STATEWIDE FRESHWATER FISHERIES RESEARCH

STUDY COMPLETION REPORT

F63

January 1, 2007 – December 31, 2007

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Study Title: STATEWIDE FRESHWATER FISHERIES RESEARCH

Job Title: Initial assessment of water quality and productivity of select public fishing lakes

Period Covered January 1, 2007 – December 31, 2007

Summary

Temperature, conductivity, secchi disk transparency, and chlorophyll were measured in 13 public fishing lakes during 2007. There were substantial differences among the lakes and, within a particular lake, small to large variability in productivity during the growing season. This initial effort identified general trends in and the condition of 13 public fishing lakes and offers recommendations for future efforts that could benefit the long-term management of these facilities.

Introduction

South Carolina's public fishing lakes, i.e. State Lakes, provide fishing opportunities throughout the state. The quality of the fishing in these lakes is partly dependent on the quality and the fertility of the water. To better understand these factors, a water quality survey was performed in 2007. The goal of this survey was to increase understanding of water quality and fertility of these lakes.

Methods

When they were working in the area, State Lake's personnel measured temperature at one meter, secchi disk visibility, and conductivity at a mid-lake station. Temperature and conductivity were measured with a YSI Model 30 meter. During these visits, water samples were collected in amber bottles for subsequent laboratory measurement of chlorophyll a, an index of the primary productivity of a lake. On a sampling day, three water samples were collected from each lake. They were collected from the upstream, middle, and downstream end of the lake to account for spatial variability. Water samples were placed in a cooler with ice and were delivered either that day or the next to the DNR water quality lab in West Columbia. State Lake personnel also noted the days upon which the lake's were fertilized.

Water samples were agitated and a 100 mL aliquot was measured by graduated cylinder and filtered on a vacuum filter apparatus using a 47 mm glass fiber filter with a pore size of 0.7 µm. The filter was removed, folded, placed into aluminum foil, and placed into a laboratory freezer maintained at -80 C. Filters were removed from the freezer and extracted with 90:10 (acetone: deionized water) using a powered tissue grinder. The extract was centrifuged and analyzed using fluorescence detection on a Turner TD-700 Fluorometer. Chlorophyll results were calculated using an external standard curve, measured at the same time as the samples, with five standards ranging from 11.4 to 157 µg/L chlorophyll. If dilutions were needed, the dilution was made so that fluorescence was within the range of the standard curve. The fluorometer was checked prior and immediately after each run to verify consistency and accuracy using a red standard.

Results

Thirteen lakes were sampled three to five times each during the summer months (Table 1). Water temperature varied seasonally, ranging from 20 to 31.6°C (Figure 1).

Average conductivity ranged from 70 to 100 µS in 9 of the 13 lakes. Lakes Paul Wallace (58 µS) and Ashwood (61 µS) had relatively low conductivity while Star Fort (116 µS) and Lancaster (112 µS) had relatively high conductivities.

Average secchi disk transparency varied from 15 to 49 inches and exhibited greater variability at certain sites (Table 2). Star Fort, Lancaster, Edgar Brown, and Wallace had average transparencies below 20”, which is indicative of a reasonable plankton bloom. Transparency was relatively high and exhibited relatively high variation at Edwin Johnson, Oliphant, John D. Long, and Jonesville, perhaps indicative of lakes possessing short-term plankton blooms due to fertilization efforts.

Table 1. South Carolina public fishing lakes sampled in 2007.

Lake	Dates sampled	County	Acres
Ashwood	Aug 6, 29, Sep 27	Lee	75
Edgar Brown	Jun 6, Aug 9, Sep 6, 27	Barnwell	100
Cherokee	Jul 12, Aug 6, Sep 10, 26	Cherokee	50
Dargans Pond	Aug 6, 29, Sep 27	Darlington	50
Edwin Johnson	Jun 5, Jul 9, Aug 6, Sep 10, 26	Spartanburg	40
Jonesville	Jun 5, Jul 9, Aug 6, Sep 10, 26	Union	35
Lancaster	Jun 14, 21, Aug 8, Sep 5, 26	Lancaster	62
John D. Long	May 9, Jul 12, Aug 6, Sep 10, 26	Union	80
Mountain Lake 1	May 9, Jul 12, Aug 2, Sep 10, 26	Chester	42
Oliphant	May 9, Aug 2, Sep 10, 26	Chester	40
Star Fort	Jun 6, Aug 9, Sep 13, 28	Greenwood	27
Sunrise	Jun 14, Aug 2, Sep 5, 26	Lancaster	25
Paul Wallace	Aug 6, 29, Sep 27	Marlboro	280

