Harris Nuclear Plant

2004 Environmental Monitoring Report

Environmental Services Section

HARRIS NUCLEAR PLANT
2004 ENVIRONMENTAL MONITORING REPORT

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Environmental Services Section

PROGRESS ENERGY SERVICE COMPANY
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Preface

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Metric-English Conversion and Units of Measure

Length

1 micron (μm) = 4.0 x 10^{-5} inch
1 millimeter (mm) = 1000 μm = 0.04 inch
1 centimeter (cm) = 10 mm = 0.4 inch
1 meter (m) = 100 cm = 3.28 feet
1 kilometer (km) = 1000 m = 0.62 mile

Area

1 square meter (m^2) = 10.76 square feet
1 hectare (ha) = 10,000 m^2 = 2.47 acres

Volume

1 milliliter (ml) = 0.034 fluid ounce
1 liter = 1000 ml = 0.26 gallon
1 cubic meter = 35.3 cubic feet

Weight

1 microgram (μg) = 10^{-3} mg or 10^{-6} g = 3.5 x 10^{-8} ounce
1 milligram (mg) = 3.5 x 10^{-5} ounce
1 gram (g) = 1000 mg = 0.035 ounce
1 kilogram (kg) = 1000 g = 2.2 pounds
1 metric ton = 1000 kg = 1.1 tons
1 kg/hectare = 0.89 pound/acre

Temperature

Degrees Celsius (°C) = 5/9 (°F-32)

Specific conductance

μS/cm = Microsiemens/centimeter

Turbidity

NTU = Nephelometric Turbidity Unit

Water Chemistry Abbreviations

Cl^-	Chloride	NH_3-N	Ammonia-nitrogen
SO_4^{2-}	Sulfate	$NO_3^- + NO_2^-$ - N	Nitrate + nitrite-nitrogen
Ca^{2+}	Total calcium	TP	Total phosphorus
Mg^{2+}	Total magnesium	TOC	Total organic carbon
Na^+	Total sodium	Cu	Total copper
TN	Total nitrogen	TDS	Total dissolved solids

EXECUTIVE SUMMARY

Harris Reservoir supplies makeup water to the closed-cycle cooling system for the Harris Nuclear Plant. The Harris Nuclear Plant discharges primarily cooling tower blowdown along with low volume waste discharges into the reservoir near the main dam.

Harris Reservoir continued to show qualities of a typical, biologically productive, southeastern reservoir in 2004. Nutrient concentrations, including total phosphorus and total nitrogen concentrations, remained similar to recent years and were in an acceptable range for a productive reservoir in this area. Most water quality and water chemistry parameters were within the range of values for the past ten years.

Largemouth bass, bluegill, and redear sunfish continued to dominate the fish community in Harris Reservoir during 2004. Annual catch rates for bluegill and largemouth bass were similar to catch rates in previous years while the annual catch rates for redear sunfish declined from recent years. Bluegill and largemouth bass were represented by multiple size groups and an abundance of small fish indicated good reproduction. Similar to previous years, young redear sunfish were less common in samples than young bluegill and largemouth bass. The largemouth bass population remained balanced with a high percentage of larger fish present in the population.

No exotic mussel species that could cause biofouling problems were found in Harris Reservoir or the auxiliary reservoir during 2004. Hydrilla stands reaching the surface of the water were observed in the intake canal in Harris Reservoir; however, no fouling of the plant intake screens occurred. No stands of hydrilla were observed in the littoral zone of the auxiliary reservoir during 2004. Grass carp released in the auxiliary reservoir in past years continue to effectively reduce the quantity and area covered by hydrilla. No new species of introduced aquatic vegetation were discovered in Harris Reservoir or the auxiliary reservoir during 2004.

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Reservoir Description

Harris Reservoir, located in Chatham and Wake Counties, North Carolina, was created by impounding Buckhorn Creek, a tributary of the Cape Fear River (Figure 1). The main body of Harris Reservoir has a surface area of 1,680 ha; the auxiliary reservoir has a surface area of 130 ha. The main reservoir has a maximum depth of 18 m, a mean depth of 5.3 m, a volume of 8.9×10^7 m^3, a full-pool elevation of 67.1 m NGVD, and an average residence time of 28 months. The reservoir began filling in December 1980 and reached full-pool elevation in February 1983. The 64.5-km shoreline is mostly wooded and the 183.9-km^2 drainage area is mostly rolling hills with land used primarily for forestry and agriculture. The conversion of areas from forestry or agricultural purposes to residential uses continues in many areas of the drainage.

Harris Reservoir was constructed to supply cooling tower makeup and auxiliary reservoir makeup water to the 900-MW Harris Nuclear Plant, which began commercial operation in May 1987. In 1986 the bottom waters of the reservoir near the main dam began receiving National Pollutant Discharge Elimination System (NPDES)-permitted wastewater discharges from the power plant cooling tower. Tributaries also receive NPDES-permitted discharges from the Harris Energy and Environmental Center and from wastewater treatment plants at Apex and Holly Springs. The reservoir is a source of drinking water for Progress Energy employees at the Harris Nuclear Plant and the Harris Energy and Environmental Center.

Objectives

The primary objectives of the 2004 Harris Nuclear Plant non-radiological environmental monitoring program were to: (1) assess the overall water quality of Harris Reservoir, (2) identify any natural or power plant-induced effects on reservoir water quality, (3) document the introduction and expansion of nonnative plant and animal populations in the reservoir, and (4) demonstrate the existence of a reasonable recreational fishery. These objectives have also been addressed in previous annual monitoring reports with the most recent detailed in CP&L 2000, 2001, 2002, and PEC 2003 and 2004.

Methods

The Harris Nuclear Plant environmental program for 2004 included monitoring the reservoir's: (1) limnological characteristics (water quality, water chemistry, and phytoplankton), (2) fisheries community, (3) possible introductions of zebra and quagga mussels, and (4) distribution of aquatic vegetation. Sampling methods and statistical analyses for data collected during 2004 were similar to those used for data collected during 2002 and 2003 (PEC 2003, 2004) (Tables 2 and 3). Supporting data summaries and appropriate statistical analyses were used to describe and interpret the environmental quality of the reservoir (Table 3). Data collected during 2004 were compared to annual reservoir-wide means for data collected since 1995 (CP&L 1997a, 1997b, 1998, 1999, 2000, 2001, 2002; PEC 2003, 2004). A list of common and scientific names of species mentioned in this report is provided (Table 4).

Three stock assessment indices were used as indicators of a balanced largemouth bass population (Gablehouse 1984). These indices include: Proportional Stock Density (PSD), the percentage of fish ≥ 300 mm; Relative Stock Density for preferred length (RSD_P), the percentage of fish ≥ 380 mm; and Relative Stock Density for memorable length (RSD_M), the percentage of fish ≥ 510 mm. Only fish greater than the minimum stock length (≥ 200 mm) were included in these calculations.

All analytical testing completed in support of the Harris Reservoir environmental program was performed by laboratories which were certified by the State of North Carolina to perform water and wastewater testing (except for the analysis of total phosphorus). Total phosphorus analysis was conducted by Perkins Limnological Consulting, LLC—a vendor approved by Progress Energy Service Company for this testing. The accuracy and precision of laboratory analyses of water chemistry data were determined with analytical standards, spikes, and replicates. Quality assurance information including the accuracy and percent recovery of water chemistry standards are available upon request. In this report where concentrations were less than the laboratory-reporting limit, the concentrations were assumed to be at one-half the reporting limit for the calculation of the mean. Where statistically significant results were reported, a Type I error rate of 5% ($\alpha = 0.05$) was used and Fisher's protected least significant difference test was applied to determine where significant differences in mean values occurred.

