ANADROMOUS FISH UTILIZATION OF THE BYPASSED REACH OF THE SANTEE RIVER AND THE ARMY CORPS OF ENGINEERS REDIVERSION CANAL DURING SPRING 2002

Agency Review Draft

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Prepared for

SANTEE COOPER
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
One Riverwood Drive
P.O. Box 2946101
Moncks Corner, South Carolina 29461-2901

Prepared by

NORMANDEAU ASSOCIATES, INC.
917 Route 12, #1
Westmoreland, New Hampshire 03467

Normandeau Project Number 18907.001

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
cfs	cubic feet per second
CPUE	catch-per-unit-of-effort
DHEC	Department of Health and Environmental Control
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
ft	foot, feet
ft^2	square feet
ft^3	cubic feet
g	gram
h	hour
km	kilometer
m	meter
mg/L	milligrams per liter
mi	mile
min	minute
mm	millimeter
mS	micro Siemens
msl	mean sea level
MW	megawatt
N	sample size or number in sample
NAI	Normandeau Associates, Inc.
NMFS	National Marine Fisheries Service
RM	river mile
SCDNR	South Carolina Department of Natural Resources
s.u.	standard units
TL	total length
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service

EXECUTIVE SUMMARY

Anadromous fish utilization of the Santee River rediversion canal and the bypass reach were investigated during spring 2002 relative to relicensing of Santee Cooper Hydroelectric Station. This report addresses elements of one study request of sixteen that were generated by interested parties. The objective was to identify the migratory patterns of anadromous fish at the juncture of the Santee River and the United States Army Corps of Engineers (USACE) rediversion canal.

The Santee Cooper Project is located in the coastal plain of South Carolina where the Santee and Cooper rivers were impounded to form Lakes Marion and Moultrie, respectively. A five-mile long canal diverts Lake Marion water into Lake Moultrie for power production at the Jefferies Hydroelectric Station (130 MW). A small generating unit at the Santee Dam (Lake Marion) provides a constant minimum flow into the Santee River and has a generating capacity of 1.92 MW. A USACE rediversion canal diverts water from Lake Moultrie back into the Santee River. The St. Stephen Hydroelectric Station, a 90 MW facility owned by the USACE and operated by Santee Cooper, is located on the rediversion canal. Flow through the Santee and Jefferies Stations is federally regulated to a continuous minimum flow of 500 cfs from the Santee Dam and a weekly average flow of 4,500 cfs from the Jefferies Station. There are no flow restrictions on operation of the St. Stephen Station.

The Project area of interest is the 37-mile bypass reach below Santee Dam and the five-mile rediversion canal below St. Stephen Station. The two segments converge near the town of St. Stephen and approximately 54 RM above the mouth of the Santee River. Anadromous fish use of the rediversion canal is documented through fish passage at the St. Stephen fish lift near the St. Stephen Hydroelectric Station; use of the bypass reach, however, is not as well defined. The objective of this study was to further document the use, by anadromous fish, of the Santee River bypass reach and the rediversion canal under various ambient flow conditions.

For this investigation, fish sampling was conducted at two stations in the bypass reach and one station in the rediversion canal during the spring 2002 migratory run of American shad and blueback herring. Fish were collected via electrofishing and gill netting once a week at each station. Sampling began 13 March and ended 2 May. After the second week, gill netting at the downstream station in the bypass reach was discontinued in favor of increased gill netting effort at the remaining two stations. Water chemistry parameters of temperature, pH, dissolved oxygen and conductivity were collected during each sampling event.

Overall water quality in both the rediversion canal and the bypass reach was considered good. Temperatures ranged from 13.1 to 26.3^{o}C, pH remained above 6.5 s.u, and mean dissolved oxygen remained above 6.0 mg/L. Due to regionally persistent drought conditions, flows were low to non-existent in the rediversion canal. Flow in the bypass reach was maintained at 515 cfs, in accordance with federal requirements.

American shad and blueback herring were collected in both the bypass reach and rediversion canal. American shad were most frequently collected via electroshocking, and catch-per-unit-of-effort (CPUE) was consistently higher in the bypass reach compared with the rediversion canal. The number of American shad collected generally increased through the course of the study and then declined in the last week. Males dominated the catch at 87% and ranged in length from 382 to 550 mm TL. Females ranged in length from 463 to 566 mm TL.

Blueback herring were collected more often in gill nets and at a slightly higher rate in the rediversion canal compared with the bypass reach. CPUE ranged from 0.2 to 2.9 fish/hr in the rediversion canal and 0 to 1.5 fish/hr at the upper most sampling station in the bypass reach. Blueback herring ranged in length from 216 to 398 mm TL.

During individual sampling events, flow in the bypass reach remained constant at 515 cfs. However, no flow passed through St. Stephen Hydroelectric Station into the rediversion canal. Conclusions relating flow to species use of a particular reach are unclear. CPUE for American shad was higher in the bypass reach; however, peak passage through the St. Stephen fish lift on the rediversion canal occurred over a two-day period of minimal flow. Overall, CPUE for blueback herring was slightly higher in the rediversion canal.

The objective of this study was to further document the use of the Santee River bypass reach by anadromous fish under various ambient flow conditions. Due to drought conditions in the Southeast U.S., river flows throughout the Santee River Basin were unusually low and a range of river flows was essentially unavailable. However, the objective of documenting the use of the bypass reach by anadromous fish was met. It is unclear whether significantly more anadromous fish would use the Santee River bypass reach if climatic conditions were conducive to continual operation of the St. Stephen Station at full capacity.

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1.0 INTRODUCTION AND BACKGROUND

The South Carolina Public Service Authority, also known as Santee Cooper, is in the process of relicensing the Santee Cooper Hydroelectric Power Project (the Project). The Project is located in southeast South Carolina on the Santee and Cooper Rivers in Berkeley, Calhoun, Clarendon, Orangeburg, and Sumter Counties (Figure 1-1) and is operated in accordance with a Federal Energy Regulatory Commission (FERC) license (FERC No. 199-SC) that expires on 31 March 2006.

An Initial Consultation Package (ICP) was prepared to describe the project, project operation, and associated aspects including water quality, and aquatic, terrestrial, and recreational resources. The ICP (Mead and Hunt 2000) was distributed to appropriate resource agencies and other stakeholders for review prior to subsequent consultations between Santee Cooper and the stakeholders.

During the First Stage Consultation phase of the relicensing process, Santee Cooper received study requests from the following agencies: South Carolina Department of Natural Resources (SCDNR), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS) and the South Carolina Department of Health and Environmental Control (DHEC). The agencies and the licensee deliberated on the proposed requests and a synthesized list of 16 studies was compiled by Santee Cooper. In February 2002 a study plan addressing study request 1, regarding anadromous fish utilization of the Santee River bypass reach and the United States Army Corps of Engineers (USACE) rediversion canal downstream of the St. Stephen Project, was distributed to the agencies. This report presents the results of that study. Previous work by SCDNR (SCDNR 1988, SCDNR 2001) and anecdotal commercial and recreational fishermen reports have indicated that anadromous fish utilize the bypass reach. The objective of this study was to further document use by anadromous fish of the Santee River bypass reach (between the Santee Dam and rediversion canal) and the rediversion canal under various ambient flow conditions.

Anadromous species in the Santee River include American shad (*Alosa sapidissima*), blueback herring(*A. aestivalis*), hickory shad (*A. mediocris*), striped bass (*Morone saxatilis*), and shortnose sturgeon (*Acipenser brevirostrum*). All of these species generally occur along much of the Atlantic coast with some of the species having broader ranges including parts of the Pacific Coast (American shad and striped bass) and Great Lakes (blueback herring) drainages (Scott and Crossman 1973). Striped bass are typically anadromous, spending most of their life in marine and estuarine waters and entering freshwater to spawn. However, a landlocked population of striped bass was established in the Santee Cooper lakes in the early 1940's (Scruggs 1957), representing the first identified, large, stable, reproducing population of striped bass that did not migrate to the sea. The alosid species, American shad, blueback herring, and hickory shad, are closely related and migrate into freshwater in late winter and early spring to spawn. Shortnose sturgeon is typically anadromous. In the south, adults enter freshwater early in the year and spawn in late winter or early spring. An apparently landlocked population of shortnose sturgeon has been identified in Lake Marion (Collins, personal communication). Due to its status under the Endangered Species Act (ESA), shortnose sturgeon was not targeted for this study.

1.1 Project Location and Water Regime

The Santee Cooper Project is located in the coastal plain of South Carolina, where the Santee and Cooper Rivers were impounded to form Lakes Marion and Moultrie, respectively (Figure 1-2). A five-mile long canal diverts Lake Marion water into Lake Moultrie for power production at the Jefferies Hydroelectric Station (130 MW). A small generating unit at the Santee Dam (Lake Marion) provides a constant minimum flow into the Santee River and has a generating capacity of 1.92 MW with a rated net head of 46 ft. Work began on the project in 1938, with power production at the

Jefferies Station beginning in 1942. The small generating unit at the Santee Dam was installed in 1950.

The Cooper River opens to the ocean in Charleston, SC. The original Santee Cooper Project configuration resulted in flow from both the Santee and Cooper river basins passing through Charleston. Due to concerns with sedimentation buildup in Charleston Harbor, the USACE constructed a rediversion canal in the 1980s that rediverted approximately 80% of the project waters back into the Santee River. At that time, the St. Stephen Hydroelectric Station, a 90 MW facility owned by the USACE and operated by Santee Cooper, was also constructed. Details on the project design and operation are provided in the ICP (Mead and Hunt 2000). Flow through the Santee and Jefferies Stations is federally regulated at a continuous minimum flow of 500 cfs from the Santee Dam and a weekly average flow of 4,500 cfs from the Jefferies Station. To insure compliance with the FERC licensed minimum flow requirement to the Santee River, Santee Cooper conservatively releases approximately 515 cfs from the Santee Dam. There are no flow restrictions on operation of the St. Stephen Station.

The Santee Cooper Project is operated as a semi-peaking hydroelectric generating facility based on an operating "rule curve". The rule curve indicates the most efficient operating levels of Lakes Marion and Moultrie for differing conditions at various times of the year. In general, the rule curve follows the annual hydrologic cycle typical to the area. The lake elevations are dropped by a few feet in the winter and then brought back up in the spring to approximately 75 ft msl where they are maintained through the summer.

