**Michelle Moser**

**From:** Alicia Williamson
**Sent:** Tuesday, July 01, 2008 4:12 PM
**To:** Michelle Moser
**Subject:** FW: NAPS Unit 3 COL Application - NRC's Environmental Review Supplemental Information Need #11 (2007 Annual Report) - 06/26/08 E-mail 4 of 5
**Attachments:** 2007 Annual Rpt (NA)l.pdf

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**From:** Tony.Banks@dom.com [mailto:Tony.Banks@dom.com]
**Sent:** Thursday, June 26, 2008 6:46 PM
**To:** Alicia Williamson; Laura Quinn; Sandusky, William F III
**Cc:** Thomas Kevern; Joseph.Hegner@dom.com; Regina.Borsh@dom.com; Joyce.Livingstone@dom.com; Tony.Banks@dom.com
**Subject:** NAPS Unit 3 COL Application - NRC's Environmental Review Supplemental Information Need #11 (2007 Annual Report) - 06/26/08 E-mail 4 of 5

On May 16, 22, and 29, 2008, NRC staff and its contractor, Pacific Northwest National Laboratory (PNNL), held conference calls with representatives from Dominion to discuss a number of supplemental "information needs" to support the North Anna Power Station Unit 3 (NAPS) combined license application environmental review. Several of these information needs were identified during the environmental site audit conducted the week of April 14, 2008. Others were identified by subject matter reviewers following the audit.

This e-mail provides some of the requested information listed in NRC's June 16, 2008 letter, which included a total of 35 items. In certain instances, the file size may dictate that more than one e-mail will be needed to transmit the information. In those instances, the e-mail will clearly be identified as "x of y" to ensure accountability.

Please note that Dominion will respond to some of the information needs via e-mail, and to others by letter. In every case, Dominion's goal is to provide complete and accurate information in a timely manner. The use of both e-mail and letters to achieve this goal has been discussed with the NRC project managers.

To ensure that you have received the information, please acknowledge receipt of this transmission.

I can be contacted at (804) 273-2170 or (tony.banks@dom.com) if there are questions.

Thank you -

Tony Banks, MPH, CHMM
Dominion
ESP/COL Project
Environmental Lead

**Information Need Request #11 (2007 Annual Report)**

*Provide a copy of the 2005, 2006, and 2007 annual reports titled "Environmental Study of Lake Anna and the Lower Lake Anna River" that were prepared by Environmental Biology, Environmental Services.*

**Dominion Response**

The following attachment addresses Information Need #11 (2007 Annual Report):

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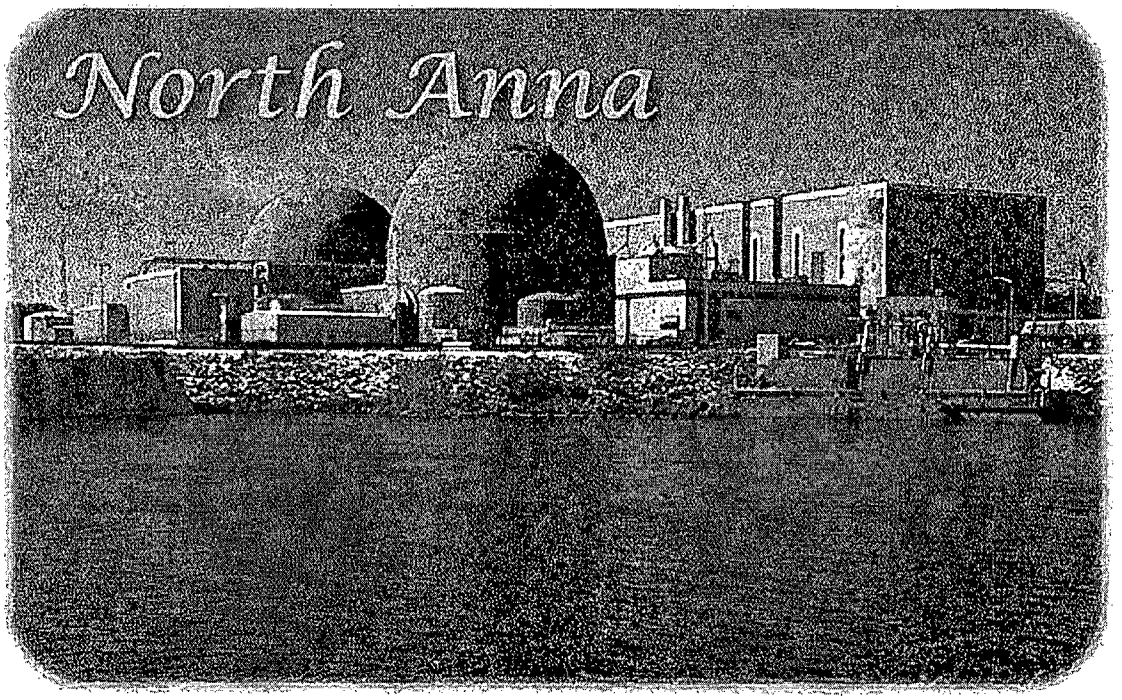
# ENVIRONMENTAL STUDY OF LAKE ANNA

# AND THE LOWER NORTH ANNA RIVER

## ANNUAL REPORT FOR 2007




**Prepared by:**

**ENVIRONMENTAL BIOLOGY**

**ELECTRIC ENVIRONMENTAL SERVICES**

In an effort to conserve our natural resources, this report is being printed on both sides of recycled paper.

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## Executive Summary

Following the successful completion of the North Anna Power Station 316(a) Demonstration in 1986, Dominion (the Company) agreed to continue selected environmental monitoring studies on Lake Anna and the North Anna River. This report represents findings from monitoring programs conducted during 2007.

Station generation for 2007 was at an average of 92.8% of capacity. The maximum lake water temperature recorded in 2007 was 32.6°C (Station NAL719ST) and the minimum was 2.5°C (Station NAL719ST). These fell within the range of previously reported maximum and minimum temperatures. The species composition of the gill net catch in 2007 was consistent with historical data and both the number and weight of fish collected by gill net in 2007 were above average. Centrarchids (sunfishes) continued to be numerically dominant in the electrofishing catch which was slightly below average in 2007.

The maximum monthly mean water temperature recorded in the North Anna River in 2007 was 30.2°C and the maximum hourly temperature recorded was 32.9°C. The previous maximum monthly mean recorded was 30.9°C while the previous maximum hourly temperature recorded was 34.0°C. In 2007, 898 fish representing 23 species were collected by electrofishing in the North Anna River. The species richness and the fish assemblage found in 2007 were consistent with previous collections. The numbers of fish collected per station and survey were somewhat below the previous 10-year average but well within the range of previous surveys.

Underwater observations of the distribution of largemouth and smallmouth bass in the river in 2007 were typical of earlier surveys, in that very few smallmouth bass were observed at the 2 uppermost stations as is usually the case. Smallmouth bass densities in the lower river in 2007 compared favorably to historical data. Young-of-the-year largemouth bass were notably abundant

at Station NAR-1. Cover use for largemouth bass was primarily wood, vegetation and open water while smallmouth bass were found near vegetation, boulders or in open water.

In summary, the 2007 data indicate that both the lake and river downstream of the lake support diverse and healthy fisheries.

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| 4.3-3 | Cover use by smallmouth bass and largemouth bass in the North Anna River observed during the first of three counts made during snorkel surveys conducted in 2007. Data for observations at all stations are pooled | 38 |

## 1.0 Introduction

In 1972, the North Anna River was impounded to create Lake Anna, a 3885 hectare (9600 acres) reservoir (lake) that provides condenser cooling water for the North Anna Power Station (NAPS). Adjacent to Lake Anna is a 1376 hectare (3400 acre) Waste Heat Treatment Facility (WHTF) that receives the cooling water and transfers excess heat from the water to the atmosphere before discharging into the lake.

Aquatic monitoring studies have been conducted on Lake Anna since its inception. In January, 1984, the Company initiated an extensive Section 316(a) demonstration study (P.L. 95-500) to determine if proposed effluent limitations on thermal discharges from the power station were more stringent than necessary to assure the protection and propagation of a balanced, indigenous community of shellfish, fish and wildlife in Lake Anna and the lower North Anna River. The final report (Virginia Power 316(a) Report 1986) successfully demonstrated that the operation of the power station had not resulted in appreciable harm to the biological community. The Virginia Water Control Board (VWCB) accepted the study as a successful demonstration in September, 1986.

Subsequent to the 316(a) study, the Company committed with the VWCB to continue environmental monitoring on Lake Anna and the lower North Anna River as part of a post-316(a) agreement. A report summarizing data from each year is prepared and submitted to the Virginia Department of Environmental Quality (DEQ) and the Virginia Department of Game and Inland Fisheries (VDGIF). This report presents the findings for calendar year 2007.

## 2.0 Station Operation

North Anna Power Station (NAPS) operated at an average of 92.8 of capacity for 2007. The station operated at 84% of capacity for the first quarter and 94% for the second quarter. Third quarter operations were at 99% and fourth quarter operations were at 94%. Unit 1 was shut down for approximately 4 days from January 3 through January 7 (Figure 2.0-1). The unit was also down from September 9 to October 11 for refueling. Unit 2 was shut down from March 18 to April 19 for refueling. Unit 2 was also down for shorter periods in June-July (approximately 12 days) and December (approximately 7 days).

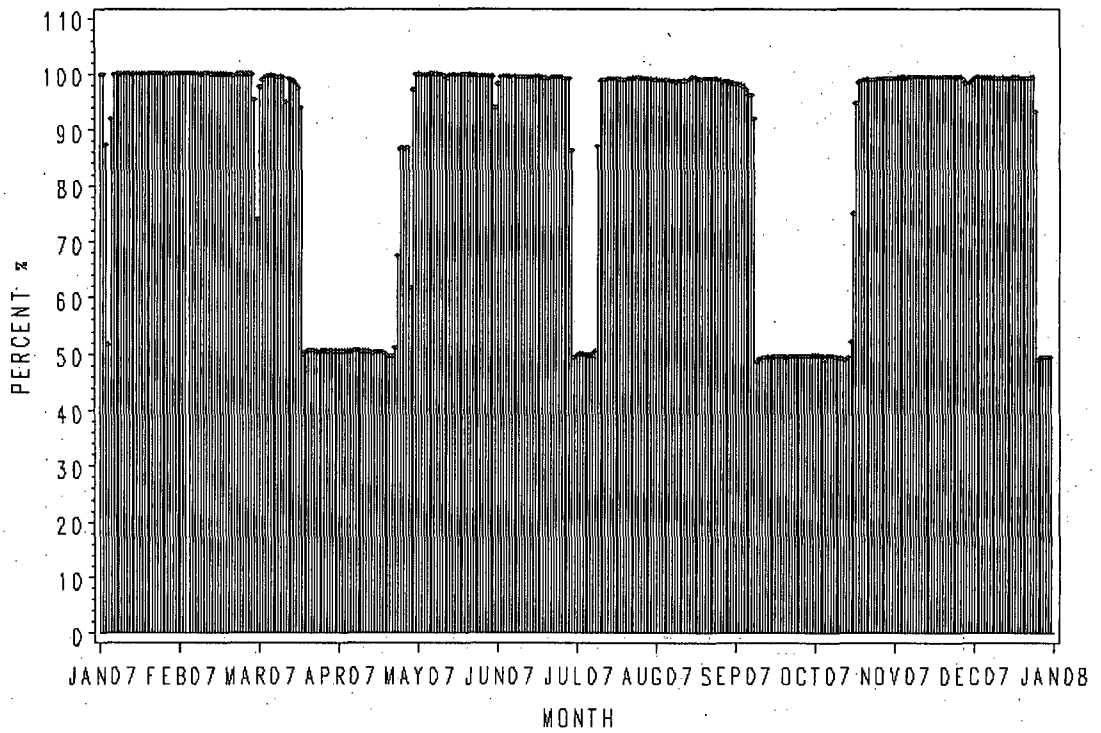



FIGURE 2.0-1. 2007 NORTH ANNA UNITS 1 & 2 DAILY POWER LEVEL

**TABLE 2.0-1** Seasonal summary of North Anna Power Station operation (percent of total Station load) 1978-2007.

| Year | Winter | Spring | Summer | Fall | Quarterly Average |
|---|---|---|---|---|---|
| 1978 | 0 | 23 | 42 | 45 | 27.5 |
| 1979 | 43 | 31 | 44 | 0 | 29.5 |
| 1980 | 31 | 37 | 53 | 65 | 46.5 |
| 1981 | 46 | 80 | 67 | 82 | 68.8 |
| 1982 | 78 | 26 | 19 | 48 | 42.8 |
| 1983 | 53 | 58 | 96 | 84 | 72.8 |
| 1984 | 76 | 64 | 16 | 66 | 55.5 |
| 1985 | 87 | 96 | 82 | 62 | 81.8 |
| 1986 | 75 | 88 | 62 | 80 | 76.3 |
| 1987 | 92 | 45 | 23 | 47 | 51.8 |
| 1988 | 75 | 99 | 94 | 97 | 91.3 |
| 1989 | 47 | 26 | 87 | 65 | 56.3 |
| 1990 | 98 | 98 | 69 | 61 | 81.5 |
| 1991 | 63 | 89 | 84 | 92 | 82.0 |
| 1992 | 35 | 80 | 92 | 71 | 69.5 |
| 1993 | 49 | 83 | 79 | 82 | 73.3 |
| 1994 | 96 | 91 | 75 | 91 | 88.3 |
| 1995 | 87 | 64 | 98 | 97 | 86.5 |
| 1996 | 76 | 98 | 83 | 66 | 80.8 |
| 1997 | 98 | 80 | 97 | 97 | 93.0 |
| 1998 | 96 | 81 | 85 | 94 | 89.0 |
| 1999 | 97 | 90 | 87 | 93 | 91.8 |
| 2000 | 84 | 91 | 100 | 100 | 93.8 |
| 2001 | 84 | 94 | 80 | 67 | 81.3 |
| 2002 | 100 | 100 | 87 | 50.7 | 84.4 |
| 2003 | 57 | 53 | 100 | 100 | 77.5 |
| 2004 | 97 | 83 | 89 | 96 | 91.3 |
| 2005 | 100 | 100 | 97 | 84 | 95.3 |
| 2006 | 90 | 94 | 99 | 96 | 94.8 |
| 2007 | 84 | 94 | 99 | 94 | 92.8 |
| Quarters at 75-100% | 20 | 20 | 21 | 17 | |

