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Harris Nuclear Plant

1999 Environmental Monitoring Report

Environmental Services Section

HARRIS NUCLEAR PLANT
1999 ENVIRONMENTAL MONITORING REPORT

August 2000

Environmental Services Section

CAROLINA POWER & LIGHT COMPANY
New Hill, North Carolina

Preface

This copy of the report is not a controlled document as detailed in Environmental Services Section Biology Program Procedures and Quality Assurance Manual. Any changes made to the original of this report subsequent to the date of issuance can be obtained from:

Manager
Environmental Services Section
Carolina Power & Light Company
3932 New Hill-Holleman Road
New Hill, North Carolina 27562-0327

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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	NO_3^- + NO_2^- - N	- Nitrate + nitrite-nitrogen	Cd	- Total cadmium
SO_4^{2-}	- Sulfate	TP	- Total phosphorus	Cu	- Total copper
Ca^{2+}	- Total calcium	TOC	- Total organic carbon	Hg	- Total mercury
Mg^{2+}	- Total magnesium	TS	- Total solids		
Na^+	- Total sodium	TDS	- Total dissolved solids		
TN	- Total nitrogen	TSS	- Total suspended solids		
NH_3-N	- Ammonia nitrogen	Al	- Total aluminum		

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.

Nutrient concentrations, including total phosphorus and total nitrogen concentrations, remained stable for the reporting period (1995-1999) and were in an acceptable range for a productive reservoir in this area. The concentrations of most chemical constituents did not exhibit any consistent statistically significant temporal changes and were in ranges which were not considered detrimental to the biological community.

Bluegill, redear sunfish, largemouth bass, and black crappie dominated the fish community in Harris Reservoir during 1999. Annual catch rates for bluegill, largemouth bass, and black crappie were similar to previous years. The 1999 annual catch rate for redear sunfish was generally greater than previous years. Length-frequency distributions indicated good reproduction with multiple size groups present for all species. The largemouth bass population remains balanced with a large percentage of larger fish present in the population.

Hydrilla stands reaching the surface of the water were not observed in the intake canal in Harris Reservoir or in the littoral zone of the auxiliary reservoir during 1999. The attempt to control hydrilla in the auxiliary reservoir by releasing grass carp in the autumns of 1994, 1996, and 1997 appears to have been effective in reducing the quantity and area covered by this vegetation.

HARRIS NUCLEAR PLANT
1999 ENVIRONMENTAL MONITORING REPORT

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 1680 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 National Geodetic Vertical Datum (NGVD), and an average residence time of 28 months. The reservoir began filling in December 1980 and full-pool elevation was reached 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 continued 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 some Company employees.

Objectives

The primary objectives of the 1999 Harris Nuclear Plant non-radiological environmental monitoring program were to: (1) assess the reservoir's overall water quality, (2) identify any natural or power plant-induced effects on the water quality in the reservoir, (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 1996b, 1997, 1998, and 1999.

Methods

The 1999 environmental program included monitoring the reservoir's: (1) limnological characteristics (water quality, water chemistry, and chlorophyll *a*), (2) distribution of aquatic vegetation, (3) possible introductions of the zebra mussel and the quagga mussel, and (4) fisheries community. Sampling methods, data summaries, and statistical analyses for data collected during 1999 were similar to those used for data collected during 1998 (CP&L 1999) (Tables 2 and 3). Long-term trend analyses of the data were evaluated for the most recent five years of monitoring (1995-1999) for most programs. Supporting data summaries and appropriate statistical analyses were used to describe and interpret the environmental quality of the reservoir (Table 3). Electrofishing data were not collected from 1992 to 1994 and from 1996 to 1998. Therefore, annual catch rates for 1999 data were compared to data from 1988 to 1991 and 1995. No largemouth bass fishing tournaments were monitored during 1999. 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 all fish ≥ 300 mm; Relative Stock Density preferred length (RSD_P), the percentage of all fish ≥ 380 mm; and Relative Stock Density memorable length (RSD_M), the percentage of all fish ≥ 510 mm.

Monthly precipitation data for 1999 and annual mean precipitation from 1995 to 1999 measured at Sanford, North Carolina, are presented as a reference (Figure 2).

All analytical testing, except total phosphorus analyses, completed in support of the Harris Reservoir environmental monitoring program was performed by testing laboratories that are certified by the N. C. Division of Water Quality's Laboratory Certification Program to perform water and wastewater testing. The University of Missouri, a vendor approved by CP&L for this testing, conducted total phosphorus analysis. 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.

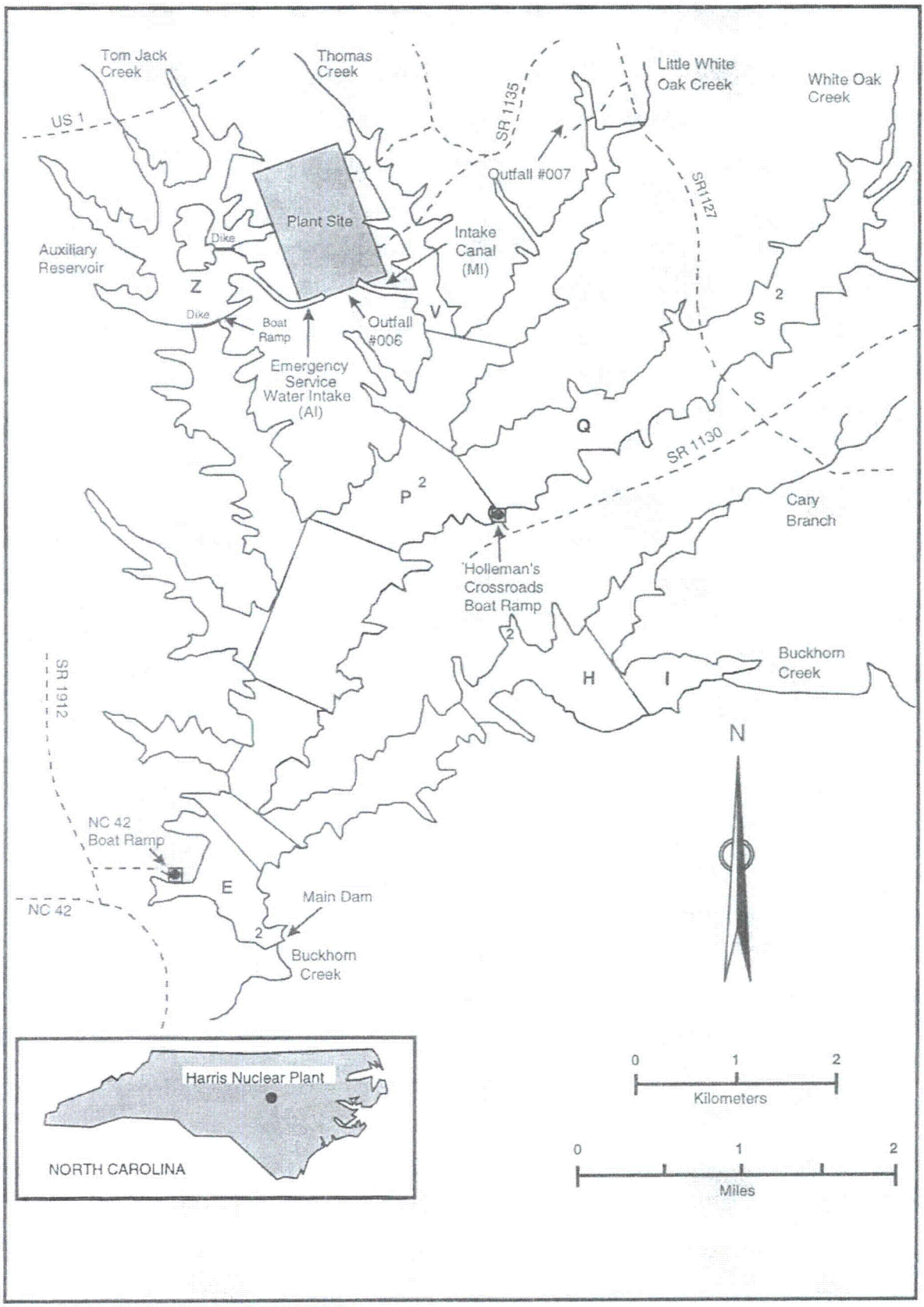


Figure 1. Sampling areas and stations at Harris Reservoir during 1999.

