up question.

Question: How often do you keep (*target species*) that you catch in the CT River?[1]		
Response	**n**	**%**
Always	557	20
Most of the time (> 50%)	295	11
Occasionally (< 50%)	439	16
Rarely (< 10%)	411	15
Never	1050	38
For those that answered "Rarely" or "Never": "Why not?"		
"I don't like to eat fish"	172	14
"It's too much bother to clean fish"	83	7
"I'm afraid of toxins in the fish"	182	15
"I'm a catch & release angler"[2]	740	60
Other[3]	47	4

[1] Anglers targeting species with length limits were asked how often they kept "legal-sized" fish.
[2] Many variations of this response were given – e.g. "I'm a sport-fisherman", "I only fish for fun", "I never kill fish", etc.
[3] "Other" responses (paraphrased) included "I can't catch a legal-sized fish" (n=39; primarily from anglers targeting striped bass), "I only eat saltwater fish" (n=4), "I can't catch a fish big enough to eat" (n=2), and "I never catch anything" (n=2).

Appendix 47.- Total estimated boat and shore angler effort (angler-hours) in Zones 1-3 during 1997, 1998, and 2008-09. Zone 4 was not sampled in 1997-98 and is therefore excluded here. In addition, estimates shown here for Zones 2-3 in 2008-09 exclude Season 1 (March-April) angler effort because Zones 2-3 were not sampled during Season 1 in 1997-98. Columns labeled "Hours" contain estimates of total angler-hours; columns labeled "RSE" contain relative standard errors of angler effort estimates.

Year	1997		1998		2008-09	
	Hours	RSE	Hours	RSE	Hours	RSE
			Boat Anglers			
Zone 1	35,555	0.10	39,043	0.10	23,247	0.05
Zone 2	31,755	0.22	38,376	0.13	37,828	0.08
Zone 3	34,398	0.13	41,357	0.12	27,383	0.11
			Shore Anglers			
Zone 1	64,141	0.12	46,768	0.08	43,816	0.07
Zone 2	36,427	0.11	39,368	0.13	12,440	0.12
Zone 3	76,363	0.08	61,587	0.11	43,995	0.10

Appendix 48.- Estimated boat and shore angler effort (angler-hours) by Season in Zones 1-4 during 1997, 1998, and 2008-09. Zones 1 and 2 were sampled in 1997, 1998, and 2009; Zone 3 was sampled in 1997, 1998, and 2008; Zone 4 was sampled only in 2008. Zones 2-3 were not sampled during Season 1 in 1997 and 1998. Columns labeled "Hours" contain estimates of total angler-hours; columns labeled "RSE" contain relative standard errors of angler effort estimates.

	1997				1998				2008-09			
	Boat Anglers		Shore Anglers		Boat Anglers		Shore Anglers		Boat Anglers		Shore Anglers	
	Hours	RSE	Hours	RSE	Hours	RSE	Hours	RSE	Hours	RSE	Hours	RSE
Season 1 (March – April)												
Zone 1	6,199	0.15	3,723	0.16	6,607	0.21	4,670	0.24	2,839	0.16	5,041	0.20
Zone 2	-	-	-	-	-	-	-	-	4,361	0.24	9,600	0.16
Zone 3	-	-	-	-	-	-	-	-	262	0.53	3,828	0.31
Zone 4	-	-	-	-	-	-	-	-	7,553	0.20	8,761	0.27
Season 2 (May – June)												
Zone 1	8,960	0.22	18,364	0.11	7,998	0.26	11,170	0.26	8,832	0.08	13,568	0.14
Zone 2	11,690	0.49	25,763	0.12	11,062	0.33	20,954	0.19	15,406	0.14	8,702	0.16
Zone 3	16,388	0.22	43,967	0.11	19,421	0.19	26,130	0.21	13,539	0.15	27,228	0.13
Zone 4	-	-	-	-	-	-	-	-	13,104	0.21	13,642	0.17
Season 3 (July – August)												
Zone 1	15,268	0.17	34,488	0.20	15,231	0.20	19,588	0.06	4,888	0.10	17,681	0.12
Zone 2	13,950	0.27	7,854	0.26	20,536	0.12	15,868	0.20	15,747	0.11	2,392	0.18
Zone 3	10,583	0.18	26,049	0.10	13,988	0.16	26,247	0.12	6,213	0.14	9,222	0.12
Zone 4	-	-	-	-	-	-	-	-	5,394	0.11	3,960	0.12
Season 4 (September – October)												
Zone 1	5,128	0.32	7,566	0.22	9,209	0.14	11,341	0.14	6,688	0.12	7,527	0.16
Zone 2	6,115	0.36	2,811	0.32	6,778	0.31	2,547	0.30	6,676	0.21	1,347	0.17
Zone 3	7,427	0.22	6,347	0.31	7,947	0.30	9,211	0.26	7,631	0.25	7,545	0.25
Zone 4	-	-	-	-	-	-	-	-	2,501	0.18	1,590	0.29

Appendix 49.- Total estimated catch and harvest of major species[1] in Zones 1-3 during 1997, 1998, and 2008-09 (boat and shore anglers combined). Species are sorted in order of descending total catch during 1997. Zone 4 was not sampled during 1997-98 and is therefore excluded here. Estimates shown here for Zones 2-3 during 2008-09 exclude Season 1 (March-April) catch and harvest because Zones 2-3 were not sampled during Season 1 in 1997-98. Columns labeled "RSE" contain relative standard errors (RSE) of catch estimates; columns labeled "% Harv" contain the estimated percentage of caught fish that were harvested. Results for 2008-09 combine data from two years (Zone 3 was sampled during 2008; Zones 1-2 were sampled during 2009).