The majority of inflows to the Project are from the Santee River entering Lake Marion. During normal flow conditions, flow exceeding the minimum flow passed at the Santee Dam leaves Lake Marion through the diversion canal and enters Lake Moultrie. There is no control structure associated with the diversion canal so the Lake Moultrie headwater level is approximately equal to the Lake Marion headwater level minus minimum head losses through the canal.

All normal flow exceeding the minimum flow passed at the Santee Dam is passed through either the Jefferies Hydroelectric Station or the USACE St. Stephen development. During high flow conditions, when inflow to the Project exceeds the generating capacity of the development generating units, excess flow is passed through the Santee Dam spillway. During drought conditions, which have persisted in South Carolina since June 1998 (SCDNR 2002), only federally regulated flows are passed, including the minimum 500 cfs continuous flow from the Santee Dam and 4,500 cfs weekly average flow from the Jefferies Station. This has resulted in lake elevations a few feet below normal.

The Project area of interest for this study is the 37-mile bypass reach below Santee Dam and the five-mile rediversion canal below the St. Stephen Station (Figure 1-2). The two segments converge near the town of St. Stephen and approximately 54 RM above the mouth of the Santee River. Fish migrating up the rediversion canal may be passed into Lake Moultrie via a fish lift at the St. Stephen development, where the SCDNR documents passage. Anadromous fish utilization of the bypass reach has been reported by SCNDR (SCDNR 2001) but is not tracked with regularity.

2.0 METHODS

With input from SCDNR and NMFS personnel and considering site conditions, it was determined that electrofishing and gill netting would be the most efficient collection gear for the purposes of this study. Except as discussed below, each sampling station was sampled with each gear type once a week over an eight-week period that began 13 March 2002 and ended 2 May 2002. The different gear types were generally sampled on different days within a week. Species identification of juvenile (>155 mm TL) clupeids was verified by peritoneum color, as described by Menhinick (1991). On each day that juvenile clupeids were collected, ten to twenty were sacrificed for verification purposes.

Water chemistry parameters of temperature, dissolved oxygen, pH and conductivity were recorded for each sampling event.

Although the probability was small, the potential for catching endangered shortnose sturgeon was of particular concern during this study. Precautions were taken to minimize the impact that collection might have on these fish. A floating live car, approximately 96 ft^3 in volume, was made available to the NAI field crew by the SCDNR. In the event a sturgeon was captured, it would have been placed in the live car for disposition by Doug Cooke (SCDNR), the local endangered species coordinator. Additionally, the NMFS guidance document "A protocol for use of shortnose and Atlantic sturgeons," (NMFS 2000) was provided to and reviewed by the field crew for appropriate handling methods.

2.1 Electrofishing

Electrofishing was conducted from an aluminum boat equipped with a 4,500 W, 230 V gasoline-powered generator. A four-electrode array was mounted on a boom and suspended in the water approximately 2 m in front of the boat, with a cathode boom secured to the bow of the boat. Direct current discharge was controlled by a Smith-Root Model IV electrofisher. Current to the electrodes was pulsed by a foot switch in the bow of the boat, operated by the person netting fish.

Sampling began at least 0.5 h past sunset with sampling runs lasting from 5 to 10 min (mean = 9.25 min) at each station (sampling stations are described below). All fish immobilized by the sampling gear were collected and placed in a live well aboard the boat. At the end of each electrofishing run, all fish were identified to species, measured for length (mm TL) and weight (g), and then returned to the river.

2.2 Gill Nets

Two stationary gill nets were fished at each station; a net with 5.25 in stretch mesh was used to target adult American shad, and an experimental net with three panels of mesh, one each measuring 2, 2.5, and 3 in stretch mesh was used to target blueback herring. The nets were 5 and 12 ft deep, respectively, and both measured 150 ft in length. Nets were set perpendicular to river flow with the shad net downstream of the herring net. At the end of each set the net was retrieved and fish were processed as described above. Originally, both nets were set at each station for approximately one hour. However, after discussions with SCDNR and Santee Cooper personnel, the Rt. 52 Bridge gill netting site (described below) was dropped in favor of increasing set times at the remaining two stations. Therefore, after the first two weeks of sampling and beginning on March 27, gill netting occurred only in the rediversion canal and Wilson's Landing. Set time averaged about 3.5 hr, with a range of 1 to 5 hr.

2.3 Sampling Stations

Two sampling areas in the Santee River bypass reach and one in the rediversion canal were fished with each gear type. In the rediversion canal, gill nets were set approximately 1.5 km below the St. Stephen Station. The nets were set approximately 150 m apart and were stretched from opposite banks with each net covering about one-half the width of the canal (Figure 2-1). Electrofishing runs began at approximately the upper gill net station and ran upstream along the left bank (looking downstream) to about the USACE boat ramp.

Sampling areas in the bypass reach were located near Wilson's Landing below the Santee Dam, and below the Rt. 52 Bridge (also referred to as Murry's Landing) (Figures 2-2 and 2-3, respectively). At Wilson's Landing, the shad net was set in the main channel approximately 200 m below and perpendicular to the dam. The herring net was set approximately 70 m upstream of the shad net in a side channel created by a small island just below the dam. Each net covered approximately three-quarters of the width of the channel (Figure 2-2). Electrofishing runs were conducted along the right bank in the vicinity of the gill nets.

At the Rt. 52 Bridge site, the nets were set approximately 100 m apart beginning approximately 1 km downstream of the bridge (Figure 2-3). Due to the shape of the river at this location, the shad net spanned the width of the river while the herring net covered about three-quarters of the width. Electrofishing was conducted along the left bank, approximately 1.5 km downstream of the gill netting stations.

2.4 Data Summarization and Analysis

The primary statistic used for analysis in this study was catch-per-unit-of-effort (CPUE) by gear type for each anadromous species in each location over time. CPUE was expressed as the number of fish per hour for both electrofishing and gill netting efforts. It was understood that comparisons of CPUE among Santee River bypass reach and rediversion canal samples may be problematic due to the differences in habitat and other factors. Therefore, the information has been presented to characterize the use of the two reaches under the environmental and flow conditions observed, and to present changes in relative abundance within a reach over the course of the eight week sampling term. Comparisons between the bypass reach and the rediversion canal were made, but qualified as appropriate while taking into consideration water chemistry and operation conditions for both the St. Stephen and Santee Hydroelectric Stations.

All data collected for each sampling event, including species, individual fish sizes, and water chemistry parameters are provided.

3.0 RESULTS

A total of 60 sampling events occurred: 24 in both the rediversion canal and Wilson's Landing sampling stations and 12 below the Rt. 52 Bridge. Shad and herring gill nets were set at the rediversion canal and Wilson's Landing on eight occasions and below the Rt. 52 Bridge twice. Electrofishing was conducted eight times at each station. A summary of the sampling events by station, and species collected by station and gear type is provided in Appendix A.

3.1 Water Quality and Project Flows

Environmental conditions associated with fisheries sampling in the Santee River bypass reach and the rediversion canal are summarized in Table 3-1 and provided in detail in Appendix B. Overall, parameter values were within expected ranges for the region and appeared to rise and fall similarly among the three sampling sites.

Mean surface water temperatures were highest in the rediversion canal and lowest at Wilson's Landing in the bypass reach. The greatest temperature difference between the two sites was 4.1°C and occurred during the March 20-22 sampling events. The smallest temperature difference, 0.9°C, occurred during the last week of sampling (30 April–2 May), which also marked a slight drop in temperature at all stations following a seven-week gradual rise. Over the eight-week study period, mean surface temperatures ranged from 15.3 to 26.3°C in the rediversion canal, 14.8 to 24.5°C in the bypass reach below the Rt. 52 Bridge, and 13.1 to 23.7°C in the bypass reach at Wilson's Landing.

Mean dissolved oxygen remained above 6.0 mg/L at all stations and generally decreased with increasing temperature, with a few exceptions. During the first two weeks of the study, mean dissolved oxygen levels in the rediversion canal were only slightly higher than the lowest mean of 6.4 mg/L, recorded in the seventh week. Comparatively, mean temperatures during the first and seventh weeks were 15.3°C and 26.3°C, an 11°C difference. In the third week, mean dissolved oxygen values increased to 8.8 mg/L in the rediversion canal.

Mean values of pH were consistently highest in the upper portion of the Santee River bypass reach near Wilson's Landing and lowest below the Rt. 52 Bridge. The highest (7.9 s.u.) and lowest (6.5 s.u.) individual readings were collected in Wilson's Landing during the first and fifth weeks of sampling, respectively. Values ranged from 6.5 to 7.2 s.u. in the rediversion canal and 6.6 to 7.2 s.u. below the Rt. 52 Bridge. Among all sites, conductivity ranged between 143 and 170 mS, with values in Wilson's Landing averaging slightly higher than in the rediversion canal and below the Rt. 52 Bridge.

A federally regulated minimum flow of 500 cfs to the bypass reach was maintained or exceeded during the course of the study. Due to a prolonged drought in the region, very little flow was released from the St. Stephen Station. Over the eight-week period, water passed through the station to the rediversion canal on 13 days for a total of approximately 36 h, ranging from 1 to 6 h in a day. During the course of a day when flow was released, velocities ranged from 0 to 13,817 cfs. Fish sampling occurred during four of the thirteen flow days but never during or within a few hours of a release (Table 3-2). Unfortunately, the timing of St. Stephen Station generation was not practically predictable such that sampling events could coincide with station operation.

3.2 Anadromous Species

Three anadromous species were collected during the course of the study: American shad, blueback herring, and striped bass. Five striped bass were collected: four in the rediversion canal and one at Wilson's Landing. Because the collection represented less than 2% of the total number of adult

anadromous species collected, no further analysis was conducted for striped bass. A complete list of the anadromous species collection, by gear and station is provided in Appendix C.

3.2.1 American Shad

Overall, 124 American shad were collected, 2 (1.6%) in the rediversion canal, 95 (76.6%) at Wilson's Landing, and 27 (21.8%) below the Rt. 52 Bridge.

Over 55% of the American shad collected were caught over a three-week period from 9 to 25 April. The number of American shad collected per week generally increased over the first seven weeks of the study period and then declined in the last week (Table 3-3). This pattern was particularly evident at Wilson's Landing, the uppermost sampling station in the Santee River bypass reach. The number of fish collected rose from 5 in week 1 to a high of 20 in week 7, before falling to 8 in the last week. The collection of American shad from the rediversion canal (N=2) was too small to discern a pattern.