Table 1. Environmental monitoring program at Harris Reservoir for 1999.

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, P3, and S2 (surface samples at all stations, bottom sample at E2 only)
Plankton[+]	January, May, July, November	Stations E2, H2, P3, 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	Once per calendar year (Fall)	Areas MI and Z

[+]Plankton included phytoplankton (algae) and chlorophyll a samples. 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 1999 environmental monitoring program at Harris Reservoir.

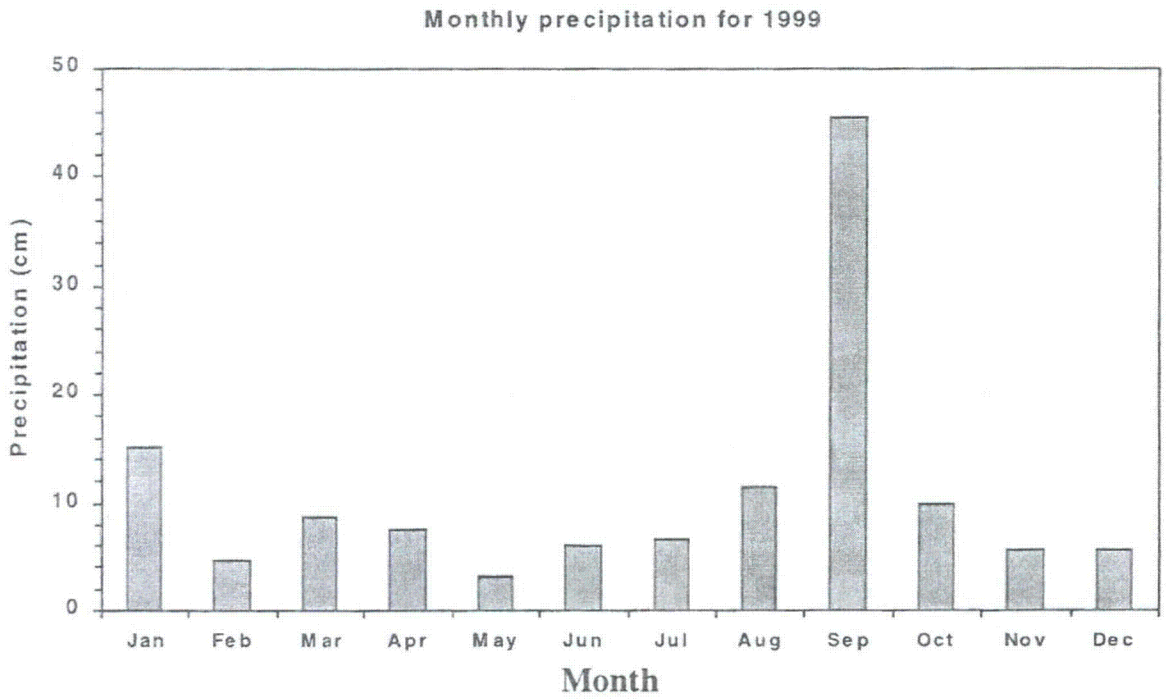
Program	Method
Water quality	Temperature, dissolved oxygen, pH, and specific conductance were measured with calibrated YSI® multiparameter instruments and YSI® dissolved oxygen meters. Measurements were taken from surface to bottom at 1-m intervals. Water clarity was measured with a Secchi disk.
Water chemistry	Surface (Stations E2, H2, P2, and S2) and bottom samples (Station E2) 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, placed in a plastic container and mixed, then a 1000-ml sub sample was collected in a dark bottle. All samples were 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 equipped, Wisconsin-design electrofishing boat with pulsed DC current. Fish were identified, measured to the nearest mm, weighed to the nearest gram, examined for the presence of disease and deformities, and released.
Zebra mussel	The dock at the Holleman's boat ramp, or water quality station marker buoys were visually inspected for the presence of 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 creeping water primrose.

Table 3. Statistical analyses performed on data collected for the 1999 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
	Specific conductance and Secchi disk transparency	None	Two-way, block on month	Station, year
Water chemistry	Select monitoring variables	None	One-way, block on month	Station
	Select monitoring variables	None	Two-way, block on month	Station, year
Phytoplankton	Biomass	None	One-way, block on month	Station
	Biomass	None	Two-way, block on month	Station, year
Fisheries	No. fish per hour	ln(x + 1)	One-way, block on month	Transect
	Relative weight (W_r) ¶		$W_r = W_o/W_s \times 100$	Selected species

+Statistical tests used were one-way and two-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).



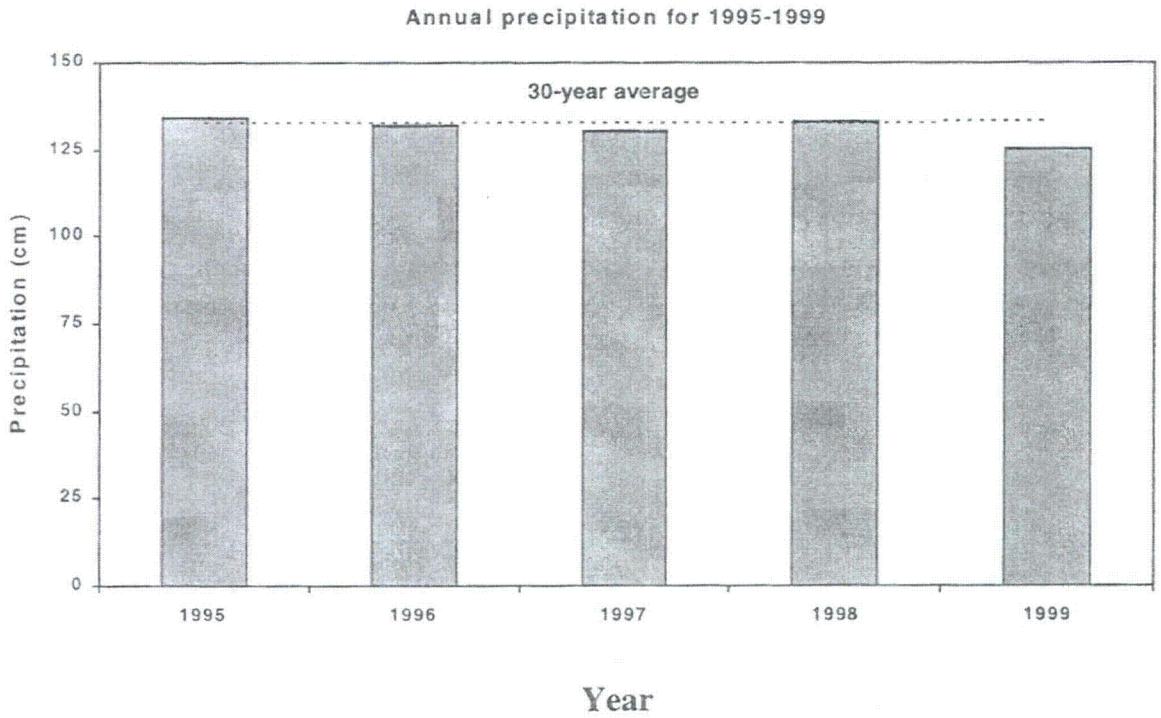


Figure 2. **Monthly and yearly precipitation recorded at Sanford, North Carolina, 1995-1999 (source: The State Climatologist, North Carolina State University).**