	1997				1998				2008-09			
Species	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**
White Perch	66,549	0.21	53,810	81	29,573	0.20	17,511	59	21,961	0.17	6,081	28
Bluefish	57,247	0.48	40,976	72	14,447	0.62	12,011	83	21,592	0.25	5,135	24
Catfish[2]	26,445	0.16	16,224	61	28,751	0.17	16,923	59	5,691	0.16	1,602	28
Striped Bass	25,941	0.27	1,965	8	42,095	0.31	1,255	3	26,728	0.14	1,770	7
Black Bass[3]	20,616	0.33	725	4	25,002	0.20	1,348	5	27,103	0.23	402	1
Yellow Perch	12,514	0.27	6,119	49	13,592	0.50	3,603	27	3,689	0.20	747	20
Sunfish[4]	11,753	0.27	5,743	49	15,386	0.19	6,807	44	7,336	0.17	1,175	16
Hickory Shad	8,905	0.35	19	<1	5,658	0.37	2,135	38	6,371	0.31	1,352	21
Black Crappie	2,339	0.48	2,050	88	477	0.86	450	94	4,169	0.30	1,900	46
Northern Pike	1,046	0.47	0	0	1,312	0.31	85	6	937	0.36	0	0
American Shad	539	0.55	461	86	30	0.83	0	0	43	0.70	0	0

[1] Includes major species from Appendix 30. Species also caught during 1997-98: river herring (alewife and blueback herring), summer flounder, winter flounder, skate, common carp, American eel, spottail shiner, Atlantic tomcod, brook trout, brown trout, golden shiner, windowpane flounder, and white sucker. See Appendix 30 for other species caught during 2008-09.
[2] Includes brown bullhead, channel catfish, and white catfish.
[3] Includes largemouth bass and smallmouth bass.
[4] Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass.

Appendix 50.- Total estimated catch and harvest of major species[1] in Zone 1 (River mouth-Haddam) during 1997, 1998, and 2009 (boat and shore anglers combined). Species are sorted in order of descending total catch during 1997. Columns labeled "RSE" contain relative standard errors (RSE) of catch estimates; columns labeled "% Harv" contain the estimated percentage of caught fish that were harvested.

	1997				1998				2009			
Species	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**
Bluefish	57,247	0.48	40,976	72	13,408	0.66	11,318	84	21,592	0.25	5,135	24
White Perch	53,734	0.26	45,914	85	18,934	0.30	10,463	55	19,127	0.19	5,515	29
Yellow Perch	9,747	0.33	4,852	50	1,413	0.33	630	45	554	0.36	155	28
Hickory Shad	8,853	0.35	0	0	4,015	0.50	1,685	42	4,522	0.39	451	10
Striped Bass	8,186	0.22	794	10	26,528	0.47	829	3	17,785	0.19	519	3
Catfish[2]	5,671	0.32	5,167	91	8,406	0.32	6,618	79	1,319	0.31	381	29
Sunfish[3]	116	0.89	0	0	3,290	0.44	1,845	56	663	0.33	33	5
American Shad	0	-	-	-	0	-	-	-	0	-	-	-
Black Bass[4]	0	-	-	-	880	0.52	662	75	542	0.65	0	0
Black Crappie	0	-	-	-	27	0.95	0	0	0	-	-	-
Northern Pike	0	-	-	-	14	0.95	0	0	4	0.69	0	0

[1] Includes major species from Appendix 30. See Appendix 49 for other species caught during 1997-98; see Appendix 30 for other species caught during 2008-09.
[2] Includes brown bullhead, channel catfish, and white catfish.
[3] Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass.
[4] Includes largemouth bass and smallmouth bass.

Appendix 51.- Total estimated catch and harvest of major species[1] in Zone 2 (Haddam–Middletown) during 1997, 1998, and 2009 (boat and shore anglers combined). Species are sorted in order of descending total catch during 1997. Estimates for 2009 exclude catch and harvest during Season 1 (March-April) because Zone 2 was not sampled during Season 1 in 1997-98. Columns labeled "RSE" contain relative standard errors (RSE) of catch estimates; columns labeled "% Harv" contain the estimated percentage of caught fish that were harvested.

	1997				1998				2009			
Species	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**
Striped Bass	13,335	0.51	349	3	8,207	0.34	221	3	1,431	0.30	74	5
Black Bass[2]	11,382	0.56	261	2	7,369	0.32	182	2	15,611	0.35	22	0
Catfish[3]	9,675	0.23	8,069	83	10,345	0.31	4,439	43	1,070	0.24	396	37
White Perch	6,672	0.28	4,772	72	6,635	0.27	4,599	69	2,095	0.36	404	19
Yellow Perch	599	0.40	295	49	1,083	0.41	447	41	1,368	0.32	19	1
Sunfish[4]	172	0.72	172	100	2,694	0.42	1,007	37	1,120	0.49	34	3
Black Crappie	69	0.96	0	0	0	-	-	-	24	0.98	0	0
Hickory Shad	52	0.50	19	37	623	0.71	0	0	466	0.98	0	0
American Shad	0	-	-	-	0	-	-	-	0	-	-	-
Northern Pike	0	-	-	-	483	0.16	0	0	908	0.37	0	0

[1] Includes major species from Appendix 30, with the exception of bluefish which were only caught in Zone 2 during 1998. See Appendix 49 for other species caught during 1997-98; see Appendix 30 for other species caught during 2008-09.
[2] Includes largemouth bass and smallmouth bass.
[3] Includes brown bullhead, channel catfish, and white catfish.
[4] Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass.

Appendix 52.- Total estimated catch and harvest of major species[1] in Zone 3 (Middletown–Hartford) during 1997, 1998, and 2008 (boat and shore anglers combined). Species are sorted in order of descending total catch during 1997. Estimates for 2008 exclude catch and harvest during Season 1 (March-April) because Zone 2 was not sampled during Season 1 in 1997-98. Columns labeled "RSE" contain relative standard errors (RSE) of catch estimates; columns labeled "% Harv" contain the estimated percentage of caught fish that were harvested.