Total length of American shad ranged from 382 to 566 mm and weight ranged from 352 to 2,203 g. Length frequencies were normally distributed around the means of 465 and 461 mm TL for fish collected below the Rt. 52 Bridge and Wilson's Landing, respectively (Figure 3-1). The two fish collected in the rediversion canal measured 450 and 562 mm TL.

Of the 124 American shad collected, gender was determined for 119. Most (87%, N=104) of the shad were males ranging in length from 382 to 550 mm TL, with a mean of 452 mm TL. Males weighed from 352 to 1822 g with a mean of 830 g (Table 3-4). Females (N=15) ranged in length from 463 to 566 mm TL (mean = 533 mm TL) (Table 3-4), with a weight range of 995 to 2,326 g (mean = 1,726 g). Most (13) of the female shad were collected at Wilson's Landing; one each were collected at the rediversion canal and Rt. 52 Bridge sampling stations. Eight were collected via electrofishing and seven in gill nets. Temporally, the number of males collected increased through the course of the study to a high of 26 in the seventh week before falling to 12 in the last week (Figure 3-2). The collection of females peaked at 6 in the fourth week.

3.2.2 Blueback Herring

The blueback herring collection totaled 216, including 80 juveniles (<155 mm TL). Because the intent of this study was to document utilization by spawning-run adults, juveniles were not considered further. Of the 136 adult blueback herring collected, 71 (52.2%) were caught in the rediversion canal, 42 (30.9%) below the Rt. 52 Bridge and 23 (16.9%) at Wilson's Landing.

Over the eight-week sampling period, 43% of the blueback herring collected were caught on two days, 20 March and 4 April, with 88% caught within the six-week period of 20 March to 16 April. Overall, no obvious temporal pattern was discernable for the number of blueback herring collected at each sampling site (Table 3-5). However, there was a general decline in the number caught toward the end of the study period. In the rediversion canal, collection numbers were highest during weeks 3 and 4 (N=17 and 19, respectively) and then gradually declined. In the bypass reach, peak collection occurred in the second week at the Rt. 52 Bridge and in the fifth week at Wilson's Landing. Collection numbers dropped rapidly after the peak collections.

Total length of the blueback herring collected ranged from 216 to 398 mm and weight ranged from 113 to 504 g. Length frequency distributions were not normally distributed; however they were similarly distributed for each of the three sampling locations (Figure 3-3). Fish larger than the 275-299 mm TL size class were not well represented in the catch. Mean lengths of blueback herring collected from the three sites were: 278 mm TL below the Rt. 52 Bridge, 238 mm TL at Wilson's Landing and 246 mm TL in the rediversion canal.

3.2.3 Electrofishing

CPUE for the number of anadromous species (blueback herring and American shad combined) caught by electrofishing was greatest in Wilson's Landing for each week of sampling (Figure 3-4). At Wilson's Landing, CPUE generally increased through the sampling period before dropping to 47 fish/hr on May 1. CPUE in the rediversion canal represented the lowest values with a peak of 13 fish/hr on April 2. At the Rt. 52 Bridge site, CPUE generally remained between 20 and 40 fish/hr during the sampling period, after a low of 0 fish/hr on March 28. The CPUE values generated for anadromous species is primarily driven by the American shad collection (Figure 3-4), which comprised 90% (N=112) of the anadromous species caught via electrofishing. CPUE for electrofished blueback herring peaked at 41 fish/hr on March 28 in the rediversion canal (Figure 3-4). However, the sample size for electrofished herring was small (N=12) and may not be representative.

3.2.4 Gill Nets

CPUE for gill netted anadromous species (herring and shad gill nets combined) was greatest in the rediversion canal for most sampling events (Figure 3-5). Although gill netting was discontinued at the Rt. 52 Bridge site after the second week of sampling, the highest CPUE (3.3 fish/hr) was collected at the site on 20 March. CPUE at Wilson's Landing peaked in the fourth week (4 April) with a value of 2.3 fish/hr. At both the rediversion canal and Wilson's Landing, CPUE declined to close to zero toward the end of the study. Blueback herring were collected with gill nets more often than shad, representing 91% (N=123) of the gill net catch. Sixty-eight herring were collected in the rediversion canal, 33 below the Rt. 52 Bridge, and 22 at Wilson's Landing (Figure 3-5). Twelve American shad were collected in the gill nets, ten at Wilson's Landing and one each at the other two sites, giving Wilson's Landing the highest CPUE.

3.3 Other Fish Species

Besides the three anadromous species, 27 additional species were collected during the course of the study (Table 3-6). The most common species collected were longnose gar (*Lepisosteus osseus*) and the introduced blue catfish (*Ictalurus furcatus*), comprising 25 and 16% of the catch, respectively. Blueback herring (12%) and American shad (11%) placed third and fourth, respectively, in relative abundance over all collections.

4.0 SUMMARY AND DISCUSSION

Anadromous fish populations in the Santee River bypass reach and rediversion canal were sampled by gill net and electrofishing during spring of 2002, in support of study request 1, for the Santee Cooper Hydroelectric Station relicensing effort. During the sampling period, water quality at the three sampling stations met or exceeded state water quality standards (SCDHEC 1998) and species specific (American shad and blueback herring) habitat requirements for dissolved oxygen, pH, and temperature (Funderburk *et al.* 1991). Comparatively, conditions in the bypass reach at Wilson's Landing were slightly 'better' than at the other two sites. This judgement is based primarily on water temperatures that remained slightly lower and dissolved oxygen values that remained slightly higher at Wilson's Landing during the eight-week sampling period.

The most effective sampling gear for blueback herring was the herring gill net, in which 90% of the blueback herring were collected. Although the catch was distributed about evenly between the rediversion canal (52%) and Santee River bypass reach (48%), CPUE was generally higher in the rediversion canal.

American shad were primarily caught via electrofishing (90%) and in the bypass reach (98%). Of those caught in the bypass reach, 78% were collected at Wilson's Landing and 22% below the Rt. 52 Bridge. CPUE for American shad was higher at Wilson's Landing for all eight weeks of the study period.

Conclusions relating flow to American shad and blueback herring use of a particular reach are unclear from these results. CPUE suggests a greater use of the bypass reach by American shad and a slightly greater use of the rediversion canal by blueback herring. During all sampling events at the Rt. 52 Bridge and Wilson's Landing, a continuous flow of 515 cfs was maintained in the bypass reach; however, there was no flow discharged from the St. Stephen Station during any of the sampling events in the rediversion canal. Although American shad were collected more often in the bypass reach where continuous flow existed, only one hour of flow (551 cfs at 1500 h) (J. Dulude, personal communication) passed into the rediversion canal over the two days of peak American shad passage (28,222 or 20% of American shad passed) at the St. Stephen fish lift. With very little flow in the rediversion canal, a considerable number of American shad (and herring) were passed upstream into Lake Moultrie.

Based on passage numbers at the St. Stephen fish lift, the timing of this study (13 March to 2 May) coincided with the peak blueback herring run and the primary American shad run. Peak passage of blueback herring (197,123 or 47% of all blueback herring passed) at the St. Stephen fish lift occurred between 23 and 26 March, and 98% were passed during the term of this study. Although peak passage of American shad occurred prior to this study (20% between 9 and 10 March), 66% were passed between 13 March and 3 May (S. Leach, personal communication).

Consideration was given to the notion that some fish collected in the bypass reach were counted twice, once at the Rt. 52 Bridge site and again upstream at Wilson's Landing where they may mill around looking for further upstream passage; or that they were collected repeatedly at Wilson's Landing. However, recapture at Wilson's Landing would not affect the primary objective of this study, which was to document anadromous fish use of the Santee River bypass reach.

No shortnose or Atlantic sturgeon were collected during the course of this study. Concurrent with this study, SCDNR conducted an American shad population study in the Santee River; no fish from that study were collected.

The objective of this study was to further document the use of the Santee River bypass reach by anadromous fish under various ambient flow conditions. Due to drought conditions in the Southeast

U.S., river flows throughout the Santee River Basin were unusually low and a range of river flows was essentially unavailable. However, the objective of documenting the use of the bypass reach by anadromous fish was met. It is unclear whether significantly more anadromous fish would use the Santee River bypass reach if climatic conditions were conducive to continual operation of the St. Stephen Station at full capacity.

This study did not include surveys for spawning behavior or collection of herring and shad eggs; however, the bypass reach of the Santee River appears to be suitable spawning habitat in that the river has a continuous flow of water and generally sufficient depth to permit the drift of alosid eggs.

It is evident that alosids use the Santee River bypass reach under the flow conditions observed and it is likely that at least some use the bypass reach when the St. Stephen Station operates. Therefore, additional studies to document use of the bypass reach may not be warranted. If further study is considered with respect to anadromous fish utilization of the bypass reach, spawning surveys, and egg and ichthyoplankton collections could demonstrate whether the bypass reach is a productive alosid spawning segment of the basin.

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TABLES

Table 3-1.

Surface water quality data collected during fisheries sampling in the Santee bypass reach and rediversion canal during spring 2002.

	13-15 March			20-22 March			27-29 March			2-4 April		
	RC	**52B**	**WL**	**RC**	**52B**	**WL**	**RC**	**52B**	**WL**	**RC**	**52B**	**WL**
Water Temperature												
N	3	3	3	3	3	3	3	1	3	3	1	3
Mean (^{o}C)	15.3	14.8	13.1	18.5	18.0	14.4	19.5	17.8	16.7	21.4	20.5	18.1
Range (^{o}C)	15.1-15.4	14.6-15.2	9.6-10.9	18.3-18.7	17.7-18.2	13.9-15.4	18.9-20.6	17.8	16.6-16.8	21.4-21.5		17.4-18.4
Dissolved Oxygen												
N	3	3	3	3	3	3	3	1	3	3	1	3
Mean (mg/L)	7.2	9.4	10.4	6.5	8.7	10.3	8.8		10.5	8.2		8.8
Range (mg/L)	6.1-7.9	8.9-9.7	9.6-70.9	5.5-9.6	8.4-8.8	10.2-10.6	6.8-9.8	8.5	10.0-10.9	7.2-8.9	7.9	8.6-9.1
pH												
N	3	3	3	3	3	3	3	1	3	3	1	3
Mean (s.u.)	7.2	7.1	7.8	7.2	7.0	7.2	7.1		7.4	7.1		7.2
Range (s.u.)	7.1-7.3	7.0-7.2	7.5-7.9	7.1-7.2	6.9-7.2	7.1-7.4	6.7-7.3	6.6	7.3-7.5	6.7-7.4	6.9	6.9-7.5
Conductivity												
N	3	3	3	3	3	3	3	1	3	3	1	3
Mean (uS)	161	147	149	164	157	158	165		162	157		153
Range (uS)	160-161	143-153	145-155	163-165	157-158	158-159	165-166	158	160-163	156-159	151	153-154

RC = Rediversion Canal; 52 B = 52 Bridge; WL = Wilson Landing

Table 3-1.

