2011 Gainesville Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
May 2014

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Tombigbee River Basin

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LIST OF ACRONYMS

A&I	Agriculture and Industry water supply use classification
ADEM	Alabama Department of Environmental Management
AGPT	Algal Growth Potential Test
APCO	Alabama Power Company
CHL *a*	Chlorophyll *a*
DO	Dissolved Oxygen
EMT	Escatawpa Mobile Tombigbee
F&W	Fish and Wildlife
MAX	Maximum
MDL	Method Detection Limit
MIN	Minimum
MSC	Mean Standing Crop
NTU	Nephelometric Turbidity Units
OAW	Outstanding Alabama Waters
ONRW	Outstanding National Resource Water
PWS	Public Water Supply
QAPP	Quality Assurance Project Plan
RRMP	Rivers and Reservoirs Monitoring Program
S	Swimming and Other Whole Body Water-Contact Sports
SD	Standard Deviation
SOP	Standard Operating Procedures
TEMP	Temperature
TN	Total Nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSI	Trophic State Index
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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INTRODUCTION

Gainesville Reservoir was established in 1978 by the U.S. Army Corps of Engineers with the completion of Howell Heflin Lock and Dam. The Reservoir is a 6,400 acre run-of-the-river reservoir located just east of Gainesville, Alabama on the Tennessee-Tombigbee Waterway.

The Alabama Department of Environmental Management (ADEM) monitored Gainesville Reservoir as part of the 2011 assessment of the Escatawpa, Mobile and Tombigbee River (EMT) Basins under the Rivers and Reservoirs Monitoring Program (RRMP). ADEM began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program (now known as RRMP) was initiated by ADEM. The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM's 2012 Monitoring Strategy (ADEM 2012).

In 2005, the ADEM implemented a specific water quality criterion for nutrient management at one location on Gainesville Reservoir. This criterion represents the maximum growing season mean (April-October) chlorophyll *a* (chl *a*) concentration allowable while still fully supporting the reservoir's Swimming and Fish & Wildlife (S/F&W) use classifications.

The purpose of this report is to summarize data collected at six stations in Gainesville Reservoir during the 2011 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chl *a*; algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)] and trophic state [Carlson's trophic state index (TSI)] were compared to ADEM's historical data and established criterion.

METHODS

Sampling stations were selected using historical data and previous assessments (Fig. 1). Specific location information can be found in Table 1. Gainesville Reservoir was sampled in the dam forebay, mid reservoir and upper reservoir. Tributary embayment stations monitored include: Bogue Chitto and Lubbub Creeks and the Sipsey River.

Water quality assessments were conducted at monthly intervals, May-October. Assessments scheduled during April were postponed due to devastating tornados in a large area of the basin, resulting in two water quality assessments conducted in May. All samples were collected, preserved, stored and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2011), Surface Water Quality Assurance Project Plan (ADEM 2008) and Quality Management Plan (ADEM 2008).

Mean growing season TN, TP, chl *a* and TSS were calculated to evaluate water quality conditions at each site. Monthly concentrations of these parameters were graphed with the closest available flow data and ADEM's previously collected data to help interpret the 2011 results.

Figure 1. Gainesville Reservoir with 2011 sampling locations.

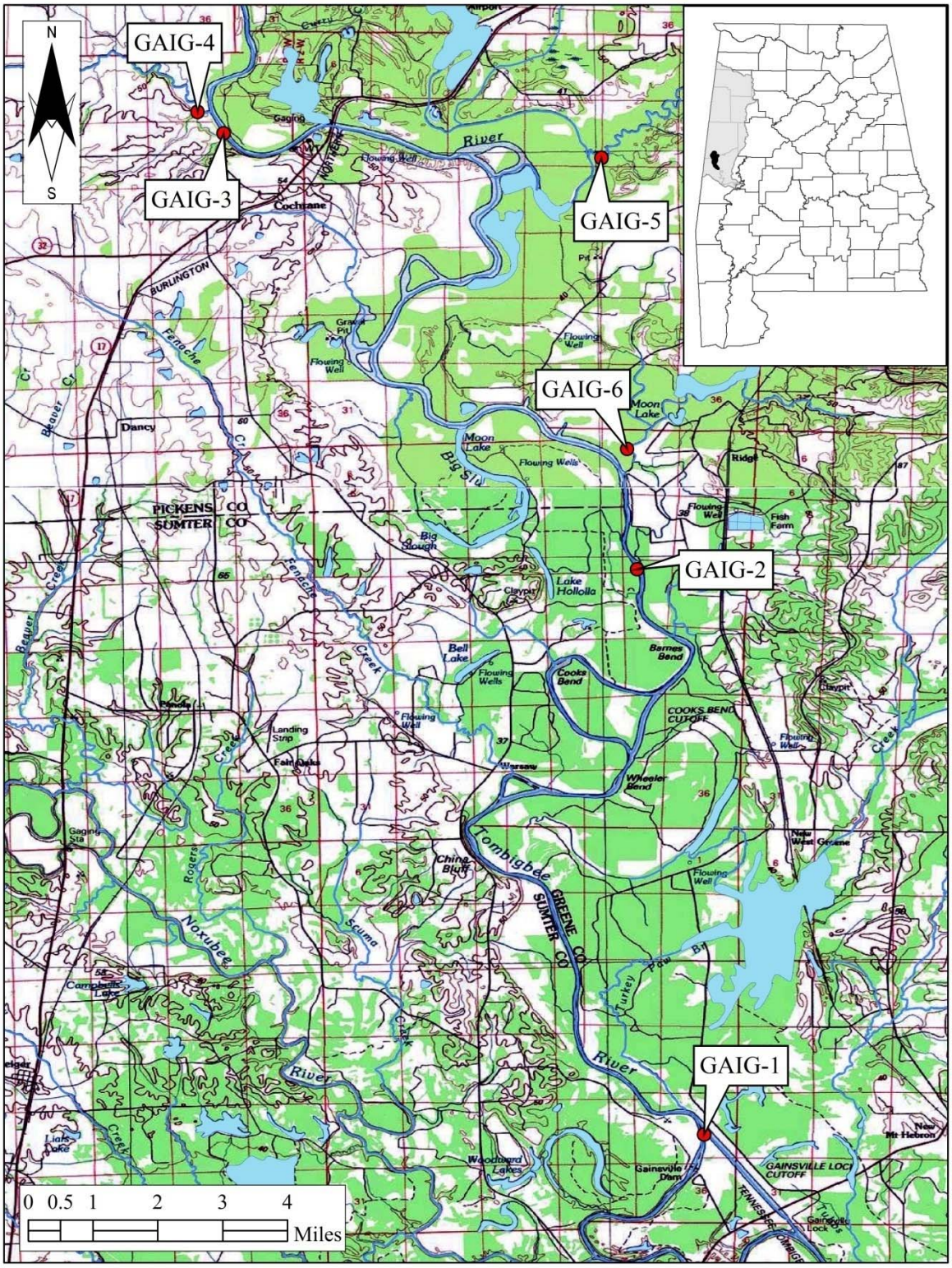


Table 1. Descriptions of the 2011 monitoring stations in Gainesville Reservoir.

HUC	County	Station Number	Report Designation	Waterbody	Station Description	Chl *a* Criteria	Latitude	Longitude
031601060609	Greene	GAIG-1*	Lower	Gainesville Res	Deepest point, main river channel, dam forebay.	14µg/L	32.8559	-88.1545
031601060603	Sumter	GAIG-2	Mid	Gainesville Res	Deepest point, Tombigbee River, approximately 1.5 miles downstream of Sipsey River confluence.		32.9818	-88.1694
031601060505	Pickens	GAIG-3	Upper	Gainesville Res	Deepest point, main river channel, approximately 0.5 miles downstream of Bogue Chitto Creek confluence.		33.0789	-88.2618
031601060504	Pickens	GAIG-4	Bogue Chitto Ck	Bogue Chitto Ck	Deepest point, main creek channel, Bogue Chitto Creek embayment, approximately 0.5 miles upstream of confluence with Tombigbee River.		33.0837	-88.2676
031601060507	Pickens	GAIG-5	Lubbub Ck	Lubbub Ck	Deepest point, main creek channel, Lubbub Creek embayment, approximately 0.5 miles upstream of confluence with Tombigbee River.		33.0734	-88.1774
031601070306	Greene	GAIG-6	Sipsey R	Sipsey R	Deepest point, main river channel, Sipsey River embayment, approximately 0.5 miles upstream of confluence with Tombigbee River.		33.0086	-88.1716

*Growing season mean chl a criterion implemented at this station in 2005.

RESULTS

Growing season mean graphs for TN, TP, chl *a* and TSS are provided in this section (Figs. 2 and 3). Monthly graphs for TN, TP, chl *a*, TSS, dissolved oxygen (DO) and TSI are also provided (Figs. 4-8 and 12). Mean monthly discharge is included in monthly graphs for TN, TP, chl *a*, TSS and TSI as an indicator of flow and retention time in the months sampled. AGPT results appear in Table 2. Depth profile graphs of temperature, DO and conductivity appear in Figures 9-11. Summary statistics of all data collected during 2011 are presented in Appendix Table 1. The table contains the minimum, maximum, median, mean and standard deviation of each parameter analyzed.

