ovember 1991 Project No. 90-11

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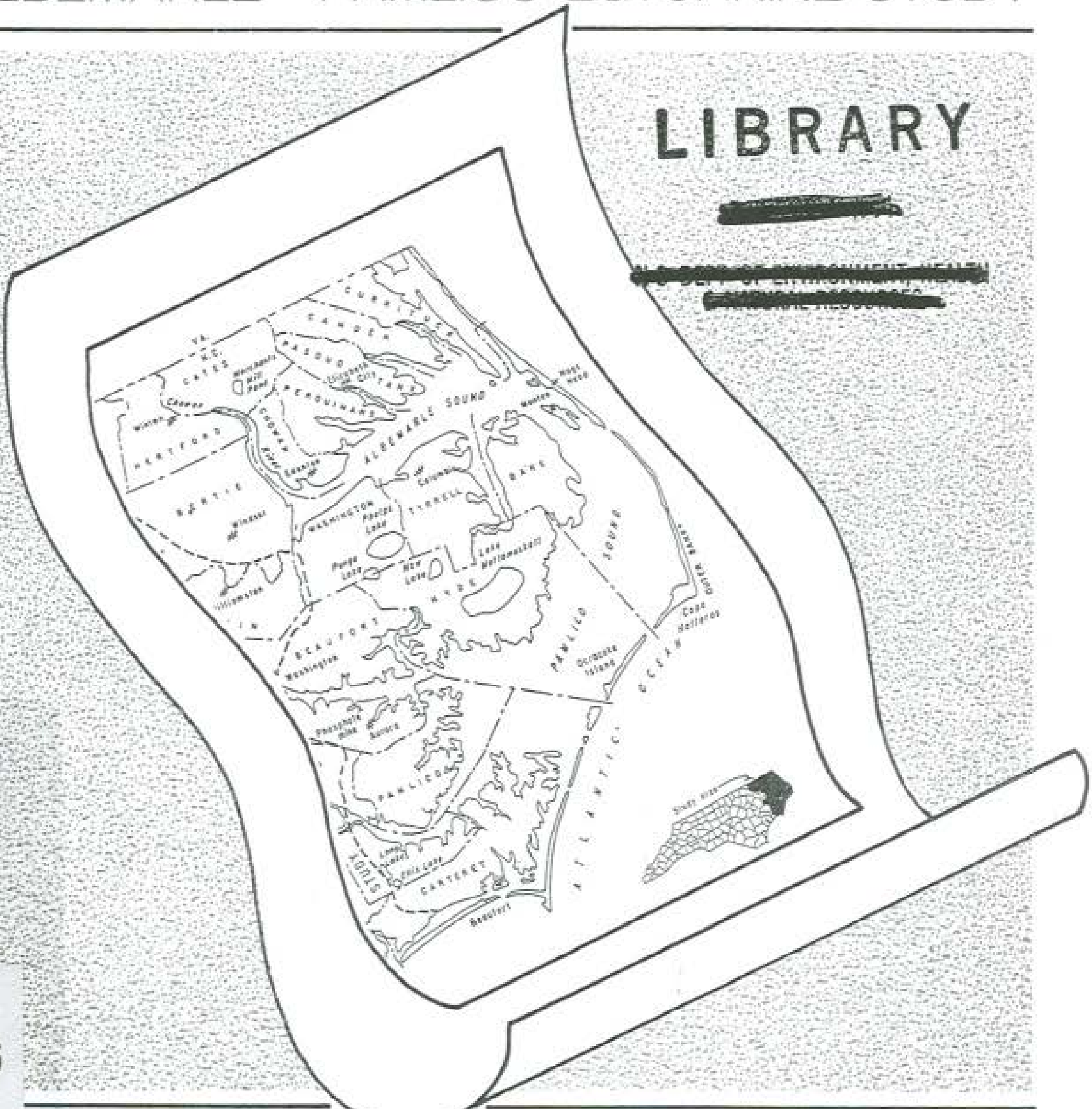
## ALBEMARLE - PAMLICO ESTUARINE STUDY








Funding Provided By
North Carolina Department of Natural Resources and Community Development
Environmental Protection Agency National Estuary Program

ALBEMARLE-PAMLICO

# ABUNDANCE AND VIABILITY OF STRIPED BASS EGGS SPAWNED IN ROANOKE RIVER, NORTH CAROLINA, IN 1989

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The research on which the report is based was financed by the United States Environmental Protection Agency and the North Carolina Department of Environment, Health, and Natural Resources, through the Albemarle-Pamlico Study.



Project No. APES 90-11

November 1990

**Acknowledgments**

This project could not have been accomplished without the dedicated field efforts of Stuart T. Laws and Mark Bowers. My thanks go to Mr. Paul Hale, Sr., for use of Barnhill's Landing throughout the field season. Also, we appreciate the assistance of North Carolina Wildlife Resources Commission personnel for help with logistics and moral support, especially Tony Mullis, Bob Curry, and others who assisted at the Weldon Hatchery during spawning season. Dr. Charles S. Manooch, III of the National Marine Fisheries Service, Beaufort Laboratory, also provided assistance and support at critical times, and his efforts were much appreciated. Marsha E. Shepherd of East Carolina University's Academic Computing Center was instrumental in the computer analyses. Kay Evans and Mark Hollingsworth typed the manuscript, and John E. Cooper drew the figures. The study was funded by the Albemarle-Pamlico Estuarine Study, which is a cooperative state-federal initiative of the North Carolina Department of Health, Environment, and Natural Resources, and the U.S. Environmental Protection Agency.

## Executive Summary

Sampling to estimate production and viability of striped bass eggs was conducted at Barnhill's Landing on the Roanoke River, North Carolina, from 15 April to 15 June 1989. Samples were taken by trailing paired nets at the surface from a small boat for five minutes every four hours for 60 days in the manner established and used by W.W. Hassler since 1959. A total of 4,722 eggs was collected in surface nets: first eggs appeared in samples on 16 April and continued sporadically until 9 June, when the last eggs were collected. Estimated striped bass egg production in the Roanoke River for 1989 was 637,919,162 (S.D. = 27,668,383) eggs. A potential major spawning activity at the end of April was terminated by high and prolonged reservoir discharge, which forestalled peak spawning until the last week in May. Three major spawning peaks were observed: 23-24 May, 26-27 May, and 31 May - 1 June. Seasonal egg production was 50% complete by 26 May, 80% complete by 29 May, and 99% complete by 2 June. Egg viability was estimated as 41.8%, the seventh lowest on record. Major egg deposition ensued when water temperatures reached 18°C. The majority of eggs (76.7%) were less than 10 hours old; an additional 18.5% were between 20 and 28 hours old, and less than five percent were 10 to 18 hours old. Approximately 89% of all eggs was collected at water temperatures between 18 and 21.9°C. Over half of the eggs were collected at water velocities ranging from 100 to 119.9 cm/second; an additional 22% were collected at 60-79.9 cm/second. An inverse relationship between egg viability and water velocity was evident. Less than one percent of all eggs were collected in waters of dissolved oxygen values less than 7.0 mg/L, and 90% of the eggs were in waters with pH values of 7.5 or higher. There was no significant difference in egg catches between surface and oblique collections. Results of this study and others conducted in 1981-1983, and 1988 clearly indicate that reservoir discharge from Roanoke Rapids dam influences striped bass spawning activity in the lower Roanoke River.

## Table of Contents

Page

## List of Figures

## List of Tables

Page

## Introduction

Striped bass (*Morone saxatilis*) inhabiting Albemarle Sound and its tributaries support important recreational and commercial fisheries in coastal North Carolina (Johnson et al. 1986; USDOI and USDOC 1986). The major spawning area for Albemarle Sound striped bass is located in the Roanoke River, which discharges into the western end of Albemarle Sound through several channels. Since the mid-1970s, these fisheries have suffered due to reduced numbers of harvestable adults. Population decline may be caused by a number of factors such as reduced egg viability (Hassler et al. 1981), poor food availability for larvae (Rulifson et al. 1986), and poor survival of juveniles on the nursery grounds of the western Sound.

Studies on egg abundance and viability have been conducted each year since the mid-1950s by Dr. W.W. Hassler and co-workers from North Carolina State University in Raleigh. The information gathered by these researchers spans nearly 30 years of complete records and is well-known as the best data base on striped bass spawning activity in North America. These daily records have been an extremely important source of information for reconstructing the historical spawning record in relation to exploitation, changes in fishing regulations, and man-induced changes in the flow regimen and water quality of the Roanoke River watershed. The retirement of Dr. Hassler in 1987 from actively pursuing his studies would have ended this valuable data base; however, funds provided by the Albemarle-Pamlico Estuarine Study (APES) to East Carolina University in the spring of 1988 allowed continuation of the study. This manuscript follows information obtained during the 1988 spawning season (Rulifson 1989), and summarizes the information obtained during the 1989 striped bass spawning season.

The manner in which water is released from dams on this watershed, and the subsequent physiological and behavioral effects on spawning striped bass, have been scrutinized closely at various times since construction of John H. Kerr Reservoir in 1952. This concern was one of the reasons for forming a Steering Committee for Roanoke River Studies in 1955. The Committee was composed of State, Federal, and private agencies and interests whose objective was to conduct a comprehensive study of the river in order to minimize multiple use conflicts (Hassler and Taylor 1986). The findings of the Committee were discussed in detail by Fish (1959). The cooperative Roanoke-Albemarle Striped Bass Studies were initiated in 1955 as part of the Steering Committee studies. Original support for these efforts was provided by the National Council for Stream Improvement, Weyerhaeuser Company, and Albemarle Paper Manufacturing Company. Weyerhaeuser Company continued their support of the studies after 1958 when the Steering Committee studies were terminated; cooperative field work was resumed in 1975 with the U.S. Fish and Wildlife Service and North Carolina Division of Marine Fisheries under the auspices of the Anadromous Fish Conservation Act (PL 89-304).

In the mid-1980s, water quality and watershed management of the lower Roanoke River basin were again key issues for several reasons: the initiation of the Albemarle-Pamlico Estuarine Study; the lawsuit between the State of North Carolina and the U.S. Army Corps of Engineers (COE) concerning the interbasin transfer of water for municipal use; the effort by the Federal government to establish a national wildlife refuge within the floodplain of the lower Roanoke River; and the continued decline of the Roanoke/Albemarle striped bass stock. These events all had the common concern of how the flow regime is managed by the system of reservoirs located in the Piedmont region of the watershed, especially during the spring season.

In 1988, an *ad hoc* group was formed to investigate the modification of Roanoke River instream flow below Roanoke Rapids Dam for striped bass and other downstream resources. The Roanoke River Water Flow Committee was comprised of 20 representatives of State, Federal, and university professionals. The purpose of the Committee was to gather information on all resources of the lower watershed and recommend a flow regime that was beneficial to downstream resources and their users. Striped bass as a resource received the most attention because of its great social and economic importance to this region, and because of the extensive data base established by Dr. Hassler. Detailed descriptions of the Flow Committee findings were presented by Manooch and Rulifson (1989) and Rulifson and Manooch (1990).

At the present time, the manner in which waters are released from Roanoke Rapids Dam is governed by a tri-party agreement involving the COE, Virginia Power, and the North Carolina Wildlife Resources Commission (NCWRC). Provisions for minimum flows from the reservoir were established by the Memorandum of Understanding signed in 1971, but no guidelines were given for maximum flows or for the manner in which the average daily discharge is derived. For example, under present guidelines the dam operator can double or cut in half the rate of discharge through the turbines every two hours to optimize on-demand hydropower generation. A discharge of 5,000 cfs (cubic feet per second) can increase to 10,000 cfs within two hours, and then to 20,000 cfs within three hours. These sudden changes in the flow regime result in dramatic changes in water depth on the spawning grounds within a several-hour period. Although these sudden and dramatic changes in flow are well-known, no studies have been conducted to determine how spawning is affected by this fluctuation in water level.

The study described herein was undertaken with several objectives in mind: 1) to continue the data base established by Dr. Hassler; 2) to develop a method to backcalculate Hassler's data in an egg density-per-unit-volume format (to compensate for radical changes in the flow regime); and 3) to correlate the intensity of striped bass spawning (as measured by egg production) with water releases from the reservoir at Roanoke Rapids, North Carolina. Only objectives 1 and 3 are addressed in this report. Objective 2 will require an additional year of study to ascertain the relationships among the physical parameters of volume, water velocity, river stage, and rate of net filtration.

### Study Site Description

The Roanoke River is a major coastal floodplain river originating on the eastern slopes of the Appalachian Ridge in Virginia and discharging into the western end of Albemarle Sound in North Carolina (Figure 1, Appendix Table A-1). The watershed encompasses 9,666 square miles (25,033 $km^2$), making it the largest basin of any North Carolina estuary (Giese et al. 1979). Waters descend 2,900 feet from the origin to the estuary, a distance of 410 miles.

Flow of the Roanoke River is highly regulated by a number of reservoirs upstream: in Virginia, Smith Mountain Lake, Philpott Lake, Leesville Lake, John H. Kerr Reservoir, and Lake Gaston; and Kerr Reservoir, Lake Gaston and Roanoke Rapids Lake in North Carolina. Operation of the Roanoke Rapids hydroelectric facility located at River Mile (RM) 137 exerts direct influence on instream flow of the lower river; approximately 87% of the flow to the coastal watershed is provided by its discharge (Giese et al. 1979). Average annual discharge of the river at Roanoke Rapids, NC (USGS gage No. 02080500), is about 8,500 cfs. The watershed itself contributes approximately 50% of the freshwater input to Albemarle Sound.

The primary spawning ground for Albemarle striped bass is located in the Roanoke River between Halifax (RM 120) and Weldon (RM 130), North Carolina. The historical spawning grounds farther upstream were blocked by completion of the Roanoke Rapids Dam (RM 137) in 1955 (McCoy 1959). Spawning activity begins in April and is completed by mid-June (Hassler et al. 1981). Once spawned, the fertilized eggs develop to the hatching stage as they are transported downstream by currents. After hatching, the larvae are transported through the distributaries of the delta into the historical nursery grounds of western Albemarle Sound (Rulifson et al. 1988).

## Methods

The field station in 1989 was located at Barnhill's Landing (RM 117), the site of Hassler's sampling efforts during the period from 1975 to 1981. This area is located (Appendix Table A-2) approximately three miles downstream of Halifax and about 12 river miles upstream of the Pollock's Ferry site used in the 1988 study (Figure 2). Initial water quality data were taken on 17 March, 23 March, 29 March, and 14 April 1989. Preliminary egg samples were taken on 6 April and 12 April. The actual study was initiated on 15 April and was terminated on 15 June 1989.

Procedures for field sampling and sample workup were identical to those used by Dr. Hassler to ensure compatibility of the data sets. The tables and figures presented herein are similar to Hassler's for purposes of comparison.

Striped bass eggs were collected in the same manner as that described by Dr. Hassler's annual reports (Hassler and others, 1961-1986) and as that used in the 1988 study (Rulifson 1989). Samples were taken six times daily at four-hour intervals (0200, 0600, 1000, 1400, 1800, and 2200 hours) by trailing paired 10-inch diameter nets constructed of 500-μm nitex mesh (6:1 tail-to-mouth ratio) from a small aluminum boat anchored in mid-stream. A solid cup attached to the tail of each net was used to retain collected eggs. Two collections of five-minute duration were made: the first collection six inches below the surface (Hassler's method), and the second collection in an oblique manner from the bottom to the surface. This procedure allowed comparisons of egg density at the surface with the abundance of eggs throughout the water column. A flowmeter with slow speed propeller was attached to the bongo frame so that the theoretical volume of water filtered could be estimated. This methodology produced two estimates of egg production: 1) an estimate of egg density per unit of water filtered; and 2) an estimate of total eggs in the cross-sectional area of the river (Hassler's method). The cross-sectional area of the river at the sampling site was determined for the range of water levels encountered during the study. River stage, air and water temperature, dissolved oxygen, conductivity, pH, total dissolved solids, and surface water velocity were recorded for each sample. Secchi visibility depth was recorded for all samples taken during daylight hours.

Samples were returned to the field station for immediate examination. Eggs collected by both nets were enumerated and averaged for each surface tow and each oblique tow. For each sample, all eggs were examined to determine viability and stage of development. Egg viability was determined as described by Hassler et al. (1981): each was examined to determine the status of the embryo, yolk and oil globules, and perivitelline space. Eggs were staged under a dissecting microscope using the criteria established by Bonn et al. (1976). Stage 1 included eggs less than 10 hours old. Stage 2 eggs were those 10 to 18 hours old. Stage 3 eggs were 20 to 28 hours old, and Stage 4 eggs were 30 to 38 hours old. Stage 5 were eggs 40 hours and older, and newly-hatched larvae. Stage of development was based on an assumed water temperature of 17°C; eggs spawned at water temperatures greater than this value will develop faster and hatch earlier (Hassler et al. 1981).

Data were entered into the mainframe computer at East Carolina University and analyzed using the Statistical Analysis System (SAS 1985). The estimated number of striped bass eggs passing the sampling station was calculated on a daily basis using the equation developed by Hassler:

$$N = 514.29\,XY,$$

where N = the estimated number of striped bass eggs spawned during the 24-hour period; X = the mean number of striped bass eggs collected per surface sample during the 24-hour period (12 samples maximum); and Y = the cross-sectional area of the river in square feet for mean river stage during the 24-hour period. The constant 514.29 was derived from the number of five-minute intervals in a 24-hour period (288) multiplied by the relationship of 1.0 square feet of river area to the mouth opening of the 10-inch diameter egg net (0.56 square feet, equaling a ratio of 1:1.785714). Only surface samples were used in the daily egg production estimates so that data were comparable to Hassler's database.

Statistical analysis of the egg count data was performed using the SAS UNIVARIATE procedure to determine distribution of the data. Normal probability plots indicated that transformation of the count data was required; natural log transformation reduced skewness and kurtosis better than square root transformation.

## Results

Approximately 95% of the scheduled sampling trips were completed in 1989 (Appendix Table A-3). The remaining trips were incomplete or were not attempted due to unfavorable weather and equipment failure.

### *Egg Production and Viability*

The estimated number of striped bass eggs produced in 1989 was 637,919,162 (n=61, S.D. 27,668,383) from a total of 4,722 eggs collected in surface nets. Initial samples were taken on 6 April and 12 April, but no eggs were observed in the nets. Eggs were first collected in surface nets at Barnhill's Landing on 16 April 1989 (Table 1). Whether spawning was initiated prior to this date is uncertain. Eggs were not observed again in surface nets until 28 April. Eggs were present in nets on a daily basis through 2 May, after which spawning activity nearly ceased. This near cessation of spawning activity by adult striped bass coincided with a sudden increase in reservoir discharge due to flooding conditions upstream. More information on this aspect will be presented later. After 17 May, spawning activity was continuous until 9 June, the last day in which eggs were collected in surface nets, for a continuous spawning window of 23 days. During this period, three major spawning peaks were observed: 23-24 May, 26-27 May, and 31 May - 1 June (Figure 3). Seasonal egg production was approximately 50% complete by 26 May, 80% complete by 29 May, and 99% complete by 2 June (Table 1, Figure 4). Sampling efforts were terminated on 15 June 1989.

Viability of striped bass eggs for 1989 was estimated at 41.8%, which was the seventh lowest estimate on record (Table 2). No seasonal change in egg viability was evident (Table 3, Figure 5); however, river stage had a small but significant role. Several statistical procedures were utilized in determining the relationship between viability and environmental parameters. Striped bass eggs were collected at the surface during 110 trips. Egg viability data from these trips were found to be normally distributed (Kolmogorov-D statistic = 0.077; P=0.106) using the UNIVARIATE procedure (SAS 1985). A correlation analysis was performed on all environmental variables to determine which variables were significantly related (alpha=0.05) and perhaps multicollinear. From results of the correlation analysis, nine variables were used in a stepwise regression procedure: PAGE (record indicating trip number); ATEMP (air temperature); WTEMP (water temperature); pH; DO (dissolved oxygen); COND (conductivity); TDS (total dissolved solids); WVEL (surface water velocity); and RSTAGE (river stage). Variables were entered into the model if the F statistic met a 0.15 level of significance. The best model was

$$SURFVIA = 59.6259 - 1.4797(RSTAGE)$$

(df=97, F=19.29, P<0.0001, $r^2$=0.17, Mallow's statistic=3.62). The addition of PAGE (a sequential time factor) resulted in $R^2$=0.19 (Mallow's statistic=2.46), but PAGE itself was not significant in the model (F=3.18, P=0.078). These results indicate that river stage had a small but significant role in influencing striped bass egg viability just downstream of the spawning grounds in 1989.

River stage is directly related to reservoir discharge, which also affects other environmental variables. River stage was highly correlated with surface water velocity (n=339, r=0.85, P<0.0001), a relationship not surprising as the volume of water increases in the river with increased reservoir discharge. Water temperature was inversely related to both surface water velocity (n=344, r=-0.38, P<0.0001) and river stage (n=347, r=-0.35, P<0.0001); i.e., discharge of cool reservoir waters reduced the ambient river temperature. The relationship between water temperature and air temperature was not as strong (n=359, r=0.64, P<0.0001) as might be expected if air temperature alone was the sole influence on ambient river temperature.

A total of 4,237 eggs was examined throughout the season to determine stage of development. The majority of the eggs (76.7%, or 3,248 eggs) was less than 10 hours old. An additional 18.5% (785) of the eggs were between 20 and 28 hours old; less than five percent (201 eggs) were 10 to 18 hours old, and only three eggs were over 30 hours old. No post-hatch striped bass larvae were encountered in samples.

Water temperatures ranged from 13.0 to 24.5°C throughout the study; spawning was initiated when water temperatures reached 18°C (Figure 6). Spawning ceased in early May coinciding with a large water release from Roanoke Rapids Reservoir and a drop in water temperature below 18°C. Entry of a cold front at this time (Figure 7) resulted in continual rain (Figure 8) and runoff into the watershed. Spawning resumed in late May after a period of high but stable instream flow and a gradual rise in water temperature to 18°C. The correlation coefficient for the water temperature-air temperature relationship was 0.64 (n=359; P=0.0001). An inverse relationship of water temperature and river stage was evident (r= -0.352; n=347; P=0.0001). Data indicated that river waters heated more quickly under low flow conditions and were cooler under high flows from the release of cooler reservoir waters. Most eggs (89%) were collected at water temperatures ranging between 18 and 21.9°C (Table 4). Only three percent of the eggs were collected at temperatures less than 18°C, a result of adults still in the act of spawning at the time of the high volume water release from the reservoir in early May. An additional eight percent were collected at temperatures ranging from 22.0 to 23.9°C. No trend in viability as a function of water temperature was observed (Table 4).

Surface water velocities ranged from a low of 39 cm/second during low flow on 4 June to a high of 137 cm/second recorded on 21 May 1989 (Figure 9). Although eggs were present in nets over the range of velocities encountered during the study, over half were collected at surface water velocities between 100 and 119.9 cm/second (Table 5). An additional 22% were collected at water velocities from 60 to 79.9 cm/second. An inverse relationship between egg viability and water velocity was evident. Nearly five percent of all eggs were collected at water velocities of 120 cm/second or higher; the average viability was only 24% (Table 5). Greatest average viability (52%) was noted at lowest water velocities. A high positive correlation (r=0.854; n=339; P=0.0001) between water velocity and river stage at Barnhill's Landing was evident.

The high variability in surface water velocity can be attributed in part to the water release schedule at Roanoke Rapids Dam. Heavy spring rains in 1989 resulted in high flows during March; on-demand hydropower generation was evident from the USGS hourly flow records at Roanoke Rapids (Figure 10). Beginning 1 April, the COE implemented the Negotiated Flow Regime recommended by the Roanoke River Water Flow Committee (Manooch and Rulifson 1989, Rulifson and Manooch 1990). The schedule provided a step-down flow range from 1 April to 15 June which was designed to more closely represent the historical river flow prior to impoundment (Kerr Reservoir construction was started in 1950). The Corps of Engineers was forced to deviate from the Negotiated Flow Regime because of greater than normal rainfall and heavy inflow to Kerr Reservoir during the periods of 10-14 April and 2-29 May (20,000 cfs operation), and 1-2 June and 11-15 June (15,000 cfs operation).

In general, secchi disk visibility (Figure 11) and total dissolved solids (Figure 12) did not fluctuate greatly during the study. However, several points can be made about secchi disk visibility data. A substantial decrease in visibility was noted for the last days in April and beginning of May. This decrease coincided with heavy rainfall events (Figure 8) in the local area below the reservoir, and resulted in increased input of sediment-laden waters into the Roanoke River (which at the time was experiencing flows of 5,000 to 6,000 cfs, Figure 10). Several days later when water release was increased from Roanoke Rapids Reservoir in response to heavy inflow upstream, waters flowing past Barnhill's Landing actually increased in surface visibility as the river stage changed a dramatic 15 feet (Figure 13). A similar drop in water clarity occurred in early June, when river flow was about 4,000 cfs (Figure 11).

Conductivity of Roanoke River waters flowing past Barnhill's Landing was low throughout the study, usually varying between 70 and 100 µS (Figure 14). However, a dip in conductivity readings to 40 µS was evident at the end of April during the low flow period just prior to the major water release event from Roanoke Rapids Reservoir.

Patterns of egg distribution in samples compared to sampling time reflected the time of travel downstream from the spawning grounds. For the entire spawning season, egg collection was lowest at 1400 and 1800 hours. At 2200 hours, the number of eggs in nets increased with peak occurrence at 0600 and 1000 hours (Table 6). In 1989 some spawning was observed at Barnhill's Landing on several occasions. However, most recreational fishing activity was concentrated between Halifax and Weldon during the period of peak spawning activity. Predicting the actual site of major spawning activity is difficult. Over 75% of the eggs were less than 10 hours old (based on development at 17°C) and caught in surface water velocities of 100-120 cm/second. Assuming an average water velocity of 100 cm/second (3.28 ft./second), major spawning activity could have occurred anywhere between 2 and 20 river miles (at the dam) upstream of Barnhill's Landing.

Levels of dissolved oxygen in Roanoke River waters remained above 7.0 mg/L throughout the study, but a general decrease was evident between April and June (Figure 15). Less than one percent of striped bass eggs were collected in waters containing dissolved oxygen levels less than 7.0 or greater than 8.9 mg/L (Table 7).

Acidity of the waters passing Barnhill's Landing ranged from 6.5 to 8.8 but remained above 7.0 throughout much of the study (Figure 16). A noticeable drop in pH was recorded late April and early May concurrent with low flows of the Roanoke River and high inflow from locally heavy rainfall. Approximately 90% of striped bass eggs were collected in waters with pH values of 7.50 or greater (Table 8). Greatest viability was observed at pH values ranging from 6.75 to 7.24; the total numbers of eggs collected in this range are too few to determine statistical significance of the trend.

*Vertical Heterogeneity*

During each sampling trip, paired-net egg samples were taken both at the surface and in an oblique manner for five-minute periods so that potential bias in the vertical distribution of eggs could be quantified. Egg production for each trip was calculated by using the ratio of the opening of the egg net to the estimated cross-sectional area of the river multiplied by the average number of eggs caught in either the surface nets or in the oblique nets during the five-minute tow.

A total of 9,829 eggs was collected in all nets. Surface net A collected 2,336 eggs (n= 344; mean = 6.81; S.D. = 23.57) and surface net B collected 2,553 eggs (n = 344; mean = 6.96; S.D. = 22.17). An analysis of variance of the paired net count (raw) data revealed that the surface egg data were skewed and not normally distributed. A signed rank test on natural log transformed data showed that the difference of egg counts between surface nets was significantly different from zero (n=344, P=0.029); i.e., surface net B was consistent in catching more eggs than surface net A even though the total **seasonal** difference between nets was only 217 eggs.

A similar comparison of oblique net egg collections indicated no significant difference in egg counts between paired nets. A total of 2,297 eggs (n = 339; mean = 6.80; S.D. = 20.66) was collected in oblique net A, and 2,810 eggs (n = 339; mean = 8.13; S.D. = 30.91) in oblique net B. Again, analysis indicated that the data were skewed and not normally distributed. The data were transformed using the natural log, and a signed rank test revealed that differences in catch between the two nets were not significantly different from zero (n=339, P=0.479).

In 1989 egg collections in surface nets and oblique nets were not significantly different. A natural log transformation on average surface net data and average oblique net data showed that differences between egg counts with depth were not significantly different from zero (n=339, P=0.082).

A comparison of egg viability estimates between surface net samples and oblique net samples indicated no significant difference in egg viability with depth (n=92, P=0.864).

Egg production estimates on a per trip basis were calculated for surface samples, oblique samples, and all samples combined. When spawning activity was low, differences in egg production estimated as a function of depth appeared large (Table 9). For example, on 3 May 1989 no eggs were collected in surface nets and therefore no egg production was estimated for that day using Hassler's method. However, egg production estimated from oblique samples for the same day resulted in a total of 20,225 for the six trips, or 1,003,728 eggs for the 24-hour period (Table 10). When spawning activity intensified later in the season, these differences in estimates were relatively smaller and not significantly different statistically.

The two methods of calculating daily egg production (Table 10) -- the Hassler method and the Trip method -- were compared statistically for surface samples, oblique samples, and all samples combined. For surface samples, Hassler's method yielded a 1989 egg production estimate of 637,919,161 (S.D. 27,078,836), and the Trip method estimated a seasonal total of 637,110,340 (S.D. 27,668,383). Analysis (sign rank test) on natural log transformed data indicated no significant difference (n=61, P=0.690) in the two methods. For oblique samples, the Hassler method estimated a total egg production of 720,331,787 (S.D. 31,057,829), while the Trip method estimated 720,161,682 (S.D. 31,057,571), again not statistically different (n=61, P=0.604, log transformed data). Using all data collected by both surface and oblique nets, egg production estimates by the two methods were not significantly different (n=61, P=0.580, log transformed data).

## Discussion

### *Water Temperature, River Flow, and Spawning*

The tendency for a fish species to be successful and thrive is ultimately determined by the ability of the individuals in the population to reproduce successfully in a fluctuating environment, thereby maintaining a viable population. Each fish species thrives under a unique set of ecological conditions, so the reproductive strategy is also unique with special anatomical, behavioral, physiological, and energetic adaptations (Moyle and Cech 1982).

The role of temperature as an environmental cue for fish reproduction is well documented. Seasonal changes in temperature and light are often the most important cues physiologically because they can act directly or indirectly on hormonal glands to control development of the gonads (Moyle and Cech 1982). The onset of striped bass spawning occurs later in the season with increasing latitude, starting in February (Florida) and continuing through June or July along the southern shore of the Gulf of St. Lawrence and the lower St. Lawrence River (Rulifson et al. 1982). Duration of spawning activity ranges from eight days (Hollis 1967) to 44 days (May and Fuller 1965), although Hassler, Trent and Gray (1963) reported spawning activity in the Roanoke River over a 51-day period in 1963.

Striped bass eggs have been collected at water temperatures ranging from a low of 10°C (Nichols 1966) to 25°C (Merriman 1941), although striped bass spawning from North Carolina southward generally begins at 13°C or higher and ends around 22°C (Rulifson et al. 1982). A variety of spawning temperatures for Roanoke striped bass have been reported: 13°C to 21.7°C with a peak from 16.7°C to 19.4°C (Shannon and Smith 1968, Shannon 1970, Street 1975). Hassler et al. (1981) reported that approximately 90% of spawning activity in the Roanoke River occurs from 15.4°C to 20.3°C. In 1988, Rulifson (1989) reported that over 94% of all eggs were collected at Pollock's Ferry (River Mile 105) between 18°C and 23.9°C. These warmer temperatures are probably the result of solar heating of river waters with increasing distance downstream from Roanoke Rapids Dam. In 1989, most eggs collected at Barnhill's Landing were in waters between 18°C and 21.9°C (Table 4). In both 1988 and 1989, a rise in water temperature to 18°C triggered the major portion of spawning activity.

The influence of water release from the reservoir on downstream water temperatures was evident in 1989. The cooler waters from the reservoir released in high volume into a low-flowing river warmed by solar input decreased the water temperature of the stream. This phenomenon helps explain a long-standing theory predicated on observations supplied by fisheries biologists and sport fishermen: spawning activity of striped bass is triggered by dropping water levels and is stopped or reduced by rising waters. Egg collections and stage of development were compared to river flow as measured by the USGS gage at Roanoke Rapids. First eggs appeared in samples on Sunday, 16 April one day after reservoir discharge decreased from about 20,000 cfs to approximately 9,000 cfs (Figure 17). Stable flows the week of 16 April resulted in water temperatures increasing throughout the week (Figure 6) and brief spawning activity near the end of the week. During the week of 23 April water releases were somewhat more variable, dropping several thousand cfs late Tuesday evening and resulting in eggs collected in nets on Wednesday. Flows increased approximately 5,000 cfs late Wednesday evening and remained at approximately 11,000 cfs until early Thursday evening when flows dropped to about 6,000 cfs for the remainder of the week (Figure 17). Water temperatures increased to 18°C at this time (Figure 6), resulting in continual, moderate spawning activity through the weekend and into Monday, 1 May. The heavy inflow to the reservoir system upstream necessitated water release from reservoir storage on 1-2 May, resulting in an increase in river flow from about 5,600 cfs to over 20,000 cfs within the two-day period. As water temperatures dropped, spawning activity ceased (Figure 17). A similar cessation of spawning activity in the Sacramento River system caused by sudden drops in temperature or the passage of cold fronts was noted by Calhoun et al. (1950).

### *Sampling Site and Egg Viability*

Bias in the estimate of egg viability due to sampling location was suspected after obtaining a high viability estimate of 89% in 1988 at Pollock's Ferry (RM 105) and a low of 42% at Barnhill's Landing (RM 117) in 1989. Additional evidence was provided by Hassler's data base as reported in Table 2. In 1959-1960, the average egg viability at Palmyra (RM 78.5) was nearly 93%, but in both years data for only a portion of the season were obtained. During the years that Hassler sampled upstream at Halifax (RM 121) near the spawning grounds (1961-1974), egg viability averaged 88.53% (S.D. 5.77, n=14). In 1975, egg viability dropped to about 56%, which also happened to coincide with a change in sampling location downstream at River Mile 117. For the seven years of data collection at Barnhill's Landing, egg viability averaged 51.08% (S.D. 11.75). In 1982, Hassler moved operations one mile upstream to Johnson's Landing and from 1982-1987, the average egg viability was only 49% (S.D. 20.22, n=6).

Based upon these observations, I hypothesized that sampling too close to, or too far away from, the spawning grounds could overestimate the yearly egg viability estimate. Biologically, this rationale is sound. Sampling too close to the spawning grounds may not allow adequate time for eggs to physically show evidence of nonviability: e.g., cloudiness, broken membranes, nonfertilization. Sampling too far downstream may provide too much time between egg release and egg collection in nets, thus allowing nonviable eggs to be removed from the water column by bursting, predation, sinking, or transport to floodplain areas. The bulk of those eggs remaining within the water column should be viable. Following this line of reasoning, the sampling location providing the best estimate of egg viability should be somewhere in between (i.e., Johnson's Landing or Barnhill's Landing). To test this hypothesis would require two or three sampling crews at the upstream (Halifax), middle (Barnhill's Landing), and downstream (Pollock's Ferry or Palmyra) sites collecting eggs at the same frequency for the entire spawning season.

Two egg studies of a similar nature conducted at different locations in 1981, 1982, and 1983 provided the opportunity to test the hypothesis indirectly. Hassler conducted his 1981 egg study at Barnhill's Landing (Hassler, Luempert and Mabry 1982) and at Johnson's Landing in 1982 and 1983 (Hassler and Taylor 1984). The N.C. Wildlife Resources Commission monitored egg production at Johnson's Landing in 1981 (Kornegay 1981), and at Pollock's Ferry in 1982 (Kornegay 1983) and 1983 (Kornegay and Mullis 1984).

The methods and equipment used in the NCWRC studies were different than that used by Hassler; an understanding of data collection is necessary prior to comparing the two data sets. Hassler's methodology and gear was explained previously. Kornegay (1981) collected eggs with two 0.5-m diameter 505-μm mesh plankton nets. One net was mounted on each side of the boat in a push net frame described by Tarplee et al. (1979). Sampling frequency was initially three times a day; maximum frequency was every four hours during peak spawning activity. The nets were pushed through the water facing upstream at a speed such that the boat remained stationary or advanced slightly in relationship to the shore. Effort was six minutes initially, but was reduced to three minutes when spawning activity was greatest. The numbers of eggs collected were converted to numbers per 100 cubic meters of water filtered. Determination of egg viability was similar to the Hassler method. The same field procedures were used in 1982 and 1983 (Kornegay and Mullis 1984). Data sets for the following comparisons are presented in the Appendix (Tables A-6 and A-7).