Continued

	9-11 April			16-18 April			23-25 April			30 April - 2 May		
	RC	**52B**	**WL**	**RC**	**52B**	**WL**	**RC**	**52B**	**WL**	**RC**	**52B**	**WL**
Water Temperature												
N	3	1	3	3	1	3	3	1	3	3	1	3
Mean (^{o}C)	21.0	20.7	18.6	24.4	24.4	20.5	26.3	24.5	23.7	24.2	24.0	23.3
Range (^{o}C)	20.6-21.3		18.5-18.7	24.1-24.5		20.4-20.7	25.6-26.8		23.1-24.0	24.0-24.4		23.2-23.6
Dissolved Oxygen												
N	3	1	3	3	1	3	3	1	3	3	1	3
Mean (mg/L)	7.4		8.8	7.5		8.7	6.4		8.7	7.5		8.3
Range (mg/L)	7.1-7.6	8.9	8.6-9.2	5.5-8.8	6.7	8.3-9.0	5.6-7.1	6.0	7.0-7.9	5.6-8.5	6.3	8.2-8.3
pH												
N	3	1	3	3	1	3	3	1	3	3	1	3
Mean (s.u.)	6.9		6.9	7.1		7.3	7.3		7.6	7.4		7.3
Range (s.u.)	6.7-7.1	6.9	6.5-7.2	6.9-7.3	6.9	7.1-7.5	7.2-7.5	6.9	7.3-7.8	7.1-7.5	6.8	7.3-7.4
Conductivity												
N	3	1	3	3	1	3	3	1	3	3	1	3
Mean (uS)	166		160	154		148	174		164	162		152
Range (uS)	165-168	162	159-162	146-170	161	143-161	173-176	165	161-165	155-165	145	145-155

RC = Rediversion Canal; 52 B = 52 Bridge; WL = Wilson Landing

Table 3-2.

Duration of NAI sampling events concurrent with days of flow from the St. Stephen Hydroelectric Station. The range in velocity of flow and the duration are also provided.

Flow through St. Stephen Station			Duration (h) of NAI Sampling Events Corresponding with St. Stephen Water Release Days
Date	**Duration (h)**	**Range of Flow (cfs)**	
18-Mar-02	1100 - 1500	0 - 12,882	
19-Mar-02	1100	914	
25-Mar-02	0800 - 2100	0 - 6,246	
27-Mar-02	0800	3122	1300 - 1600
3-Apr-02	1200 - 1300	4,081 - 5,831	0015 - 0020
12-Apr-02	2300	1138	
14-Apr-02	0100 - 0200	369 - 1,477	
16-Apr-02	0100 - 0200	1,928 - 3,029	1400 - 1730
18-Apr-02	1200 - 1500	5,960 - 13,817	
19-Apr-02	1400	5,774	
21-Apr-02	1400 - 2200	0 - 11,739	
29-Apr-02	0800 - 1400	0 - 3,577	
2-May-02	1400 - 1800	0 - 6,382	0100-0110

Table 3-3.

Number of American shad collected by week at each of the three sampling stations.

	Week							
Station	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Rediversion Canal	0	0	1	0	0	0	0	1
Rt. 52 Bridge	0	1	0	3	7	3	7	6
Wilson's Landing	5	5	12	14	14	17	20	8

Table 3-4.

Summary of collected male and female American shad by sampling station and gear type (note: gender was not determined for five shad).

	Males (N=104)		Females (N=15)	
	Number	**Percent**	**Number**	**Percent**
Collection Station				
Rt. 52 Bridge	26	25	1	7
Rediversion Canal	1	1	1	7
Wilson's Landing	77	74	13	87
Collection Gear				
Electrofishing	99	95	8	53
Gill Net	5	5	7	47
Length				
Range	382 - 555 mm TL		463 - 566 mm TL	
Mean	452 mm		533 mm	
Weight				
Range	352 - 1822 mm TL		995 - 2326 mm TL	
Mean	830 mm		1726 mm	

Table 3-5.

Number of blueback herring collected by week at each of the three sampling stations.

	Week							
Station	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Rediversion Canal	2	5	17	19	9	14	3	2
Rt. 52 Bridge	2	32	7	0	0	1	0	0
Wilson's Landing	0	0	2	9	10	1	0	1

Table 3-6.

Fish collected in the Santee River bypass reach and rediversion canal during spring 2002, presented in descending order of frequency.

Common Name	Scientific Name	Frequency	% Frequency
Longnose gar	*Lepisosteus osseus*	287	24.8
Blue catfish	*Ictalurus furcatus*	187	16.1
Blueback herring	*Alosa aestivalis*	136	11.7
American shad	*Alosa sapidissima*	124	10.7
Redbreast sunfish	*Lepomis auritus*	83	7.2
Gizzard shad	*Dorosoma cepedianum*	56	4.8
Striped mullet	*Mugil cephalus*	54	4.7
Bluegill	*Lepomis macrochirus*	52	4.5
White perch	*Morone americana*	42	3.6
Inland silverside	*Menidia beryllina*	26	2.2
Redear sunfish	*Lepomis microlophus*	24	2.1
Largemouth bass	*Micropterus salmoides*	17	1.5
Ironcolor shiner	*Notropis chalybaeus*	12	1.0
Channel catfish	*Ictalurus punctatus*	9	0.8
Spotted sucker	*Minytrema melanops*	7	0.6
Common carp	*Cyprinus carpio*	7	0.6
Silvery minnow	*Hybognathus regalis*	6	0.5
Yellow perch	*Perca flavescens*	6	0.5
Striped bass	*Morone saxatilis*	5	0.4
Grass carp	*Ctenopharyngodon idella*	3	0.3
Flathead catfish	*Pylodictis olivaris*	3	0.3
Warmouth	*Lepomis gulosus*	3	0.3
American eel	*Anguilla rostrata*	3	0.3
Bowfin	*Amia calva*	2	0.2
Tesselated darter	*Etheostoma olmstedi*	1	0.1
Black crappie	*Pomoxis nigromaculatus*	1	0.1
Southern flounder	*Paralichthys lethostigma*	1	0.1
Spotted sunfish	*Lepomis punctatus*	1	0.1
White crappie	*Pomoxis annularis*	1	0.1

FIGURES

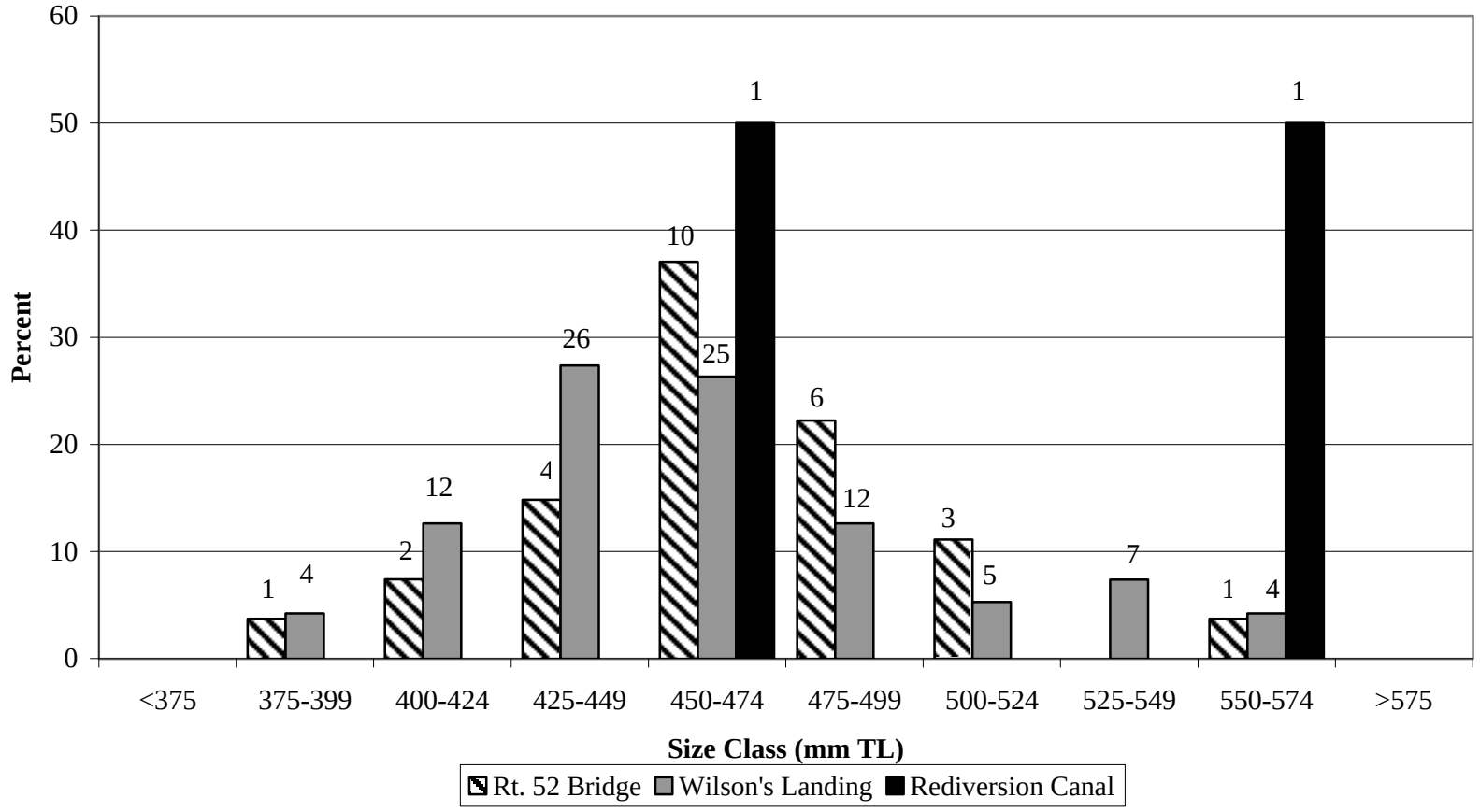

Figure 3-1.