Stations with the highest concentrations of nutrients, chlorophyll and TSS are noted in the paragraphs to follow. Though stations with lowest concentrations may not always be mentioned, review of the graphs included in this report will indicate these stations that may be potential candidates for reference waterbodies and watersheds.

In 2011, the highest mean growing season TN value calculated among Gainesville Reservoir mainstem stations was in the lower station while the lowest value was in the upper station (Fig. 2). The highest value calculated among tributary stations was in the Bogue Chitto Ck station. Mean growing season TN values in the lower and mid mainstem stations have shown an overall increase from 2003 through 2011. Mean growing season TN values in the upper mainstem station and the Sipsey R, Lubbub and Bogue Chitto Ck tributary stations have varied in the years monitored. The highest monthly TN concentrations in the lower and mid mainstem stations were measured during the first sampling event in May, while the highest concentration in the upper station was measured during the second sampling event in May (Fig. 4). Historic high monthly TN concentrations were measured in the lower station in September, the mid station in May (5/11/2011) and July, and the upper station in July. Historic low TN concentrations were measured in the mid and upper stations in October.

In 2011, mean growing season TP values among Gainesville Reservoir mainstem stations were similar (Fig. 2). The highest mean growing season TP value calculated among tributary stations was in Lubbub Ck. All mean growing season TP values among Gainesville Reservoir mainstem and tributary stations were the lowest since monitoring began, with the exception of

the Lubbub Ck station. The highest monthly TP concentrations in the lower and mid mainstem stations were measured during the first sampling event in May, while the highest concentration in the upper station was measured during the second sampling event in May (Fig. 5). Historic, or near historic, low monthly TP concentrations were measured in all Gainesville Reservoir mainstem stations most months monitored May-October, 2011.

The specific water quality criterion for nutrient management was established for the lower station in Gainesville Reservoir. The growing season mean chl *a* value calculated in the lower station in Gainesville Reservoir during 2011 was in compliance with the criterion limit (Fig. 3). In 2011, the highest mean growing season chl *a* value calculated among Gainesville Reservoir mainstem stations was in the upper station. The highest value calculated among tributary stations was in the Bogue Chitto Ck station. Mean growing season chl *a* values in the lower Gainesville Reservoir station increased from 2001 through 2006, then decreased through 2011. Mean growing season values in the mid mainstem station and the Lubbub Ck tributary station have increased overall in the years monitored. The highest monthly chl *a* concentrations in the lower and mid mainstem stations were measured in June, while the highest concentration in the upper station was measured in July (Fig. 6). Historic, or near historic, high monthly chl *a* concentrations were measured in the lower and upper stations in May (5/24/2011) and the mid station in May (5/11/2011), June and October. Historic, or near historic, low chl *a* concentrations were measured in the lower station in May (5/11/2011) and the upper station in August.

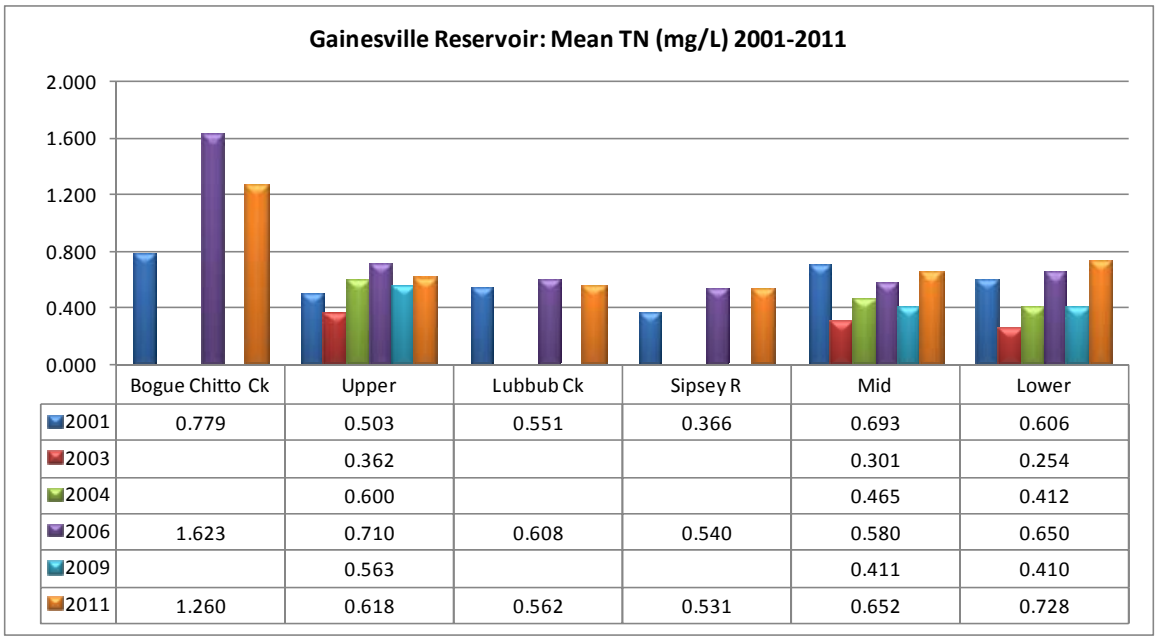
In 2011, the highest mean growing season TSS value calculated among Gainesville Reservoir mainstem stations was in the upper station and the lowest was in the lower station (Fig. 3). The highest value calculated among tributary stations was in the Lubbub Ck station while the lowest was in the Sipsey R station. All mean growing season TSS values among Gainesville Reservoir mainstem and tributary stations were the lowest since monitoring began and have declined overall in the years monitored with the exception of the Lubbub Ck station. The highest monthly TSS concentrations were measured during the second May sampling event in all mainstem stations (Fig. 7). Historic low monthly TSS concentrations were measured in all Gainesville Reservoir mainstem stations most months monitored May-October, 2011.

AGPT results for the lower, mid and upper Gainesville Reservoir stations indicate they were nitrogen-limited in 2001, 2006 and 2011 (Table 2). In 2011, the MSC values calculated for the lower, mid and upper stations were below 5.0 mg/L, the value that Raschke et al. (1996) defined as protective of reservoir and lake systems.

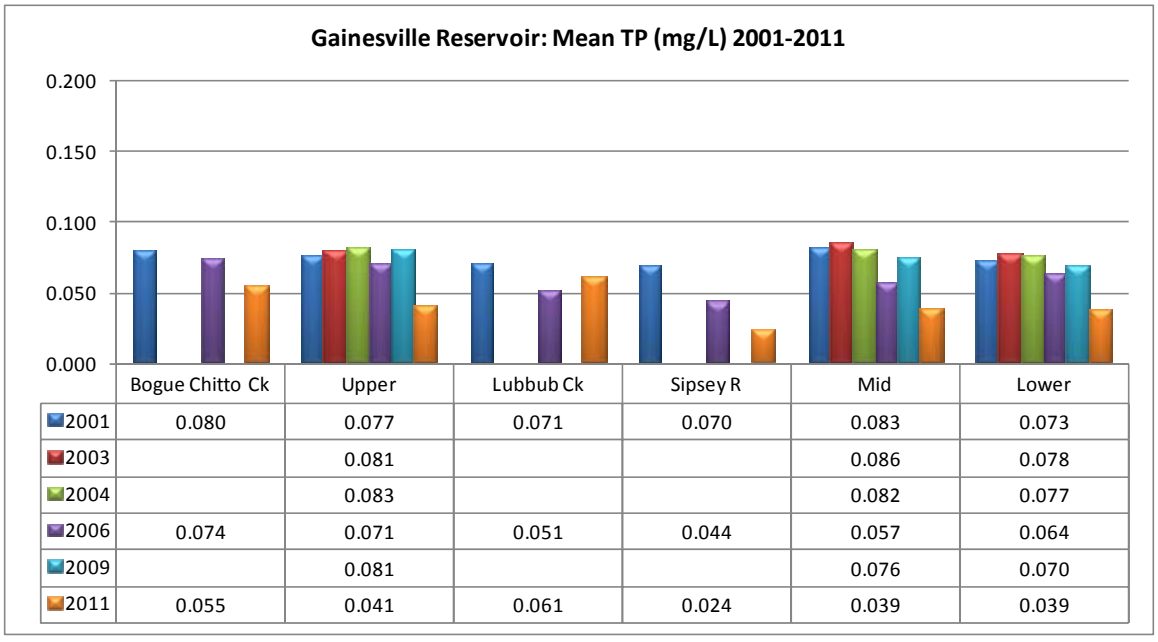
Dissolved oxygen concentrations were near or below the ADEM Criterion (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) in the Lubbub Ck tributary station in July and August (Fig. 8). All measurements of DO concentrations in the mainstem stations and the Bogue Chitto Ck and Sipsey R tributary stations were above the ADEM Criterion. Based on monthly DO profiles, DO concentrations were near or below 5.0 mg/L in the majority of the water column in the lower and mid stations in July and August, when temperatures were highest (Fig. 9 & 10).

TSI values were calculated using monthly chl *a* concentrations and Carlson's Trophic State Index. TSI values in the lower station were oligotrophic in May (5/11/2011), mesotrophic in September and eutrophic all other months monitored (Fig. 12). The mid and upper stations were eutrophic May-October. Among the tributaries, Bogue Chitto Ck had the highest TSI value, reaching hypereutrophic conditions in September, while values in the Lubbub Ck and Sipsey R stations were eutrophic all months monitored.

