2010 Dannelly Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
June 2013

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Alabama River Basin

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LIST OF ACRONYMS

A&I	Agricultural and Industrial Water Supply Use Classification
ADEM	Alabama Department of Environmental Management
AGPT	Algal Growth Potential Test
CHL *a*	Chlorophyll *a*
DO	Dissolved Oxygen
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
COE	United States Army Corp of Engineers

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INTRODUCTION

Dannelly Reservoir was created with the construction of Millers Ferry Lock and Dam. Construction of the reservoir began in 1963 and was completed in 1974 by the United States Army Corps of Engineers (COE). The reservoir covers approximately 17,200 acres and stretches from Benton, Alabama to just northwest of Camden, Alabama. Dannelly provides hydroelectricity to the area and also provides a number of recreational opportunities such as camping, hiking, fishing, and hunting.

The Alabama Department of Environmental Management (ADEM) monitored Dannelly Reservoir as part of the 2010 assessment of the Alabama, Coosa, and Tallapoosa (ACT) River 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 the Field Operations Division of the 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).

A specific water quality criterion for nutrient management was implemented in 2004 at one location on Dannelly Reservoir (Table 1). This criterion represents the maximum growing season mean (April-October) chlorophyll *a* (chl *a*) concentration allowable while still fully supporting Dannelly Reservoir's Swimming and Fish & Wildlife (S/F&W) use classifications.

The purpose of this report is to summarize data collected at eight stations in Dannelly Reservoir during the 2010 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and 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 criteria.

METHODS

Sampling stations were selected using historical data and previous assessments (Fig. 1). Specific location information can be found in Table 1. Dannelly was sampled in the dam forebay, mid reservoir, upper reservoir, and Alabama River mile 220. Four tributary embayments were also monitored: Mullberry Ck, Cahaba R, Bogue Chitto Ck and Pine Barren Ck.

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2010), Surface Water Quality Assurance Project Plan (ADEM 2008a), and Quality Management Plan (ADEM 2008b).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions at each site. For mainstem stations, monthly concentrations of these parameters were graphed with the closest available COE flow data and ADEM's previously collected data to help interpret the 2010 results.

Figure 1. Dannelly Reservoir with 2010 sampling locations. A description of each sampling location is provided in Table 1.