Length frequency distribution of American shad collected in the Santee River bypass reach (Rt.52 Bridge and Wilson's Landing) and rediversion canal. Frequencies are shown as a percent of the total catch for each station, the number collected in each size class is shown above the bar.

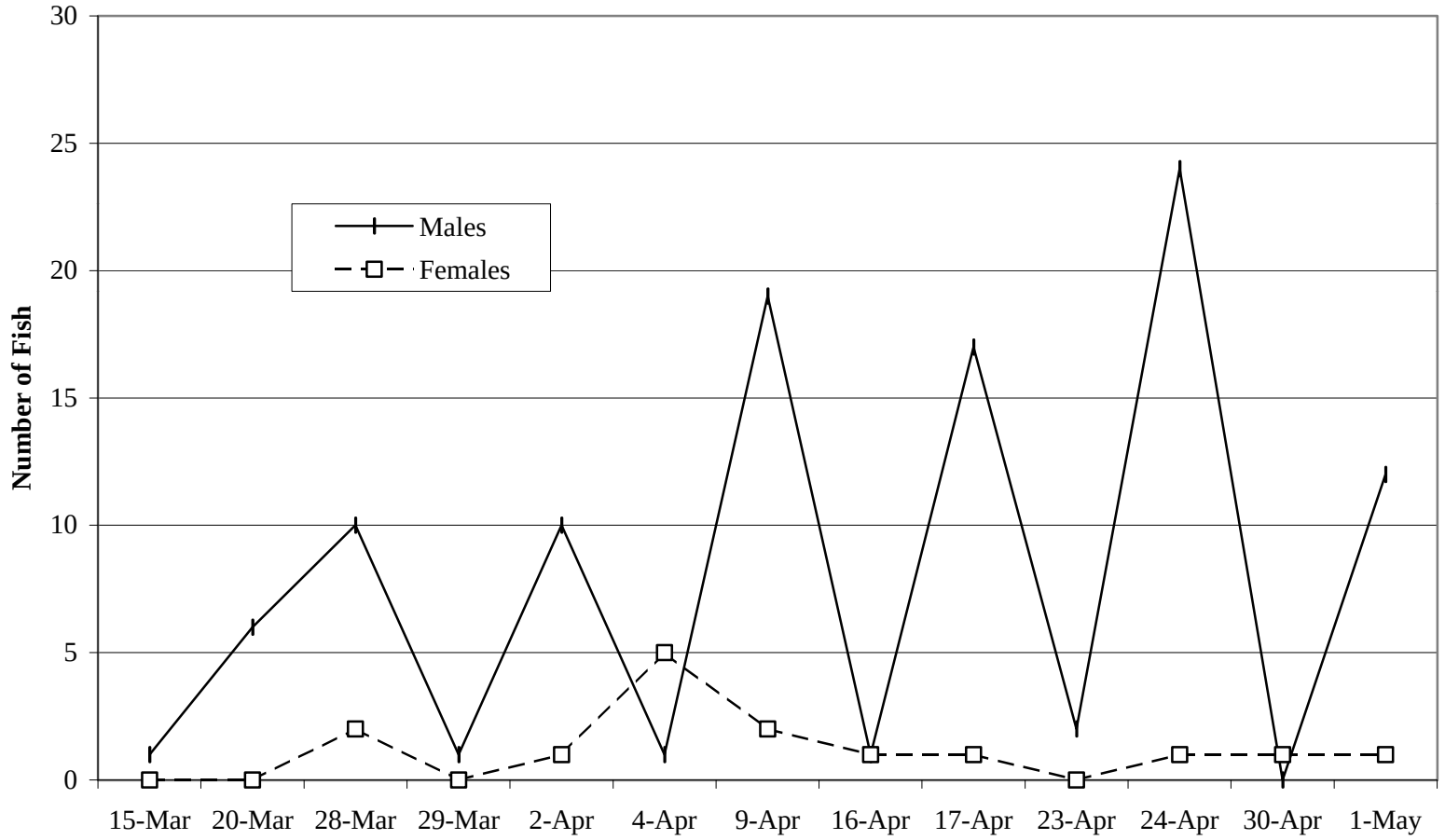

Figure 3-2.

Spatial distribution of male and female American shad collected in the Santee River bypass and rediversion canal during Spring 2002.

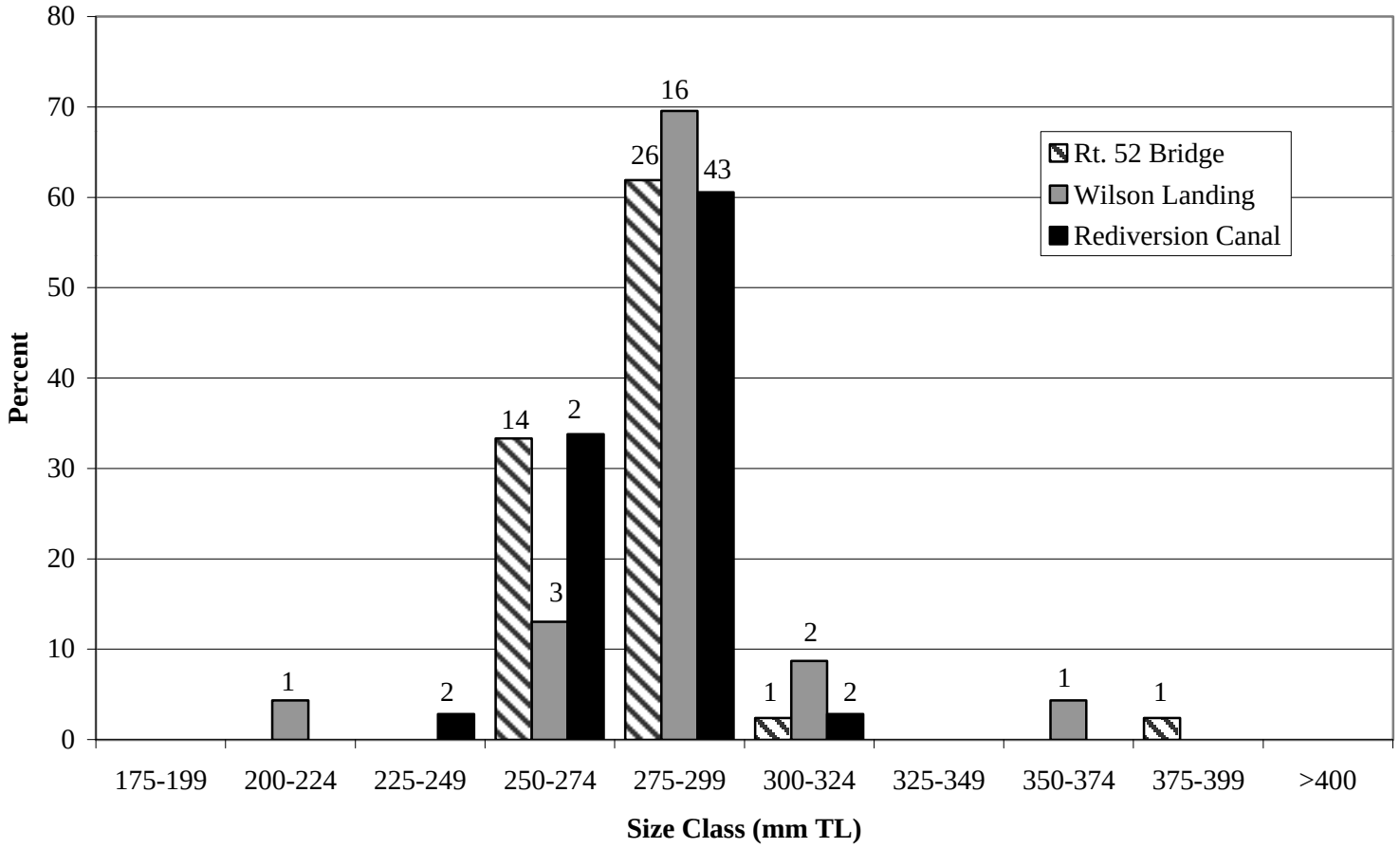

Figure 3-3.

Length frequency distribution of blueback herring collected in the Santee River bypass reach (Rt. 52 Bridge and Wilson's Landing) and rediversion canal. Frequencies are shown as a percent of the total catch for each station, the number collected in each size class is shown above the bar.