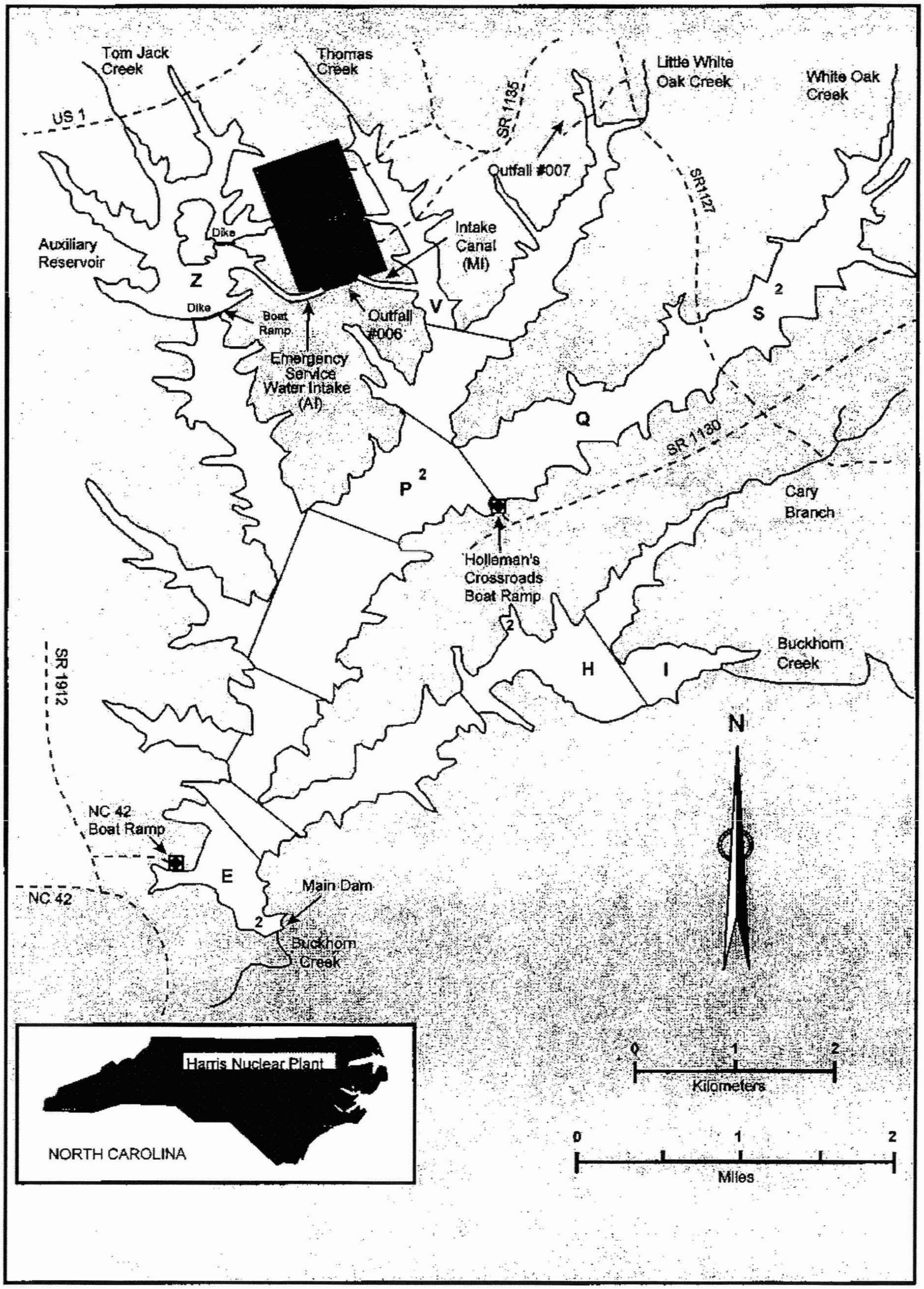

Figure 1. Sampling areas and stations at Harris Reservoir during 2004.

Table 1. Environmental monitoring program at Harris Reservoir for 2004.

Program	Frequency	Location
Water quality	January, May, July, November	Stations E2, H2, P2, and S2 (surface to bottom at 1-m intervals)
Water chemistry	January, May, July, November	Stations E2, H2, P2, and S2 (surface samples at all stations)
Plankton		
Chlorophyll *a*	January, May, July, November	Stations E2, H2, P2, and S2
Phytoplankton⁺	January, May, July, November	Stations E2, H2, P2, and S2
Biofouling monitoring		
Zebra mussel surveys	January, May, July, November	Areas E, P or Q, and V
Fisheries		
Electrofishing	February, May, August, November	Stations E1, E3, H1, H3, P1, P3, S1, S3, V1, and V3
Aquatic vegetation survey	November	Areas MI and Z

⁺Phytoplankton samples were collected and preserved but were not identified because all sampled chlorophyll *a* concentrations were < 40 μg/L.

Table 2. Field sampling and laboratory methods followed in the 2004 environmental monitoring program at Harris Reservoir.

Program	Method
Water quality	Temperature, dissolved oxygen, pH, turbidity, and specific conductance were measured with calibrated YSI® multiparameter instruments and YSI® dissolved oxygen meters. Measurements were taken from surface to bottom at 1-m intervals. Water clarity was measured with a Secchi disk.
Water chemistry	Surface water samples were collected in appropriate containers, transported to the laboratory on ice, and analyzed according to accepted laboratory methods.
Phytoplankton	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 250-ml sub sample was taken and preserved with 5 ml of "M3" fixative.
Chlorophyll *a*	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 1000-ml sub sample was collected in a dark bottle, placed on ice, and returned to the laboratory. In the laboratory a 250-ml sub sample was analyzed according to Strickland and Parsons (1972) and APHA (1995).
Electrofishing	Fifteen-minute samples were collected at each station using a Smith-Root Type VI-A, 5.0 GPP, or 7.5 GPP equipped, Wisconsin-design electrofishing boat with pulsed DC current. Fish were identified to species, measured to the nearest mm, weighed to the nearest gram, examined for the presence of disease and deformities, and released.
Biofouling monitoring	The dock at the Holleman's boat ramp or water quality station marker buoys were visually inspected for mussels during routine water quality monitoring.
Aquatic vegetation survey	Portions of the shoreline and/or littoral zone of the Harris Plant main reservoir intake canal and auxiliary reservoir were systematically surveyed by boat to document the presence of aquatic vegetation, specifically hydrilla and water primrose.

Table 3. Statistical analyses performed on data collected for the 2004 environmental monitoring program at Harris Reservoir.

Program	Variable	Transformation	Statistical Test/model[+]	Main effect(s)
Water quality	Specific conductance and Secchi disk transparency	None	One-way, block on month	Station
Water chemistry	Select monitoring variables	None	One-way, block on month	Station
Phytoplankton	Chlorophyll *a*	None	One-way, block on month	Station
Fisheries	Relative weight (W_r) [¶]	None	$W_r = W_o/W_s \times 100$	Selected species

[+]Statistical tests used were one-way analysis of variance models. A Type I error rate of 5% ($\alpha = 0.05$) was used to judge the significance of all tests. Fisher's protected least significant difference (LSD) test was applied to determine where differences in means occurred.