In 1981, Hassler (Hassler, Luempert and Mabry 1982) sampled from 29 April to 29 May and reported an egg viability of 73.7% (Table 2). Kornegay's efforts one mile downstream began on 21 April and ended 15 May, resulting in an egg viability estimate of 68.97%. These two egg viability estimates are within five percent and so appear similar. The similarity is not so striking when daily viability estimates are plotted (Figure 18). With one exception, daily egg viability estimates for Johnson's Landing were consistently higher than for the downstream Barnhill's Landing site. These results support the egg viability bias hypothesis described above. However, the daily egg production data are very similar and show peak spawning activity around 29 April and again around 9-15 May (Figure 18). Coincidentally, these spawning activity peaks occur just after sudden changes in river flow: a 4,000 cfs increase on 22-24 April and a similar decrease on 7-8 May (Figure 19). Minor spawning peaks in mid and late May exhibit this similar pattern.

In 1982, Hassler (Hassler and Taylor 1984) sampled at Johnson's Landing from 3 May to 2 June; spawning activity had started prior to sampling efforts. Hassler's egg viability estimate for 1982 was 71.93% (Table 2). Thirteen miles downstream at Pollock's Ferry, Kornegay (1983) sampled from 20 April to 14 May and obtained an egg viability estimate of 76.47%, a value within five percent of the Hassler estimate. Again, the lower value obtained at Johnson's Landing and the higher value estimated downstream at Pollock's Ferry fits the sampling location bias hypothesis.

However, visual inspection of the 1982 daily viability estimates shows a high degree of similarity between the two stations (Figure 20). Even though the sites are 13 miles apart, egg transport time may be as short as 7.6 hours, assuming a uniform water velocity of 2.5 feet/sec (75 cm/sec). Thus, egg viability estimates calculated on a daily, rather than per sample, basis may not be adequate to determine egg viability differences between the two sites. Both daily egg production estimates reveal similar patterns in spawning activity: peak spawning occurred approximately 9-11 May (Figure 20) just after river flow dropped from 11,600 cfs to about 6,300 cfs on 7-8 May (Figure 21). Kornegay (1983) attributed the spawning peak to increases in water temperature to 18.4°C.

In 1983, Hassler (Hassler and Taylor 1984) sampled at Johnson's Landing from 6 May to 12 June and estimated egg viability as 33.29% (Table 2). Kornegay and Mullis (1984) sampled at Pollock's Ferry from 24 April to 31 May and reported egg viability at 40.48%. Again, the higher egg viability estimate downstream supports the sampling location bias hypothesis.

Trends in daily egg viability data are obscured because of extensive flooding in the spring of 1983 (Figure 22), although higher daily egg viability later in the season seemed to coincide with lower river flow (Figure 23). Flow models by the U.S. Army Corps of Engineers indicate that the watershed floods under prolonged periods of 8,000 cfs river flow or more (M. Grimes, Wilmington District, Corps of Engineers, personal communication).

Similar to the 1981 and 1982 spawning seasons, peaks in 1983 striped bass spawning activity coincided with changes in river flow. During the latter half of April and early May river flows approached 26,000 cfs, then dropped to about 20,000 cfs on 7 May. The first, though minor, spawning peak was observed on 9 May. A second, slightly larger, spawning peak occurred on 15-17 May during a rather stable period of river flow. A third, larger peak on 24-26 May coincided with dropping water levels initiated on 25 May. The major peak spawn, which occurred on 30 May, coincided with lowest water levels of the season established two days earlier (Figure 23).

From the results of the independent studies conducted by Hassler and the NCWRC in 1981, 1982, and 1983, and the 1988 and 1989 studies funded by the Albemarle-Pamlico Estuarine Study, it is clear that spawning activity of Roanoke River striped bass is affected by reservoir discharge. The relationship between egg viability and success of juvenile recruitment to the year class is unclear. Ongoing studies of egg and larval transport, food abundance, and water quality should provide additional information to answer questions about environmental influences on striped bass recruitment.

## Summary and Conclusions

1. The estimated number of striped bass eggs produced in the Roanoke River for 1989 was 637,919,162 (S.D.=27,668,383) from a total of 4,722 eggs collected in surface nets during the period 15 April to 15 June. Spawning prior to 15 April was undetermined.

2. In 1989, major spawning activity at the end of April ceased coinciding with high volume discharge from Roanoke Rapids Reservoir. Continued prolonged discharge forestalled major spawning activity until the last week in May at which time there were three peaks: 23-24 May, 26-27 May, and 31 May- 1 June. Seasonal egg production was 50% complete by 26 May and 99% complete by 2 June.

3. Major egg deposition was observed after water temperatures reached 18°C.

4. Egg viability for 1989 was estimated at 41.8%, the seventh lowest on record.

5. Most eggs (76.7%) passing Barnhill's Landing were less than 10 hours old. An additional 18.5% were 20-28 hours old, and less than five percent were 10-18 hours old. Only three eggs were over 30 hours old.

6. Most eggs (89%) were collected between 18 and 21.9°C, temperatures representing the bulk of those recorded during the study; only three percent were collected below 18°C. No trend in viability with water temperature was observed.

7. Over half of the eggs were collected in surface water velocities of 100-119.9 cm/second. An additional 22% were collected in waters flowing 60-79.9 cm/second. An inverse relationship between viability and water velocity was observed.

8. Over 99% of all eggs were collected at dissolved oxygen levels between 7 and 8.9 mg/L, values representing the majority of those recorded during the study.

9. Approximately 90% of all eggs were collected in waters of pH values 7.5 and higher, although greatest viability was observed at pH values between 6.75 and 7.24.

10. No significant difference in estimated egg production between surface and oblique methods was evident.

11. Based on data from 1988 and 1989, as well as comparisons of two independent egg studies conducted in 1981, 1982, and 1983, it is clear that reservoir discharge from Roanoke Rapids Dam influences spawning activity of striped bass.

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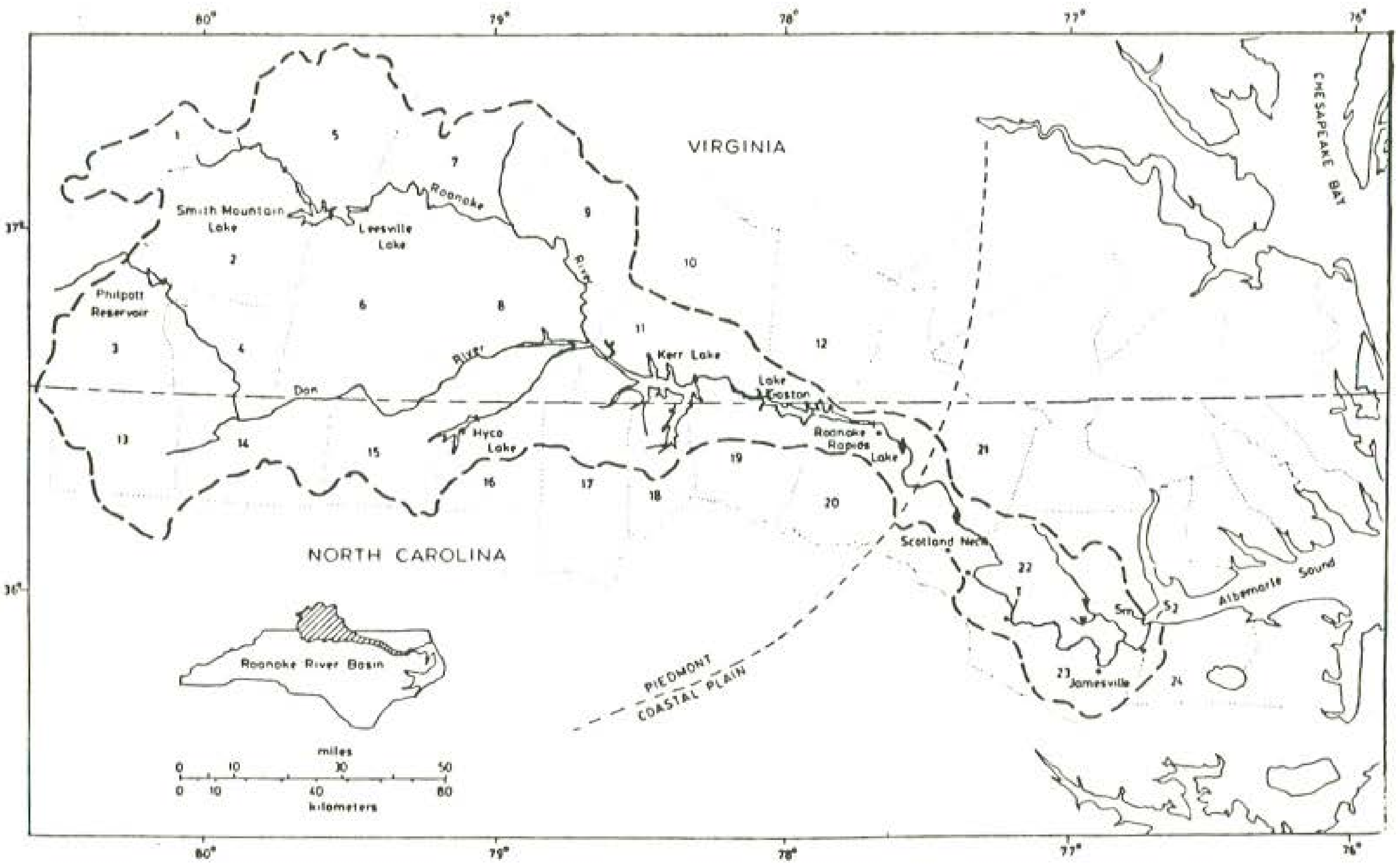



Figure 1. Drainage area of the Roanoke River Basin. Dashed line indicated approximate location of the Fall Line; diamonds=locations of USGS water quality and gaging stations; inverted triangle=USGS water quality station; T=upstream limit of tidal influence; S2=mean upstream intrusion limit of saltwater front (200 mg/L chloride); Sm=maximum upstream intrusion of saltwater front (Giese et al. 1979. Counties containing Roanoke watershed are enumerated and listed in Appendix Table A-1.

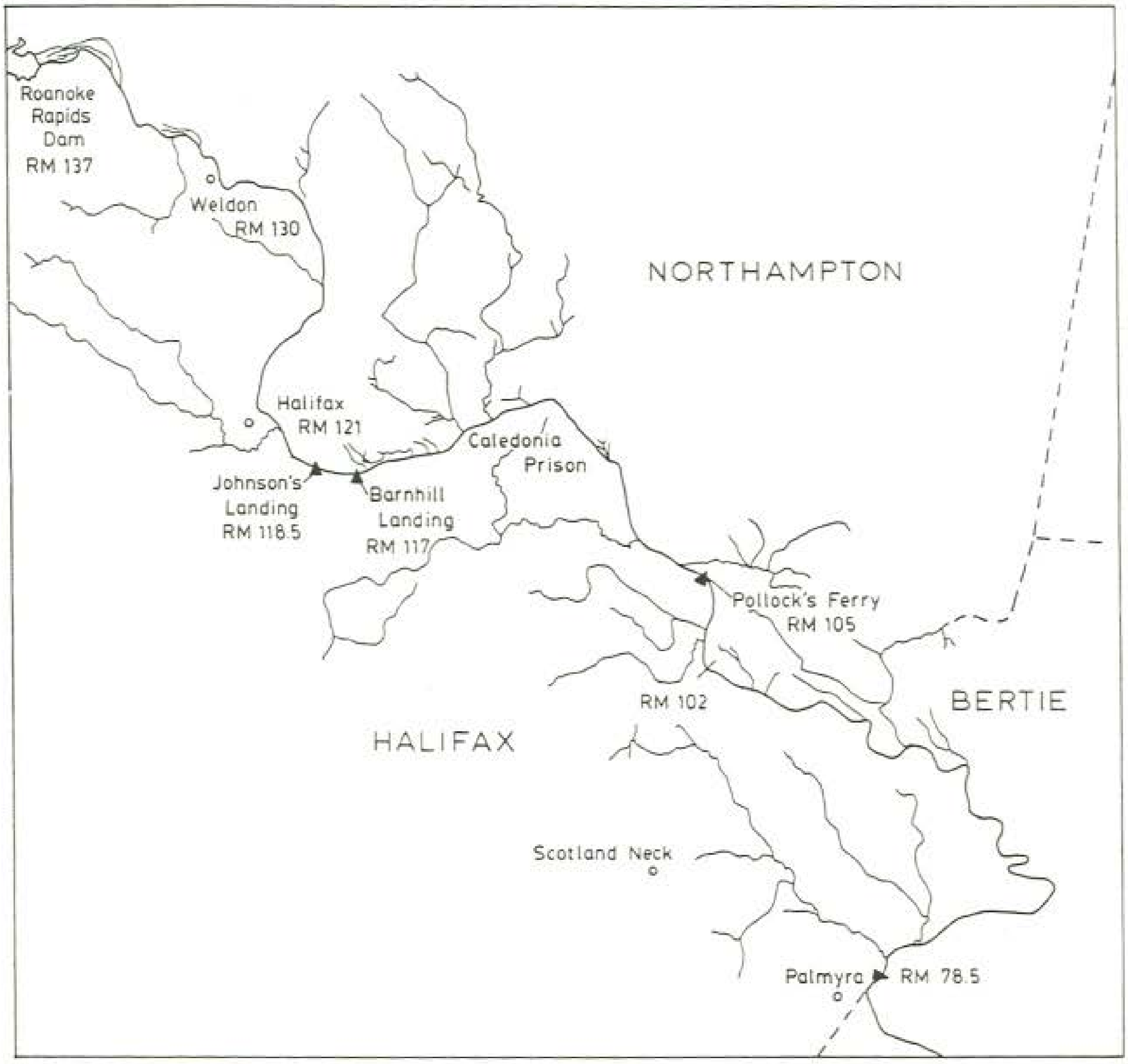



Figure 2. Roanoke River watershed downstream of Roanoke Rapids Reservoir showing the historical sampling stations for striped bass eggs: Palmyra (1959-60), Halifax (1961-74), Barnhill's Landing (1975-81, 1989), Johnson's Landing (1982-87), and Pollock's Ferry (1988).

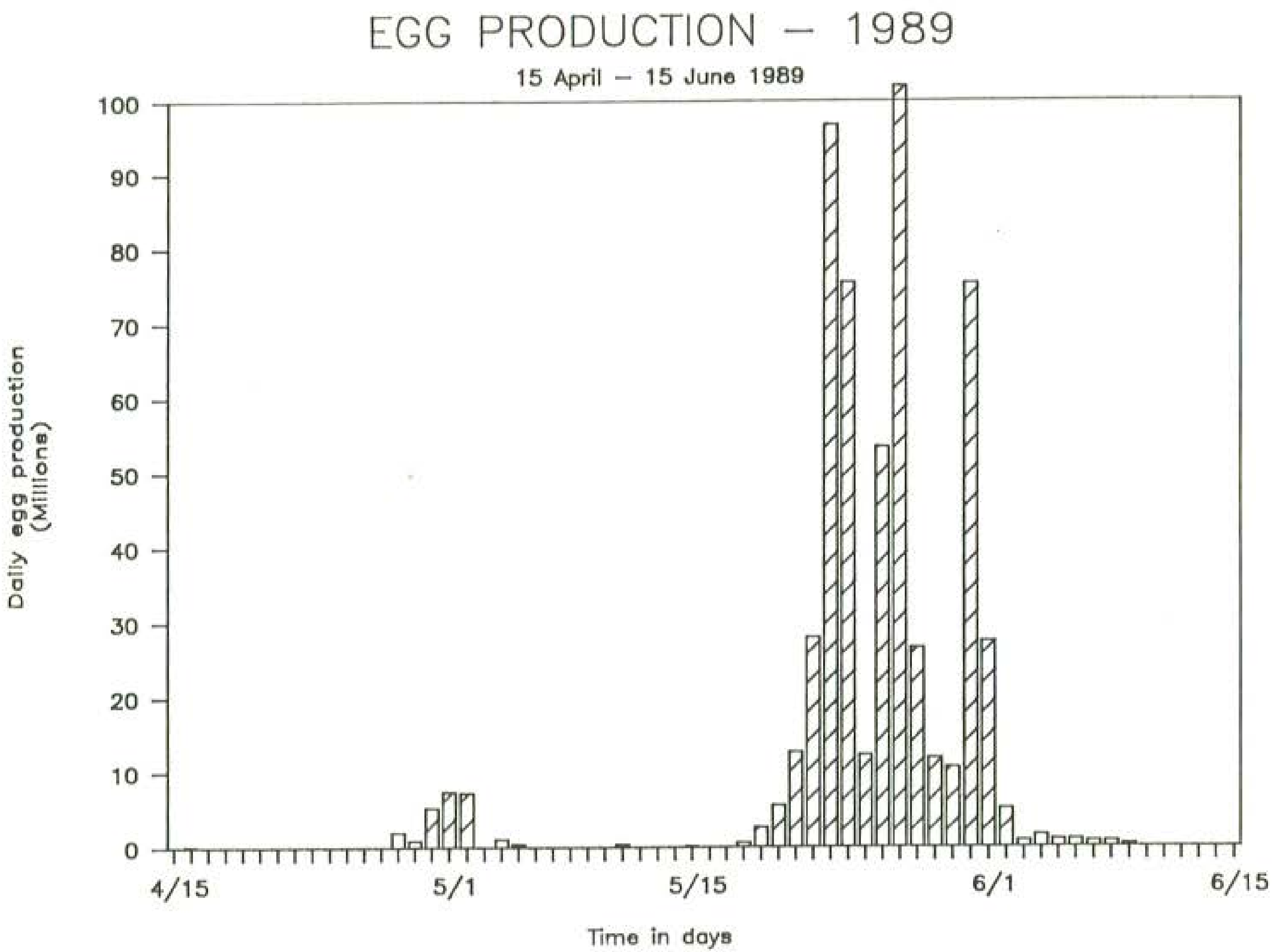



Figure 3. Estimated daily production of striped bass eggs in the Roanoke River based on samples collected at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

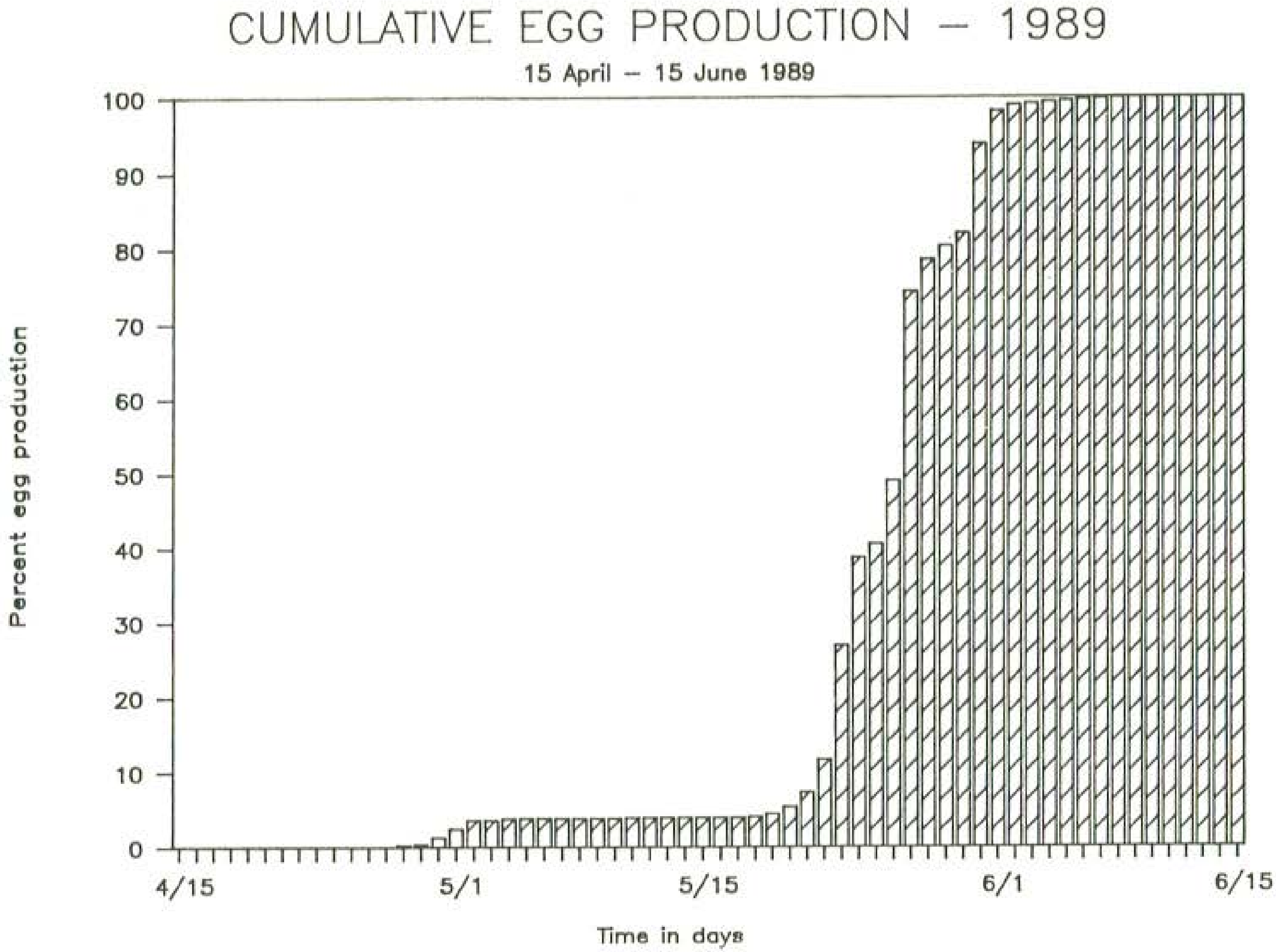



Figure 4. Estimated production of striped bass eggs in the Roanoke River based on samples collected at Barnhill's Landing, NC, in 1989, presented as percentage of total production.

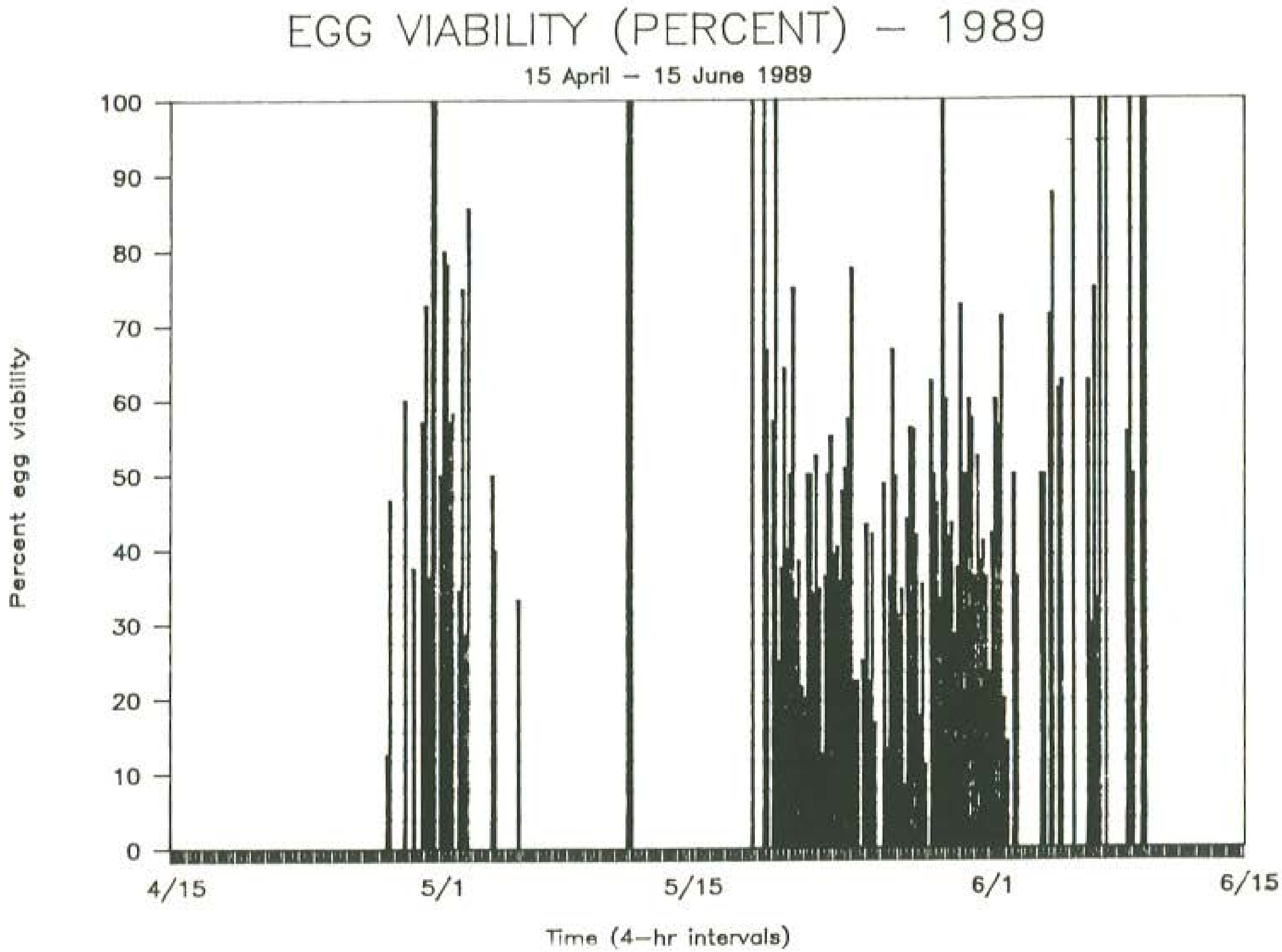



Figure 5. Daily viability estimates of striped bass eggs in the Roanoke River based on samples collected at Barnhill's Landing, NC, in 1989.

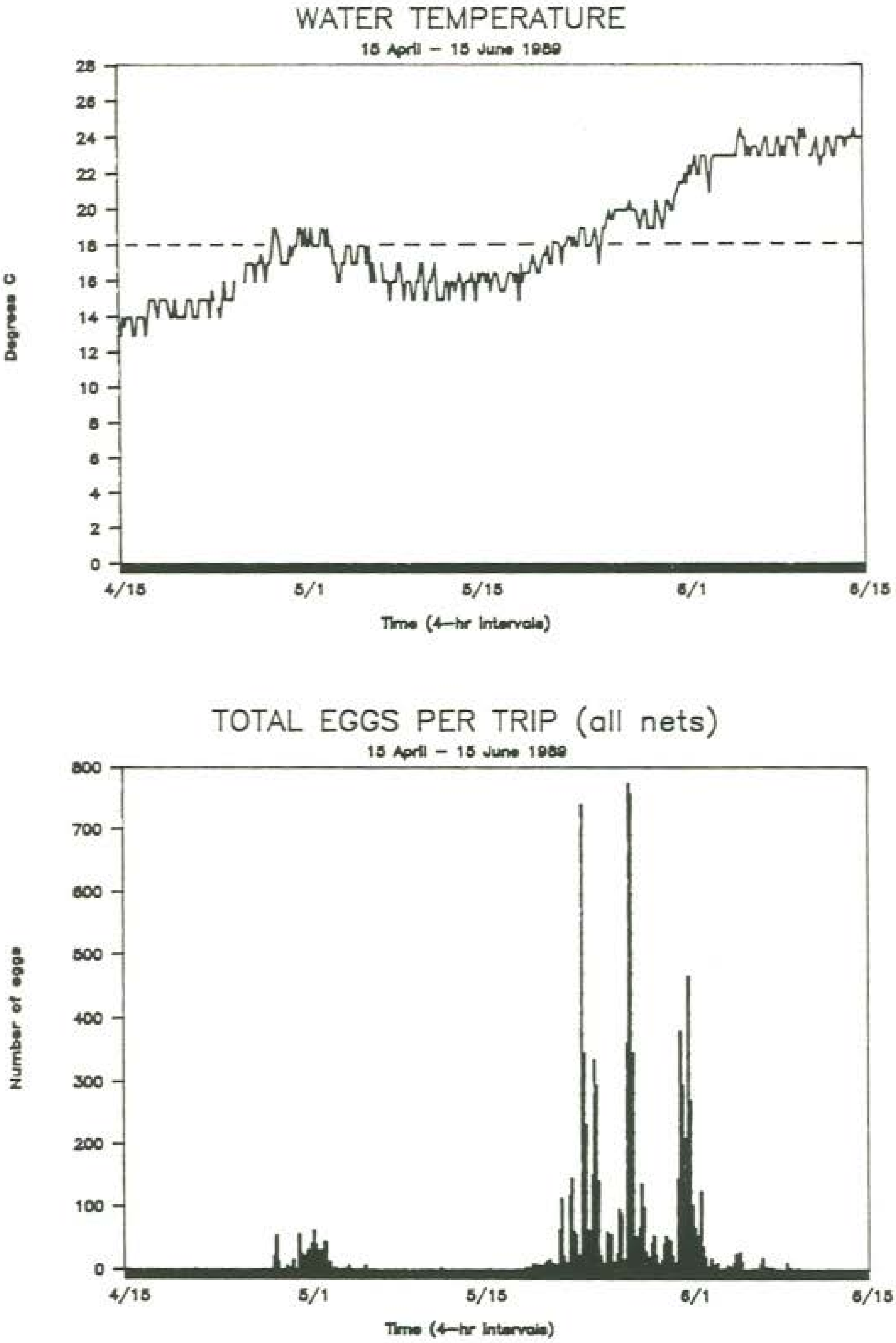



Figure 6. Number of striped bass eggs collected in all nets during each trip, and corresponding water temperatures (°C) at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

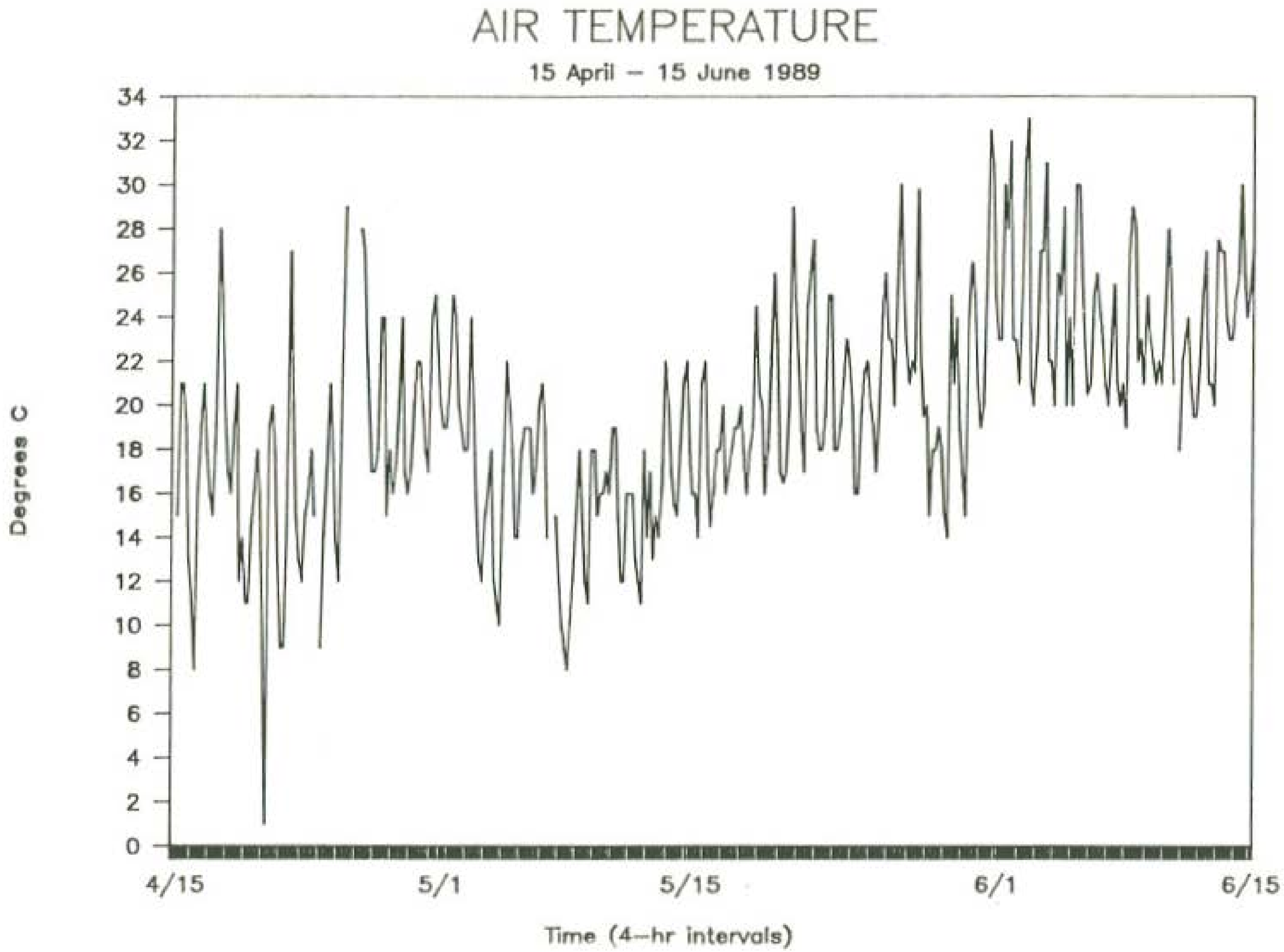
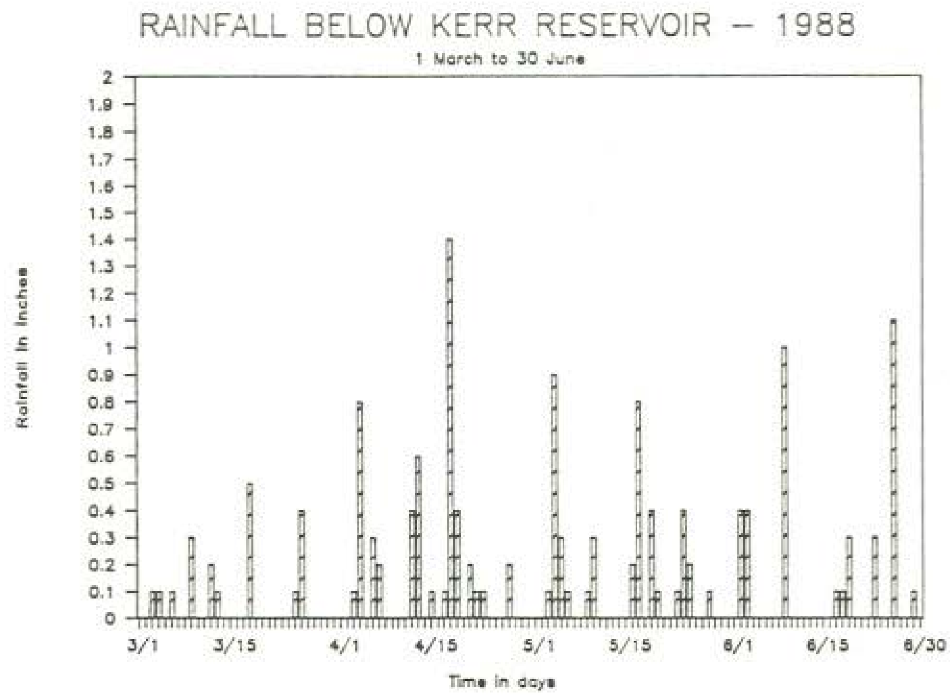



Figure 7. Air temperature (°C) measured at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.



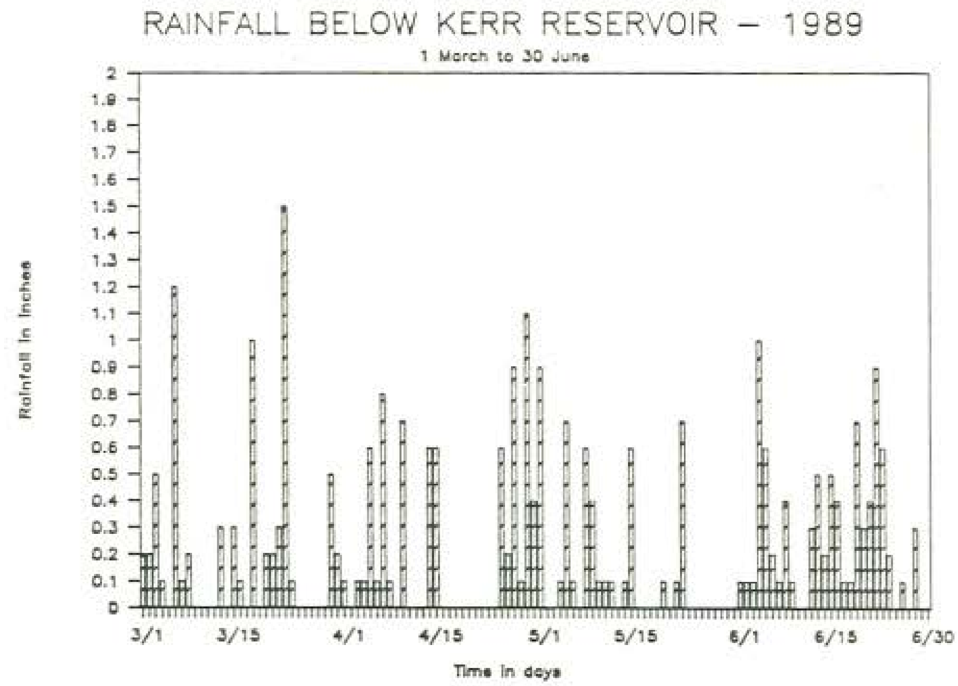




Figure 8. Daily rainfall (inches) in the Roanoke watershed below Kerr Reservoir, March through June 1988 and 1989 (U.S. Army Corps of Engineers data).