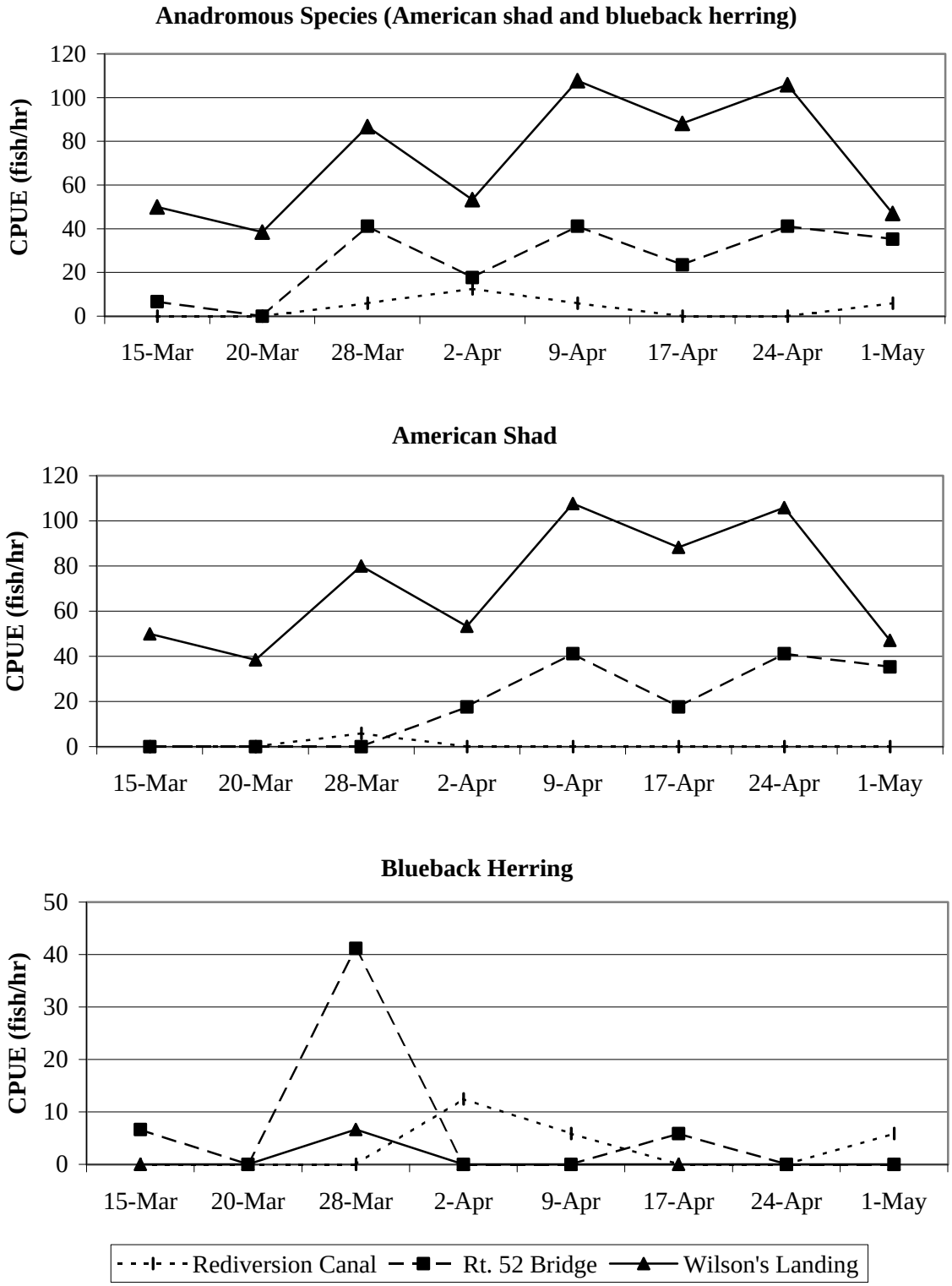

Figure 3-4.
Catch-per-unit-of-effort for electrofished American shad and blueback herring together (anadromous species) and separately, in the Santee River bypass reach (Rt. 52 Bridge and Wilson's Landing) and rediversion canal, spring 2002.

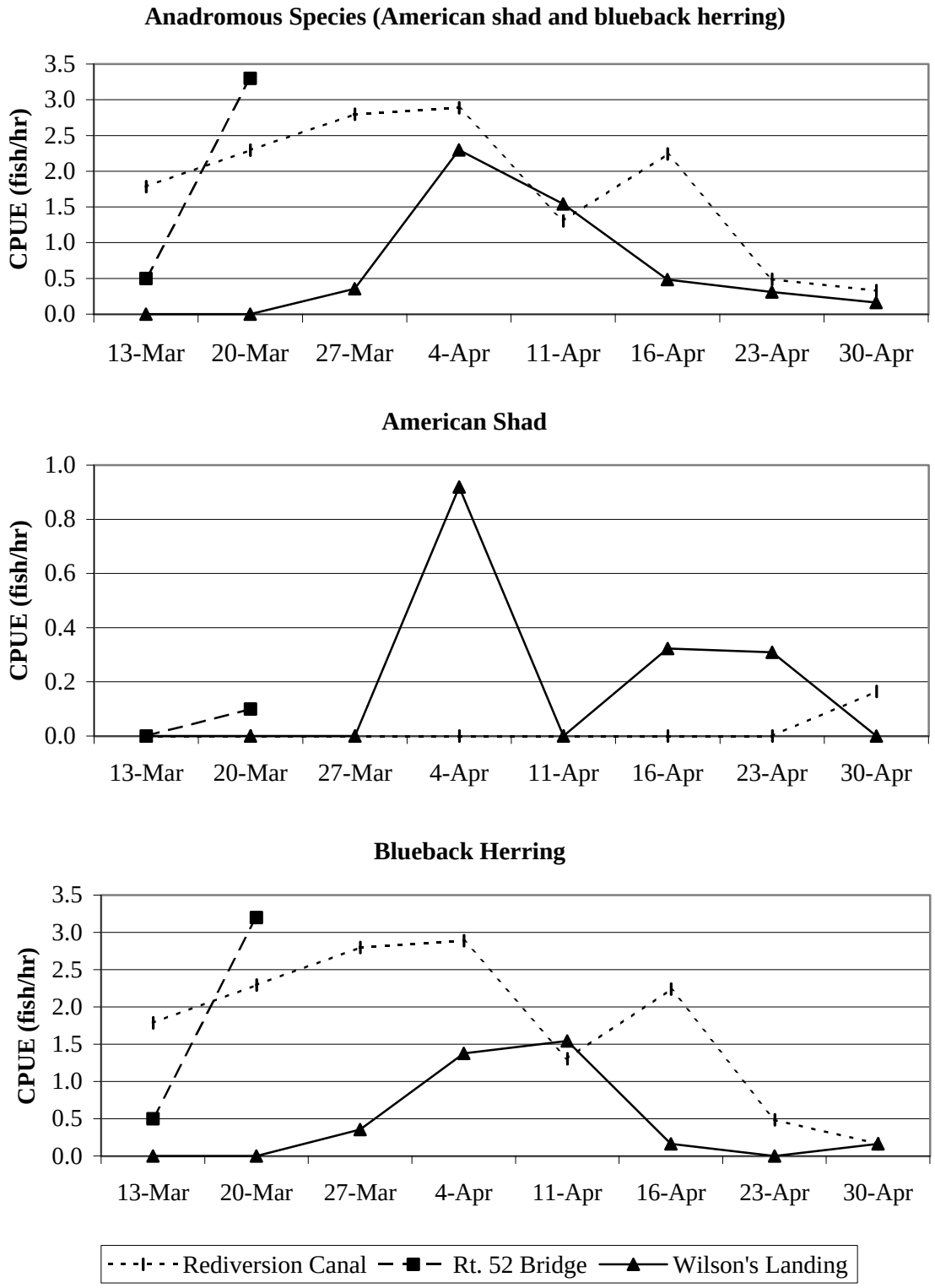

Figure 3-5.
Catch-per-unit-of-effort for gill netted American shad and blueback herring together (anadromous species) and seperately, in the Santee River bypass reach (Rt. 52 Bridge and Wilson's Landing) and rediversion canal, spring 2002.

APPENDIX A

SUMMARY RESULTS OF ANADROMOUS FISH COLLECTIONS IN THE SANTEE RIVER BYPASS REACH AND REDIVERSION CANAL, SPRING 2002

Appendix A

Summary of anadromous fish sampling study in the Santee River bypass reach and rediversion canal, spring 2002.

	Number of Fish Collected by Species and Gear Type			
	Rediversion Canal	**Wilson's Landing**	**52 Bridge**	**Total**
Anadromous Species				
American Shad	2	95	27	124
Electrofishing	1	85	26	112
Shad Gill Net	1	8	0	9
Herring Gill Net	0	2	1	3
Blueback Herring	71	23	42	136
Electrofishing	3	1	9	13
Shad Gill Net	0	0	0	0
Herring Gill Net	68	22	33	123
Striped Bass	4	1	0	5
Electrofishing	1	1	0	2
Shad Gill Net	1	0	0	1
Herring Gill Net	2	0	0	2
Other Species Collected	198	522	254	974
Electrofishing	90	240	249	579
Shad Gill Net	28	11	0	39
Herring Gill Net	80	271	5	356
	Number and Date Range of Sampling Events by Station			
All Sampling Events	24	24	12	60
Electrofishing	8	8	8	24
Shad Gill Net	8	8	2	18
Herring Gill Net	8	8	2	18
Date Range	3/14 - 5/2	3/13 - 5/1	3/13 - 5/1	
Electrofishing	3/15 - 5/2	3/15 - 5/1	3/15 - 5/1	
Gill Netting	3/13 - 4/30	3/14 - 4/30	3/13 - 3/20	

APPENDIX B

ENVIRONMENTAL CONDITIONS ASSOCIATED WITH FISHERIES SAMPLING IN THE SANTEE RIVER BYPASS REACH AND REDIVERSION CANAL, SPRING 2002

Appendix B

Environmental conditions associated with fisheries sampling in the Santee River bypass reach and rediversion canal.

Station	Gear	Date	Time	Temperature (oC)	DO (mg/L)	Depth (ft)	pH (s.u.)	Conductivity (uS)	Weather
Rediversion Canal	Gill Net	03/14/02	11:16	15.1	7.7	8	7.3	161	Clear
Rediversion Canal	Gill Net	03/14/02	11:25	15.3	7.9	11	7.2	161	Clear
Rediversion Canal	Efish	03/15/02	4:00	15.4	6.1	5	7.1	160	Fog
Rediversion Canal	Efish	03/21/02	2:35	18.7	5.5	5	7.1	163	Partly Cloudy
Rediversion Canal	Gill Net	03/22/02	17:43	18.3	6.9	9	7.2	164	Sunny
Rediversion Canal	Gill Net	03/22/02	17:49	18.4	7.0	8	7.2	165	Sunny
Rediversion Canal	Gill Net	03/27/02	12:52	19.0	9.8	10	6.7	165	Partly Cloudy
Rediversion Canal	Gill Net	03/27/02	12:58	20.6	9.8	9	7.3	165	Partly Cloudy
Rediversion Canal	Efish	03/29/02	0:10	18.9	6.8	8	6.8	166	Clear
Rediversion Canal	Efish	04/03/02	0:15	21.4	7.2	9	7.2	159	Clear
Rediversion Canal	Gill Net	04/04/02	10:00	21.4	8.6	10	6.7	156	Partly Cloudy
Rediversion Canal	Gill Net	04/04/02	10:06	21.5	8.9	8	7.4	156	Partly Cloudy
Rediversion Canal	Efish	04/10/02	0:20	20.6	7.6	10	7.0	168	Clear
Rediversion Canal	Gill Net	04/11/02	14:01	21.1	7.1	10	6.7	165	Partly Cloudy
Rediversion Canal	Gill Net	04/11/02	14:07	21.3	7.6	9	7.1	166	Partly Cloudy
Rediversion Canal	Gill Net	04/16/02	14:04	24.5	8.3	9	6.9	147	Partly Cloudy
Rediversion Canal	Gill Net	04/16/02	14:10	24.5	8.8	9	7.3	146	Partly Cloudy
Rediversion Canal	Efish	04/18/02	0:40	24.1	5.5	9	7.2	170	Clear
Rediversion Canal	Gill Net	04/23/02	14:42	26.4	6.6	11	7.2	174	Clear
Rediversion Canal	Gill Net	04/23/02	14:48	26.8	7.1	10	7.5	176	Clear
Rediversion Canal	Efish	04/25/02	0:50	25.6	5.6	9	7.2	173	Partly Cloudy
Rediversion Canal	Gill Net	04/30/02	14:18	24.4	8.5	10	7.5	165	Partly Cloudy
Rediversion Canal	Gill Net	04/30/02	14:25	24.3	8.5	9	7.5	165	Partly Cloudy
Rediversion Canal	Efish	05/02/02	1:00	24.0	5.6	10	7.1	155	Clear
Rt. 52 Bridge	Gill Net	03/13/02	15:33	14.7	9.7	6	7.2	145	Overcast
Rt. 52 Bridge	Gill Net	03/13/02	15:40	14.6	9.5	6	7.2	143	Overcast
Rt. 52 Bridge	Efish	03/15/02	0:50	15.2	8.9	6	7.0	153	Clear
Rt. 52 Bridge	Gill Net	03/20/02	11:38	18.2	8.8	6	7.2	158	Partly Cloudy
Rt. 52 Bridge	Gill Net	03/20/02	12:28	18.1	8.8	4	7.0	157	Partly Cloudy
Rt. 52 Bridge	Efish	03/21/02	0:10	17.7	8.4	5	6.9	157	Partly Cloudy