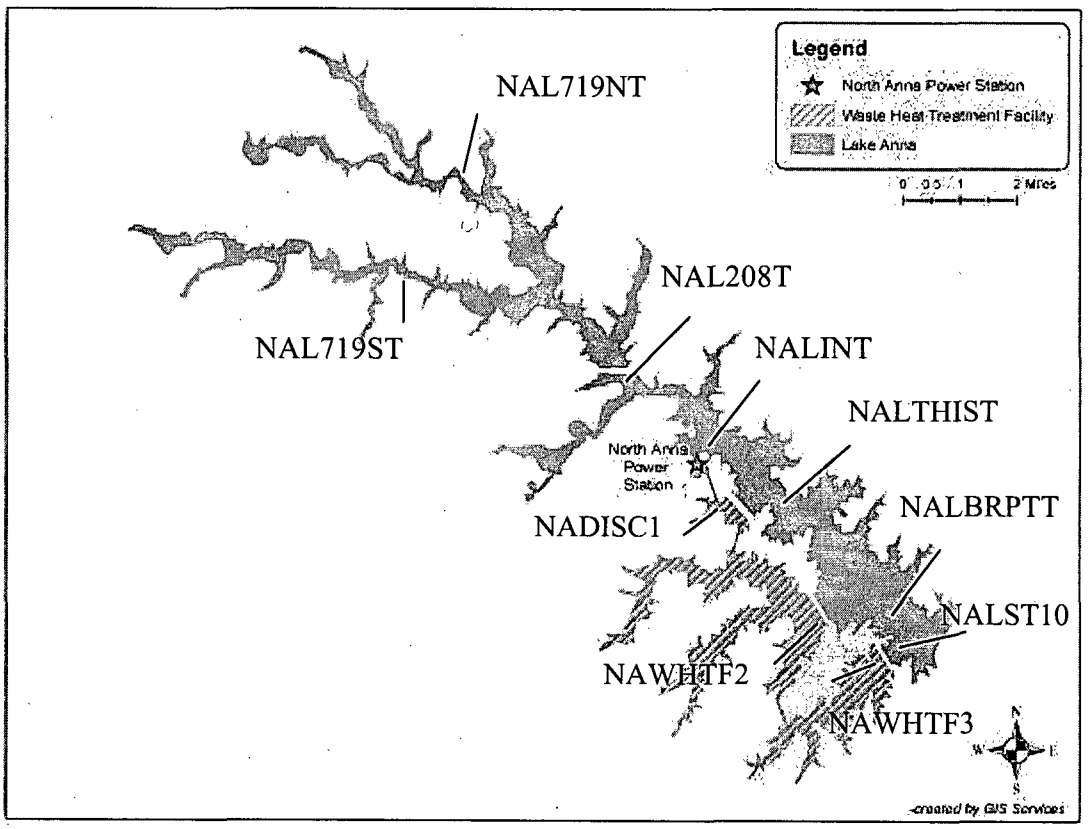
## 3.0 Lake Anna

### 3.1 Temperature

**Methods**

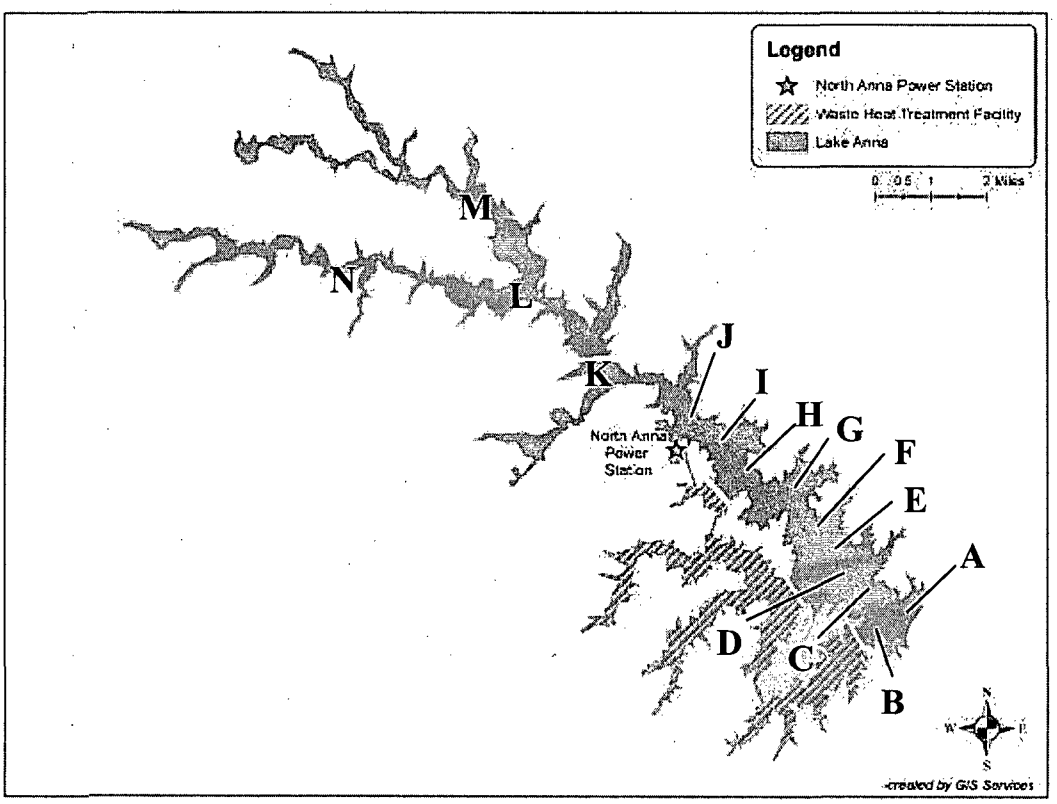
Lake water temperature data in 2007 were collected using continuous monitors (fixed temperature recorders) and instantaneous field surveys. Continuous temperatures were measured with In-Situ Minitroll (±0.25°C) and Onset Optical Stowaway (±0.20°C) temperature recorders which measure and record the water temperature at one (1) hour intervals at seven (7) stations in the lake and three (3) stations in the WHTF. These instruments were located 1 meter below the lake surface at the stations depicted in Figure 3.1-1, the lone exception being Station NALST10. The instrument at this station was located at a depth of three (3) meters to account for the turbulence associated with mixing.

Figure 3.1-1 Approximate location of Onset temperature recorders in Lake Anna and WHTF



The instantaneous temperatures were measured using a Hydrolab field temperature instrument with an accuracy of $\pm$ 0.1°C. Temperatures were measured at one (1) meter intervals, surface to bottom, at the stations shown in Figure 3.1-2.

Figure 3.1-2 Approximate location of thermal plume sampling stations on Lake Anna




## Results

The maximum hourly temperature recorded for the Lake in 2007 by continuous monitors was 32.6°C in August at Station NAL719ST which is located in the North Anna Arm of the upper lake (Table 3.1-1). This temperature was within the range of previously reported maximum lake temperatures. The lowest hourly temperature recorded (2.5°C February) was also found in the North Anna Arm of the lake. This temperature was also within the range of previously reported annual minimum temperatures.

TABLE 3.1-1 SUMMARY OF NORTH ANNA FIXED RECORDER TEMPERATURE DATA DURING 2007. ALL RESULTS ARE CALCULATED FROM HOURLY TEMPERATURES (IN DEGREES CELSIUS). ALL ARE SURFACE INTRUMENTS EXCEPT FOR NALST10 WHICH IS AT MID-DEPTH. A "*" INDICATES DATA MISSING DUE TO INSTRUMENT MALFUNCTION OR DAMAGE.

YEAR=2007 MONTH=JANUARY

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 10.2 | 10.4 | 11.8 | 12.3 | 12.7 | 13.7 | 14.4 | 25.4 | 20.5 | 17 | 14.1 |
| HOURLY MEAN | 7.4 | 7.6 | 9.1 | 10 | 10.3 | 11.8 | 12.8 | 22.8 | 17.5 | 14.7 | 11.9 |
| HOURLY LOW | 4 | 4.6 | 5.8 | 7.3 | 7.3 | 8.9 | 10.4 | 19 | 13.9 | 11.5 | 8.2 |
| HOURS | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 743 |

YEAR=2007 MONTH=FEBRUARY

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 6.8 | 6.6 | 6.8 | 7.4 | 8.7 | 10.2 | 10.7 | 19.9 | 15.5 | 13.7 | 9.9 |
| HOURLY MEAN | 4.1 | 4.4 | 4.2 | 5.8 | 6.3 | 8.3 | 9.5 | 18.2 | 13.3 | 11 | 8.4 |
| HOURLY LOW | 2.5 | 3.1 | 2.8 | 4.8 | 5 | 6.9 | 8.2 | 16 | 11 | 9.4 | 6.2 |
| HOURS | 672 | 672 | 672 | 672 | 672 | 672 | 672 | 672 | 672 | 672 | 672 |

YEAR=2007 MONTH=MARCH

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 17 | 16.7 | 15.6 | 15.7 | 15.6 | 15.9 | 15.7 | 25.4 | 21 | 19.5 | 15.4 |
| HOURLY MEAN | 10.1 | 10.1 | 9.7 | 10.3 | 10.7 | 11.8 | 12.4 | 21.4 | 17 | 15 | 11.7 |
| HOURLY LOW | 5.7 | 5.6 | 5.6 | 6.3 | 7.3 | 8.2 | 10 | 16.2 | 13.8 | 12.2 | 8.5 |
| HOURS | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 |

YEAR=2007 MONTH=APRIL

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 20.3 | 20.9 | 19 | 18.6 | 19 | 18.8 | 18.7 | 27.1 | 24.1 | 22.1 | 19.6 |
| HOURLY MEAN | 14.8 | 14.9 | 14.4 | 14.4 | 14.6 | 15 | 15.2 | 23.7 | 19 | 17.7 | 15 |
| HOURLY LOW | 11.3 | 11.3 | 11.4 | 11.6 | 11.8 | 12.4 | 13.4 | 18.3 | 15.6 | 14.5 | 12.5 |
| HOURS | 718 | 719 | 719 | 719 | 719 | 720 | 719 | 719 | 720 | 719 | 719 |

TABLE 3.1-1(CONT.)

YEAR=2007 MONTH=MAY

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 29 | 28.4 | 27.8 | 27.3 | 26.9 | 26.2 | 25.8 | 33.2 | 32.1 | 30.4 | 27.2 |
| HOURLY MEAN | 22.7 | 22.6 | 21.9 | 21.5 | 21.8 | 21.6 | 21.3 | 29 | 26.7 | 25.3 | 21.7 |
| HOURLY LOW | 19 | 18.6 | 18.2 | 17.8 | 18 | 18.5 | 17.9 | 25.9 | 23.1 | 21.9 | 17.9 |
| HOURS | 744 | 744 | 744 | 744 | 744 | 744 | 625 | 744 | 744 | 744 | 744 |

YEAR=2007 MONTH=JUNE

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 30 | 30.1 | 29.6 | 29.7 | 30 | 29.8 | 29.1 | 36.6 | 34.4 | 32.6 | 30.4 |
| HOURLY MEAN | 27.6 | 27.6 | 27.3 | 27.1 | 27.3 | 27.4 | 27.1 | 34.6 | 31.9 | 30.6 | 27.3 |
| HOURLY LOW | 25.7 | 25.5 | 25.7 | 25.3 | 25.3 | 24.9 | 24.3 | 32.3 | 30 | 28.9 | 24.7 |
| HOURS | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 |

YEAR=2007 MONTH=JULY

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 30.8 | 30.9 | 30.7 | 30.4 | 30.7 | 30.8 | 30.3 | 37.1 | 35 | 33 | 30.9 |
| HOURLY MEAN | 28.5 | 28.5 | 28.5 | 28.5 | 28.8 | 29.1 | 29.1 | 35.5 | 32.7 | 31.4 | 28.7 |
| HOURLY LOW | 26.9 | 26.8 | 27.2 | 27.2 | 27.4 | 27.5 | 27.3 | 32.3 | 29.7 | 29.1 | 26.8 |
| HOURS | 743 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 |

YEAR=2007 MONTH=AUGUST

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 32.6 | 32.2 | 32.2 | 32 | 32.4 | 32.4 | 31.8 | 39.4 | 36.9 | 35.5 | 32.9 |
| HOURLY MEAN | 29.6 | 29.5 | 29.8 | 29.8 | 30 | 30.5 | 30.6 | 37.5 | 34.6 | 33.1 | 30.2 |
| HOURLY LOW | 26.9 | 27 | 27.6 | 28 | 28.2 | 29.2 | 29.7 | 35.9 | 32.6 | 31.1 | 28.4 |
| HOURS | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 |

YEAR=2007 MONTH=SEPTEMBER

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 30.1 | 29.9 | 30.3 | 30.8 | 30.3 | 30.7 | 30.6 | 37.3 | 35.2 | 33.1 | 31.3 |
| HOURLY MEAN | 27 | 26.8 | 27.2 | 27.3 | 27.5 | 28 | 28.2 | 34.8 | 31.2 | 29.8 | 27.2 |
| HOURLY LOW | 24.1 | 24.1 | 24.5 | 24.7 | 24.9 | 25.4 | 25.9 | 32.5 | 28.1 | 27.1 | 23 |
| HOURS | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 |

YEAR=2007 MONTH=OCTOBER

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 26.8 | 26.3 | 26.5 | 26.9 | 26.9 | 26.8 | 26.9 | 33.1 | 30.7 | 29.4 | 26.8 |
| HOURLY MEAN | 22.5 | 22.5 | 23.2 | 23.5 | 23.8 | 24.5 | 25 | 30.3 | 27.5 | 26.1 | 22.8 |
| HOURLY LOW | 17.5 | 17.5 | 19.3 | 20 | 20.4 | 21.5 | 22.3 | 27.7 | 24.4 | 23 | 17.5 |
| HOURS | 742 | 744 | 744 | 743 | 744 | 743 | 744 | 744 | 744 | 744 | 744 |

TABLE 3.1-1(CONT.)

YEAR=2007 MONTH=NOVEMBER

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 18.3 | 18.1 | 19.8 | 20.4 | 20.9 | 21.8 | 22.5 | 29.5 | 25.4 | 23.2 | 20.2 |
| HOURLY MEAN | 13.5 | 13.6 | 15.5 | 16.2 | 16.7 | 18 | 18.9 | 25.6 | 21.8 | 19.7 | 14.9 |
| HOURLY LOW | 10.7 | 10.9 | 12.4 | 13.4 | 13.8 | 15.4 | 16.5 | 22.8 | 19.1 | 17.1 | 10.8 |
| HOURS | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 |

YEAR=2007 MONTH=DECEMBER

| STATISTIC/ | NAL719ST | NAL719NT | NAL208T | NALINT | NALTHIST | NALBRPTT | NALST10 | NADISC1 | NAVHTF2 | NAVHTF3 | NARIV601 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | 6 | 5 | 4 | 2 | 1 | 3 | 10 | 7 | 8 | 9 | 11 |
| HOURLY HIGH | 10.6 | 10.8 | 12.9 | 13.6 | 14 | 15.7 | 16.6 | 25.3 | 20.5 | 17.4 | 13.8 |
| HOURLY MEAN | 7.8 | 7.8 | 10.1 | 10.9 | 11.4 | 12.9 | 13.7 | 22 | 17.3 | 15.1 | 10.8 |
| HOURLY LOW | 6.3 | 6.3 | 8.2 | 9.3 | 9.6 | 11 | 12.2 | 17.1 | 13.8 | 13.4 | 7.9 |
| HOURS | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 | 744 |

The instantaneous temperature surveys were conducted in February, August, and November to provide temperature data to assess seasonal thermal stratification patterns in the lake (Table 3.1-2). The February survey results show a maximum temperature decrease of 2.9° C from surface to bottom with very little stratification. The August survey shows a thermocline at the 17 to 21 meter depths in the lower lake up to Station G. Beyond that point, in the middle and upper lake, a thermocline was absent with gradual changes in temperatures from surface to bottom. The November survey shows consistent slight decreases in temperature with decreasing depth, and an overall difference of approximately 1 to 3°C from surface to bottom throughout the lake.