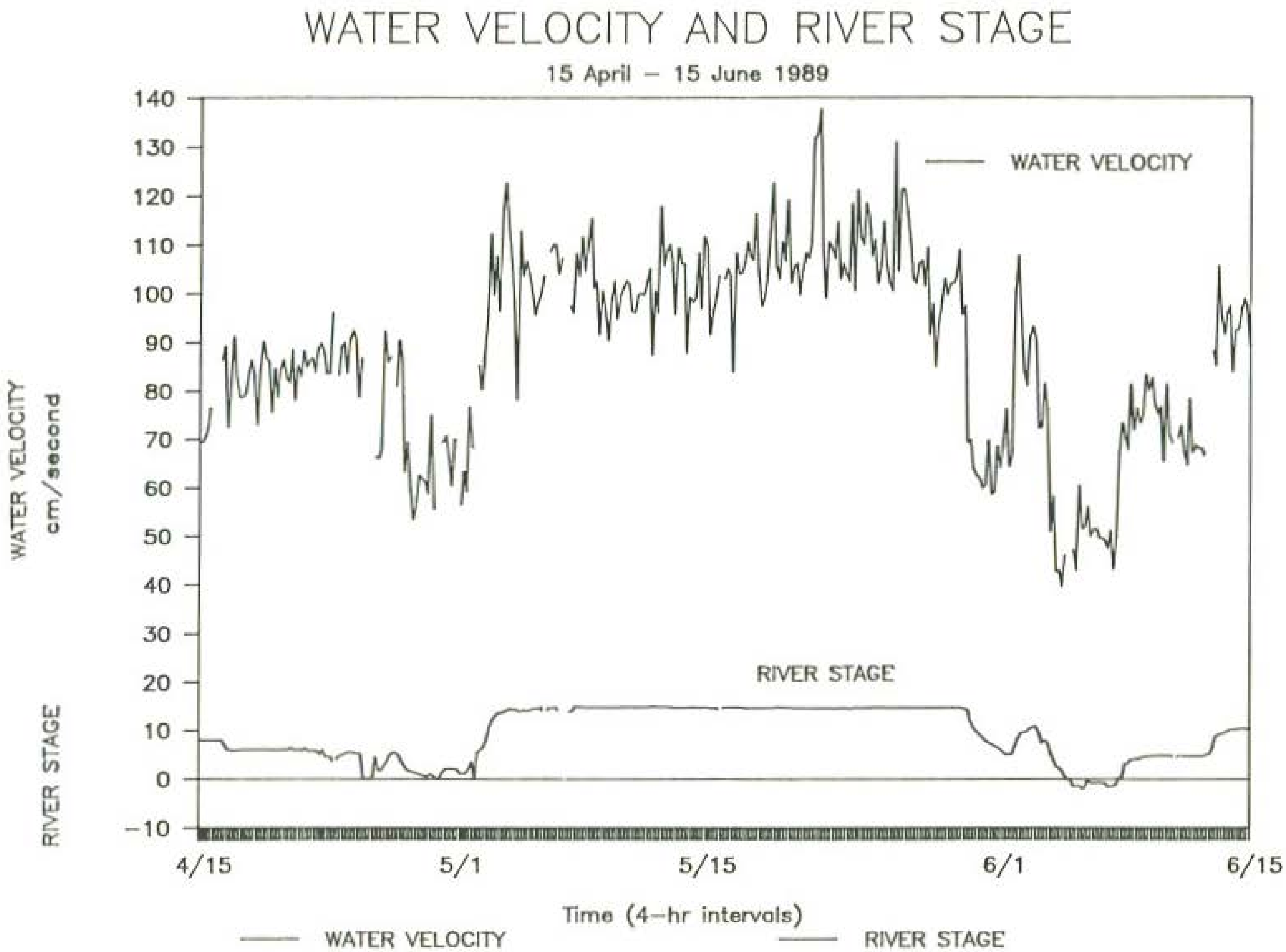



Figure 9. Surface water velocity and relative change in river stage of the Roanoke River at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

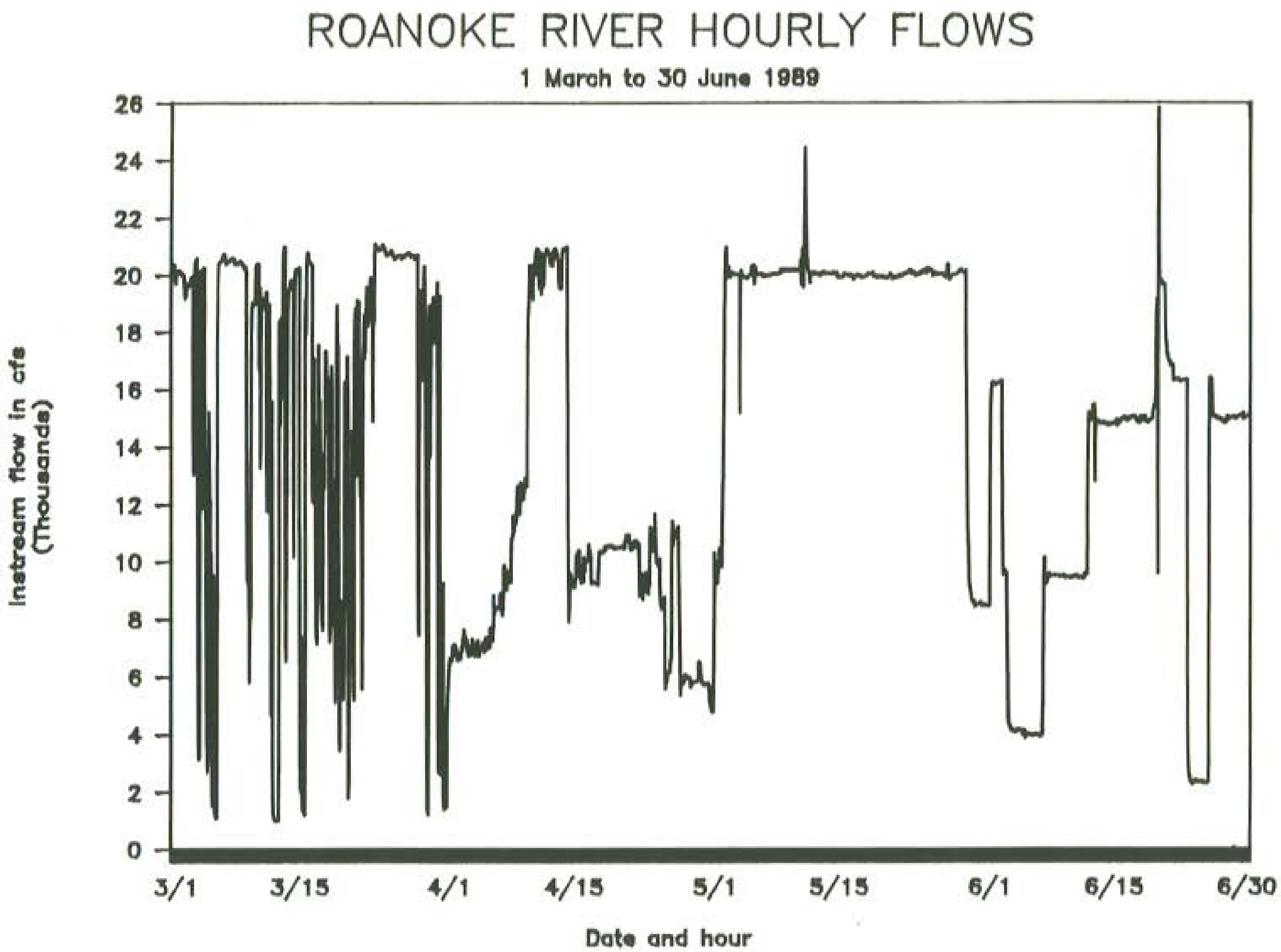



Figure 10. Hourly record of Roanoke River flows (cfs) downstream of the Roanoke Rapids Reservoir (USGS data), March through June 1989.

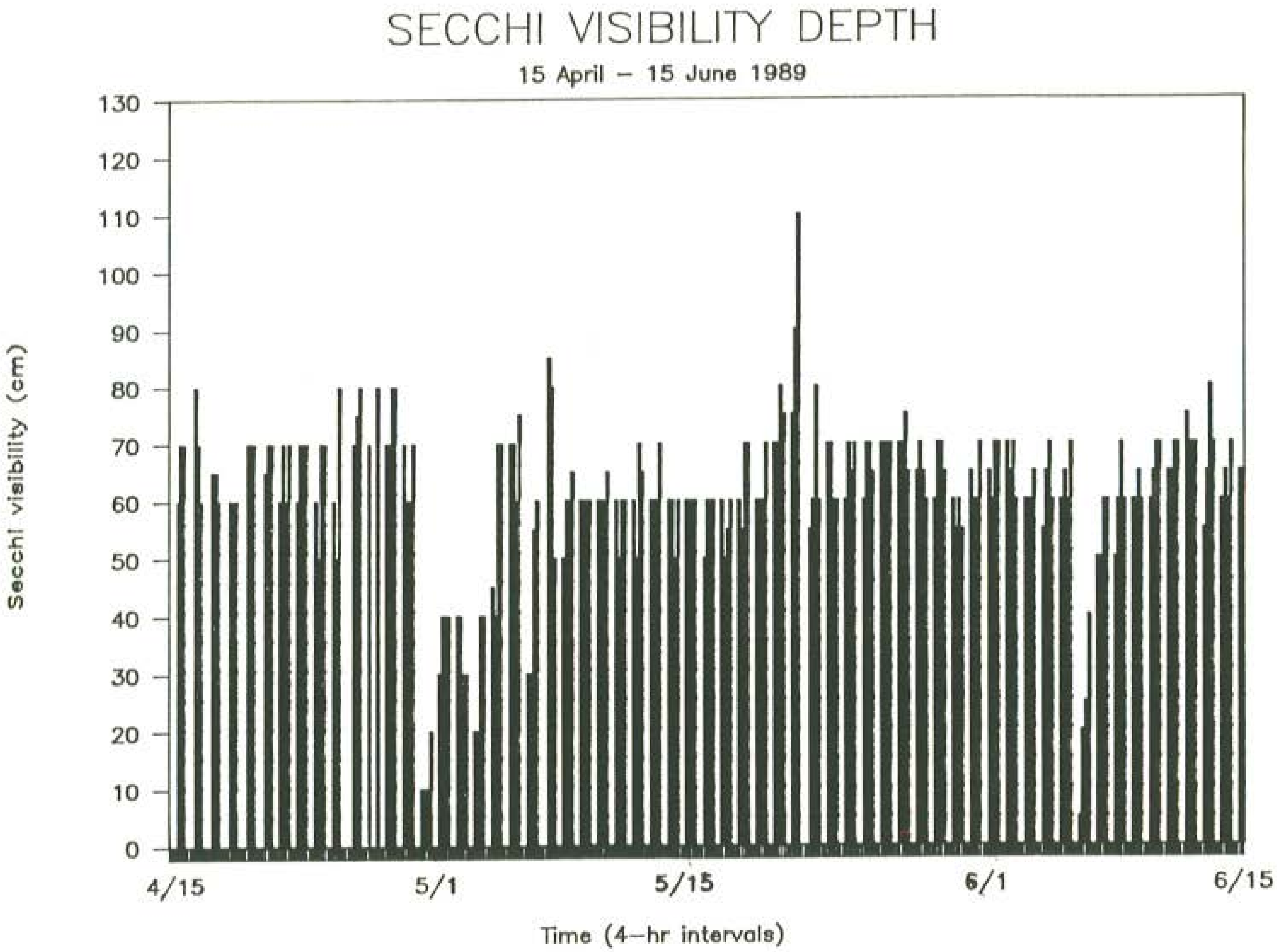



Figure 11. Depth (cm) of secchi disk visibility in the Roanoke River at Barnhill's Landing, NC, for the period 15 April to 15 June 1989. Unfilled bars indicate no information available.

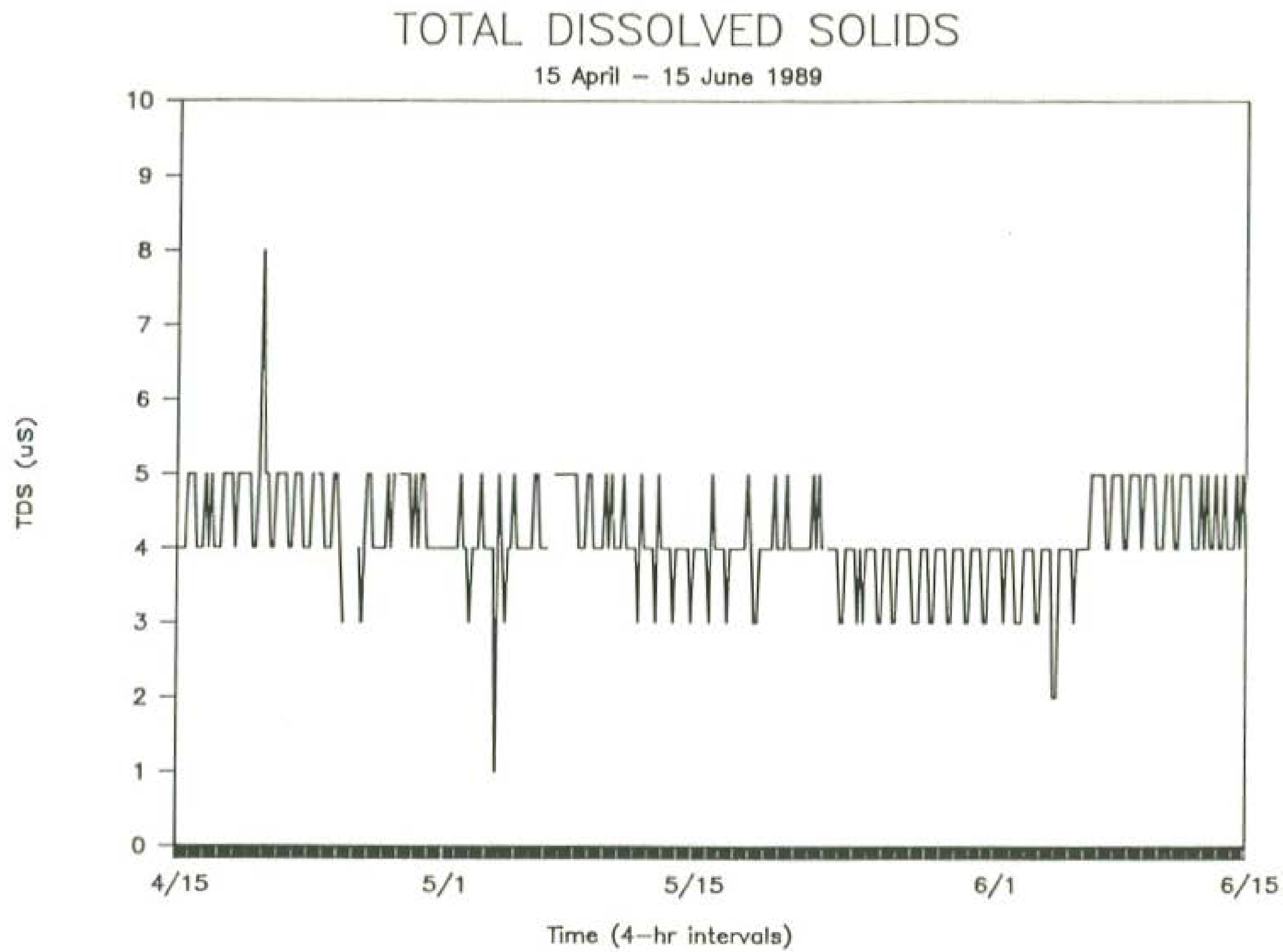



Figure 12. Levels of total dissolved solids (µS) measured in the Roanoke River at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

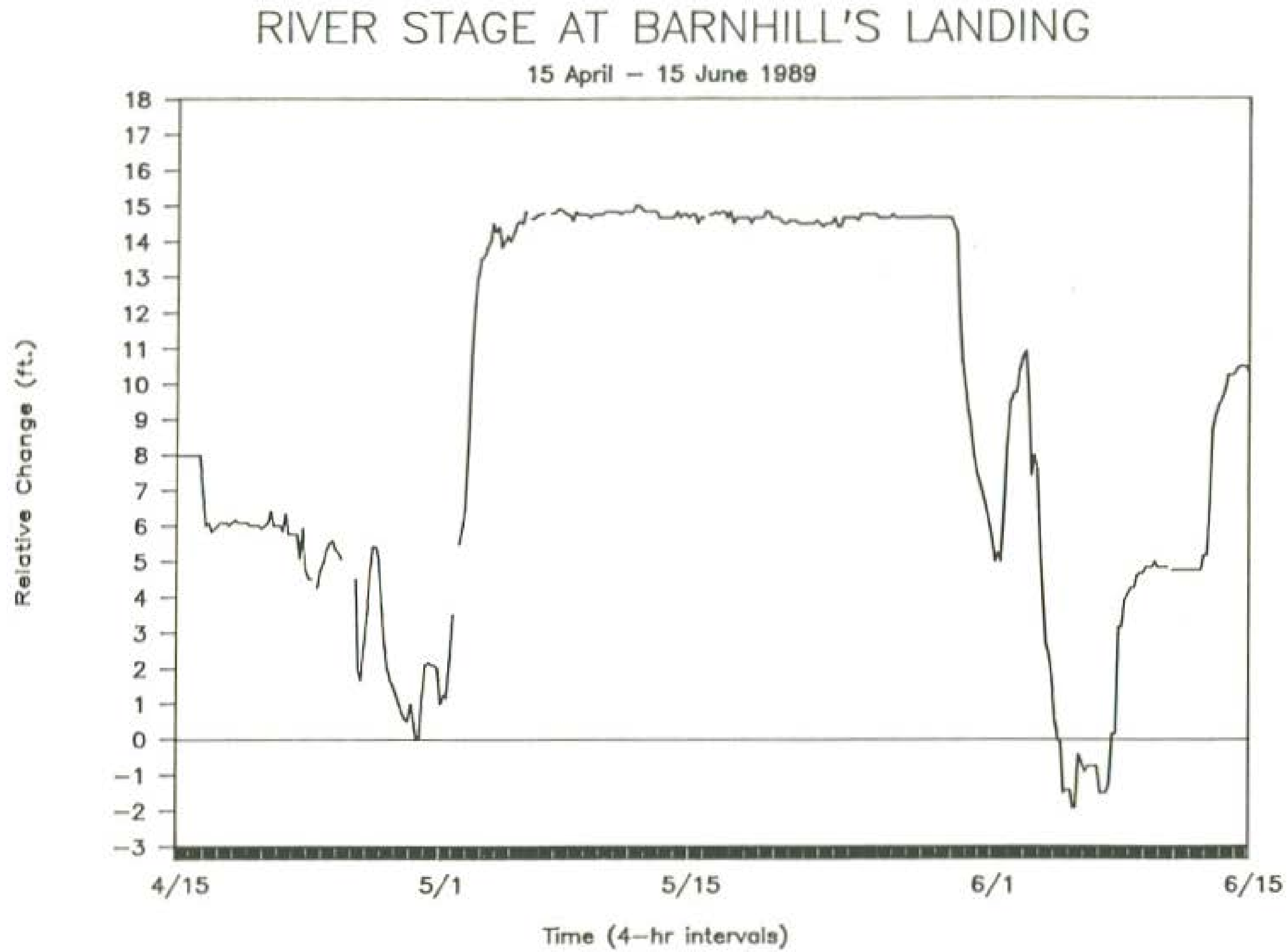



Figure 13. Relative change in stage of the Roanoke River at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

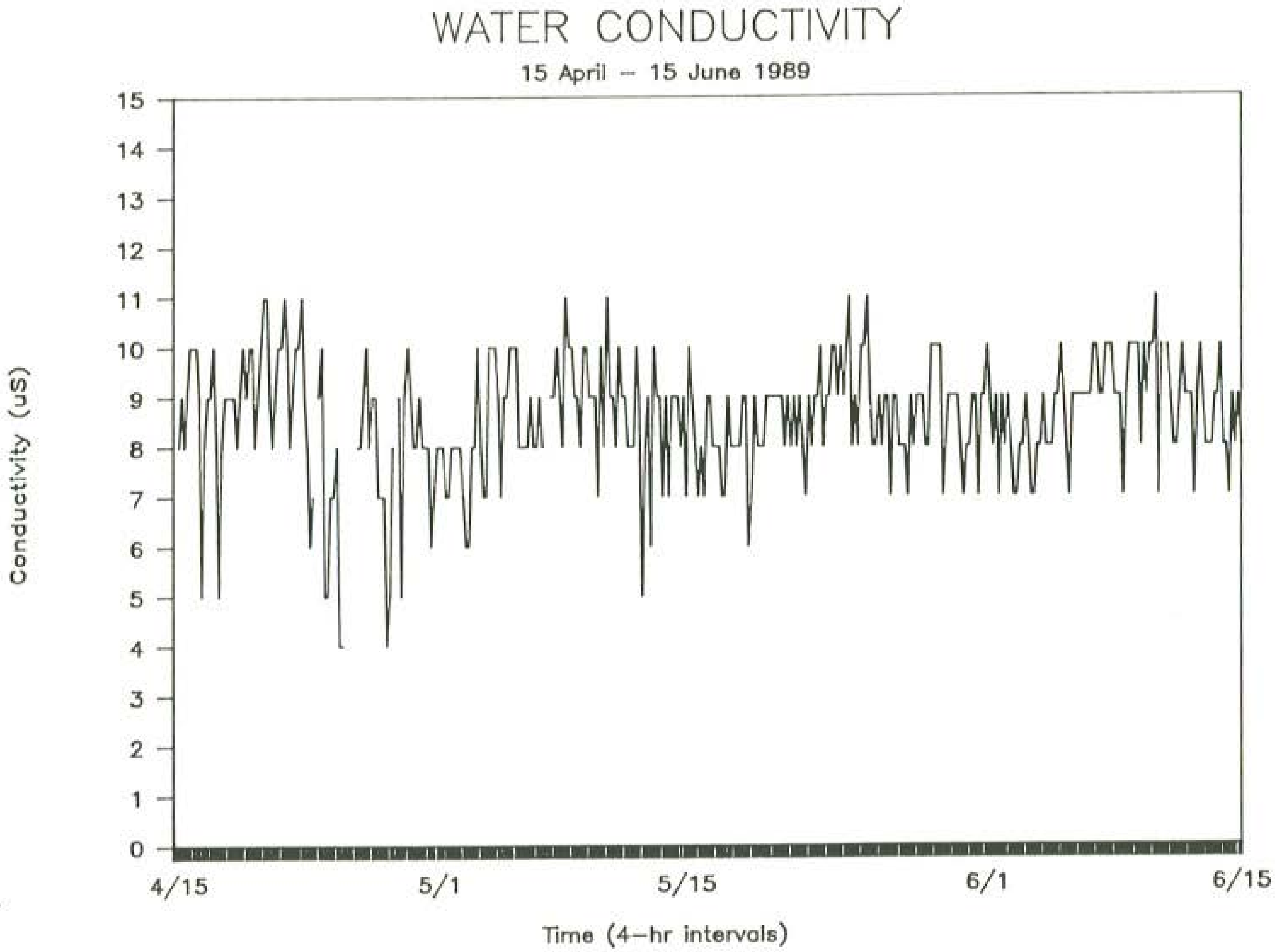



Figure 14. Changes in conductivity of Roanoke River waters at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

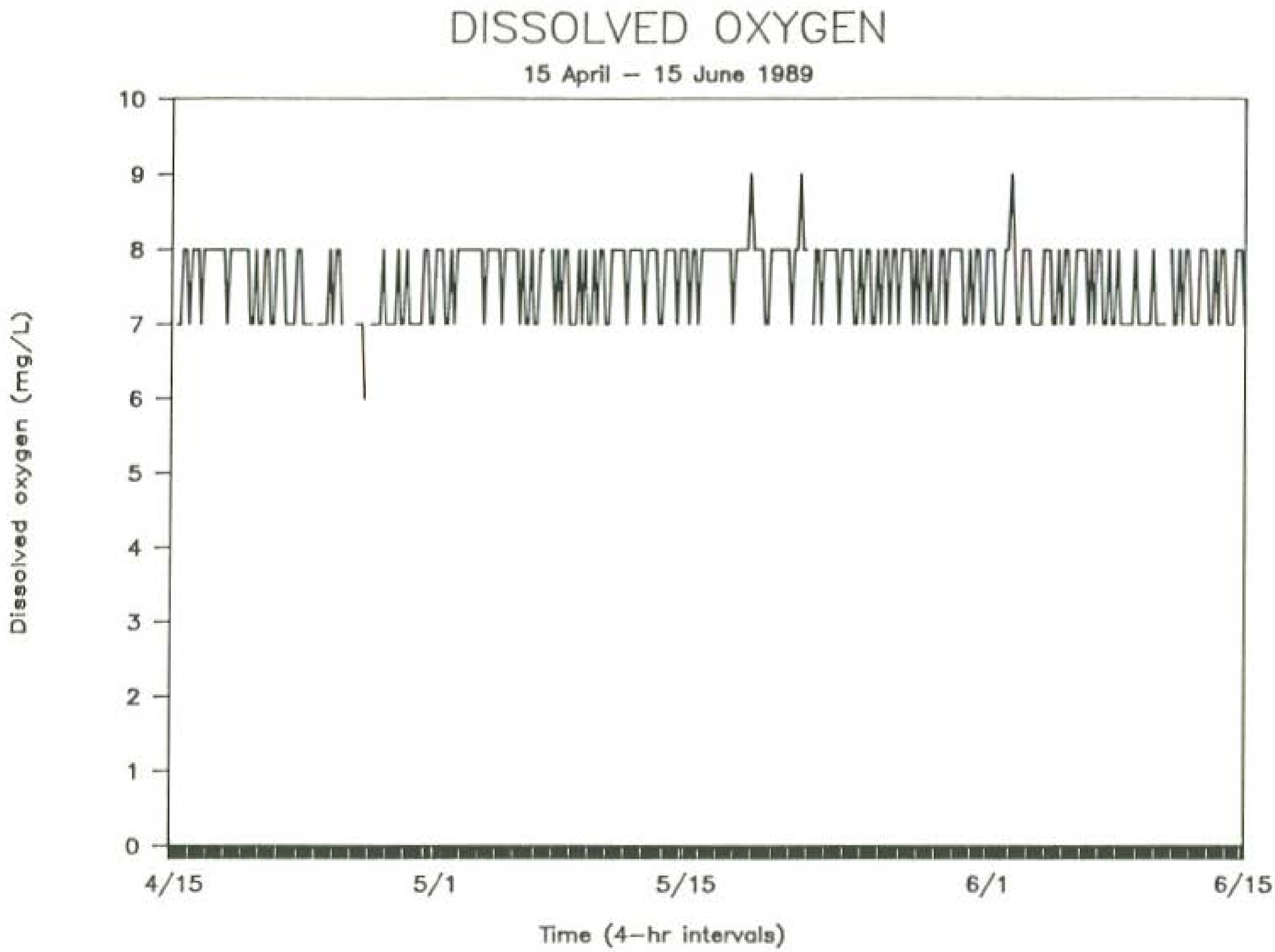



Figure 15. Changes in dissolved oxygen (mg/L) of Roanoke River waters at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

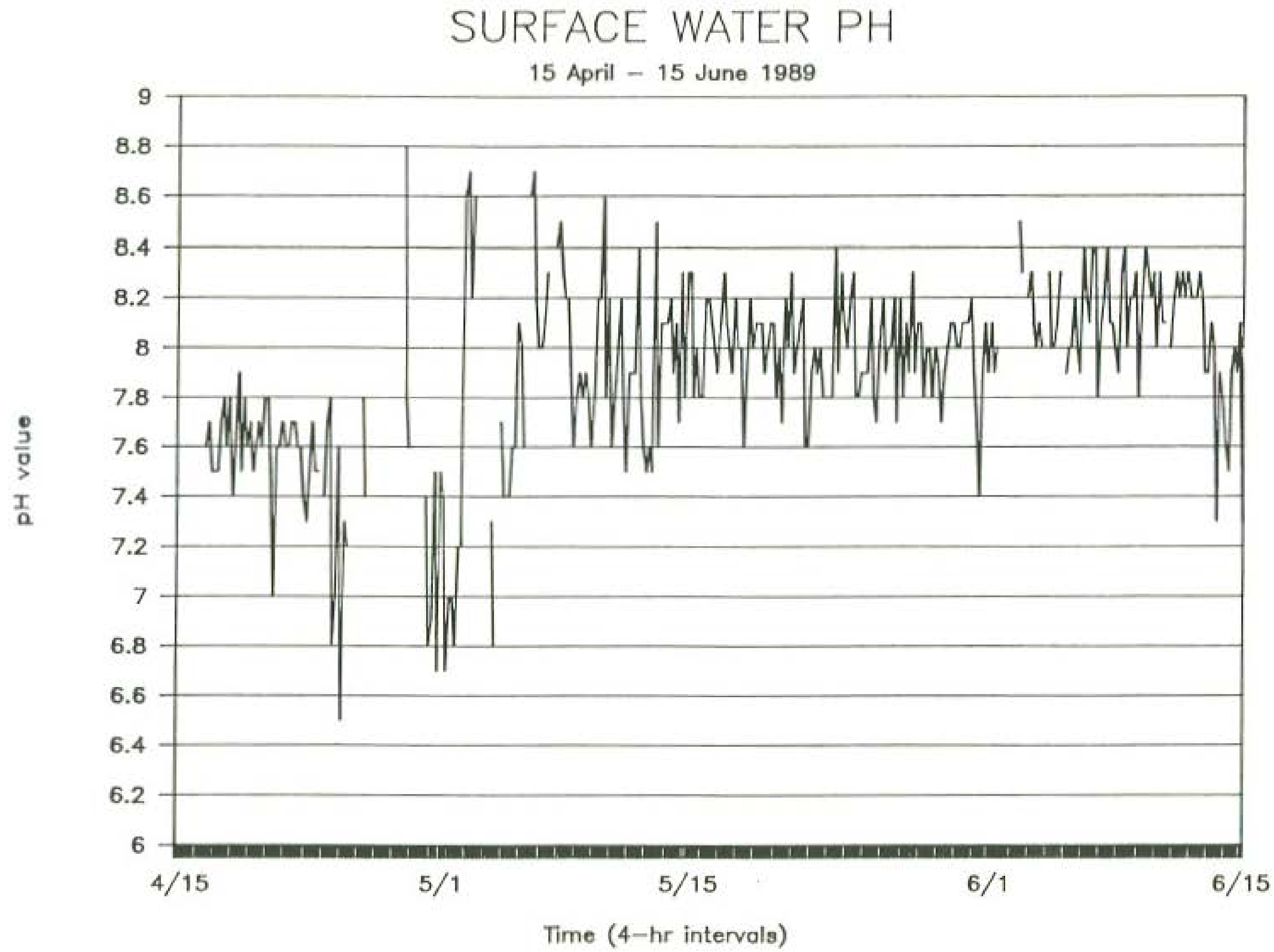



Figure 16. Changes in pH of Roanoke River waters at Barnhill's Landing, NC, for the period 15 April to 15 June 1989.

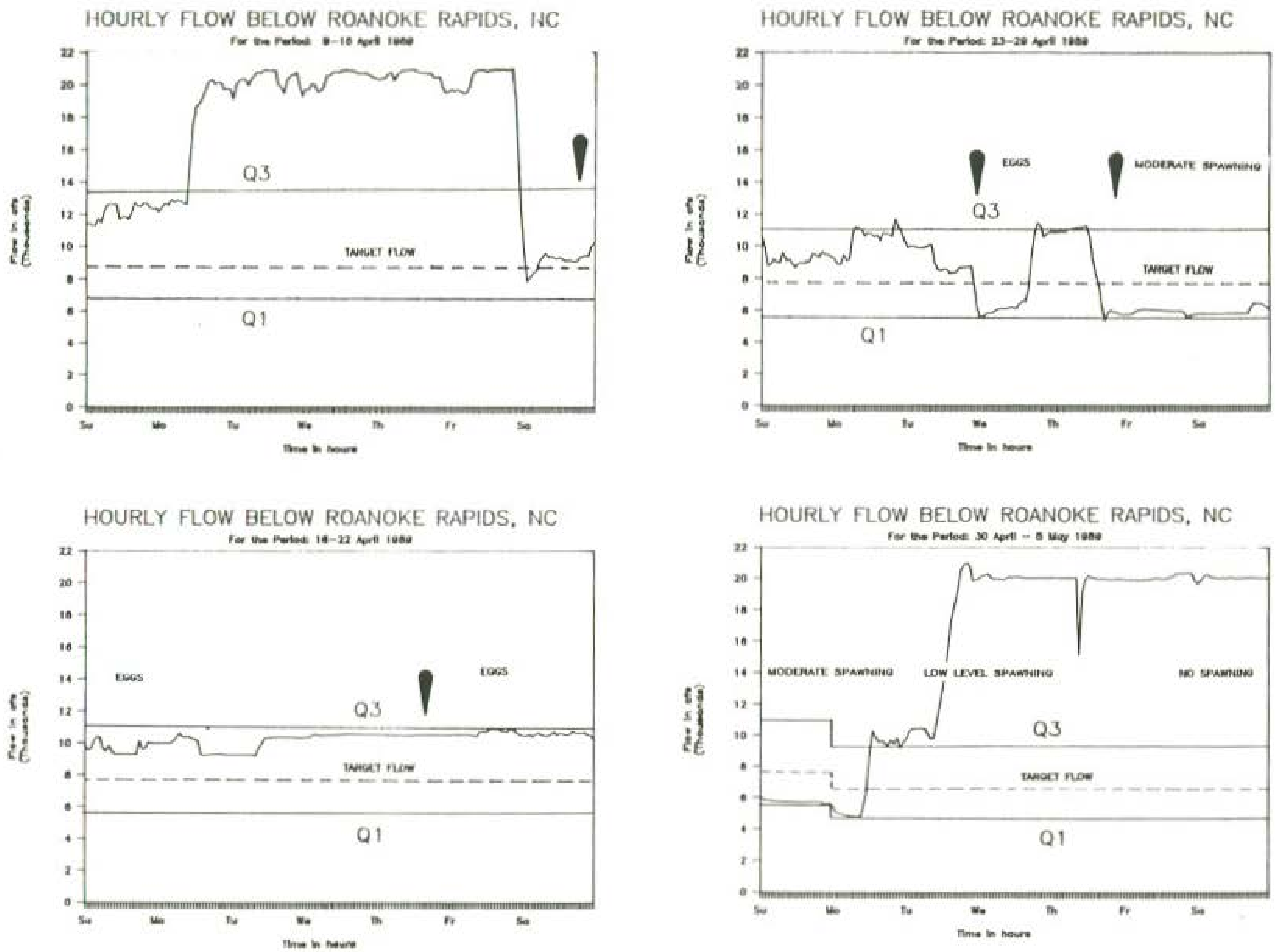
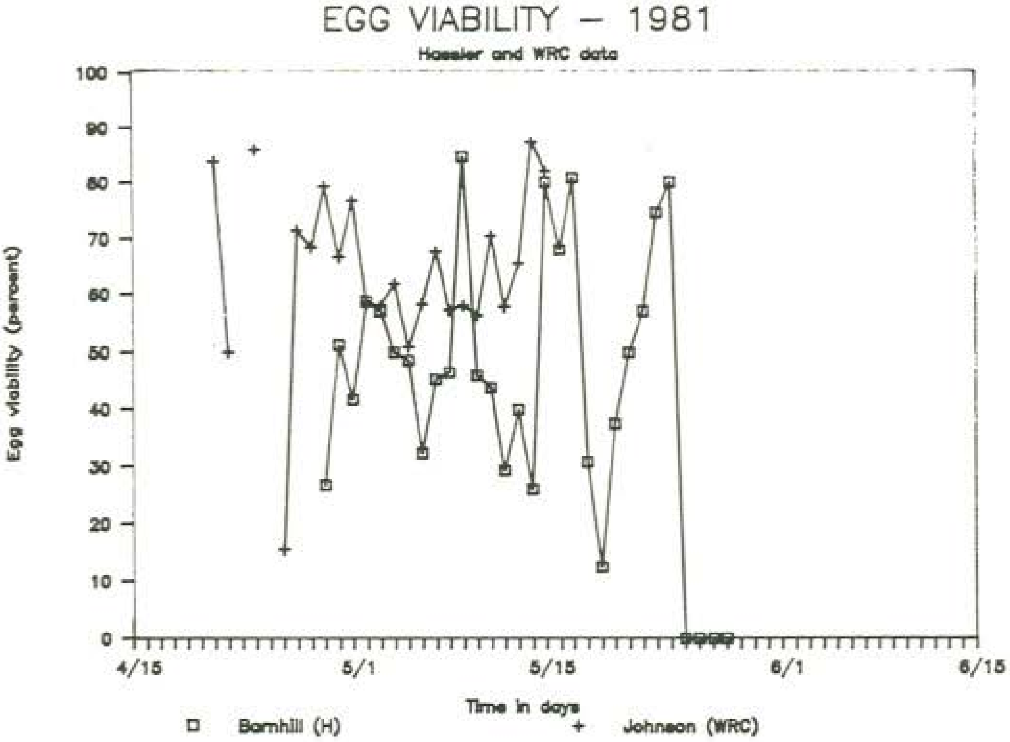



Figure 17. Roanoke River flow and spawning activity of striped bass for the period 9 April to 5 May 1989. Q1 = historical 25% low flows; Q3 = historical 75% high flows; Target flow = Negotiated Flow Regime accepted by the Army Corps of Engineers and Virginia Power Company (Manooch and Rulifson 1989).