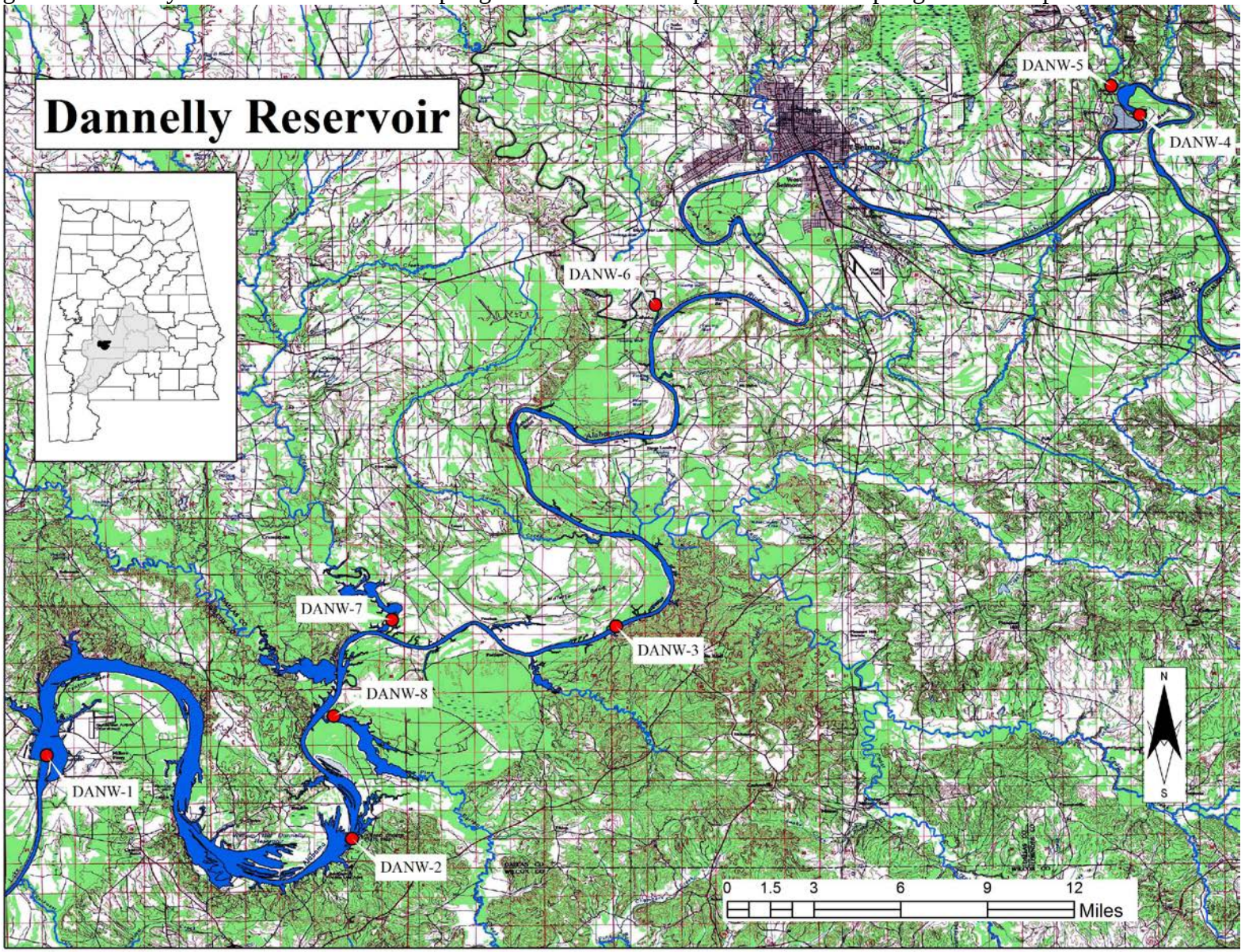


Table 1. Descriptions of the 2010 monitoring stations in Dannelly Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
Dannelly Reservoir								
031502030701	Wilcox	**DANW-1	Lower	Alabama R	Deepest point, main river channel, dam forebay.	17 μg/L	32.1035	-87.3986
031502030701	Wilcox	DANW-2	Mid	Alabama R	Deepest point, main river channel, immediately. upstream of Roland Cooper State Park.		32.0619	-87.2457
031502030203	Dallas	DANW-3	Upper	Alabama R	Deepest point, main river channel, immediately upstream of Elm Bluff Park.		32.1680	-87.1136
031502011204	Dallas	DANW-4	ARM 220	Alabama R	Deepest point, main river channel, upstream of paper mill discharge.		32.4240	-86.8514
031502011005	Dallas	DANW-5	Mullberry Ck	Mulberry Ck	Deepest point, main creek channel, Mulberry Creek embayment, approximately 0.5 miles upstream of lake confluence.		32.4386	-86.8655
031502020902	Dallas	DANW-6	Cahaba R	Cahaba R	Deepest point, main river channel, Cahaba River embayment, approximately 0.5 miles upstream of lake confluence.		32.3289	-87.0937
031502030308	Dallas	DANW-7	Bogue Chitto Ck	Bogue Chitto Ck	Deepest point, main creek channel of Bogue Chitto Creek embayment, approximately 0.5 miles upstream of lake confluence.		32.1713	-87.2257
031502030506	Dallas	DANW-8	Pine Barren Ck	Pine Barren Ck	Deepest point, main creek channel, Pine Barrens Creek embayment, approximately 0.5 miles upstream of lake confluence.		32.1231	-87.2548

**Growing season mean Chl a criterion implemented at this station in 2004

RESULTS

Growing season mean graphs for TN, TP, chl *a* and TSS are provided in this section (Figs. 2 & 3). Monthly graphs for TN, TP, chl *a*, TSS, DO and TSI are also provided (Figs. 4-8 and 11). 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 9-10. Summary statistics of all data collected during 2010 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 that follow will indicate these stations that may be potential candidates for reference waterbodies and watersheds.

In 2010, the highest mean growing season TN value was calculated for the Bogue Chitto Ck station (Fig. 2). Mean growing season TN values at the upper and mid stations have generally decreased from 2002-2010 while the ARM 220 and lower stations were generally similar to previous sampling. Cahaba R, Bogue Chitto Ck and Pine Barren Ck stations showed an increase in mean TN concentrations compared to 2005. Monthly TN graphs show each mainstem station was below historic means most months during the 2010 growing season (Fig. 4). Historic high concentrations were measured in the lower station in April and October and the ARM 220 station in April and September, along with historical lows in August and October at the mid station and June and July at the upper station.