Figure 2. Mean growing season TN and TP measured in Gainesville Reservoir, May-October, 2001-2011. Stations are illustrated from upstream to downstream as the graph is read from left to right.

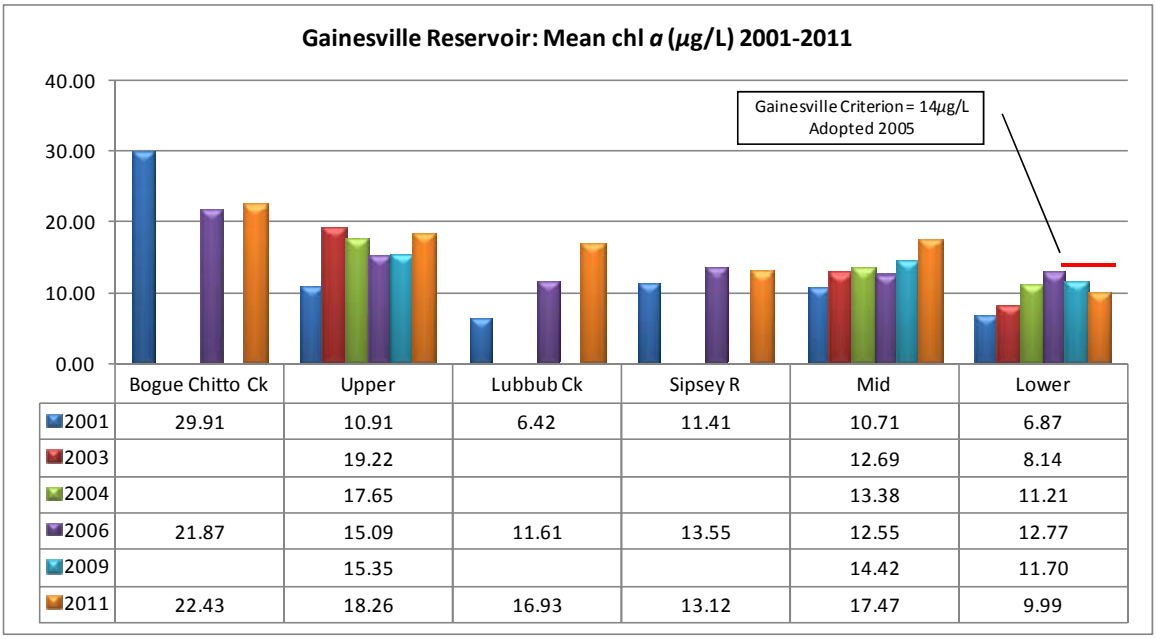


	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	0.779	0.503	0.551	0.366	0.693	0.606
2003		0.362			0.301	0.254
2004		0.600			0.465	0.412
2006	1.623	0.710	0.608	0.540	0.580	0.650
2009		0.563			0.411	0.410
2011	1.260	0.618	0.562	0.531	0.652	0.728

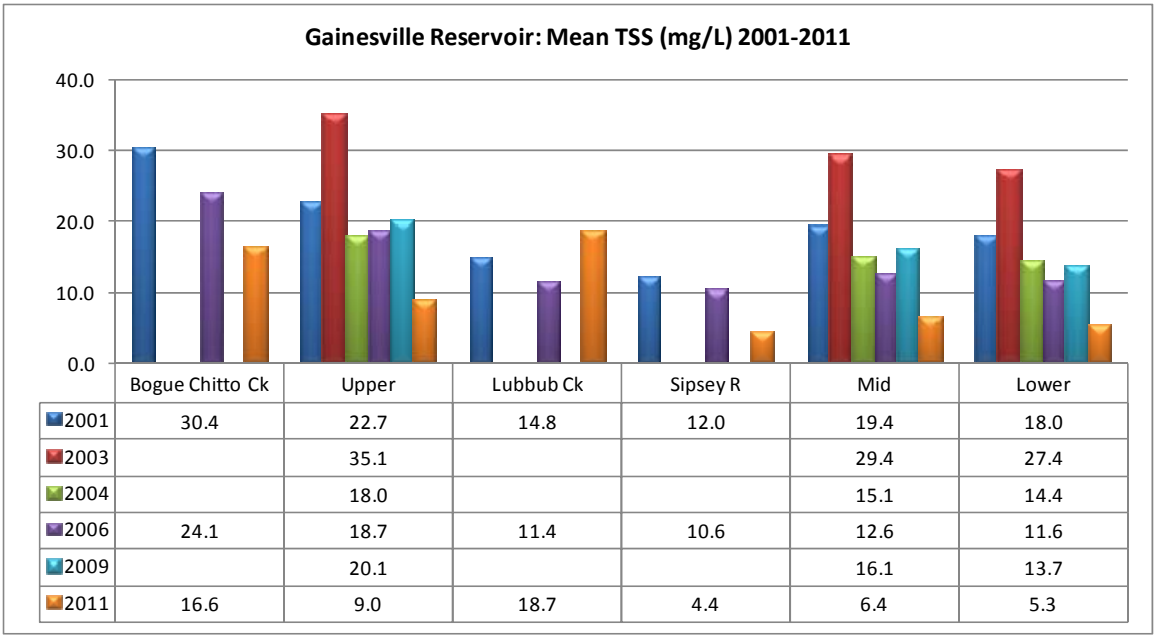


	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	0.080	0.077	0.071	0.070	0.083	0.073
2003		0.081			0.086	0.078
2004		0.083			0.082	0.077
2006	0.074	0.071	0.051	0.044	0.057	0.064
2009		0.081			0.076	0.070
2011	0.055	0.041	0.061	0.024	0.039	0.039

Figure 3. Mean growing season chl *a* and TSS measured in Gainesville Reservoir, May-October, 2001-2011. Stations are illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criterion applies to the growing season means of the lower station.



	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	29.91	10.91	6.42	11.41	10.71	6.87
2003		19.22			12.69	8.14
2004		17.65			13.38	11.21
2006	21.87	15.09	11.61	13.55	12.55	12.77
2009		15.35			14.42	11.70
2011	22.43	18.26	16.93	13.12	17.47	9.99



	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	30.4	22.7	14.8	12.0	19.4	18.0
2003		35.1			29.4	27.4
2004		18.0			15.1	14.4
2006	24.1	18.7	11.4	10.6	12.6	11.6
2009		20.1			16.1	13.7
2011	16.6	9.0	18.7	4.4	6.4	5.3

Figure 4. Monthly TN concentrations measured in Gainesville Reservoir, May-October, 2011, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin lock and dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

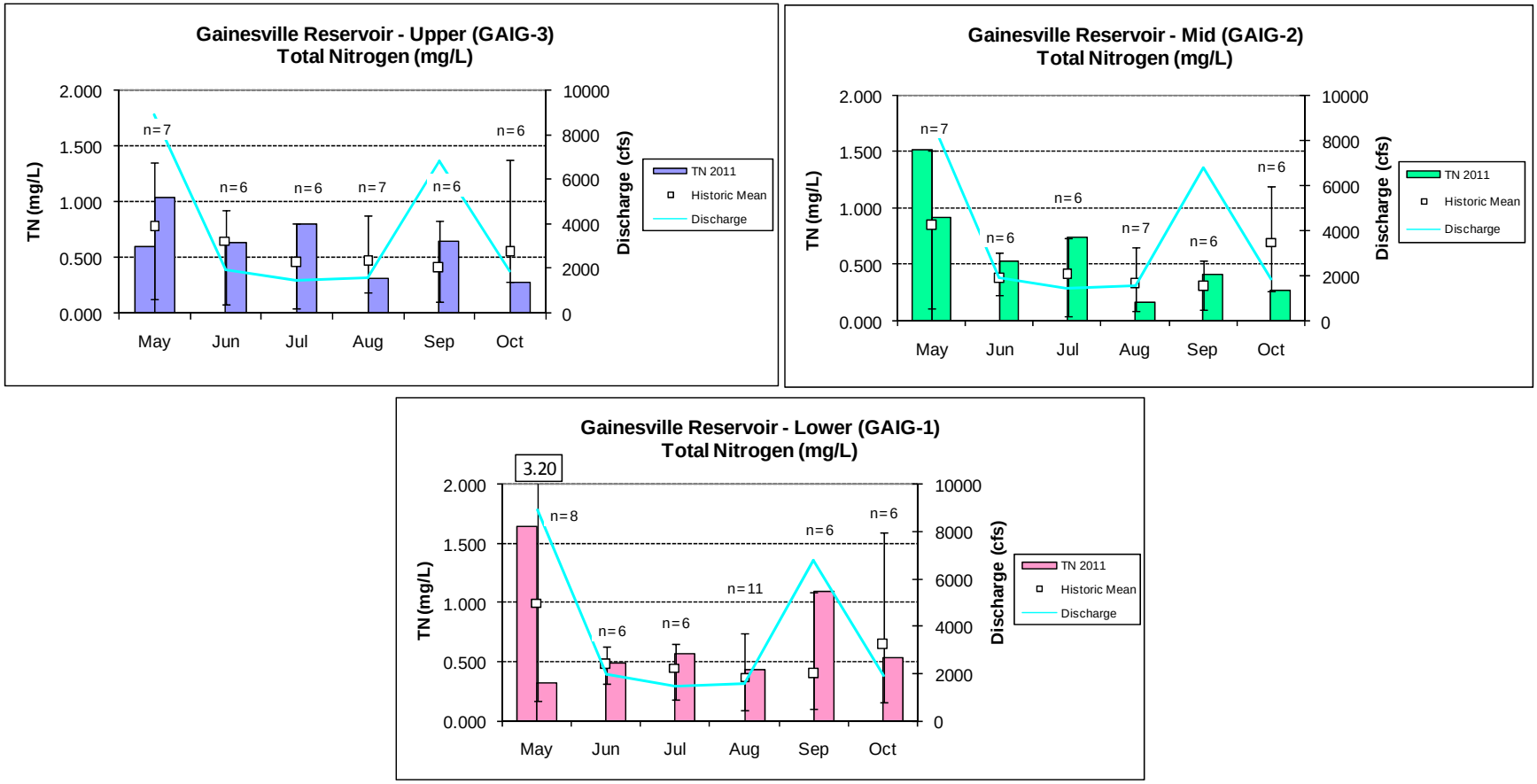


Figure 5. Monthly TP concentrations measured in Gainesville Reservoir, May-October, 2011, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin lock and dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