[¶]Relative weight (W_r) where W_o is the observed weight of each fish and W_s is the length-specific standard weight predicted by a weight-length regression equation constructed to represent the species as a whole ($W_r = W_o / W_s * 100$). Relative weight (Anderson and Neumann 1996) was calculated for bluegill (Hillman 1982), redear sunfish (Pope et al. 1995), and largemouth bass (Wege and Anderson 1978). Minimum total lengths for inclusion in these calculations are 80 mm for bluegill and redear sunfish and 150 mm for largemouth bass.

Table 4. Common and scientific names of species mentioned in this report.

Common Name	Scientific Name
Fish	
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Bluespotted sunfish	*Enneacanthus gloriosus*
Bowfin	*Amia calva*
Brown bullhead	*Ameiurus nebulosus*
Chain pickerel	*Esox niger*
Channel catfish	*Ictalurus punctatus*
Coastal shiner	*Notropis petersoni*
Comely shiner	*Notropis amoenus*
Common carp	*Cyprinus carpio*
Eastern mosquitofish	*Gambusia holbrooki*
Flat bullhead	*Ameiurus platycephalus*
Flier	*Centrarchus macropterus*
Gizzard shad	*Dorosoma cepedianum*
Golden shiner	*Notemigonus crysoleucas*
Grass carp	*Ctenopharyngodon idella*
Largemouth bass	*Micropterus salmoides*
Pumpkinseed	*Lepomis gibbosus*
Redbreast sunfish	*Lepomis auritus*
Redear sunfish	*Lepomis microlophus*
Snail bullhead	*Ameiurus brunneus*
Spottail shiner	*Notropis hudsonius*
Swamp darter	*Etheostoma fusiforme*
Threadfin shad	*Dorosoma petenense*
Warmouth	*Lepomis gulosus*
White catfish	*Ameiurus catus*
White crappie	*Pomoxis annularis*
White perch	*Morone americana*
Yellow bullhead	*Ameiurus natalis*
Mussels	
Quagga mussel	*Dreissena bugensis*
Zebra mussel	*Dreissena polymorpha*
Aquatic Vegetation	
Water primrose	*Ludwigia* spp.
Hydrilla	*Hydrilla verticillata*

RESULTS OF ENVIRONMENTAL MONITORING AT HARRIS RESERVOIR DURING 2004

Limnology

Temperature and Dissolved Oxygen

- Reservoir waters were stratified at all four stations during May and July and were well mixed during January and November 2004 (Appendix 1). Portions of the hypolimnion just above the reservoir bottom were anoxic (i.e., conditions where dissolved oxygen concentrations are less than 1 mg/L) during May and July at all four stations (Appendix 1). At Station E2, water was anoxic during the May and July sampling dates from five or six meters to the bottom. A bottom-water oxygen decline is typical at this deeper station during the warm summer months in Harris Reservoir and in other productive southeastern water bodies.

Water Clarity (Secchi Disk Transparency, Total Dissolved Solids, and Turbidity)

- Secchi disk transparency depths varied among stations during January, May, July, and November with depths ranging from 1.0 to 2.7 m (Appendix 1). There were no significant differences in the annual mean Secchi disk transparency depths among stations during 2004 (Appendix 2).

- There were no significant spatial trends for total dissolved solids or turbidity during 2004 (Appendix 2). Mean total dissolved solids concentrations ranged from 59 to 64 mg/L. Turbidity was generally low at all stations with values ranging from 2.0 to 8.8 NTU.

- Over the past ten years, total dissolved solids concentrations ranged from 54 to 78 mg/L and have ranged from 62 to 68 mg/L for the last three years (Appendix 3). Although there were significant differences in concentrations, no consistent temporal trend was observed. Annual mean turbidity values ranged from 2.6 to 8.9 NTU since 1995. The annual mean turbidity value for 2004 was the lowest over the ten year period (Appendix 3).

Chlorophyll *a*

- During 2004, mean chlorophyll *a* concentrations (an indicator of algal biomass) in Harris Reservoir continued to be indicative of moderate biological productivity. Reservoir-wide mean chlorophyll *a* concentrations were highest in May and averaged 12 µg/liter for 2004 (Appendix 2). The greatest recorded chlorophyll *a* concentration was 22 µg/liter at Station H2 in July. Because chlorophyll *a* concentrations did not exceed the North Carolina water quality standard of 40 µg/liter (NCDWQ 2004), the collected phytoplankton was not identified (as specified in the study plans). There were no significant differences in chlorophyll *a* concentrations among stations during 2004 (Appendix 2).

- Using quarterly data from 1995 through 2004, annual mean chlorophyll *a* concentrations for Harris Reservoir ranged from 11 to 25 µg/liter (Appendix 3). For seven of the past ten years, annual mean chlorophyll *a* concentrations ranged from 11 to 14 µg/liter. The annual mean chlorophyll *a* concentration for 2004 was significantly less than the concentrations for 1997, 1998, and 2000.

Nutrients and Total Organic Carbon

- During 2004 total nitrogen concentrations were significantly greater at Station E2 than at Stations P2 and S2 (Appendix 2). There were no significant spatial differences among stations for other mean nutrient (i.e., total phosphorus, ammonia-N, and nitrate + nitrite-N) and total organic carbon concentrations in Harris Reservoir. Nearly all measured ammonia-N concentrations were below the lower reporting limit.

- Although the annual ammonia-N and total organic carbon concentrations for Harris Reservoir differed statistically over the past ten years, the variance was small and not biologically significant (Appendix 3). Concentrations for both nutrients were greatest during 2001.

- Concentrations of nitrate + nitrite-N and total nitrogen during 2004 were within the range of measured concentrations from 1995 to 2004 (Appendix 3). Total phosphorus concentrations in 2004 were at the low end of the range of concentrations for the past ten years.

Ions, Specific Conductance, and Hardness

- Calcium and sodium concentrations differed significantly among stations during 2004 (Appendix 2). For calcium, concentrations at Station S2 were significantly greater than concentrations at Stations E2 or H2. Sodium concentrations at Station H2 were significantly lower than at the other three stations. There were no significant spatial differences in concentrations of the other ions (chloride, magnesium, or sulfate), specific conductance, or hardness during 2004 (Appendix 2).

- There were significant differences among annual averages for all ions and hardness for the period from 1995 to 2004 (Appendix 3). Annual mean hardness calculations were significantly less in 2003 and 2004 than calculations for the previous eight years.

- Reservoir-wide calcium concentrations ranged from 2.2 to 5.3 mg/L from 1995 to 2004 (Appendix 3). The annual mean concentration for 2004 was the second lowest for the ten year period. Chloride concentrations for the last five years have been steady yet at a level significantly greater than concentrations measured in 1995 through 1999.

- Magnesium concentrations ranged from 1.2 to 2.0 mg/L for the past ten years (Appendix 3).

- Reservoir-wide sodium concentrations ranged from 7.5 to 12 mg/L since 1995 (Appendix 3). The annual averages for 2003 and 2004 were significantly less than concentrations from 1998 to 2002.

- Sulfate concentrations ranged from 7.1 to 17 mg/L from 1995 to 2004 (Appendix 3). The mean sodium concentration for 2004 was the third lowest concentration for the past 10 years.

pH and Total Alkalinity

- Surface water pH values in Harris Reservoir ranged from 6.7 to 9.1 in 2004 (Appendix 1). Surface pH values were highest during May and July at all stations. Stations E2 and H2 had pH values above 9.0 on May 27, 2004. These high pH values correspond with chlorophyll *a* values of 18.3 at Station E2 and 16.8 at Station H2.