RESULTS OF ENVIRONMENTAL MONITORING AT HARRIS RESERVOIR DURING 1999

Limnology

Temperature and Dissolved Oxygen

- During 1999 the waters at all reservoir stations (except Station S2) were stratified during July and were freely circulating during January, May, and November (Appendix 1). Portions of the hypolimnion were anoxic (i.e., conditions where dissolved oxygen concentrations are less than 1 mg/liter) at Stations E2, H2, and P2 during July (Appendix 1). The shallower station (Station S2) remained mixed and well oxygenated from surface to the bottom year round. A bottom-water oxygen decline is typical at the deeper stations during the warm summer months in Harris Reservoir and in other southeastern productive water bodies when well-defined thermoclines develop and block bottom waters from mixing with the upper, more oxygenated waters.

Water Clarity (Secchi disk transparency, Solids, and Turbidity)

- The Secchi disk transparency depth (a water clarity indicator) continued to reflect linear distance from the headwater region with transparency depth being significantly less at Station S2 compared to the other stations (Stations E2, H2, and P2) during 1999 (Appendix 2). This spatial pattern is typical of patterns observed during 1995 through 1997.

- The reservoir-wide annual mean Secchi disk transparency values remained similar during the period 1996 to 1999 (Appendix 3).

- With the exception of annual mean total solids concentrations, which were significantly greater at Station S2 compared to Stations E2, H2, and P2, there were no significant spatial trends for solids (i.e., total dissolved solids and total suspended solids) or turbidity for Harris Reservoir surface waters during 1999 (Appendix 2).

- There were no consistent statistically significant temporal trends for solids (i.e., total solids, total dissolved solids, and total suspended solids) or turbidity during 1995 through 1999 (Appendix 3).

Algal Biomass (Chlorophyll *a*)

- During 1999, mean chlorophyll *a* concentrations (an indicator of algal biomass) in Harris Reservoir continued to be indicative of moderate to high biological productivity. Unlike concentrations measured in 1997 and 1998, no chlorophyll *a* concentration exceeded the North Carolina water quality standard of 40 µg/liter during 1999 (NCDEM 1992). There were no significant spatial differences in chlorophyll *a* concentrations during 1999 (Appendix 2).

- There were no consistent statistical trends in reservoir-wide annual mean chlorophyll *a* concentrations during the 1995 through 1999 period (Appendix 3).

Nutrients and Total Organic Carbon (surface waters)

- There were no significant spatial differences among stations for mean nutrient (i.e., phosphorus, ammonia-N, nitrate + nitrite-N, and total nitrogen) and total organic carbon concentrations in Harris Reservoir during 1999 (Appendix 2).

- There were no statistically significant temporal trends for nutrient concentrations and no biologically meaningful trends for total carbon concentrations during the period 1995 to 1999 (Appendix 3).

Specific Conductance, Ions, and Hardness (surface waters)

- There were no biologically meaningful spatial differences in specific conductance, ion, or hardness concentrations during 1999 (Appendix 2).

- With the exception of annual mean sulfate concentrations, which were significantly less for 1999 compared to concentrations during 1995-1997, there were no consistent temporal trends for the other ion or hardness concentrations during the period 1995-1999 (Appendix 3).

- The reservoir annual mean specific conductance was similar among years during the period 1995-1999 (Appendix 3).

pH and Total Alkalinity

- The median pH in the surface waters of Harris Reservoir was 6.8 during 1999 (Appendix 1).

- In 1999 total alkalinity concentrations were not statistically different among stations (Appendix 2).

- There were no consistent significant temporal trends in annual mean total alkalinity concentrations during the 1995-1999 comparison period (Appendix 3).

Trace Metals and Metalloids (surface waters)

- Mean concentrations of trace elements in Harris Reservoir were generally low in 1999 with most concentrations less than or near their respective laboratory reporting limits (Appendix 5). There were no significant spatial trends for trace elements during 1999 (Appendix 2). Aluminum concentrations ranged from < 50 to 1100 µg/liter during 1999 with the greater value recorded in a headwater region where aluminum concentrations may have been influenced by upstream watershed sources (Appendices 2 and 4).

- With the exception of annual mean aluminum concentrations, which were significantly greater for 1999 compared to concentrations during 1995-1997, there were no significant temporal differences among trace element concentrations in Harris Reservoir for the period 1995 to 1999 (Appendix 3).

Chemical Constituents in the Bottom Waters at Station E2

- The concentrations of most chemical constituents in the bottom waters remain within a range expected for productive, southeastern reservoir waters and were not considered detrimental to the biological community (Appendix 4).

- In the bottom waters at Station E2, there were no significant differences among years (1995-1999) for solids (total, dissolved, and suspended solids), turbidity, nutrients (i.e., nitrogen, nitrate + nitrite-N, ammonia-N, and total phosphorus), total organic carbon, ions (calcium, chloride, magnesium, and sodium), total alkalinity, hardness, and metals (i.e., aluminum, copper, cadmium, and mercury) (Appendices 4 and 5). Although the annual mean

concentration of sulfate for 1999 was significantly less than the concentration for 1995, this difference was not considered to be biologically important. There was extreme variability in chemical concentrations between periods of stratification and periods of uniform mixing throughout the water column. This variability was the probable cause for being unable to detect any significant temporal differences in the chemical constituents in bottom waters.

Biofouling Monitoring Surveys

- No zebra mussels (*Dreissena polymorpha*) or quagga mussels (D. *bugensis*), potentially serious biofouling organisms to power plant operations, were found in Harris Reservoir or the auxiliary reservoir during 1999. Zebra mussels and quagga mussels are not expected to thrive in Harris Reservoir because concentrations of alkalinity, calcium, total hardness, and pH are sub optimal for mussel growth and reproduction (Claudi and Mackie 1993).

Fisheries

- A total of 22 fish species were collected with quarterly electrofishing sampling during 1999 (Appendix 6). In addition, one 277 mm-long *Morone* spp. was collected during May at Transect H. This is the first time this genus has been collected in Harris Reservoir. The number of species collected during 1999 was greater than the number collected with semiannual sampling during 1998 (CP&L 1999). This was likely the result of the increased sampling frequency plus the additional efforts to identify shiners (*Notropis* spp.) to species rather than genus.

- Bluegill, redear sunfish, largemouth bass, and black crappie comprised approximately 87% of the mean number per hour collected (Appendix 6). These recreationally important species have historically dominated electrofishing samples from Harris Reservoir (Appendix 6 and CP&L 1996, 1999).

- There was no significant difference in the mean catch rate between transects for any species except for redear sunfish. As the following table of geometric mean catch rates indicates, significantly more redear sunfish were collected from Transects E and H compared to Transects P, S, and V (means with superscripts are significantly different).