Table 3.1-2 North Anna Lake survey showing temperatures (in Celsius degrees) measured at one meter interval depths for stations in Lake Anna.

| DATE | DEPTH (M) | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/27/2007 | 0 | 9.5 | 9.6 | 9.5 | 9.5 | 9.7 | 9.4 | 8.5 | 7.4 | 7.4 | 6.9 | 4.7 | 4.8 | 4.9 | 5.4 |
| | 1 | 9.3 | 9.4 | 8.9 | 8.9 | 9 | 8.6 | 7.9 | 7.3 | 6.8 | 6.4 | 4.5 | 4.4 | 4.8 | 4.8 |
| | 2 | 9.2 | 9.4 | 8.8 | 8.8 | 8.8 | 8.5 | 7.5 | 7 | 6.6 | 6.3 | 4.2 | 4 | 4.7 | 4.7 |
| | 3 | 9.2 | 9.3 | 8.4 | 8.6 | 8.5 | 8.4 | 7.4 | 6.8 | 6.5 | 6.2 | 4.1 | 3.9 | 4.7 | 4.6 |
| | 4 | 9.2 | 9.3 | 7.7 | 7.8 | 8 | 8.2 | 7.4 | 6.7 | 6.2 | 6.2 | 4 | 3.9 | 4.7 | 4.6 |
| | 5 | 9.2 | 9.2 | 7.6 | 7.8 | 7.7 | 8.2 | 7.3 | 6.7 | 6.2 | 6 | 4 | 3.9 | 4.6 | 4.6 |
| | 6 | 9.1 | 9.2 | 7.5 | 7.6 | 7.6 | 8.1 | 7.3 | 6.5 | 6.1 | 5.9 | 4 | 3.9 | 4.6 | 4.6 |
| | 7 | 9 | 9.1 | 7.5 | 7.5 | 7.5 | 8 | 7.2 | 6.4 | 6 | 5.5 | 4 | 3.9 | 4.6 | 4.6 |
| | 8 | 8.9 | 8.9 | 7.5 | 7.4 | 7.4 | 7.6 | 6.9 | 6.3 | 5.8 | 5.3 | 4 | | 4.6 | |
| | 9 | 7.9 | 8.7 | 7.4 | 7.4 | 7.4 | 7.1 | 6.9 | 6.3 | 5.7 | 5.2 | 4 | | | |
| | 10 | 7.4 | 8.5 | 7.4 | 7.4 | 7.3 | 7 | 6.8 | 6.2 | 5.7 | 5.1 | 4 | | | |
| | 11 | 7.3 | 8.3 | 7.4 | 7.4 | 7.3 | 6.9 | 6.7 | 6 | 5.3 | 5 | 4 | | | |
| | 12 | 7.3 | 8.2 | 7.3 | 7.4 | 7.3 | 6.9 | 6.6 | 5.8 | 4.6 | 4.8 | 4 | | | |
| | 13 | 7.3 | 8 | 7.3 | 7.3 | 7.3 | 6.9 | 6.4 | 5.3 | 4.6 | 4.4 | 4 | | | |
| | 14 | 7.3 | 8 | 7.2 | 7.2 | 7.3 | 6.7 | 6.3 | 4.9 | | 4.4 | 4 | | | |
| | 15 | 7.3 | 8 | 7.2 | 7.2 | 7.3 | 6.5 | 6.2 | 4.9 | | | 4 | | | |
| | 16 | 7.3 | 8 | 7.2 | 7.2 | 7.2 | 6.5 | 6.2 | | | | | | | |
| | 17 | 7.3 | | 7.2 | 7.2 | 7.2 | 6.5 | 6.2 | | | | | | | |
| | 18 | 7.3 | | 7.2 | 7.2 | 7.2 | 6.5 | 6.2 | | | | | | | |
| | 19 | 7.3 | | 7.2 | 7.2 | | 6.5 | 6.2 | | | | | | | |
| | 20 | 7.3 | | | | | 6.5 | | | | | | | | |
| | 21 | 7.2 | | | | | | | | | | | | | |

| DATE | DEPTH (M) | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/7/2007 | 0 | 31.5 | 31 | 31.2 | 31.1 | 31.3 | 31.4 | 31.1 | 31.1 | 31.1 | 30.8 | 30.5 | 30.5 | 31 | 31.1 |
| | 1 | 31.2 | 30.8 | 30.9 | 30.9 | 30.7 | 31.1 | 30.6 | 30.5 | 30.5 | 30.3 | 30.2 | 30.1 | 30.2 | 30.1 |
| | 2 | 31.1 | 30.7 | 30.7 | 30.6 | 30.6 | 31 | 30.6 | 30.1 | 30.4 | 30.2 | 30.1 | 30 | 29.9 | 29.9 |
| | 3 | 31.1 | 30.7 | 30.6 | 30.5 | 30.5 | 30.8 | 30.6 | 30.1 | 30.3 | 30.1 | 30 | 29.9 | 29.7 | 29.6 |
| | 4 | 31.1 | 30.6 | 30.3 | 30.4 | 30.4 | 30.7 | 30.5 | 30 | 30.3 | 30.1 | 29.8 | 29.7 | 29.2 | 29.4 |
| | 5 | 31.1 | 30.3 | 30.3 | 30.3 | 30.3 | 30.6 | 30.5 | 30 | 29.8 | 29.9 | 29.7 | 29.4 | 29.1 | 28.6 |
| | 6 | 31 | 30.1 | 30.2 | 30.1 | 30.2 | 30.3 | 30.4 | 29.9 | 29.7 | 29.9 | 29.5 | 29.2 | 28.5 | 28.2 |
| | 7 | 30.6 | 28.6 | 30.1 | 30.1 | 30.1 | 30.2 | 30.2 | 29.3 | 29.1 | 29.4 | 28.9 | 28.9 | 28 | 27.8 |
| | 8 | 30.3 | 28.3 | 30.1 | 30 | 29.9 | 29.9 | 30.1 | 28.9 | 28.5 | 28.5 | 28.1 | | 27.7 | |
| | 9 | 29.3 | 28.3 | 29.4 | 29.6 | 29.7 | 29.6 | 28.7 | 28.6 | 28.2 | 27.9 | 27.8 | | | |
| | 10 | 28.8 | 27.6 | 29.4 | 29.3 | 28.7 | 28.3 | 28.1 | 27.9 | 27.2 | 27.6 | 27.4 | | | |
| | 11 | 27.5 | 26.8 | 27.5 | 27.8 | 27.8 | 27.7 | 27.6 | 27.5 | 27.5 | 27.1 | 27.1 | | | |
| | 12 | 27.1 | 26.7 | 27.2 | 27.3 | 27.4 | 27.4 | 27.1 | 27.1 | 27 | 26.8 | 26.7 | | | |
| | 13 | 27 | 26.3 | 26.9 | 26.9 | 27.1 | 26.8 | 26.9 | 27 | 26.9 | 26.5 | 26.3 | | | |
| | 14 | 26.4 | 26.1 | 26.7 | 26.7 | 26.6 | 26.5 | 26.6 | 26.9 | | 25.6 | 26.2 | | | |
| | 15 | 26.2 | 26.1 | 26.7 | 26.5 | 26.5 | 26.4 | 26.3 | 26.5 | | | 26.1 | | | |
| | 16 | 25.8 | 26.1 | 25.7 | 26.2 | 26.5 | 26.2 | 25.6 | | | | | | | |
| | 17 | 24.7 | | 25.2 | 25.3 | 26.6 | 25.3 | 24.7 | | | | | | | |
| | 18 | 23 | | 21.7 | 24.1 | | 23.9 | 24.2 | | | | | | | |
| | 19 | 21 | | 20.3 | 21 | | 19.7 | 20.7 | | | | | | | |
| | 20 | 18.5 | | | | | 18.4 | | | | | | | | |
| | 21 | 17.1 | | | | | | | | | | | | | |

Table 3.1-2 (cont.)

| DATE | DEPTH (M) | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/7/2007 | 0 | 31.5 | 31 | 31.2 | 31.1 | 31.3 | 31.4 | 31.1 | 31.1 | 31.1 | 30.8 | 30.5 | 30.5 | 31 | 31.1 |
| | 1 | 31.2 | 30.8 | 30.9 | 30.9 | 30.7 | 31.1 | 30.6 | 30.5 | 30.5 | 30.3 | 30.2 | 30.1 | 30.2 | 30.1 |
| | 2 | 31.1 | 30.7 | 30.7 | 30.6 | 30.6 | 31 | 30.6 | 30.1 | 30.4 | 30.2 | 30.1 | 30 | 29.9 | 29.9 |
| | 3 | 31.1 | 30.7 | 30.6 | 30.5 | 30.5 | 30.8 | 30.6 | 30.1 | 30.3 | 30.1 | 30 | 29.9 | 29.7 | 29.6 |
| | 4 | 31.1 | 30.6 | 30.3 | 30.4 | 30.4 | 30.7 | 30.5 | 30 | 30.3 | 30.1 | 29.8 | 29.7 | 29.2 | 29.4 |
| | 5 | 31.1 | 30.3 | 30.3 | 30.3 | 30.3 | 30.6 | 30.5 | 30 | 29.8 | 29.9 | 29.7 | 29.4 | 29.1 | 28.6 |
| | 6 | 31 | 30.1 | 30.2 | 30.1 | 30.2 | 30.3 | 30.4 | 29.9 | 29.7 | 29.9 | 29.5 | 29.2 | 28.5 | 28.2 |
| | 7 | 30.6 | 28.6 | 30.1 | 30.1 | 30.1 | 30.2 | 30.2 | 29.3 | 29.1 | 29.4 | 28.9 | 28.9 | 28 | 27.8 |
| | 8 | 30.3 | 28.3 | 30.1 | 30 | 29.9 | 29.9 | 30.1 | 28.9 | 28.5 | 28.5 | 28.1 | | 27.7 | |
| | 9 | 29.3 | 28.3 | 29.4 | 29.6 | 29.7 | 29.6 | 28.7 | 28.6 | 28.2 | 27.9 | 27.8 | | | |
| | 10 | 28.8 | 27.6 | 29.4 | 29.3 | 28.7 | 28.3 | 28.1 | 27.9 | 27.2 | 27.6 | 27.4 | | | |
| | 11 | 27.5 | 26.8 | 27.5 | 27.8 | 27.8 | 27.7 | 27.6 | 27.5 | 27.5 | 27.1 | 27.1 | | | |
| | 12 | 27.1 | 26.7 | 27.2 | 27.3 | 27.4 | 27.4 | 27.1 | 27.1 | 27 | 26.8 | 26.7 | | | |
| | 13 | 27 | 26.3 | 26.9 | 26.9 | 27.1 | 26.8 | 26.9 | 27 | 26.9 | 26.5 | 26.3 | | | |
| | 14 | 26.4 | 26.1 | 26.7 | 26.7 | 26.6 | 26.5 | 26.6 | 26.9 | | 25.6 | 26.2 | | | |
| | 15 | 26.2 | 26.1 | 26.7 | 26.5 | 26.5 | 26.4 | 26.3 | 26.5 | | | 26.1 | | | |
| | 16 | 25.8 | 26.1 | 25.7 | 26.2 | 26.5 | 26.2 | 25.6 | | | | | | | |
| | 17 | 24.7 | | 25.2 | 25.3 | 26.6 | 25.3 | 24.7 | | | | | | | |
| | 18 | 23 | | 21.7 | 24.1 | | 23.9 | 24.2 | | | | | | | |
| | 19 | 21 | | 20.3 | 21 | | 19.7 | 20.7 | | | | | | | |
| | 20 | 18.5 | | | | | 18.4 | | | | | | | | |
| | 21 | 17.1 | | | | | | | | | | | | | |

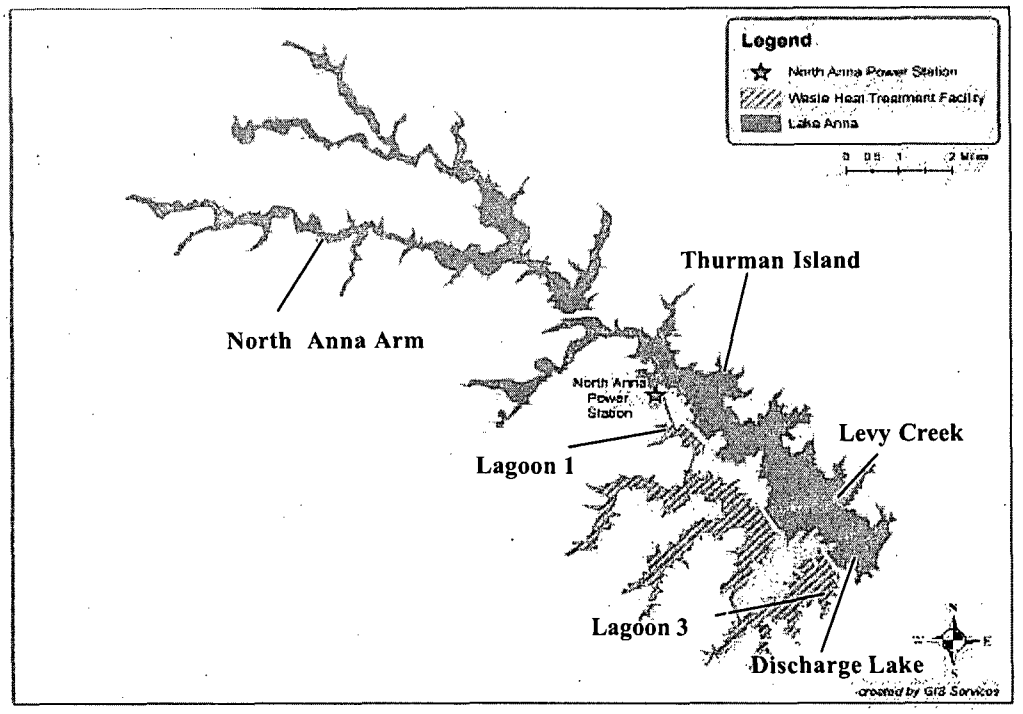
## 3.2 Fish Population Studies - Gill Netting

### Methods

The monitoring of fish assemblage abundance and species composition for Lake Anna and the WHTF continued in 2007 using the same basic sampling technologies applied since 1972, gill netting and boat electrofishing.

Gill netting was used to capture fishes which normally inhabit the deeper strata of the lake, or exhibit a diel movement to and from the shoreline. Similar to previous years, gill net surveys for 2007 were conducted seasonally (March, May, August, and November) at the stations shown in Figure 3.2-1. Gill nets were set near littoral drop-off areas with procedures remaining unchanged since 1972. Standard physicochemical measurements including surface water temperature (°C), dissolved oxygen (mg/l), pH and conductivity (umhos) were recorded at the time of each sample collection. Fish collected by gill netting were returned to the laboratory where all individuals were measured to the nearest millimeter total length and weighed to the nearest gram.

Figure 3.2-1 Location of gill netting stations on Lake Anna and WHTF




## Results

Standard physicochemical measurements recorded during gill net surveys are shown in Table 3.2-1. The data demonstrate expected seasonal changes in temperature and dissolved oxygen, while conductivity and pH were relatively stable. The data are consistent with historical trends and indicate that water quality in Lake Anna continues to be capable of supporting a healthy fishery.

TABLE 3.2- 1 Surface water temperature (C), conductivity (umhos),pH (standard units) and dissolved oxygen (mg/l) recorded at time of gill net sampling during 2007

MARCH

| Gillnetting Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Lagoon 1 | 20.2 | 64 | 7.3 | 13.1 |
| Lagoon 3 | 15.1 | 65 | 7.4 | 12.5 |
| Lower Lake | 13.3 | 64 | 7.3 | 13.4 |
| Thurman Island | 11.2 | 66 | 7.5 | 13.2 |
| North Anna Arm | 10.2 | 75 | 8.2 | 15.2 |
| Levy Creek | 12.1 | 68 | 7.5 | 13.3 |

AUGUST

| Gillnetting Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Lagoon 1 | 38.2 | 55 | 7.3 | 7.0 |
| Lagoon 3 | 34.2 | 55 | 7.6 | 7.4 |
| Lower Lake | 32.2 | 55 | 7.3 | 6.7 |
| Thurman Island | 30.8 | 54 | 7.7 | 7.7 |
| North Anna Arm | 30.1 | 53 | 8.2 | 8.0 |
| Levy Creek | 31.2 | 55 | 7.2 | 6.5 |

MAY

| Gillnetting Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Lagoon 1 | 25.6 | 64 | 6.3 | 8.2 |
| Lagoon 3 | 22.3 | 64 | 6.4 | 8.1 |
| Lower Lake | 21.9 | 64 | 6.1 | 7.8 |
| Thurman Island | 20.5 | 63 | 6.3 | 9.2 |
| North Anna Arm | 20.7 | 62 | 7.5 | 10.7 |
| Levy Creek | 20.9 | 64 | 6.2 | 8.5 |

NOVEMBER

| Gillnetting Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Lagoon 1 | 26.9 | 60 | 7.9 | 8.7 |
| Lagoon 3 | 21.2 | 61 | 8.4 | 8.8 |
| Lower Lake | 19.6 | 60 | 8.2 | 9.5 |
| Thurman Island | 17.3 | 60 | 8.1 | 9.5 |
| North Anna Arm | 13.0 | 60 | 7.9 | 10.0 |
| Levy Creek | 18.5 | 60 | 8.3 | 8.8 |

Nineteen (19) species of fish representing 7 families were collected in Lake Anna and the WHTF by quarterly gill netting in 2007 (Table 3.2-2).