- Total alkalinity concentrations ranged from 11 to 17 mg/L as $CaCO_3$ and were not statistically different among stations (Appendix 2). Over the past ten years total alkalinity concentrations ranged from 12 to 15 mg/L (Appendix 3). The 2004 concentration (13 mg/L) was statistically similar to most of the previous annual concentrations.

Trace Metal—Copper

- All measured concentrations of copper in 2004 were low (< 3.2 µg/L) with an annual reservoir mean of 1.6 µg/L (Appendix 2). No spatial trends were observed. Since 1995, annual copper concentrations for Harris Reservoir ranged from 1.1 to 3.5 µg/L (Appendix 3).

Fisheries

Community Composition and Structure

- Twenty-two fish species (identified to species level) were collected with quarterly electrofishing sampling during 2004 (Appendix 4). Two of these species were white perch and common carp—species recently introduced into Harris Reservoir. White perch, a species not collected in Harris Reservoir before 1999, was collected at three transects in 2004. Common carp were collected at Transects S and V during 2004 and represented 38% of the fish biomass at Transect V (Appendix 5). This introduced species was present in the Cape Fear River before Harris Reservoir was created but had not been collected in the reservoir before 2000, when one common carp was collected at Transect V. White perch and common carp will probably continue to become more abundant and widespread in Harris Reservoir in the near future.

- Since 1995, 27 fish species have been collected with electrofishing sampling (Appendix 6). Additionally, one flier, a sunfish species, was collected with electrofishing during an extra sampling trip near Transect E in 2003. Swamp darter was collected in Harris Reservoir for the first time since 1992 (CP&L 1993).

- The contribution of bluegill, redear sunfish, largemouth bass, and black crappie to the electrofishing catch in Harris Reservoir has been similar for the past ten years. These four sunfish species comprised 78% of the mean number per hour collected in Harris Reservoir during 2004 (Appendix 4). From 1995 to 2002, these four species comprised 80% to 90% of the total collected when the number of threadfin shad, a schooling species that can dramatically affect proportional abundance, is omitted from the 1998 data.

- By weight, largemouth bass, common carp, gizzard shad, and redear sunfish were the dominant taxa in 2004 (Appendix 5). In 2002 largemouth bass, redear sunfish, bluegill, and gizzard shad were the dominant taxa by weight (Appendix 7). From 1995 to 2000, largemouth bass and redear sunfish were always the two most dominant taxa by weight. The primary change in species contribution by weight resulted from the contribution of common carp. Common carp had not been collected in Harris Reservoir before 2000. By 2004 this species was the second only to largemouth bass by weight. Common carp can grow larger than nearly all other species currently collected in Harris Reservoir and are expected to continue to represent a large portion of the biomass as the population expands.

Catch Rates

- The mean catch rates by transect ranged from 149 fish/hr at Transect V to 357 fish/hr at Transect H (Appendix 4). These differences in total fish abundance were primarily due to differences in bluegill and shiner abundance among transects. In 2002 the mean catch rates by transect ranged from 240 fish/hr at Transect V to 416 fish/hr at Transect H (PEC 2003). The mean number per hour at each transect was slightly higher in 2002 than in 2004. The reservoir-wide average of 244 fish/hr was within the ten year range of 203 to 373 fish/hr (Appendix 6).

- In 2004 the mean weight per hour for fish ranged from 21.5 kg/hr at Transect E to 64.3 kg/hr at Transect V (Appendix 5). Despite having the fewest fish per hour, the mean weight per hour at Transect V was more than double the weight collected at the other four stations. This difference was due to the increased weight of largemouth bass (27.6 kg/hr) and common carp (24.5 kg/hr) at Transect V. Smaller fish accounted for the greater abundance at Transects E and H (Appendix 5).

- The reservoir-wide weight per hour average for 2004 of 34.0 kg/hr was within the range for the past decade of 17.8 to 43.5 kg/hr. Since 1999, the reservoir-wide weight per hour averages have ranged from 32.5 to 34.0 kg/hr. Most of the variation in weight per hour averages for 1995 and 1998 compared to the averages during more recent years can be attributed to the weights of largemouth bass collected (Appendix 7).

- Bluegill was the most abundant species collected at every transect during 2004 with the mean number per hour ranging from 55 fish/hr at Transect V to 144 fish/hr at Transect E (Appendix 4). Mean weight per hour ranged from 2.0 to 3.5 kg/hr. The reservoir-wide number of bluegill collected per hour in 2004 (102 fish/hr) was within the ten-year range of 77 to 119 fish/hr. The reservoir-wide weight of bluegill per hour for 2004 (2.8 kg/hr) was also within the ten year range (2.1 to 3.8 kg/hr).

- Redear sunfish was the second most abundant species in electrofishing samples in Harris Reservoir during 2004 (Appendix 4). Abundance ranged from 23 to 73 fish/hr at the five transects during 2004. Redear sunfish were less abundant in 2004 than during the years of sampling since 1995 (Appendix 6). Redear sunfish abundance ranged from 67 to 92 fish/hr from 1995 to 2002, but only 44 fish/hr were collected during 2004. The weight per hour for redear sunfish also declined; the 2004 value of 3.0 kg/hr was below the range of 4.7 to 7.1 kg/hr calculated for 1995 to 2002 (Appendix 7). However, redear sunfish were more abundant in 2004 than during the period from 1983 to 1994 (CP&L 1996).

- Largemouth bass was the third most abundant species in electrofishing samples in Harris Reservoir during 2004. Catch rates ranged from 15 fish/hr at Transect H to 30 fish/hr at Transect V (Appendix 4). Largemouth bass contributed more weight per hour at every transect during 2004 (Appendix 5). Largemouth bass weight per hour ranged from 5.7 kg/hr at Transect E to 27.6 kg/hr at Transect V, which is a restricted area that prohibits angling access. The largemouth bass catch rate for 2004 of 24 fish/hr was within the range of catch rates from 1995 to 2002 (20 to 39 fish/hr) (Appendix 6). The largemouth bass catch rate by weight of 11.6 kg/hr was within the range of catch rates for Harris Reservoir from 1995 to 2002 (5.7 to 26.0 kg/hr) (Appendix 7).

Population Assessments

- The length-frequency distribution for bluegill indicated strong recruitment during 2004 (Appendix 8). Additionally, there were adequate numbers of older, larger fish to support a recreational fishery. The mean relative weight of bluegill ($n = 905$, fish ≥ 80 mm TL) collected during 2004 was 84. This was less than optimal (100 = optimum), but was consistent with the range that might be expected under relatively high population densities. Bluegill relative weights averaged 84 in 2000 and 82 in 2002 (CP&L 2001; PEC 2003).

- Similar to previous years, the length-frequency distribution for redear sunfish indicated low reproductive success during 2004 (Appendix 8). However, the relatively high mean electrofishing catch rate and the presence of older, larger fish in the population indicated that a viable redear sunfish fishery exists in Harris Reservoir. Similar to bluegill, the less than optimal mean relative weight (77) for redear sunfish (n = 444, fish ≥ 80 mm TL) was in the range consistent with a relatively large population density. The relative weight average for 2004 was similar to relative weight averages from previous years. Redear sunfish relative weights averaged 78 in 2000 and 77 in 2002 (CP&L 2001; PEC 2003).

- The mean relative weight of largemouth bass collected during 2004 (n = 164, fish ≥ 150 mm TL) was 95, indicating a healthy, robust body condition. The relative weight average for 2004 was similar to averages in previous years. Largemouth bass relative weights averaged 94 in 2000 and 96 in 2002 (CP&L 2001; PEC 2003).