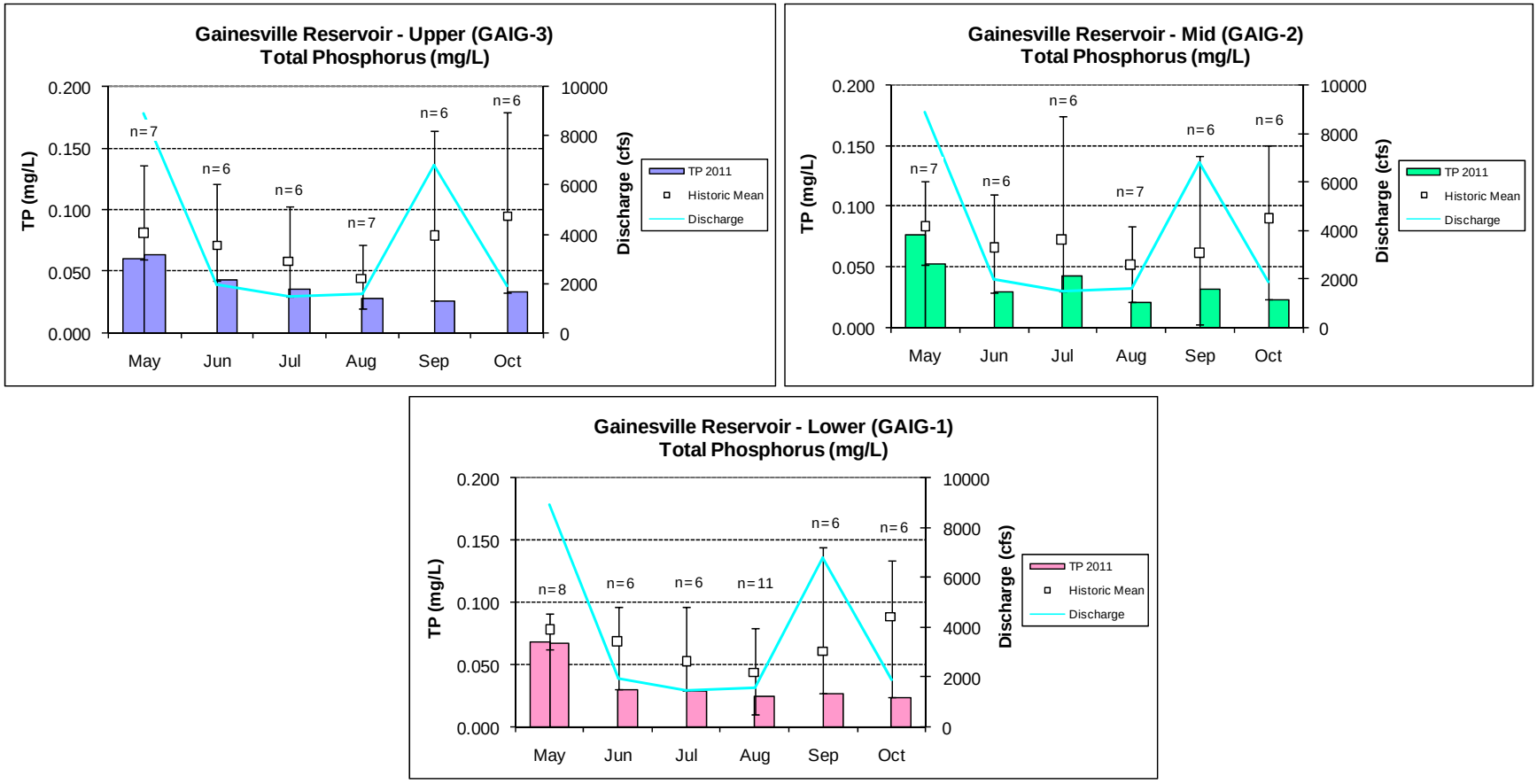


Figure 6. Monthly chl *a* concentrations measured in Gainesville Reservoir, May-October, 2011, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin lock and dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

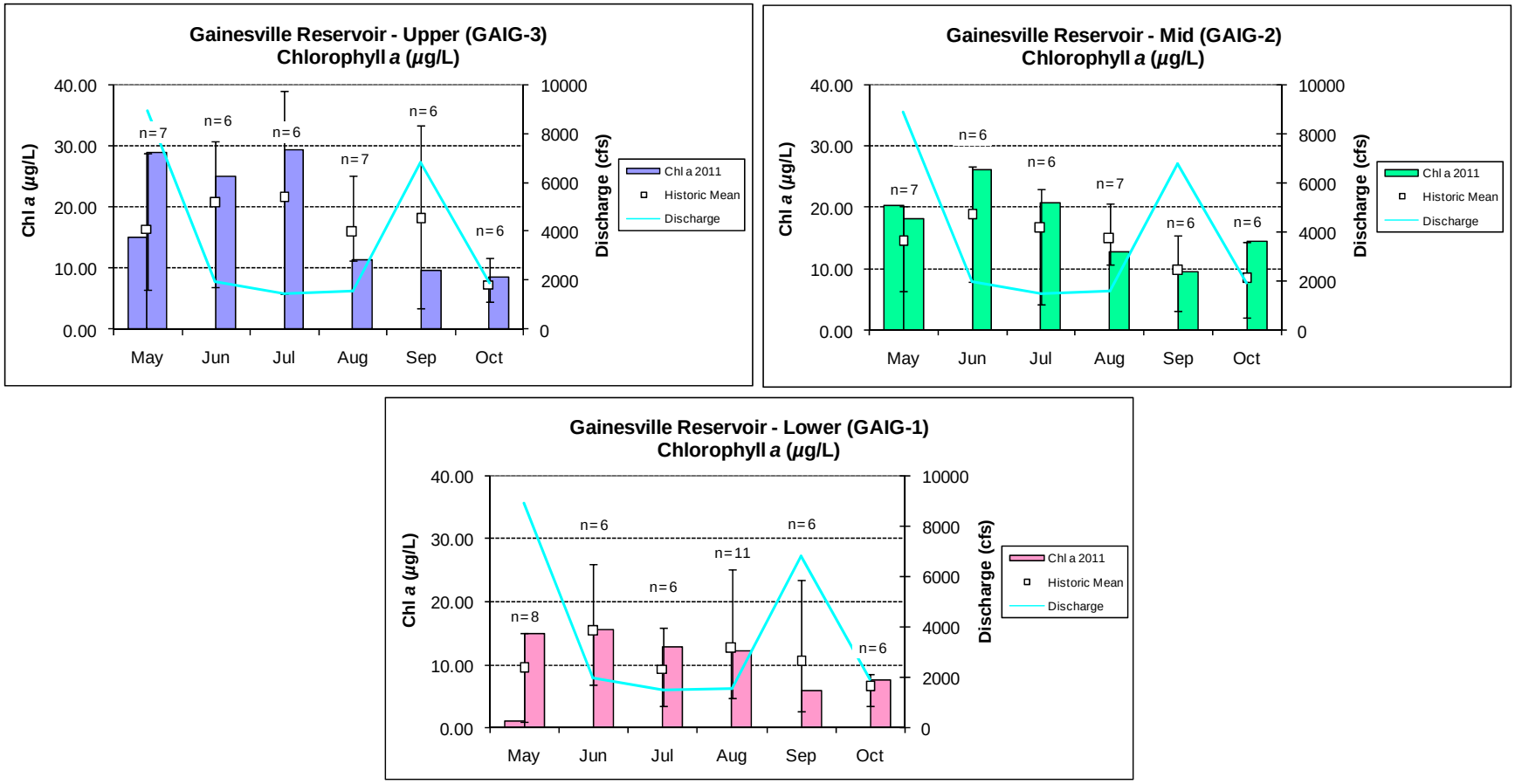


Figure 7. Monthly TSS concentrations measured in Gainesville Reservoir, May-October, 2011, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin lock and dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