Figure 1. Daylight water temperature at one meter at 13 public fishing lakes in 2007.

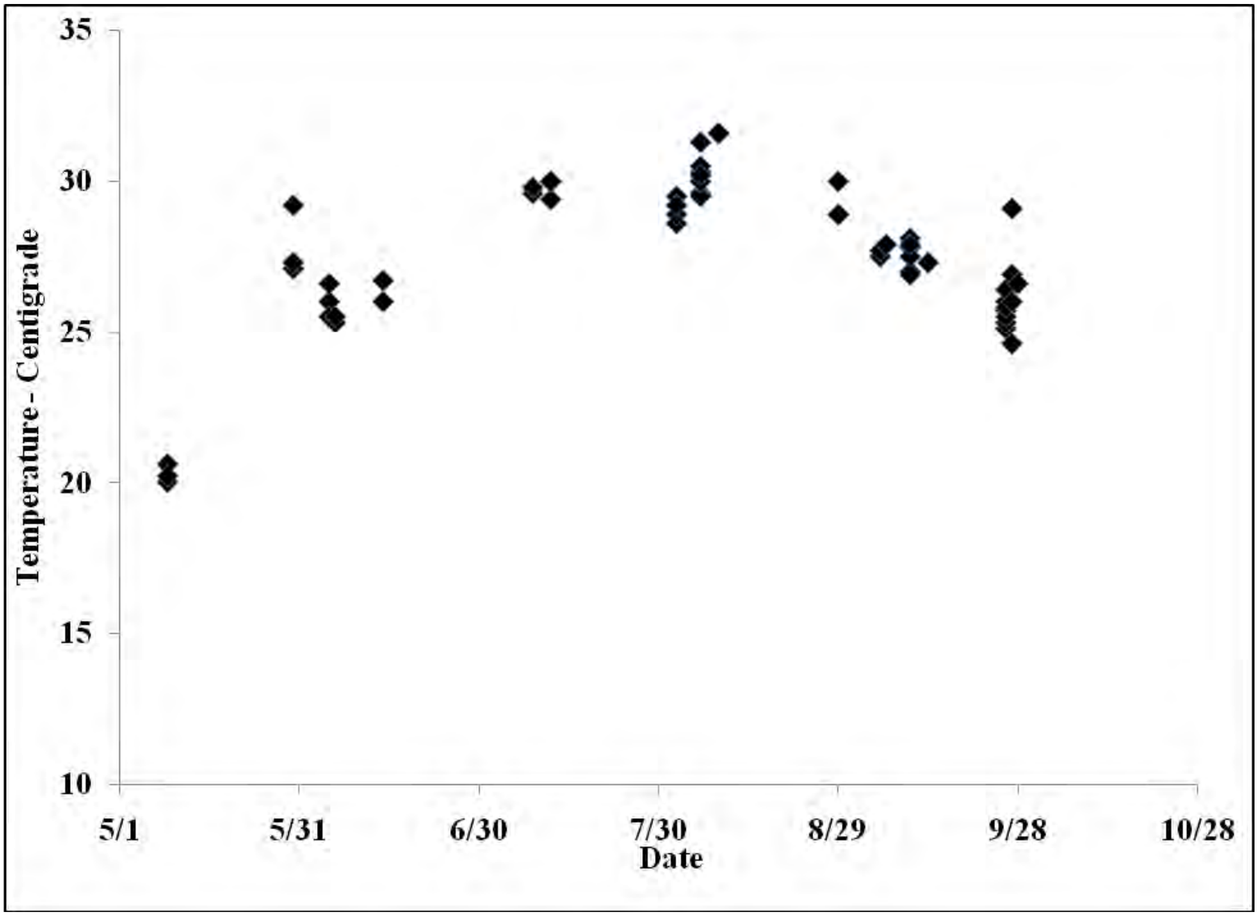


Table 2. Average secchi disk transparency of 13 public fishing lakes in 2007. RSE denotes relative standard error (RSE = 100 * (standard error/estimate)).