	1997				1998				2008			
Species	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**	**Catch**	**RSE**	**Harvest**	**% Harv**
Sunfish[2]	11,465	0.28	5,571	49	9,402	0.23	3,955	42	5,553	0.20	1,108	20
Catfish[3]	11,099	0.28	2,988	27	10,000	0.24	5,866	59	3,173	0.25	825	26
Black Bass[4]	9,234	0.26	463	5	16,753	0.27	504	3	10,950	0.25	380	3
White Perch	6,143	0.34	3,124	51	4,005	0.26	2,450	61	738	0.30	162	22
Striped Bass	4,419	0.22	822	19	7,360	0.35	204	3	7,512	0.23	1,177	16
Black Crappie	2,270	0.50	2,050	90	450	0.91	450	100	4,145	0.30	1,900	46
Yellow Perch	2,167	0.41	973	45	11,096	0.61	2,526	23	1,767	0.33	573	32
Northern Pike	1,046	0.47	0	0	815	0.49	85	10	25	0.96	0	0
American Shad	539	0.55	461	86	30	0.83	0	0	43	0.93	0	0
Hickory Shad	0	-	-	-	1,020	0.53	451	44	1,382	0.57	901	65

[1] Includes major species from Appendix 30, with the exception of bluefish which were not caught in Zone 3 during any year. See Appendix 49 for other species caught during 1997-98; see Appendix 30 for other species caught during 2008-09.
[2] Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass.
[3] Includes brown bullhead, channel catfish, and white catfish.
[4] Includes largemouth bass and smallmouth bass.

Appendix 53.- Directed angler effort (angler-hrs) by target species in Zone 1 (River mouth–Haddam) during 1997, 1998, and 2009 (shore anglers and boat anglers combined, all Seasons combined). Species are sorted in order of descending directed effort during 1997. Directed effort was calculated by applying target species percentages by years/Seasons (Appendix 32) to sums of shore and boat angler effort within years/Seasons (Appendix 48) and then summing across Seasons within a year. Sums of directed effort for 2009 are greater than sums of angler effort for this year shown in Appendix 47 because angler target percentages summed to greater than 100 in this year (see Appendix 32); small discrepancies between sums of directed effort for 1997 and 1998 shown here and sums of angler effort for these years shown in Appendix 47 are due to rounding.

Species	1997	1998	2009
Bluefish	28,671	12,375	16,521
Striped Bass	23,812	24,428	32,757
"Anything"	19,196	26,509	19,584
White Perch	10,246	8,847	4,245
Catfish[1]	5,763	4,980	1,063
Summer Flounder	4,449	3,341	2,772
Hickory Shad	3,695	2,590	1,433
Winter Flounder	2,149	1,156	214
Yellow Perch	1,255	104	159
Black Bass[2]	261	1,334	1,740
American Shad	82	0	0
Common Carp	63	103	378
American Eel	60	0	47
Northern Pike	30	0	205
Chain Pickerel	0	0	45
False Albacore	0	0	270
Scup	0	0	293
Sunfish[3]	0	115	135
Tautog	0	0	128

[1]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[2]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for "sunfish".

Appendix 54.- Directed angler effort (angler-hrs) by target species in Zone 2 (Haddam-Middletown) during 1997, 1998, and 2009 (shore anglers and boat anglers combined, all Seasons combined). Species are sorted in order of descending directed effort during 1997. Angler effort during Season 1 (March-April) of 2009 was excluded from this summary because Zone 2 was not surveyed during Season 1 of 1997-98. Directed effort was calculated by applying target species percentages by years/Seasons (Appendix 33) to sums of shore and boat angler effort within years/Seasons (Appendix 48) and then summing across Seasons within a year. Sums of directed effort for 2009 are greater than sums of angler effort for this year shown in Appendix 47 because angler target percentages summed to greater than 100 in this year (see Appendix 33); small discrepancies between sums of directed effort for 1997 and 1998 shown here and sums of angler effort for these years shown in Appendix 47 are due to rounding.

Species	1997	1998	2009
"Anything"	23,746	37,458	17,729
Striped Bass	13,907	14,235	14,592
Catfish[1]	10,377	7,207	4,663
Black Bass[2]	8,236	11,182	17,684
White Perch	7,623	5,613	1,531
Sunfish[3]	1,025	524	290
Northern Pike	869	937	3,650
Yellow Perch	375	0	459
Bluefish	205	364	145
Black Crappie	0	0	96
Common Carp	0	0	410
Hickory Shad	0	252	0

[1]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[2]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[3]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for "sunfish".

Appendix 55.- Directed angler effort (angler-hrs) by target species in Zone 3 (Middletown-Hartford) during 1997, 1998, and 2008 (shore anglers and boat anglers combined, all Seasons combined). Species are sorted in order of descending directed effort during 1997. Angler effort during Season 1 (March-April) of 2008 was excluded from this summary because Zone 2 was not surveyed during Season 1 of 1997-98. Directed effort was calculated by applying target species percentages by years/Seasons (Appendix 34) to sums of shore and boat angler effort within years/Seasons (Appendix 48) and then summing across Seasons within a year. Sums of directed effort for 2008 are greater than sums of angler effort for this year shown in Appendix 47 because angler target percentages summed to greater than 100 in this year (see Appendix 34); small discrepancies between sums of directed effort for 1997 and 1998 shown here and sums of angler effort for these years shown in Appendix 47 are due to rounding.