**Table 3.2-2. Fishes collected in Lake Anna and the WHTF by gill netting during 2007**

| FAMILY | SPECIES | LAKE | WHTF |
|---|---|---|---|
| *Clupeidae* | Dorosoma cepedianum | X | X |
| | Dorosoma petenense | X | X |
| *Cyprinidae* | Cyprinus carpio | X | X |
| | Notropis hudsonius | X | |
| *Catostomidae* | Erimyzon oblongus | X | |
| | Moxostoma macrolepidotum | X | |
| *Ictaluridae* | Ameiurus catus | X | X |
| | Ameiurus natalis | | X |
| | Ameiurus nebulosus | X | |
| | Ictalurus punctatus | X | X |
| *Moronidae* | Morone americana | X | X |
| | Morone saxatilis | X | X |
| *Centrarchidae* | Lepomis auritus | X | |
| | Lepomis gulosus | X | |
| | Lepomis macrochirus | X | X |
| | Lepomis microlophus | X | X |
| | Micropterus salmoides | X | X |
| | Pomoxis nigromaculatus | X | |
| *Percidae* | Sander vitreus | X | X |

A total of 931 fish weighing 422.9 kg was collected by gill netting in 2007 from four (4) stations in the lake and two (2) stations in the WHTF (Table 3.2-3). The 2007 total number of fish (931) was greater than 2006 (784) yet less than 2005 (996). Gill net biomass in 2007 (422.9 kg) was greater than biomass totals in both 2006 (356.5) and 2005 (383.3 kg). Of the 931 fish collected, 550 (244.7 kg) were collected in the lake and 381 (178.2 kg) were collected in the WHTF. The March survey yielded the greatest total number (266) of fish collected from gill netting and represented 28.6% of the total of all fish collected. Biomass was also highest in the March survey representing 36.2% of the total gill net biomass for the year.

Table 3.2-3 also includes the average number and weight of fish collected per net set for each station for comparison of catch per unit effort by number (CPUE-N) and weight (CPUE-W). CPUE-N for all stations combined in 2007 was 39 fish per set while CPUE-W was 17.6 kg per set. Among stations, CPUE-N ranged from a low of 22 fish per net at the Levy Creek Station to a high of 61 fish per net at the Lagoon 1 Station. CPUE-W ranged from a low of 7.9 kg per net at the Thurman Island Station to a high of 26.5 kg at the Lagoon 1 Station.

TABLE 3.2-3 NUMBER AND WEIGHT (g) OF FISHES BY STATION COLLECTED BY GILL NETTING IN WHTF AND LAKE ANNA DURING 2007

| STATION | MARCH | MAY | AUGUST | NOVEMBER | TOTAL | CPUE |
|---|---|---|---|---|---|---|
| LAGOON 1 | | | | | | |
| NUMBER | 97 | 28 | 8 | 109 | 242 | 61 |
| WEIGHT | 61151 | 17159 | 566 | 27203 | 106079 | 26520 |
| LAGOON 3 | | | | | | |
| NUMBER | 10 | 38 | 68 | 23 | 139 | 35 |
| WEIGHT | 7112 | 35775 | 18127 | 11147 | 72161 | 18040 |
| LEVY CREEK | | | | | | |
| NUMBER | 30 | 29 | 8 | 19 | 86 | 22 |
| WEIGHT | 26691 | 10853 | 2739 | 3742 | 44025 | 11006 |
| LOWER LAKE | | | | | | |
| NUMBER | 67 | 40 | 45 | 12 | 164 | 41 |
| WEIGHT | 45528 | 7722 | 11758 | 8154 | 73162 | 18291 |
| NORTH ANNA ARM | | | | | | |
| NUMBER | 50 | 56 | 58 | 43 | 207 | 52 |
| WEIGHT | 5491 | 31483 | 33955 | 24904 | 95833 | 23958 |
| THURMAN ISLAND | | | | | | |
| NUMBER | 12 | 43 | 31 | 7 | 93 | 23 |
| WEIGHT | 7261 | 13856 | 6017 | 4532 | 31666 | 7917 |
| TOTALS | | | | | | |
| NUMBER | 266 | 234 | 218 | 213 | 931 | 39 |
| WEIGHT | 153234 | 116848 | 73162 | 79682 | 422926 | 17622 |

These values are compared to CPUE in previous years in Figure 3.2-2. Over the previous 10 years, CPUE-N has ranged from 24 to 42 with a mean of 33.9, while CPUE-W has ranged from 10 kg to 16 kg with a mean of 13.9 kg. In 2007, both CPUE-N (39) and CPUE-W (17.6 kg) were well above the mean for the past ten (10) years.

**FIGURE 3.2-2 Lake Anna and WHTF gill net data (1997-2007) average number and average weight (kg).**

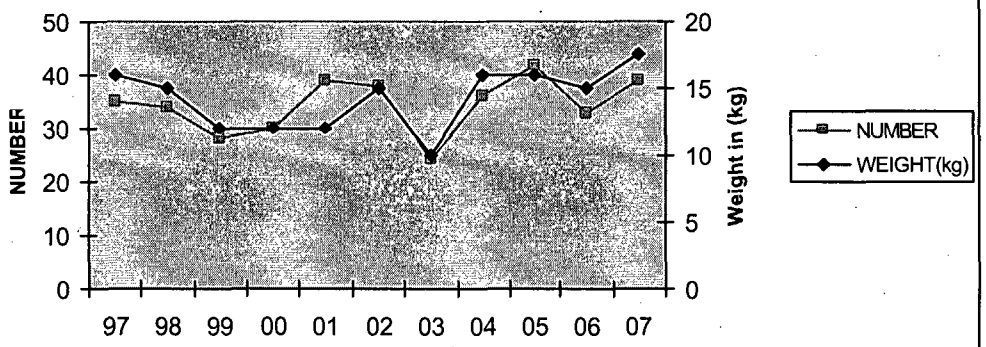



Table 3.2-4 presents the gill net catch by species and season at lake stations in 2007. The numerically dominant species collected in the lake was gizzard shad Dorosoma cepedianum followed by channel catfish Ictalurus punctatus, striped bass Morone saxatillis, white catfish Ameiurus catus, black crappie Pomoxis nigromaculatus and white perch Morone americana. These 6 species represented 84% of the gill net catch by number. These results are similar to data collected in most previous years.

TABLE 3.2-4 GILL NET SUMMARY 2007
GILL NET - LAKE
STATION:ALL STATIONS

| SPECIES | MARCH NUMBER | MARCH WEIGHT | MAY NUMBER | MAY WEIGHT | AUGUST NUMBER | AUGUST WEIGHT | NOVEMBER NUMBER | NOVEMBER WEIGHT | TOTALS NUMBER | TOTALS WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|
| D.cepedianum | 11 | 2556 | 39 | 9164 | 68 | 14076 | 8 | 1839 | 126 | 27635 |
| I. punctatus | 21 | 3882 | 24 | 7861 | 14 | 5668 | 23 | 7245 | 82 | 24656 |
| P. nigromaculatus | 18 | 2380 | 2 | 92 | 25 | 821 | 13 | 1732 | 58 | 5024 |
| M. saxatilis | 29 | 34564 | 34 | 24898 | 5 | 8008 | 8 | 5754 | 76 | 73224 |
| S.vitreus | 20 | 28277 | | | | | 5 | 6847 | 25 | 35124 |
| D. petenense | | | | | 8 | 96 | 2 | 14 | 10 | 110 |
| M. americana | 24 | 4129 | 16 | 855 | 3 | 262 | 8 | 174 | 51 | 5420 |
| A. catus | 31 | 7028 | 38 | 5121 | | | | | 69 | 12149 |
| M. salmoides | 3 | 1463 | 3 | 2521 | 7 | 2543 | 3 | 1165 | 16 | 7692 |
| C. carpio | 1 | 496 | 3 | 11386 | 7 | 22511 | 4 | 10269 | 15 | 44662 |
| L. macrochirus | | | 1 | 45 | 2 | 16 | | | 3 | 61 |
| L.microlophus | 1 | 196 | 4 | 1085 | 2 | 456 | 1 | 209 | 8 | 1946 |
| E.oblongus | | | 1 | 480 | | | | | 1 | 480 |
| A.nebulosus | | | 2 | 399 | | | | | 2 | 399 |
| N.hudsonius | | | | | | | 1 | 11 | 1 | 11 |
| M.macrolepidotum | | | | | | | 5 | 6074 | 5 | 6074 |
| L. gulosus | | | | | 1 | 12 | | | 1 | 12 |
| L.auritus | | | 1 | 7 | | | | | 1 | 7 |
| Total No. | 159 | | 168 | | 142 | | 81 | | 550 | |
| Total Wt. | 84971 | | 63914 | | 54469 | | 41332 | | 244685 | |

The dominant species in the lake from gill netting in terms of biomass was striped bass followed by common carp Cyprinus carpio, walleye Sander vitreus, gizzard shad and channel catfish. These 5 species represented 84% of fish biomass collected by gill netting in the lake. Again, this is consistent with previously collected and reported data .

The numerically dominant species collected by gill netting in the WHTF in 2007 was channel catfish, followed by gizzard shad, largemouth bass Micropterus salmoides, striped bass, white perch and common carp (Table 3.2-5). Together these species represented 93% of the number of fish collected.

The weight-dominant species in the WHTF gill netting in 2007 was common carp followed by striped bass and gizzard shad. These species represented 83% of the WHTF biomass in 2007. Channel catfish, common carp, gizzard shad and largemouth bass have commonly ranked high in numbers and biomass in the WHTF. The striped bass catch in the WHTF in 2007 was higher than 2005 and 2006.

TABLE 3.2-5 GILL NET SUMMARY 2007
GILL NET- WHTF
STATION:ALL STATIONS

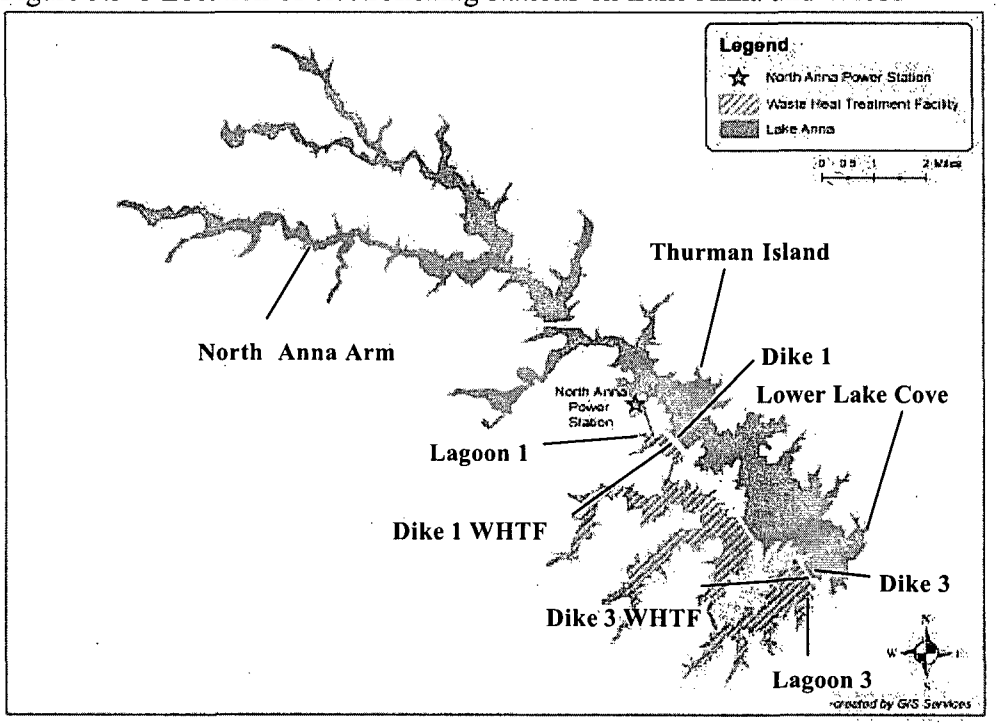
| SPECIES | MARCH NUMBER | MARCH WEIGHT | MAY NUMBER | MAY WEIGHT | AUGUST NUMBER | AUGUST WEIGHT | NOVEMBER NUMBER | NOVEMBER WEIGHT | TOTALS NUMBER | TOTALS WEIGHT | % OF TOTAL NUMBER | % OF TOTAL WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. punctatus | 36 | 10646 | 9 | 2739 | 29 | 4471 | 66 | 15234 | 140 | 33090 | 37 | 19 |
| D. cepedianum | 26 | 9981 | 12 | 4352 | 30 | 8513 | 10 | 2834 | 78 | 25680 | 20 | 14 |
| M. salmoides | 2 | 1576 | 3 | 1277 | 5 | 1231 | 29 | 9570 | 39 | 13654 | 10 | 8 |
| C. carpio | 2 | 4538 | 24 | 35521 | 1 | 3115 | 1 | 3742 | 28 | 46916 | 7 | 26 |
| M. americana | 8 | 1694 | 1 | 17 | 2 | 455 | 22 | 3658 | 33 | 5824 | 9 | 3 |
| L. microlophus | | | 1 | 161 | 5 | 732 | | | 6 | 893 | 2 | 1 |
| A. catus | | | 7 | 915 | | | 1 | 2384 | 8 | 3299 | 2 | 2 |
| M.saxatilis | 28 | 34093 | 9 | 7952 | | | 1 | 685 | 38 | 42730 | 10 | 24 |
| D. petenense | | | | | | | 1 | 73 | 1 | 73 | 0 | 0 |
| L.macrochirus | | | | | 4 | 176 | | | 4 | 176 | 1 | 0 |
| S. vitreus | 5 | 5735 | | | | | | | 5 | 5735 | 1 | 3 |
| A. natalis | | | | | | | 1 | 170 | 1 | 170 | 0 | 0 |
| Total No. | 107 | | 66 | | 76 | | 132 | | 381 | | 100 | 100 |
| Total Wt. | 68263 | | 52934 | | 18693 | | 38350 | | 178240 | | | |

## 3.3 Fish Population Studies - Electrofishing

### Methods

Boat electrofishing was used in 2007 to evaluate the assemblage and abundance of fish populations which normally occupy the shoreline habitat. The techniques, stations, and frequency have remained virtually unchanged since 1972. Sampling was performed in March, May, August, and November at the stations identified in Figure 3.3-1. Each station is 100 meters in length and normally includes a brush pile except for the dike stations which are comprised of uniform rip-rap. Standard physicochemical measurements of surface water temperature (°C),

Figure 3.3-1 Location of electrofishing stations on Lake Anna and WHTF




dissolved oxygen (mg/l), pH and conductivity (μmhos) were recorded at the time of each sample collection.

All fish collected were either returned to the laboratory for processing or released in the field, i.e., larger game fish were measured, weighed, and released in the field. In the laboratory, up to 25 individuals per species from each station were measured to the nearest millimeter total length and weighed to the nearest 0.1 gram. The remaining fish (per species) were enumerated and bulk weighed.

## Results

Standard physicochemical measurements were recorded at each station during electrofishing surveys and are presented in Table 3.3-1. Again, seasonal changes in water temperatures and dissolved oxygen are noticeable and expected while conductivity and pH remained relatively stable.