In 2010, the highest mean growing season TP value was calculated for the Bogue Chitto Ck station (Fig. 2). Growing season mean TP concentrations at all mainstem stations were lower in 2010 than previous years. Mean concentrations in all tributaries except Bogue Chitto Ck decreased from 2005 to 2010. Monthly TP concentrations at all stations were at or below historic means April-October (Fig. 5). Historic lows occurred in April and September at the ARM 220 station while a historic low also occurred in September in both the upper and lower stations.

In 2010, the highest growing season mean chl. *a* was calculated for the Bogue Chitto Ck station (Fig. 3). Growing season mean chl *a* concentrations at the ARM 220, upper and mid stations were lower than in previous years of sampling. Cahaba R, increased from 2000-2010, while Bogue Chitto Ck mean chl *a* concentration increased from 2005 to 2010. Concentrations for the remaining two embayment stations decreased 2000-2010. The mean chl *a* concentration in lower Dannelly was below the established criterion, though the mean concentration was over the limit in 2008. Monthly chl. *a* concentrations at the mainstem stations were below mean historic values in most months, reaching historic lows in the upper and mid stations in 4 of 7 months (Fig. 6). Highest values were reached in October at the lower station, July at the upper station and September at both the ARM 220 and mid stations.

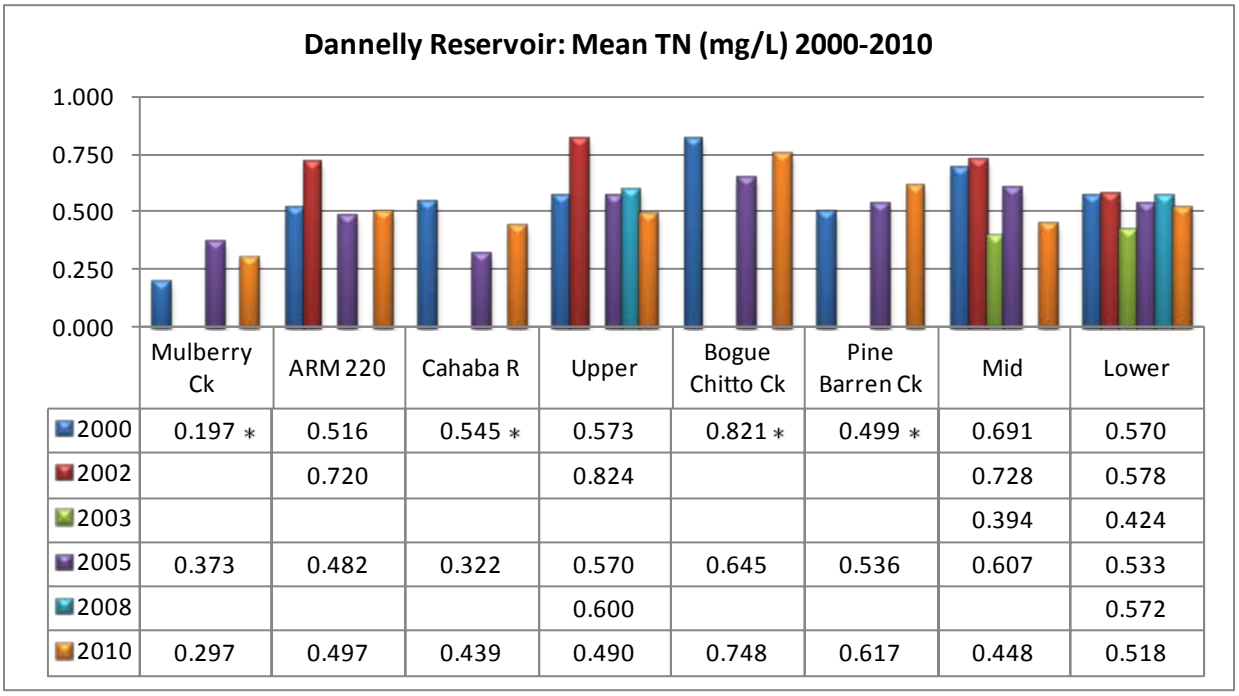
In 2010, the highest mean growing season TSS value was calculated for the Mulberry Ck station (Fig. 3). Mean concentrations generally decreased at all stations 2000-2010. Monthly TSS graphs show each mainstem reservoir station had a similar decrease in concentration June or July-September and were below historic means most months during the 2010 growing season (Fig. 7). A historic high monthly TSS concentration was measured in July at the upper station. Historic lows were measured in multiple months at all stations.