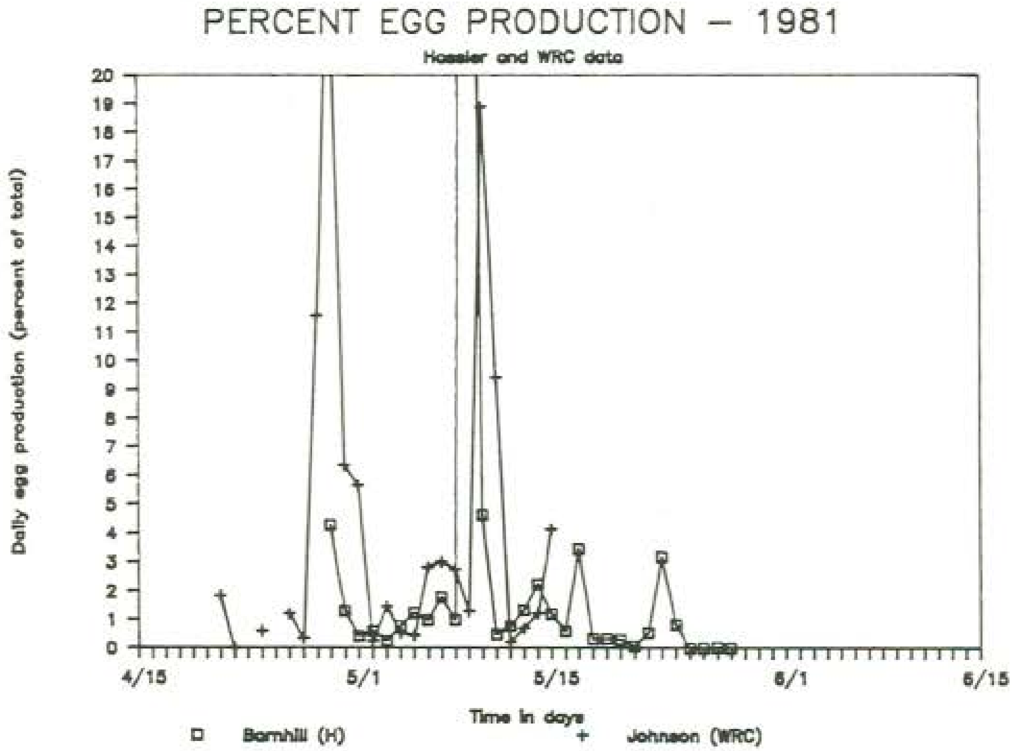




Figure 18. Daily estimates of striped bass egg production and viability in the Roanoke River by Hassler (Barnhill's Landing) and the Wildlife Resources Commission (Johnson's Landing) for the 1981 spawning season.

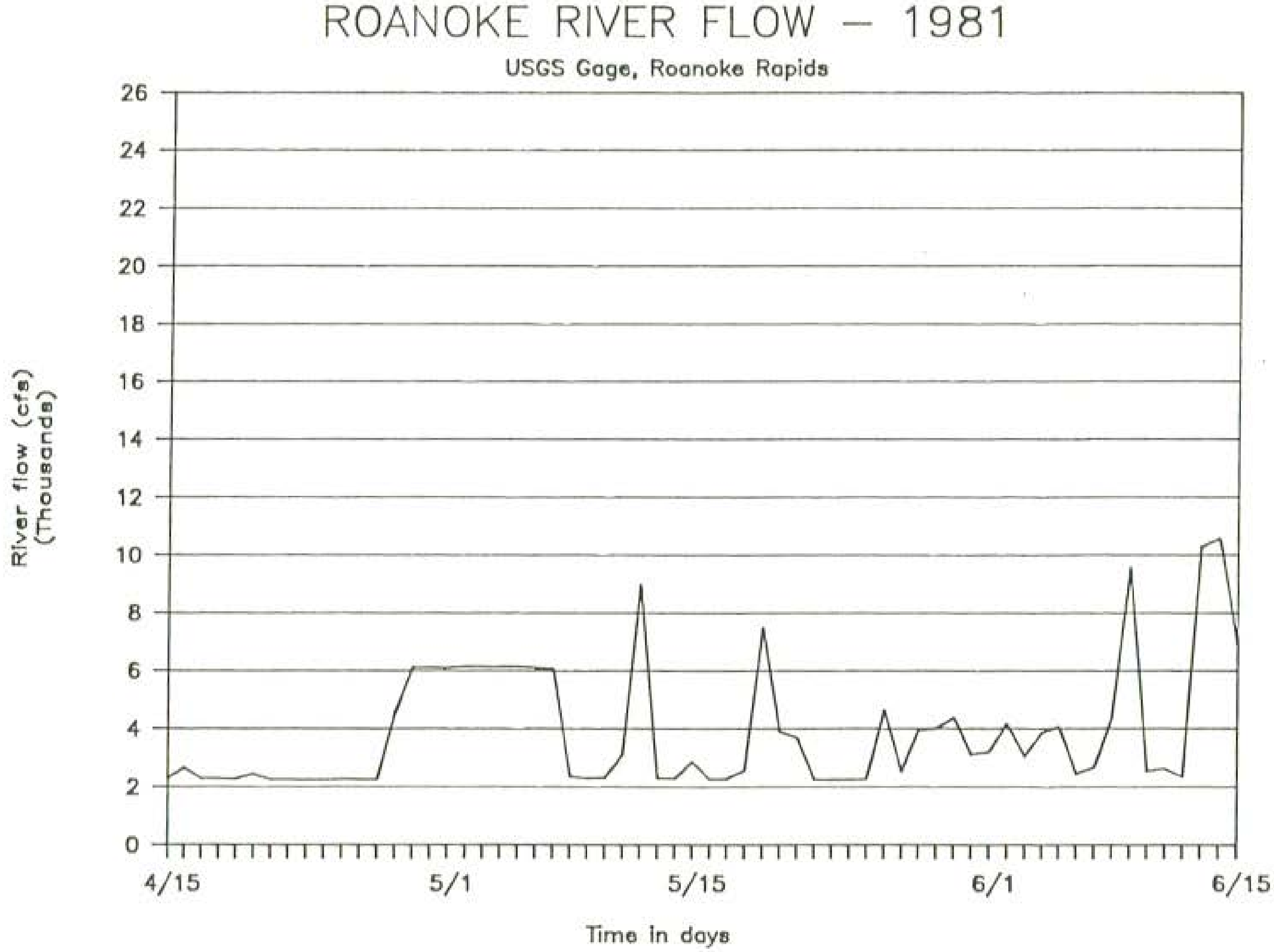
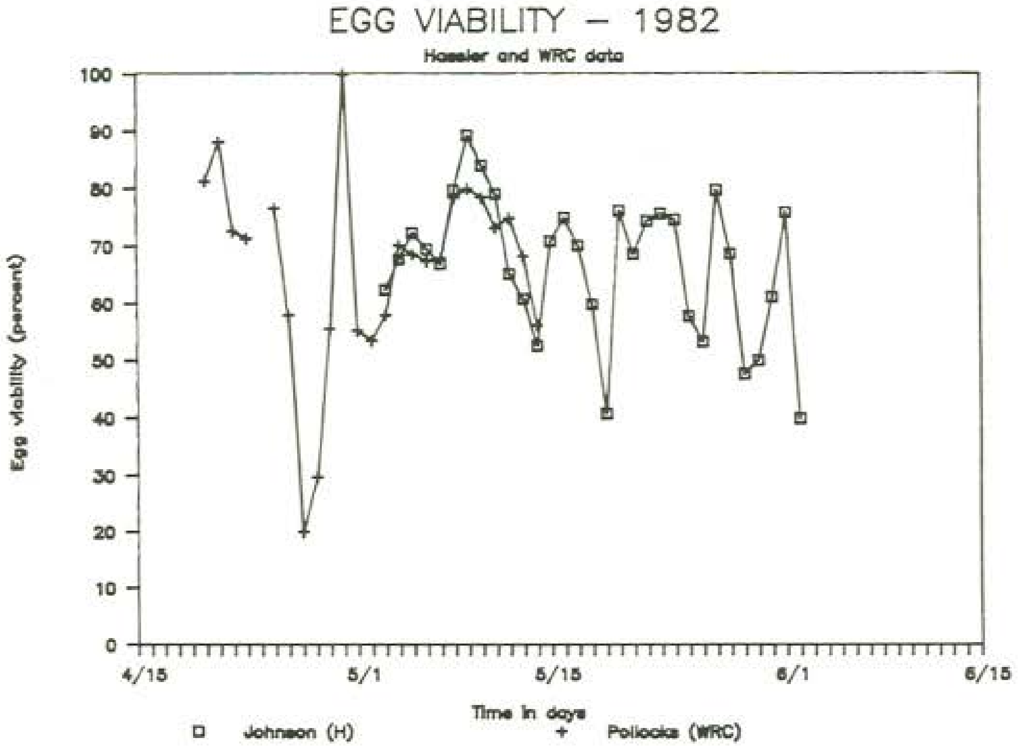



Figure 19. Average daily flow (cfs) of the Roanoke River for the period 15 April to 15 June 1981 (USGS data).



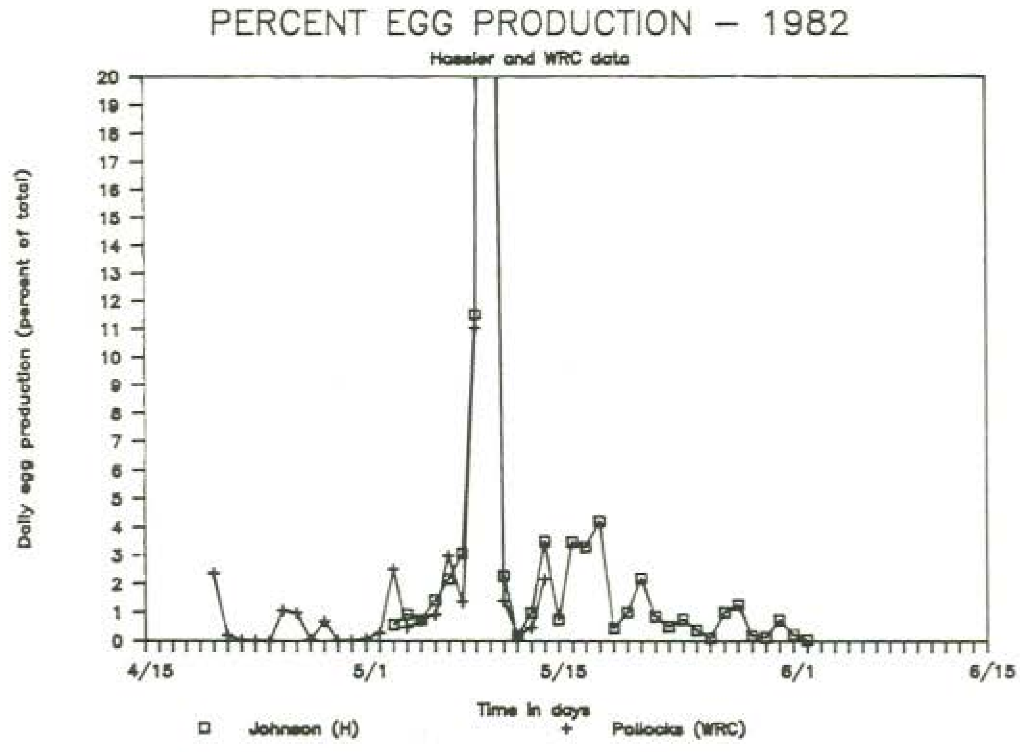




Figure 20. Daily estimates of striped bass egg production and viability in the Roanoke River by Hassler (Johnson's Landing) and the Wildlife Resources Commission (Pollock's Ferry) for the 1982 spawning season.

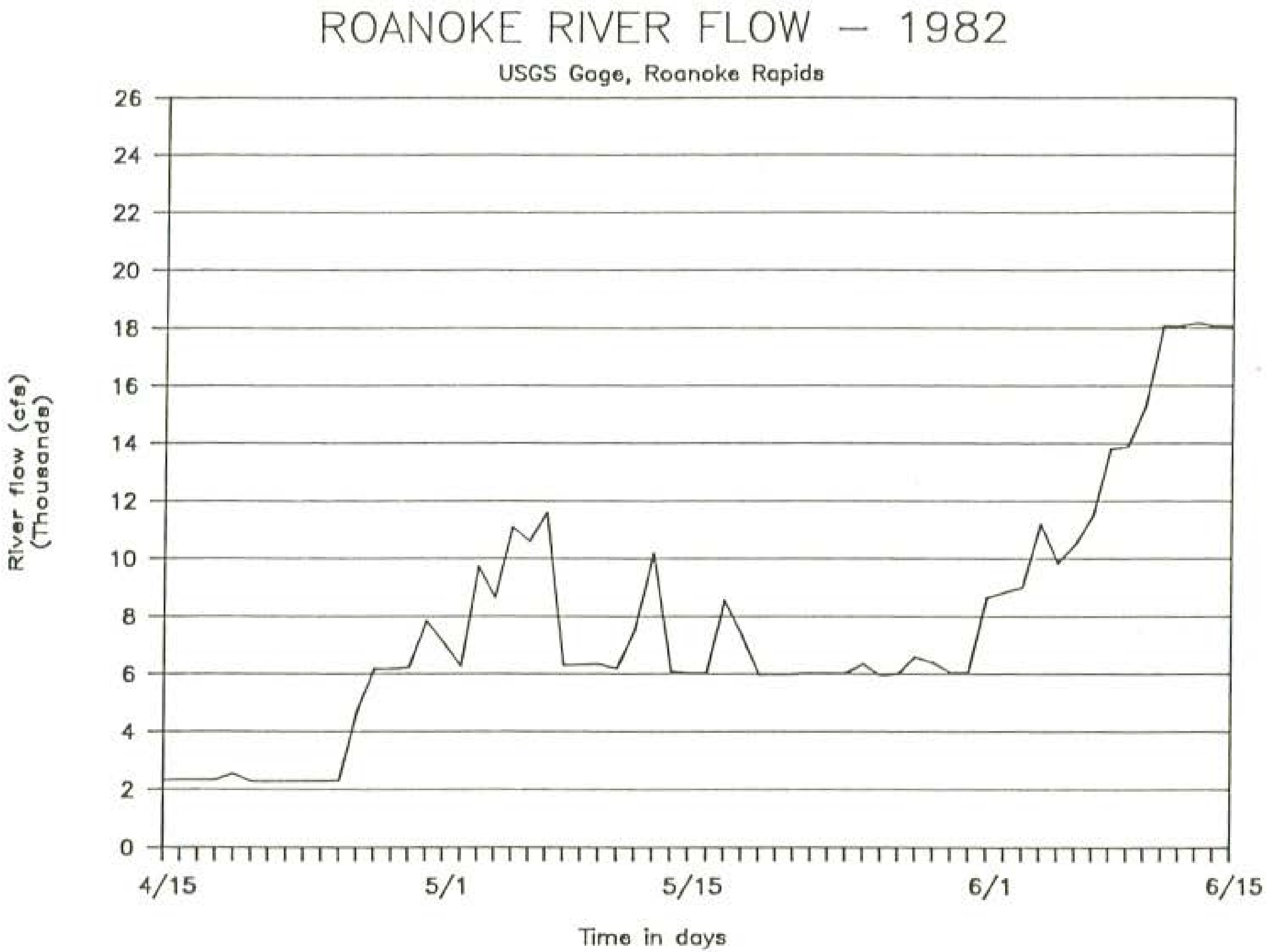



Figure 21. Average daily flow (cfs) of the Roanoke River for the period 15 April to 15 June 1982 (USGS data).

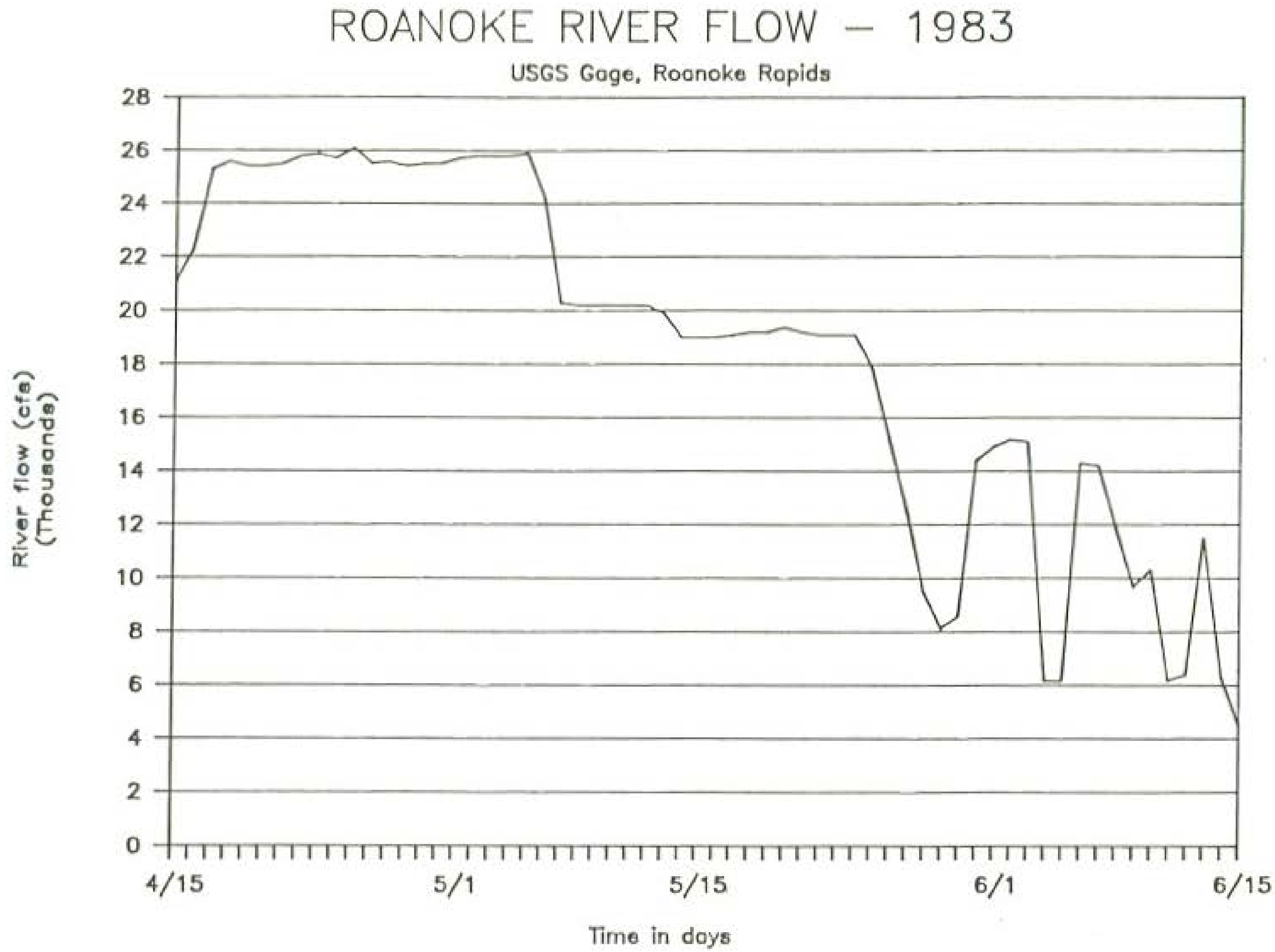



Figure 22. Average daily flow (cfs) of the Roanoke River for the period 15 April to 15 June 1983 (USGS data).

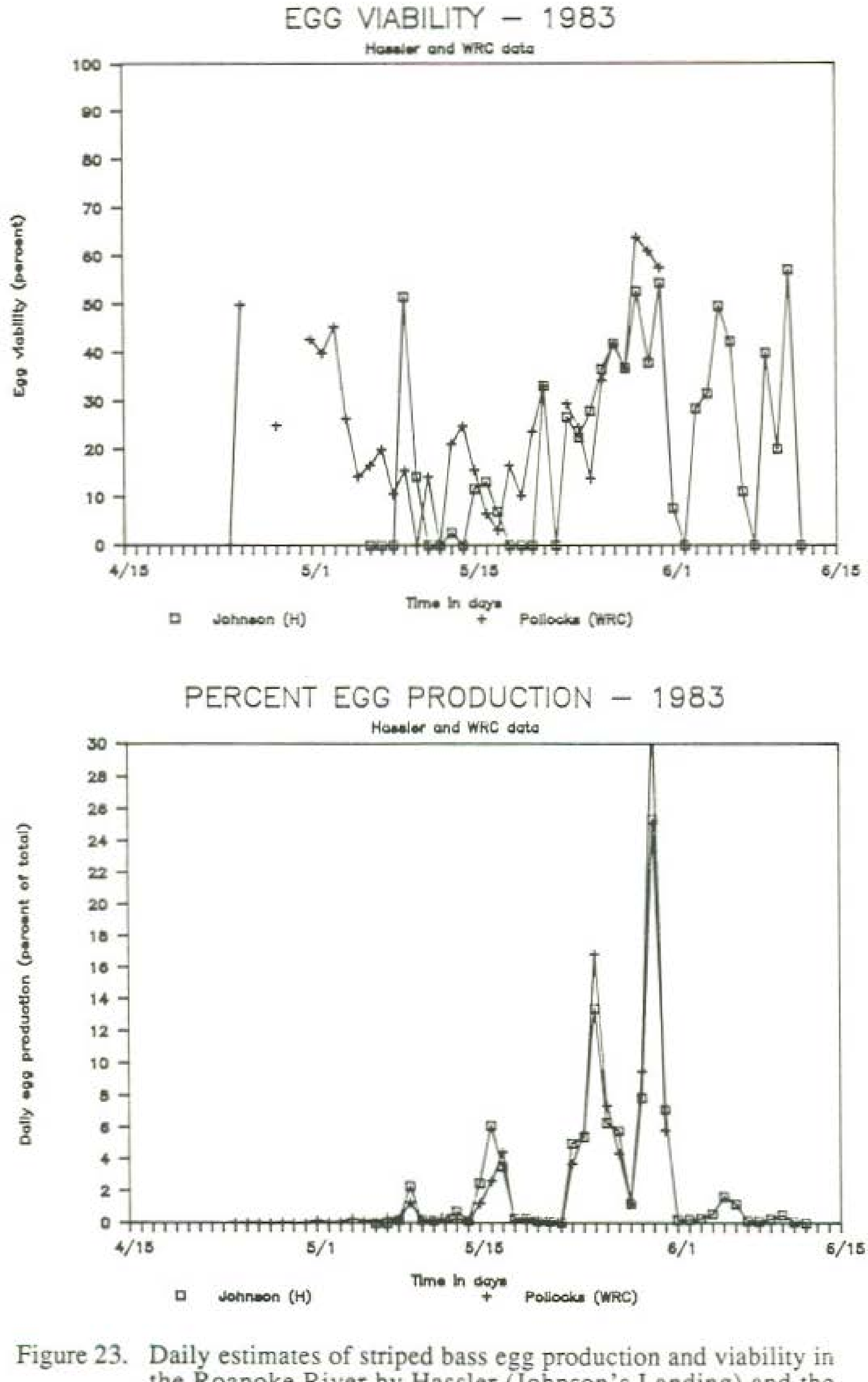



Figure 23. Daily estimates of striped bass egg production and viability in the Roanoke River by Hassler (Johnson's Landing) and the Wildlife Resources Commission (Pollock's Ferry) for the 1983 spawning season.

Table 1. Striped bass spawning in the Roanoke River, NC, as estimated from samples collected in surface waters at Barnhill's Landing, 1989.

| Date | Number samples | Average river stage (ft) | Area of river cross-section (sq.ft) | Average eggs/net | Est. no. eggs/day | Percentage of total spawning | Cumulative percentage of spawning |
|---|---|---|---|---|---|---|---|
| 890317 | 0 | . | . | . | . | . | . |
| 890323 | 0 | . | . | . | . | . | . |
| 890329 | 0 | . | . | . | . | . | . |
| 890406 | 2 | . | . | 0.00 | . | . | 0.00 |
| 890412 | 2 | . | . | 0.00 | . | . | 0.00 |
| 890414 | 0 | . | . | . | . | . | . |
| 890415 | 0 | . | . | . | . | . | . |
| 890416 | 8 | 8.0 | 2,445 | 0.13 | 157,193 | 0.02 | 0.02 |
| 890417 | 12 | 7.5 | 2,366 | 0.00 | 0 | 0.00 | 0.02 |
| 890418 | 12 | 6.0 | 2,128 | 0.00 | 0 | 0.00 | 0.02 |
| 890419 | 10 | 6.1 | 2,140 | 0.00 | 0 | 0.00 | 0.02 |
| 890420 | 12 | 6.0 | 2,133 | 0.00 | 0 | 0.00 | 0.02 |
| 890421 | 12 | 6.1 | 2,138 | 0.00 | 0 | 0.00 | 0.02 |
| 890422 | 12 | 5.9 | 2,115 | 0.00 | 0 | 0.00 | 0.02 |
| 890423 | 12 | 5.1 | 1,988 | 0.00 | 0 | 0.00 | 0.02 |
| 890424 | 10 | 5.0 | 1,969 | 0.00 | 0 | 0.00 | 0.02 |
| 890425 | 8 | 5.3 | 2,022 | 0.00 | 0 | 0.00 | 0.02 |
| 890426 | 8 | 2.7 | 1,625 | 0.00 | 0 | 0.00 | 0.02 |
| 890427 | 10 | 4.6 | 1,919 | 0.00 | 0 | 0.00 | 0.02 |
| 890428 | 12 | 1.7 | 1,487 | 2.58 | 1,975,890 | 0.31 | 0.33 |
| 890429 | 10 | 0.7 | 1,346 | 1.30 | 899,597 | 0.14 | 0.48 |
| 890430 | 10 | 1.9 | 1,518 | 6.80 | 5,307,658 | 0.83 | 1.31 |
| 890501 | 10 | 1.8 | 1,507 | 9.60 | 7,440,172 | 1.17 | 2.47 |
| 890502 | 10 | 7.4 | 2,349 | 6.00 | 7,249,576 | 1.14 | 3.61 |
| 890503 | 12 | 13.3 | 3,346 | 0.00 | 0 | 0.00 | 3.61 |
| 890504 | 12 | 14.2 | 3,510 | 0.58 | 1,053,124 | 0.17 | 3.78 |
| 890505 | 12 | 14.4 | 3,562 | 0.25 | 457,930 | 0.07 | 3.85 |
| 890506 | 10 | 14.2 | 3,513 | 0.00 | 0 | 0.00 | 3.85 |
| 890507 | 8 | 14.3 | 3,543 | 0.00 | 0 | 0.00 | 3.85 |
| 890508 | 12 | 14.8 | 3,627 | 0.00 | 0 | 0.00 | 3.85 |
| 890509 | 12 | 14.8 | 3,631 | 0.00 | 0 | 0.00 | 3.85 |
| 890510 | 12 | 14.8 | 3,634 | 0.00 | 0 | 0.00 | 3.85 |
| 890511 | 12 | 14.8 | 3,634 | 0.25 | 467,258 | 0.07 | 3.92 |
| 890512 | 12 | 14.9 | 3,652 | 0.00 | 0 | 0.00 | 3.92 |
| 890513 | 12 | 14.7 | 3,620 | 0.00 | 0 | 0.00 | 3.92 |
| 890514 | 12 | 14.7 | 3,624 | 0.00 | 0 | 0.00 | 3.92 |
| 890515 | 12 | 14.7 | 3,613 | 0.08 | 154,858 | 0.02 | 3.94 |
| 890516 | 10 | 14.8 | 3,634 | 0.00 | 0 | 0.00 | 3.94 |
| 890517 | 12 | 14.7 | 3,613 | 0.00 | 0 | 0.00 | 3.94 |
| 890518 | 12 | 14.7 | 3,606 | 0.33 | 618,239 | 0.10 | 4.04 |
| 890519 | 12 | 14.7 | 3,620 | 1.42 | 2,637,645 | 0.41 | 4.45 |
| 890520 | 12 | 14.6 | 3,589 | 3.00 | 5,537,258 | 0.87 | 5.32 |
| 890521 | 12 | 14.5 | 3,575 | 6.92 | 12,717,366 | 1.99 | 7.32 |
| 890522 | 12 | 14.5 | 3,572 | 15.25 | 28,012,436 | 4.39 | 11.71 |
| 890523 | 12 | 14.6 | 3,586 | 52.50 | 96,812,007 | 15.18 | 26.88 |
| 890524 | 12 | 14.7 | 3,617 | 40.58 | 75,487,716 | 11.83 | 38.72 |
| 890525 | 12 | 14.8 | 3,627 | 6.58 | 12,280,878 | 1.93 | 40.64 |

Table 1. *continued*

| Date | Number samples | Average river stage (ft) | Area of river cross-section (sq.ft) | Average eggs/net | Est. no. eggs/day | Percentage of total spawning | Cumulative percentage of spawning |
|---|---|---|---|---|---|---|---|
| 890526 | 12 | 14.7 | 3,617 | 28.75 | 53,477,171 | 8.38 | 49.03 |
| 890527 | 12 | 14.7 | 3,613 | 86.92 | 161,515,856 | 25.32 | 74.34 |
| 890528 | 12 | 14.7 | 3,613 | 14.33 | 26,635,405 | 4.18 | 78.52 |
| 890529 | 12 | 14.7 | 3,613 | 6.42 | 11,923,989 | 1.87 | 80.39 |
| 890530 | 12 | 11.8 | 3,083 | 6.75 | 10,701,231 | 1.68 | 82.07 |
| 890531 | 12 | 7.4 | 2,358 | 62.17 | 75,377,001 | 11.82 | 93.88 |
| 890601 | 12 | 5.6 | 2,065 | 25.92 | 27,529,283 | 4.32 | 98.20 |
| 890602 | 12 | 9.8 | 2,732 | 3.67 | 5,150,997 | 0.81 | 99.01 |
| 890603 | 12 | 8.1 | 2,469 | 0.67 | 846,596 | 0.13 | 99.14 |
| 890604 | 10 | 1.9 | 1,514 | 2.10 | 1,635,242 | 0.26 | 99.39 |
| 890605 | 12 | -1.4 | 1,075 | 1.83 | 1,013,250 | 0.16 | 99.55 |
| 890606 | 12 | -0.7 | 1,158 | 1.67 | 992,237 | 0.16 | 99.71 |
| 890607 | 12 | -1.1 | 1,114 | 1.25 | 716,138 | 0.11 | 99.82 |
| 890608 | 12 | 3.1 | 1,696 | 0.83 | 726,977 | 0.11 | 99.94 |
| 890609 | 12 | 4.6 | 1,918 | 0.42 | 410,989 | 0.06 | 100.00 |
| 890610 | 12 | 4.8 | 1,946 | 0.00 | 0 | 0.00 | 100.00 |
| 890611 | 10 | 4.8 | 1,941 | 0.00 | 0 | 0.00 | 100.00 |
| 890612 | 10 | 4.9 | 1,951 | 0.00 | 0 | 0.00 | 100.00 |
| 890613 | 10 | 8.1 | 2,463 | 0.00 | 0 | 0.00 | 100.00 |
| 890614 | 12 | 10.3 | 2,813 | 0.00 | 0 | 0.00 | 100.00 |
| 890615 | 6 | 10.4 | 2,840 | 0.00 | 0 | 0.00 | 100.00 |

Table 2. Estimated number of striped bass eggs spawned in the Roanoke River, NC, 1959-1987 (Hassler and co-workers, 1959-1987), 1988 (Rulifson 1989), and 1989 (this study). Egg production and viability data from 1959 through 1987 taken from Hassler and Maraveyias (1987).

| Year | Sampling Period | Number of eggs | Egg viability (%) | Site of egg collection |
|---|---|---|---|---|
| 1959 | 8 May-23 May[1] | 300,000,000 | 92.88 | Palmyra (RM 78.5) |
| 1960 | 23 Apr-8 Jun[1] | 740,000,000 | 92.88 | Palmyra |
| 1961 | 29 Apr-14 Jun | 2,065,232,519 | 79.24 | Halifax (RM 121) |
| 1962 | 24 Apr-5 Jun | 1,088,076,294 | 86.22 | Halifax |
| 1963 | 18 Apr-8 Jun[2] | 918,652,436 | 79.94 | Halifax |
| 1964 | 24 Apr-27 May | 1,285,351,276 | 95.77 | Halifax |
| 1965 | 21 Apr-28 May | 823,522,540 | 95.91 | Halifax |
| 1966 | 26 Apr-31 May | 1,821,385,754 | 94.51 | Halifax |
| 1967 | 21 Apr-11 Jun | 1,333,312,869 | 96.20 | Halifax |
| 1968 | 24 Apr-4 Jun | 1,483,102,338 | 86.20 | Halifax |
| 1969 | 27 Apr-6 Jun | 3,229,715,526 | 89.86 | Halifax |
| 1970 | 30 Apr-1 Jun | 1,464,841,490 | 89.23 | Halifax |
| 1971 | 1 May-2 Jun | 2,833,119,620 | 80.81 | Halifax |
| 1972 | 2 May-28 May | 4,932,000,707 | 90.51 | Halifax |
| 1973 | 29 Apr-3 Jun | 1,501,498,887 | 87.21 | Halifax |
| 1974 | 1 May-2 Jun | 2,163,239,468 | 87.31 | Halifax |
| 1975 | 7 May-2 Jun | 2,193,008,096 | 55.69 | Barnhill's (RM 117) |
| 1976 | 1 May-30 May | 1,496,768,659 | 50.73 | Barnhill's Landing |
| 1977 | 29 Apr-31 May | 1,775,957,318 | 52.72 | Barnhill's Landing |
| 1978 | 29 Apr-22 Jun | 1,691,227,585 | 37.72 | Barnhill's Landing |
| 1979 | 10 May-11 Jun | 1,613,382,382 | 43.62 | Barnhill's Landing |
| 1980 | 1 May-1 Jun | 870,322,832 | 43.39 | Barnhill's Landing |
| 1981 | 29 Apr-29 May | 344,364,065 | 73.70 | Barnhill's Landing |
| 1982 | 3 May-2 Jun | 1,698,888,853 | 71.93 | Johnson's (RM 118) |
| 1983 | 6 May-12 Jun | 1,352,611,202 | 33.29 | Johnson's Landing |
| 1984 | 9 May-9 Jun | 703,879,559 | 22.73 | Johnson's Landing |
| 1985 | 23 Apr-23 May | 600,562,645 | 72.21 | Johnson's Landing |
| 1986 | 28 Apr-31 May | 2,279,071,483 | 51.10 | Johnson's Landing |
| 1987 | 27 Apr-9 Jun | 1,382,496,006 | 42.87 | Johnson's Landing |
| 1988 | 10 Apr-7 Jun | 2,082,130,728 | 89.00 | Pollock's Ferry (RM 105) |
| 1989 | 16 Apr-15 Jun | 637,919,162 | 41.80 | Barnhill's Landing |

[1] Incomplete sampling season; estimates are partial.
[2] Spawning season interrupted from 21 April to 1 May because of an extensive fish kill just after a 10-day minimum flow period (Hassler et al. 1963).