- Proportional Stock Density (PSD) and Relative Stock Density preferred length (RSD_P) values of 70 and 44, respectively, were consistent with objectives for a largemouth bass management strategy targeting larger fish (Gablehouse 1984; Willis et al. 1993). The management objective for Harris Reservoir to contain a large number of big bass equates to a PSD ranging from 50 to 80 and an RSD_P in the range of 30 to 60. Also, the Relative Stock Density memorable length index (RSD_M) was 6 during 2002, which was in the range (0-10) of values indicating a balanced largemouth bass population.

- Largemouth bass length-frequency analysis revealed a large number of bass less than 100 mm TL, no missing year classes, and a wide length range of larger bass (Appendix 8). Most of these Young-of-Year (YOY) were collected at Transect S (43%).

- No fish kills or disease outbreaks were noted in Harris Reservoir during 2004.

Biofouling Monitoring Surveys

- No zebra mussels or quagga mussels, potentially serious biofouling organisms to power plant operations, were found in Harris Reservoir or the auxiliary reservoir during 2004. Zebra and quagga mussels are not expected to thrive in Harris Reservoir because alkalinity, calcium, total hardness, and pH levels are sub-optimal for mussel growth and reproduction (Claudi and Mackie 1993).

Aquatic Vegetation

- A visual survey for troublesome aquatic vegetation was conducted in the Harris Auxiliary Reservoir, Harris Reservoir main intake canal, and in the Thomas Creek arm during November 2004. No hydrilla was observed in the auxiliary reservoir. These observations indicated that grass carp stocked in the 1990s have effectively controlled the abundance of hydrilla in the auxiliary reservoir. The dominant troublesome aquatic vegetation species growing in the main intake canal were hydrilla and water primrose. The areal coverage of both aquatic weeds was similar to 2003. Similar levels of hydrilla growth in the past have had no effect on Harris Nuclear Plant operations.

- No impacts to Harris Nuclear Plant operations from aquatic vegetation occurred during 2004.

- No new species of aquatic vegetation were observed in Harris Reservoir or in the auxiliary reservoir during 2004.

CONCLUSIONS

The environmental monitoring program conducted during 2004 continued to provide an assessment of the effects of the Harris Nuclear Plant's operation on various components of the aquatic environment. Most key indicators of the environmental quality in Harris Reservoir were unchanged from previous years. Harris Reservoir continued to typify a biologically productive southeastern reservoir with seasonally occurring oxygen-deficient bottom waters, elevated nutrient concentrations, abundant rooted, shallow-water aquatic plants, and a sunfish-dominated fishery.

Nutrient concentrations have been a concern in Harris Reservoir since phosphorous and nitrogen concentrations increased rapidly in the late 1980s and early 1990s. Water quality assessments determined that nutrient concentrations have remained stable in recent years and at levels acceptable for a productive, southeastern reservoir. Assessments of other water quality parameters, including total dissolved solids, turbidity, total organic carbon, ions, total alkalinity, hardness, and copper, indicated no consistent, biologically significant spatial trends. None of these variables were at concentrations that would be detrimental to the aquatic community.

Bluegill, redear sunfish, and largemouth bass continued to dominate the Harris Reservoir fishery during 2004. Bluegills from various size classes were abundant throughout the reservoir. Redear sunfish was the second most abundant species, but catch rates were lower than in previous years. Results indicated the presence of a balanced largemouth bass population exhibiting strong reproduction, no missing year classes, and the presence of a large percentage of larger fish. Abundant forage species have resulted in a very healthy, robust body condition for largemouth bass. White perch and common carp continue to be more abundant and widespread at Harris Reservoir. In terms of weight of fish collected, the non-native common carp were only surpassed by largemouth bass during 2004.

No nuisance algal blooms, as indicated by chlorophyll *a* concentrations, or exotic biofouling mussels were detected in the main reservoir during 2004. Coverage of the non-native aquatic vegetation species hydrilla and water primrose in the intake canal was similar during 2004 and 2003. Grass carp continued to control the amount and areal coverage of hydrilla in the auxiliary reservoir during 2004. No operational impacts occurred at the Harris Nuclear Plant because of aquatic vegetation biofouling and no new species of aquatic vegetation were discovered in 2004.

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Appendix 1. Water temperature, dissolved oxygen, conductivity, pH, and Secchi disk transparency data collected from Harris Reservoir during 2004.

January 29, 2004

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	5.4	4.6	5.0	3.0	11.6	11.6	12.0	12.4	89	82	84	105	7.2	7.1	7.3	7.2	2.1	2.0	1.6	1.9
1.0	5.3	4.7	5.0	3.0	11.6	11.6	11.9	12.4	89	82	84	105	7.2	7.1	7.2	7.2				
2.0	5.2	4.5	5.0	3.0	11.6	11.5	11.9	12.4	89	82	84	105	7.1	7.1	7.2	7.2				
3.0	5.2	4.4	5.0	2.9	11.5	11.5	11.9	12.4	89	82	84	105	7.1	7.1	7.2	7.2				
4.0	5.2	4.4	4.9	3.0	11.4	11.5	11.9	12.4	89	82	84	105	7.1	7.1	7.2	7.2				
5.0	5.2	4.3	4.8	3.3	11.5	11.5	11.9	12.3	89	82	84	103	7.1	7.1	7.2	7.2				
6.0	5.2	4.4	4.8		11.4	11.4	11.8		89	82	84		7.1	7.0	7.2					
7.0	5.2	4.3	4.8		11.5	11.4	11.8		89	82	84		7.1	7.0	7.1					
8.0	5.1	4.4	4.8		11.4	11.4	11.8		89	82	84		7.1	7.0	7.1					
9.0	5.2				11.4				89				7.1							
10.0	5.1				11.4				89				7.1							
11.0	5.1				11.4				89				7.1							
12.0	5.1				11.4				89				7.1							
13.0	5.1				11.4				89				7.1							
14.0	5.1				11.4				89				7.1							
15.0	5.1				11.4				89				7.1							
16.0	5.1				11.4				89				7.1							

May 27, 2004

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	28.3	29.7	29.1	29.7	11.3	10.3	9.6	9.3	97	98	98	100	9.0	9.1	7.9	7.8	1.0	1.1	1.0	1.0
1.0	27.9	29.6	29.0	29.6	11.3	10.3	9.4	9.3	97	97	97	100	9.3	9.1	7.9	7.8				
2.0	27.1	29.1	28.7	29.2	11.3	9.7	9.2	9.0	95	94	97	99	9.2	8.3	7.8	7.7				
3.0	26.1	25.5	28.3	27.9	10.4	7.8	8.9	4.7	91	88	96	102	8.5	7.8	7.7	6.8				
4.0	22.3	22.8	22.7	23.8	3.0	4.1	2.7	0.4	88	86	88	125	7.7	7.4	7.0	6.7				
5.0	19.7	19.8	19.8	21.0	0.5	0.8	1.8	0.6	87	86	86	109	7.3	6.9	6.7	6.9				
6.0	17.8	17.6	18.4		0.4	0.2	0.7		90	89	85		6.9	6.7	6.6					
7.0	17.0	16.6	17.4		0.3	0.1	0.4		86	90	87		6.8	6.7	6.6					
8.0	16.4	16.5	17.2		0.2	0.1	0.2		85	90	90		6.7	6.7	6.6					
9.0	15.7				0.2				83				6.7							
10.0	15.2				0.1				82				6.6							
11.0	14.8				0.1				82				6.6							
12.0	14.4				0.1				83				6.6							
13.0	13.8				0.1				87				6.6							
14.0	13.3				0.1				95				6.6							
15.0	13.2				0.1				97				6.7							
16.0	13.1				0.1				101				6.7							