Lake	**Average Transparency - inches**	**N**	**RSE**
Star Fort	15	4	24
Lancaster	15	3	9
Edgar Brown	16	4	14
Paul Wallace	19	4	10
Sunrise	23	4	15
Dargans Pond	29	4	10
Mountain Lakes 1	30	5	16
Oliphant	30	4	24
Ashwood	30	4	9
Edwin Johnson	32	5	27
John D. Long	33	5	22
Jonesvillle	35	5	19
Cherokee	49	5	14

Average chlorophyll a concentration ranged from 16 to 127 µg/L, nearly an order of magnitude difference among lakes (Table 3). Dargans Pond and Ashwood had the lowest average chlorophyll concentrations. As also shown by secchi disk data, Star Fort, Lancaster, Wallace, and Brown had the highest average chlorophyll concentrations. Similar to secchi disk results, Cherokee, Oliphant, Jonesville, and Edwin Johnson had the highest variation in chlorophyll values, perhaps indicative of short-term plankton blooms as a result of fertilization. Seasonal patterns of chlorophyll abundance are shown in Figures 2-7. The trends in these figures suggest that spring fertilizations were not as successful as those performed during the summer.

There was a significant negative correlation, $r = -0.79$, between average chlorophyll and average secchi disk transparency. While not significant ($P = 0.0576$), there was a trend for a positive relationship between average chlorophyll and conductivity.

Table 3. Average chlorophyll a concentration in 13 public fishing lakes in 2007. RSE denotes relative standard error (RSE = 100 * (standard error/estimate)).

Lake	**Average Chlorophyll a - µg/L**	**N**	**RSE**
Star Fort	127	3	38
Lancaster	100	4	24
Edgar Brown	97	3	30
Paul Wallace	97	5	23
Sunrise	83	5	27
Edwin Johnson	60	4	40
Jonesville	57	5	39
Oliphant	54	5	56
Mountain Lakes 1	51	4	24
John D. Long	50	4	34
Dargans	45	3	9
Cherokee	40	5	75
Ashwood	16	4	11

Figure 2. Chlorophyll a levels in Mountain Lake I and Sunrise Lake during 2007. Three water samples were collected each sampling day from the upstream, middle, and lower ends of each lake. Error bars denote the 90% confidence interval. Dates of fertilizer applications are noted.