AGPT results show the upper station was co-limited in 2010 (Table 2). Due to resource constraints, AGPT samples were not collected at the ARM 220, mid and lower stations. Mean MSC value at the upper station was 8.91 mg/L, above the value that Raschke et al. (1996) defined as protective of reservoir and lake systems. MSC values for all stations were above 5 mg/L when measured in 2005.

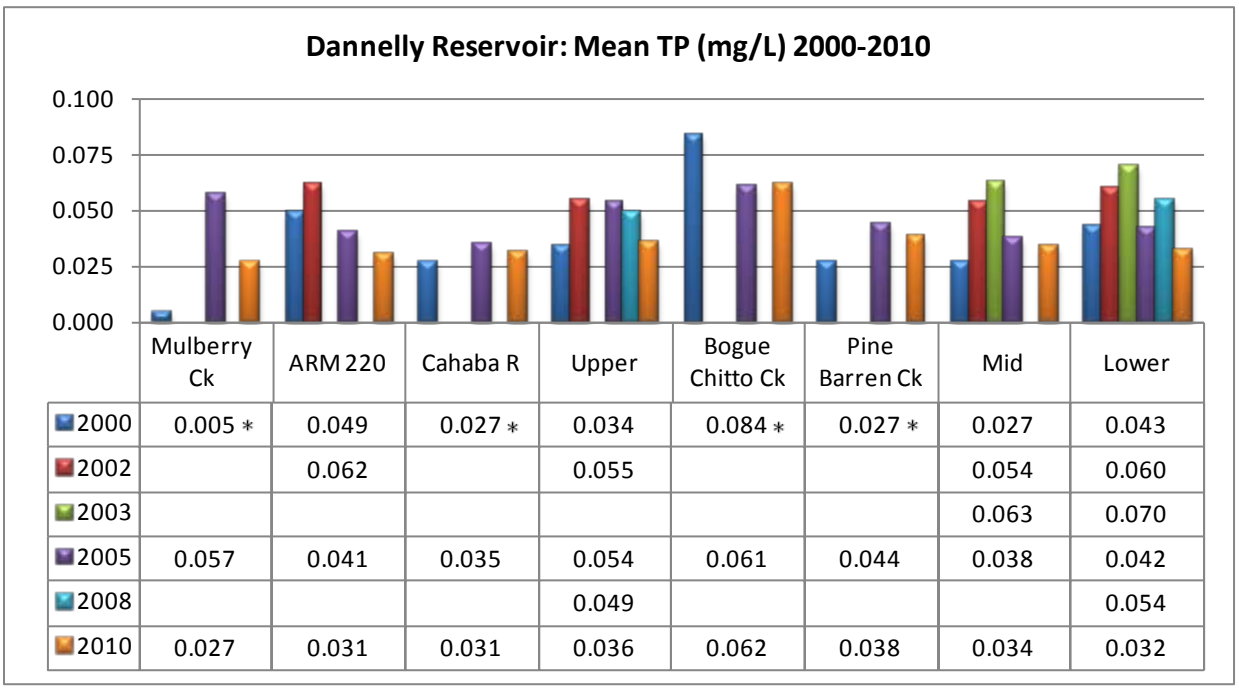
DO concentrations at the Bogue Chitto Ck station were below the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) July-August (ADEM Admin. Code R. 335-6-10-.09) (Fig. 8). The August DO concentration at the lower, mid and Pine Barren Ck stations were also below criteria limits. Profiles of the mainstem stations show both locations were mostly mixed throughout the sampling season and highest temperatures were reached in July and August (Figs. 9 & 10).

TSI values were calculated using monthly chl *a* concentrations and Carlson's Trophic State Index. The Bogue Chitto Ck station had the highest trophic state, bordering hypereutrophic in May and highly eutrophic June-July (Fig. 11). The lower and upper stations were eutrophic May-October while the Cahaba R was eutrophic April-October. TSI values at the ARM 220, mid, and Pine Barren Ck stations varied between oligotrophic and eutrophic April-October. The Mulberry Ck station varied between mesotrophic and oligotrophic April-October.