Appendix 1 (continued)

July 20, 2004

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	29.5	30.0	29.7	29.7	8.1	7.9	7.7	7.8	89	84	89	91	7.7	7.6	7.5	7.9	1.5	1.9	2.4	1.5
1.0	29.3	29.9	29.7	29.6	8.1	8.0	7.8	7.7	90	84	89	91	7.9	7.8	7.6	7.9				
2.0	29.1	29.7	29.6	29.6	8.2	8.0	7.9	7.7	89	84	89	91	7.9	7.8	7.6	7.8				
3.0	29.0	29.0	29.5	28.5	8.2	6.9	7.9	3.4	89	88	89	95	7.9	7.6	7.5	7.5				
4.0	28.9	27.7	28.6	27.3	7.5	0.5	6.1	0.9	89	84	90	115	7.7	6.9	7.3	7.0				
5.0	25.9	25.4	24.9	27.1	1.1	0.4	2.1	0.4	103	105	114	117	7.1	6.8	7.2	6.9				
6.0	22.1	21.1	21.6		0.3	0.4	0.9		128	129	125		6.8	6.8	7.1					
7.0	21.0	20.0	20.8		0.3	0.4	0.6		129	134	126		6.7	6.7	7.0					
8.0	19.8	19.2	19.9		0.2	0.5	0.4		131	136	127		6.6	6.7	6.8					
9.0	18.3				0.2				126				6.6							
10.0	17.3				0.2				125				6.5							
11.0	16.4				0.2				127				6.5							
12.0	15.6				0.2				133				6.4							
13.0	14.7				0.2				147				6.4							
14.0	14.3				0.2				158				6.4							
15.0	14.2				0.1				183				6.5							
16.0	14.2				0.1				199				6.6							

November 30, 2004

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	15.1	15.0	15.1	13.1	8.7	8.6	8.3	9.1	104	100	101	106	6.7	6.8	6.9	6.9	1.0	1.1	1.1	2.7
1.0	14.5	14.5	14.7	12.7	8.0	8.5	8.2	8.8	104	100	101	106	6.7	6.7	6.9	6.8				
2.0	14.3	14.0	14.1	12.5	7.5	8.0	8.2	8.2	104	100	101	106	6.6	6.7	6.8	6.7				
3.0	14.3	13.9	14.1	12.2	7.3	7.8	8.2	8.2	104	100	101	112	6.6	6.6	6.8	6.6				
4.0	14.2	13.9	14.1	12.0	7.1	7.6	8.2	8.1	104	100	101	121	6.6	6.6	6.7	6.5				
5.0	14.2	13.9	14.1	11.7	7.0	7.4	8.1	7.5	104	100	101	140	6.5	6.6	6.7	6.4				
6.0	14.2	13.8	14.1		7.0	7.4	8.1		104	100	101		6.5	6.6	6.7					
7.0	14.2	13.8	14.0		7.0	7.4	8.0		104	100	101		6.5	6.6	6.6					
8.0	14.2	13.8	14.0		7.0	7.2	8.0		104	100	101		6.5	6.5	6.6					
9.0	14.2	13.3	14.0		7.1	5.7	7.9		104	95	101		6.5	6.4	6.6					
10.0	14.2				7.0				104				6.5							
11.0	14.2				6.9				104				6.4							
12.0	14.2				6.9				104				6.4							
13.0	14.2				6.9				104				6.4							
14.0	14.2				6.8				104				6.4							
15.0	14.2				6.8				104				6.4							
16.0	14.2				6.8				104				6.4							

Appendix 2. Means, ranges, and spatial trends of selected limnological variables from the surface waters of Harris Reservoir during 2004.[+]

Variable	Station				Reservoir Mean
	E2	H2	P2	S2	
Total dissolved solids (mg/L)	65 (60-70)	59 (50-64)	61 (54-66)	64 (62-65)	62
Turbidity (NTU)	3.7 (2.0-7.1)	4.0 (2.8-6.3)	4.2 (2.4-8.8)	3.2 (2.8-3.9)	3.8
Secchi disk transparency (m)	1.4 (1.0-2.1)	1.5 (1.1-2.0)	1.5 (1.0-2.4)	1.8 (1.0-2.7)	1.6
Chlorophyll *a* (µg/L)	12 (7.8-18)	14 (7.5-22)	12 (10-16)	7.6 (1.2-17)	12
Nutrients (mg/L)					
Ammonia-N	0.02 (< 0.02-0.06)	< 0.02	< 0.02	< 0.02	< 0.02
Nitrate + nitrite-N	0.06 (< 0.02-0.13)	0.05 (< 0.02-0.09)	0.05 (< 0.02-0.10)	0.04 (< 0.02-0.11)	0.05
Total nitrogen	0.77[a] (0.69-0.97)	0.72[ab] (0.60-0.88)	0.64[b] (0.54-0.76)	0.63[b] (0.51-0.82)	0.69
Total phosphorus	0.036 (0.020-0.052)	0.022 (0.019-0.026)	0.022 (0.017-0.029)	0.022 (0.014-0.029)	0.025
Total organic carbon	8.0 (7.2-8.8)	7.5 (6.7-8.5)	8.0 (7.5-9.1)	7.6 (6.5-9.6)	7.8
Hardness[¶]	12 (< 1-17)	11 (< 1-16)	12 (< 1-17)	13 (< 1-17)	12
Specific conductance (µS/cm)	95 (89-104)	91 (82-100)	93 (84-101)	100 (91-106)	95
Ions (mg/L)					
Calcium	3.0[b] (1.3-3.6)	2.8[b] (1.3-3.6)	3.0[ab] (1.3-3.7)	3.3[a] (1.7-4.1)	3.0
Chloride	13 (9.5-15)	12 (9.1-14)	12 (9.7-15)	13 (9.8-15)	13
Magnesium	1.4 (< 1-2.0)	1.3 (< 1-1.9)	1.4 (< 1-1.9)	1.4 (< 1-1.9)	1.4
Sodium	8.4[a] (6.6-10)	7.5[b] (6.0-8.6)	8.5[a] (6.5-11)	8.9[a] (7.1-11)	8.3
Sulfate	10 (8.5-12)	9.8 (7.6-11)	10 (8.1-11)	10 (8.3-12)	10
Total alkalinity[¶]	12 (11-15)	13 (11-15)	12 (11-13)	15 (13-17)	13
Copper (µg/L)	1.8 (1.1-2.7)	1.4 (< 1.0-2.4)	1.6 (< 1.0-3.2)	1.4 (1.0-2.2)	1.6

[+]Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$)—see shaded rows. Sample size equaled 4 for all stations and equaled 16 for reservoir mean.

[¶]Total alkalinity units are in mg/L as $CaCO_3$ and hardness is calculated as mg equivalents $CaCO_3$/L.