Appendix B, Cont.

Station	Gear	Date	Time	Temperature (oC)	DO (mg/L)	Depth (ft)	pH (s.u.)	Conductivity (uS)	Weather
Rt. 52 Bridge	Efish	03/28/02	21:45	17.8	8.5	5	6.6	158	Partly Cloudy
Rt. 52 Bridge	Efish	04/02/02	22:00	20.5	7.9	7	6.9	151	Clear
Rt. 52 Bridge	Efish	04/09/02	22:30	20.7	8.9	5	6.9	162	Clear
Rt. 52 Bridge	Efish	04/17/02	22:40	24.4	6.7	6	6.9	161	Clear
Rt. 52 Bridge	Efish	04/24/02	23:10	24.5	6.0	5	6.9	165	Partly Cloudy
Rt. 52 Bridge	Efish	05/01/02	23:00	24.0	6.3	6	6.8	145	Clear
Wilson Landing	Gill Net	03/13/02	12:45	13.1	10.9	7	7.9	146	Overcast
Wilson Landing	Gill Net	03/13/02	12:55	13.2	10.8	5	7.9	145	Overcast
Wilson Landing	Efish	03/15/02	22:00	13.1	9.6	7	7.5	155	Clear
Wilson Landing	Gill Net	03/20/02	9:00	13.8	10.2	4	7.1	158	Partly Cloudy
Wilson Landing	Gill Net	03/20/02	9:08	13.9	10.6	6	7.2	158	Partly Cloudy
Wilson Landing	Efish	03/20/02	21:30	15.4	10.2	6	7.4	159	Partly Cloudy
Wilson Landing	Gill Net	03/27/02	9:12	16.7	10.5	6	7.5	163	Overcast
Wilson Landing	Gill Net	03/27/02	9:16	16.8	10.9	6	7.5	162	Overcast
Wilson Landing	Efish	03/28/02	19:30	16.6	10.0	8	7.3	160	Partly Cloudy
Wilson Landing	Efish	04/02/02	19:50	17.4	8.6	8	6.9	154	Clear
Wilson Landing	Gill Net	04/04/02	14:52	18.4	8.8	6	7.2	153	Overcast
Wilson Landing	Gill Net	04/04/02	14:58	18.4	9.1	8	7.5	153	Overcast
Wilson Landing	Efish	04/09/02	20:25	18.7	9.2	6	6.5	162	Partly Cloudy
Wilson Landing	Gill Net	04/11/02	8:50	18.5	8.7	5	7.1	159	Partly Cloudy
Wilson Landing	Gill Net	04/11/02	8:56	18.6	8.6	7	7.2	159	Partly Cloudy
Wilson Landing	Gill Net	04/16/02	9:10	20.5	9.0	8	7.1	140	Clear
Wilson Landing	Gill Net	04/16/02	9:18	20.7	8.9	6	7.5	143	Clear
Wilson Landing	Efish	04/17/02	20:30	20.4	8.3	8	7.4	161	Partly Cloudy
Wilson Landing	Gill Net	04/23/02	9:19	23.9	7.4	8	7.6	165	Partly Cloudy
Wilson Landing	Gill Net	04/23/02	9:26	24.0	7.9	5	7.8	165	Clear
Wilson Landing	Efish	04/24/02	20:30	23.1	7.0	7	7.3	161	Partly Cloudy
Wilson Landing	Gill Net	04/30/02	9:27	23.2	8.3	7	7.3	155	Partly Cloudy
Wilson Landing	Gill Net	04/30/02	9:33	23.2	8.3	5	7.3	155	Partly Cloudy
Wilson Landing	Efish	05/01/02	20:40	23.6	8.2	7	7.4	145	Partly Cloudy

APPENDIX C

ANADROMOUS SPECIES COLLECTED IN THE SANTEE RIVER BYPASS REACH AND REDIVERSION CANAL, SPRING 2002

Appendix C

Raw data from electrofishing and gillnet sampling in the Santee River bypass reach (Wilson's Landing and Rt. 52 Bridge) and rediversion canal during spring 2002, sorted by station, date, and common name.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Rediversion Canal	Herring Net	14-Mar-02	Blueback herring	Alosa aestivalis	268	208	
Rediversion Canal	Herring Net	14-Mar-02	Blueback herring	Alosa aestivalis	255	179	
Rediversion Canal	Electrofishing	15-Mar-02	Blueback herring	Alosa aestivalis	79	3	
Rediversion Canal	Electrofishing	15-Mar-02	Blueback herring	Alosa aestivalis	90	4	
Rediversion Canal	Herring Net	22-Mar-02	Blueback herring	Alosa aestivalis	280	213	
Rediversion Canal	Herring Net	22-Mar-02	Blueback herring	Alosa aestivalis	298	322	
Rediversion Canal	Herring Net	22-Mar-02	Blueback herring	Alosa aestivalis	276	207	
Rediversion Canal	Herring Net	22-Mar-02	Blueback herring	Alosa aestivalis	283	188	
Rediversion Canal	Herring Net	22-Mar-02	Blueback herring	Alosa aestivalis	279	211	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	286	227	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	271	202	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	279	215	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	268	177	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	284	241	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	283	201	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	247	131	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	279	183	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	277	212	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	272	200	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	324	341	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	282	225	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	271	192	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	276	211	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	286	222	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	270	182	
Rediversion Canal	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	271	182	
Rediversion Canal	Herring Net	27-Mar-02	Striped bass	Morone saxatilis	417	867	
Rediversion Canal	Electrofishing	29-Mar-02	American shad	Alosa sapidissima	450	830	Male
Rediversion Canal	Electrofishing	29-Mar-02	Blueback herring	Alosa aestivalis	151	33	
Rediversion Canal	Electrofishing	29-Mar-02	Blueback herring	Alosa aestivalis	90	6	
Rediversion Canal	Electrofishing	29-Mar-02	Blueback herring	Alosa aestivalis	81	4	
Rediversion Canal	Electrofishing	29-Mar-02	Blueback herring	Alosa aestivalis	83	3	

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Rediversion Canal	Electrofishing	29-Mar-02	Blueback herring	Alosa aestivalis	91	5	
Rediversion Canal	Electrofishing	29-Mar-02	Blueback herring	Alosa aestivalis	90	6	
Rediversion Canal	Electrofishing	3-Apr-02	Blueback herring	Alosa aestivalis	261	147	Male
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	269	175	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	265	161	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	275	156	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	287	222	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	276	181	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	293	197	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	257	174	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	270	175	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	299	221	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	269	159	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	277	184	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	281	221	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	286	222	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	295	219	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	260	161	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	301	239	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	265	159	
Rediversion Canal	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	276	204	
Rediversion Canal	Electrofishing	10-Apr-02	Blueback herring	Alosa aestivalis	274	157	
Rediversion Canal	Electrofishing	10-Apr-02	Blueback herring	Alosa aestivalis	115	11	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	287	188	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	272	181	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	294	209	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	293	257	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	273	163	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	285	186	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	275	168	
Rediversion Canal	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	262	155	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	281	202	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	246	113	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	295	199	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	261	129	

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	276	191	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	292	205	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	290	196	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	287	204	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	290	191	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	283	238	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	289	236	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	293	260	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	256	135	
Rediversion Canal	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	265	170	
Rediversion Canal	Electrofishing	18-Apr-02	Blueback herring	Alosa aestivalis	82	9	
Rediversion Canal	Electrofishing	18-Apr-02	Blueback herring	Alosa aestivalis	85	5	
Rediversion Canal	Electrofishing	18-Apr-02	Blueback herring	Alosa aestivalis	83	7	
Rediversion Canal	Electrofishing	18-Apr-02	Blueback herring	Alosa aestivalis	85	6	
Rediversion Canal	Electrofishing	18-Apr-02	Blueback herring	Alosa aestivalis	79	4	
Rediversion Canal	Herring Net	23-Apr-02	Blueback herring	Alosa aestivalis	295	216	
Rediversion Canal	Herring Net	23-Apr-02	Blueback herring	Alosa aestivalis	284	166	
Rediversion Canal	Herring Net	23-Apr-02	Blueback herring	Alosa aestivalis	282	200	
Rediversion Canal	Electrofishing	25-Apr-02	Blueback herring	Alosa aestivalis	99	6	
Rediversion Canal	Shad Net	30-Apr-02	American shad	Alosa sapidissima	562	1900	Female
Rediversion Canal	Herring Net	30-Apr-02	Blueback herring	Alosa aestivalis	291	221	
Rediversion Canal	Herring Net	30-Apr-02	Striped bass	Morone saxatilis	226	116	
Rediversion Canal	Herring Net	30-Apr-02	Striped bass	Morone saxatilis	413	720	
Rediversion Canal	Electrofishing	2-May-02	Blueback herring	Alosa aestivalis	273	102	
Rediversion Canal	Electrofishing	2-May-02	Striped bass	Morone saxatilis	556	1947	
Rt. 52 Bridge	Herring Net	13-Mar-02	Blueback herring	Alosa aestivalis	398	504	
Rt. 52 Bridge	Electrofishing	15-Mar-02	Blueback herring	Alosa aestivalis	281	224	
Rt. 52 Bridge	Herring Net	20-Mar-02	American shad	Alosa sapidissima	456	1079	Male
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	299	253	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	280	198	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	295	272	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	294	300	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	287	248	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	279	203	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	271	182	