Figure 2. Mean growing season TN and TP measured in Dannelly Reservoir, April-October, 2000-2010. Bar graphs consist of mainstem and embayment stations, illustrated from upstream to downstream as the graph is read from left to right.



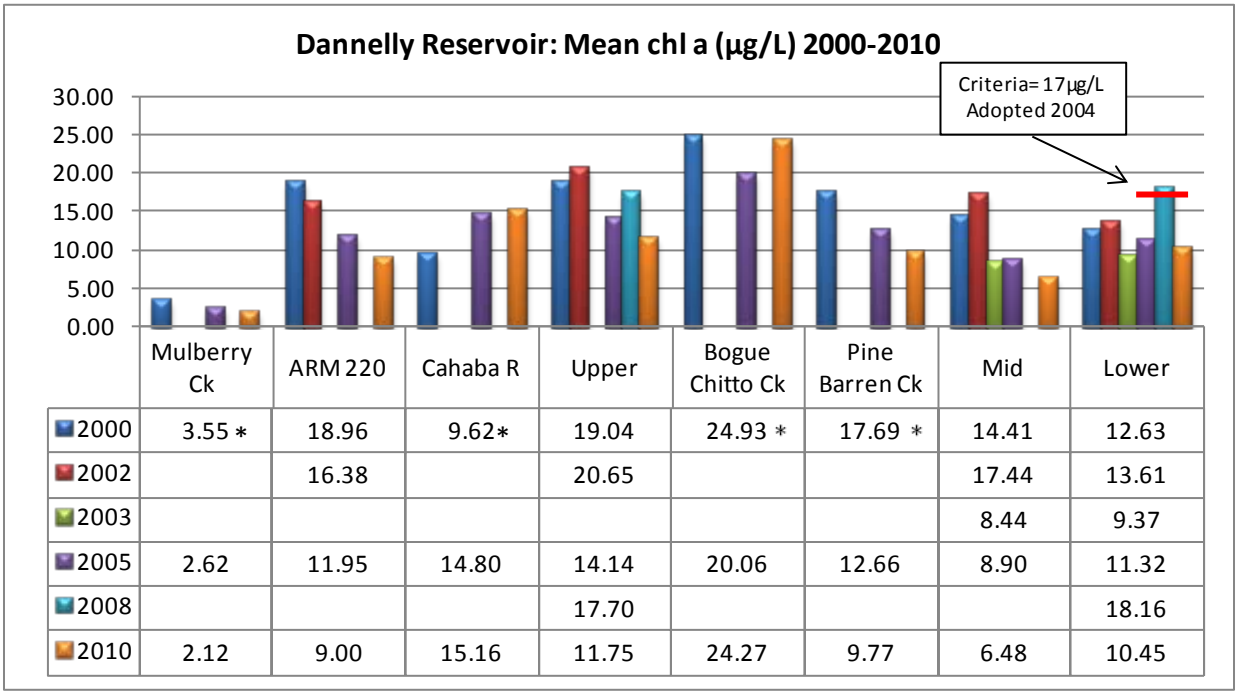
	Mulberry Ck	ARM 220	Cahaba R	Upper	Bogue Chitto Ck	Pine Barren Ck	Mid	Lower
2000	0.197 *	0.516	0.545 *	0.573	0.821 *	0.499 *	0.691	0.570
2002		0.720		0.824			0.728	0.578
2003							0.394	0.424
2005	0.373	0.482	0.322	0.570	0.645	0.536	0.607	0.533
2008				0.600				0.572
2010	0.297	0.497	0.439	0.490	0.748	0.617	0.448	0.518