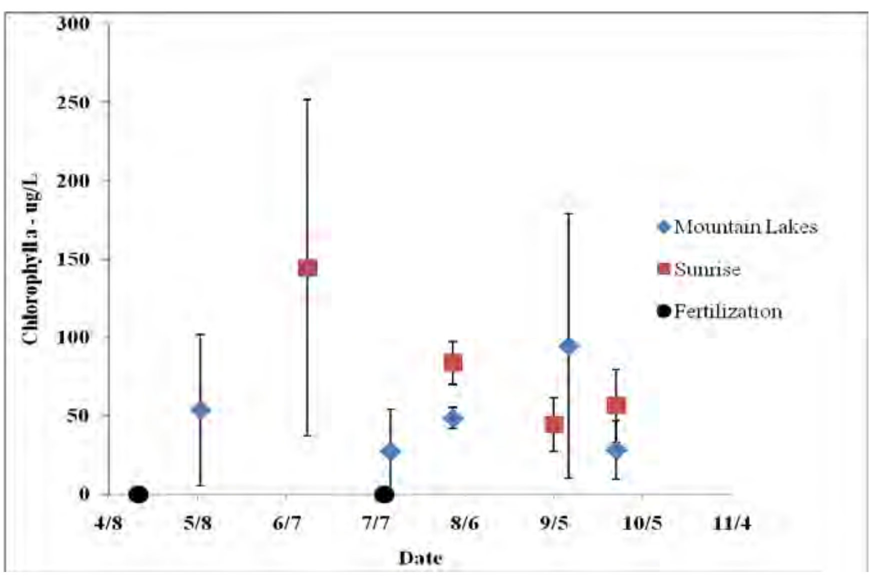


Figure 3. Chlorophyll a levels in lakes Cherokee and John D. Long during 2007. Three water samples were collected each sampling day from the upstream, middle, and lower ends of each lake. Error bars denote the 90% confidence interval. Dates of fertilizer applications are noted.

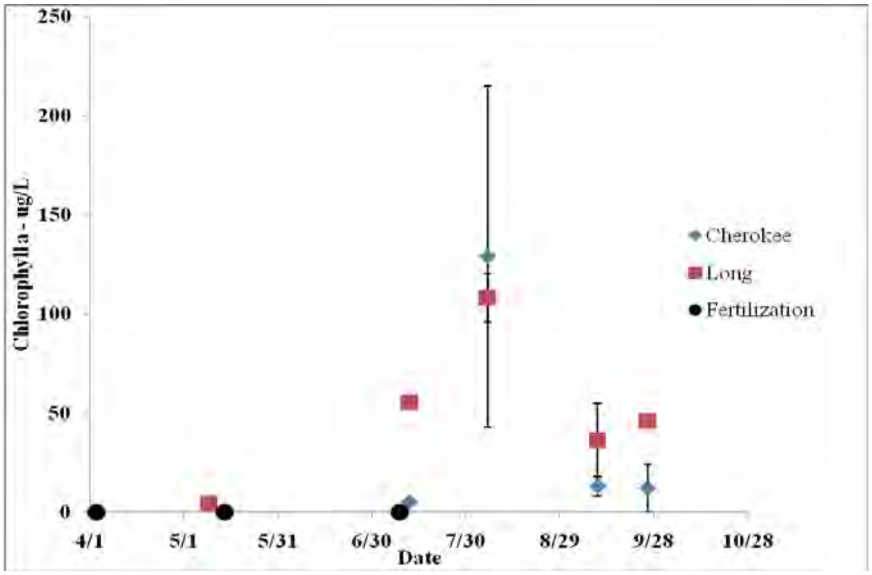


Figure 4. Chlorophyll a levels in lakes Edwin Johnson and Jonesville during 2007. Three water samples were collected each sampling day from the upstream, middle, and lower ends of each lake. Error bars denote the 90% confidence interval. Dates of fertilizer applications are noted.