Species	1997	1998	2008
"Anything"	50,219	50,308	26,671
Striped Bass	20,538	17,829	21,777
Black Bass[1]	19,823	21,020	13,203
Catfish[2]	9,289	3,466	3,548
River Herring[3]	3,320	4,737	0
Northern Pike	2,502	1,529	3,254
White Perch	2,351	1,048	448
Sunfish[4]	854	1,748	2,103
Black Crappie	853	91	2,579
American Shad	664	91	571
Trout[5]	241	0	82
Hickory Shad	121	974	917
Common Carp	0	0	3,167
Yellow Perch	0	91	742

[1]Includes largemouth bass and smallmouth bass; anglers were often not specific about which species of black bass they were targeting.
[2]Includes channel catfish, white catfish, and brown bullhead; anglers were often not specific about which catfish species they were targeting.
[3]Includes alewife and blueback herring; the taking of these species was prohibited during 2008 due to an emergency fishery closure initiated in 2002.
[4]Includes bluegill, pumpkinseed, redbreast sunfish, green sunfish, and rock bass; anglers often just stated that they were fishing for "sunfish".
[5]Anglers were not specific about which species of trout they were targeting.

Appendix 56.- Number of boat trailers at bus stops vs. number of boats on the river during six concurrent counts conducted in Zones 3-4 during 2006.

	Zone 3		Zone 4	
Date	**Trailers**	**Boats on River**	**Trailers**	**Boats on River**
7/20/2006	8	7	5	3
7/23/2006	30	30	9	18
7/28/2006	6	10	2	2
8/05/2006	25	113	23	53
8/12/2006	56	50	11	11
9/21/2006	7	4	1	0

Appendix 57.- Launch points for boat angling parties interviewed during on-water surveys in Zone 1 (River mouth-Haddam) during 2009. The column "Bus Stop" indicates whether the launch site was a bus stop in Zone 1; the column "Inside Zone" indicates whether the launch site was located within Zone 1. This summary includes only launch usage interviews from angling parties (recreational boaters excluded) that provided information on their launch points – the total number of launch usage interviews shown here are therefore less than the totals shown for this Zone in Appendices 14-15.

Launch Point	Bus Stop	Inside Zone	Angler Boating Parties
Essex Pier	Y	Y	1
I-95 Launch	Y	Y	42
Chester Launch	N	Y	4
Chester Point Marina	N	Y	1
Duck River Launch	N	Y	1
Ferry Point Marina	N	Y	1
Hamburg Cove Yacht Club	N	Y	2
Hays Haven Marina	N	Y	2
Mooring (Essex)	N	Y	1
Haddam Meadows Launch	N	N	14
NY (Montauk)	N	N	1
Salmon River Launch	N	N	8
Mooring (Haddam)	N	N	1
Portland Boat Works	N	N	2
Private Residence (Haddam)	N	N	1
Westbrook, CT	N	N	1
SUM			**83**

Appendix 58.- Launch points for boat angling parties interviewed during on-water surveys in Zone 2 (Haddam-Middletown) during 2009. The column "Bus Stop" indicates whether the launch site was a bus stop in Zone 2; the column "Inside Zone" indicates whether the launch site was located within Zone 2. This summary includes only launch usage interviews from angling parties (recreational boaters excluded) that provided information on their launch points – the total number of launch usage interviews shown here are therefore less than the totals shown for this Zone in Appendices 14-15.

Launch Point	Bus Stop	Inside Zone	Angler Boating Parties
Haddam Meadows Launch	Y	Y	29
Rock Landing	Y	Y	1
Salmon River Launch	Y	Y	18
Portland Boat Works	N	Y	2
Riverside Marina	N	Y	2
Yankee Marina	N	Y	1
Riverside Park & Launch	N	N	1
Rocky Hill Ferry & Launch	N	N	1
Cromwell Outboard Association	N	N	1
Hartford Yacht Club	N	N	1
Hays Haven Marina	N	N	1
SUM			**58**

Appendix 59.- Launch points for boat angling parties interviewed during on-water surveys in Zone 3 (Middletown-Hartford) during 2008-09. The column "Bus Stop" indicates whether the launch site was a bus stop in Zone 3; the column "Inside Zone" indicates whether the launch site was located within Zone 3. This summary includes only launch usage interviews from angling parties (recreational boaters excluded) that provided information on their launch points – the total number of launch usage interviews shown here are therefore less than the totals shown for this Zone in Appendices 14-15.