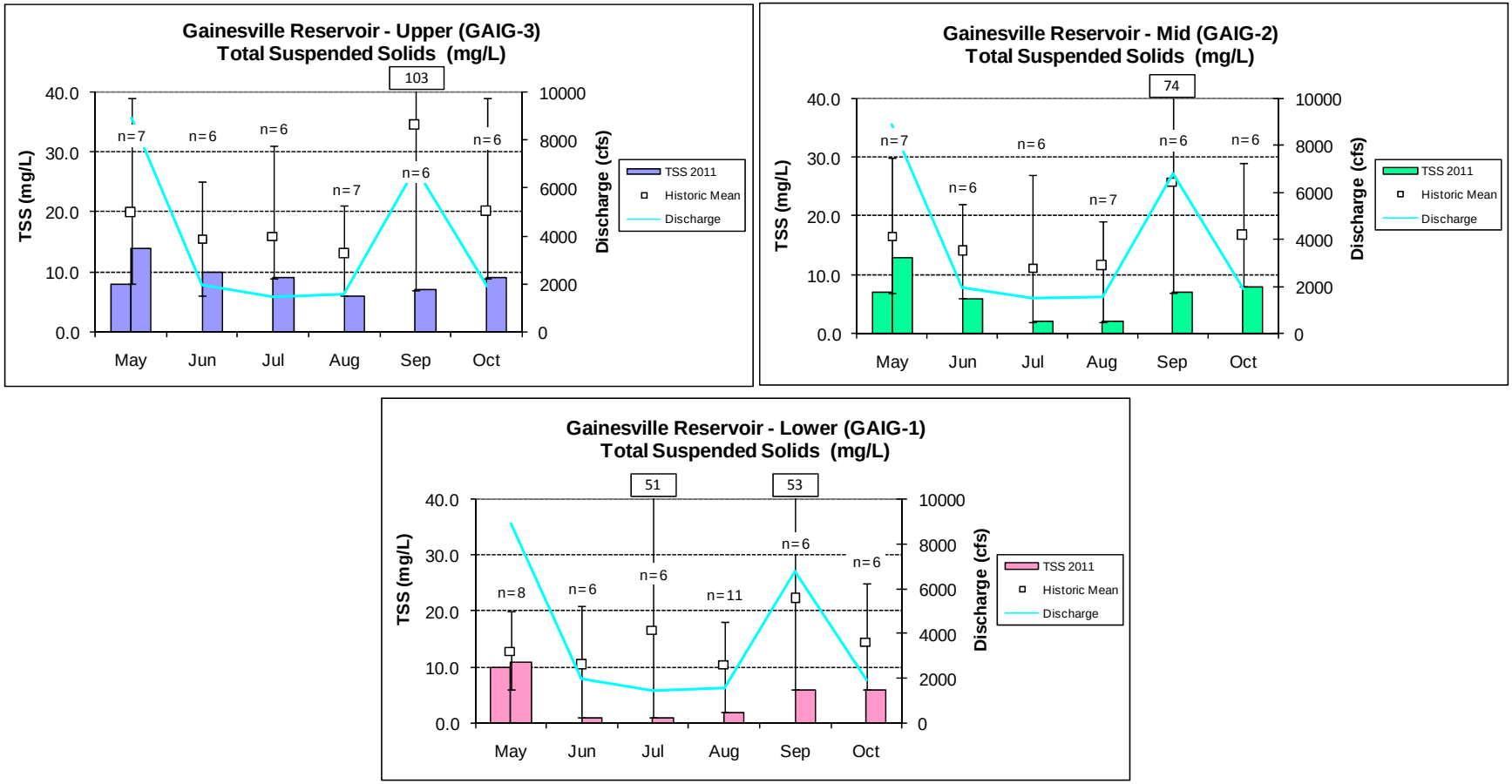
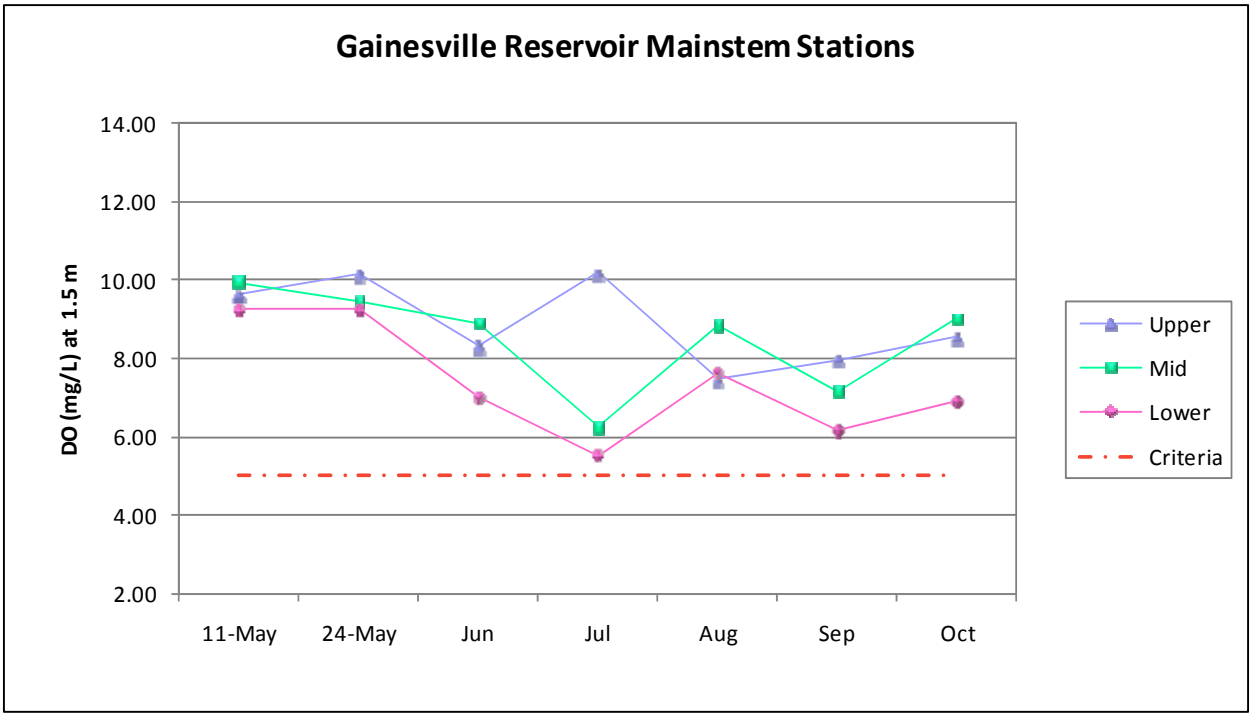


Table 2. Algal growth potential test results, Gainesville Reservoir, 2001-2011, (expressed as mean Maximum Standing Crop (MSC) dry weights of Selenastrum capricornutum in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers (Raschke and Schultz 1987).

Station	**Upper**		**Mid**		**Lower**	
	MSC	Limiting Nutrient	MSC	Limiting Nutrient	MSC	Limiting Nutrient
August 2001	2.30	Nitrogen	0.72	Nitrogen	3.56	Nitrogen
August 2006	1.55	Nitrogen	1.41	Nitrogen	1.63	Nitrogen
August 2011	1.14	Nitrogen	1.41	Nitrogen	2.39	Nitrogen

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for Gainesville Reservoir stations collected May-October, 2011. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2005).



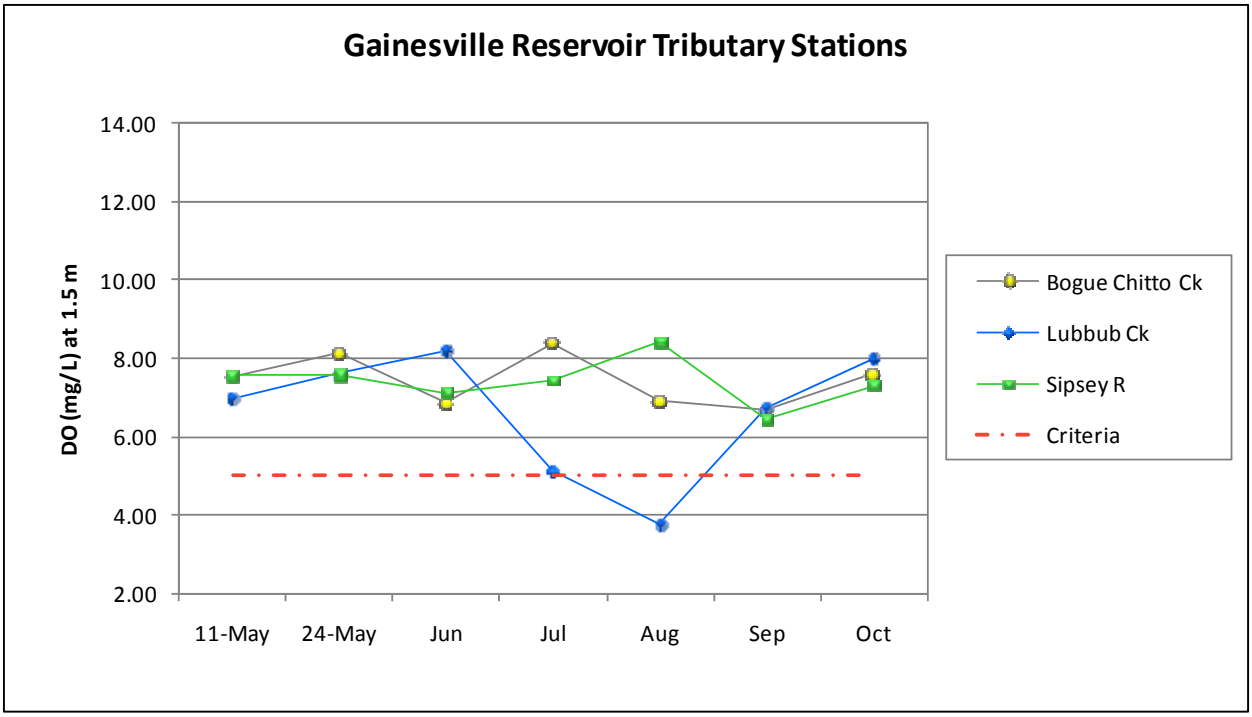


Figure 9. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C) and conductivity (umhos) in the lower Gainesville Reservoir station, May-October, 2011.