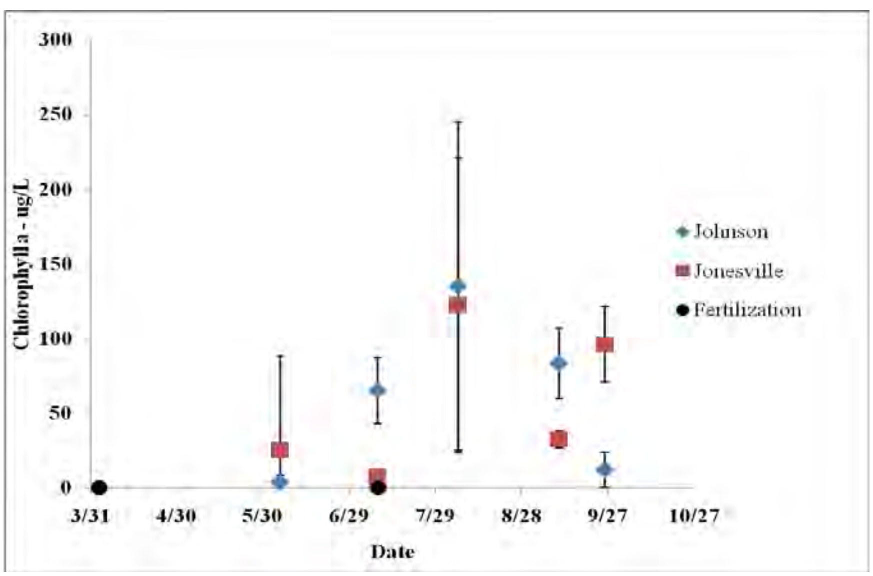


Figure 5. Chlorophyll a levels in lakes Oliphant and Star Fort during 2007. Three water samples were collected each sampling day from the upstream, middle, and lower ends of each lake. Error bars denote the 90% confidence interval. Dates of fertilizer applications are noted.

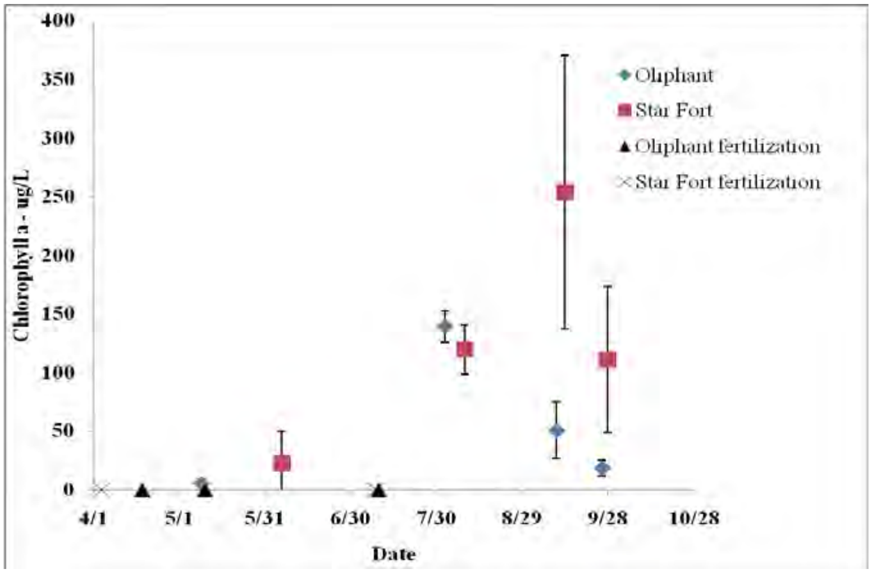


Figure 6. Chlorophyll a levels in Lake Ashwood and Dargans Pond during 2007. Three water samples were collected each sampling day from the upstream, middle, and lower ends of each lake. Error bars denote the 90% confidence interval.