TABLE 3.3-1. Surface water temperature (C), conductivity (umhos),pH (standard units) and dissolved oxygen (mg/l) recorded at time of electrofishing sampling during 2007

MARCH

| Electrofish Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Dike 1 WHTF | 20.2 | 64 | 7.4 | 13.4 |
| Dike 3 WHTF | 15.2 | 64 | 7.3 | 15.2 |
| Lagoon 1 | 20.2 | 64 | 7.4 | 12.9 |
| Lagoon 3 | 15.2 | 65 | 7.4 | 13.4 |
| Thurman Island | 11.3 | 65 | 7.4 | 13.1 |
| Dike 1 Lake | 9.2 | 66 | 7.5 | 13.6 |
| Dike 3 Lake | 12.2 | 66 | 7.2 | 13.3 |
| Lower Lake Cove | 15.1 | 61 | 7.4 | 12.9 |
| North Anna Arm | 10.1 | 76 | 8.1 | 15.1 |

AUGUST

| Electrofish Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Dike 1 WHTF | 38.1 | 55 | 7.2 | 7.0 |
| Dike 3 WHTF | 33.1 | 55 | 7.5 | 8.2 |
| Lagoon 1 | 37.1 | 55 | 7.4 | 7.0 |
| Lagoon 3 | 34.2 | 54 | 7.8 | 7.9 |
| Thurman Island | 30.5 | 54 | 7.6 | 7.6 |
| Dike 1 Lake | 29.2 | 54 | 7.3 | 6.8 |
| Dike 3 Lake | 30.1 | 55 | 7.0 | 5.4 |
| Lower Lake Cove | 30.2 | 54 | 7.2 | 6.9 |
| North Anna Arm | 29.6 | 53 | 7.9 | 7.0 |

MAY

| Electrofish Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Dike 1 WHTF | 25.5 | 63 | 6.2 | 8.8 |
| Dike 3 WHTF | 21.8 | 64 | 6.2 | 8.4 |
| Lagoon 1 | 25.5 | 63 | 6.3 | 8.6 |
| Lagoon 3 | 21.8 | 64 | 6.3 | 8.6 |
| Thurman Island | 17.9 | 62 | 6.1 | 8.6 |
| Dike 1 Lake | 19.4 | 63 | 6.1 | 6.1 |
| Dike 3 Lake | 20.6 | 64 | 6.1 | 8.1 |
| Lower Lake Cove | 22.6 | 64 | 6.3 | 8.6 |
| North Anna Arm | 22.5 | 62 | 6.9 | 9.8 |

NOVEMBER

| Electrofish Stations | Temperature | Conductivity | pH | Dissolved Oxygen |
|---|---|---|---|---|
| Dike 1 WHTF | | | | |
| Dike 3 WHTF | 21.1 | 60 | 8.2 | 8.3 |
| Lagoon 1 | 26.0 | 60 | 8.4 | 9.3 |
| Lagoon 3 | 21.4 | 60 | 8.4 | 9.2 |
| Thurman Island | 17.4 | 60 | 8.3 | 9.7 |
| Dike 1 Lake | 17.5 | 60 | 8.1 | 9.4 |
| Dike 3 Lake | 19.7 | 60 | 8.4 | 9.3 |
| Lower Lake Cove | 19.0 | 61 | 8.4 | 9.3 |
| North Anna Arm | 14.0 | 60 | 8.2 | 8.1 |

Twenty-two (22) species of fish representing 7 families were collected by electrofishing operations in the lake and WHTF in 2007 (Table 3.3-2).

**Table 3.3-2. Fishes collected in Lake Anna and the WHTF by electrofishing in 2007**

| FAMILY | SPECIES | LAKE | WHTF |
|---|---|---|---|
| *Clupeidae* | Alosa aestivalis | X | |
| | Dorosoma cepedianum | X | |
| *Cyprinidae* | Cyprinella analostana | X | X |
| | Cyprinus carpio | X | |
| | Notropis hudsonius | X | |
| | Notropis procne | X | |
| *Ictaluridae* | Ameiurus catus | X | |
| | Ameiurus nebulosus | X | X |
| | Ictalurus punctatus | X | X |
| *Cyprinodontidae* | Fundulus diaphanus | X | |
| *Moronidae* | Morone americana | X | |
| | Morone saxatilis | X | |
| *Centrarchidae* | Lepomis auritus | X | X |
| | Lepomis cyanellus | X | X |
| | Lepomis gulosus | X | X |
| | Lepomis macrochirus | X | X |
| | Lepomis microlophus | X | X |
| | Micropterus salmoides | X | X |
| | Pomoxis nigromaculatus | X | X |
| *Percidae* | Etheostoma nigrum | X | |
| | Etheostoma olmstedi | X | |
| | Perca flavescens | X | |

Further, a total of 5,633 fish weighing 81.6 kg was collected via electrofishing from the 5 stations in the lake and the 4 stations in the WHTF during the 2007 sampling period (Table 3.3-3). This number was lower than the total in 2006 (6,408) yet higher than the total in 2005 (5,320). Electrofishing biomass in 2007 (81.6 kg) was lower than 2006 (100 kg) and 2005 (90.8 kg). Of the 5,633 fish collected in 2007, 3,521 (51.8 kg) were collected from the lake and 2,112 (29.8 kg) were collected from the WHTF. When the data are compared seasonally, the 2007 electrofishing results are similar to previous years with the greatest numbers of fish being collected in the fourth quarter (2,705 individuals in November) survey.

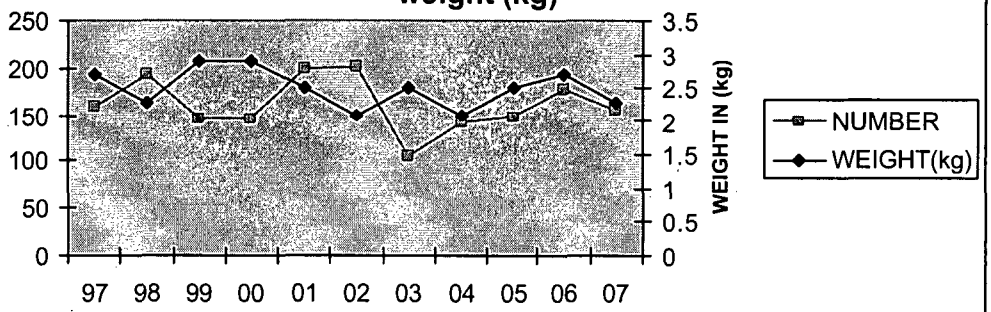
TABLE 3.3-3. NUMBER AND WEIGHT (g) OF FISHES BY STATION COLLECTED BY ELECTROFISHING IN WHTF A LAKE ANNA DURING 2007

| STATION | MARCH | MAY | AUGUST | NOVEMBER | TOTAL | CPUE |
|---|---|---|---|---|---|---|
| LAGOON 1 | | | | | | |
| NUMBER | 83 | 53 | 44 | 160 | 340 | 85 |
| WEIGHT | 1744 | 463 | 261 | 1423 | 3892 | 973 |
| LAGOON 3 | | | | | | |
| NUMBER | 32 | 51 | 48 | 200 | 331 | 83 |
| WEIGHT | 2514 | 2910 | 825 | 2771 | 9020 | 2255 |
| DIKE 1-WHTF | | | | | | |
| NUMBER | 125 | 159 | 11 | 71 | 366 | 92 |
| WEIGHT | 1929 | 1908 | 71 | 1340 | 5248 | 1312 |
| DIKE 3-WHTF | | | | | | |
| NUMBER | 334 | 110 | 35 | 596 | 1075 | 269 |
| WEIGHT | 4633 | 1785 | 513 | 4679 | 11610 | 2902 |
| DIKE 1-LAKE | | | | | | |
| NUMBER | 406 | 149 | 51 | 458 | 1064 | 266 |
| WEIGHT | 6738 | 2566 | 661 | 4206 | 14171 | 3543 |
| DIKE 3-LAKE | | | | | | |
| NUMBER | 376 | 144 | 21 | 296 | 837 | 209 |
| WEIGHT | 4508 | 1306 | 197 | 2958 | 8969 | 2242 |
| LOWER LAKE | | | | | | |
| NUMBER | 71 | 73 | 46 | 182 | 372 | 93 |
| WEIGHT | 460 | 579 | 541 | 1723 | 3304 | 826 |
| THURMAN ISLAND | | | | | | |
| NUMBER | 131 | 65 | 29 | 503 # | 728 | 182 |
| WEIGHT | 6598 | 3865 | 189 | 1337 | 11988 | 2997 |
| NORTH ANNA ARM | | | | | | |
| NUMBER | 137 | 110 | 34 | 239 | 520 | 130 |
| WEIGHT | 3173 | 6477 | 685 | 3076 | 13411 | 3353 |
| TOTAL NUMBER | 1695 | 914 | 319 | 2705 | 5633 | 156 |
| TOTAL WEIGHT | 32297 | 21859 | 3943 | 23514 | 81613 | 2267 |

Table 3.3-3 also includes the average number and weight of fish collected per electrofishing sample for each station for comparison of catch per unit effort by number (CPUE-N) and weight (CPUE-W). CPUE-N for all stations combined in 2007 was 156 fish per sample while CPUE-W was 2.3 kg per sample. When the catch per unit effort among stations in 2007 is compared, CPUE-N ranged from a low of 83 fish per sample at Lagoon 3 Station to a high of 269 fish per sample at the Dike 3 - WHTF. CPUE-W ranged from a low of 0.8 kg per sample at the Lower Lake Station to a high of 3.5 kg at the Dike 3 - WHTF Station.

These values are compared to CPUE in previous years in Figure 3.3-2. Over the previous 10 years, CPUE-N ranged from 104 to 201 with a mean of 161.7, while CPUE-W ranged from 2.1 kg to 2.9 kg with a mean of 2.5 kg. In 2007, both CPUE-N (156) and CPUE-W (2.3 kg) were slightly below the historical 10 year mean.

**FIGURE 3.3-2 Lake Anna and WHTF electrofish data combined (1997-2007) average number and average weight (kg)**




The numerically dominant species collected in both the lake and WHTF by boat electrofishing in 2007 was the bluegill Lepomis macrochirus (Table 3.3-4 and 3.3-5). Bluegill also ranked first in terms of weight in both the lake and WHTF. Other numerically dominant species collected by electrofishing in both areas were also Centrachids (sunfishes) and included green sunfish Lepomis cyanellus, warmouth Lepomis microlophus, redbreast sunfish Lepomis auritus and largemouth bass. Largemouth bass ranked second in weight in both the lake and in

TABLE 3.3-4. ELECTROFISH SUMMARY 2007

| ELECTROFISH - LAKE STATION:ALL STATIONS | MARCH Number | MARCH Weight(g) | MAY Number | MAY Weight(g) | AUGUST Number | AUGUST Weight(g) | NOVEMBER Number | NOVEMBER Weight(g) | TOTALS Number | TOTALS Weight(g) | % OF TOTAL Number | % OF TOTAL Weight(g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L.macrochirus | 832 | 9953 | 397 | 3733 | 77 | 554 | 1492 | 8300 | 2798 | 22540 | 79 | 43 |
| M.salmoides | 45 | 4428 | 23 | 4426 | 3 | 45 | 16 | 1954 | 87 | 10852 | 2 | 21 |
| C.carpio | | | 1 | 3000 | | | | | 1 | 3000 | 0 | 6 |
| L.microlophus | 103 | 4661 | 16 | 393 | 8 | 114 | 31 | 393 | 158 | 5562 | 4 | 11 |
| L.auritus | 56 | 1327 | 43 | 505 | 10 | 114 | 1 | 17 | 110 | 1962 | 3 | 4 |
| L.cyanellus | 51 | 378 | 37 | 426 | 19 | 339 | 110 | 1567 | 217 | 2710 | 6 | 5 |
| P. nigromaculatus | | | 8 | 1647 | 1 | 79 | 2 | 201 | 11 | 1927 | 0 | 4 |
| L.gulosus | 14 | 256 | 11 | 345 | 6 | 189 | 17 | 418 | 48 | 1209 | 1 | 2 |
| D.cepedianum | | | | | 34 | 685 | 1 | 100 | 35 | 785 | 1 | 2 |
| P. flavescens | | | 1 | 29 | 1 | 25 | 1 | 25 | 3 | 79 | 0 | 0 |
| M.americana | 5 | 186 | | | | | | | 5 | 186 | 0 | 0 |
| A.aestivalis | 9 | 64 | | | | | | | 9 | 64 | 0 | 0 |
| I. punctatus | | | | | 3 | 80 | 1 | 317 | 4 | 397 | 0 | 1 |
| F.diaphanus | 3 | 8 | | | | | 1 | 3 | 4 | 11 | 0 | 0 |
| E.nigrrum | | | 1 | 1 | | | | | 1 | 1 | 0 | 0 |
| C.analostana | | | 2 | 5 | | | | | 2 | 5 | 0 | 0 |
| A.nebulosus | 1 | 206 | 1 | 284 | | | | | 2 | 490 | 0 | 1 |
| N.hudsonius | | | | | 19 | 48 | | | 19 | 48 | 1 | 0 |
| M.saxatilis | 1 | 9 | | | | | | | 1 | 9 | 0 | 0 |
| E.olmstedi | | | | | | | 1 | 2 | 1 | 2 | 0 | 0 |
| A.catus | 1 | 2 | | | | | | | 1 | 2 | 0 | 0 |
| N.procne | | | | | | | 4 | 4 | 4 | 4 | 0 | 0 |
| Total No. | 1121 | | 541 | | 181 | | 1678 | | 3521 | | 100 | 100 |
| Total Wt.(g) | 21477 | | 14793 | | 2273 | | 13300 | | 51844 | | | |

TABLE 3.3-5. ELECTROFISH SUMMARY 2007

ELECTROFISH - WHTF

| STATION:ALL STATIONS SPECIES | MARCH NUMBER | MARCH WEIGHT(g) | MAY NUMBER | MAY WEIGHT(g) | AUGUST NUMBER | AUGUST WEIGHT(g) | NOVEMBER NUMBER | NOVEMBER WEIGHT(g) | TOTALS NUMBER | TOTALS WEIGHT(g) | % OF TOTAL NUMBER | % OF TOTAL WEIGHT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L.macrochirus | 457 | 5340 | 244 | 2266 | 72 | 262 | 749 | 5416 | 1522 | 13284 | 72 | 45 |
| L.cyanellus | 57 | 524 | 40 | 224 | 3 | 114 | 209 | 1015 | 309 | 1877 | 15 | 6 |
| M.salmoides | 20 | 4364 | 51 | 1796 | 5 | 11 | 20 | 2614 | 96 | 8785 | 5 | 30 |
| L.microlophus | 10 | 122 | 16 | 1281 | 3 | 100 | 28 | 518 | 57 | 2021 | 3 | 7 |
| L.gulosus | 1 | 16 | 2 | 16 | 2 | 20 | 14 | 256 | 19 | 308 | 1 | 1 |
| L.auritus | 27 | 425 | 15 | 121 | 50 | 387 | | | 92 | 932 | 4 | 3 |
| I.punctatus | 1 | 27 | 4 | 971 | 3 | 777 | 3 | 23 | 11 | 1799 | 1 | 6 |
| C.analostana | 1 | 2 | | | | | | | 1 | 2 | 0 | 0 |
| A.nebulosus | | | | | | | 3 | 26 | 3 | 26 | 0 | 0 |
| P.nigromaculatus | | | 1 | 391 | | | 1 | 346 | 2 | 737 | 0 | 2 |
| Total No. | 574 | | 373 | | 138 | | 1027 | | 2112 | | 100 | 100 |
| Total Wt.(g) | 10820 | | 7066 | | 1670 | | 10213 | | 29769 | | | |

the WHTF. These results are similar to those of 2006 and 2005 as well as those in the historical records as Centrarchids (sunfishes) continued to dominate the electrofishing catch.

Lake Anna was again among the leaders in the Commonwealth of Virginia for largemouth bass citations with 22 being reported in 2007. A citation for largemouth bass is awarded for fish greater than 55.9 cm in length or 3.6 kg in weight. Lake Anna fisherman also recorded 29 citations for crappie and 5 for walleye.

Overall, the data for gill netting and electrofishing in 2007 reveal no significant changes in the fish assemblage of the lake when compared to data from previous years. Lake Anna continues to support a healthy, well-balanced fisheries community.

## 3.5 Conclusions

- North Anna Power Station operated at an average of 92.8% of capacity in 2007.

- The 2007 water temperature data from the fixed recorders showed that water temperatures in Lake Anna were within the historical ranges.

- Thermal stratification patterns measured in 2007 showed seasonal changes similar to previous years.