Table 3. Striped bass egg viability at Barnhill's Landing, Roanoke River, NC, 1989.

| Date | Number samples | Number non-viable eggs | Number viable eggs | Percentage viable eggs |
|---|---|---|---|---|
| 890317 | 0 | . | . | . |
| 890323 | 0 | . | . | . |
| 890329 | 0 | . | . | . |
| 890406 | 2 | 0 | 0 | . |
| 890412 | 2 | 0 | 0 | . |
| 890414 | 0 | . | . | . |
| 890415 | 0 | . | . | . |
| 890416 | 8 | 1 | 0 | 0.00 |
| 890417 | 12 | 0 | 0 | . |
| 890418 | 12 | 0 | 0 | . |
| 890419 | 10 | 0 | 0 | . |
| 890420 | 12 | 0 | 0 | . |
| 890421 | 12 | 0 | 0 | . |
| 890422 | 12 | 0 | 0 | . |
| 890423 | 12 | 0 | 0 | . |
| 890424 | 10 | 0 | 0 | . |
| 890425 | 8 | 0 | 0 | . |
| 890426 | 8 | 0 | 0 | . |
| 890427 | 10 | 0 | 0 | . |
| 890428 | 12 | 23 | 8 | 25.81 |
| 890429 | 10 | 7 | 6 | 46.15 |
| 890430 | 10 | 22 | 46 | 67.65 |
| 890501 | 10 | 31 | 65 | 67.71 |
| 890502 | 10 | 30 | 30 | 50.00 |
| 890503 | 12 | 0 | 0 | . |
| 890504 | 12 | 4 | 3 | 43.86 |
| 890505 | 12 | 2 | 1 | 33.33 |
| 890506 | 10 | 0 | 0 | . |
| 890507 | 8 | 0 | 0 | . |
| 890508 | 12 | 0 | 0 | . |
| 890509 | 12 | 0 | 0 | . |
| 890510 | 12 | 0 | 0 | . |
| 890511 | 12 | 0 | 3 | 100.00 |
| 890512 | 12 | 0 | 0 | . |
| 890513 | 12 | 0 | 0 | . |
| 890514 | 12 | 0 | 0 | . |
| 890515 | 12 | 1 | 0 | 0.00 |
| 890516 | 10 | 0 | 0 | . |
| 890517 | 12 | 0 | 0 | . |
| 890518 | 12 | 3 | 1 | 25.00 |
| 890519 | 12 | 9 | 8 | 47.06 |
| 890520 | 12 | 18 | 18 | 50.00 |
| 890521 | 12 | 60 | 23 | 27.71 |
| 890522 | 12 | 115 | 68 | 37.16 |
| 890523 | 12 | 335 | 295 | 46.83 |
| 890524 | 12 | 210 | 277 | 56.88 |
| 890525 | 12 | 50 | 29 | 36.71 |
| 890526 | 12 | 213 | 132 | 38.26 |

Table 3. *continued*

| Date | Number samples | Number non-viable eggs | Number viable eggs | Percentage viable eggs |
|---|---|---|---|---|
| 890527 | 12 | 742 | 301 | 28.86 |
| 890528 | 12 | 117 | 55 | 31.98 |
| 890531 | 12 | 410 | 336 | 45.04 |
| 890601 | 12 | 179 | 132 | 42.44 |
| 890602 | 12 | 35 | 9 | 20.45 |
| 890603 | 12 | 8 | 0 | 0.00 |
| 890604 | 10 | 7 | 14 | 66.67 |
| 890605 | 12 | 8 | 14 | 63.64 |
| 890606 | 12 | 12 | 8 | 40.00 |
| 890607 | 12 | 4 | 11 | 73.33 |
| 890608 | 12 | 5 | 5 | 50.00 |
| 890609 | 12 | 1 | 4 | 80.00 |
| 890610 | 12 | 0 | 0 | . |
| 890611 | 10 | 0 | 0 | . |
| 890612 | 10 | 0 | 0 | . |
| 890613 | 10 | 0 | 0 | . |
| 890614 | 12 | 0 | 0 | . |
| 890615 | 6 | 0 | 0 | . |

Table 4. Striped bass egg viability at Barnhill's Landing, Roanoke River, NC, 1989, as a function of temperature.

| Temperature range (°C) | Number non-viable eggs | Number viable eggs | Percent viable eggs | Percent of all eggs collected |
|---|---|---|---|---|
| 14.0-15.9 | 1 | 1 | 50.00 | 0.042 |
| 16.0-17.9 | 82 | 62 | 43.06 | 3.050 |
| 18.0-19.9 | 1,006 | 900 | 47.22 | 40.364 |
| 20.0-21.9 | 1,451 | 829 | 36.36 | 48.285 |
| 22.0-23.9 | 208 | 176 | 45.83 | 8.132 |
| 24.0-25.9 | 0 | 6 | 0.00 | 0.127 |
| Totals | 2,748 | 1,974 | | 100.000 |

Table 5. Striped bass egg viability in surface waters of the Roanoke River at Barnhill's Landing, NC, 1989, as a function of surface water velocity.

| Water velocities (cm/second) | Number non-viable eggs | Number viable eggs | Percent viable eggs | Percent of all eggs collected |
|---|---|---|---|---|
| missing | 7 | 13 | 65.00 | 0.424 |
| 40.0-59.9 | 157 | 171 | 52.13 | 6.946 |
| 60.0-79.9 | 569 | 452 | 44.27 | 21.622 |
| 80.0-99.9 | 235 | 167 | 41.54 | 8.513 |
| 100.0-119.9 | 1,603 | 1,116 | 41.04 | 57.582 |
| 120.0-139.9 | 177 | 55 | 23.71 | 4.913 |
| | 2,748 | 1,974 | | 100.000 |

Table 6. Striped bass egg viability at Barnhill's Landing, Roanoke River, NC, 1989, as a function of time of day.

| Time of collection | Number non-viable eggs | Number viable eggs | Percent viable eggs | Percent of all eggs collected |
|---|---|---|---|---|
| 0200 | 530 | 322 | 37.79 | 18.043 |
| 0600 | 753 | 581 | 43.55 | 28.251 |
| 1000 | 624 | 409 | 39.59 | 21.876 |
| 1400 | 307 | 201 | 39.57 | 10.758 |
| 1800 | 171 | 127 | 42.62 | 6.311 |
| 2200 | 363 | 334 | 47.92 | 14.761 |
| | 2,748 | 1,974 | | 100.000 |

Table 7. Striped bass egg viability in surface waters of the Roanoke River at Barnhill's Landing, NC, 1989, as a function of dissolved oxygen (mg/L).

| Dissolved oxygen values | Number non-viable eggs | Number viable eggs | Percent viable eggs | Percent of all eggs collected |
|---|---|---|---|---|
| missing | 1 | 1 | 50.00 | 0.042 |
| 6.0-6.9 | 0 | 0 | 0.00 | 0.000 |
| 7.0-7.9 | 674 | 636 | 48.55 | 27.742 |
| 8.0-8.9 | 2,059 | 1,331 | 39.26 | 71.792 |
| 9.0-9.9 | 14 | 6 | 30.00 | 0.424 |
| | 2,748 | 1,974 | | 100.000 |

Table 8. Striped bass egg viability in surface waters of the Roanoke River at Barnhill's Landing, North Carolina, 1989, as a function of pH.

| Range of pH values | Number non-viable eggs | Number viable eggs | Percent viable eggs | Percent of all eggs collected |
|---|---|---|---|---|
| missing | 78 | 65 | 45.45 | 3.028 |
| 6.50-6.74 | 12 | 15 | 55.56 | 0.572 |
| 6.75-6.99 | 23 | 35 | 60.34 | 1.228 |
| 7.00-7.24 | 16 | 49 | 75.38 | 1.377 |
| 7.25-7.49 | 105 | 60 | 36.36 | 3.494 |
| 7.50-7.74 | 137 | 124 | 47.51 | 5.527 |
| 7.75-7.99 | 1,137 | 639 | 35.98 | 37.611 |
| 8.0 or more | 1,240 | 987 | 44.32 | 47.162 |
| | 2,748 | 1,974 | | 100.000 |

Table 9. Raw data and egg production estimates by trip for striped bass at Barnhill's Landing, Roanoke River, North Carolina, in 1989. Combined production is the average of all samples.

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890317 | 1437 | . | . | . | . | . | . | . | . | . |
| 890323 | 1030 | . | . | . | . | . | . | . | . | . |
| 890329 | 1043 | . | . | . | . | . | . | . | . | . |
| 890406 | 1042 | 0 | 0 | 0 | 0 | . | . | . | . | . |
| 890412 | 1035 | 0 | 0 | 0 | 0 | . | . | . | . | . |
| 890414 | 1800 | . | . | . | . | . | . | . | . | . |
| | 2200 | . | . | . | . | . | . | . | . | . |
| 890415 | 600 | . | . | . | . | . | . | . | . | . |
| | 1000 | . | . | . | . | . | . | . | . | . |
| | 1800 | . | . | . | . | . | . | . | . | . |
| 890416 | 1000 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| | 1400 | 0 | 1 | 0 | 0 | 8.0 | 2,445 | 2,183 | 0 | 1,092 |
| | 1800 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| 890417 | 200 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 8.0 | 2,445 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 7.0 | 2,286 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| 890418 | 200 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 5.8 | 2,096 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 5.9 | 2,112 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890419 | 200 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| 890420 | 200 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| 890421 | 200 | 0 | 0 | 0 | 0 | 5.9 | 2,112 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 6.1 | 2,143 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 6.4 | 2,191 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 2 | 6.0 | 2,128 | 0 | 3,799 | 1,900 |
| 890422 | 200 | 0 | 0 | 0 | 0 | 6.0 | 2,128 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 5.8 | 2,096 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 6.3 | 2,175 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 5.8 | 2,096 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 5.8 | 2,096 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 5.8 | 2,096 | 0 | 0 | 0 |
| 890423 | 200 | 0 | 0 | 0 | 0 | 5.8 | 2,096 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 5.1 | 1,987 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 5.9 | 2,112 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 4.5 | 1,895 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 4.5 | 1,895 | 0 | 0 | 0 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890424 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | 0 | 0 | 0 | 0 | 4.3 | 1,864 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 5.0 | 1,972 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 5.3 | 2,018 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 5.5 | 2,050 | 0 | 0 | 0 |
| 890425 | 200 | 0 | 0 | 0 | 0 | 5.6 | 2,065 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 5.3 | 2,018 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 5.3 | 2,018 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 5.1 | 1,987 | 0 | 0 | 0 |
| | 1800 | . | . | . | . | . | . | . | . | . |
| | 2200 | . | . | . | . | . | . | . | . | . |
| 890426 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | . | . | . | . | . | . | . | . | . |
| | 1000 | 0 | 0 | 0 | 1 | 4.5 | 1,895 | 0 | 1,692 | 846 |
| | 1400 | 0 | 0 | 0 | 0 | 1.9 | 1,512 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 1.7 | 1,484 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 2.6 | 1,610 | 0 | 0 | 0 |
| 890427 | 200 | 0 | 0 | 0 | 0 | 3.5 | 1,743 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1000 | . | . | . | . | 5.4 | 2,034 | . | . | . |
| | 1400 | 0 | 0 | 0 | 0 | 5.4 | 2,034 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 5.0 | 1,972 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 3.8 | 1,788 | 0 | 0 | 0 |
| 890428 | 200 | 0 | 0 | 0 | 0 | 2.8 | 1,639 | 0 | 0 | 0 |
| | 600 | 3 | 5 | 5 | 9 | 2.0 | 1,526 | 10,898 | 19,071 | 14,985 |
| | 1000 | 8 | 7 | 17 | 22 | 1.7 | 1,484 | 19,876 | 51,678 | 35,777 |
| | 1400 | 5 | 3 | 6 | 0 | 1.5 | 1,457 | 10,404 | 7,803 | 9,104 |
| | 1800 | 0 | 0 | 0 | 0 | 1.3 | 1,429 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 1.0 | 1,389 | 0 | 0 | 0 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890429 | 200 | 0 | 0 | 0 | 0 | 0.8 | 1,362 | 0 | 0 | 0 |
| | 600 | 4 | 1 | 1 | 1 | 0.6 | 1,335 | 5,958 | 2,383 | 4,171 |
| | 1000 | 0 | 0 | 4 | 0 | 0.5 | 1,321 | 0 | 4,719 | 2,359 |
| | 1400 | 0 | 0 | 0 | 0 | 1.0 | 1,389 | 0 | 0 | 0 |
| | 1800 | 4 | 4 | 3 | 5 | 0.5 | 1,321 | 9,438 | 9,438 | 9,438 |
| | 2200 | . | . | . | . | . | . | . | . | . |
| 890430 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | 8 | 13 | 20 | 15 | 1.2 | 1,416 | 26,544 | 44,241 | 35,392 |
| | 1000 | 3 | 19 | 4 | 0 | 2.1 | 1,540 | 30,244 | 5,499 | 17,872 |
| | 1800 | 1 | 2 | 0 | 5 | 2.1 | 1,540 | 4,124 | 6,874 | 5,499 |
| | 1400 | 9 | 2 | 7 | 5 | 2.2 | 1,554 | 15,260 | 16,647 | 15,953 |
| | 2200 | 7 | 4 | 6 | 15 | 2.1 | 1,540 | 15,122 | 28,869 | 21,996 |
| 890501 | 200 | . | . | . | . | 2.0 | 1,526 | . | . | . |
| | 600 | 15 | 9 | 10 | 8 | 1.0 | 1,389 | 29,758 | 22,318 | 26,038 |
| | 1000 | 11 | 19 | 16 | 16 | 1.3 | 1,429 | 38,285 | 40,837 | 39,561 |
| | 1400 | 14 | 9 | 12 | 5 | 1.2 | 1,416 | 29,072 | 21,488 | 25,280 |
| | 1800 | 3 | 4 | . | . | 2.1 | 1,540 | 9,623 | . | 9,623 |
| | 2200 | 4 | 8 | 4 | 16 | 3.5 | 1,743 | 18,672 | 31,120 | 24,896 |
| 890502 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | 14 | 15 | 11 | 5 | 5.5 | 2,050 | 53,067 | 29,279 | 41,173 |
| | 1000 | 4 | 12 | 11 | 17 | 5.9 | 2,112 | 30,170 | 52,797 | 41,484 |
| | 1400 | 4 | 3 | 1 | 7 | 6.4 | 2,191 | 13,691 | 15,647 | 14,669 |
| | 1800 | 3 | 4 | 3 | 4 | 8.3 | 2,494 | 15,584 | 15,584 | 15,584 |
| | 2200 | 1 | 0 | 0 | 0 | 10.8 | 2,901 | 2,591 | 0 | 1,295 |
| 890503 | 200 | 0 | 0 | 0 | 3 | 12.1 | 3,124 | 0 | 8,367 | 4,183 |
| | 600 | 0 | 0 | 0 | 3 | 13.0 | 3,284 | 0 | 8,796 | 4,398 |
| | 1000 | 0 | 0 | 0 | 0 | 13.5 | 3,375 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 13.6 | 3,393 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 1 | 0 | 13.8 | 3,430 | 0 | 3,062 | 1,531 |
| | 2200 | 0 | 0 | 0 | 0 | 14.0 | 3,470 | 0 | 0 | 0 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890504 | 200 | 2 | 0 | 0 | 0 | 14.5 | 3,572 | 6,378 | 0 | 3,189 |
| | 600 | 2 | 3 | 0 | 2 | 14.3 | 3,531 | 15,761 | 6,304 | 11,033 |
| | 1000 | 0 | 0 | 0 | 1 | 14.4 | 3,551 | 0 | 3,171 | 1,585 |
| | 1400 | 0 | 0 | 0 | 0 | 13.8 | 3,430 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 1 | 14.0 | 3,470 | 0 | 3,098 | 1,549 |
| | 2200 | 0 | 0 | 0 | 0 | 14.2 | 3,510 | 0 | 0 | 0 |
| 890505 | 200 | 0 | 0 | 0 | 0 | 14.0 | 3,470 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.3 | 3,531 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.5 | 3,572 | 0 | 0 | 0 |
| | 1400 | 2 | 1 | 3 | 1 | 14.6 | 3,592 | 9,622 | 12,830 | 11,226 |
| | 1800 | 0 | 0 | 0 | 0 | 14.5 | 3,572 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| 890506 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | 0 | 0 | 1 | 0 | 14.7 | 3,613 | 0 | 3,226 | 1,613 |
| | 1000 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 11.8 | 3,071 | 0 | 0 | 0 |
| 890507 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | . | . | . | . | . | . | . | . | . |
| | 1000 | 0 | 0 | 0 | 0 | 13.8 | 3,430 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 13.8 | 3,430 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.9 | 3,656 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.9 | 3,656 | 0 | 0 | 0 |
| 890508 | 200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.6 | 3,592 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg pro-duction Surface | Egg pro-duction Oblique | Egg pro-duction Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890509 | 200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| 890510 | 200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| 890511 | 200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1800 | 2 | 0 | 0 | 1 | 14.8 | 3,634 | 6,490 | 3,245 | 4,867 |
| | 2200 | 0 | 1 | 0 | 0 | 14.8 | 3,634 | 3,245 | 0 | 1,622 |
| 890512 | 200 | 0 | 0 | 0 | 0 | 15.0 | 3,677 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 15.0 | 3,677 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.9 | 3,656 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| 890513 | 200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890514 | 200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| 890515 | 200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.5 | 3,572 | 0 | 0 | 0 |
| | 1800 | 0 | 1 | 1 | 0 | 14.7 | 3,613 | 3,226 | 3,226 | 3,226 |
| | 2200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| 890516 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| 890517 | 200 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.8 | 3,634 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 14.5 | 3,572 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| 890518 | 200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 2 | 0 | 14.5 | 3,572 | 0 | 6,378 | 3,189 |
| | 1800 | 0 | 1 | 2 | 1 | 14.7 | 3,613 | 3,226 | 9,678 | 6,452 |
| | 2200 | 0 | 3 | 0 | 0 | 14.7 | 3,613 | 9,678 | 0 | 4,839 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890519 | 200 | 0 | 0 | 0 | 0 | 14.7 | 3,613 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 1 | 8 | 14.7 | 3,613 | 0 | 29,035 | 14,518 |
| | 1000 | 0 | 2 | 1 | 0 | 14.8 | 3,634 | 6,490 | 3,245 | 4,867 |
| | 1400 | 3 | 0 | 5 | 1 | 14.8 | 3,634 | 9,734 | 19,469 | 14,602 |
| | 1800 | 0 | 5 | 0 | 3 | 14.7 | 3,613 | 16,131 | 9,678 | 12,905 |
| | 2200 | 2 | 5 | 0 | 1 | 14.7 | 3,613 | 22,583 | 3,226 | 12,905 |
| 890520 | 200 | 1 | 0 | 0 | 0 | 14.7 | 3,613 | 3,226 | 0 | 1,613 |
| | 600 | 2 | 2 | 5 | 3 | 14.6 | 3,592 | 12,830 | 25,659 | 19,244 |
| | 1000 | 5 | 3 | 5 | 2 | 14.5 | 3,572 | 25,512 | 22,323 | 23,918 |
| | 1400 | 2 | 12 | 0 | 3 | 14.5 | 3,572 | 44,646 | 9,567 | 27,107 |
| | 1800 | 4 | 1 | 3 | 1 | 14.6 | 3,592 | 16,037 | 12,830 | 14,433 |
| | 2200 | 2 | 2 | 0 | 7 | 14.6 | 3,592 | 12,830 | 22,452 | 17,641 |
| 890521 | 200 | 0 | 4 | 3 | 1 | 14.6 | 3,592 | 12,830 | 12,830 | 12,830 |
| | 600 | 0 | 3 | 1 | 5 | 14.5 | 3,572 | 9,567 | 19,134 | 14,351 |
| | 1000 | 4 | 9 | 22 | 29 | 14.5 | 3,572 | 41,457 | 162,640 | 102,049 |
| | 1400 | 23 | 28 | 28 | 35 | 14.5 | 3,572 | 162,640 | 200,908 | 181,774 |
| | 1800 | 2 | 8 | 5 | 8 | 14.5 | 3,572 | 31,890 | 41,457 | 36,674 |
| | 2200 | 1 | 1 | 3 | 1 | 14.5 | 3,572 | 6,378 | 12,756 | 9,567 |
| 890522 | 200 | 4 | 2 | 1 | 5 | 14.5 | 3,572 | 19,134 | 19,134 | 19,134 |
| | 600 | 39 | 11 | 19 | 51 | 14.6 | 3,592 | 160,371 | 224,519 | 192,445 |
| | 1000 | 18 | 43 | 45 | 41 | 14.5 | 3,572 | 194,530 | 274,255 | 234,393 |
| | 1400 | 9 | 14 | 28 | 10 | 14.4 | 3,551 | 72,922 | 120,480 | 96,701 |
| | 1800 | 18 | 14 | 9 | 15 | 14.5 | 3,572 | 102,049 | 76,536 | 89,292 |
| | 2200 | 6 | 5 | 5 | 9 | 14.5 | 3,572 | 35,079 | 44,646 | 39,863 |
| 890523 | 200 | 2 | 2 | 11 | 9 | 14.5 | 3,572 | 12,756 | 63,780 | 38,268 |
| | 600 | 183 | 93 | 103 | 361 | 14.7 | 3,613 | 890,420 | 1,496,938 | 1,193,679 |
| | 1000 | 98 | 42 | 66 | 140 | 14.4 | 3,551 | 443,875 | 653,130 | 548,503 |
| | 1400 | 41 | 83 | 55 | 53 | 14.4 | 3,551 | 393,146 | 342,418 | 367,782 |
| | 1800 | 34 | 8 | 4 | 17 | 14.7 | 3,613 | 135,499 | 67,749 | 101,624 |
| | 2200 | 11 | 33 | . | . | 14.7 | 3,613 | 141,951 | . | 141,951 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890524 | 200 | 42 | 21 | 31 | 59 | 14.7 | 3,613 | 203,248 | 290,354 | 246,801 |
| | 600 | 81 | 88 | 90 | 78 | 14.7 | 3,613 | 545,221 | 541,995 | 543,608 |
| | 1000 | 86 | 79 | 83 | 48 | 14.7 | 3,613 | 532,316 | 422,627 | 477,472 |
| | 1400 | 16 | 65 | 29 | 32 | 14.6 | 3,592 | 259,800 | 195,652 | 227,726 |
| | 1800 | 7 | 2 | 6 | 9 | 14.8 | 3,634 | 29,203 | 48,672 | 38,938 |
| | 2200 | 0 | 0 | 4 | 6 | 14.8 | 3,634 | 0 | 32,448 | 16,224 |
| 890525 | 200 | 2 | 6 | 2 | 3 | 14.8 | 3,634 | 25,959 | 16,224 | 21,091 |
| | 600 | 22 | 15 | 13 | 10 | 14.8 | 3,634 | 120,058 | 74,631 | 97,345 |
| | 1000 | 3 | 6 | 9 | 7 | 14.8 | 3,634 | 29,203 | 51,917 | 40,560 |
| | 1400 | 8 | 11 | 21 | 16 | 14.8 | 3,634 | 61,652 | 120,058 | 90,855 |
| | 1800 | 1 | 5 | 3 | 5 | 14.7 | 3,613 | 19,357 | 25,809 | 22,583 |
| | 2200 | 0 | 0 | 3 | 0 | 14.7 | 3,613 | 0 | 9,678 | 4,839 |
| 890526 | 200 | 5 | 7 | 9 | 5 | 14.7 | 3,613 | 38,714 | 45,166 | 41,940 |
| | 600 | 5 | 36 | 40 | 16 | 14.7 | 3,613 | 132,273 | 180,665 | 156,469 |
| | 1000 | 39 | 52 | . | . | 14.7 | 3,613 | 293,581 | . | 293,581 |
| | 1400 | 3 | 8 | 5 | 1 | 14.8 | 3,634 | 35,693 | 19,469 | 27,581 |
| | 1800 | 7 | 2 | 3 | 6 | 14.7 | 3,613 | 29,035 | 29,035 | 29,035 |
| | 2200 | 87 | 94 | 113 | 69 | 14.7 | 3,613 | 583,935 | 587,161 | 585,548 |
| 890527 | 200 | 168 | 247 | 163 | 196 | 14.7 | 3,613 | 1,338,856 | 1,158,192 | 1,248,524 |
| | 600 | 206 | 141 | 175 | 234 | 14.7 | 3,613 | 1,119,478 | 1,319,500 | 1,219,489 |
| | 1000 | 123 | 92 | 69 | 63 | 14.7 | 3,613 | 693,624 | 425,853 | 559,739 |
| | 1400 | 10 | 15 | 10 | 19 | 14.7 | 3,613 | 80,654 | 93,559 | 87,106 |
| | 1800 | 5 | 11 | 4 | 13 | 14.7 | 3,613 | 51,619 | 54,845 | 53,232 |
| | 2200 | 12 | 13 | 17 | 25 | 14.7 | 3,613 | 80,654 | 135,499 | 108,076 |
| 890528 | 200 | 18 | 44 | 55 | 21 | 14.7 | 3,613 | 200,022 | 245,188 | 222,605 |
| | 600 | 45 | 23 | 18 | 14 | 14.7 | 3,613 | 219,379 | 103,237 | 161,308 |
| | 1000 | 2 | 15 | 5 | 7 | 14.7 | 3,613 | 54,845 | 38,714 | 46,779 |
| | 1400 | 5 | 4 | 7 | 5 | 14.7 | 3,613 | 29,035 | 38,714 | 33,875 |
| | 1800 | 0 | 0 | 1 | 0 | 14.7 | 3,613 | 0 | 3,226 | 1,613 |
| | 2200 | 4 | 12 | 12 | 15 | 14.7 | 3,613 | 51,619 | 87,106 | 69,362 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890529 | 200 | 9 | 17 | 4 | 24 | 14.7 | 3,613 | 83,880 | 90,332 | 87,106 |
| | 600 | 5 | 8 | 8 | 3 | 14.7 | 3,613 | 41,940 | 35,488 | 38,714 |
| | 1000 | 0 | 3 | 5 | 2 | 14.7 | 3,613 | 9,678 | 22,583 | 16,131 |
| | 1400 | 1 | 0 | 2 | 5 | 14.7 | 3,613 | 3,226 | 22,583 | 12,905 |
| | 1800 | 7 | 3 | 4 | 3 | 14.7 | 3,613 | 32,262 | 22,583 | 27,422 |
| | 2200 | 4 | 20 | 10 | 8 | 14.7 | 3,613 | 77,428 | 58,071 | 67,749 |
| 890530 | 200 | 10 | 13 | 16 | 14 | 14.4 | 3,551 | 72,922 | 95,116 | 84,019 |
| | 600 | 15 | 6 | 5 | 4 | 14.3 | 3,531 | 66,197 | 28,370 | 47,283 |
| | 1000 | 6 | 10 | 18 | 13 | 12.0 | 3,106 | 44,370 | 85,967 | 65,168 |
| | 1400 | 11 | 0 | 4 | 8 | 10.7 | 2,885 | 28,333 | 30,909 | 29,621 |
| | 1800 | 3 | 3 | 2 | 1 | 10.0 | 2,769 | 14,833 | 7,417 | 11,125 |
| | 2200 | 2 | 2 | 5 | 3 | 9.3 | 2,655 | 9,481 | 18,962 | 14,222 |
| 890531 | 200 | 30 | 35 | 24 | 56 | 8.7 | 2,558 | 148,450 | 182,707 | 165,578 |
| | 600 | 80 | 40 | 102 | 159 | 8.0 | 2,445 | 261,986 | 569,819 | 415,902 |
| | 1000 | 82 | 83 | 56 | 75 | 7.5 | 2,365 | 348,430 | 276,632 | 312,531 |
| | 1400 | 31 | 32 | 48 | 25 | 7.2 | 2,317 | 130,348 | 151,038 | 140,693 |
| | 1800 | 24 | 41 | 84 | 62 | 6.8 | 2,254 | 130,801 | 293,799 | 212,300 |
| | 2200 | 141 | 127 | 61 | 137 | 6.5 | 2,206 | 527,960 | 390,060 | 459,010 |
| 890601 | 200 | 53 | 71 | 72 | 75 | 6.1 | 2,143 | 237,294 | 281,308 | 259,301 |
| | 600 | 43 | 21 | 19 | 21 | 5.7 | 2,081 | 118,891 | 74,307 | 96,599 |
| | 1000 | 15 | 23 | 18 | 12 | 5.0 | 1,972 | 66,904 | 52,819 | 59,861 |
| | 1400 | 7 | 3 | 30 | 14 | 5.3 | 2,018 | 18,021 | 79,294 | 48,658 |
| | 1800 | 9 | 14 | 19 | 13 | 5.0 | 1,972 | 40,494 | 56,340 | 48,417 |
| | 2200 | 28 | 24 | 45 | 28 | 6.5 | 2,206 | 102,440 | 143,810 | 123,125 |
| 890602 | 200 | 9 | 6 | 7 | 15 | 8.3 | 2,494 | 33,395 | 48,979 | 41,187 |
| | 600 | 4 | 3 | 3 | 11 | 9.5 | 2,687 | 16,795 | 33,590 | 25,192 |
| | 1000 | 0 | 0 | 2 | 3 | 9.8 | 2,736 | 0 | 12,215 | 6,108 |
| | 1400 | 0 | 2 | 1 | 2 | 9.8 | 2,736 | 4,886 | 7,329 | 6,108 |
| | 1800 | 5 | 6 | 1 | 6 | 10.4 | 2,835 | 27,843 | 17,718 | 22,780 |
| | 2200 | 4 | 5 | 0 | 0 | 10.8 | 2,901 | 23,315 | 0 | 11,657 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890603 | 200 | 0 | 2 | 2 | 0 | 10.9 | 2,918 | 5,211 | 5,211 | 5,211 |
| | 600 | 2 | 3 | 1 | 5 | 9.6 | 2,704 | 12,069 | 14,483 | 13,276 |
| | 1000 | 0 | 0 | 0 | 0 | 7.4 | 2,349 | 0 | 0 | 0 |
| | 1400 | 1 | 0 | 0 | 0 | 8.0 | 2,445 | 2,183 | 0 | 1,092 |
| | 1800 | 0 | 0 | 0 | 0 | 7.6 | 2,381 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 1 | 1 | 5.3 | 2,018 | 0 | 3,604 | 1,802 |
| 890604 | 200 | 1 | 1 | 2 | 3 | 4.0 | 1,818 | 3,247 | 8,117 | 5,682 |
| | 600 | 0 | 2 | 1 | 0 | 2.7 | 1,625 | 2,901 | 1,451 | 2,176 |
| | 1000 | 0 | 2 | 0 | 2 | 2.3 | 1,568 | 2,800 | 2,800 | 2,800 |
| | 1400 | 3 | 4 | 3 | 1 | 1.8 | 1,498 | 9,362 | 5,350 | 7,356 |
| | 1800 | 3 | 5 | 7 | 10 | 0.5 | 1,321 | 9,438 | 20,055 | 14,747 |
| | 2200 | . | . | . | . | 0.0 | 1,255 | . | . | . |
| 890605 | 200 | 3 | 10 | 12 | 3 | -0.1 | 1,241 | 14,409 | 16,626 | 15,517 |
| | 600 | 3 | 5 | 1 | 4 | -1.5 | 1,057 | 7,549 | 4,718 | 6,134 |
| | 1000 | 0 | 0 | 0 | 0 | -1.4 | 1,070 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | -1.4 | 1,070 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | -1.9 | 1,005 | 0 | 0 | 0 |
| | 2200 | 0 | 1 | . | . | -1.9 | 1,005 | 897 | . | 897 |
| 890606 | 200 | 0 | 0 | . | . | -0.4 | 1,202 | 0 | . | 0 |
| | 600 | 1 | 1 | 0 | 0 | -0.7 | 1,162 | 2,075 | 0 | 1,037 |
| | 1000 | 0 | 0 | 1 | 0 | -0.9 | 1,136 | 0 | 1,014 | 507 |
| | 1400 | 0 | 0 | 0 | 0 | -0.8 | 1,149 | 0 | 0 | 0 |
| | 1800 | 4 | 4 | 1 | 0 | -0.8 | 1,149 | 8,206 | 1,026 | 4,616 |
| | 2200 | 2 | 8 | 5 | 4 | -0.8 | 1,149 | 10,257 | 9,231 | 9,744 |
| 890607 | 200 | 1 | 3 | 0 | 0 | -0.8 | 1,149 | 4,103 | 0 | 2,051 |
| | 600 | 1 | 2 | 1 | 0 | -1.5 | 1,057 | 2,831 | 944 | 1,887 |
| | 1000 | 3 | 1 | 0 | 0 | -1.5 | 1,057 | 3,775 | 0 | 1,887 |
| | 1400 | 0 | 0 | 1 | 1 | -1.5 | 1,057 | 0 | 1,887 | 944 |
| | 1800 | 2 | 1 | 0 | 0 | -1.3 | 1,083 | 2,901 | 0 | 1,451 |
| | 2200 | 1 | 0 | 0 | 0 | 0.2 | 1,281 | 1,144 | 0 | 572 |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890608 | 200 | 0 | 0 | 0 | 0 | 0.2 | 1,281 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 3.2 | 1,698 | 0 | 0 | 0 |
| | 1000 | 0 | 1 | 0 | 0 | 3.2 | 1,698 | 1,516 | 0 | 758 |
| | 1400 | 0 | 0 | 0 | 0 | 3.9 | 1,803 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 4.1 | 1,834 | 0 | 0 | 0 |
| | 2200 | 4 | 5 | 1 | 1 | 4.3 | 1,864 | 14,980 | 3,329 | 9,155 |
| 890609 | 200 | 1 | 0 | 1 | 1 | 4.3 | 1,864 | 1,664 | 3,329 | 2,497 |
| | 600 | 1 | 1 | 0 | 0 | 4.6 | 1,910 | 3,411 | 0 | 1,706 |
| | 1000 | 0 | 0 | 0 | 0 | 4.7 | 1,926 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 4.7 | 1,926 | 0 | 0 | 0 |
| | 1800 | 1 | 0 | 1 | 0 | 4.8 | 1,941 | 1,733 | 1,733 | 1,733 |
| | 2200 | 1 | 0 | 0 | 0 | 4.8 | 1,941 | 1,733 | 0 | 867 |
| 890610 | 200 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 5.0 | 1,972 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| 890611 | 200 | . | . | . | . | . | . | . | . | . |
| | 600 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| 890612 | 200 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 1 | 0 | 4.8 | 1,941 | 0 | 1,733 | 867 |
| | 1000 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 4.8 | 1,941 | 0 | 0 | 0 |
| | 2200 | . | . | . | . | 5.2 | 2,003 | . | . | . |

Table 9. *continued*

| Date | Time | Egg count Surface (rep A) | Egg count Surface (rep B) | Egg count Oblique (rep A) | Egg count Oblique (rep B) | River stage (feet) | Cross-section (sq.ft.) | Egg production Surface | Egg production Oblique | Egg production Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| 890613 | 200 | . | . | . | . | 5.2 | 2,003 | . | . | . |
| | 600 | 0 | 0 | 0 | 0 | 6.4 | 2,191 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 8.8 | 2,574 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 9.2 | 2,639 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 9.4 | 2,671 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 9.6 | 2,704 | 0 | 0 | 0 |
| 890614 | 200 | 0 | 0 | 0 | 0 | 9.8 | 2,736 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 10.3 | 2,818 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 10.3 | 2,818 | 0 | 0 | 0 |
| | 1400 | 0 | 0 | 0 | 0 | 10.3 | 2,818 | 0 | 0 | 0 |
| | 1800 | 0 | 0 | 0 | 0 | 10.4 | 2,835 | 0 | 0 | 0 |
| | 2200 | 0 | 0 | 0 | 0 | 10.5 | 2,852 | 0 | 0 | 0 |
| 890615 | 200 | 0 | 0 | 0 | 0 | 10.5 | 2,852 | 0 | 0 | 0 |
| | 600 | 0 | 0 | 0 | 0 | 10.5 | 2,852 | 0 | 0 | 0 |
| | 1000 | 0 | 0 | 0 | 0 | 10.3 | 2,818 | 0 | 0 | 0 |

Table 10. Daily egg production of striped bass at Barnhill's Landing, Roanoke River, NC, in 1989, estimated by two methods and two depths.