	Transect				
	E	H	P	S	V
Mean number per hour	4.6[a]	5.1[a]	3.0[b]	3.2[b]	3.1[b]

- The annual mean electrofishing catch rate for bluegill of 119 per hour was greater than the range of values (77-105 fish/hour) reported for quarterly data from 1988 through 1995 (Appendix 7). The length-frequency distribution for bluegill indicated strong recruitment during 1999 (Appendix 8). Additionally, there were adequate numbers of older, larger fish to support a recreational fishery. The mean relative weight of bluegill collected during 1999 (80 fish/hour) was less than optimal (100 = optimum) but was consistent with the range that might be expected under relatively high population densities (Appendix 9).

- The annual mean electrofishing catch rate for redear sunfish of 87 per hour was similar to the value (73 fish/hour) reported for quarterly data during 1995 (Appendix 7). Mean annual catch rates for 1995 and 1999 were greater than those reported for quarterly data from 1988 through 1991. Similar to previous years, the length-frequency distribution for redear sunfish during 1999 indicated low recruitment (Appendix 8). However, the relatively high mean electrofishing catch rate, increasing population size in recent years, and the presence of older, larger fish in the population indicate a viable redear sunfish fishery exists in Harris Reservoir. Similar to bluegill, the less than optimal mean relative weight (76) was in the range consistent with a relatively large population density (Appendix 9).

- The annual mean electrofishing catch rate for largemouth bass of 43 per hour was similar to the values reported for quarterly data from 1998 and 1989 (Appendix 7). The length-frequency distribution for largemouth bass indicated very strong reproduction and the presence of multiple age classes during 1999 (Appendix 8). The values for proportional stock density (PSD) and relative stock density preferred length (RSD_p) were consistent with objectives for a large bass management strategy (Gablehouse 1984; Willis et al. 1993). The management objectives consistent with a population containing a large number of big bass are a range of values from 50-80 for the PSD and 30-60 for the RSD_p indices. The relative stock density memorable length index was in the range of values indicative of a balanced largemouth bass population (0-10). The mean relative weight of largemouth bass (94) collected during 1999 indicated healthy, robust body conditions (Appendix 9).

- No disease outbreaks or fish kills were observed or reported during 1999 and the incidence of deformities remained low (< 1%).

- No habitat improvement activities were conducted in Harris Reservoir during 1999. Discarded Christmas trees targeted for artificial reefs in the main reservoir were placed in the auxiliary reservoir.

Aquatic Vegetation

- A visual survey revealed no stands of hydrilla (*Hydrilla verticillata*), a non-native submersed plant, reaching the surface of the water of the intake canal in Harris Reservoir during 1999. The survey also revealed that creeping water primrose (*Ludwigia uruguayensis*) was established in approximately the same locations and existed in amounts similar to those observed during 1998. Although creeping water primrose was well established in this region, no impacts to the Harris Plant have occurred nor are they expected because of the low velocity of water drawn from the main reservoir into the cooling tower makeup water intake structure.

- During November 1999 no hydrilla stands extending to the water surface were observed in the littoral zone of the auxiliary reservoir. The presence of hydrilla stands in the auxiliary reservoir during 1999 has substantially diminished from the size and extent of stands observed in 1996 and 1997.

CONCLUSIONS

During 1999, the Harris Reservoir continued to show characteristics of a typical southeastern, biologically productive reservoir with seasonally occurring oxygen-deficient subsurface waters, elevated nutrient concentrations, and an abundance of rooted shallow-water aquatic plants.

The environmental monitoring program conducted in 1999 continued to provide an assessment of the effects of the Harris Nuclear Plant's operation on the various components of the aquatic environment. Most key indicators of the environmental quality in Harris Reservoir were unchanged from the previous five years. 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 since 1995 and at levels acceptable for southeastern, productive reservoirs. Assessments of other water quality parameters, including solids (total, dissolved, and suspended solids), turbidity, total organic carbon, ions (calcium, chloride, magnesium, sodium, and sulfate), total alkalinity, hardness, and metals, indicate few if any consistent statistically significant spatial or temporal trends with none of these variables at concentrations which would be detrimental to the aquatic community.

No nuisance algal blooms, as indicated by chlorophyll *a* concentrations, were detected during 1999. Reservoir-wide chlorophyll *a* concentrations demonstrated no consistent statistically significant temporal trend for the period 1995 through 1999.

Neither the zebra mussel nor the quagga mussels were found in the main reservoir during 1999.

Based on surveys conducted during 1999, no stands of the aquatic plant, hydrilla, extending to the surface of the water were observed in the littoral zone of the intake canal of the main reservoir or the auxiliary reservoir. The reduced size and extent of aquatic vegetation stands in the auxiliary reservoir indicates that grass carp released in the fall of 1994, 1996, and 1997 continued to control the amount and area coverage of hydrilla during 1999. No operational impacts have occurred at the Harris Nuclear Plant because of aquatic vegetation biofouling.

Bluegill, redear sunfish, largemouth bass, and black crappie continued to dominate the fishery in Harris Reservoir during 1999. Annual catch rates were generally in the range of values reported for annual catch rates reported for quarterly data from 1988 through 1995. The abundance of redear sunfish has increased since 1988. Results indicate the presence of a balanced largemouth bass population exhibiting strong reproduction and the presence of a large percentage of older, larger fish. Abundant forage species such as shad and other sunfish have resulted in very healthy, robust body condition for largemouth bass.

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Appendix 1. Water temperature, dissolved oxygen, conductivity, pH, and Secchi disk transparency data collected from Harris Reservoir during 1999.

January 7, 1999

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	7.8	6.6	6.8	4.4	11.1	12.0	12.2	12.3	69	59	61	70	6.6	6.3	6.0	5.8	1.2	0.7	1.2	0.3
1.0	7.5	6.5	6.8	4.4	10.5	11.7	11.9	10.8	68	59	61	70	6.6	6.3	6.0	5.8				
2.0	7.4	6.1	6.8	4.4	10.4	11.6	11.7	10.7	67	59	61	70	6.5	6.3	6.0	5.8				
3.0	7.3	6.1	6.5	4.4	10.3	11.4	11.6	10.4	67	58	61	70	6.5	6.3	6.0	5.9				
4.0	7.2	6.0	6.5		10.2	11.3	11.4		67	58	61		6.5	6.3	6.1					
5.0	7.2	6.0	6.5		10.1	11.2	11.4		67	58	61		6.5	6.3	6.1					
6.0	7.2	6.0	6.4		10.1	11.2	11.4		67	58	61		6.4	6.3	6.1					
7.0	7.2	6.0	6.4		10.0	11.1	11.4		67	58	60		6.3	6.3	6.1					
8.0	7.2	6.0	6.3		10.0	11.1	11.2		67	58	60		6.5	6.3	6.1					
9.0	7.2				10.0				67				6.4							
10.0	7.2				10.0				67				6.4							
11.0	7.2				9.9				67				6.4							
12.0	7.2				9.9				67				6.4							
13.0	7.2				9.9				67				6.4							
14.0	7.2				9.9				67				6.4							
15.0	7.2				9.9				67				6.4							
16.0	7.2				9.9				67				6.5							