Appendix 3. Means and temporal trends of selected limnological variables from the surface waters of Harris Reservoir from 1995 to 2004.⁺

Variable	Year									
	1995§	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total dissolved solids (mg/L)	62^{cd}	78^{a}	54^{d}	69^{abc}	73^{ab}	58^{cd}	73^{ab}	64^{bcd}	68^{abc}	62^{cd}
Turbidity (NTU)	2.6	4.7	5.7	5.8	8.9	6.2	4.8	4.9	4.7	3.8
Chlorophyll *a* (µg/L)	12^{c}	12^{c}	24^{a}	25^{a}	14^{bc}	20^{ab}	13^{c}	12^{c}	11^{c}	12^{c}
Nutrients (mg/L)										
Ammonia-N	0.03^{bc}	0.05^{b}	0.03^{bc}	0.05^{b}	0.04^{b}	0.03^{bc}	0.10^{a}	0.03^{bc}	0.03^{bc}	0.01^{c}
Nitrate + nitrite-N	0.03	0.03	0.05	0.04	0.08	0.03	0.03	0.05	0.04	0.05
Total nitrogen	0.66	0.86	0.74	0.56	0.62	0.58	0.63	0.62	0.62	0.69
Total phosphorus	0.033	0.032	0.034	0.034	0.033	0.032	0.031	0.030	0.028	0.025
Total organic carbon	7.1^{d}	6.5^{e}	7.2^{d}	7.2^{cd}	7.8^{b}	8.3^{ab}	8.4^{a}	7.8^{bc}	7.8^{bc}	7.8^{bc}
Hardness¶	18^{ab}	17^{ab}	16^{b}	20^{a}	17^{ab}	16^{b}	16^{b}	18^{ab}	8.9^{c}	12^{c}
Ions (mg/L)										
Calcium	4.0^{b}	3.8^{b}	3.7^{b}	5.3^{a}	3.9^{b}	3.6^{b}	3.8^{b}	3.9^{b}	2.2^{c}	3.0^{bc}
Chloride	9.9^{cd}	9.8^{de}	6.3^{f}	8.6^{e}	9.3^{de}	12^{ab}	11^{bc}	11^{ab}	12^{a}	13^{a}
Magnesium	1.9^{ab}	1.7^{bc}	1.7^{bcd}	1.6^{cd}	1.7^{bc}	1.6^{bcd}	1.6^{cd}	2.0^{a}	1.2^{e}	1.4^{de}
Sodium	12^{a}	9.2^{def}	8.9^{ef}	9.8^{de}	11^{bc}	10^{cd}	12^{ab}	11^{abc}	7.5^{g}	8.3^{gf}
Sulfate	14^{bc}	13^{cd}	13^{cd}	7.1^{f}	9.4^{e}	12^{d}	15^{b}	17^{a}	11^{e}	10^{e}
Total alkalinity¶	14^{ab}	13^{bcd}	12^{cd}	13^{cd}	15^{a}	14^{abc}	14^{abc}	13^{bcd}	12^{d}	13^{bcd}
Copper (µg/L)	1.1^{c}	2.0^{bc}	1.5^{c}	3.5^{a}	2.6^{b}	1.6^{c}	1.6^{c}	1.6^{c}	1.9^{bc}	1.6^{c}

⁺Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$). Sample size equaled 4 for all stations and equaled 16 for reservoir mean.

¶Total alkalinity units are in mg/L as $CaCO_3$ and hardness is calculated as mg equivalents $CaCO_3$/L.

§ Water chemistry samples were collected bimonthly during 1995 but only data collected quarterly (January, May, July, and November) were analyzed and presented in this table.

Appendix 4. Mean number per hour for fish collected with electrofishing sampling by transect from Harris Reservoir during 2004.

Species	Transect					Reservoir mean
	E	H	P	S	V	
Bowfin	0	< 1	< 1	2	0	< 1
Gizzard shad	14	11	15	10	15	13
Threadfin shad	4	0	4	0	0	1
Common carp	0	0	0	1	6	2
Golden shiner	13	5	9	11	< 1	8
Coastal shiner	8	0	3	0	< 1	2
Unidentified shiner	28	42	5	1	0	15
White catfish	2	1	3	0	1	1
Yellow bullhead	0	0	< 1	0	0	< 1
Brown bullhead	1	1	4	1	1	2
Flat bullhead	1	1	0	0	1	< 1
Channel catfish	2	1	< 1	0	< 1	1
Chain pickerel	0	2	0	6	4	2
Eastern mosquitofish	0	0	0	0	< 1	< 1
White perch	1	1	1	0	0	1
Bluespotted sunfish	1	0	1	0	0	< 1
Redbreast sunfish	2	0	0	0	0	< 1
Warmouth	4	1	1	1	4	2
Bluegill	144	139	101	71	55	102
Redear sunfish	50	73	46	23	27	44
Largemouth bass	25	15	19	29	30	24
Black crappie	12	64	24	3	2	21
Swamp darter	< 1	0	0	0	0	< 1
Total[¶]	**312**	**357**	**239**	**162**	**149**	**244**

[¶]Summations may vary from column totals due to rounding.

Appendix 5. Mean weight (measured in kilograms) per hour for fish collected with electrofishing sampling by transect from Harris Reservoir during 2004.

Species	Transect E	Transect H	Transect P	Transect S	Transect V	Reservoir mean
Bowfin	0	1.6	1.8	3.1	0	1.3
Gizzard shad	3.5	2.4	4.3	2.5	4.8	3.5
Threadfin shad	< 0.1	0	< 0.1	0	0	< 0.1
Common carp	0	0	0	5.0	24.5	5.9
Golden shiner	0.5	0.3	0.4	0.4	< 0.1	0.3
Coastal shiner	< 0.1	0	< 0.1	0	< 0.1	< 0.1
Unidentified shiner	< 0.1	< 0.1	< 0.1	< 0.1	0	< 0.1
White catfish	1.4	2.2	2.2	0	< 0.1	1.2
Yellow bullhead	0	0	0.1	0	0	< 0.1
Brown bullhead	0.2	0.4	0.9	0.3	0.2	0.4
Flat bullhead	< 0.1	< 0.1	0	0	0.3	0.1
Channel catfish	2.8	0.4	0.6	0	0.3	0.8
Chain pickerel	0	1.1	0	2.4	2.5	1.2
Eastern mosquitofish	0	0	0	0	< 0.1	< 0.1
White perch	0.1	< 0.1	0.1	0	0	< 0.1
Bluespotted sunfish	< 0.1	0	< 0.1	0	0	< 0.1
Redbreast sunfish	0.1	0	0	0	0	< 0.1
Warmouth	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1
Bluegill	2.6	3.4	3.5	2.2	2.0	2.8
Redear sunfish	3.4	4.5	4.0	1.1	1.8	3.0
Largemouth bass	5.7	8.3	10.2	6.2	27.6	11.6
Black crappie	0.9	5.2	2.0	0.4	0.1	1.7
Swamp darter	< 0.1	0	0	0	0	< 0.1
Total[¶]	**21.5**	**30.1**	**30.2**	**23.8**	**64.3**	**34.0**

[¶]Summations may vary from column totals due to rounding.

Appendix 6. Mean number per hour for fish collected with electrofishing sampling by year from Harris Reservoir during 1995, 1998, 1999, 2000, 2002, and 2004.