- The species composition of the gill net catch in 2007 was consistent with historical data and both CPUE-N and CPUE-W were well above the historical 10 year means.

- Centrarchids (sunfishes) continue to be the numerically dominant fish taxa collected by electrofishing in 2007 with electrofishing CPUE-N and CPUE-N were slightly below the historical 10 year means, yet within the 10 year ranges.

## 4.0 North Anna River

### 4.1 Temperature

#### Methods

Water temperatures (°C) were recorded hourly at Station NAR-1 in the lower North Anna River during 2007 (Figure 4.1-1) using an Onset temperature recorder. This instrument has an accuracy range of ±0.20°C. Station NAR-1 is located approximately 1 km below the Lake Anna dam.

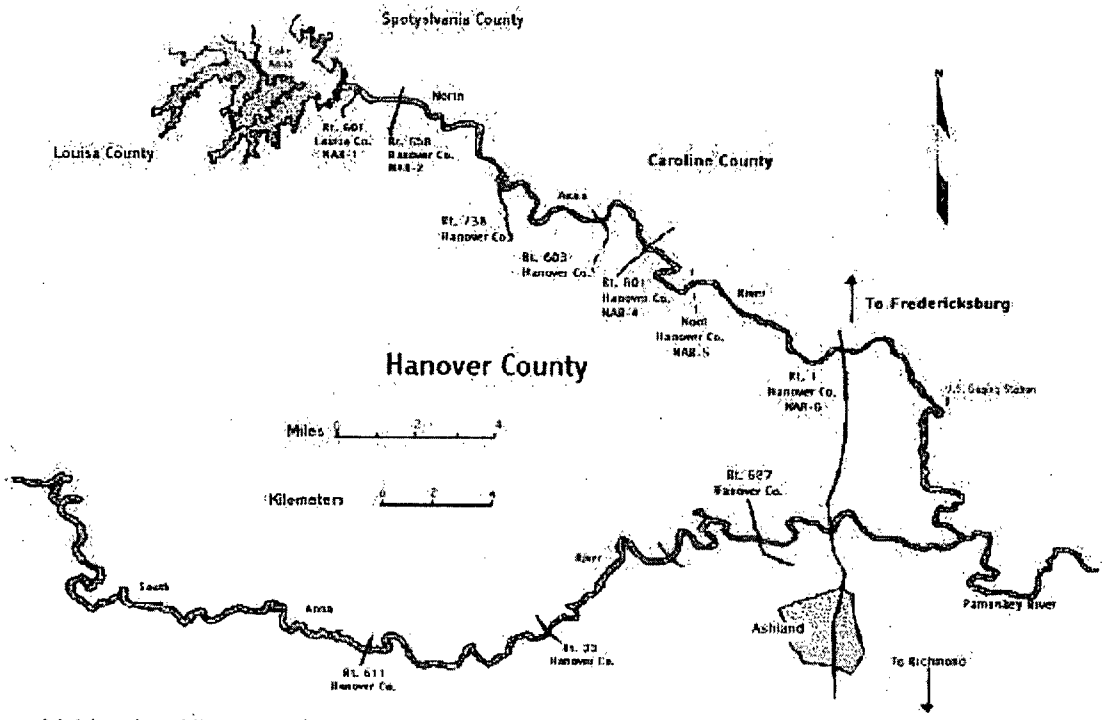



Figure 4.1-1 Location of North Anna River temperature recording, electrofishing, and snorkel survey stations.

## Results and Discussion

Water temperatures in the lower North Anna River for 2007 were highest from June through September with a maximum monthly mean water temperature of 30.2° C in August (Table 4.1-1). The highest hourly water temperature measured in 2007 (32.9°C) also occurred in August. The previous maximum monthly mean was 30.9°C while the previous hourly maximum was 34.0°C.

Winter water temperatures were moderate in 2007 with a minimum monthly mean of 8.4°C recorded in February and a minimum hourly temperature of 6.2°C recorded in February.

Table 4.1-1 Mean, maximum, and minimum hourly water temperatures (C) recorded in the North Anna River, at station NAR-1 by month during 2007. Sample size (n) equals the number of hourly observations recorded each month.

NAR-1

| Month | Mean | Max | Min | n |
|---|---|---|---|---|
| January | 11.9 | 14.1 | 8.2 | 743 |
| February | 8.4 | 9.9 | 6.2 | 672 |
| March | 11.7 | 15.4 | 8.5 | 744 |
| April | 15.0 | 19.6 | 12.5 | 719 |
| May | 21.7 | 27.2 | 17.9 | 744 |
| June | 27.3 | 30.4 | 24.7 | 720 |
| July | 28.7 | 30.9 | 26.8 | 744 |
| August | 30.2 | 32.9 | 28.4 | 744 |
| September | 27.2 | 31.3 | 23.0 | 720 |
| October | 24.0 | 26.8 | 20.6 | 398 |
| November | 14.9 | 20.2 | 10.8 | 720 |
| December | 10.8 | 13.8 | 7.9 | 744 |

## 4.2 Fish Population Studies-Electrofishing

### Methods

Abundance and species composition data for the North Anna River fish assemblage in 2007 were collected during electrofishing surveys. Consistent sampling techniques have been used in all North Anna River electrofishing surveys since 1981.

The locations of the following four (4) electrofishing stations are shown in Figure 4.1-1: NAR-1 (Route 601 Louisa Bridge), NAR-2 (Route 658 Bridge), NAR-4 (Route 601 Hanover Bridge) and NAR-6 (U.S Route 1 Bridge). An approximately 70-m reach of riffle/run type habitat is sampled at each station with an electric seine (Virginia Power 1986). Prior to sampling, each reach is blocked at the downstream end with a 6.5-mm mesh net. Sampling is conducted by working the electric seine from bank to bank in a zigzag pattern from the upstream to the downstream end of the section. Nearby pool type habitats are then sampled for 10 minutes of effort with a backpack electrofisher. Fish sampled by electric seine and backpack electrofisher are collected using 6.5-mm mesh dip nets.

Most fish collected are preserved in 10% formalin and transported to the laboratory for appropriate processing. Some larger fish are weighed and measured in the field and released. In the laboratory, a maximum of 15 individual specimens of each species is weighed to the nearest 0.1 g and measured to the nearest 1 mm total length (TL). If more than 15 specimens of a species are collected, those in excess of 15 are counted and weighed in bulk. Electric seine and backpack electrofisher collections are then pooled by station and survey month for analyses.

Sample frequency for electrofishing is typically once per month each year in May, July and September. Further, the total number of river electrofishing collections for a typical sample year (May, July and September) is 24 (12 electric seine and 12 backpack).

## Results and Discussion

Since 1981, a total of 52 species of fish representing 15 families has been collected by electrofishing in the North Anna River (Table 4.2-1). Species richness is usually highest at Station NAR-6, with forty-five (45) species having been collected at this station. Species richness at the other 3 stations has been generally similar among the 3 stations ranging from 31 to 34 species per station. Twenty-four (24) species have been found at all stations while 16 species have been found at only 1 station.

Table 4.2-1 Fishes collected from the North Anna River during annual electrofishing surveys, 1981-2007.

| Family | Species | NAR-1 | NAR-2 | NAR-4 | NAR-6 |
|---|---|---|---|---|---|
| Petromyzontidae | *Lampetra appendix* | | X | X | X |
| | *Petromyzon marinus* | X | X | X | X |
| Anguillidae | *Anguilla rostrata* | X | X | X | X |
| Clupeidae | *Alose aestivalis* | X | | | |
| | *Dorosoma cepedianum* | X | | | |
| Esocidae | *Esox americanus* | | | | X |
| | *Esox niger* | X | X | X | X |
| Cyprinidae | *Cyprinella analostana* | X | X | X | X |
| | *Hybognathus regius* | | | X | X |
| | *Luxilus cornutus* | | | X | |
| | *Lythrurus ardens* | X | X | X | X |
| | *Nocomis leptocephalus* | X | X | X | X |
| | *Nocomis micropogon* | X | X | X | X |
| | *Notemigonuxc crysoleucas* | X | X | X | X |
| | *Notropis amoenus* | X | X | X | X |
| | *Notropis hudsonius* | | | | X |
| | *Notropis procne* | X | X | X | X |
| | *Notropis rubellus* | X | X | X | X |
| | *Phoxinus oreas* | | | X | |
| | *Rhinichthys atratulus* | | | | X |
| | *Semotilus corporalis* | X | X | X | X |
| Catostomidae | *Catostomus commersoni* | | X | X | X |
| | *Erimyzon oblongus* | X | X | X | |
| | *Hypentelium nigricans* | X | X | X | X |
| | *Moxostoma macrolepidotum* | | X | X | X |
| Ictaluridae | *Ameriurus natalis* | X | X | X | X |
| | *Ameriurus nebulosus* | X | X | | X |
| | *Ictalurus punctatus* | | | | X |
| | *Noturus gyrinus* | | | | X |
| | *Noturus insignis* | X | X | X | X |
| Aphredoderidae | *Aphredoderus sayanus* | | | X | X |
| Percichthyidae | *Morone americana* | X | | | |
| Centrarchidae | *Acantharchur pomotis* | X | | | X |
| | *Centrarchus macropterus* | | | | X |
| | *Enneacanthus gloriosus* | | | | X |
| | *Lepomis auritus* | X | X | X | X |
| | *Lepomis gibbosus* | X | X | X | X |
| | *Lepomis gulosus* | | | | X |
| | *Lepomis macrochirus* | X | X | X | X |
| | *Lepomis microlophus* | X | X | | X |
| | *Micropterus dolomieu* | X | X | X | X |
| | *Micropterus salmoides* | X | X | X | X |
| | *Pomoxis nigromaculatus* | X | X | X | X |
| Percidae | *Etheostoma olmstedi* | X | X | X | X |
| | *Etheostoma vitreum* | X | X | X | X |
| | *Perca flavescens* | X | | | X |
| | *Percina notograma* | | X | X | X |
| | *Percina peltata* | X | X | X | X |
| Achiridae | *Trinectes maculatus* | | | | X |
| Poecillidae | *Gambusia holbrooki* | | | X | X |
| Amiidae | *Amia calva* | | | | X |
| Cyprinodontidae | *Fundulus diaphanus* | X | | | |

In 2007, a total of 898 fish representing 23 species and 8 families was collected by electrofishing in the North Anna River (Table 4.2-2). Species richness was again highest at Station NAR-6 with 17 species collected. The fewest number of species were collected at NAR-1 and NAR-2 with 14 species, while 16 species were collected at NAR-4. The total number of fish collected and total biomass was highest at Station NAR-1 where a relatively high number of

American eels Anguilla rostrata, redbreast sunfish, largemouth bass were collected. Fish numbers and biomass were lowest at Station NAR-2.

Most of the species collected in 2007 (Table 4.2-2) are relatively common in the North

Table 4.2-2 Number and biomass (g) of fishes collected during May, July and September, 2007 electrofishing surveys of the North Anna River.

| | | NAR-1 | | NAR-2 | | NAR-4 | | NAR-6 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Family* | *Species* | Number | Total Weight | Number | Total Weight | Number | Total Weight | Number | Total Weight | Number | Total Weight |
| Petromyzontidae | *Petromyzon marinus* | | | 1 | 5.3 | | | 3 | 10.6 | 4 | 15.9 |
| Anguillidae | *Anguilla rostrata* | 166 | 2037.2 | 19 | 313.0 | 39 | 493.6 | 15 | 158.1 | 239 | 3001.9 |
| Cyprinidae | *Cyprinella analostana* | 1 | 1.6 | 15 | 78.7 | 25 | 77.8 | 18 | 46.0 | 59 | 204.1 |
| | *Lythrurus ardens* | 6 | 17.1 | 9 | 16.1 | 41 | 87.8 | 29 | 45.5 | 85 | 166.5 |
| | *Nocomis micropogon* | | | | | 15 | 296.9 | | | 15 | 296.9 |
| | *Notropis amoenus* | 1 | 2.8 | 14 | 36.6 | 3 | 2.2 | 2 | 7.6 | 20 | 49.2 |
| | *Notropis procne* | | | | | 14 | 10.0 | 3 | 4.0 | 17 | 14.0 |
| | *Notropis rubellus* | 2 | 3.2 | | | 2 | 1.2 | | | 4 | 4.4 |
| | *Semotilus corporalis* | 2 | 122.0 | | | 48 | 110.1 | 2 | 99.0 | 52 | 331.1 |
| Catostomidae | *Catostomus commersoni* | | | | | 2 | 14.0 | | | 2 | 14.0 |
| | *Hypentelium nigricans* | 5 | 589.0 | 1 | 1.5 | 5 | 357.5 | 2 | 11.8 | 13 | 959.8 |
| Ictaluridae | | | | | | | | | | | |
| | *Ameiurus natalis* | 1 | 10.6 | | | | | 1 | 193.0 | 2 | 203.6 |
| | *Noturus insignis* | 25 | 118.9 | 1 | 2.1 | 28 | 116.6 | 14 | 51.6 | 68 | 289.2 |
| Centrarchidae | | | | | | | | | | | |
| | *Lepomis auritus* | 85 | 1411.1 | 27 | 278.4 | 49 | 670.2 | 34 | 448.1 | 195 | 2807.8 |
| | *Lepomis gulosus* | | | | | | | 1 | 80.0 | 1 | 80.0 |
| | *Lepomis macrochirus* | 16 | 106.8 | 3 | 7.0 | | | 2 | 84.5 | 21 | 198.3 |
| | *Micropterus dolomieu* | | | 1 | 4.1 | 3 | 21.3 | | | 4 | 25.4 |
| | *Micropterus salmoides* | 13 | 214.4 | 4 | 312.8 | | | | | 17 | 527.2 |
| Percidae | | | | | | | | | | | |
| | *Etheostoma olmstedi* | 6 | 14.0 | 6 | 5.8 | 15 | 16.2 | 9 | 9.7 | 36 | 45.7 |
| | *Etheostoma vitreum* | | | | | | | 13 | 12.5 | 13 | 12.5 |
| | *Percina notogramma* | | | 1 | 2.5 | 4 | 7.8 | | | 5 | 10.3 |
| | *Percina peltata* | 9 | 35.0 | 2 | 2.3 | 13 | 34.8 | 1 | 3.3 | 25 | 75.4 |
| Esocidae | *Esox niger* | | | | | | | 1 | 13.0 | 1 | 13.0 |
| Total | | 338 | 4683.7 | 104 | 1066.2 | 306 | 2318.0 | 150 | 1278.3 | 898 | 9346.2 |
| Number of Species | | 14 | | 14 | | 16 | | 17 | | 23 | |

Anna River electrofishing catch and reflect the historical numerical dominants (Table 4.2-3). It is not uncommon for stream fish assemblages to be numerically dominated by relatively few species (Mathews, 1982) and, for the most part, the numerically dominant species found in the North Anna River have been consistent over time (Table 4.2-3). These have included American eel, margined madtom Noturus insignis, redbreast sunfish, shield darter Percina peltata, and several minnow species (satinfin shiner Cyprinella analostana, rosefin shiner Lythrurus ardens, and swallowtail shiner Notropis procne).

Table 4.2-3. Ranked abundance of species comprising greater than 80 percent of the pooled annual North Anna River electrofishing catch from all stations, 1981-2007. A species rank of 1 indicates it was the most abundant fish collected.