May 4, 1999

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	19.1	18.7	18.2	18.6	10.8	10.7	9.5	10.6	92	89	89	89	7.3	7.0	6.4	6.9	1.3	1.3	1.3	0.9
1.0	17.7	16.8	16.7	17.2	10.8	11.0	10.5	10.8	89	84	86	87	7.4	7.3	6.4	7.0				
2.0	17.3	16.7	16.5	15.6	10.8	10.0	10.4	10.2	88	85	85	83	7.3	7.0	6.4	6.9				
3.0	16.7	16.5	16.4	14.9	9.1	10.6	9.6	9.5	87	84	85	82	7.2	6.9	6.4	6.6				
4.0	16.5	15.9	16.2		8.8	9.8	9.0		87	84	85		7.1	6.8	6.4					
5.0	16.3	15.7	16.0		8.5	8.8	9.3		85	93	85		7.0	6.7	6.4					
6.0	16.2	15.5	15.8		8.4	8.7	9.1		87	83	83		7.0	6.7	6.4					
7.0	16.2	15.5	15.8		8.4	8.6	9.0		87	83	84		7.0	6.7	6.4					
8.0	16.2	15.4	15.6		8.3	8.4	9.0		87	83	84		6.9	6.6	6.4					
9.0	16.2		15.5		8.3		8.7		87		84		6.9		6.4					
10.0	16.2		15.5		8.3		8.5		87		84		6.9		6.3					
11.0	16.2				8.3				87				6.9							
12.0	16.1				8.2				87				6.9							
13.0	15.9				8.1				87				6.9							
14.0	14.8				4.3				93				6.9							
15.0	12.3				1.2				95				6.8							
16.0	11.9				0.4				115				6.7							

Appendix 1 (continued)

July 8, 1999

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	28.6	30.3	29.4	30.0	9.0	9.0	8.5	8.5	121	124	122	126	8.1	7.9	7.5	6.9	1.9	1.7	1.6	1.3
1.0	28.4	30.2	29.4	30.0	8.9	8.7	8.3	8.2	121	124	122	125	8.1	7.9	7.5	6.9				
2.0	28.1	29.4	29.4	29.9	8.9	8.2	8.3	8.0	120	121	121	125	8.2	7.9	7.5	6.9				
3.0	27.7	25.6	29.3	29.4	8.9	4.1	7.8	6.8	119	115	121	124	8.1	7.9	7.5	7.0				
4.0	24.6	24.2	25.7		2.9	0.9	4.1		115	111	117		8.1	7.4	7.6					
5.0	23.1	22.7	23.2		0.7	0.4	0.8		117	117	114		7.8	7.4	7.3					
6.0	22.5	21.6	22.5		0.3	0.3	0.5		120	123	116		7.6	7.3	7.2					
7.0	21.6	21.0	21.3		0.2	0.3	0.4		122	125	119		7.6	7.3	7.1					
8.0	20.5	20.9	20.4		0.2	0.3	0.3		125	126	123		7.5	7.2	7.0					
9.0	19.6				0.2				124				7.4							
10.0	18.2				0.2				121				7.4							
11.0	17.3				0.2				120				7.4							
12.0	16.1				0.2				122				7.2							
13.0	15.6				0.2				127				7.2							
14.0	15.3				0.2				135				7.2							
15.0	14.9				0.2				142				7.1							
16.0	14.5				0.2				172				7.1							

November 4, 1999

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	17.4	17.0	17.0	15.4	6.5	7.3	7.3	7.9	82	78	78	66	6.9	6.8	6.7	6.6	1.7	1.4	1.5	1.4
1.0	17.3	16.9	17.0	15.4	6.4	7.2	7.3	7.5	81	77	78	66	6.9	6.8	6.7	6.6				
2.0	17.3	16.8	16.9	15.2	6.0	7.2	7.3	7.2	81	78	78	66	6.9	6.8	6.7	6.5				
3.0	16.8	16.8	16.8	15.2	6.0	6.9	7.3	7.2	80	77	78	66	6.9	6.8	6.7	6.4				
4.0	16.7	16.7	16.8		5.9	6.9	7.3		80	77	77		6.8	6.8	6.7					
5.0	16.7	16.6	16.8		5.9	6.8	7.2		80	77	77		6.8	6.8	6.7					
6.0	16.7	16.6	16.8		5.9	6.8	7.2		80	77	77		6.8	6.8	6.7					
7.0	16.7	16.6	16.8		5.9	6.8	7.2		80	77	77		6.8	6.8	6.7					
8.0	16.7	16.5	16.7		5.9	6.8	7.2		80	77	77		6.8	6.8	6.7					
9.0	16.7	16.5	16.6		5.9	6.7	7.0		80	77	78		6.8	6.8	6.7					
10.0	16.7				5.9				80				6.8							
11.0	16.7				5.8				80				6.8							
12.0	16.7				5.8				80				6.8							
13.0	16.7				5.8				80				6.8							
14.0	16.7				5.7				80				6.8							
15.0	16.7				4.7				84				6.9							

Appendix 2. Means, ranges, and spatial trends of selected limnological variables from the surface waters of Harris Reservoir during 1999.[+]

Variable	Station			
	E2	H2	P2	S2
Solids (mg/liter)				
Total	67[b] (46-86)	72[b] (56-86)	69[b] (50-82)	97[a] (58-142)
Total dissolved	74 (67-78)	67 (41-78)	69 (48-78)	83 (56-128)
Total suspended[¶]	< 5 NA	< 5 (< 5-6)	< 5 NA	7.8 (< 5-19)
Turbidity (NTU)	3.1 (2.3-4.4)	5.1 (2.9-11)	3.5 (2.6-5.4)	24 (4.3-76)
Secchi disk transparency (m)	1.5[a] (1.2-1.9)	1.3[a] (0.7-1.7)	1.4[a] (1.2-1.6)	1.0[b] (0.3-1.4)
Chlorophyll *a* (µg/liter)	13.5 (4.8-18.9)	17.5 (7.2-26.0)	17.6 (11.1-28.7)	9.1 (5.7-11.7)
Nutrients (mg/liter)				
Ammonia-N[§]	< 0.1 (< 0.1-0.1)	< 0.1 NA	< 0.1 (< 0.1-0.1)	0.1 (< 0.1-0.2)
Nitrate + Nitrite-N	0.08 (< 0.02-0.14)	0.06 (< 0.02-0.11)	0.06 (< 0.02-0.11)	0.11 (< 0.02-0.33)
Total nitrogen (TN)	0.69 (0.51-0.82)	0.54 (0.41- 0.69)	0.53 (0.44-0.62)	0.72 (0.53-0.99)
Total phosphorus (TP)	0.040 (0.030-0.051)	0.028 (0.026-0.030)	0.026 (0.024-0.030)	0.038 (0.022 –0.065)
TN:TP[§]	19 (11-27)	19 (16-26)	20 (18-22)	21 (15-30)
Total organic carbon (mg/liter)	7.8 (6.6-9.2)	7.6 (6.9-9.0)	7.7 (7.1-8.7)	8.0 (7.5-9.2)
Ions (mg/liter)				
Calcium	3.8[ab] (3.5-4.4)	3.8[b] (3.6-3.9)	3.6[b] (3.4-3.9)	4.2[a] (3.7-5.0)
Chloride	9.5 (9.0-10)	9.2 (9.0-10)	9.2 (9.0-10)	9.4 (8.0-11)
Magnesium	1.7 (1.6-1.8)	1.7 (1.5-1.8)	1.7 (1.5-1.8)	1.7 (1.5-2.0)
Sodium	11 (9.8-12)	11 (9.5-13)	11 (9.2-12)	11 (7.7-13)
Sulfate	10 (8.0-12)	9.2 (6.0-11)	9.5 (7.0-11)	9.0 (8.0-10)
Total alkalinity (mg/liter as $CaCO_3$)	16 (13-20)	15 (13-16)	16 (13-18)	14 (12-16)
Hardness (calculated as mg equivalents $CaCO_3$/liter)	17 (15-18)	16 (16-17)	16 (15-17)	18 (16-21)
Conductivity (µS/cm)	91 (69-121)	88 (59-124)	88 (61-122)	88 (66-126)

Appendix 2 (continued)

Variable	N.C. water quality standard	Station			
		E2	H2	P2	S2
Metals (µg/liter)					
Aluminum	None	75 (< 50-120)	110 (58-220)	78 (< 50-150)	413 (92-1100)
Cadmium	2	< 0.5 NA	< 0.5 NA	< 0.5 NA	< 0.5 NA
Copper	7[¥]	2.5 (1.4-4.1)	2.2 (1.1-4.2)	2.6 (< 1.0-6.0)	3.0 (< 1.0-6.4)
Mercury	0.012	< 0.2 NA	< 0.2 NA	< 0.2 NA	< 0.2 NA

[+]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 variables unless otherwise noted. The variable TN:TP was not subjected to statistical analyses.