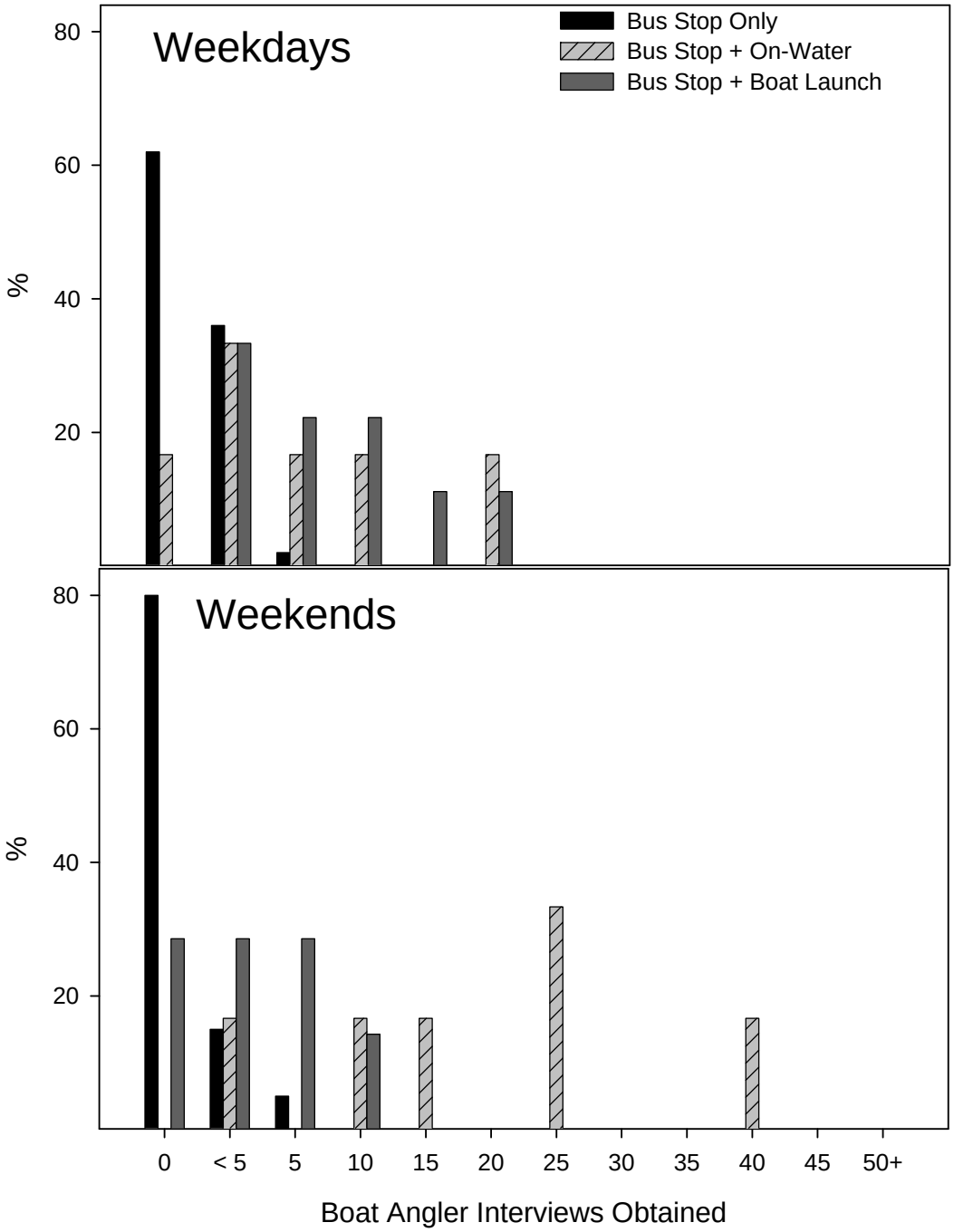
Launch Point	Bus Stop	Inside Zone	Angler Boating Parties
Charter Oak Landing & Launch	Y	Y	5
Great River Park & Launch	Y	Y	14
Keeney Cove	Y	Y	3
Riverside Park & Launch	Y	Y	14
Rocky Hill Ferry & Launch	Y	Y	23
Wethersfield Cove & Launch	Y	Y	33
Cromwell Outboard Association	N	Y	5
Guthries Farm Launch	N	Y	2
Hartford Yacht Club	N	Y	1
Middlesex Marina	N	Y	1
Petzolds Marina	N	Y	1
Seaboard Marina	N	Y	2
Barts Launch	N	N	2
Wilsons Launch	N	N	2
Portland Boat Works	N	N	4
Yankee Marina	N	N	1
Private Launch	N	?	6
SUM			**119**

Appendix 60.- Launch points for boat angling parties interviewed during on-water surveys in Zone 4 (Hartford-MA) during 2008-09. The column "Bus Stop" indicates whether the launch site was a bus stop in Zone 4; the column "Inside Zone" indicates whether the launch site was located within Zone 4. This summary includes only launch usage interviews from angling parties (recreational boaters excluded) that provided information on their launch points – the total number of launch usage interviews shown here are therefore less than the totals shown for this Zone in Appendices 14-15.