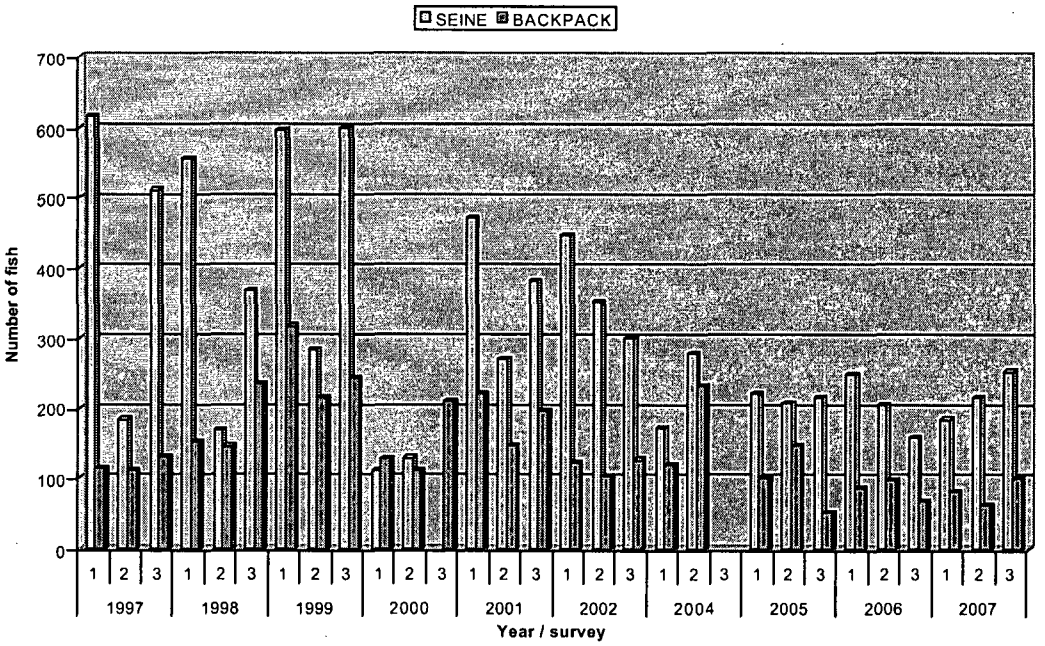
| Species | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Notropis procne* | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 2 | 3 | 1 | 2 | 7 | 3 | 2 | 2 | 4 | -- | 7 | 6 | -- | 4 | -- | -- | -- |
| *Cyprinella analostana* | 1 | 2 | 2 | 3 | 2 | 2 | 5 | 2 | 3 | 2 | 1 | 1 | 3 | 6 | 6 | 1 | 1 | 4 | 2 | -- | 4 | 4 | -- | 1 | 4 | 5 | 5 |
| *Lepomis auritus* | 3 | 3 | 3 | 2 | 3 | 4 | 2 | 3 | 2 | 1 | 4 | 2 | 2 | 1 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | -- | 3 | 2 | 2 | 2 |
| *Notropis rubellus* | -- | 5 | 8 | 8 | 10 | 3 | 3 | 4 | 4 | 3 | 3 | 5 | 4 | 3 | 5 | -- | 8 | 6 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| *Noturus insignis* | 8 | -- | -- | -- | 6 | 5 | 4 | 6 | 7 | 6 | 5 | 6 | 5 | 4 | 3 | -- | 4 | 7 | 6 | 4 | 5 | 5 | -- | 5 | 5 | 4 | 4 |
| *Percina peltata* | -- | -- | 7 | 4 | 5 | 6 | -- | 5 | -- | 5 | 6 | -- | 8 | 5 | 8 | 6 | 10 | -- | -- | 6 | -- | -- | -- | 6 | 6 | -- | -- |
| *Anguilla rostrata* | 4 | 4 | 4 | 6 | 9 | -- | 6 | -- | 6 | 7 | -- | 7 | 6 | 7 | 4 | 4 | 6 | 5 | 7 | 3 | 3 | 3 | -- | 2 | 1 | 1 | 1 |
| *Lythrurus ardens* | -- | -- | -- | -- | 7 | 7 | 7 | -- | -- | -- | 7 | 4 | 7 | -- | 2 | -- | 5 | 3 | 3 | 2 | 2 | 2 | -- | -- | 3 | 3 | 3 |
| *Nocomis micropogon* | 6 | -- | 5 | -- | -- | 8 | -- | -- | -- | -- | 8 | 8 | -- | -- | 9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| *Nocomis leptocephalus* | 5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| *Semotilus corporalis* | -- | -- | 9 | -- | 4 | 9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 9 | -- | 5 | 5 | 6 | -- | -- | -- | -- | -- | 6 |
| *Notropis amoenus* | 7 | 6 | -- | 7 | -- | -- | -- | -- | 5 | -- | -- | -- | -- | -- | -- | 5 | 7 | 8 | -- | -- | -- | -- | -- | -- | 7 | -- | -- |
| *Hypentelium nigricans* | -- | -- | -- | -- | 8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 8 | -- | -- |
| *Notemigonus crysoleucas* | -- | -- | -- | 5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| *Pomoxis nigromaculatus* | -- | -- | 6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| *Lepomis macrochirus* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| *Etheostoma olmstedi* | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7 |
| Total number of species collected | 26 | 27 | 29 | 31 | 31 | 29 | 32 | 30 | 18 | 25 | 25 | 29 | 25 | 25 | 22 | 20 | 24 | 28 | 28 | 23 | 27 | 28 | -- | 28 | 29 | 26 | 23 |
| Number of species accounting for >80% | 8 | 6 | 9 | 7 | 10 | 9 | 7 | 6 | 7 | 7 | 8 | 8 | 8 | 7 | 9 | 7 | 10 | 8 | 7 | 6 | 7 | 6 | -- | 6 | 8 | 5 | 7 |
| Percent of electrofishing catch | 83 | 82 | 81 | 83 | 83 | 83 | 80 | 82 | 80 | 80 | 84 | 83 | 83 | 85 | 82 | 82 | 84 | 80 | 82 | 83 | 84 | 86 | -- | 83 | 82 | 82 | 82 |

*-- indicates species was not among those comprising greater than 80% of the electrofishing catch

The numerically dominant species collected in 2007 were, in descending order, American eel, redbreast sunfish, rosefin shiner, margined madtom and satinfin shiner, fallfish Semotilus corporalis, and tessellated darter Etheostoma olmstedi (Table 4.2-3). These 7 species represented 81.7% of the electrofishing catch in 2007. Most of the other species collected in 2007 (Table 4.2-2) have sometimes ranked as numerical dominants previously (i.e. shield darter, swallowtail shiner, rosyface shiner Notropis rubellus, comely shiner Notropis amoenus in Table 4.2-3). Other species that are common in the electrofishing catch, as evidenced by their distribution among stations in the 2007 collections, include bluegill sunfish, largemouth bass and Northern hogsucker Hypentelium nigricans (Table 4.2-2).

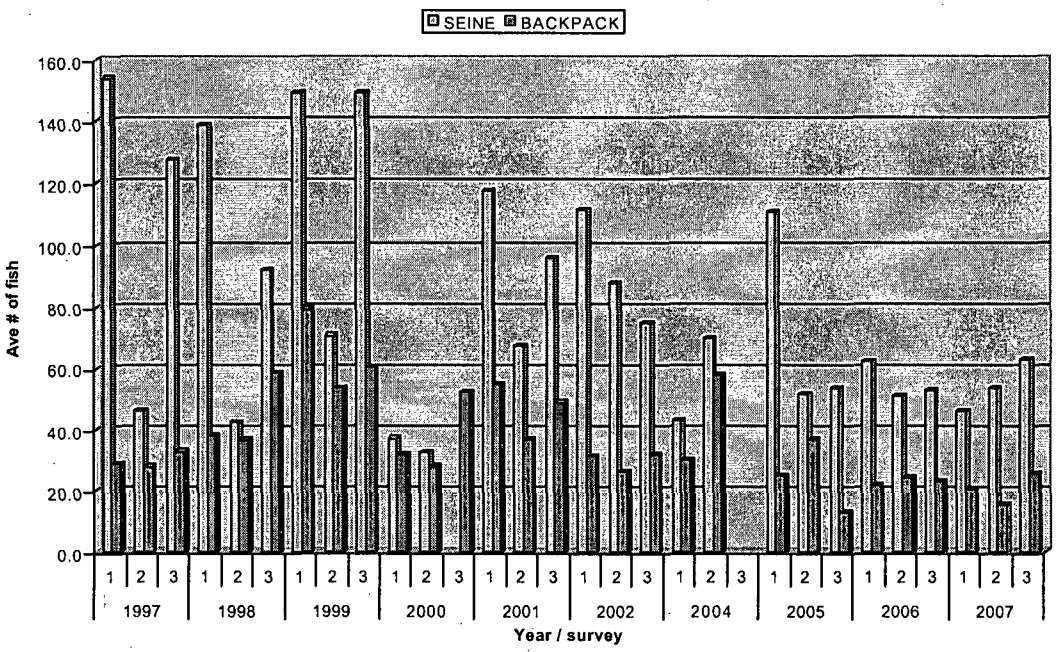
The numbers of fish caught electrofishing in the last 11 years are compared by survey, gear type and year in Figure 4.2-1. Figure 4.2-1 shows the high variability in catch among surveys, but does not compensate for missed samples. In 2007, 267 fish (184 seine, 83 backpack) were caught during the May survey (survey 1), 277 fish (215 seine, 62 backpack) were caught during the July survey (survey 2) and 354 fish (252 seine, 102 backpack) were caught during the September survey (survey 3). A full complement of samples was collected in 2007; however, some samples have been

**Figure 4.2-1. Total numbers of fish caught electrofishing by survey, gear type and year 1997-2007**




missed in previous years due to high river flows. This complicates comparison of total fish numbers among surveys and years; therefore, the average number of fish caught per sampling station was calculated by gear type, survey and year to represent a catch per unit effort (CPUE) to better compare fish numbers over time (Figure 4.2-2).

**Figure 4.2-2. Average numbers of fish caught per station by survey, gear type and year 1997-2007**




The minimum CPUE, maximum CPUE and mean CPUE per station for the electric seine for years 1997-2006 were 32.5, 154.25 and 83.7 respectively (Table 4.2-4). The CPUE's per station for the electric seine on surveys 1, 2, and 3 in 2007 were 46.0, 53.8 and 63.0 respectively. The minimum CPUE, maximum CPUE and mean CPUE per station for the backpack for years 1997-2006 were 13.25, 79.58 and 38.1 respectively. The CPUE's per station for the backpack on surveys 1, 2, and 3 in 2007 were 20.75, 15.5, and 25.5 respectively. CPUE for both backpack and seine in 2007 were below the previous 10 year means, but within the range of CPUE's calculated for previous surveys.

Table 4.2-4 Fish CPUE Summary on the North Anna River 1997-2007

Electric Seine

| Mean CPUE 1997-2006 | Min 1997-2006 | Max 1997-2006 | Survey | CPUE 2007 |
|---|---|---|---|---|
| 83.7 | 32.5 | 154.25 | 1 | 46.00 |
| | | | 2 | 53.80 |
| | | | 3 | 63.00 |

Backpack

| Mean CPUE 1997-2006 | Min 1997-2006 | Max 1997-2006 | Survey | CPUE 2007 |
|---|---|---|---|---|
| 38.1 | 13.25 | 79.5 | 1 | 20.75 |
| | | | 2 | 15.50 |
| | | | 3 | 25.50 |

## 4.3 Fish Population Studies- Direct Observation

### Methods

To further understand fish population studies in the North Anna River, abundance and distribution data for smallmouth bass and largemouth bass are gathered via direct observation using snorkel surveys. Consistent observation techniques have been used in snorkel surveys since 1987 with some variation in sampling frequency at some stations among years due to instances of high river flow conditions, electrical storms, etc.

Snorkel surveys are conducted during July, August, and September. Four (4) stations (NAR-1, NAR-2, NAR-4 and NAR-5) are monitored twice per month in July, August and September. Abundance estimation procedures are identical to those employed since 1987 (Virginia Power 1988). Counts of smallmouth bass (SMB) and largemouth bass (LMB) are made while swimming 100 m transects along the north and south banks of each station. Transects follow an approximately one-meter depth contour.

All bass sighted are categorized by species as to young-of-year (YOY) ($\leq$120 mm), stock-size (120<SMB<280 mm or 120<LMB<305 mm), or quality-size (SMB$\geq$280 mm or LMB$\geq$305 mm). In addition to size group, all bass sighted are categorized as to type of cover being used; bedrock ledge (Ledge), boulders (Boulder), instream woody debris (Wood), aquatic vegetation (Vegetation), or no apparent cover use (Open). Fish have to be within 0.5m of a cover object at the moment of sighting to be included in a cover use category other than the Open category. Aquatic vegetation was included as a cover type beginning in 1993 due to annual increases in the amount of vegetation observed from 1990 through 1992, and its associated increased use by fish.

During each survey, three successive counts at each station are made at each bankside

transect. Each observer makes an independent estimate of the distance that YOY smallmouth bass (TL≤120 mm) could be distinguished from YOY largemouth bass (TL≤120 mm) at each station. Lateral visibility at each station is estimated by averaging the independent estimates of both observers. Counts of smallmouth bass and largemouth bass are converted to density estimates (number/hectare of bankside channel) to account for differences in average visibility among survey days and sampling stations. Density estimates for all smallmouth bass and largemouth bass larger than YOY size are then pooled by species, station, and sample year to facilitate identification of species-specific and station-specific changes over time. Calculations of median density estimates by sample year and associated 95% confidence intervals are based on Walsh averages (Hollander and Wolfe 1973). YOY densities are not calculated as it was doubtful that YOY are as susceptible to the observation technique as are larger fish, due primarily to their small size and cryptic nature.

Cover utilization data from the first of three sets of observations obtained during each snorkel survey are used to examine differences in cover use by smallmouth bass and largemouth bass. Data from only the first count are used because it is assumed fish observed during the first count would be relatively undisturbed by divers, whereas fish observed on the second and third counts may change their positions in response to divers passing by during the first count.

## Results and Discussion

Snorkel surveys for 2007 were conducted in July, August and September with two surveys being completed each month. The 2007 surveys were conducted between 0834 and 1420 hours. River temperatures at time of surveys ranged from 21.7°C at NAR-4 on 9/24/07 to 31.2°C at NAR-1 on 8/9/07. The average visibility for all four stations in 2007 was 1.93 meters. Comparatively, average visibility was highest at NAR-5 (2.33 meters), followed in decreasing

order by NAR-4 (2.04 meters), NAR-2 (1.83 meters) and NAR-1 (1.50 meters).

Observations in 2007 indicated that largemouth bass were numerically dominant (562 vs. 100) at the upper stations (NAR-1 and NAR-2) while smallmouth bass were numerically dominant (317 vs. 142) at the lower stations (NAR-4 and NAR-5) (Table 4.3-1). More

Table 4.3-1. Number of smallmouth bass and largemouth bass observed during North Anna River snorkel surveys conducted in 2007. Sample size (n) equals the number of times each count was performed in 2007.

| | | | | Smallmouth bass [1] | | | Largemouth bass [2] | | |
|---|---|---|---|---|---|---|---|---|---|
| Station | Bank | Count | n | SMBYOY | SMB<11 | SMB>11 | LMBYOY | LMB<12 | LMB>12 |
| NAR-1 | North | 1 | 6 | 3 | 1 | 1 | 85 | 8 | 5 |
| | | 2 | 6 | 2 | 2 | 0 | 109 | 5 | 1 |
| | | 3 | 6 | 1 | 1 | 0 | 75 | 2 | 0 |
| | South | 1 | 6 | 6 | 1 | 1 | 15 | 4 | 8 |
| | | 2 | 6 | 8 | 0 | 0 | 25 | 6 | 5 |
| | | 3 | 6 | 7 | 0 | 2 | 27 | 4 | 6 |
| NAR-2 | North | 1 | 6 | 6 | 2 | 0 | 27 | 11 | 2 |
| | | 2 | 6 | 9 | 0 | 0 | 22 | 8 | 3 |
| | | 3 | 6 | 9 | 3 | 0 | 28 | 6 | 2 |
| | South | 1 | 6 | 10 | 3 | 0 | 13 | 8 | 3 |
| | | 2 | 6 | 5 | 5 | 0 | 9 | 2 | 5 |
| | | 3 | 6 | 7 | 3 | 2 | 7 | 11 | 5 |
| **Total NAR-1 and NAR-2** | | | | | **100** | | | **562** | |
| NAR-4 | North | 1 | 6 | 11 | 5 | 2 | 5 | 6 | 8 |
| | | 2 | 6 | 14 | 3 | 2 | 5 | 5 | 5 |
| | | 3 | 6 | 12 | 3 | 2 | 12 | 4 | 4 |
| | South | 1 | 6 | 11 | 5 | 8 | 0 | 5 | 2 |
| | | 2 | 6 | 9 | 8 | 2 | 2 | 4 | 4 |
| | | 3 | 6 | 12 | 5 | 6 | 1 | 1 | 2 |
| NAR-5 | North | 1 | 6 | 10 | 31 | 4 | 0 | 10 | 4 |
| | | 2 | 6 | 6 | 17 | 10 | 1 | 4 | 4 |
| | | 3 | 6 | 10 | 21 | 7 | 2 | 8 | 4 |
| | South | 1 | 6 | 17 | 8 | 7 | 1 | 6 | 4 |
| | | 2 | 6 | 13 | 7 | 3 | 3 | 8 | 0 |
| | | 3 | 6 | 19 | 6 | 1 | 2 | 5 | 1 |
| **Total NAR-4 and NAR-5** | | | | | **317** | | | **142** | |
| **Grand Total** | | | | | **417** | | | **704** | |

[1] SMYOY were less than or equal to 120 mm, SMB<11 were 121-279 mm, SMB>11 were larger than or equal to 280 mm TL.