| Date | Number of Samples | Total eggs surface only (trip method) | Total eggs oblique only (trip method) | Total eggs all depths (trip method) | Total eggs surface only (Hassler) | Total eggs oblique only (Hassler) | Total eggs all depths (Hassler) |
|---|---|---|---|---|---|---|---|
| 890317 | 0 | . | . | . | . | . | . |
| 890323 | 0 | . | . | . | . | . | . |
| 890329 | 0 | . | . | . | . | . | . |
| 890406 | 4 | . | . | . | . | . | . |
| 890412 | 4 | . | . | . | . | . | . |
| 890414 | 0 | . | . | . | . | . | . |
| 890415 | 0 | . | . | . | . | . | . |
| 890416 | 16 | 157,193 | 0 | 78,596 | 157,193 | 0 | 78,596 |
| 890417 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890418 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890419 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890420 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890421 | 24 | 0 | 182,367 | 91,184 | 0 | 183,267 | 91,634 |
| 890422 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890423 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890424 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890425 | 16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890426 | 16 | 0 | 121,816 | 60,908 | 0 | 104,483 | 52,241 |
| 890427 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890428 | 24 | 1,976,584 | 3,770,573 | 2,873,578 | 1,975,890 | 3,760,565 | 2,868,227 |
| 890429 | 20 | 886,837 | 952,722 | 919,779 | 899,597 | 968,797 | 934,197 |
| 890430 | 20 | 5,258,595 | 5,882,701 | 5,570,648 | 5,307,658 | 6,010,142 | 5,658,900 |
| 890501 | 18 | 7,223,676 | 8,335,040 | 7,223,002 | 7,440,172 | 8,428,320 | 7,879,349 |
| 890502 | 20 | 6,630,021 | 6,526,572 | 6,578,296 | 7,249,576 | 7,128,750 | 7,189,163 |
| 890503 | 24 | 0 | 970,804 | 485,402 | 0 | 1,003,728 | 501,864 |
| 890504 | 24 | 1,062,690 | 603,498 | 833,094 | 1,053,124 | 601,785 | 827,454 |
| 890505 | 24 | 461,871 | 615,828 | 538,849 | 457,930 | 610,574 | 534,252 |
| 890506 | 20 | 0 | 185,828 | 92,914 | 0 | 180,679 | 90,340 |
| 890507 | 16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890508 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890509 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890510 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890511 | 24 | 467,258 | 155,753 | 311,505 | 467,258 | 155,753 | 311,505 |
| 890512 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890513 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890514 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890515 | 24 | 154,857 | 154,857 | 154,857 | 154,858 | 154,858 | 154,858 |

Table 10. *continued*

| Date | Number of Samples | Total eggs surface only (trip method) | Total eggs oblique only (trip method) | Total eggs all depths (trip method) | Total eggs surface only (Hassler) | Total eggs oblique only (Hassler) | Total eggs all depths (Hassler) |
|---|---|---|---|---|---|---|---|
| 890516 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890517 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890518 | 24 | 619,428 | 770,719 | 695,074 | 618,239 | 772,799 | 695,519 |
| 890519 | 24 | 2,637,048 | 3,103,410 | 2,870,229 | 2,637,645 | 3,103,112 | 2,870,378 |
| 890520 | 24 | 5,523,929 | 4,455,924 | 4,989,927 | 5,537,258 | 4,460,569 | 4,998,913 |
| 890521 | 24 | 12,708,684 | 21,586,984 | 17,147,834 | 12,717,366 | 21,604,200 | 17,160,783 |
| 890522 | 24 | 28,036,305 | 36,459,732 | 32,248,019 | 28,012,436 | 36,431,474 | 32,221,955 |
| 890523 | 22 | 96,847,896 | 151,144,611 | 114,807,723 | 96,812,007 | 151,026,731 | 121,455,063 |
| 890524 | 24 | 75,350,522 | 73,524,570 | 74,437,546 | 75,487,716 | 73,627,649 | 74,557,683 |
| 890525 | 24 | 12,299,091 | 14,319,398 | 13,309,244 | 12,280,878 | 14,301,782 | 13,291,330 |
| 890526 | 22 | 53,435,520 | 49,622,634 | 54,439,851 | 53,477,171 | 49,664,016 | 51,743,918 |
| 890527 | 24 | 161,515,856 | 152,998,721 | 157,257,288 | 161,515,856 | 152,998,721 | 157,257,288 |
| 890528 | 24 | 26,635,405 | 24,777,121 | 25,706,263 | 26,635,405 | 24,777,121 | 25,706,263 |
| 890529 | 24 | 11,923,989 | 12,078,846 | 12,001,418 | 11,923,989 | 12,078,846 | 12,001,418 |
| 890530 | 24 | 11,334,647 | 12,803,648 | 12,069,148 | 10,701,231 | 12,286,598 | 11,493,914 |
| 890531 | 24 | 74,303,381 | 89,475,411 | 81,889,396 | 75,377,001 | 89,825,944 | 82,601,472 |
| 890601 | 24 | 28,034,389 | 33,018,434 | 30,526,412 | 27,529,283 | 32,397,806 | 29,963,544 |
| 890602 | 24 | 5,099,262 | 5,751,978 | 5,425,620 | 5,150,997 | 5,970,474 | 5,560,736 |
| 890603 | 24 | 934,246 | 1,118,324 | 1,026,285 | 846,596 | 1,058,245 | 952,420 |
| 890604 | 20 | 1,598,264 | 2,175,724 | 1,886,994 | 1,635,242 | 2,258,191 | 1,946,716 |
| 890605 | 22 | 1,097,075 | 1,229,436 | 1,082,334 | 1,013,250 | 1,105,363 | 1,055,120 |
| 890606 | 22 | 985,825 | 649,219 | 763,421 | 992,237 | 654,876 | 838,891 |
| 890607 | 24 | 708,182 | 135,888 | 422,035 | 716,138 | 143,228 | 429,683 |
| 890608 | 24 | 791,814 | 159,790 | 475,802 | 726,977 | 145,395 | 436,186 |
| 890609 | 24 | 410,001 | 242,976 | 326,488 | 410,989 | 246,593 | 328,791 |
| 890610 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890611 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890612 | 20 | 0 | 99,824 | 49,912 | 0 | 100,354 | 50,177 |
| 890613 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890614 | 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 890615 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | ============ | ============ | ============ | ============ | ============ | ============ |
| | | 637,110,340 | 720,161,682 | 671,666,876 | 637,919,162 | 720,331,787 | 676,790,744 |

APPENDIX

Table A-1. List of Counties Enumerated in Figure 1.

| 1-12 (Virginia) | | 13-24 (North Carolina) | |
|---|---|---|---|
| 1. | Roanoke | 13. | Stokes |
| 2. | Franklin | 14. | Rockingham |
| 3. | Patrick | 15. | Caswell |
| 4. | Henry | 16. | Person |
| 5. | Bedford | 17. | Granville |
| 6. | Pittsylvania | 18. | Vance |
| 7. | Campbell | 19. | Warren |
| 8. | Halifax | 20. | Halifax |
| 9. | Charlotte | 21. | Northampton |
| 10. | Lunenburg | 22. | Bertie |
| 11. | Mecklenburg | 23. | Martin |
| 12. | Brunswick | 24. | Washington |

Table A-2. Location of the historical sampling locations used by W.W. Hassler and co-workers (1959-1987), Rulifson (1989), and this study.

| Location | River Mile | Latitude | Longitude |
|---|---|---|---|
| Halifax | 120 | 77°35'5"E | 36°20'6"N |
| Johnson's Landing | 118.5 | 77°18'23"E | 36°33'20"N |
| Barnhill's Landing | 117 | 77°18'23"E | 36°32'15"N |
| Pollock's Ferry | 105 | 77°24'30"E | 36°15'30"N |
| Palmyra | 78.5 | 77°19'30"E | 36°4'32"N |

Table A-3. Hourly sample grid for the 1989 striped bass egg study at Barnhill's Landing, Roanoke River, North Carolina.

| | | Hour of Day | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY | DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
| 0 | 890317 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 6 | 890323 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 12 | 890329 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 20 | 890406 | . | . | . | . | . | . | . | . | . | . | 4 | . | . | . | . | . | . | . | . | . | . | . | . | . | 4 |
| 26 | 890412 | . | . | . | . | . | . | . | . | . | . | 4 | . | . | . | . | . | . | . | . | . | . | . | . | . | 4 |
| 28 | 890414 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 29 | 890415 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 30 | 890416 | . | . | . | . | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 16 |
| 31 | 890417 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 32 | 890418 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 33 | 890419 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | . | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 34 | 890420 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 35 | 890421 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 36 | 890422 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 37 | 890423 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 38 | 890424 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 39 | 890425 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | . | . | . | . | . | . | . | 16 |
| 40 | 890426 | . | . | . | . | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 16 |
| 41 | 890427 | . | 4 | . | . | . | 4 | . | . | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 42 | 890428 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 43 | 890429 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | . | . | . | 20 |
| 44 | 890430 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 45 | 890501 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 2 | . | . | . | 4 | . | . | 18 |
| 46 | 890502 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 47 | 890503 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 48 | 890504 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 49 | 890505 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 50 | 890506 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 51 | 890507 | . | . | . | . | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 16 |
| 52 | 890508 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 53 | 890509 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 54 | 890510 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 55 | 890511 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 56 | 890512 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 57 | 890513 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 58 | 890514 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 59 | 890515 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 60 | 890516 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 61 | 890517 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 62 | 890518 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 63 | 890519 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 64 | 890520 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 65 | 890521 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 66 | 890522 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 67 | 890523 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 2 | . | . | 22 |
| 68 | 890524 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 69 | 890525 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 70 | 890526 | . | 4 | . | . | . | 4 | . | . | . | 2 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 22 |
| 71 | 890527 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 72 | 890528 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |

Table A-3. *continued*

| DAY | DATE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hour of Day | | | | | | | | | | | | | | | | | | | | | | | | |
| 73 | 890529 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 74 | 890530 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 75 | 890531 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 76 | 890601 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 77 | 890602 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 78 | 890603 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 79 | 890604 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | . | . | . | 20 |
| 80 | 890605 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 2 | . | . | 22 |
| 81 | 890606 | . | 2 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 22 |
| 82 | 890607 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 83 | 890608 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 84 | 890609 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 85 | 890610 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 86 | 890611 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 87 | 890612 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | . | . | . | 20 |
| 88 | 890613 | . | . | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 20 |
| 89 | 890614 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | 24 |
| 90 | 890615 | . | 4 | . | . | . | 4 | . | . | . | 4 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 12 |

Code listing for Appendix Tables A-4 and A-5.

| Variable name | Description |
| --- | --- |
| PAGE | page number of the original field sheet. |
| DATE | YY/MM/DD. |
| TIME | military time |
| ATEMP | air temperature (°C). |
| WTEMP | surface water temperature (°C). |
| PH | pH of surface water (standard units). |
| DO | dissolved oxygen of surface waters (mg/L). |
| TDS | total dissolved solids. |
| SECCHI | secchi disk visibility (cm). |
| WVEL | surface water velocity (cm/second). |
| RSTAGE | river stage (relative measurement, feet and tenths). |
| SREVS | surface flowmeter revolutions (number in five minutes). |
| OREVS | oblique flowmeter revolutions (number in five minutes). |
| ASURF | number of eggs in surface net A. |
| BSURF | number of eggs in surface net B. |
| AOBL | number of eggs in oblique net A. |
| BOBL | number of eggs in oblique net B. |
| ASVIA | number of viable eggs in surface net A. |
| BSVIA | number of viable eggs in surface net B. |
| AOVIA | number of viable eggs in oblique net A. |
| BOVIA | number of viable eggs in oblique net B. |
| ST1 | number of eggs less than 10 hours old (17°C criteria). |
| ST2 | number of eggs 10-18 hours old (17°C criteria). |
| ST3 | number of eggs 20-28 hours old (17°C criteria). |
| ST4 | number of eggs 30+ hours old (17°C criteria). |
| HATCH | number of striped bass larvae. |

Table A-4. Water quality data collected at Barnhills Landing, Roanoke River, NC, from 17 March to 15 April 1989.