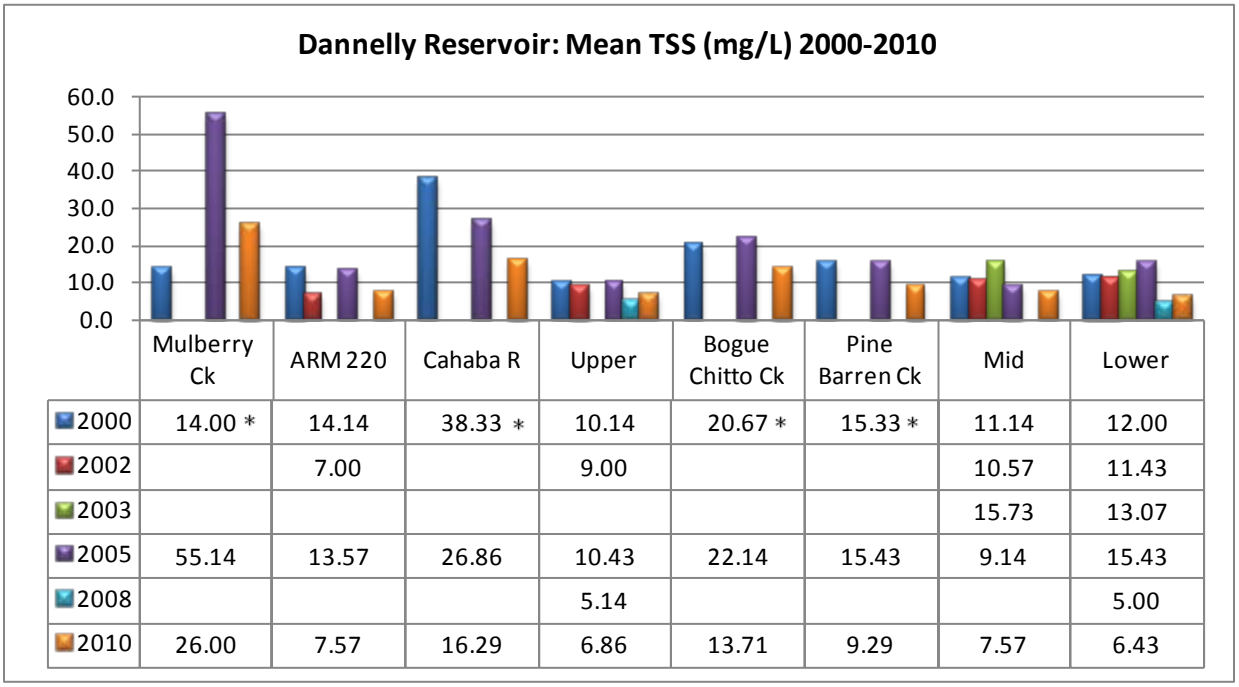
	Mulberry Ck	ARM 220	Cahaba R	Upper	Bogue Chitto Ck	Pine Barren Ck	Mid	Lower
2000	0.005 *	0.049	0.027 *	0.034	0.084 *	0.027 *	0.027	0.043
2002		0.062		0.055			0.054	0.060
2003							0.063	0.070
2005	0.057	0.041	0.035	0.054	0.061	0.044	0.038	0.042
2008				0.049				0.054
2010	0.027	0.031	0.031	0.036	0.062	0.038	0.034	0.032

*Mean of April/June/August only.

Figure 3. Mean growing season chl a and TSS measured in Dannelly Reservoir, April-October, 2000-2010. Bar graphs consist of mainstem and embayment stations, illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria applies to the growing season mean of the lower station only.



	Mulberry Ck	ARM 220	Cahaba R	Upper	Bogue Chitto Ck	Pine Barren Ck	Mid	Lower
2000	3.55 *	18.96	9.62*	19.04	24.93 *	17.69 *	14.41	12.63
2002		16.38		20.65			17.44	13.61
2003							8.44	9.37
2005	2.62	11.95	14.80	14.14	20.06	12.66	8.90	11.32
2008				17.70				18.16
2010	2.12	9.00	15.16	11.75	24.27	9.77	6.48	10.45



	Mulberry Ck	ARM 220	Cahaba R	Upper	Bogue Chitto Ck	Pine Barren Ck	Mid	Lower
2000	14.00 *	14.14	38.33 *	10.14	20.67 *	15.33 *	11.14	12.00
2002		7.00		9.00			10.57	11.43
2003							15.73	13.07
2005	55.14	13.57	26.86	10.43	22.14	15.43	9.14	15.43
2008				5.14				5.00
2010	26.00	7.57	16.29	6.86	13.71	9.29	7.57	6.43

*Mean of April/June/August only.

Figure 4. Monthly TN concentrations measured in Dannelly Reservoir, April-October 2010. Each bar graph depicts monthly changes in each station. The historic mean and min/max range are also displayed for comparison. The "n" value equals the number of data points included in the monthly historic calculations. TN was plotted vs. the closest discharge (COE Alabama River at Millers Ferry L& D near Camden, AL).