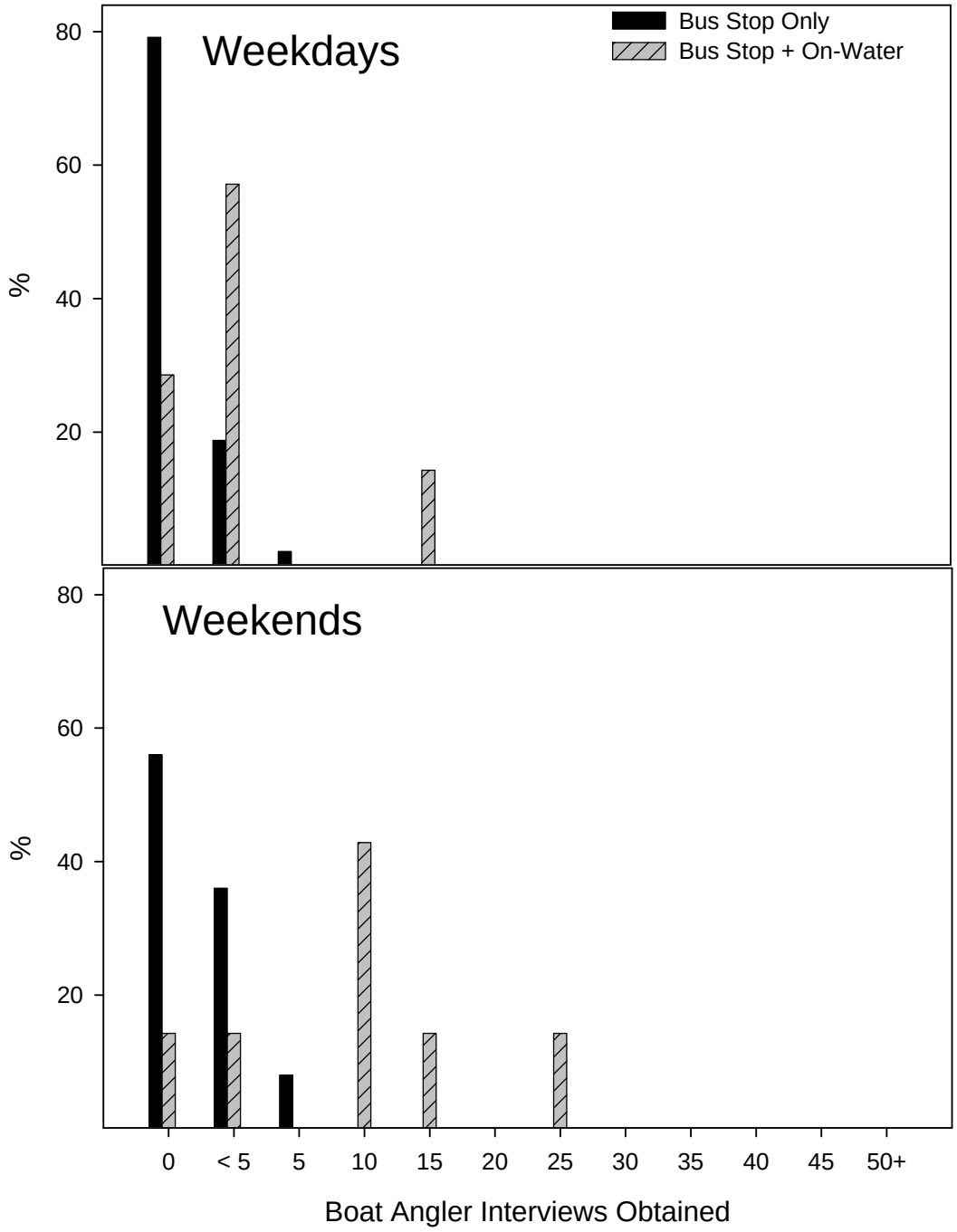
Launch Point	Bus Stop	Inside Zone	Angler Boating Parties
Alberts Riverside Launch	Y	Y	3
Barts Launch	Y	Y	2
Enfield Launch	Y	Y	25
Sanctuary Launch	Y	Y	4
Wilsons Launch	Y	Y	12
Great River Park & Launch	N	N	1
MA (Chicopee)	N	N	1
Riverside Park & Launch	N	N	2
Rocky Hill Ferry & Launch	N	N	1
Wethersfield Cove & Launch	N	N	1
Private Launch	N	?	2
Private Residence	N	?	1
SUM			**55**

Appendix 61.- Percentage of angler boating parties interviewed during 2008-09 on-water surveys that launched at bus stops within a Zone, at non-bus-stop sites within a Zone, and at sites outside of a Zone. For this summary, all non-bus-stop launch points of unknown location (i.e. those indicated by "?" in Appendices 57-60) were assumed to be located outside of a Zone.

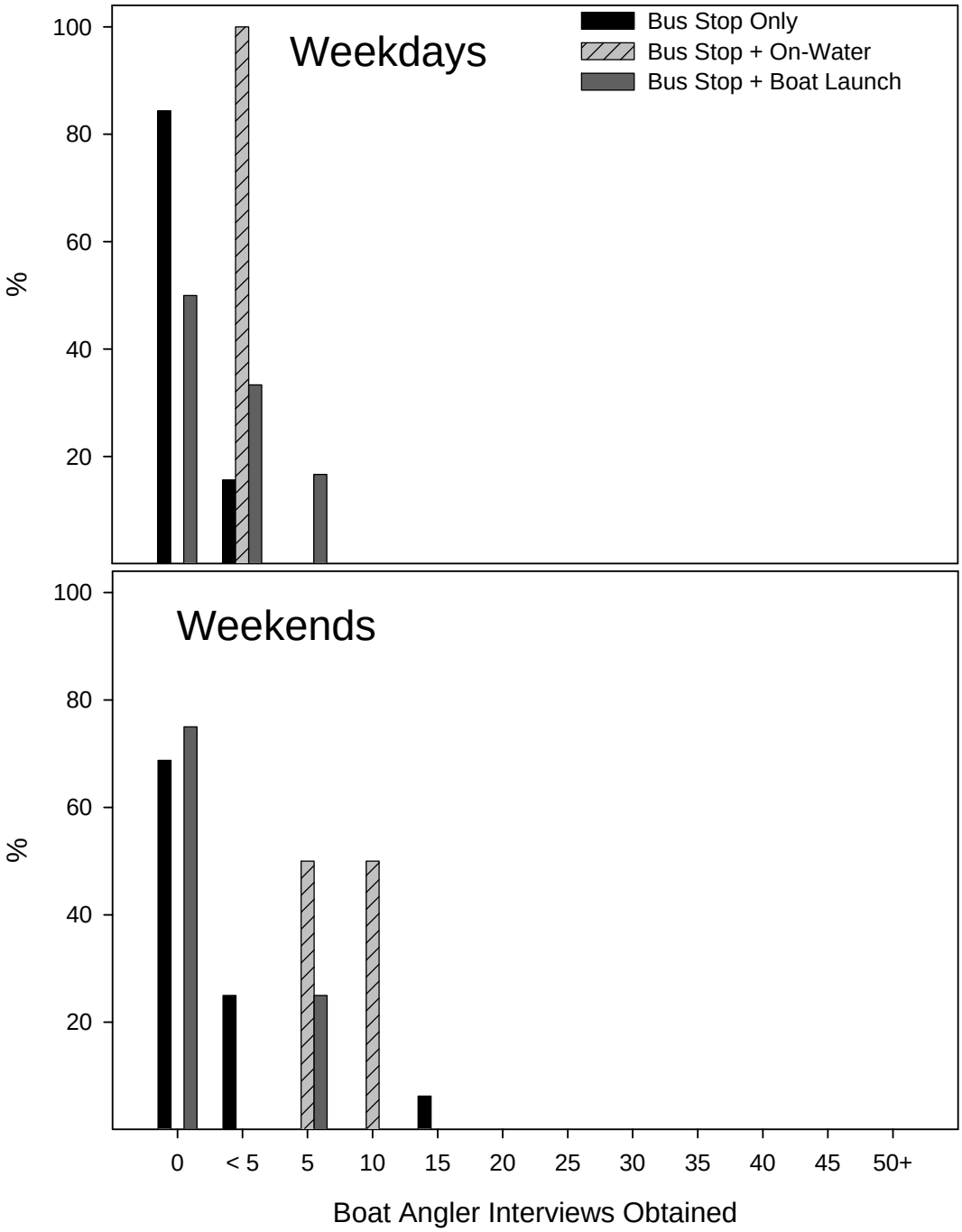
Zone	Bus Stops	Non-Bus-Stop Sites Within Zone	Outside Zone
1 (Mouth–Haddam)	51.8	14.5	33.7
2 (Haddam–Middletown)	82.8	8.6	8.6
3 (Middletown–Hartford)	77.3	10.1	12.6
4 (Hartford–MA)	83.6	0.0	16.4