[¶]In 1999, the LRLs changed for total suspended solids from 3 to 5 mg/L.

[§]Variable was not subjected to statistical analyses.

[¥]This value is an action level, not a water quality standard. An action level is for toxic substances, which are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics, or associated waste characteristics (NCDEM 1994b).

NA = All measured values were less than the laboratory lower reporting limit.

Appendix 3. Temporal trends of selected limnological variables from the surface waters of Harris Reservoir at Stations E2, H2, P2 and S2, 1995-1999.[+]

Variable	Year				
	1995	1996	1997	1998	1999
Solids (mg/liter)					
Total	74[b]	89[a]	54[c]	68[b]	76[b]
Total dissolved	62[bc]	78[a]	54[c]	69[ab]	73[ab]
Total suspended[¶]	< 6	< 6	< 6	4	< 5
Turbidity (NTU)	2.6	4.7	5.7	5.8	8.9
Secchi disk transparency (m)	1.8[a]	1.6[b]	1.3[b]	1.2[b]	1.3[b]
Chlorophyll *a* (µg/liter)	12.4[b]	12.3[b]	23.8[a]	24.7[a]	14.4[b]
Nutrients (mg/liter)					
Ammonia-N	< 0.07	0.05	< 0.07	0.05	< 0.05
Nitrate + nitrite-N	0.03	0.03	0.05	0.04	0.08
Total nitrogen	0.66	0.86	0.74	0.56	0.62
Total phosphorus	0.033	0.032	0.034	0.034	0.033
TN:TP[§]	22	27	22	N/A	20
Total organic carbon (mg/liter)	7.1[bc]	6.5[c]	7.2[b]	7.2[ab]	7.8[a]
Ions (mg/liter)					
Calcium	4.0	3.8	3.7	5.3	3.9
Chloride	9.9[a]	9.8[a]	6.3[b]	8.6[a]	9.3[a]
Magnesium	1.9[a]	1.7[b]	1.7[b]	1.6[b]	1.7[b]
Sodium	12[a]	9.2[c]	8.9[c]	9.8[c]	11[b]
Sulfate	14[a]	13[a]	13[a]	7.1[c]	9.4[b]
Total alkalinity (mg/liter as $CaCO_3$)	14[ab]	13[bc]	12[c]	13[c]	15[a]
Hardness (mg equivalents $CaCO_3$/liter)	18	17	16	20	17
Conductivity (µS/cm)	96[a]	79[bc]	81[bc]	76[c]	88[ab]
Metals (µg/liter)					
Aluminum	38[b]	58[b]	76[b]	83[ab]	169[a]
Cadmium	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Copper	1.1[c]	2.0[bc]	1.5[bc]	3.5[a]	2.6[ab]
Mercury	0.1	0.1	0.1	0.1	0.1

[+]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 ($P > 0.05$). Data were rounded to conform to significant digit requirements. The mean separation technique may yield separations that are obscured by data rounding.

[¶]In 1999, the lower reporting limits (LRLs) changed for total suspended solids from 3 to 5 mg/L while in June 1998, the LRLs changed for total suspended solids from 6 to 3 mg/l.

[§]Variable was not subjected to statistical analyses. Variable not calculated (NA) due to nitrogen concentrations at the LRL during May 1998.

Appendix 4. Temporal trends of selected limnological variables from the bottom waters of Harris Reservoir at Station E2, 1995-1999. [+]

Variable	Year				
	1995	1996	1997	1998	1999
Solids (mg/liter)					
Total	85	113	71	82	90
Total dissolved	77	87	78	74	81
Total suspended[¶]	< 6	< 6	6	6	13
Turbidity (NTU)	4.9	4.0	7.2	13	15
Nutrients (mg/liter)					
Ammonia-N	0.26	0.09	0.70	0.47	0.42
Nitrate + nitrite-N	0.06	0.19	0.06	0.14	0.08
Total nitrogen	0.92	1.3	1.3	1.2	1.0
Total phosphorus	0.100	0.147	0.105	0.147	0.146
TN:TP[§]	12	12	14	12	11
Total organic carbon (mg/liter)	7.2	7.4	7.8	8.5	8.4
Ions (mg/liter)					
Calcium	4.6	4.6	4.5	4.7	4.4
Chloride	12	9.7	6.8	9.1	9.2
Magnesium	2.1	2.0	1.9	2.0	1.9
Sodium	13	10	10	11	12
Sulfate	16^{a}	14^{ab}	11^{abc}	7.1^{c}	9.2^{bc}
Total alkalinity (mg/liter as $CaCO_3$)	20	25	26	21	21
Hardness (mg equivalents $CaCO_3$/liter)	20	20	19	20	19
Metals (µg/liter)					
Aluminum	52	42	56	155	222
Copper	2.2	2.2	1.9	3.7	5.6
Cadmium	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Mercury	< 0.2	< 0.2	< 0.2	0.2	0.2

[+]Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Annual means followed by the same superscript were not significantly different ($P > 0.05$).

[¶]In 1999, the lower reporting limits (LRLs) changed for total suspended solids from 3 to 5 mg/L.

[§]Variable was not subjected to statistical analyses.

Appendix 5. Concentrations of chemical variables in Harris Reservoir during 1999.[+]

Station E2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^-+NO_2^-$-N
Jan	14	18	10	8.0	4.4	1.8	12	0.70	0.09	0.13
May	13	15	10	12	3.5	1.6	9.9	0.51	< 0.05	0.06
Jul	16	16	9.0	9.0	3.7	1.7	11	0.82	< 0.05	< 0.02
Nov	20	17	9.0	11	3.7	1.8	9.8	0.73	0.08	0.14

Month	TP	TOC	Turbidity	TS	TDS	TSS[¶]	Al	Cd	Cu	Hg	TN:TP
Jan	0.051	7.4	4.4	86	78	< 3	84	< 0.5	4.1	< 0.20	13.7
May	0.045	8.2	3.2	70	67	< 3	120	< 0.5	2.9	< 0.20	11.3
Jul	0.030	6.6	2.3	67	78	< 3	< 50	< 0.5	1.4	< 0.20	27.3
Nov	0.033	9.2	2.7	46	72	< 5	71	< 0.5	1.6	< 0.20	22.1

Station H2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^-+NO_2^-$-N
Jan	13	17	9.0	6.0	3.9	1.7	11	0.52	< 0.05	0.01
May	14	16	10	11	3.9	1.5	13	0.52	< 0.05	< 0.02
Jul	16	16	9.0	9.0	3.6	1.7	11	0.41	< 0.05	< 0.02
Nov	16	16	9.0	11	3.6	1.8	9.5	0.69	< 0.05	0.11

Month	TP	TOC	Turbidity	TS	TDS	TSS[¶]	Al	Cd	Cu	Hg	TN:TP
Jan	0.030	6.9	11	86	78	6	220	< 0.5	4.2	< 0.20	17.3
May	0.027	7.0	3.1	75	71	3	89	< 0.5	2.2	< 0.20	19.2
Jul	0.026	7.6	2.9	70	77	< 3	58	< 0.5	1.1	< 0.20	15.8
Nov	0.027	9.0	3.4	56	41	< 5	73	< 0.5	1.1	< 0.20	25.6