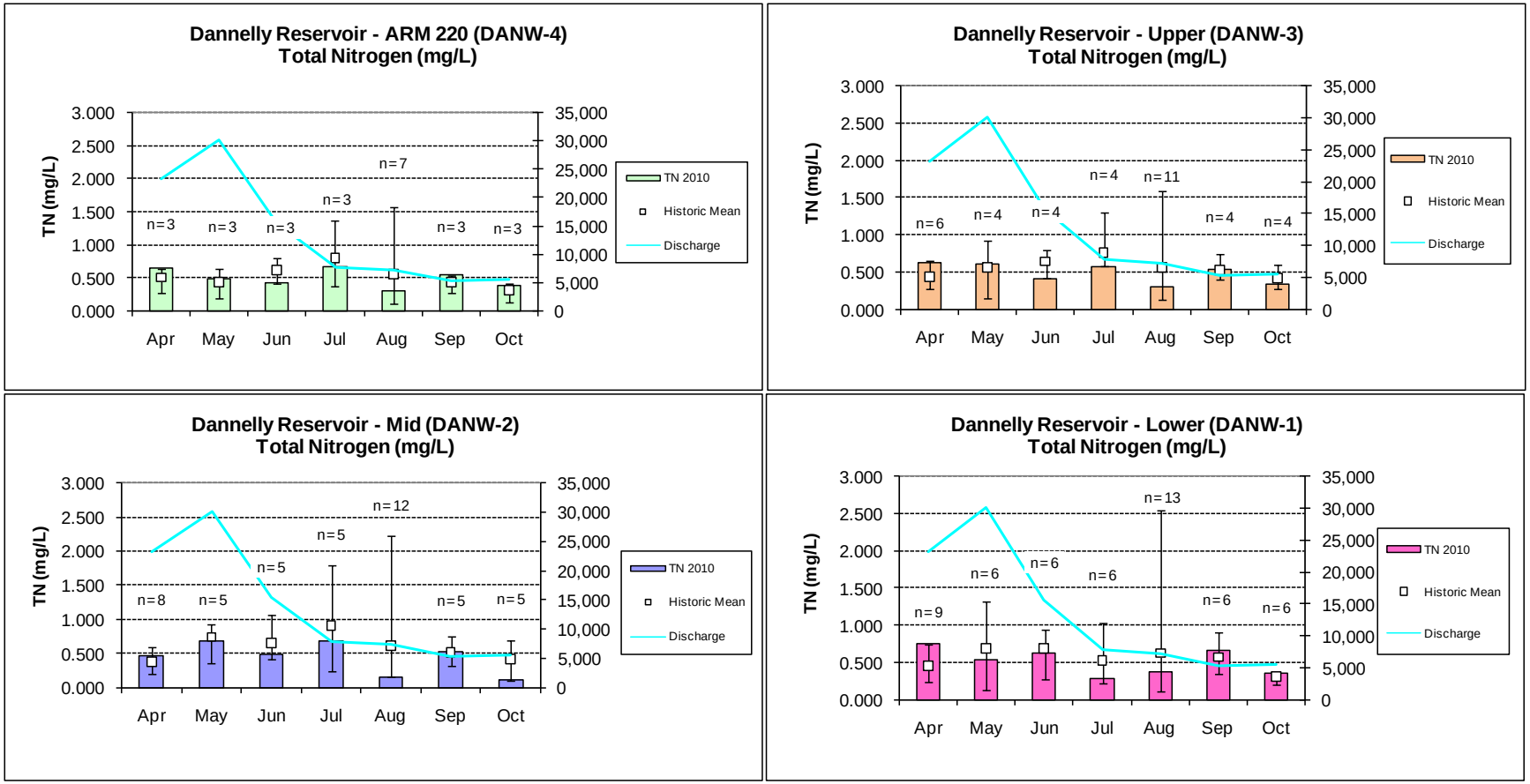


Figure 5. Monthly TP concentrations measured in Dannelly Reservoir, April-October 2010. Each bar graph depicts monthly changes in each station. The historic mean and min/max range are also displayed for comparison. The "n" value equals the number of data points included in the monthly historic calculations. TP was plotted vs. the closest discharge (COE Alabama River at Millers Ferry L&D near Camden, AL).