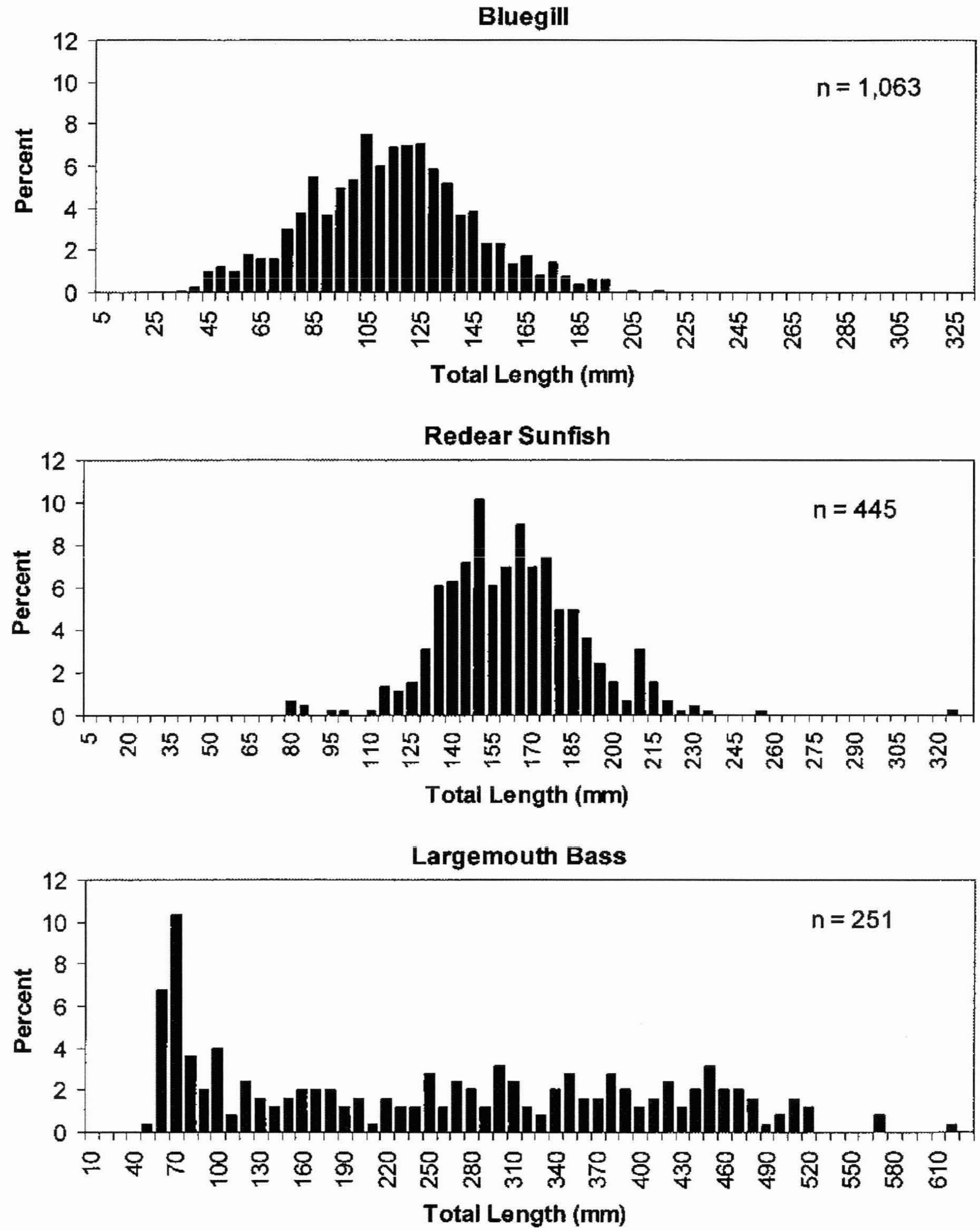
Species	Year					
	1995	1998	1999	2000	2002	2004
Bowfin	0	0	< 1	< 1	1	< 1
Gizzard shad	5	12	7	8	12	13
Threadfin shad	< 1	132	5	3	16	1
Common carp	0	0	0	< 1	< 1	2
Golden shiner	7	13	8	9	13	8
Comely shiner	0	< 1	< 1	0	0	0
Spottail shiner	0	0	< 1	< 1	0	0
Coastal shiner	0	0	< 1	18	11	2
Unidentified shiner	2	4	0	0	0	15
Snail bullhead	0	1	0	0	0	0
White catfish	0	< 1	< 1	3	1	1
Yellow bullhead	< 1	0	< 1	0	0	< 1
Brown bullhead	1	3	1	1	1	2
Flat bullhead	< 1	1	0	< 1	< 1	< 1
Channel catfish	< 1	< 1	< 1	< 1	1	1
Chain pickerel	1	1	2	1	3	2
Eastern mosquitofish	0	0	< 1	0	0	< 1
White perch	0	0	0	< 1	< 1	1
Unidentified *Morone* sp.	0	0	< 1	0	0	0
Bluespotted sunfish	3	1	10	1	1	< 1
Redbreast sunfish	1	1	< 1	< 1	0	< 1
Pumpkinseed	1	0	< 1	< 1	< 1	0
Warmouth	4	2	5	2	3	2
Bluegill	77	88	119	96	117	102
Redear sunfish	73	67	90	90	92	44
Hybrid sunfish	< 1	0	0	0	0	0
Largemouth bass	20	39	43	27	29	24
White crappie	0	0	< 1	1	0	0
Black crappie	6	7	19	5	21	21
Swamp darter	0	0	0	0	0	< 1
Total¶	**203**	**373**	**311**	**241**	**322**	**244**

¶Summations may vary from column totals due to rounding.

Appendix 7. Mean weight (measured in kilograms) per hour for fish collected with electrofishing sampling by year from Harris Reservoir during 1995, 1998, 1999, 2000, 2002, and 2004.

Species	Year					
	1995	1998	1999	2000	2002	2004
Bowfin	0	0	0.7	0.6	2.2	1.3
Gizzard shad	1.2	3.4	1.4	2.0	3.3	3.5
Threadfin shad	< 0.1	1.0	< 0.1	< 0.1	< 0.1	< 0.1
Common carp	0	0	0	0.3	0.5	5.9
Golden shiner	0.1	0.7	0.2	0.2	0.2	0.3
Comely shiner	0	< 0.1	< 0.1	0	0	0
Spottail shiner	0	0	< 0.1	0	0	0
Coastal shiner	0	0	< 0.1	< 0.1	< 0.1	< 0.1
Unidentified shiner	< 0.1	< 0.1	0	0	0	< 0.1
Snail bullhead	0	0.1	0	0	0	0
White catfish	0	0.1	0.3	2.0	0.7	1.2
Yellow bullhead	< 0.1	0	< 0.1	0	0	< 0.1
Brown bullhead	0.4	1.3	0.4	0.3	0.3	0.4
Flat bullhead	< 0.1	0.2	0	< 0.1	< 0.1	0.1
Channel catfish	1.2	0.7	0.3	0.4	1.3	0.8
Chain pickerel	0.2	0.7	0.6	0.3	1.4	1.2
Eastern mosquitofish	0	0	< 0.1	0	0	< 0.1
White perch	0	0	0	< 0.1	< 0.1	< 0.1
Unidentified *Morone* sp.	0	0	< 0.1	0	0	0
Bluespotted sunfish	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Redbreast sunfish	< 0.1	< 0.1	< 0.1	< 0.1	0	< 0.1
Pumpkinseed	< 0.1	0	< 0.1	0	< 0.1	0
Warmouth	0.2	0.1	0.2	0.1	0.1	< 0.1
Bluegill	2.1	3.3	3.0	2.7	3.8	2.8
Redear sunfish	5.9	4.7	7.1	5.7	6.0	3.0
Hybrid sunfish	< 0.1	0	0	0	0	0
Largemouth bass	5.7	26.0	16.1	18.1	11.3	11.6
White crappie	0	0	0.5	0.1	0	0
Black crappie	0.6	1.2	2.5	0.4	1.2	1.7
Swamp darter	0	0	0	0	0	< 0.1
Total[¶]	**17.8**	**43.5**	**33.1**	**33.3**	**32.5**	**34.0**

[¶]Summations may vary from column totals due to rounding.



Appendix 8. Length-frequency distributions for bluegill, redear sunfish, and largemouth bass collected with electrofishing sampling from Harris Reservoir in 2004.