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 890317 | 1437 | | 10.0 | 8.0 | 8 | 9 | | 110 | 63.60 | | 1448 | |
| 2 | 890323 | 1030 | 4.0 | 8.5 | 8.2 | 10.9 | 12 | 2 | 130 | 92.80 | | 2357 | |
| 3 | 890329 | 1043 | 22.0 | 12.0 | 7.1 | | 8 | 4 | 90 | | | | |
| 4 | 890406 | 1042 | 14.0 | 13.5 | 7.4 | 9 | 9 | 5 | 40 | 71.12 | | 4316 | 1775 |
| 5 | 890412 | 1035 | 13.0 | 11.0 | 7.5 | 7 | 9 | 5 | 80 | 108.30 | | 4966 | 6992 |
| 6 | 890414 | 1800 | 20.0 | 13.0 | 7.4 | 7 | 8 | 4 | 75 | 107.59 | | | |
| 7 | 890414 | 2200 | 17.0 | 13.0 | 7.2 | 7.5 | 8 | 4 | | | | | |
| 8 | 890415 | 600 | | | | | | | | | | | |
| 9 | 890415 | 1000 | | | | | | | | | | | |
| 10 | 890415 | 1800 | 15.0 | 13.0 | 7.3 | 7 | 8 | 4 | | | | | |
| 11 | 890416 | 1000 | 21.0 | 13.0 | | 7 | 9 | 4 | 60 | 69.49 | 8.0 | 1697 | 3806 |
| 12 | 890416 | 1400 | 21.0 | 14.0 | | 8 | 8 | 4 | 70 | 70.71 | 8.0 | 3848 | 3230 |
| 13 | 890416 | 1800 | 19.0 | 13.5 | | 8 | 9 | 4 | 70 | 71.93 | 8.0 | 3747 | 3378 |
| 14 | 890416 | 2200 | 13.0 | 14.0 | | 7 | 10 | 5 | | 76.50 | 8.0 | 3466 | 3278 |
| 15 | 890417 | 200 | 11.0 | 14.0 | | 8 | 10 | 5 | | | 8.0 | 4452 | |
| 16 | 890417 | 600 | 8.0 | 14.0 | | 8 | 10 | 5 | | 92.77 | 8.0 | 3206 | 3202 |
| 17 | 890417 | 1000 | 16.0 | 13.0 | | 8 | 9 | 4 | 80 | | 8.0 | | 3505 |
| 18 | 890417 | 1400 | 19.0 | 13.0 | 7.6 | 7 | 5 | 4 | 70 | 86.60 | 8.0 | 2750 | 3060 |
| 19 | 890417 | 1800 | 21.0 | 14.0 | 7.7 | 8 | 8 | 4 | 60 | 89.27 | 7.0 | 2489 | 3463 |
| 20 | 890417 | 2200 | 18.0 | 14.0 | 7.5 | 8 | 9 | 5 | | 72.57 | 6.0 | 4291 | 2154 |
| 21 | 890418 | 200 | 16.0 | 14.0 | 7.5 | 8 | 9 | 4 | | 81.13 | 6.1 | 4784 | 3006 |
| 22 | 890418 | 600 | 15.0 | 14.0 | 7.5 | 8 | 10 | 5 | | 91.18 | 5.8 | 3168 | 3527 |
| 23 | 890418 | 1000 | 19.0 | 13.0 | 7.7 | 8 | 8 | 4 | 65 | 82.38 | 5.9 | 3918 | 3682 |
| 24 | 890418 | 1400 | 28.0 | 14.0 | 7.8 | 8 | 5 | 4 | 65 | 78.73 | 6.0 | 4431 | 3886 |
| 25 | 890418 | 1800 | 25.0 | 15.0 | 7.6 | 8 | 8 | 4 | 60 | 78.73 | 6.1 | 4677 | 4132 |
| 26 | 890418 | 2200 | 20.0 | 15.0 | 7.8 | 8 | 9 | 5 | | 79.61 | 6.1 | 4580 | 3583 |
| 27 | 890419 | 200 | 17.0 | 15.0 | 7.4 | 7 | 9 | 5 | | 83.67 | 6.1 | 5718 | 4447 |
| 28 | 890419 | 600 | 16.0 | 14.5 | 7.6 | 8 | 9 | 5 | | 86.38 | 6.0 | 4235 | 3863 |
| 29 | 890419 | 1000 | 19.0 | 14.0 | 7.9 | 8 | 9 | 5 | 60 | 83.34 | 6.1 | 4940 | 5175 |
| 30 | 890419 | 1400 | 21.0 | 15.0 | 7.5 | 8 | 8 | 4 | 60 | 73.07 | 6.2 | 4156 | 2957 |
| 31 | 890419 | 1800 | 12.0 | 15.0 | 7.8 | 8 | 9 | 5 | 60 | 84.12 | 6.1 | 4050 | 4291 |
| 32 | 890419 | 2200 | 14.0 | 15.0 | 7.6 | 8 | 10 | 5 | | 90.22 | 6.1 | 4249 | 4086 |
| 33 | 890420 | 200 | 11.0 | 15.0 | 7.7 | 8 | 9 | 5 | | 86.73 | 6.1 | 4316 | 4837 |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 890420 | 600 | 11.0 | 14.5 | 7.5 | 8 | 10 | 5 | | 86.03 | 6.1 | 4405 | 3945 |
| 35 | 890420 | 1000 | 14.5 | 14.0 | 7.6 | 7 | 10 | 5 | 70 | 75.66 | 6.0 | 5120 | 3181 |
| 36 | 890420 | 1400 | 16.0 | 14.0 | 7.7 | 7 | 8 | 4 | 70 | 84.67 | 6.0 | 4219 | 3654 |
| 37 | 890420 | 1800 | 18.0 | 15.0 | 7.6 | 8 | 9 | 4 | 70 | 78.73 | 6.0 | 3975 | 4087 |
| 38 | 890420 | 2200 | 16.0 | 14.0 | 7.8 | 7 | 10 | 5 | | 84.67 | 6.0 | 4245 | 3828 |
| 39 | 890421 | 200 | 9.0 | 14.0 | 7.8 | 7 | 11 | 8 | | 86.38 | 5.9 | 4195 | 5178 |
| 40 | 890421 | 600 | 1.0 | 14.0 | 7.5 | 8 | 11 | 5 | | 82.70 | 6.0 | 5393 | 3987 |
| 41 | 890421 | 1000 | 19.0 | 14.0 | 7.0 | 8 | 9 | 5 | 65 | 81.75 | 6.1 | 5080 | 4390 |
| 42 | 890421 | 1400 | 20.0 | 14.0 | 7.6 | 7 | 8 | 4 | 70 | 88.53 | 6.4 | 4598 | 3833 |
| 43 | 890421 | 1800 | 18.0 | 15.0 | 7.6 | 7 | 9 | 4 | 70 | 78.02 | 6.0 | 4812 | 4318 |
| 44 | 890421 | 2200 | 13.0 | 15.0 | 7.7 | 8 | 10 | 5 | | 85.34 | 6.0 | 4330 | 4480 |
| 45 | 890422 | 200 | 9.0 | 15.0 | 7.6 | 8 | 10 | 5 | | 83.02 | 6.0 | 4112 | 3263 |
| 46 | 890422 | 600 | 9.0 | 14.0 | 7.6 | 8 | 11 | 5 | 60 | 88.32 | 5.8 | 4644 | 4071 |
| 47 | 890422 | 1000 | 14.0 | 14.0 | 7.7 | 7 | 10 | 5 | 70 | 85.00 | 6.3 | 4684 | 4762 |
| 48 | 890422 | 1400 | 27.0 | 14.0 | 7.7 | 7 | 8 | 4 | 60 | 86.38 | 5.8 | 4694 | 3808 |
| 49 | 890422 | 1800 | 20.0 | 15.0 | 7.6 | 7 | 9 | 4 | 70 | 86.86 | 5.8 | 4697 | 3828 |
| 50 | 890422 | 2200 | 15.0 | 15.0 | 7.6 | 7 | 10 | 5 | | 84.00 | 5.8 | 3807 | 3678 |
| 51 | 890423 | 200 | 13.0 | 15.0 | 7.4 | 8 | 10 | 5 | | 88.90 | 5.8 | 4800 | 4560 |
| 52 | 890423 | 600 | 12.0 | 15.0 | 7.3 | 8 | 11 | 5 | 60 | 89.91 | 5.1 | 4140 | 3943 |
| 53 | 890423 | 1000 | 15.0 | 15.0 | 7.5 | 7 | 9 | 4 | 70 | 88.17 | 5.9 | 4423 | 2850 |
| 54 | 890423 | 1400 | 16.0 | 14.0 | 7.7 | 7 | 8 | 4 | 70 | 83.67 | 4.8 | 4407 | 3532 |
| 55 | 890423 | 1800 | 18.0 | 15.5 | 7.5 | 7 | 6 | 4 | 70 | 83.67 | 4.5 | 4042 | 3907 |
| 56 | 890423 | 2200 | 15.0 | 15.0 | 7.5 | 7 | 7 | 5 | | 96.11 | 4.5 | 3994 | 3476 |
| 57 | 890424 | 200 | | | | | | | | | | | |
| 58 | 890424 | 600 | 9.0 | 14.5 | 7.4 | 7 | 9 | 5 | 60 | 83.34 | 4.3 | 4234 | 3019 |
| 59 | 890424 | 1000 | 14.0 | 14.0 | 7.7 | 7 | 10 | 5 | 50 | 89.27 | 4.8 | 4982 | 4596 |
| 60 | 890424 | 1400 | 17.0 | 15.0 | 7.8 | 7 | 5 | 4 | 70 | 90.03 | 5.0 | 4597 | 3603 |
| 61 | 890424 | 1800 | 21.0 | 16.0 | 6.8 | 7 | 5 | 4 | 70 | 83.78 | 5.3 | 4686 | 4757 |
| 62 | 890424 | 2200 | 18.0 | 15.0 | 7.0 | 8 | 7 | 4 | | 90.79 | 5.5 | 4531 | 3760 |
| 63 | 890425 | 200 | 14.0 | 15.0 | 7.6 | 7 | 7 | 5 | | 92.36 | 5.6 | 3745 | 3664 |
| 64 | 890425 | 600 | 12.0 | 15.0 | 6.5 | 8 | 8 | 5 | 60 | 90.41 | 5.3 | 4545 | 3084 |
| 65 | 890425 | 1000 | 22.0 | 15.0 | 7.3 | 8 | 4 | 4 | 50 | 78.73 | 5.3 | 4999 | 3078 |
| 66 | 890425 | 1400 | 29.0 | 16.0 | 7.2 | 7 | 4 | 3 | 80 | 86.73 | 5.1 | 4199 | 3295 |
| 67 | 890425 | 1800 | | | | | | | | | | | |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68 | 890425 | 2200 | | | | | | | | | | | |
| 69 | 890426 | 200 | | | | | | | | | | | |
| 70 | 890426 | 600 | | | | | | | | | | | |
| 71 | 890426 | 1000 | 28.0 | 16.0 | 7.8 | 7 | 8 | 4 | 70 | 66.47 | 4.5 | 3782 | 3490 |
| 72 | 890426 | 1400 | 27.0 | 17.0 | 7.4 | 7 | 8 | 3 | 75 | 66.06 | 1.9 | 2730 | 3020 |
| 73 | 890426 | 1800 | 23.0 | 17.0 | | 7 | 9 | 4 | 80 | 68.60 | 1.7 | 3782 | 2416 |
| 74 | 890426 | 2200 | 20.0 | 17.0 | | 6 | 10 | 5 | | 92.36 | 2.6 | 3778 | 3402 |
| 75 | 890427 | 200 | 17.0 | 17.0 | | | 8 | 5 | | 86.03 | 3.5 | 8655 | |
| 76 | 890427 | 600 | 17.0 | 16.0 | | 7 | 9 | 4 | 70 | 87.09 | 4.8 | 4890 | 4516 |
| 77 | 890427 | 1000 | 18.0 | 17.0 | | 7 | 9 | 4 | | | 5.4 | | |
| 78 | 890427 | 1400 | 24.0 | 17.0 | | 7 | 7 | 4 | | 81.13 | 5.4 | | |
| 79 | 890427 | 1800 | 24.0 | 17.5 | 8.0 | 7 | 7 | 4 | 80 | 90.41 | 5.0 | 4493 | 3356 |
| 80 | 890427 | 2200 | 15.0 | 17.0 | | 8 | 7 | 4 | | 86.03 | 3.8 | 2491 | 3119 |
| 81 | 890428 | 200 | 18.0 | 16.0 | | 7 | 4 | 5 | | 63.31 | 2.8 | 2886 | 2321 |
| 82 | 890428 | 600 | 16.0 | 17.0 | | 7 | 5 | 4 | 70 | 69.50 | 2.0 | 3188 | 3063 |
| 83 | 890428 | 1000 | 17.0 | 17.0 | | 7 | 8 | 5 | 70 | 59.93 | 1.7 | 3344 | 2994 |
| 84 | 890428 | 1400 | 20.0 | 17.5 | | 7 | | | 80 | 53.47 | 1.5 | 3208 | 2564 |
| 85 | 890428 | 1800 | 24.0 | 19.0 | 8.8 | 8 | 9 | 5 | 80 | 57.05 | 1.3 | 3372 | 2764 |
| 86 | 890428 | 2200 | 17.0 | 19.0 | 7.8 | 7 | 5 | 5 | | 62.57 | 1.0 | 5920 | 1291 |
| 87 | 890429 | 200 | 16.0 | 18.5 | 7.6 | 7 | 9 | 5 | | 61.84 | 0.8 | 3010 | 2019 |
| 88 | 890429 | 600 | 17.0 | 18.0 | 7.6 | 8 | 10 | 5 | 70 | 61.31 | 0.6 | 3264 | 2377 |
| 89 | 890429 | 1000 | 20.0 | 17.0 | | 7 | 9 | 4 | 60 | 58.78 | 0.5 | 5257 | 2971 |
| 90 | 890429 | 1400 | 22.0 | 17.0 | | 7 | 8 | 5 | 60 | 75.13 | 1.0 | 1183 | 3581 |
| 91 | 890429 | 1800 | 22.0 | 17.0 | 6.8 | 7 | 8 | 4 | 70 | 55.71 | 0.5 | 3260 | 2733 |
| 92 | 890429 | 2200 | 20.0 | 17.0 | | 7 | 9 | 5 | | | | | |
| 93 | 890430 | 200 | 18.0 | 18.0 | 7.4 | 7 | 8 | 5 | | | | | |
| 94 | 890430 | 600 | 17.0 | 17.5 | 6.8 | 8 | 8 | 4 | 10 | 69.50 | 1.2 | 2946 | 3561 |
| 95 | 890430 | 1000 | 24.0 | 18.0 | 6.9 | 8 | 8 | 4 | 10 | 70.80 | 2.1 | 5010 | 3885 |
| 96 | 890430 | 1400 | 25.0 | 18.0 | 7.5 | 7 | 6 | 4 | 10 | 66.06 | 2.2 | 3523 | 3034 |
| 97 | 890430 | 1800 | 22.5 | 19.0 | 6.7 | 7 | 7 | 4 | 20 | 60.44 | 2.1 | 3381 | 3009 |
| 98 | 890430 | 2200 | 20.0 | 19.0 | 7.5 | 8 | 8 | 4 | | 70.18 | 2.1 | 3496 | 3400 |
| 99 | 890501 | 200 | 19.0 | 18.0 | 7.4 | 8 | 8 | 4 | | | 2.0 | | |
| 100 | 890501 | 600 | 19.0 | 19.0 | 6.7 | 8 | 8 | 4 | 30 | 56.59 | 1.0 | 2500 | 2408 |
| 101 | 890501 | 1000 | 21.0 | 18.0 | 7.0 | 7 | 7 | 4 | 40 | 63.31 | 1.3 | 2886 | 2687 |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102 | 890501 | 1400 | 25.0 | 18.0 | 7.0 | 7 | 7 | 4 | 40 | 59.27 | 1.2 | 3484 | 1812 |
| 103 | 890501 | 1800 | 24.0 | 19.0 | 6.8 | 8 | 8 | 4 | 40 | 76.75 | 2.1 | 3514 | |
| 104 | 890501 | 2200 | 20.0 | 18.0 | 7.2 | 7 | 8 | 4 | | 68.38 | 3.5 | 3369 | 3535 |
| 105 | 890502 | 200 | 19.0 | 18.0 | 7.2 | 8 | 8 | 5 | | | | | |
| 106 | 890502 | 600 | 18.0 | 18.0 | 8.6 | 8 | 8 | 4 | 40 | 85.34 | 5.5 | 4644 | 3784 |
| 107 | 890502 | 1000 | 18.0 | 18.0 | 8.7 | 8 | 7 | 4 | 40 | 80.51 | 5.9 | 5312 | 6432 |
| 108 | 890502 | 1400 | 24.0 | 19.0 | 8.2 | 8 | 6 | 3 | 30 | 86.73 | 6.4 | 4566 | 4034 |
| 109 | 890502 | 1800 | 20.0 | 19.0 | 8.6 | 8 | 6 | 4 | 30 | 95.68 | 8.3 | 7130 | 5153 |
| 110 | 890502 | 2200 | 16.0 | 18.0 | | 8 | 8 | 4 | | 112.29 | 10.8 | 4944 | 6068 |
| 111 | 890503 | 200 | 13.0 | 19.0 | | 8 | 8 | 4 | | 99.70 | 12.1 | 5680 | 5509 |
| 112 | 890503 | 600 | 12.0 | 18.0 | | 8 | 10 | 5 | 20 | 107.76 | 13.0 | 5888 | 5139 |
| 113 | 890503 | 1000 | 15.0 | 18.0 | | 8 | 8 | 4 | 20 | 96.54 | 13.5 | 5801 | 5602 |
| 114 | 890503 | 1400 | 16.0 | 17.0 | | 7 | 7 | 4 | 40 | 117.23 | 13.6 | 6362 | 6767 |
| 115 | 890503 | 1800 | 18.0 | 17.0 | 7.3 | 8 | 7 | 4 | 40 | 122.62 | 13.8 | 6080 | 5815 |
| 116 | 890503 | 2200 | 12.0 | 16.0 | 6.8 | 8 | 10 | 4 | | 113.49 | 14.0 | 5627 | 5398 |
| 117 | 890504 | 200 | 11.0 | 16.0 | | 8 | 10 | 1 | | 107.22 | 14.5 | 5867 | 6495 |
| 118 | 890504 | 600 | 10.0 | 17.0 | 7.7 | 8 | 10 | 5 | 45 | 98.78 | 14.3 | 6790 | 6188 |
| 119 | 890504 | 1000 | 17.0 | 17.0 | 7.4 | 8 | 9 | 4 | 40 | 78.15 | 14.4 | 2777 | 3121 |
| 120 | 890504 | 1400 | 22.0 | 18.0 | 7.4 | 7 | 7 | 3 | 70 | 112.89 | 13.8 | 3472 | 4122 |
| 121 | 890504 | 1800 | 20.0 | 18.0 | 7.4 | 8 | 9 | 4 | 70 | 103.57 | 14.0 | 5452 | 6167 |
| 122 | 890504 | 2200 | 18.0 | 18.0 | 7.6 | 8 | 9 | 4 | | 106.68 | 14.2 | 6878 | 7252 |
| 123 | 890505 | 200 | 14.0 | 17.0 | 7.6 | 8 | 10 | 5 | | 104.08 | 14.0 | 5713 | 3677 |
| 124 | 890505 | 600 | 14.0 | 17.0 | 8.1 | 8 | 10 | 4 | 70 | 100.17 | 14.3 | 6386 | 4937 |
| 125 | 890505 | 1000 | 18.0 | 17.0 | 8.0 | 8 | 10 | 4 | 70 | 95.68 | 14.5 | 5334 | 2121 |
| 126 | 890505 | 1400 | 19.0 | 18.0 | 7.6 | 7 | 8 | 4 | 60 | 98.32 | 14.6 | 6158 | 6459 |
| 127 | 890505 | 1800 | 19.0 | 18.0 | | 8 | 8 | 4 | 75 | 100.17 | 14.5 | 6964 | 5826 |
| 128 | 890505 | 2200 | 19.0 | 18.0 | 8.6 | 7 | 8 | 4 | | 103.57 | 14.8 | 5213 | 4749 |
| 129 | 890506 | 200 | 16.0 | 18.0 | 8.7 | 7 | 8 | 4 | | | | | |
| 130 | 890506 | 600 | 17.0 | 17.0 | 8.2 | 8 | 9 | 5 | 30 | 108.86 | 14.7 | 6831 | 6470 |
| 131 | 890506 | 1000 | 20.0 | 18.0 | 8.0 | 7 | 8 | 5 | 30 | 109.98 | 14.7 | 8474 | 9335 |
| 132 | 890506 | 1400 | 21.0 | 16.0 | 8.0 | 7 | 8 | 4 | 55 | 109.98 | 14.8 | 7100 | 7410 |
| 133 | 890506 | 1800 | 19.0 | 17.0 | 8.1 | 8 | 9 | 4 | 60 | 104.08 | 14.8 | 5287 | 6005 |
| 134 | 890506 | 2200 | 14.0 | 16.0 | 8.3 | 8 | 8 | 4 | | 107.22 | 11.8 | 7704 | 5676 |
| 135 | 890507 | 200 | | | | | | | | | | | |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 136 | 890507 | 600 | | | | | | | | | | | |
| 137 | 890507 | 1000 | 15.0 | 17.0 | 8.4 | 8 | 9 | 5 | 85 | 97.42 | 13.8 | 5718 | 16227 |
| 138 | 890507 | 1400 | 12.0 | 16.0 | 8.5 | 7 | 9 | 5 | 80 | 96.11 | 13.8 | 4772 | 4389 |
| 139 | 890507 | 1800 | 10.0 | 16.0 | 8.3 | 8 | 10 | 5 | 50 | 108.30 | 14.9 | 6068 | 5831 |
| 140 | 890507 | 2200 | 9.0 | 16.0 | 8.2 | 7 | 9 | 5 | | 103.57 | 14.9 | 6646 | 7004 |
| 141 | 890508 | 200 | 8.0 | 15.0 | 8.2 | 8 | 8 | 5 | | 111.71 | 14.8 | 2917 | 5553 |
| 142 | 890508 | 600 | 10.0 | 16.0 | 7.9 | 8 | 11 | 5 | 50 | 104.59 | 14.8 | 5750 | 5989 |
| 143 | 890508 | 1000 | 12.0 | 16.0 | 7.6 | 7 | 10 | 5 | 60 | 109.98 | 14.8 | 6359 | 7681 |
| 144 | 890508 | 1400 | 15.0 | 16.0 | 7.8 | 7 | 10 | 5 | 60 | 115.33 | 14.6 | 5093 | 6144 |
| 145 | 890508 | 1800 | 18.0 | 17.0 | 7.9 | 7 | 9 | 4 | 65 | 101.12 | 14.8 | 6012 | 5945 |
| 146 | 890508 | 2200 | 15.0 | 17.0 | 7.8 | 8 | 9 | 4 | | 102.58 | 14.8 | 6082 | 5863 |
| 147 | 890509 | 200 | 12.0 | 16.0 | 7.9 | 7 | 8 | 4 | | 91.57 | 14.8 | 6095 | 5996 |
| 148 | 890509 | 600 | 11.0 | 15.0 | 7.8 | 8 | 10 | 5 | 60 | 100.64 | 14.8 | 6014 | 5988 |
| 149 | 890509 | 1000 | 18.0 | 16.0 | 7.6 | 7 | 10 | 5 | 60 | 96.11 | 14.8 | 4528 | 6905 |
| 150 | 890509 | 1400 | 18.0 | 16.0 | 7.8 | 7 | 9 | 4 | 60 | 90.41 | 14.7 | 5337 | 5503 |
| 151 | 890509 | 1800 | 15.0 | 16.0 | 8.2 | 8 | 9 | 4 | 60 | 98.78 | 14.8 | 6129 | 5312 |
| 152 | 890509 | 2200 | 16.0 | 15.0 | 8.2 | 7 | 9 | 4 | | 102.58 | 14.8 | 5519 | 5777 |
| 153 | 890510 | 200 | 16.0 | 15.0 | 8.6 | 8 | 7 | 4 | | 94.83 | 14.8 | 6953 | 5667 |
| 154 | 890510 | 600 | 17.0 | 16.0 | 7.8 | 8 | 10 | 5 | 60 | 99.70 | 14.8 | 5841 | 6021 |
| 155 | 890510 | 1000 | 16.0 | 16.0 | 8.2 | 7 | 8 | 4 | 60 | 101.44 | 14.8 | 6674 | 5377 |
| 156 | 890510 | 1400 | 19.0 | 17.0 | 7.6 | 7 | 11 | 5 | 60 | 102.58 | 14.8 | 6213 | 3536 |
| 157 | 890510 | 1800 | 19.0 | 17.0 | 7.8 | 8 | 9 | 4 | 65 | 102.09 | 14.8 | 6045 | 5987 |
| 158 | 890510 | 2200 | 15.0 | 15.0 | 8.0 | 8 | 9 | 4 | | 96.54 | 14.8 | 5900 | 5745 |
| 159 | 890511 | 200 | 12.0 | 15.0 | 8.2 | 8 | 8 | 4 | | 96.11 | 14.8 | 5915 | 5815 |
| 160 | 890511 | 600 | 12.0 | 16.0 | 7.8 | 8 | 10 | 5 | 60 | 99.70 | 14.8 | 6841 | 5862 |
| 161 | 890511 | 1000 | 16.0 | 16.0 | 7.5 | 8 | 9 | 4 | 50 | 100.17 | 14.8 | 6069 | 6158 |
| 162 | 890511 | 1400 | 16.0 | 16.5 | 7.9 | 7 | 9 | 4 | 60 | 99.70 | 14.8 | 6375 | 6815 |
| 163 | 890511 | 1800 | 16.0 | 17.0 | 7.9 | 8 | 8 | 4 | 60 | 102.09 | 14.8 | 6052 | 6212 |
| 164 | 890511 | 2200 | 13.0 | 15.0 | 7.9 | 8 | 8 | 4 | | 105.10 | 14.8 | 5331 | 5011 |
| 165 | 890512 | 200 | 12.0 | 15.0 | 8.4 | 8 | 8 | 3 | | 87.44 | 15.0 | 4677 | 5328 |
| 166 | 890512 | 600 | 11.0 | 15.0 | 7.8 | 8 | 10 | 5 | 60 | 100.64 | 15.0 | 5421 | 5534 |
| 167 | 890512 | 1000 | 18.0 | 15.0 | 7.6 | 8 | 9 | 4 | 50 | 96.11 | 14.9 | 5807 | 5865 |
| 168 | 890512 | 1400 | 4.0 | 16.0 | 7.5 | 7 | 5 | 4 | 70 | 117.88 | 14.8 | 5349 | 5585 |
| 169 | 890512 | 1800 | 17.0 | 16.0 | 7.6 | 8 | 8 | 4 | 65 | 105.62 | 14.8 | 5852 | 6215 |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 170 | 890512 | 2200 | 13.0 | 15.0 | 7.5 | 8 | 9 | 4 | | 108.86 | 14.8 | 5403 | 5877 |
| 171 | 890513 | 200 | 15.0 | 16.0 | 8.5 | 8 | 6 | 3 | | 109.98 | 14.8 | 6519 | 7152 |
| 172 | 890513 | 600 | 14.0 | 16.0 | 7.6 | 8 | 10 | 5 | 60 | 105.62 | 14.8 | 5823 | 5712 |
| 173 | 890513 | 1000 | 16.0 | 15.5 | 8.1 | 7 | 9 | 4 | 60 | 95.68 | 14.7 | 6581 | 6474 |
| 174 | 890513 | 1400 | 22.0 | 16.0 | 8.1 | 7 | 9 | 4 | 60 | 109.42 | 14.7 | 6936 | 6048 |
| 175 | 890513 | 1800 | 20.0 | 16.5 | 8.1 | 8 | 7 | 4 | 70 | 106.15 | 14.7 | 6036 | 6410 |
| 176 | 890513 | 2200 | 17.0 | 16.0 | 8.2 | 8 | 9 | 4 | | 106.15 | 14.7 | 6379 | 5556 |
| 177 | 890514 | 200 | 15.5 | 15.0 | 7.9 | 8 | 7 | 3 | | 87.80 | 14.7 | 6172 | 5023 |
| 178 | 890514 | 600 | 15.0 | 16.0 | 8.1 | 8 | 9 | 4 | 60 | 99.24 | 14.7 | 5755 | 5231 |
| 179 | 890514 | 1000 | 18.0 | 16.0 | 7.7 | 7 | 9 | 4 | 60 | 98.32 | 14.8 | 6118 | 6566 |
| 180 | 890514 | 1400 | 21.0 | 16.0 | 8.3 | 8 | 9 | 4 | 50 | 99.24 | 14.7 | 1489 | 11799 |
| 181 | 890514 | 1800 | 22.0 | 16.5 | 7.8 | 8 | 8 | 4 | 60 | 108.30 | 14.8 | 6804 | 6569 |
| 182 | 890514 | 2200 | 18.0 | 16.0 | 8.3 | 8 | 9 | 4 | | 96.98 | 14.8 | 6552 | 5667 |
| 183 | 890515 | 200 | 16.0 | 15.0 | 8.3 | 7 | 7 | 3 | | 111.71 | 14.7 | 6491 | 6838 |
| 184 | 890515 | 600 | 16.0 | 16.5 | 7.8 | 8 | 10 | 4 | 60 | 109.42 | 14.8 | 5862 | 6012 |
| 185 | 890515 | 1000 | 14.0 | 16.0 | 8.0 | 8 | 9 | 4 | 60 | 91.57 | 14.8 | 5984 | 6552 |
| 186 | 890515 | 1400 | 21.0 | 16.5 | 7.8 | 7 | 8 | 4 | 60 | 96.11 | 14.5 | 6096 | 6521 |
| 187 | 890515 | 1800 | 22.0 | 16.5 | 7.8 | 8 | 7 | 4 | 60 | 99.24 | 14.7 | 6589 | 5777 |
| 188 | 890515 | 2200 | 17.0 | 16.0 | 8.2 | 8 | 8 | 4 | | 103.57 | 14.7 | 6195 | 6538 |
| 189 | 890516 | 200 | 14.5 | 16.5 | 8.2 | 8 | 7 | 3 | | | | | |
| 190 | 890516 | 600 | 16.0 | 15.5 | 8.1 | 8 | 9 | 5 | 50 | 103.07 | 14.8 | 4395 | 5070 |
| 191 | 890516 | 1000 | 18.0 | 16.0 | 8.0 | 8 | 9 | 4 | 60 | 105.10 | 14.8 | 5412 | 5828 |
| 192 | 890516 | 1400 | 18.0 | 16.5 | 7.9 | 8 | 8 | 4 | 60 | 103.57 | 14.8 | 5842 | 6022 |
| 193 | 890516 | 1800 | 20.0 | 16.5 | 8.1 | 8 | 8 | 4 | 60 | 84.00 | 14.8 | 4265 | 4126 |
| 194 | 890516 | 2200 | 16.0 | 16.0 | 8.3 | 8 | 8 | 4 | | 108.30 | 14.8 | 5748 | 5407 |
| 195 | 890517 | 200 | 17.0 | 15.5 | 8.1 | 8 | 7 | 3 | | 104.08 | 14.8 | 5557 | 5549 |
| 196 | 890517 | 600 | 18.0 | 15.5 | 8.0 | 8 | 7 | 4 | 60 | 104.08 | 14.7 | 6686 | 6266 |
| 197 | 890517 | 1000 | 19.0 | 15.5 | 7.9 | 8 | 9 | 4 | 50 | 106.15 | 14.8 | 5580 | 5007 |
| 198 | 890517 | 1400 | 19.0 | 16.0 | 8.2 | 7 | 8 | 4 | 55 | 110.55 | 14.5 | 6104 | 5635 |
| 199 | 890517 | 1800 | 20.0 | 16.5 | 8.0 | 8 | 8 | 4 | 60 | 107.76 | 14.7 | 5641 | 5923 |
| 200 | 890517 | 2200 | 18.0 | 16.5 | 8.0 | 8 | 8 | 4 | | 106.86 | 14.7 | 6012 | 5822 |
| 201 | 890518 | 200 | 16.0 | 16.5 | 7.6 | 8 | 8 | 4 | | 116.59 | 14.7 | 6138 | 6166 |
| 202 | 890518 | 600 | 18.0 | 16.0 | 7.9 | 8 | 9 | 5 | 60 | 104.59 | 14.7 | 5744 | 5966 |
| 203 | 890518 | 1000 | 19.0 | 16.5 | 8.2 | 8 | 9 | 4 | 55 | 97.42 | 14.7 | 5428 | 5334 |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 204 | 890518 | 1400 | 24.5 | 15.0 | 8.0 | 9 | 6 | 3 | 70 | 99.24 | 14.5 | 6454 | 7610 |
| 205 | 890518 | 1800 | 20.5 | 17.0 | 8.1 | 8 | 7 | 3 | 70 | 103.57 | 14.7 | 6099 | 6282 |
| 206 | 890518 | 2200 | 20.0 | 16.0 | 8.1 | 8 | 9 | 4 | | 112.89 | 14.7 | 6194 | 4894 |
| 207 | 890519 | 200 | 16.0 | 16.5 | 8.1 | 8 | 8 | 4 | | 122.62 | 14.7 | 5133 | 6130 |
| 208 | 890519 | 600 | 18.0 | 16.5 | 7.9 | 8 | 8 | 4 | 60 | 105.62 | 14.7 | 5312 | 5872 |
| 209 | 890519 | 1000 | 22.0 | 16.5 | 8.0 | 7 | 8 | 4 | 60 | 103.07 | 14.8 | 5616 | 2699 |
| 210 | 890519 | 1400 | 26.0 | 17.0 | 8.1 | 7 | 9 | 4 | 60 | 110.55 | 14.8 | 5497 | 7418 |
| 211 | 890519 | 1800 | 23.0 | 17.5 | 8.1 | 8 | 9 | 5 | 70 | 106.68 | 14.7 | 5795 | 6298 |
| 212 | 890519 | 2200 | 17.0 | 17.0 | 7.8 | 8 | 9 | 4 | | 119.20 | 14.7 | 6504 | 6495 |
| 213 | 890520 | 200 | 16.5 | 16.5 | 8.0 | 8 | 9 | 4 | | 102.09 | 14.7 | 6317 | 6478 |
| 214 | 890520 | 600 | 17.0 | 16.5 | 7.7 | 8 | 9 | 4 | 70 | 105.62 | 14.6 | 7035 | 6059 |
| 215 | 890520 | 1000 | 20.0 | 17.0 | 8.2 | 8 | 9 | 5 | 70 | 106.15 | 14.5 | 6278 | 6474 |
| 216 | 890520 | 1400 | 29.0 | 17.5 | 8.0 | 8 | 8 | 4 | 80 | 99.70 | 14.5 | 5634 | 5256 |
| 217 | 890520 | 1800 | 25.0 | 17.5 | 8.3 | 8 | 9 | 4 | 75 | 104.68 | 14.6 | 5927 | 4885 |
| 218 | 890520 | 2200 | 22.0 | 18.0 | 7.9 | 7 | 8 | 4 | | 108.30 | 14.6 | 6255 | 5698 |
| 219 | 890521 | 200 | 19.0 | 17.0 | 8.0 | 8 | 9 | 4 | | 107.22 | 14.6 | 4703 | 5041 |
| 220 | 890521 | 600 | 17.0 | 17.0 | 8.1 | 8 | 8 | 4 | 75 | 110.55 | 14.5 | 7392 | 6916 |
| 221 | 890521 | 1000 | 24.5 | 18.3 | 8.2 | 9 | 9 | 4 | 90 | 131.70 | 14.5 | 6322 | 6848 |
| 222 | 890521 | 1400 | 26.0 | 18.2 | 7.6 | 8 | 8 | 4 | 110 | 132.52 | 14.5 | 6640 | 6212 |
| 223 | 890521 | 1800 | 27.5 | 18.2 | 7.6 | 8 | 7 | 4 | | 137.65 | 14.5 | 5792 | 6142 |
| 224 | 890521 | 2200 | 19.0 | 18.0 | 7.9 | | 9 | 5 | | 108.86 | 14.5 | 6964 | 6936 |
| 225 | 890522 | 200 | 18.0 | 17.0 | 8.0 | 7 | 8 | 4 | | 99.07 | 14.5 | 382 | 5428 |
| 226 | 890522 | 600 | 18.0 | 18.0 | 7.9 | 8 | 9 | 5 | 55 | 110.55 | 14.6 | 4499 | 6282 |
| 227 | 890522 | 1000 | 19.5 | 18.0 | 8.0 | 8 | 9 | 4 | 60 | 109.42 | 14.5 | 6938 | 8667 |
| 228 | 890522 | 1400 | 25.0 | 18.5 | 7.8 | 7 | 10 | | 80 | 107.22 | 14.4 | 6781 | 5615 |
| 229 | 890522 | 1800 | 25.0 | 18.5 | 7.8 | 8 | 8 | 4 | 60 | 114.71 | 14.5 | 5590 | 6290 |
| 230 | 890522 | 2200 | 18.0 | 18.0 | 7.8 | 8 | 9 | 4 | | 103.07 | 14.5 | 6800 | 6525 |
| 231 | 890523 | 200 | 18.0 | 18.5 | 7.8 | 8 | 9 | 4 | | 106.15 | 14.5 | 6552 | 6428 |
| 232 | 890523 | 600 | 19.0 | 18.0 | 8.4 | 8 | 10 | 4 | 70 | 104.08 | 14.7 | 6702 | 7492 |
| 233 | 890523 | 1000 | 21.0 | 18.0 | 7.9 | 8 | 10 | 3 | 70 | 102.58 | 14.4 | 4830 | 6927 |
| 234 | 890523 | 1400 | 23.0 | 19.0 | 8.3 | 7 | 9 | 3 | 60 | 118.53 | 14.4 | 7126 | 6128 |
| 235 | 890523 | 1800 | 22.0 | 19.0 | 8.1 | 8 | 10 | 4 | 60 | 100.64 | 14.7 | 4242 | 4988 |
| 236 | 890523 | 2200 | 20.0 | 19.0 | 8.0 | 8 | 9 | 4 | | 121.23 | 14.7 | 6066 | |
| 237 | 890524 | 200 | 16.0 | 18.0 | 8.2 | 8 | 10 | 4 | | 111.71 | 14.7 | 7324 | 5725 |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 238 | 890524 | 600 | 16.0 | 18.0 | 8.3 | 8 | 11 | 4 | 60 | 109.98 | 14.7 | 5463 | 6204 |
| 239 | 890524 | 1000 | 19.5 | 18.0 | 7.8 | 7 | 8 | 3 | 70 | 118.53 | 14.7 | 6134 | 5361 |
| 240 | 890524 | 1400 | 21.5 | 18.5 | 7.8 | 7 | 9 | 4 | 65 | 115.33 | 14.6 | 5980 | 5217 |
| 241 | 890524 | 1800 | 22.0 | 19.0 | 7.9 | 8 | 8 | 3 | 70 | 107.76 | 14.8 | 5954 | 4833 |
| 242 | 890524 | 2200 | 20.0 | 18.5 | 7.9 | 7 | 10 | 4 | | 111.12 | 14.8 | 6348 | 6122 |
| 243 | 890525 | 200 | 19.0 | 17.0 | 7.9 | 8 | 10 | 4 | | 102.09 | 14.8 | 5654 | 5776 |
| 244 | 890525 | 600 | 17.0 | 18.0 | 8.2 | 8 | 11 | 4 | 60 | 105.62 | 14.8 | 6052 | 6063 |
| 245 | 890525 | 1000 | 20.0 | 19.0 | 7.8 | 7 | 9 | 4 | 70 | 114.71 | 14.8 | 5074 | 5118 |
| 246 | 890525 | 1400 | 24.0 | 19.0 | 7.7 | 7 | 8 | 3 | 70 | 105.62 | 14.8 | 6375 | 5280 |
| 247 | 890525 | 1800 | 26.0 | 19.5 | 8.0 | 8 | 8 | 3 | 65 | 102.09 | 14.7 | 5940 | 5555 |
| 248 | 890525 | 2200 | 23.0 | 20.0 | 8.2 | 7 | 9 | 4 | | 100.64 | 14.7 | 5564 | 6183 |
| 249 | 890526 | 200 | 23.0 | 19.5 | 7.9 | 8 | 8 | 4 | | 130.90 | 14.7 | 5837 | 5500 |
| 250 | 890526 | 600 | 20.0 | 19.5 | 8.0 | 8 | 9 | 4 | 70 | 104.59 | 14.7 | 5134 | 5100 |
| 251 | 890526 | 1000 | 25.0 | 20.0 | 8.0 | 7 | 9 | 3 | 70 | 121.23 | 14.7 | 19799 | |
| 252 | 890526 | 1400 | 30.0 | 20.0 | 8.2 | 8 | 7 | 3 | 70 | 121.92 | 14.8 | | |
| 253 | 890526 | 1800 | 26.0 | 20.0 | 7.7 | 8 | 9 | 4 | 70 | 116.59 | 14.7 | | |
| 254 | 890526 | 2200 | 23.0 | 20.0 | 8.2 | 7 | 9 | 4 | | 111.12 | 14.7 | | |
| 255 | 890527 | 200 | 21.0 | 20.0 | 7.8 | 8 | 8 | 4 | | 103.07 | 14.7 | | |
| 256 | 890527 | 600 | 22.0 | 20.0 | 8.1 | 8 | 8 | 4 | 70 | 102.09 | 14.7 | | |
| 257 | 890527 | 1000 | 21.5 | 20.0 | 7.9 | 8 | 8 | 4 | 70 | 106.15 | 14.7 | | |
| 258 | 890527 | 1400 | 29.8 | 20.5 | 8.3 | 8 | 7 | 3 | 75 | 106.68 | 14.7 | | |
| 259 | 890527 | 1800 | 22.0 | 20.0 | 7.9 | 7 | 9 | 3 | 65 | 101.60 | 14.7 | | |
| 260 | 890527 | 2200 | 19.5 | 20.0 | 8.1 | 8 | 8 | 3 | | 109.42 | 14.7 | | |
| 261 | 890528 | 200 | 20.0 | 20.0 | 8.1 | 7 | 9 | 4 | | 91.57 | 14.7 | | |
| 262 | 890528 | 600 | 15.0 | 19.5 | 7.8 | 8 | 9 | 4 | 65 | 97.87 | 14.7 | | |
| 263 | 890528 | 1000 | 18.0 | 19.0 | 8.0 | 8 | 9 | 4 | 70 | 85.00 | 14.7 | | |
| 264 | 890528 | 1400 | 18.0 | 19.5 | 8.0 | 7 | 8 | 3 | 65 | 93.99 | 14.7 | | |
| 265 | 890528 | 1800 | 19.0 | 20.0 | 7.8 | 8 | 8 | 3 | 60 | 98.32 | 14.7 | | |
| 266 | 890528 | 2200 | 18.0 | 20.0 | 8.0 | 7 | 10 | 4 | | 103.07 | 14.7 | | |
| 267 | 890529 | 200 | 15.0 | 19.0 | 7.9 | 7 | 10 | 4 | | 99.70 | 14.7 | | |
| 268 | 890529 | 600 | 14.0 | 19.0 | 7.7 | 8 | 10 | 4 | 60 | 102.09 | 14.7 | | |
| 269 | 890529 | 1000 | 25.0 | 19.0 | 7.9 | 8 | 10 | 4 | 70 | 102.12 | 14.7 | | |
| 270 | 890529 | 1400 | 21.0 | 19.0 | 8.0 | 7 | 7 | 3 | 70 | 103.57 | 14.7 | | |
| 271 | 890529 | 1800 | 24.0 | 20.5 | 8.1 | 8 | 8 | 3 | 65 | 108.86 | 14.7 | | |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 272 | 890529 | 2200 | 19.0 | 20.0 | 8.1 | 8 | 9 | 4 | | 95.68 | 14.7 | | |
| 273 | 890530 | 200 | 17.0 | 19.5 | 8.0 | 8 | 9 | 4 | | 97.42 | 14.4 | | |
| 274 | 890530 | 600 | 15.0 | 19.0 | 8.0 | 8 | 9 | 4 | 60 | 69.27 | 14.3 | | |
| 275 | 890530 | 1000 | 24.0 | 19.5 | 8.1 | 8 | 9 | 4 | 55 | 69.95 | 12.0 | | |
| 276 | 890530 | 1400 | 26.5 | 20.5 | 8.1 | 7 | 8 | 3 | 60 | 63.88 | 10.7 | | |
| 277 | 890530 | 1800 | 25.0 | 20.5 | 8.1 | 7 | 7 | 3 | 55 | 62.57 | 10.0 | | |
| 278 | 890530 | 2200 | 21.0 | 20.0 | 8.2 | 8 | 8 | 4 | | 61.84 | 9.3 | | |
| 279 | 890531 | 200 | 19.0 | 20.0 | 7.9 | 7 | 8 | 4 | | 59.93 | 8.7 | | |
| 280 | 890531 | 600 | 20.0 | 20.8 | 7.7 | 8 | 9 | 4 | 65 | 60.61 | 8.0 | | |
| 281 | 890531 | 1000 | 26.0 | 21.0 | 7.4 | 8 | 9 | 4 | 60 | 69.73 | 7.5 | | |
| 282 | 890531 | 1400 | 32.5 | 21.5 | 7.9 | 7 | 7 | 3 | 60 | 58.62 | 7.2 | | |
| 283 | 890531 | 1800 | 31.0 | 21.5 | 8.1 | 7 | 9 | 3 | 70 | 59.10 | 6.8 | | |
| 284 | 890531 | 2200 | 25.0 | 21.5 | 7.9 | 8 | 9 | 4 | | 68.60 | 6.5 | | |
| 285 | 890601 | 200 | 23.0 | 22.0 | 8.1 | 8 | 10 | 4 | | 64.07 | 6.1 | | |
| 286 | 890601 | 600 | 23.0 | 21.5 | 7.9 | 8 | 9 | 4 | 65 | 68.38 | 5.7 | | |
| 287 | 890601 | 1000 | 30.0 | 22.5 | 8.0 | 7 | 8 | 4 | 60 | 76.20 | 5.0 | | |
| 288 | 890601 | 1400 | 28.0 | 22.0 | | 7 | 9 | 4 | 70 | 64.27 | 5.3 | | |
| 289 | 890601 | 1800 | 32.0 | 22.6 | 8.1 | 7 | 7 | 3 | 70 | 66.88 | 5.0 | | |
| 290 | 890601 | 2200 | 23.0 | 23.0 | | 8 | 9 | 4 | | 99.70 | 6.5 | | |
| 291 | 890602 | 200 | 23.0 | 22.0 | | 8 | 8 | 4 | | 107.76 | 8.3 | | |
| 292 | 890602 | 600 | 21.0 | 22.0 | | 9 | 9 | 4 | 70 | 94.41 | 9.5 | | |
| 293 | 890602 | 1000 | 25.0 | 23.0 | | 8 | 8 | 3 | 65 | 84.00 | 9.8 | | |
| 294 | 890602 | 1400 | 31.0 | 23.0 | 8.5 | 7 | 7 | 3 | 70 | 81.13 | 9.8 | | |
| 295 | 890602 | 1800 | 33.0 | 23.0 | 8.3 | 7 | 7 | 3 | 60 | 91.18 | 10.4 | | |
| 296 | 890602 | 2200 | 21.0 | 22.0 | | 8 | 8 | 4 | | 93.17 | 10.8 | | |
| 297 | 890603 | 200 | 20.0 | 21.0 | 8.2 | 8 | 8 | 4 | | 90.03 | 10.9 | | |
| 298 | 890603 | 600 | 22.5 | 22.8 | 8.3 | 8 | 9 | 4 | 60 | 72.33 | 9.6 | | |
| 299 | 890603 | 1000 | 27.0 | 23.0 | 8.1 | 7 | 8 | 4 | 60 | 72.57 | 7.4 | | |
| 300 | 890603 | 1400 | 27.0 | 23.0 | 8.0 | 7 | 7 | 3 | 60 | 81.44 | 8.0 | | |
| 301 | 890603 | 1800 | 31.0 | 23.0 | 8.1 | 7 | 7 | 3 | 65 | 76.20 | 7.6 | | |
| 302 | 890603 | 2200 | 22.0 | 23.0 | 8.0 | 7 | 8 | 4 | | 50.92 | 5.3 | | |
| 303 | 890604 | 200 | 22.0 | 23.0 | | 8 | 8 | 4 | | 58.30 | 4.0 | | |
| 304 | 890604 | 600 | 20.0 | 23.0 | 8.3 | 8 | 9 | 4 | 55 | 42.67 | 2.7 | | |
| 305 | 890604 | 1000 | 26.0 | 23.0 | 8.0 | 8 | 8 | 4 | 65 | 42.97 | 2.3 | | |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 306 | 890604 | 1400 | 25.0 | 23.0 | 8.0 | 7 | 8 | 2 | 70 | 39.62 | 1.8 | | |
| 307 | 890604 | 1800 | 29.0 | 23.0 | 8.1 | 7 | 8 | 2 | 60 | 46.02 | 0.5 | | |
| 308 | 890604 | 2200 | 20.0 | 23.0 | 8.3 | 8 | 9 | 4 | | | 0.0 | | |
| 309 | 890605 | 200 | 24.0 | 23.0 | | 7 | 9 | 4 | | | -0.1 | | |
| 310 | 890605 | 600 | 20.0 | 23.0 | 7.9 | 8 | 10 | 4 | 60 | 47.24 | -1.5 | | |
| 311 | 890605 | 1000 | 30.0 | 24.0 | 8.0 | 8 | 9 | 4 | 65 | 42.98 | -1.4 | | |
| 312 | 890605 | 1400 | 30.0 | 24.5 | 8.0 | 7 | 8 | 4 | 60 | 60.44 | -1.4 | | |
| 313 | 890605 | 1800 | 26.0 | 24.0 | 8.2 | 7 | 7 | 3 | 70 | 51.51 | -1.9 | | |
| 314 | 890605 | 2200 | 23.0 | 24.0 | 8.0 | 8 | 9 | 4 | | 51.82 | -1.9 | | |
| 315 | 890606 | 200 | 20.5 | 23.0 | 7.9 | 8 | 9 | 4 | | 56.00 | -0.4 | | |
| 316 | 890606 | 600 | 21.0 | 23.5 | 8.4 | 8 | 9 | 4 | 5 | 49.99 | -0.7 | | |
| 317 | 890606 | 1000 | 25.0 | 23.0 | 8.2 | 8 | 9 | 4 | 20 | 51.51 | -0.9 | | |
| 318 | 890606 | 1400 | 26.0 | 23.5 | 8.1 | 7 | 9 | 4 | 25 | 51.51 | -0.8 | | |
| 319 | 890606 | 1800 | 24.5 | 23.5 | 8.4 | 8 | 9 | 5 | 40 | 49.68 | -0.8 | | |
| 320 | 890606 | 2200 | 23.0 | 23.5 | 8.4 | 7 | 9 | 5 | | 49.68 | -0.8 | | |
| 321 | 890607 | 200 | 21.0 | 23.0 | 7.8 | 8 | 10 | 5 | | 49.07 | -0.8 | | |
| 322 | 890607 | 600 | 20.0 | 23.0 | 8.1 | 8 | 10 | 5 | 50 | 47.55 | -1.5 | | |
| 323 | 890607 | 1000 | 22.5 | 23.5 | 8.2 | 7 | 9 | 5 | 50 | 51.20 | -1.5 | | |
| 324 | 890607 | 1400 | 25.5 | 24.0 | 8.4 | 7 | 9 | 4 | 60 | 43.28 | -1.5 | | |
| 325 | 890607 | 1800 | 21.0 | 24.0 | 8.1 | 8 | 10 | 4 | 60 | 49.68 | -1.3 | | |
| 326 | 890607 | 2200 | 20.0 | 23.0 | 8.1 | 7 | 10 | 5 | | 66.75 | 0.2 | | |
| 327 | 890608 | 200 | 21.0 | 23.0 | 8.0 | 7 | 10 | 5 | | 73.32 | 0.2 | | |
| 328 | 890608 | 600 | 19.0 | 23.0 | 7.9 | 8 | 9 | 5 | 50 | 70.42 | 3.2 | | |
| 329 | 890608 | 1000 | 27.0 | 23.0 | 8.3 | 7 | 9 | 5 | 60 | 67.95 | 3.2 | | |
| 330 | 890608 | 1400 | 29.0 | 24.0 | 8.4 | 7 | 9 | 4 | 70 | 81.44 | 3.9 | | |
| 331 | 890608 | 1800 | 28.0 | 24.0 | 8.0 | 7 | 7 | 4 | 60 | 71.93 | 4.1 | | |
| 332 | 890608 | 2200 | 22.0 | 23.0 | 8.2 | 7 | 9 | 5 | | 76.47 | 4.3 | | |
| 333 | 890609 | 200 | 23.0 | 23.5 | 8.2 | 7 | 10 | 5 | | 73.32 | 4.3 | | |
| 334 | 890609 | 600 | 21.0 | 23.0 | 8.3 | 8 | 10 | 5 | 60 | 75.13 | 4.6 | | |
| 335 | 890609 | 1000 | 25.0 | 24.0 | 7.8 | 7 | 10 | 5 | 60 | 83.34 | 4.7 | | |
| 336 | 890609 | 1400 | 23.0 | 24.0 | 8.2 | 7 | 10 | 4 | 65 | 80.21 | 4.7 | | |
| 337 | 890609 | 1800 | 22.0 | 24.0 | 8.4 | 7 | 8 | 5 | 60 | 82.70 | 4.8 | | |
| 338 | 890609 | 2200 | 21.0 | 24.0 | 8.3 | 7 | 10 | 5 | | 77.03 | 4.8 | | |
| 339 | 890610 | 200 | 22.0 | 23.5 | 8.2 | 7 | 9 | 5 | | 75.39 | 4.8 | | |

Table A-4. *continued*

| PAGE | DATE | TIME | ATEMP | WTEMP | PH | DO | COND | TDS | SECCHI | WVEL | RSTAGE | SREVS | OREVS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 340 | 890610 | 600 | 21.0 | 23.0 | 8.3 | 8 | 10 | 5 | 60 | 76.75 | 5.0 | | |
| 341 | 890610 | 1000 | 24.0 | 24.5 | 8.0 | 7 | 10 | 4 | 65 | 65.45 | 4.8 | | |
| 342 | 890610 | 1400 | 28.0 | 24.0 | 8.3 | 7 | 11 | 4 | 70 | 81.44 | 4.8 | | |
| 343 | 890610 | 1800 | 26.0 | 24.5 | 8.1 | 7 | 7 | 4 | 70 | 70.88 | 4.8 | | |
| 344 | 890610 | 2200 | 21.0 | 24.0 | 8.1 | 7 | 10 | 5 | | 69.27 | 4.8 | | |
| 345 | 890611 | 200 | | | | | | | | | 0.0 | | |
| 346 | 890611 | 600 | 18.0 | 23.0 | 8.0 | 8 | 10 | 5 | 65 | 70.42 | 4.8 | | |
| 347 | 890611 | 1000 | 22.0 | 23.0 | 8.2 | 7 | 9 | 4 | 65 | 72.82 | 4.8 | | |
| 348 | 890611 | 1400 | 23.0 | 23.5 | 8.3 | 7 | 8 | 4 | 70 | 67.54 | 4.8 | | |
| 349 | 890611 | 1800 | 24.0 | 24.0 | 8.2 | 8 | 8 | 5 | 70 | 64.73 | 4.8 | | |
| 350 | 890611 | 2200 | 21.0 | 23.0 | 8.3 | 7 | 9 | 5 | | 78.44 | 4.8 | | |
| 351 | 890612 | 200 | 19.5 | 22.5 | 8.2 | 8 | 10 | 5 | | 67.31 | 4.8 | | |
| 352 | 890612 | 600 | 19.5 | 23.0 | 8.3 | 8 | 9 | 5 | 75 | 68.83 | 4.8 | | |
| 353 | 890612 | 1000 | 22.0 | 23.0 | 8.2 | 7 | 9 | 4 | 70 | 68.17 | 4.8 | | |
| 354 | 890612 | 1400 | 25.0 | 24.0 | 8.2 | 7 | 9 | 4 | 70 | 68.17 | 4.8 | | |
| 355 | 890612 | 1800 | 27.0 | 24.0 | 8.2 | 7 | 7 | 4 | 70 | 66.88 | 4.8 | | |
| 356 | 890612 | 2200 | 21.0 | 23.5 | 8.3 | 8 | 9 | 5 | | | 5.2 | | |
| 357 | 890613 | 200 | 21.0 | 23.0 | 8.2 | 8 | 10 | 4 | | | 5.2 | | |
| 358 | 890613 | 600 | 20.0 | 23.0 | 7.9 | 8 | 9 | 5 | 55 | 88.17 | 6.4 | | |
| 359 | 890613 | 1000 | 27.5 | 24.0 | 7.9 | 7 | 8 | 4 | 65 | 85.34 | 8.8 | | |
| 360 | 890613 | 1400 | 27.0 | 24.0 | 8.1 | 7 | 8 | 4 | 80 | 105.62 | 9.2 | | |
| 361 | 890613 | 1800 | 27.0 | 24.0 | 8.0 | 8 | 8 | 5 | 70 | 95.25 | 9.4 | | |
| 362 | 890613 | 2200 | 24.0 | 24.0 | 7.3 | 7 | 9 | 4 | | 91.57 | 9.6 | | |
| 363 | 890614 | 200 | 23.0 | 23.5 | 7.9 | 8 | 9 | 4 | | 96.11 | 9.8 | | |
| 364 | 890614 | 600 | 23.0 | 24.0 | 7.8 | 8 | 10 | 5 | 60 | 97.42 | 10.3 | | |
| 365 | 890614 | 1000 | 25.0 | 24.0 | 7.6 | 7 | 8 | 4 | 65 | 84.00 | 10.3 | | |
| 366 | 890614 | 1400 | 26.0 | 24.0 | 7.5 | 7 | 8 | 4 | 60 | 92.36 | 10.3 | | |
| 367 | 890614 | 1800 | 30.0 | 24.5 | 7.9 | 7 | 7 | 4 | 70 | 92.77 | 10.4 | | |
| 368 | 890614 | 2200 | 26.0 | 24.0 | 8.0 | 8 | 9 | 5 | | 96.98 | 10.5 | | |
| 369 | 890615 | 200 | 24.0 | 24.0 | 7.9 | 8 | 8 | 4 | | 98.78 | 10.5 | | |
| 370 | 890615 | 600 | 25.0 | 24.0 | 8.1 | 8 | 9 | 5 | 65 | 97.42 | 10.5 | | |
| 371 | 890615 | 1000 | 27.0 | 24.0 | 7.3 | 7 | 8 | 4 | 65 | 89.27 | 10.3 | | |

Table A-5. Striped bass egg enumeration and stage of development data collected at Barnhills Landing Roanoke River, NC, from 17 March to 15 April 1989.