Station P2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^-+NO_2^-$-N
Jan	15	17	9.0	7.0	3.9	1.8	12	0.54	< 0.05	0.11
May	13	15	10	11	3.4	1.5	9.2	0.52	0.07	0.05
Jul	16	17	9.0	9.0	3.8	1.8	12	0.44	< 0.05	< 0.02
Nov	18	16	9.0	11	3.5	1.8	9.4	0.62	< 0.05	0.08

Month	TP	TOC	Turbidity	TS	TDS	TSS[¶]	Al	Cd	Cu	Hg	TN:TP
Jan	0.025	7.1	5.4	82	78	4	75	< 0.5	6.0	< 0.20	21.6
May	0.027	7.1	3.0	75	72	3	150	< 0.5	2.6	< 0.20	19.2
Jul	0.024	7.8	2.6	69	77	4	< 50	< 0.5	1.5	< 0.20	18.3
Nov	0.030	8.7	3.0	50	48	< 5	63	< 0.5	< 1.0	< 0.20	20.7

Appendix 5 (continued)

Station S2

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^-+NO_2^-$-N
Jan	16	21	11	8.0	5.0	2.0	13	0.99	< 0.05	0.33
May	14	17	9.5	10	4.2	1.5	12	0.70	< 0.05	0.07
Jul	16	17	9.0	10	4.0	1.8	12	0.67	< 0.05	< 0.02
Nov	12	16	8.0	8.0	3.7	1.6	7.7	0.53	0.17	0.04

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.065	8.0	76	142	128	19	1100	< 0.5	3.9	< 0.20	15.2
May	0.032	7.5	7.2	115	74	4	120	< 0.5	6.4	< 0.20	21.9
Jul	0.022	7.5	4.3	73	75	6	92	< 0.5	1.1	< 0.20	30.4
Nov	0.032	9.2	8.5	58	56	< 5	340	< 0.5	< 1.0	< 0.20	16.6

Station E2 (bottom)

Month	Alkalinity	Hardness	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	TN	NH_3-N	$NO_3^-+NO_2^-$-N
Jan	15	18	10	8.0	4.1	1.9	13	0.94	0.08	0.13
May	21	17	10	12	4.2	1.6	13	1.03	0.55	0.05
Jul	32	23	8.0	6.0	5.5	2.2	11	1.31	1.01	< 0.02
Nov	16	17	9.0	11	3.7	1.8	9.9	0.64	0.06	0.13

Month	TP	TOC	Turbidity	TS	TDS	TSS¶	Al	Cd	Cu	Hg	TN:TP
Jan	0.055	7.1	4.8	80	86	4	89	< 0.5	9.6	< 0.20	17.1
May	0.255	8.4	29	96	84	9	230	< 0.5	9.7	< 0.20	4.0
Jul	0.239	9.2	25	132	100	38	490	< 0.5	2.7	< 0.20	5.5
Nov	0.034	9.1	3.1	54	55	< 5	79	< 0.5	< 1.0	0.40	18.8

+Units are in mg/L except for trace metals and metalloids (μg/L), turbidity (NTU), total alkalinity (mg/L as $CaCO_3$), and hardness (calculated as mg equivalents $CaCO_3$/L).

¶In November 1999, the lower reporting limits (LRLs) changed for total suspended solids from 3 to 5 mg/L.

Appendix 6. Mean number per hour for fish collected with electrofishing sampling by transect from Harris Reservoir during 1999.

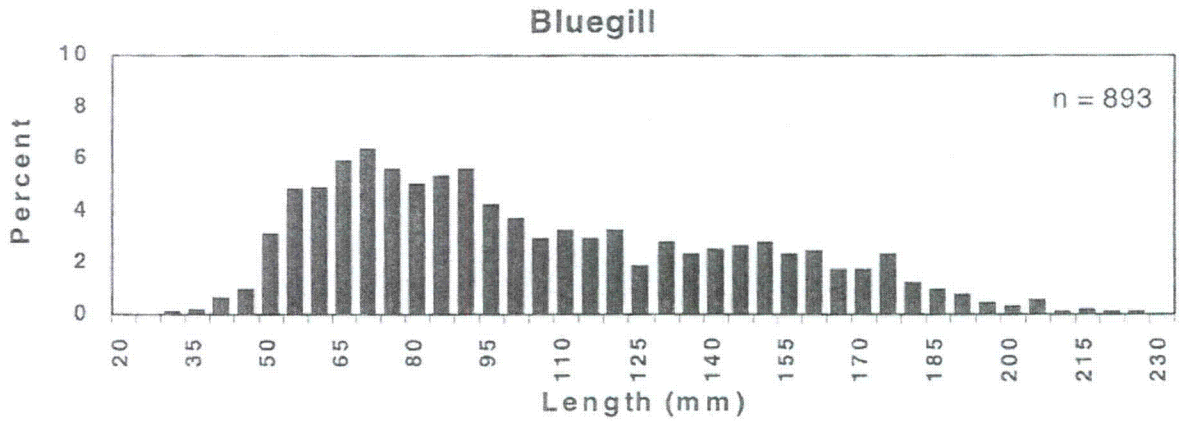
Taxon	Transect					Reservoir mean
	E	H	P	S	V	
Bowfin	< 1	0	0	0	1	< 1
Gizzard shad	9	7	13	3	2	7
Threadfin shad	< 1	1	0	25	0	5
Chain pickerel	2	< 1	1	1	4	2
Golden shiner	6	5	19	6	4	8
Comely shiner	< 1	< 1	0	0	0	< 1
Spottail shiner	< 1	0	2	0	0	< 1
Coastal shiner	0	0	< 1	0	0	< 1
White catfish	0	0	0	0	1	< 1
Yellow bullhead	0	< 1	0	0	0	< 1
Brown bullhead	2	0	< 1	1	2	1
Channel catfish	0	< 1	0	0	0	< 1
Eastern mosquitofish	0	0	< 1	0	0	< 1
Morone spp.	0	< 1	0	0	0	< 1
Bluespotted sunfish	0	0	0	45	2	9
Redbreast sunfish	< 1	1	0	0	0	< 1
Pumpkinseed	0	< 1	0	1	0	< 1
Warmouth	< 1	< 1	1	18	6	5
Bluegill	90	146	89	209	61	119
Redear sunfish	121	171	48	72	35	90
Largemouth bass	26	29	51	34	73	43
Black crappie	17	10	50	9	6	19
White crappie	< 1	0	0	< 1	0	< 1
Total[+]	**279**	**374**	**276**	**427**	**200**	**311**

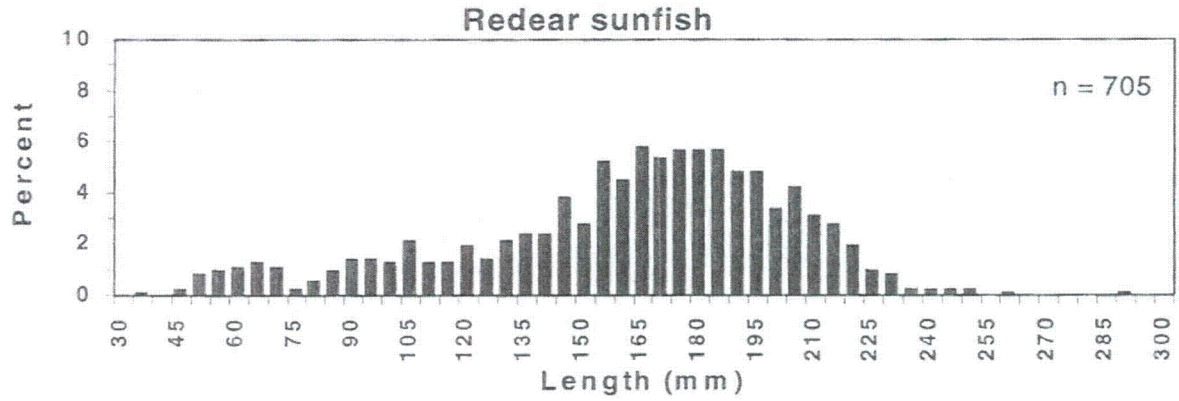
[+]Summations may vary from column totals due to rounding.