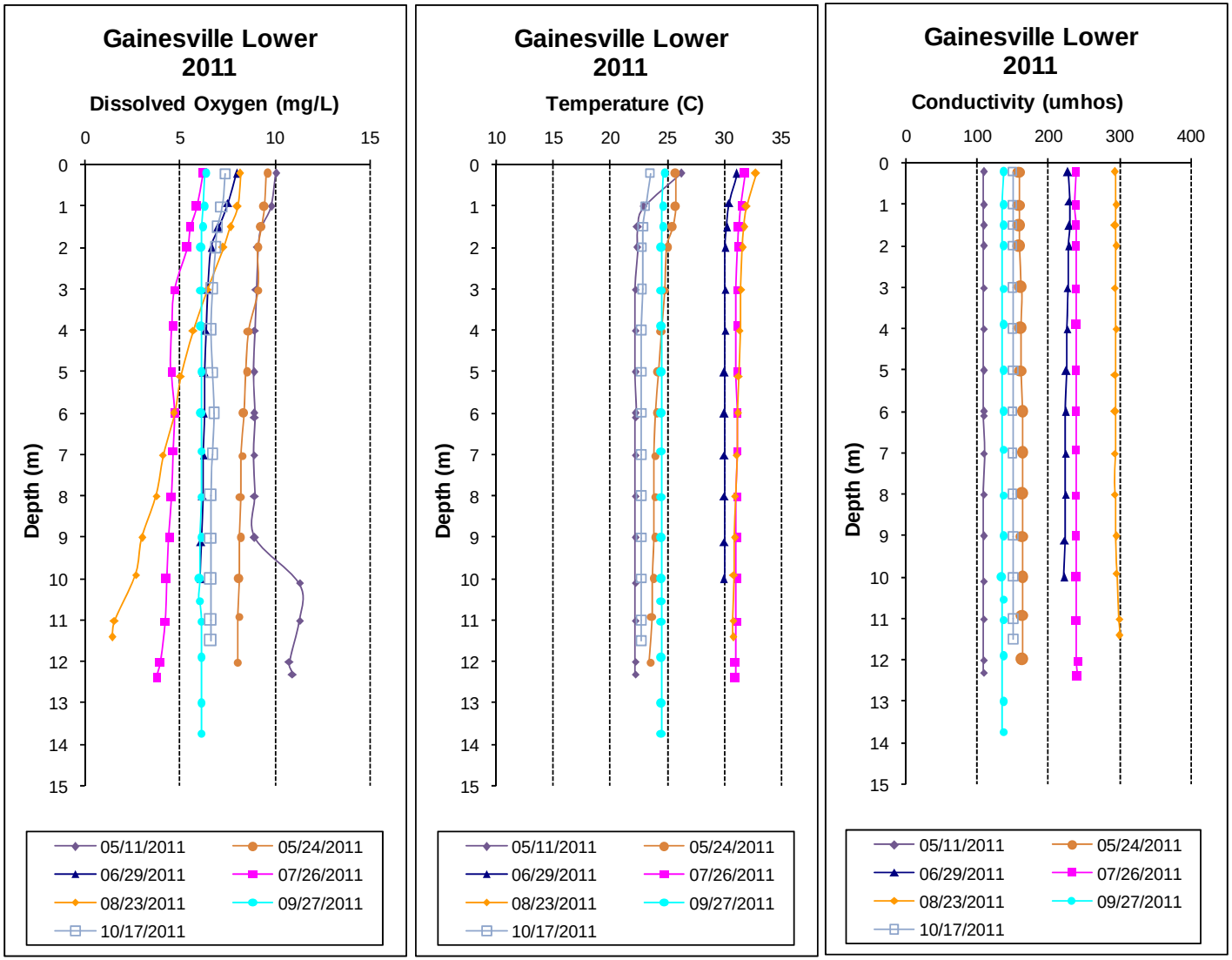


Figure 10. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C) and conductivity (umhos) in the mid Gainesville Reservoir station, May-October, 2011.

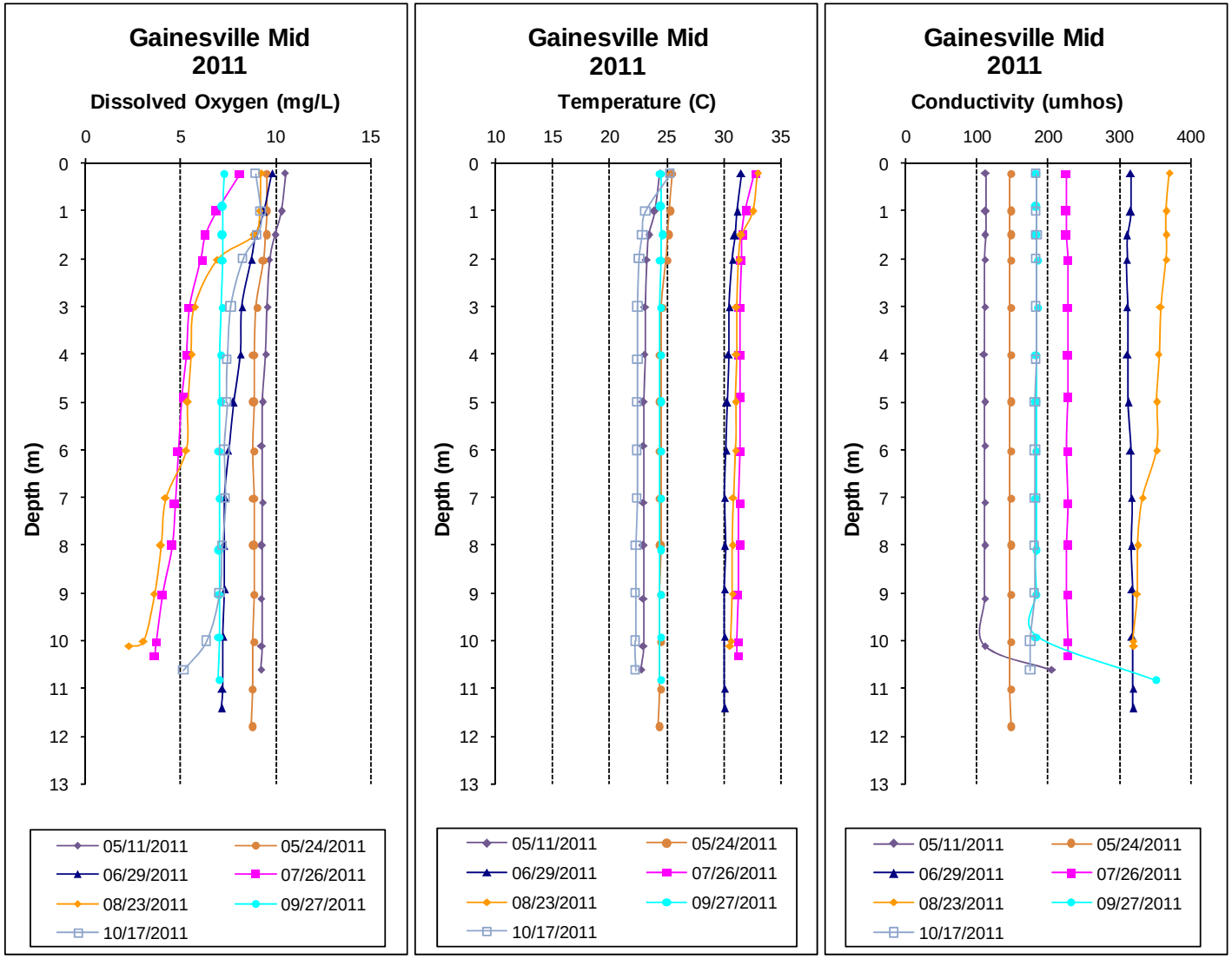


Figure 11. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C) and conductivity (umhos) in the upper Gainesville Reservoir station, May-October, 2011.