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 890317 | 1437 | | | | | | | | | | | | | |
| 2 | 890323 | 1030 | | | | | | | | | | | | | |
| 3 | 890329 | 1043 | | | | | | | | | | | | | |
| 4 | 890406 | 1042 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 5 | 890412 | 1035 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 6 | 890414 | 1800 | | | | | | | | | | | | | |
| 7 | 890414 | 2200 | | | | | | | | | | | | | |
| 8 | 890415 | 600 | | | | | | | | | | | | | |
| 9 | 890415 | 1000 | | | | | | | | | | | | | |
| 10 | 890415 | 1800 | | | | | | | | | | | | | |
| 11 | 890416 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 12 | 890416 | 1400 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 13 | 890416 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 14 | 890416 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 15 | 890417 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 16 | 890417 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 17 | 890417 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 18 | 890417 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 19 | 890417 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 20 | 890417 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 21 | 890418 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 22 | 890418 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 23 | 890418 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 24 | 890418 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 25 | 890418 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 26 | 890418 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 27 | 890419 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 28 | 890419 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 29 | 890419 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 30 | 890419 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 31 | 890419 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 32 | 890419 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 33 | 890420 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 890420 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 35 | 890420 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 36 | 890420 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 37 | 890420 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 38 | 890420 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 39 | 890421 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 40 | 890421 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 41 | 890421 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 42 | 890421 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 43 | 890421 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 44 | 890421 | 2200 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 |
| 45 | 890422 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 46 | 890422 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 47 | 890422 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 48 | 890422 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 49 | 890422 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 50 | 890422 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 51 | 890423 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 52 | 890423 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 53 | 890423 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 54 | 890423 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 55 | 890423 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 56 | 890423 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 57 | 890424 | 200 | | | | | | | | | | | | | |
| 58 | 890424 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 59 | 890424 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 60 | 890424 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 61 | 890424 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 62 | 890424 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 63 | 890425 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 64 | 890425 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 65 | 890425 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 66 | 890425 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 67 | 890425 | 1800 | | | | | | | | | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68 | 890425 | 2200 | | | | | | | | | | | | | |
| 69 | 890426 | 200 | | | | | | | | | | | | | |
| 70 | 890426 | 600 | | | | | | | | | | | | | |
| 71 | 890426 | 1000 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 72 | 890426 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 73 | 890426 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 74 | 890426 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 75 | 890427 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 76 | 890427 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 77 | 890427 | 1000 | | | | | | | | | | | | | |
| 78 | 890427 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 79 | 890427 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 80 | 890427 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 81 | 890428 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 82 | 890428 | 600 | 3 | 5 | 5 | 9 | 0 | 1 | 2 | 6 | 9 | 0 | 0 | 0 | 0 |
| 83 | 890428 | 1000 | 8 | 7 | 17 | 22 | 5 | 2 | 8 | 11 | 26 | 0 | 0 | 0 | 0 |
| 84 | 890428 | 1400 | 5 | 3 | 6 | 0 | 0 | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 |
| 85 | 890428 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 86 | 890428 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 87 | 890429 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 88 | 890429 | 600 | 4 | 1 | 1 | 1 | 3 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 |
| 89 | 890429 | 1000 | 0 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 90 | 890429 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 91 | 890429 | 1800 | 4 | 4 | 3 | 5 | 1 | 2 | 2 | 2 | 7 | 0 | 0 | 0 | 0 |
| 92 | 890429 | 2200 | | | | | | | | | | | | | |
| 93 | 890430 | 200 | | | | | | | | | | | | | |
| 94 | 890430 | 600 | 8 | 13 | 20 | 15 | 4 | 8 | 8 | 6 | 26 | 0 | 0 | 0 | 0 |
| 95 | 890430 | 1000 | 3 | 19 | 4 | 0 | 2 | 14 | 1 | 0 | 17 | 0 | 0 | 0 | 0 |
| 96 | 890430 | 1400 | 9 | 2 | 7 | 5 | 3 | 1 | 1 | 2 | 7 | 0 | 0 | 0 | 0 |
| 97 | 890430 | 1800 | 1 | 2 | 0 | 5 | 1 | 2 | 0 | 2 | 4 | 1 | 0 | 0 | 0 |
| 98 | 890430 | 2200 | 7 | 4 | 6 | 15 | 7 | 4 | 3 | 10 | 24 | 0 | 0 | 0 | 0 |
| 99 | 890501 | 200 | | | | | | | | | | | | | |
| 100 | 890501 | 600 | 15 | 9 | 10 | 8 | 7 | 5 | 3 | 4 | 19 | 0 | 0 | 0 | 0 |
| 101 | 890501 | 1000 | 11 | 19 | 16 | 16 | 9 | 15 | 13 | 12 | 49 | 0 | 0 | 0 | 0 |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102 | 890501 | 1400 | 14 | 9 | 12 | 5 | 12 | 6 | 9 | 3 | 30 | 0 | 0 | 0 | 0 |
| 103 | 890501 | 1800 | 3 | 4 | | | 2 | 2 | | | 4 | 0 | 0 | 0 | 0 |
| 104 | 890501 | 2200 | 4 | 8 | 4 | 16 | 4 | 3 | 0 | 10 | 17 | 0 | 0 | 0 | 0 |
| 105 | 890502 | 200 | | | | | | | | | | | | | |
| 106 | 890502 | 600 | 14 | 15 | 11 | 5 | 6 | 4 | 7 | 1 | 18 | 0 | 0 | 0 | 0 |
| 107 | 890502 | 1000 | 4 | 12 | 11 | 17 | 3 | 9 | 7 | 6 | 25 | 0 | 0 | 0 | 0 |
| 108 | 890502 | 1400 | 4 | 3 | 1 | 7 | 1 | 1 | 0 | 3 | 5 | 0 | 0 | 0 | 0 |
| 109 | 890502 | 1800 | 3 | 4 | 3 | 4 | 2 | 4 | 2 | 2 | 10 | 0 | 0 | 0 | 0 |
| 110 | 890502 | 2200 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 111 | 890503 | 200 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 |
| 112 | 890503 | 600 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 113 | 890503 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 114 | 890503 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 115 | 890503 | 1800 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 116 | 890503 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 117 | 890504 | 200 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 118 | 890504 | 600 | 2 | 3 | 0 | 2 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 119 | 890504 | 1000 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | | | | |
| 120 | 890504 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 121 | 890504 | 1800 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | | | | |
| 122 | 890504 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 123 | 890505 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 124 | 890505 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 125 | 890505 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 126 | 890505 | 1400 | 2 | 1 | 3 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 0 |
| 127 | 890505 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 128 | 890505 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 129 | 890506 | 200 | | | | | | | | | | | | | |
| 130 | 890506 | 600 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 131 | 890506 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 132 | 890506 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 133 | 890506 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 134 | 890506 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 135 | 890507 | 200 | | | | | | | | | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 136 | 890507 | 600 | | | | | | | | | | | | | |
| 137 | 890507 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 138 | 890507 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 139 | 890507 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 140 | 890507 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 141 | 890508 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 142 | 890508 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 143 | 890508 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 144 | 890508 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 145 | 890508 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 146 | 890508 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 147 | 890509 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 148 | 890509 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 149 | 890509 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 150 | 890509 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 151 | 890509 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 152 | 890509 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 153 | 890510 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 154 | 890510 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 155 | 890510 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 156 | 890510 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 157 | 890510 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 158 | 890510 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 159 | 890511 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 160 | 890511 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 161 | 890511 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 162 | 890511 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 163 | 890511 | 1800 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 164 | 890511 | 2200 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 165 | 890512 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 166 | 890512 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 167 | 890512 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 168 | 890512 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 169 | 890512 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 170 | 890512 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 171 | 890513 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 172 | 890513 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 173 | 890513 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 174 | 890513 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 175 | 890513 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 176 | 890513 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 177 | 890514 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 178 | 890514 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 179 | 890514 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 180 | 890514 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 181 | 890514 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 182 | 890514 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 183 | 890515 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 184 | 890515 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 185 | 890515 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 186 | 890515 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 187 | 890515 | 1800 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 188 | 890515 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 189 | 890516 | 200 | | | | | | | | | | | | | |
| 190 | 890516 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 191 | 890516 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 192 | 890516 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 193 | 890516 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 194 | 890516 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 195 | 890517 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 196 | 890517 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 197 | 890517 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 198 | 890517 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 199 | 890517 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 200 | 890517 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 201 | 890518 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 202 | 890518 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 203 | 890518 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 204 | 890518 | 1400 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 |
| 205 | 890518 | 1800 | 0 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| 206 | 890518 | 2200 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 207 | 890519 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 208 | 890519 | 600 | 0 | 0 | 1 | 8 | 0 | 0 | 1 | 5 | 6 | 0 | 0 | 0 | 0 |
| 209 | 890519 | 1000 | 0 | 2 | 1 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 210 | 890519 | 1400 | 3 | 0 | 5 | 1 | 2 | 0 | 3 | 0 | 5 | 0 | 0 | 0 | 0 |
| 211 | 890519 | 1800 | 0 | 5 | 0 | 3 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 |
| 212 | 890519 | 2200 | 2 | 5 | 0 | 1 | 0 | 4 | 0 | 1 | 5 | 0 | 0 | 0 | 0 |
| 213 | 890520 | 200 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 214 | 890520 | 600 | 2 | 2 | 5 | 3 | 1 | 0 | 2 | 2 | 5 | 0 | 0 | 0 | 0 |
| 215 | 890520 | 1000 | 5 | 3 | 5 | 2 | 2 | 1 | 2 | 1 | 6 | 0 | 0 | 0 | 0 |
| 216 | 890520 | 1400 | 2 | 12 | 0 | 3 | 0 | 9 | 0 | 0 | 9 | 0 | 0 | 0 | 0 |
| 217 | 890520 | 1800 | 4 | 1 | 3 | 1 | 2 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 |
| 218 | 890520 | 2200 | 2 | 2 | 0 | 7 | 2 | 0 | 0 | 4 | 6 | 0 | 0 | 0 | 0 |
| 219 | 890521 | 200 | 0 | 4 | 3 | 1 | 0 | 3 | 1 | 0 | 4 | 0 | 0 | 0 | 0 |
| 220 | 890521 | 600 | 0 | 3 | 1 | 5 | 0 | 1 | 1 | 3 | 5 | 0 | 0 | 0 | 0 |
| 221 | 890521 | 1000 | 4 | 9 | 22 | 29 | 1 | 4 | 10 | 20 | 35 | 0 | 0 | 0 | 0 |
| 222 | 890521 | 1400 | 23 | 28 | 28 | 35 | 5 | 6 | 6 | 13 | 29 | 1 | 0 | 0 | 0 |
| 223 | 890521 | 1800 | 2 | 8 | 5 | 8 | 1 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 0 |
| 224 | 890521 | 2200 | 1 | 1 | 3 | 1 | 0 | 1 | 1 | 1 | 3 | 0 | 0 | 0 | 0 |
| 225 | 890522 | 200 | 4 | 2 | 1 | 5 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| 226 | 890522 | 600 | 39 | 11 | 19 | 51 | 10 | 7 | 6 | 23 | 46 | 0 | 0 | 0 | 0 |
| 227 | 890522 | 1000 | 18 | 43 | 45 | 41 | 5 | 27 | 17 | 9 | 58 | 0 | 0 | 0 | 0 |
| 228 | 890522 | 1400 | 9 | 14 | 28 | 10 | 2 | 6 | 8 | 3 | 19 | 0 | 0 | 0 | 0 |
| 229 | 890522 | 1800 | 18 | 14 | 9 | 15 | 1 | 3 | 0 | 6 | 10 | 0 | 0 | 0 | 0 |
| 230 | 890522 | 2200 | 6 | 5 | 5 | 9 | 1 | 3 | 2 | 1 | 7 | 0 | 0 | 0 | 0 |
| 231 | 890523 | 200 | 2 | 2 | 11 | 9 | 1 | 1 | 2 | 4 | 8 | 0 | 0 | 0 | 0 |
| 232 | 890523 | 600 | 183 | 93 | 103 | 361 | 117 | 35 | 36 | 140 | 328 | 0 | 0 | 0 | 0 |
| 233 | 890523 | 1000 | 98 | 42 | 66 | 140 | 36 | 19 | 27 | 55 | 137 | 0 | 0 | 0 | 0 |
| 234 | 890523 | 1400 | 41 | 83 | 55 | 53 | 21 | 29 | 21 | 17 | 87 | 1 | 0 | 0 | 0 |
| 235 | 890523 | 1800 | 34 | 8 | 4 | 17 | 8 | 7 | 3 | 4 | 22 | 0 | 0 | 0 | 0 |
| 236 | 890523 | 2200 | 11 | 33 | | | 4 | 17 | | | 20 | 1 | 0 | 0 | 0 |
| 237 | 890524 | 200 | 42 | 21 | 31 | 59 | 23 | 9 | 14 | 17 | 63 | 0 | 0 | 0 | 0 |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 238 | 890524 | 600 | 81 | 88 | 90 | 78 | 45 | 52 | 57 | 60 | 210 | 4 | 0 | 0 | 0 |
| 239 | 890524 | 1000 | 86 | 79 | 83 | 48 | 69 | 59 | 61 | 40 | 225 | 4 | 0 | 0 | 0 |
| 240 | 890524 | 1400 | 16 | 65 | 29 | 32 | 4 | 14 | 9 | 21 | 48 | 0 | 0 | 0 | 0 |
| 241 | 890524 | 1800 | 7 | 2 | 6 | 9 | 1 | 1 | 1 | 7 | 10 | 0 | 0 | 0 | 0 |
| 242 | 890524 | 2200 | 0 | 0 | 4 | 6 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 |
| 243 | 890525 | 200 | 2 | 6 | 2 | 3 | 0 | 2 | 0 | 1 | 3 | 0 | 0 | 0 | 0 |
| 244 | 890525 | 600 | 22 | 15 | 13 | 10 | 9 | 7 | 4 | 5 | 25 | 0 | 0 | 0 | 0 |
| 245 | 890525 | 1000 | 3 | 6 | 9 | 7 | 0 | 2 | 5 | 4 | 11 | 0 | 0 | 0 | 0 |
| 246 | 890525 | 1400 | 8 | 11 | 21 | 16 | 3 | 5 | 9 | 1 | 18 | 0 | 0 | 0 | 0 |
| 247 | 890525 | 1800 | 1 | 5 | 3 | 5 | 0 | 1 | 1 | 3 | 5 | 0 | 0 | 0 | 0 |
| 248 | 890525 | 2200 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 249 | 890526 | 200 | 5 | 7 | 9 | 5 | 0 | 0 | 2 | 3 | 5 | 0 | 0 | 0 | 0 |
| 250 | 890526 | 600 | 5 | 36 | 40 | 16 | 1 | 19 | 17 | 10 | 47 | 0 | 0 | 0 | 0 |
| 251 | 890526 | 1000 | 39 | 52 | | | 3 | 9 | | | 12 | 0 | 0 | 0 | 0 |
| 252 | 890526 | 1400 | 3 | 8 | 5 | 1 | 1 | 3 | 1 | 1 | 6 | 0 | 0 | 0 | 0 |
| 253 | 890526 | 1800 | 7 | 2 | 3 | 6 | 5 | 1 | 2 | 5 | 13 | 0 | 0 | 0 | 0 |
| 254 | 890526 | 2200 | 87 | 94 | 113 | 69 | 55 | 35 | 64 | 32 | 186 | 0 | 0 | 0 | 0 |
| 255 | 890527 | 200 | 168 | 247 | 163 | 196 | 45 | 84 | 33 | 65 | 227 | 0 | 0 | 0 | 0 |
| 256 | 890527 | 600 | 206 | 141 | 175 | 234 | 65 | 55 | 48 | 84 | 99 | 0 | 153 | 0 | 0 |
| 257 | 890527 | 1000 | 123 | 92 | 69 | 63 | 7 | 11 | 8 | 8 | 0 | 0 | 34 | 0 | 0 |
| 258 | 890527 | 1400 | 10 | 15 | 10 | 19 | 3 | 8 | 4 | 5 | 20 | 0 | 0 | 0 | 0 |
| 259 | 890527 | 1800 | 5 | 11 | 4 | 13 | 3 | 6 | 0 | 7 | 16 | 0 | 0 | 0 | 0 |
| 260 | 890527 | 2200 | 12 | 13 | 17 | 25 | 8 | 6 | 10 | 14 | 38 | 0 | 0 | 0 | 0 |
| 261 | 890528 | 200 | 18 | 44 | 55 | 21 | 7 | 19 | 11 | 6 | 43 | 0 | 0 | 0 | 0 |
| 262 | 890528 | 600 | 45 | 23 | 18 | 14 | 6 | 6 | 4 | 5 | 19 | 2 | 0 | 0 | 0 |
| 263 | 890528 | 1000 | 2 | 15 | 5 | 7 | 1 | 5 | 3 | 3 | 12 | 0 | 0 | 0 | 0 |
| 264 | 890528 | 1400 | 5 | 4 | 7 | 5 | 1 | 0 | 1 | 2 | 4 | 0 | 0 | 0 | 0 |
| 265 | 890528 | 1800 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 266 | 890528 | 2200 | 4 | 12 | 12 | 15 | 2 | 8 | 8 | 3 | 21 | 0 | 0 | 0 | 0 |
| 267 | 890529 | 200 | 9 | 17 | 4 | 24 | 5 | 8 | 1 | 11 | 25 | 0 | 0 | 0 | 0 |
| 268 | 890529 | 600 | 5 | 8 | 8 | 3 | 3 | 3 | 2 | 1 | 9 | 0 | 0 | 0 | 0 |
| 269 | 890529 | 1000 | 0 | 3 | 5 | 2 | 0 | 1 | 3 | 0 | 4 | 0 | 0 | 0 | 0 |
| 270 | 890529 | 1400 | 1 | 0 | 2 | 5 | 1 | 0 | 0 | 3 | 4 | 0 | 0 | 0 | 0 |
| 271 | 890529 | 1800 | 7 | 3 | 4 | 3 | 3 | 3 | 3 | 1 | 10 | 0 | 0 | 0 | 0 |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 272 | 890529 | 2200 | 4 | 20 | 10 | 8 | 1 | 9 | 6 | 4 | 20 | 0 | 0 | 0 | 0 |
| 273 | 890530 | 200 | 10 | 13 | 16 | 14 | 7 | 3 | 7 | 5 | 22 | 0 | 0 | 0 | 0 |
| 274 | 890530 | 600 | 15 | 6 | 5 | 4 | 4 | 2 | 2 | 1 | 9 | 0 | 0 | 0 | 0 |
| 275 | 890530 | 1000 | 6 | 10 | 18 | 13 | 2 | 4 | 5 | 4 | 9 | 2 | 4 | 0 | 0 |
| 276 | 890530 | 1400 | 11 | 0 | 4 | 8 | 8 | 0 | 3 | 6 | 2 | 15 | 0 | 0 | 0 |
| 277 | 890530 | 1800 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 0 | 0 |
| 278 | 890530 | 2200 | 2 | 2 | 5 | 3 | 1 | 1 | 2 | 1 | 0 | 0 | 5 | 0 | 0 |
| 279 | 890531 | 200 | 30 | 35 | 24 | 56 | 16 | 23 | 11 | 27 | 72 | 5 | 0 | 0 | 0 |
| 280 | 890531 | 600 | 80 | 40 | 102 | 159 | 44 | 25 | 86 | 90 | 0 | 0 | 245 | 0 | 0 |
| 281 | 890531 | 1000 | 82 | 83 | 56 | 75 | 30 | 30 | 27 | 41 | 8 | 0 | 120 | 0 | 0 |
| 282 | 890531 | 1400 | 31 | 32 | 48 | 25 | 16 | 17 | 23 | 9 | 11 | 0 | 54 | 0 | 0 |
| 283 | 890531 | 1800 | 24 | 41 | 84 | 62 | 13 | 12 | 52 | 41 | 35 | 60 | 23 | 0 | 0 |
| 284 | 890531 | 2200 | 141 | 127 | 61 | 137 | 65 | 45 | 36 | 59 | 164 | 41 | 0 | 0 | 0 |
| 285 | 890601 | 200 | 53 | 71 | 72 | 75 | 22 | 23 | 49 | 33 | 127 | 0 | 0 | 0 | 0 |
| 286 | 890601 | 600 | 43 | 21 | 19 | 21 | 10 | 5 | 9 | 11 | 6 | 11 | 18 | 0 | 0 |
| 287 | 890601 | 1000 | 15 | 23 | 18 | 12 | 5 | 11 | 7 | 5 | 26 | 2 | 0 | 0 | 0 |
| 288 | 890601 | 1400 | 7 | 3 | 30 | 14 | 4 | 2 | 17 | 8 | 29 | 2 | 0 | 0 | 0 |
| 289 | 890601 | 1800 | 9 | 14 | 19 | 13 | 4 | 9 | 16 | 9 | 9 | 2 | 26 | 1 | 0 |
| 290 | 890601 | 2200 | 28 | 24 | 45 | 28 | 18 | 19 | 22 | 19 | 9 | 18 | 50 | 1 | 0 |
| 291 | 890602 | 200 | 9 | 6 | 7 | 15 | 1 | 2 | 2 | 6 | 9 | 2 | 0 | 0 | 0 |
| 292 | 890602 | 600 | 4 | 3 | 3 | 11 | 1 | 0 | 0 | 4 | 5 | 0 | 0 | 0 | 0 |
| 293 | 890602 | 1000 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 |
| 294 | 890602 | 1400 | 0 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 4 | 0 | 0 | 0 | 0 |
| 295 | 890602 | 1800 | 5 | 6 | 1 | 6 | 3 | 1 | 1 | 2 | 7 | 0 | 0 | 0 | 0 |
| 296 | 890602 | 2200 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 297 | 890603 | 200 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 298 | 890603 | 600 | 2 | 3 | 1 | 5 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 299 | 890603 | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 300 | 890603 | 1400 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 301 | 890603 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 302 | 890603 | 2200 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 303 | 890604 | 200 | 1 | 1 | 2 | 3 | 1 | 0 | 0 | 3 | 3 | 0 | 0 | 1 | 0 |
| 304 | 890604 | 600 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 305 | 890604 | 1000 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 306 | 890604 | 1400 | 3 | 4 | 3 | 1 | 1 | 4 | 2 | 0 | 7 | 0 | 0 | 0 | 0 |
| 307 | 890604 | 1800 | 3 | 5 | 7 | 10 | 2 | 5 | 6 | 8 | 0 | 9 | 12 | 0 | 0 |
| 308 | 890604 | 2200 | | | | | | | | | | | | | |
| 309 | 890605 | 200 | 3 | 10 | 12 | 3 | 2 | 6 | 7 | 2 | 2 | 8 | 7 | 0 | 0 |
| 310 | 890605 | 600 | 3 | 5 | 1 | 4 | 3 | 2 | 1 | 2 | 0 | 0 | 8 | 0 | 0 |
| 311 | ·890605 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 312 | 890605 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 313 | 890605 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 314 | 890605 | 2200 | 0 | 1 | | | 0 | 1 | | | 0 | 0 | 1 | 0 | 0 |
| 315 | 890606 | 200 | 0 | 0 | | | | | | | | | | | |
| 316 | 890606 | 600 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 317 | 890606 | 1000 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 318 | 890606 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 319 | 890606 | 1800 | 4 | 4 | 1 | 0 | 3 | 2 | 1 | 0 | 0 | 0 | 6 | 0 | 0 |
| 320 | 890606 | 2200 | 2 | 8 | 5 | 4 | 0 | 3 | 1 | 1 | 0 | 1 | 3 | 0 | 0 |
| 321 | 890607 | 200 | 1 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| 322 | 890607 | 600 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 323 | 890607 | 1000 | 3 | 1 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 1 | 3 | 0 | 0 |
| 324 | 890607 | 1400 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 |
| 325 | 890607 | 1800 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 0 |
| 326 | 890607 | 2200 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 327 | 890608 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 328 | 890608 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 329 | 890608 | 1000 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 330 | 890608 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 331 | 890608 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 332 | 890608 | 2200 | 4 | 5 | 1 | 1 | 3 | 2 | 0 | 1 | 3 | 3 | 0 | 0 | 0 |
| 333 | 890609 | 200 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 |
| 334 | 890609 | 600 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 335 | 890609 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 336 | 890609 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 337 | 890609 | 1800· | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| 338 | 890609 | 2200 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 339 | 890610 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |

Table A-5. *continued*

| PAGE | DATE | TIME | ASURF | BSURF | AOBL | BOBL | ASVIA | BSVIA | AOVIA | BOVIA | ST1 | ST2 | ST3 | ST4 | HATCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 340 | 890610 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 341 | 890610 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 342 | 890610 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 343 | 890610 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 344 | 890610 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 345 | 890611 | 200 | | | | | | | | | | | | | |
| 346 | 890611 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 347 | 890611 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 348 | 890611 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 349 | 890611 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 350 | 890611 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 351 | 890612 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 352 | 890612 | 600 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | |
| 353 | 890612 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 354 | 890612 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 355 | 890612 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 356 | 890612 | 2200 | | | | | | | | | | | | | |
| 357 | 890613 | 200 | | | | | | | | | | | | | |
| 358 | 890613 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 359 | 890613 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 360 | 890613 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 361 | 890613 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 362 | 890613 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 363 | 890614 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 364 | 890614 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 365 | 890614 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 366 | 890614 | 1400 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 367 | 890614 | 1800 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 368 | 890614 | 2200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 369 | 890615 | 200 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 370 | 890615 | 600 | 0 | 0 | 0 | 0 | | | | | | | | | |
| 371 | 890615 | 1000 | 0 | 0 | 0 | 0 | | | | | | | | | |

Table A-6. Roanoke River flow (cfs), and daily production and viability of striped bass eggs estimated by W.W. Hassler.

| | 1981 | | | 1982 | | | 1983 | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | River flow | Totnum | Percent viable | River flow | Totnum | Percent viable | River flow | Totnum | Percent viable |
| 415 | 2,280 | | | 2,310 | | | 21,100 | | |
| 416 | 2,660 | | | 2,350 | | | 22,300 | | |
| 417 | 2,280 | | | 2,340 | | | 25,300 | | |
| 418 | 2,290 | | | 2,320 | | | 25,600 | | |
| 419 | 2,260 | | | 2,560 | | | 25,400 | | |
| 420 | 2,460 | | | 2,280 | | | 25,400 | | |
| 421 | 2,250 | | | 2,270 | | | 25,500 | | |
| 422 | 2,250 | | | 2,300 | | | 25,800 | | |
| 423 | 2,240 | | | 2,300 | | | 25,900 | | |
| 424 | 2,250 | | | 2,300 | | | 25,700 | | |
| 425 | 2,260 | | | 2,310 | | | 26,100 | | |
| 426 | 2,260 | | | 4,680 | | | 25,500 | | |
| 427 | 2,250 | | | 6,200 | | | 25,600 | | |
| 428 | 4,560 | | | 6,200 | | | 25,400 | | |
| 429 | 6,130 | 14,807,849 | 26.81 | 6,240 | | | 25,500 | | |
| 430 | 6,120 | 4,466,917 | 51.35 | 7,840 | | | 25,500 | | |
| 501 | 6,110 | 1,450,291 | 41.66 | 7,100 | | | 25,700 | | |
| 502 | 6,160 | 2,049,754 | 58.82 | 6,260 | | | 25,800 | | |
| 503 | 6,160 | 850,841 | 57.14 | 9,740 | 9,689,224 | 62.50 | 25,800 | | |
| 504 | 6,130 | 2,668,548 | 50.00 | 8,650 | 15,930,133 | 67.86 | 25,800 | | |
| 505 | 6,170 | 4,234,870 | 48.57 | 11,100 | 12,677,068 | 72.50 | 25,900 | | |
| 506 | 6,110 | 3,384,028 | 32.35 | 10,600 | 24,203,403 | 69.62 | 24,200 | 0 | 0.00 |
| 507 | 6,080 | 6,136,315 | 45.28 | 11,600 | 36,862,867 | 66.99 | 20,300 | 0 | 0.00 |
| 508 | 2,350 | 3,404,646 | 46.51 | 6,290 | 52,449,125 | 79.86 | 20,200 | 2,479,392 | 0.00 |
| 509 | 2,280 | 231,102,640 | 84.73 | 6,320 | 195,991,599 | 89.41 | 20,200 | 31,345,564 | 51.61 |
| 510 | 2,310 | 15,980,245 | 45.91 | 6,350 | 861,737,906 | 84.09 | 20,200 | 2,778,863 | 14.29 |
| 511 | 3,100 | 1,624,128 | 43.75 | 6,200 | 38,727,708 | 79.13 | 20,200 | 2,274,149 | 0.00 |
| 512 | 8,980 | 2,643,097 | 29.41 | 7,530 | 3,368,147 | 65.22 | 20,200 | 3,921,461 | 0.00 |
| 513 | 2,290 | 4,567,860 | 40.00 | 10,200 | 16,831,627 | 60.87 | 19,900 | 9,761,224 | 2.50 |
| 514 | 2,280 | 7,747,779 | 26.08 | 6,110 | 59,829,691 | 52.65 | 19,000 | 2,159,153 | 0.00 |
| 515 | 2,870 | 4,107,506 | 80.00 | 6,030 | 12,813,921 | 70.93 | 19,000 | 33,880,293 | 11.81 |
| 516 | 2,270 | 1,996,474 | 68.00 | 6,030 | 59,403,581 | 75.08 | 19,000 | 83,007,948 | 13.18 |
| 517 | 2,270 | 11,995,043 | 80.82 | 8,570 | 56,412,465 | 70.25 | 19,100 | 48,137,029 | 6.90 |

Table A-6. *continued*

| Date | 1981 | | | 1982 | | | 1983 | | |
|---|---|---|---|---|---|---|---|---|---|
| | River flow | Totnum | Percent viable | River flow | Totnum | Percent viable | River flow | Totnum | Percent viable |
| 518 | 2,570 | 1,068,052 | 30.76 | 7,330 | 71,883,748 | 59.86 | 19,200 | 3,562,898 | 0.00 |
| 519 | 7,480 | 1,097,238 | 12.50 | 5,980 | 7,889,620 | 40.82 | 19,200 | 4,151,811 | 0.00 |
| 520 | 3,900 | 999,523 | 37.50 | 6,010 | 17,087,491 | 76.27 | 19,400 | 1,911,615 | 0.00 |
| 521 | 3,690 | 223,840 | 50.00 | 5,990 | 37,450,084 | 68.73 | 19,200 | 1,664,998 | 33.33 |
| 522 | 2,250 | 1,807,590 | 57.14 | 6,050 | 14,635,665 | 74.51 | 19,100 | 729,443 | 0.00 |
| 523 | 2,240 | 11,015,722 | 74.62 | 6,030 | 8,746,962 | 75.81 | 19,100 | 67,953,394 | 26.86 |
| 524 | 2,250 | 2,840,649 | 80.00 | 6,020 | 13,016,484 | 74.71 | 19,100 | 73,328,239 | 22.55 |
| 525 | 2,260 | 0 | 0.00 | 6,360 | 6,761,628 | 57.78 | 17,900 | 181,935,230 | 28.14 |
| 526 | 4,650 | 0 | 0.00 | 5,940 | 2,192,804 | 53.33 | 15,300 | 85,173,366 | 36.71 |
| 527 | 2,530 | 92,613 | 0.00 | 6,010 | 17,243,938 | 79.83 | 12,600 | 78,739,084 | 42.02 |
| 528 | 3,940 | 0 | 0.00 | 6,600 | 21,834,696 | 68.75 | 9,490 | 16,695,190 | 36.96 |
| 529 | 4,020 | | | 6,400 | 3,412,828 | 47.62 | 8,120 | 106,866,581 | 52.83 |
| 530 | 4,380 | | | 6,050 | 2,398,124 | 50.00 | 8,550 | 343,217,551 | 37.96 |
| 531 | 3,100 | | | 6,050 | 12,577,924 | 61.18 | 14,400 | 96,575,021 | 54.55 |
| 601 | 3,220 | | | 8,650 | 3,920,536 | 76.00 | 14,900 | 2,661,682 | 7.69 |
| 602 | 4,170 | | | 8,830 | 907,856 | 40.00 | 15,200 | 3,076,379 | 0.00 |
| 603 | 3,040 | | | 9,010 | | | 15,100 | 3,727,573 | 28.57 |
| 604 | 3,860 | | | 11,200 | | | 6,160 | 7,794,064 | 31.71 |
| 605 | 4,070 | | | 9,850 | | | 6,140 | 22,418,003 | 49.69 |
| 606 | 2,440 | | | 10,500 | | | 14,300 | 16,157,706 | 42.35 |
| 607 | 2,680 | | | 11,500 | | | 14,200 | 2,134,174 | 11.11 |
| 608 | 4,380 | | | 13,800 | | | 11,900 | 1,668,459 | 0.00 |
| 609 | 9,570 | | | 13,900 | | | 9,660 | 3,106,877 | 40.00 |
| 610 | 2,530 | | | 15,300 | | | 10,300 | 6,551,900 | 20.00 |
| 611 | 2,630 | | | 18,100 | | | 6,160 | 1,064,888 | 57.14 |
| 612 | 2,340 | | | 18,100 | | | 6,390 | 0 | 0.00 |
| 613 | 10,300 | | | 18,200 | | | 11,500 | | |
| 614 | 10,600 | | | 18,100 | | | 6,330 | | |
| 615 | 6,920 | | | 18,100 | | | 4,500 | | |
| Total eggs | | 344,364,058 | | | 1,698,888,853 | | | 1,352,611,202 | |

Table A-7. Roanoke River flow (cfs), and daily production and viability of striped bass eggs estimated by WRC.

| Date | 1981 Egg count | 1981 Number/ 100m3 | 1981 Percent viable | 1982 Egg count | 1982 Number/ 100m3 | 1982 Percent viable | 1983 Egg count | 1983 Number/ 100m3 | 1983 Percent viable |
|---|---|---|---|---|---|---|---|---|---|
| 415 | | | | | | | | | |
| 416 | | | | | | | | | |
| 417 | | | | | | | | | |
| 418 | | | | | | | | | |
| 419 | | | | | | | | | |
| 420 | | | | 814 | 239.5 | 81.4 | | | |
| 421 | 682 | 219.2 | 84.0 | 68 | 19.8 | 88.2 | | | |
| 422 | 2 | 0.5 | 50.0 | 11 | 3.9 | 72.7 | | | |
| 423 | 0 | 0.0 | | 7 | 2.9 | 71.4 | | | |
| 424 | 224 | 59.1 | 86.2 | 0 | 0.0 | | 1 | 0.3 | 0.0 |
| 425 | | | | 365 | 101.7 | 76.7 | 2 | 0.6 | 50.0 |
| 426 | 445 | 135.8 | 15.5 | 335 | 88.5 | 57.9 | 0 | 0.0 | |
| 427 | 123 | 36.8 | 71.5 | 20 | 8.9 | 20.0 | 0 | 0.0 | |
| 428 | 4260 | 979.0 | 68.5 | 235 | 109.9 | 29.8 | 4 | 1.1 | 25.0 |
| 429 | 9224 | 4444.0 | 79.4 | 9 | 3.2 | 55.6 | 0 | 0.0 | |
| 430 | 2336 | 974.3 | 66.7 | 12 | 3.9 | 100.0 | 0 | 0.0 | |
| 501 | 2083 | 993.7 | 76.9 | 29 | 12.6 | 55.2 | 21 | 5.8 | 42.9 |
| 502 | 87 | 43.9 | 58.6 | 101 | 45.9 | 53.5 | 5 | 1.4 | 40.0 |
| 503 | 537 | 246.6 | 58.1 | 857 | 219.8 | 58.0 | 11 | 3.5 | 45.5 |
| 504 | 194 | 88.7 | 61.9 | 165 | 45.4 | 70.3 | 34 | 7.9 | 26.5 |
| 505 | 159 | 48.1 | 50.9 | 249 | 64.4 | 68.7 | 21 | 5.9 | 14.3 |
| 506 | 1042 | 330.3 | 58.3 | 317 | 81.0 | 67.5 | 18 | 5.6 | 16.7 |
| 507 | 1117 | 349.4 | 67.7 | 1023 | 278.0 | 68.1 | 45 | 14.3 | 20.0 |
| 508 | 1019 | 320.6 | 57.3 | 468 | 140.0 | 78.6 | 28 | 9.3 | 10.7 |
| 509 | 471 | 148.4 | 58.2 | 3762 | 1059.1 | 80.1 | 166 | 48.8 | 15.7 |
| 510 | 6938 | 2208.3 | 56.4 | 23673 | 7624.9 | 78.6 | 16 | 5.7 | 0.0 |
| 511 | 3459 | 1090.9 | 70.6 | 479 | 2.3 | 73.3 | 21 | 7.3 | 14.3 |
| 512 | 76 | 25.5 | 57.9 | 64 | 3.8 | 75.0 | 12 | 4.5 | 0.0 |
| 513 | 255 | 144.1 | 65.5 | 164 | 7.6 | 68.3 | 33 | 12.6 | 21.2 |
| 514 | 445 | 428.4 | 87.4 | 742 | 343.6 | 56.2 | 16 | 6.0 | 25.0 |
| 515 | 1529 | 1285.7 | 82.1 | | | | 159 | 42.5 | 15.7 |
| 516 | | | | | | | 339 | 93.8 | 6.5 |

Table A-7. *continued*

| Date | 1981 | | | 1982 | | | 1983 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Egg count | Number/ 100m3 | Percent viable | Egg count | Number/ 100m3 | Percent viable | Egg count | Number/ 100m3 | Percent viable |
| 517 | | | | | | | 574 | 161.6 | 3.1 |
| 518 | | | | | | | 12 | 4.2 | 16.7 |
| 519 | | | | | | | 29 | 9.9 | 10.3 |
| 520 | | | | | | | 21 | 6.7 | 23.8 |
| 521 | | | | | | | 3 | 0.9 | 33.3 |
| 522 | | | | | | | 0 | 0.0 | |
| 523 | | | | | | | 479 | 112.9 | 29.6 |
| 524 | | | | | | | 730 | 158.7 | 24.7 |
| 525 | | | | | | | 2161 | 449.6 | 13.9 |
| 526 | | | | | | | 949 | 224.3 | 34.5 |
| 527 | | | | | | | 560 | 139.6 | 42.0 |
| 528 | | | | | | | 157 | 47.9 | 36.9 |
| 529 | | | | | | | 1221 | 357.1 | 64.0 |
| 530 | | | | | | | 4190 | 1171.1 | 514.6 |
| 531 | | | | | | | 746 | 301.1 | 57.6 |
| 601 | | | | | | | | | |
| 602 | | | | | | | | | |
| 603 | | | | | | | | | |
| 604 | | | | | | | | | |
| 605 | | | | | | | | | |
| 606 | | | | | | | | | |
| 607 | | | | | | | | | |
| 608 | | | | | | | | | |
| 609 | | | | | | | | | |
| 610 | | | | | | | | | |
| 611 | | | | | | | | | |
| 612 | | | | | | | | | |
| 613 | | | | | | | | | |
| 614 | | | | | | | | | |
| 615 | | | | | | | | | |
| | 36707 | | | 33969 | | | 12784 | | |