[2] LMBYOY were less than or equal to 120 mm, LMB<11 were 121-304 mm, LMB>11 were larger than or equal to 305 mm TL.

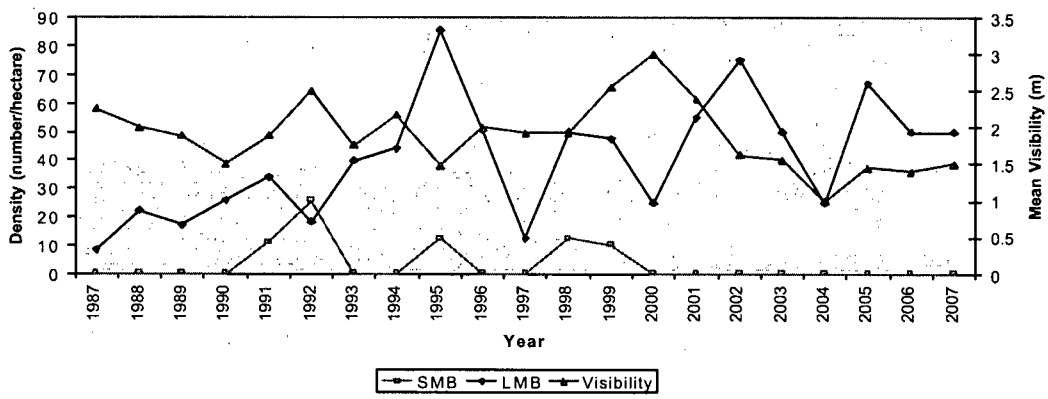
largemouth bass were seen than smallmouth bass in 2007 (704 vs. 417) (Table 4.3-1). Fish sightings were higher for largemouth bass (704 vs. 551) and smallmouth bass (417 vs. 203 in 2007 as compared to 2006. Particularly notable in 2007 was the large number of YOY largemouth bass observed along the north shore of NAR-1. This was also observed in 2005 and 2006 along the same shore (Dominion 2006 and 2007). Relatively high numbers of smallmouth bass were observed in each of the three size classes in 2007 at NAR-4 and 5, but notable were the YOY that were observed at both locations.

Median density estimates for largemouth bass and smallmouth bass observed in 2007 for stations NAR-1, NAR-2, NAR-4 and NAR-5 are compared to historical density estimates in Figures 4.3-1 through 4.3-4. These estimates do not include young-of-year (YOY) size fish as it is doubtful that the smaller individuals are as susceptible to the observation techniques as are larger fish. Instances with median densities of zero do not necessarily indicate that no fish of a given species and size category were observed. A median density of zero simply indicates that fewer than 50% of the ranked (ordered lowest to highest) density estimates were greater than zero. Assuming all scheduled snorkel surveys are conducted each year, there are 36 density estimates developed for each species and size category of fish for each sampling station (6 surveys per year x 2 banks per station x 3 counts per bank). If species and size category of fish are observed in fewer than 18 of those 36 counts that the density estimates are based on, the median will be zero, despite the presence of the fish. Although the use of medians versus averages tends to make it more difficult to report relatively uncommon fishes, it has the advantage of being more representative of non-normally distributed data like that generally obtained by the snorkel surveys.

During most years, the median density estimates show largemouth bass to be more abundant at the two uppermost stations (NAR-1 and NAR-2) which are nearer the Lake Anna dam, while smallmouth bass are more abundant at the downstream sites, especially NAR-5.

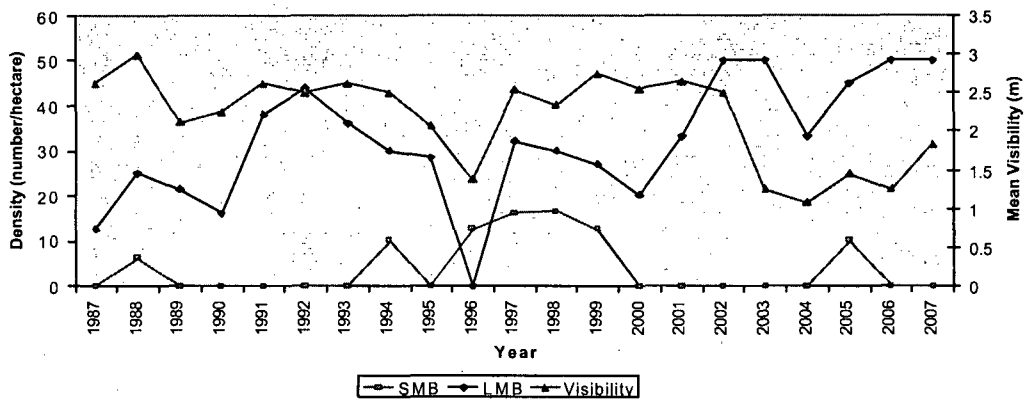
Largemouth bass annual median densities have generally ranged from 20-80 fish/hectare at NAR-1 (Figure 4.3-1) while smallmouth bass annual median densities there rarely exceed 10 fish/hectare. In 2007, median densities for largemouth and smallmouth bass at NAR-1 were 50 fish/hectare and 0 fish/hectare, respectively. These values were identical to 2006 NAR-1 density estimates for largemouth and smallmouth bass.

**Figure 4.3-1. NAR-1 smallmouth and largemouth bass median densities, and mean visibility, 1987-2007.**



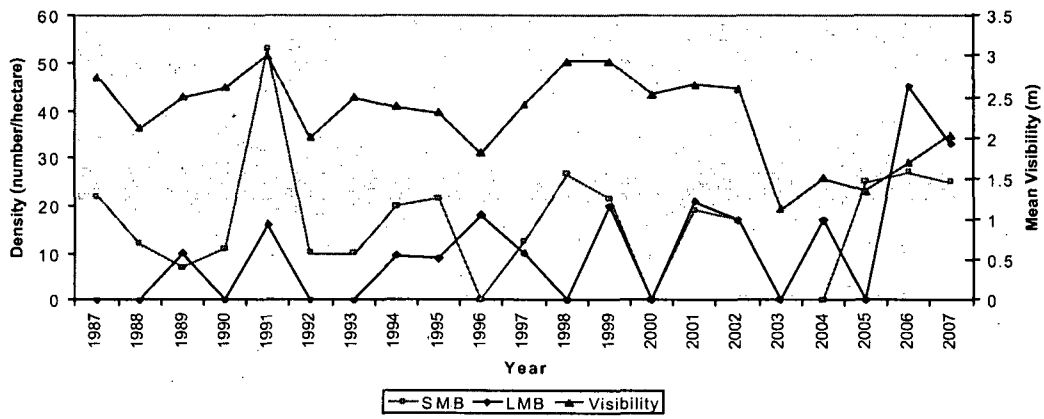

At Station NAR-2, annual median densities of largemouth bass have generally ranged from 20-50 fish/hectare while, similar to NAR-1, smallmouth bass median densities have rarely exceeded 10 fish/hectare. The median density for 2007 at NAR-2 for largemouth bass was 50 fish/hectare and the median density for smallmouth bass was 0 fish/hectare. These densities were also identical to 2006 densities for largemouth and smallmouth bass (Figure 4.3-2).

Figure 4.3-2. NAR-2 smallmouth and largemouth bass median densities, and mean visibilities, 1987-2007.



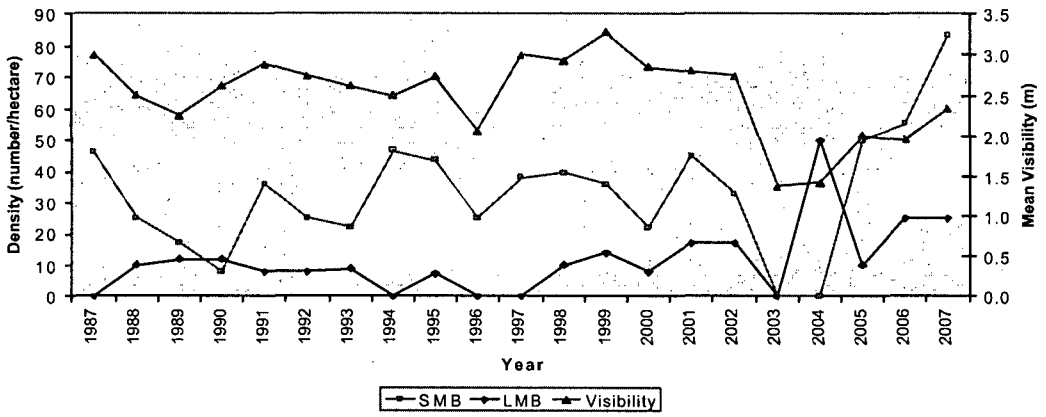

Annual median density estimates at NAR-4 for 2007 show largemouth bass to be more abundant at this site than smallmouth bass. Generally smallmouth bass are slightly more abundant with annual median densities ranging from 10-30 fish/hectare (Figure 4.3-3), largemouth bass annual median densities range from approximately 0-25 fish/hectare. The median density of smallmouth bass at NAR-4 in 2007 was 25 fish/hectare while the median density for largemouth bass was 33 fish/hectare.

Figure 4.3-3. NAR-4 smallmouth and largemouth bass median densities, and mean visibilities, 1987-2007.




Annual median densities for smallmouth bass have usually ranged from about 20-50 fish/ hectare at NAR-5 since 1987; however in 2007 the median smallmouth bass density was 83 fish/ hectare at NAR-5 (Figure 4.3-4). This median density was the highest annual smallmouth bass

Figure 4.3-4 . NAR-5 smallmouth and largemouth bass median densities, and mean visibilities, 1987-2007.




median density since surveys began in 1987. It also represents the second highest median density of all four stations (both species of bass). Largemouth bass annual median densities at this station have rarely exceeded 20 fish/hectare, however a median density of 25 largemouth bass/hectare was recorded in both 2006 and 2007.

Observations of cover use by smallmouth bass and largemouth bass are difficult to interpret without accounting for the availability of various cover types. Regardless of the variability in types of cover among stations, largemouth bass tended to be more associated with vegetation at all sites in 2007 (Table 4.3-2).

Table 4.3-2. Cover use by smallmouth bass and largemouth bass in the North Anna River observed during the first of three counts made during snorkel surveys conducted in 2007.

| | Cover Type | | | | |
|---|---|---|---|---|---|
| NAR-1 | Ledge | Boulder | Wood | Vegetation | Open* |
| SMBYOY** | 0 | 0 | 0 | 6 | 3 |
| SMB<11 | 0 | 0 | 0 | 2 | 0 |
| SMB>11 | 0 | 1 | 0 | 1 | 0 |
| LMBYOY | 0 | 0 | 1 | 97 | 0 |
| LMB<12 | 0 | 0 | 2 | 10 | 1 |
| LMB>12 | 0 | 0 | 3 | 8 | 0 |
| NAR-2 | Ledge | Boulder | Wood | Vegetation | Open |
| SMBYOY | 0 | 2 | 4 | 7 | 3 |
| SMB<11 | 0 | 0 | 0 | 2 | 3 |
| SMB>11 | 0 | 0 | 0 | 0 | 0 |
| LMBYOY | 0 | 0 | 2 | 33 | 1 |
| LMB<12 | 0 | 0 | 2 | 13 | 2 |
| LMB>12 | 0 | 0 | 1 | 3 | 1 |

| | Cover Type | | | | |
|---|---|---|---|---|---|
| NAR-4 | Ledge | Boulder | Wood | Vegetation | Open |
| SMBYOY | 0 | 7 | 1 | 8 | 6 |
| SMB<11 | 0 | 6 | 1 | 1 | 2 |
| SMB>11 | 0 | 7 | 2 | 0 | 1 |
| LMBYOY | 0 | 1 | 0 | 4 | 2 |
| LMB<12 | 0 | 1 | 1 | 4 | 2 |
| LMB>12 | 0 | 0 | 6 | 2 | 0 |
| NAR-5 | Ledge | Boulder | Wood | Vegetation | Open |
| SMBYOY | 0 | 1 | 1 | 2 | 6 |
| SMB<11 | 5 | 7 | 2 | 4 | 13 |
| SMB>11 | 0 | 3 | 1 | 0 | 0 |
| LMBYOY | 0 | 0 | 0 | 0 | 0 |
| LMB<12 | 0 | 2 | 2 | 2 | 3 |
| LMB>12 | 0 | 2 | 2 | 0 | 0 |

*Fish observed in open water that were farther than 0.5 m from any cover type.
**See Table 4.3-1 for size category definitions.

When cover use data are pooled for all stations in 2007 (Table 4.3-3) smallmouth bass were usually observed in open water or associated with boulder or vegetation cover when it was available. Largemouth bass were observed most frequently near vegetation followed by wood.

Table 4.3-3. Cover use by smallmouth bass and largemouth bass in the North Anna River observed during the first of three counts made during snorkel surveys conducted in 2007. Data for observations at all stations are pooled.

| All Stations | Cover Type | | | | |
|---|---|---|---|---|---|
| | Ledge | Boulder | Wood | Vegetation | Open |
| SMBYOY | 0 | 10 | 6 | 23 | 18 |
| SMB<11 | 5 | 13 | 3 | 9 | 18 |
| SMB>11 | 0 | 11 | 3 | 1 | 1 |
| LMBYOY | 0 | 1 | 3 | 134 | 3 |
| LMB<12 | 0 | 3 | 7 | 29 | 8 |
| LMB>12 | 0 | 2 | 12 | 13 | 1 |

## 4.4 Conclusions

- Water temperatures in the North Anna River in 2007 were highest from June through September with a maximum monthly mean water temperature of 30.2°C in August.

- In 2007, 898 fish were collected from the North Anna River electrofishing surveys representing 23 species and 8 families. The species richness and fish assemblage found in 2007 were consistent with previous collections. The numbers of fish collected per station in 2007 were somewhat below the previous 10-year average but well within the range of previous surveys.

- Historically, 6 to 10 fish species have accounted for 80 percent of the North Anna River electrofishing catch which is not uncommon in stream systems. In 2007, 7 species comprised 81.7% of the total catch: American eel, redbreast sunfish, rosefin shiner, margined madtom, satinfin shiner, fallfish and tessellated darter.

- Underwater observations of smallmouth bass and largemouth bass made in 2007 were typical of earlier surveys. Historically, the median density estimates show largemouth bass to be more abundant at the two uppermost stations (NAR-1 and NAR-2) which are nearer the Lake Anna dam, while smallmouth bass are more abundant at the downstream sites, especially NAR-5. However, both species do occupy the entire study area. Especially notable in 2007 were large numbers of YOY largemouth bass observed at NAR-1.

- Observation of cover use in 2007 indicated smallmouth bass were usually observed in open water or associated with boulder or vegetation cover when it was available. Largemouth bass were observed most frequently near vegetation followed by wood.

## 5.0 Literature Cited

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