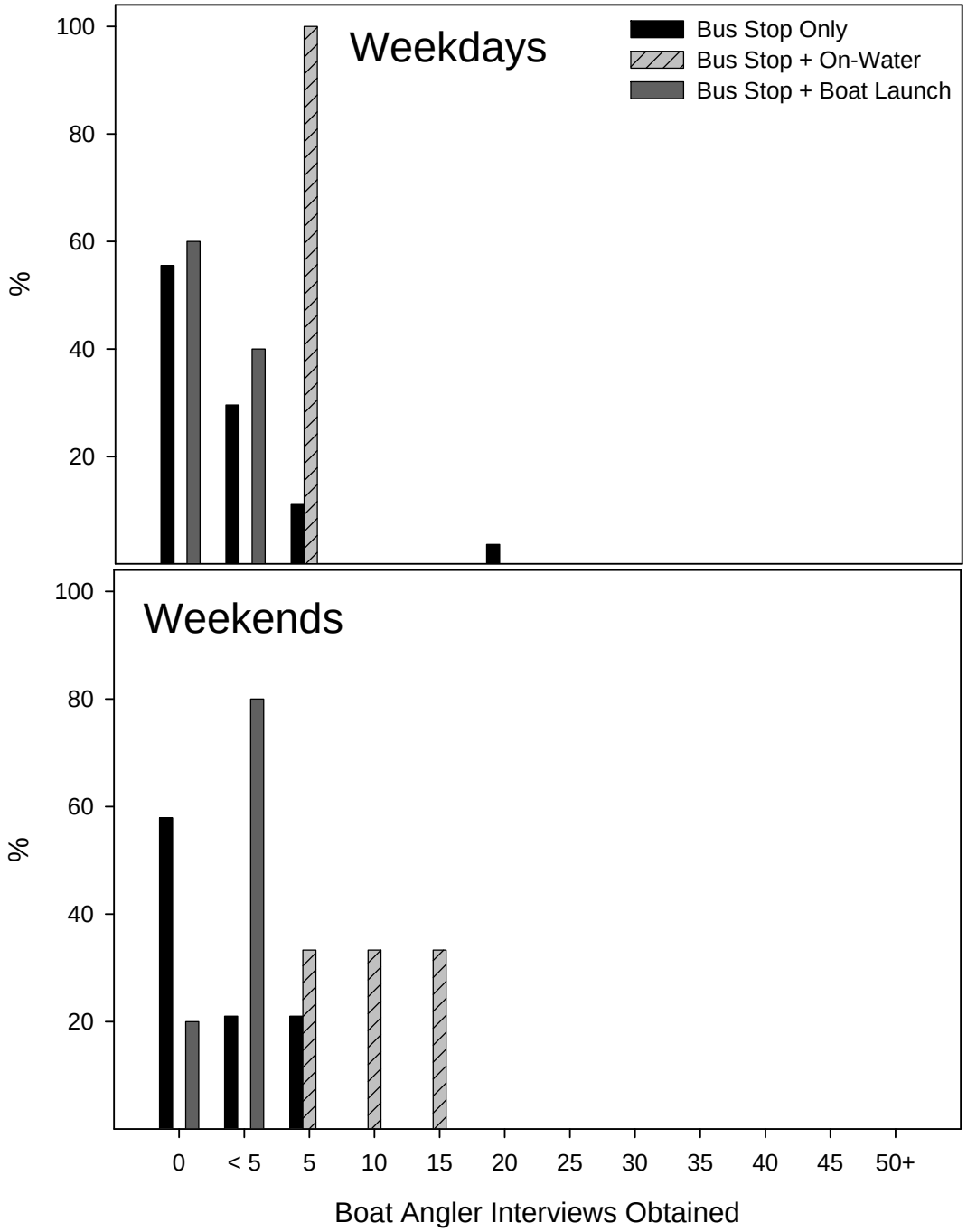
Appendix 62.- Frequency distribution of number of boat angler interviews obtained during bus stop only survey days, bus stop + concurrent boat launch survey days, and bus stop + concurrent on-water survey days in Zone 1 (River mouth-Haddam) during 2009.



Appendix 63.- Frequency distribution of number of boat angler interviews obtained during bus stop only survey days and bus stop + concurrent on-water survey days in Zone 2 (Haddam-Middletown) during 2009. No boat launch surveys were conducted in Zone 2.



Appendix 64.- Frequency distribution of number of boat angler interviews obtained during bus stop only survey days, bus stop + concurrent boat launch survey days, and bus stop + concurrent on-water survey days in Zone 3 (Middletown-Hartford) during 2008.



Appendix 65.- Frequency distribution of number of boat angler interviews obtained during bus stop only survey days, bus stop + concurrent boat launch survey days, and bus stop + concurrent on-water survey days in Zone 4 (Hartford-MA) during 2008.