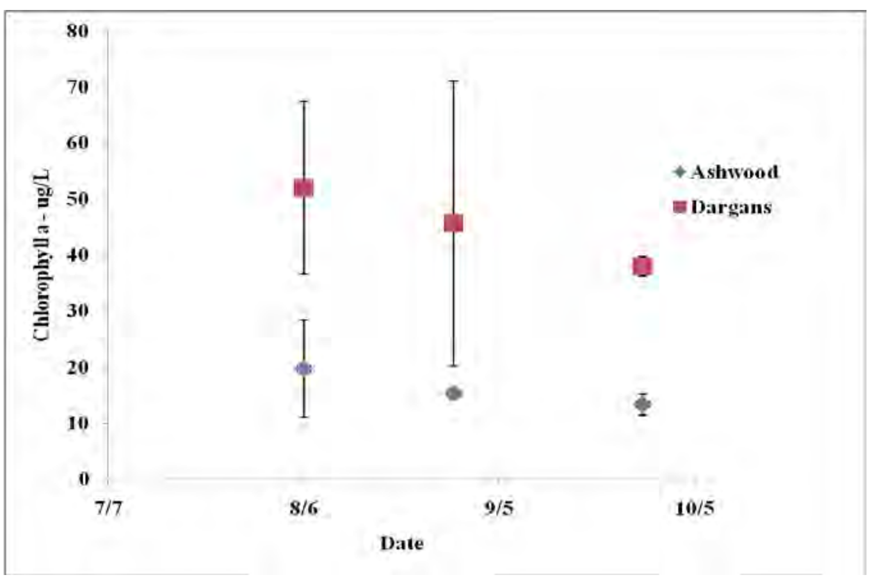
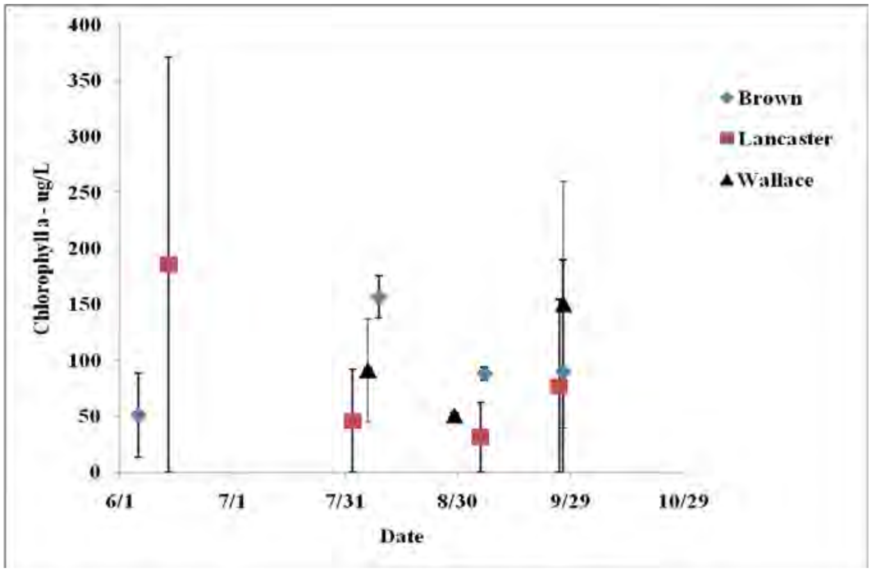


Figure 7. Chlorophyll a levels in lakes Edgar Brown, Lancaster, and Paul Wallace during 2007. Three water samples were collected each sampling day from the upstream, middle, and lower ends of each lake. Error bars denote the 90% confidence interval.



Discussion

This was a first look at the basic water chemistry and fertility of 13 public fishing lakes in South Carolina. The analysis assumes these lakes were randomly sampled, though this is probably not true as State Lake personnel revisited lakes at a regular interval. Nevertheless, the information suggests some important trends. These are:

- Ashwood and Dargans Pond have a consistently low fertility and are not fertilized. The Dargans Pond fishery is limited entry, which would hold down fishing pressure. Lake Ashwood is continually open, providing a local recreational opportunity. Due to the low fertility, innovative management is needed on these lakes.

- Lancaster, Edgar Brown, and Paul Wallace are not fertilized but maintain relatively high fertility throughout the growing season. In the absence of hypereutrophic conditions, these lakes should support 'good' fisheries.
- Of the fertilized lakes, only Star Fort maintained relatively high fertility throughout the growing season, though there was substantial variation.
- Cherokee, Edwin Johnson, Jonesville, John D. Long and Oliphant, are primary examples of fertilized lakes that responded to fertilization but the plankton bloom was relatively short-lived. On lakes such as this, a more in-depth investigation is needed to determine whether more aggressive management (i.e. increased liming and fertilization) to maintain fertility is cost effective. These studies should quantify the average retention time of these lakes.
- In fertilized lakes, chlorophyll peaks were higher in mid-summer than in spring.

Recommendations

- Discuss these results with regional and state lakes staff. Develop a basic, water quality monitoring strategy for state lakes in 2009. On those lakes which seem to only have a short-term ability to maintain production after fertilization, include an assessment of retention time and natural nutrient inflow and outflow.
- Consider a more intensive sampling selected fertilized lakes to follow bloom dynamics.
- This study did not distinguish between fluorescence due to green algae as opposed to that due to blue-green algae, which are not as beneficial to fisheries. Future studies

should partition the sources of chlorophyll as this may explain higher chlorophyll peaks in late summer, as opposed to spring.