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	291	261	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	273	199	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	282	223	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	280	187	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	304	327	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	283	210	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	285	234	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	280	200	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	279	228	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	266	201	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	273	199	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	285	231	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	289	243	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	280	218	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	270	192	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	275	217	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	289	233	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	272	212	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	265	180	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	282	256	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	286	262	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	274	191	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	271	223	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	270	198	
Rt. 52 Bridge	Herring Net	20-Mar-02	Blueback herring	Alosa aestivalis	291	225	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	265	171	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	283	220	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	286	199	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	260	152	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	270	178	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	267	182	
Rt. 52 Bridge	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	277	180	
Rt. 52 Bridge	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	486	929	Male
Rt. 52 Bridge	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	453	813	Male
Rt. 52 Bridge	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	456	969	Male

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	566	2203	Female
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	482	1038	Male
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	430	835	Male
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	504	1225	Male
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	480	1051	Male
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	437	695	Male
Rt. 52 Bridge	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	461	770	Male
Rt. 52 Bridge	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	484	759	Male
Rt. 52 Bridge	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	473	935	Male
Rt. 52 Bridge	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	456	790	Male
Rt. 52 Bridge	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	285	203	
Rt. 52 Bridge	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	80	4	
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	503	777	Male
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	488	816	Male
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	523	1194	Male
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	486	809	Male
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	433	598	Male
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	417	591	Male
Rt. 52 Bridge	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	432	524	Male
Rt. 52 Bridge	Electrofishing	1-May-02	American shad	Alosa sapidissima	382	352	Male
Rt. 52 Bridge	Electrofishing	1-May-02	American shad	Alosa sapidissima	404	428	Male
Rt. 52 Bridge	Electrofishing	1-May-02	American shad	Alosa sapidissima	450	644	Male
Rt. 52 Bridge	Electrofishing	1-May-02	American shad	Alosa sapidissima	463	810	Male
Rt. 52 Bridge	Electrofishing	1-May-02	American shad	Alosa sapidissima	471	652	Male
Rt. 52 Bridge	Electrofishing	1-May-02	American shad	Alosa sapidissima	472	1013	Male
Wilson's Landing	Electrofishing	15-Mar-02	American shad	Alosa sapidissima	461	941	Male
Wilson's Landing	Electrofishing	15-Mar-02	American shad	Alosa sapidissima	447	882	
Wilson's Landing	Electrofishing	15-Mar-02	American shad	Alosa sapidissima	543	1419	
Wilson's Landing	Electrofishing	15-Mar-02	American shad	Alosa sapidissima	446	909	
Wilson's Landing	Electrofishing	15-Mar-02	American shad	Alosa sapidissima	463	1160	
Wilson's Landing	Electrofishing	15-Mar-02	Blueback herring	Alosa aestivalis	95	7	
Wilson's Landing	Electrofishing	15-Mar-02	Blueback herring	Alosa aestivalis	116	14	
Wilson's Landing	Electrofishing	20-Mar-02	American shad	Alosa sapidissima	469	1059	Male
Wilson's Landing	Electrofishing	20-Mar-02	American shad	Alosa sapidissima	499	1173	Male
Wilson's Landing	Electrofishing	20-Mar-02	American shad	Alosa sapidissima	469	970	Male

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Wilson's Landing	Electrofishing	20-Mar-02	American shad	Alosa sapidissima	442	860	Male
Wilson's Landing	Electrofishing	20-Mar-02	American shad	Alosa sapidissima	387	658	Male
Wilson's Landing	Electrofishing	20-Mar-02	Blueback herring	Alosa aestivalis	80	4	
Wilson's Landing	Electrofishing	20-Mar-02	Blueback herring	Alosa aestivalis	78	3	
Wilson's Landing	Electrofishing	20-Mar-02	Striped bass	Morone saxatilis	471	1451	
Wilson's Landing	Herring Net	27-Mar-02	Blueback herring	Alosa aestivalis	286	221	
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	545	1791	Female
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	553	2100	Female
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	450	1017	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	467	1066	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	495	1222	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	439	1046	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	487	1158	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	463	921	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	480	1127	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	456	966	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	424	716	Male
Wilson's Landing	Electrofishing	28-Mar-02	American shad	Alosa sapidissima	410	733	Male
Wilson's Landing	Electrofishing	28-Mar-02	Blueback herring	Alosa aestivalis	289	251	
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	555	1799	Female
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	463	1018	Male
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	445	774	Male
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	458	891	Male
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	435	899	Male
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	459	1010	Male
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	445	924	Male
Wilson's Landing	Electrofishing	2-Apr-02	American shad	Alosa sapidissima	424	451	Male
Wilson's Landing	Electrofishing	2-Apr-02	Blueback herring	Alosa aestivalis	81	5	
Wilson's Landing	Electrofishing	2-Apr-02	Blueback herring	Alosa aestivalis	86	5	
Wilson's Landing	Electrofishing	2-Apr-02	Blueback herring	Alosa aestivalis	80	4	
Wilson's Landing	Electrofishing	2-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	2-Apr-02	Blueback herring	Alosa aestivalis	85	4	
Wilson's Landing	Shad Net	4-Apr-02	American shad	Alosa sapidissima	512	1679	Female
Wilson's Landing	Shad Net	4-Apr-02	American shad	Alosa sapidissima	559	1812	Female
Wilson's Landing	Shad Net	4-Apr-02	American shad	Alosa sapidissima	527	1650	Female

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Wilson's Landing	Shad Net	4-Apr-02	American shad	Alosa sapidissima	548	1805	Female
Wilson's Landing	Shad Net	4-Apr-02	American shad	Alosa sapidissima	546	2326	Female
Wilson's Landing	Shad Net	4-Apr-02	American shad	Alosa sapidissima	506	1431	Male
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	285	245	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	361	432	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	300	261	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	292	268	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	264	185	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	285	193	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	277	197	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	266	177	
Wilson's Landing	Herring Net	4-Apr-02	Blueback herring	Alosa aestivalis	263	173	
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	499	1495	Female
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	417	717	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	455	892	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	436	797	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	459	851	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	392	570	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	416	602	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	455	974	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	483	1035	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	416	770	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	453	890	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	391	600	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	435	738	Male
Wilson's Landing	Electrofishing	9-Apr-02	American shad	Alosa sapidissima	481	1037	Male
Wilson's Landing	Electrofishing	9-Apr-02	Blueback herring	Alosa aestivalis	92	6	
Wilson's Landing	Electrofishing	9-Apr-02	Blueback herring	Alosa aestivalis	87	5	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	281	204	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	286	240	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	301	306	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	298	259	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	298	279	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	299	296	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	275	186	

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	282	221	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	294	250	
Wilson's Landing	Herring Net	11-Apr-02	Blueback herring	Alosa aestivalis	291	234	
Wilson's Landing	Shad Net	16-Apr-02	American shad	Alosa sapidissima	543	1938	Female
Wilson's Landing	Shad Net	16-Apr-02	American shad	Alosa sapidissima	550	1822	Male
Wilson's Landing	Herring Net	16-Apr-02	Blueback herring	Alosa aestivalis	280	168	
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	492	969	Female
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	446	494	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	490	1068	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	452	864	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	448	730	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	464	1037	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	437	757	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	466	619	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	451	770	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	411	657	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	500	1181	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	434	709	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	452	845	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	412	597	Male
Wilson's Landing	Electrofishing	17-Apr-02	American shad	Alosa sapidissima	434	741	Male
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	80	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	76	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	109	10	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	84	3	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	78	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	81	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	77	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	82	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	81	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	77	3	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	80	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	83	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	78	3	

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	80	3	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	83	4	
Wilson's Landing	Electrofishing	17-Apr-02	Blueback herring	Alosa aestivalis	86	4	
Wilson's Landing	Herring Net	23-Apr-02	American shad	Alosa sapidissima	450	720	Male
Wilson's Landing	Herring Net	23-Apr-02	American shad	Alosa sapidissima	429	661	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	525	1435	Female
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	520	1073	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	436	737	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	450	679	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	450	710	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	445	733	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	434	658	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	430	722	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	445	670	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	454	916	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	443	670	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	420	594	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	429	688	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	427	670	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	428	623	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	432	656	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	408	592	Male
Wilson's Landing	Electrofishing	24-Apr-02	American shad	Alosa sapidissima	420	611	Male
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	85	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	87	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	85	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	90	6	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	83	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	83	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	83	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	83	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	83	5	

Appendix C, Cont.

Station	Gear	Date	Common Name	Scientific Name	Length	Weight	Gender
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	80	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	80	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	85	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	80	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	83	4	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	87	6	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	85	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	84	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	89	6	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	79	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	88	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	82	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	86	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	86	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	80	4	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	91	6	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	85	5	
Wilson's Landing	Electrofishing	24-Apr-02	Blueback herring	Alosa aestivalis	84	5	
Wilson's Landing	Herring Net	30-Apr-02	Blueback herring	Alosa aestivalis	216	214	
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	463	995	Female
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	428	583	Male
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	501	848	Male
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	485	887	Male
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	423	554	Male
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	484	847	Male
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	477	869	Male
Wilson's Landing	Electrofishing	1-May-02	American shad	Alosa sapidissima	382	613	
Wilson's Landing	Electrofishing	1-May-02	Blueback herring	Alosa aestivalis	121	12	
Wilson's Landing	Electrofishing	1-May-02	Blueback herring	Alosa aestivalis	83	5	
Wilson's Landing	Electrofishing	1-May-02	Blueback herring	Alosa aestivalis	84	4	
Wilson's Landing	Electrofishing	1-May-02	Blueback herring	Alosa aestivalis	79	4	