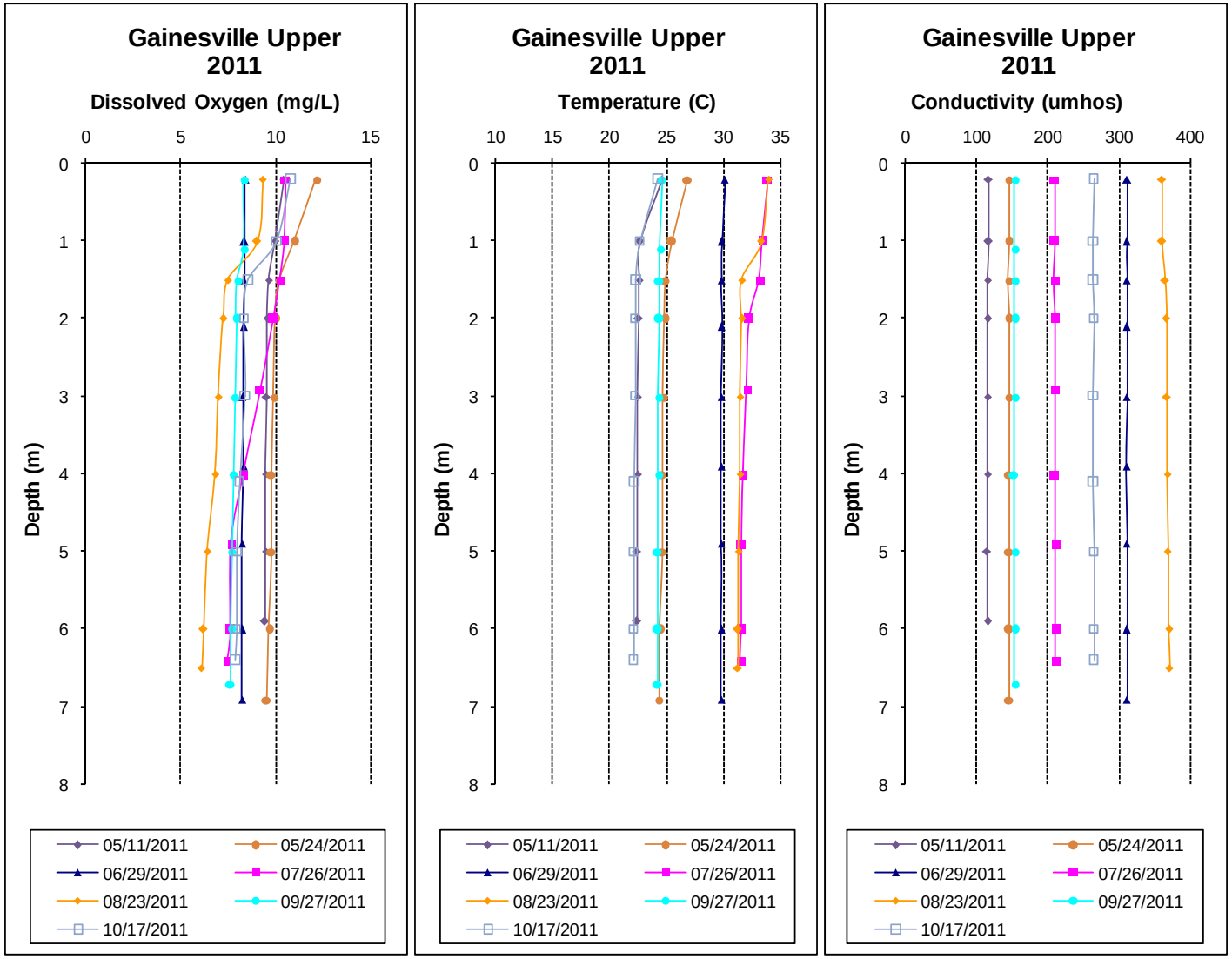
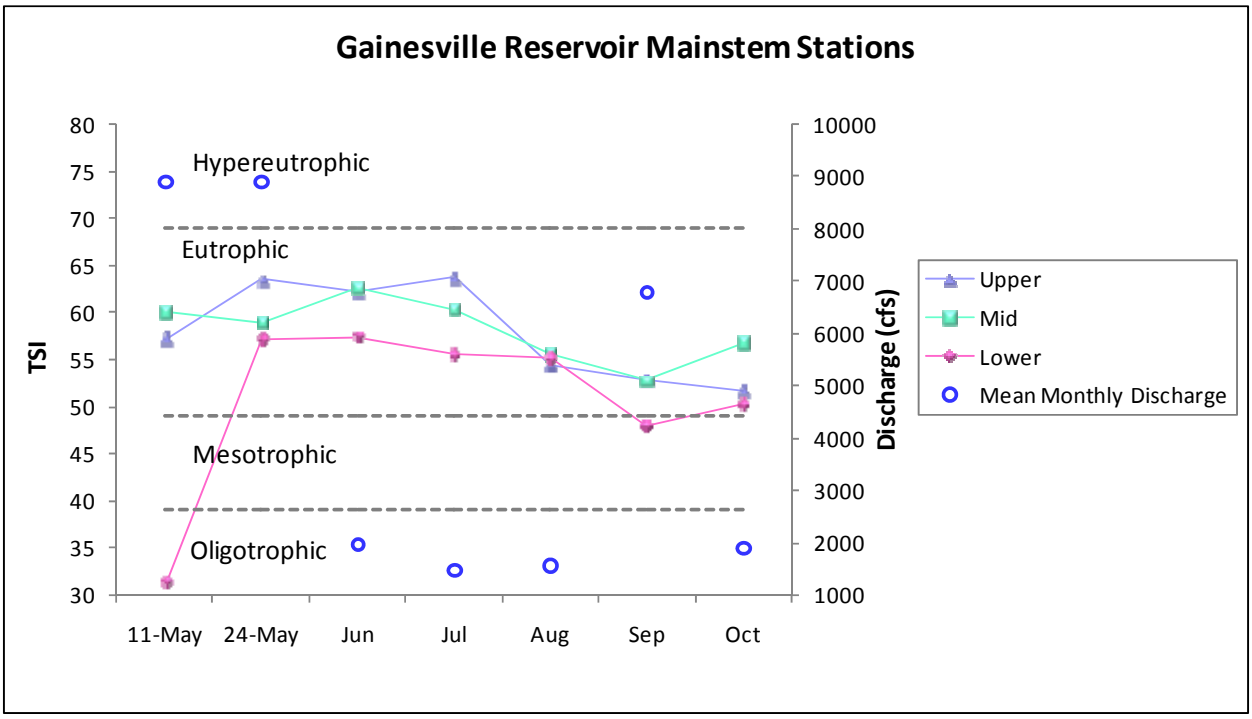
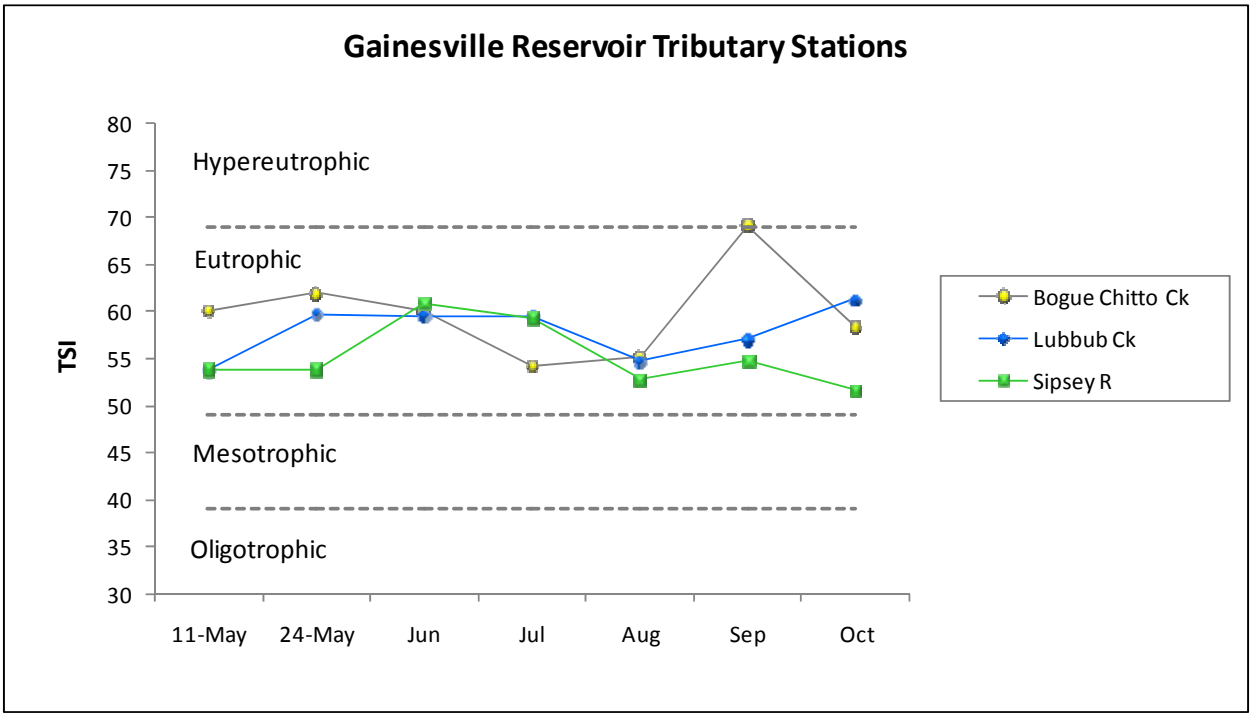


Figure 12. Monthly TSI values calculated for mainstem and tributary Gainesville Reservoir stations, May-October, 2011, using chl *a* concentrations and Carlson's Trophic State Index calculation. Mean monthly discharge measured at USGS gage 02447025, Tombigbee River at Heflin lock and dam near Gainesville, AL.