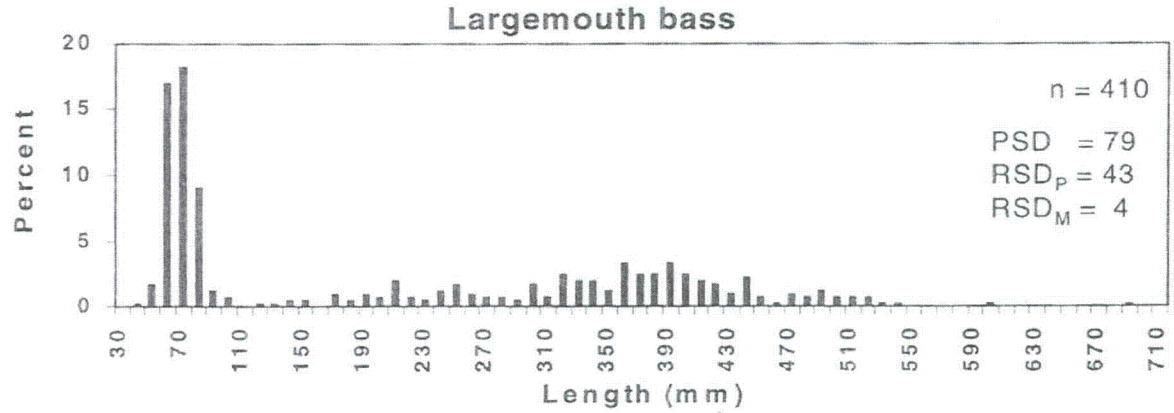
Appendix 7. Mean catch rates (number per hour) for the numerically dominant recreational and forage fish species collected with quarterly electrofishing sampling from Harris Reservoir, 1988-1991, 1995, and 1999. +

Taxon	Year					
	1988	1989	1990	1991	1995	1999
Gizzard shad	8	29	20	19	5	7
Threadfin shad	< 5	12	< 5	< 5	< 5	5
Golden shiner	5	9	9	5	7	8
Bluegill	86	101	105	92	77	119
Redear sunfish	7	14	21	24	73	90
Largemouth bass	33	42	24	29	20	43
Black crappie	8	14	15	12	6	19
Total (all species)	**195**	**299**	**249**	**214**	**203**	**311**

+Annual catch rates for 1992-1994, and 1998 were collected semiannually and were not included in this comparison. Data for these years can be obtained from CP&L (1996, 1999).

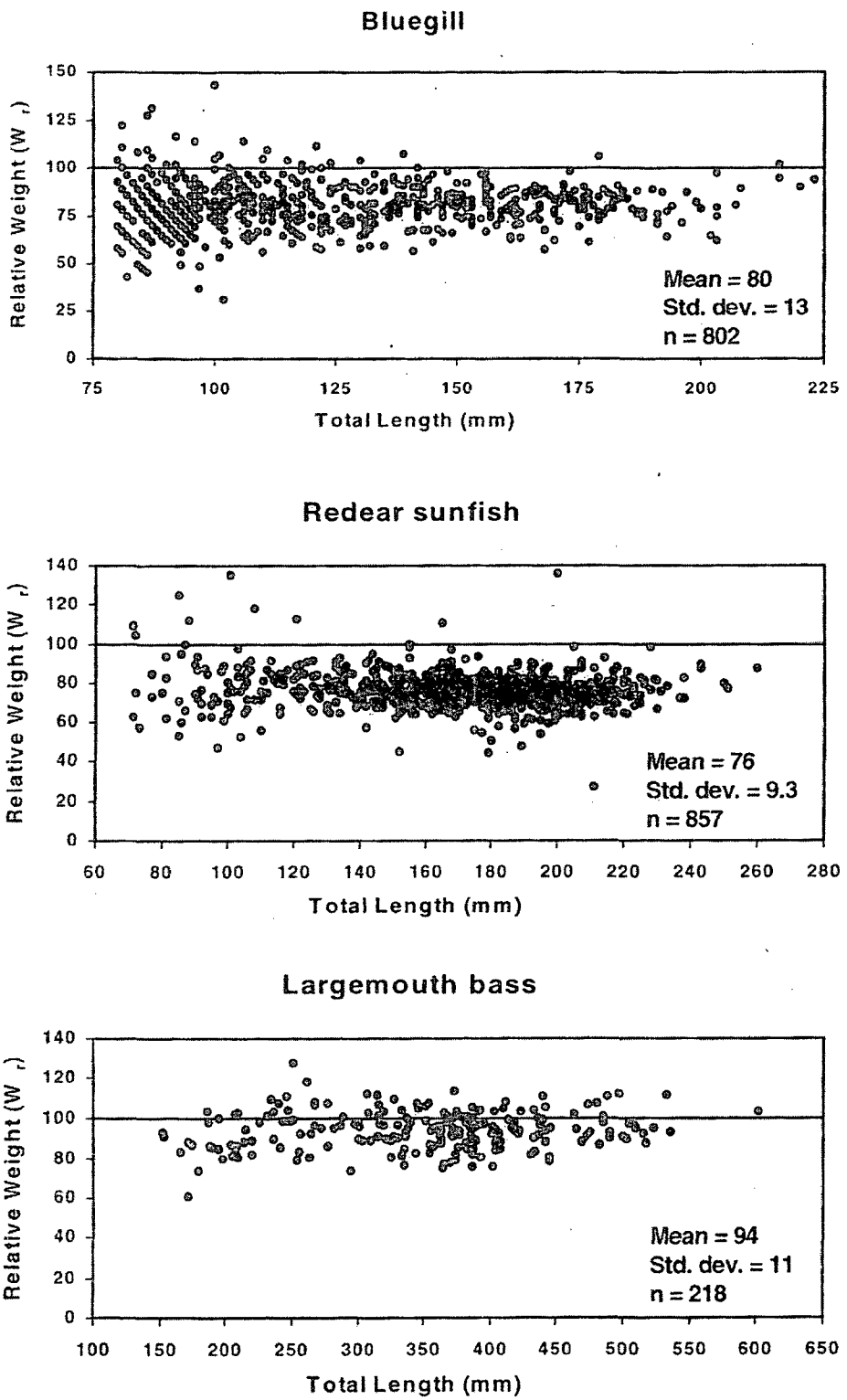






Note: PSD = Porportional stock density, RSD_P = Relative stock density preferred length, RSD_M = Relative stock density memorable length

Appendix 8. Length-frequency distributions for bluegill, redear sunfish, and largemouth bass collected with electrofishing sampling from Harris Reservoir during 1999.



Appendix 9. Relative weight values for bluegill, redear sunfish, and largemouth bass collected with electrofishing sampling from Harris Reservoir during 1999.