Appendix 66.- Summary of the efficiency of boat launch surveys for obtaining launch usage interviews during 2006-09. Surveys during 2006-07 were conducted in Zones 3-4 as resources permitted to aid in planning for the 2008-09 survey; surveys were conducted primarily during May-early July. Surveys during 2008 were conducted in Zones 3-4 primarily during May-early July. Surveys were limited to a single bus stop launch during 2009 (the "I-95 Launch" in Zone 1) and were conducted during May-October (see Appendix 11 for more details on timing of surveys in all Zones/years). The number of surveys, number of launch usage interviews, and number of launch usage interviews per man-day of labor are reported for each day-type at each launch. Boat launch surveys during 2006-07 and 2009 were full-day surveys (1 man-day/survey), while 2008 surveys were half-day surveys (0.5 man-days/survey). The row labeled "MEAN" represents the mean of the "Interviews/Man-Day" column.

		Weekdays			Weekends		
Zone	**Launch**	**Surveys**	**Interviews**	**Interviews/Man-Day**	**Surveys**	**Interviews**	**Interviews/Man-Day**
				2006-07			
3	Charter Oak	1	4	4.0	1	10	10.0
3	Great River	3	5	1.7	1	19	19.0
3	Riverside	0	-	-	1	14	14.0
3	Rocky Hill	1	2	2.0	1	3	3.0
3	Wethersfield Cove	3	7	2.3	0	-	-
4	Alberts Riverside	3	10	3.3	1	2	2.0
4	Barts	1	11	11.0	0	-	-
4	Enfield	5	7	1.4	2	10	5.0
4	Wilson	3	5	1.7	3	22	7.3
4	Parsons	2	0	0.0	0	-	-
4	Sanctuary	1	0	0.0	0	-	-
SUMS		**23**	**51**		**10**	**80**	
MEAN				**2.7**			**8.6**
				2008			
3	Charter Oak	3	5	3.3	2	1	1.0
3	Great River	3	5	3.3	1	4	8.0
3	Riverside	1	1	2.0	2	4	4.0
3	Rocky Hill	6	24	8.0	0	-	-
3	Wethersfield Cove	6	6	2.0	1	4	8.0
4	Alberts Riverside	4	7	3.5	1	1	2.0
4	Barts	2	2	2.0	1	0	0.0
4	Enfield	1	1	2.0	1	3	6.0
4	Parsons	1	0	0.0	1	1	2.0

Appendix 66 continued

4	Sanctuary	0	-	-	1	2	4.0
4	Wilson	3	8	5.3	2	7	7.0
SUMS		**30**	**59**		**13**	**27**	
MEAN				**3.1**			**4.2**
				2009			
1	I-95 Launch	11	255	**23.2**	8	327	**40.9**

Appendix 67.- Summary of the efficiency of on-water surveys for obtaining launch usage interviews during 2008-09. The number of surveys, number of launch usage interviews, and number of launch usage interviews per man-day of labor are reported for each Zone/month/day-type. On-water surveys required two man-days per survey. The row labeled "MEAN" indicates the mean of the "Interviews/Man-Day" column. Not all launch usage interviews tallied here for a particular Zone were used to estimate boat trailer expansion values for that Zone (i.e. interview totals for a Zone/Season/day-type shown here do not match similar totals shown in Appendices 14-15). Only interviews from boaters who launched at bus stop survey sites within a Zone were used to estimate expansion values for that Zone. Additionally, Zone 1 launch usage interviews shown here were not used to estimate boat trailer expansion values for Zone 1 and therefore do not match the totals shown in Appendices 14-15 (only launch usage interviews obtained during 2009 boat launch surveys at the I-95 Launch were used to estimate boat trailer expansion values for Zone 1, see Methods).

		Weekdays			Weekends		
Season	**Month**	**Surveys**	**Interviews**	**Interviews/Man-Day**	**Surveys**	**Interviews**	**Interviews/Man-Day**
				Zone 1 (Mouth – Haddam)			
2	May	1	15	7.5	1	19	9.5
	June	1	7	3.5	1	24	12.0
3	July	2	38	9.5	1	21	10.5
	August	1	16	8.0	1	29	14.5
4	September	1	11	5.5	1	20	10.0
	October	1	0	0.0	1	2	1.0
	SUMS	**7**	**87**		**6**	**115**	
	MEAN			**5.7**			**9.6**
				Zone 2 (Haddam – Middletown)			
2	May	1	1	0.5	1	6	3.0
	June	1	1	0.5	1	13	6.5
3	July	2	10	2.5	2	74	18.5
	August	1	31	15.5	1	11	5.5
4	September	1	12	6.0	1	12	6.0
	October	1	1	0.5	1	0	0.0
	SUMS	**7**	**56**		**7**	**116**	
	MEAN			**4.3**			**6.6**
				Zone 3 (Middletown – Hartford)			
2	May	0	-	-	2	31	7.8
	June	1	11	5.5	1	34	17.0
3	July	3	19	3.2	1	17	8.5
	August	1	2	1.0	3	76	12.7

Appendix 67 continued

4	September	1	1	0.5	2	32	8.0
	October	3	10	1.7	3	15	2.5
	SUMS	**9**	**43**		**12**	**205**	
	MEAN			**2.4**			**9.4**
				Zone 4 (Hartford – MA)			
2	May	1	6	3.0	1	2	1.0
	June	1	2	1.0	0	-	-
3	July	2	5	1.3	1	8	4.0
	August	2	11	2.8	2	14	3.5
4	September	1	2	1.0	2	18	4.5
	October	1	1	0.5	1	2	1.0
	SUMS	**8**	**27**		**7**	**44**	
	MEAN			**1.6**			**2.8**