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APPENDIX

Appendix Table 1. Summary of Gainesville Reservoir water quality data collected May-October, 2011. Minimum (min) and maximum (max) values calculated using minimum detection limits when results were less than this value. Median (med), mean, and standard deviation (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Station	Parameter	N		Min	Max	Med	Mean	SD
GAIG-1	**Physical**							
	Turbidity (NTU)	7		6.1	23.1	10.1	12.5	6.1
	Total Dissolved Solids (mg/L)[J]	7		70.0	230.0	106.0	128.6	56.7
	Total Suspended Solids (mg/L)	7		1.0	11.0	6.0	5.3	4.2
	Hardness (mg/L)	4		39.0	81.8	54.0	57.2	20.6
	Alkalinity (mg/L)	7		32.7	55.4	36.8	42.3	9.1
	Photic Zone (m)	7		1.71	3.96	3.07	2.77	0.78
	Secchi (m)	7		0.55	1.31	0.96	0.94	0.28
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7		0.003	0.158	0.034	0.060	0.058
	Total Kjeldahl Nitrogen (mg/L)	7		0.310	1.570	0.464	0.668	0.453
	Total Nitrogen (mg/L)[J]	7		0.318	1.650	0.535	0.728	0.475
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.004	0.010	0.006	0.006	0.002
	Total Phosphorus (mg/L)	7		0.024	0.068	0.029	0.039	0.020
	CBOD-5 (mg/L)	7	<	2.0	2.4	1.0	1.2	0.5
	Chlorides (mg/L)	7		5.2	37.9	16.8	18.8	11.3
	Biological							
	Chlorophyll a (ug/L)	7		1.07	15.49	12.28	9.99	5.34
	E. coli (col/100mL)[J]	3	<	1	2	2	2	1
GAIG-2	**Physical**							
	Turbidity (NTU)	7		6.4	20.4	11.0	12.4	5.6
	Total Dissolved Solids (mg/L)	7		84.0	288.0	122.0	151.4	80.0
	Total Suspended Solids (mg/L)	7		2.0	13.0	7.0	6.4	3.8
	Hardness (mg/L)	4		42.4	102.0	68.8	70.5	29.3
	Alkalinity (mg/L)	7		35.5	50.2	42.3	42.5	5.6
	Photic Zone (m)	7		1.83	3.70	2.71	2.61	0.74
	Secchi (m)	7		0.47	1.25	0.98	0.86	0.27
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.004	0.106	0.011	0.037	0.043
	Total Kjeldahl Nitrogen (mg/L)	7		0.164	1.430	0.532	0.615	0.443
	Total Nitrogen (mg/L)[J]	7	<	0.170	1.517	0.534	0.652	0.461
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.004	0.010	0.005	0.006	0.002
	Total Phosphorus (mg/L)	7		0.021	0.077	0.031	0.039	0.020
	CBOD-5 (mg/L)	7	<	2.0	2.8	1.0	1.3	0.7
	Chlorides (mg/L)	7		6.5	58.1	21.0	25.8	19.4
	Biological							
	Chlorophyll a (ug/L)	7		9.61	26.17	18.16	17.47	5.60
	E. coli (col/100mL)[J]	3	<	1	14	3	6	7

Station	Parameter	N		Min	Max	Med	Mean	SD
GAIG-3	**Physical**							
	Turbidity (NTU)	7		9.1	24.6	13.6	15.3	6.2
	Total Dissolved Solids (mg/L)	7		92.0	288.0	134.0	154.6	74.0
	Total Suspended Solids (mg/L)[J]	7		6.0	14.0	9.0	9.0	2.6
	Hardness (mg/L)	4		38.5	102.0	71.5	70.9	28.9
	Alkalinity (mg/L)	7		34.6	54.0	44.6	43.6	7.4
	Photic Zone (m)	7		1.55	2.88	2.40	2.26	0.56
	Secchi (m)	7		0.52	0.94	0.81	0.75	0.18
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.098	0.076	0.051	0.044
	Total Kjeldahl Nitrogen (mg/L)	7		0.274	0.962	0.552	0.567	0.248
	Total Nitrogen (mg/L)[J]	7	<	0.282	1.038	0.639	0.618	0.264
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.005	0.008	0.006	0.006	0.001
	Total Phosphorus (mg/L)	7		0.026	0.064	0.036	0.041	0.015
	CBOD-5 (mg/L)	7	<	2.0	3.0	1.0	1.7	0.9
	Chlorides (mg/L)	7		8.2	57.2	21.3	26.8	17.1
	Biological							
	Chlorophyll a (ug/L)	7		8.54	29.37	14.95	18.26	9.22
	E. coli (col/100mL)[J]	3		1	33	4	13	18
GAIG-4	**Physical**							
	Turbidity (NTU)	7		11.9	44.5	17.2	22.4	12.3
	Total Dissolved Solids (mg/L)	7		136.0	302.0	160.0	188.3	62.9
	Total Suspended Solids (mg/L)	7		8.0	38.0	13.0	16.6	11.1
	Hardness (mg/L)	4		66.1	112.0	92.2	90.6	19.0
	Alkalinity (mg/L)	7		52.1	77.2	59.2	60.6	8.4
	Photic Zone (m)	7		1.24	2.53	1.72	1.84	0.42
	Secchi (m)	7		0.45	0.91	0.85	0.76	0.19
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.022	0.002	0.005	0.007
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	1.953	0.026	0.397	0.724
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.107	2.260	0.751	0.863	0.697
	Total Nitrogen (mg/L)[J]	7	<	0.422	4.213	0.752	1.260	1.320
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.004	0.010	0.007	0.007	0.002
	Total Phosphorus (mg/L)	7		0.028	0.099	0.039	0.055	0.028
	CBOD-5 (mg/L)	7	<	2.0	3.1	1.0	1.8	1.0
	Chlorides (mg/L)	7		12.2	58.6	22.8	30.3	16.1
	Biological							
	Chlorophyll a (ug/L)	7		11.21	51.26	20.29	22.43	13.55
	E. coli (col/100mL)[J]	3		11	20	16	16	5

Station	Parameter	N		Min	Max	Med	Mean	SD
GAIG-5	**Physical**							
	Turbidity (NTU)	7		19.3	49.4	22.0	25.5	10.7
	Total Dissolved Solids (mg/L)	7		38.0	230.0	88.0	117.4	75.0
	Total Suspended Solids (mg/L)	7		6.0	44.0	17.0	18.7	11.1
	Hardness (mg/L)	4		12.2	88.7	45.2	47.8	36.9
	Alkalinity (mg/L)	7		12.3	51.6	24.4	29.8	13.4
	Photic Zone (m)	7		0.98	1.87	1.55	1.51	0.28
	Secchi (m)	7		0.26	0.66	0.53	0.52	0.13
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.035	0.012	0.016	0.016
	Total Kjeldahl Nitrogen (mg/L)	7		0.216	1.070	0.472	0.546	0.290
	Total Nitrogen (mg/L)[J]	7	<	0.217	1.102	0.473	0.562	0.296
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.006	0.009	0.008	0.007	0.001
	Total Phosphorus (mg/L)	7		0.035	0.134	0.053	0.061	0.034
	CBOD-5 (mg/L)	7	<	2.0	2.8	2.2	1.9	0.8
	Chlorides (mg/L)	7		2.7	45.2	7.9	17.4	17.3
	Biological							
	Chlorophyll a (ug/L)	7		10.68	23.14	19.22	16.93	4.58
	E. coli (col/100mL)[J]	3		4	137	21	54	73
GAIG-6	**Physical**							
	Turbidity (NTU)	7		6.3	23.3	10.0	13.0	6.3
	Total Dissolved Solids (mg/L)	7		68.0	224.0	96.0	117.4	53.0
	Total Suspended Solids (mg/L)	7		2.0	8.0	4.0	4.4	2.4
	Hardness (mg/L)	4		31.5	87.0	48.1	53.7	23.6
	Alkalinity (mg/L)	7		22.4	45.8	35.0	33.8	8.7
	Photic Zone (m)	7		1.92	3.83	2.62	2.70	0.71
	Secchi (m)	7		0.67	1.43	1.01	0.99	0.27
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.094	0.018	0.036	0.039
	Total Kjeldahl Nitrogen (mg/L)	7		0.179	0.914	0.493	0.495	0.238
	Total Nitrogen (mg/L)[J]	7	<	0.182	0.983	0.506	0.531	0.259
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.003	0.007	0.005	0.005	0.002
	Total Phosphorus (mg/L)	7		0.015	0.031	0.026	0.024	0.006
	CBOD-5 (mg/L)	7	<	2.0	2.5	2.0	1.7	0.7
	Chlorides (mg/L)	7		1.8	40.0	4.6	11.8	13.9
	Biological							
	Chlorophyll a (ug/L)	7		8.54	21.89	10.68	13.12	5.08
	E. coli (col/100mL)[J]	3		1	91	5	32	51

J=one or more of the values provided are estimated; < = Actual value is less than the detection limit