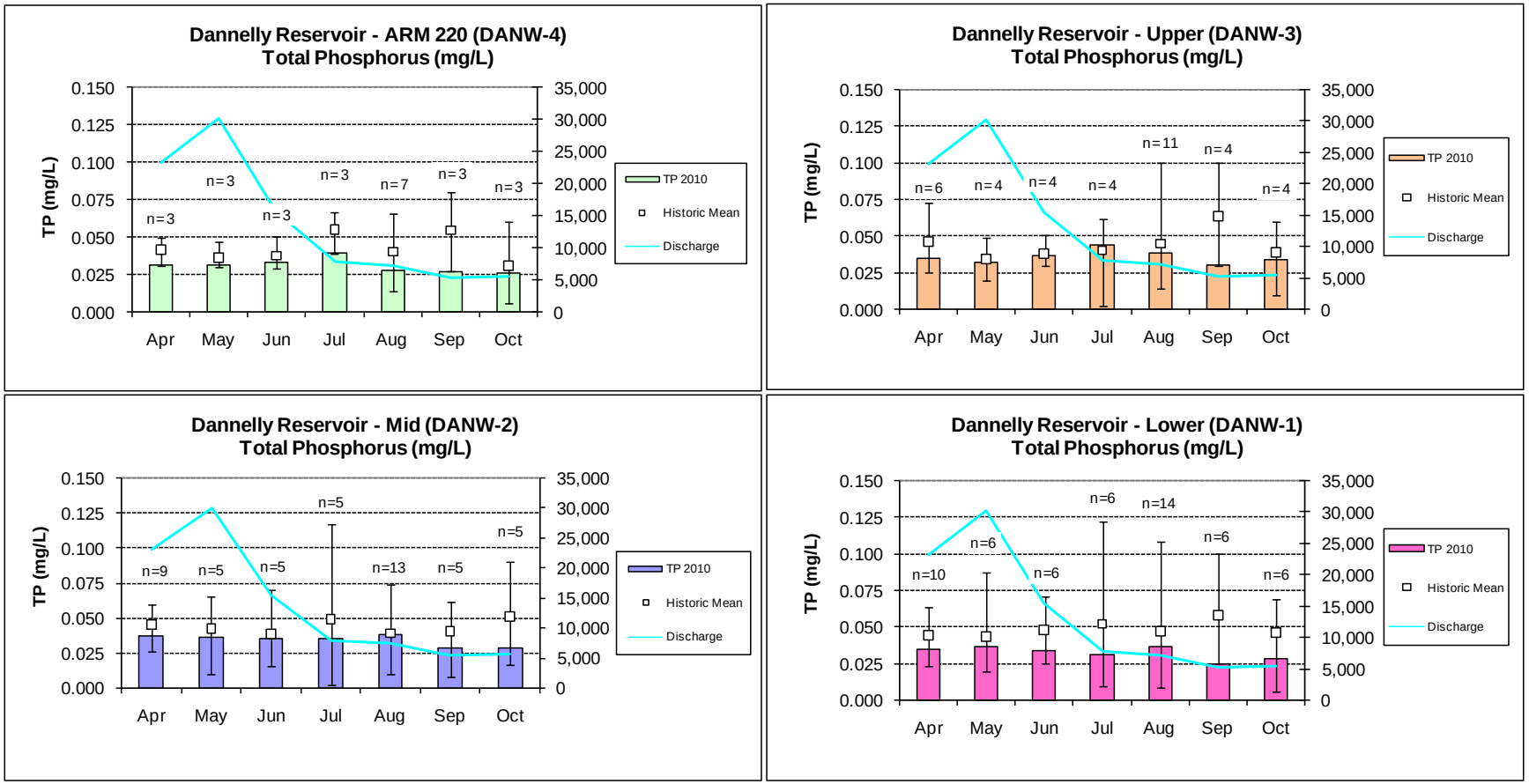


Figure 6. Monthly chl *a* concentrations measured in Dannelly Reservoir, April-October 2010**.** Each bar graph depicts monthly changes in each station**.** The historic mean and min/max range are also displayed for comparison. The "n" value equals the number of data points included in the monthly historic calculations. Chl *a* was plotted vs. the closest discharge (COE Alabama River at Millers Ferry L&D near Camden, AL).

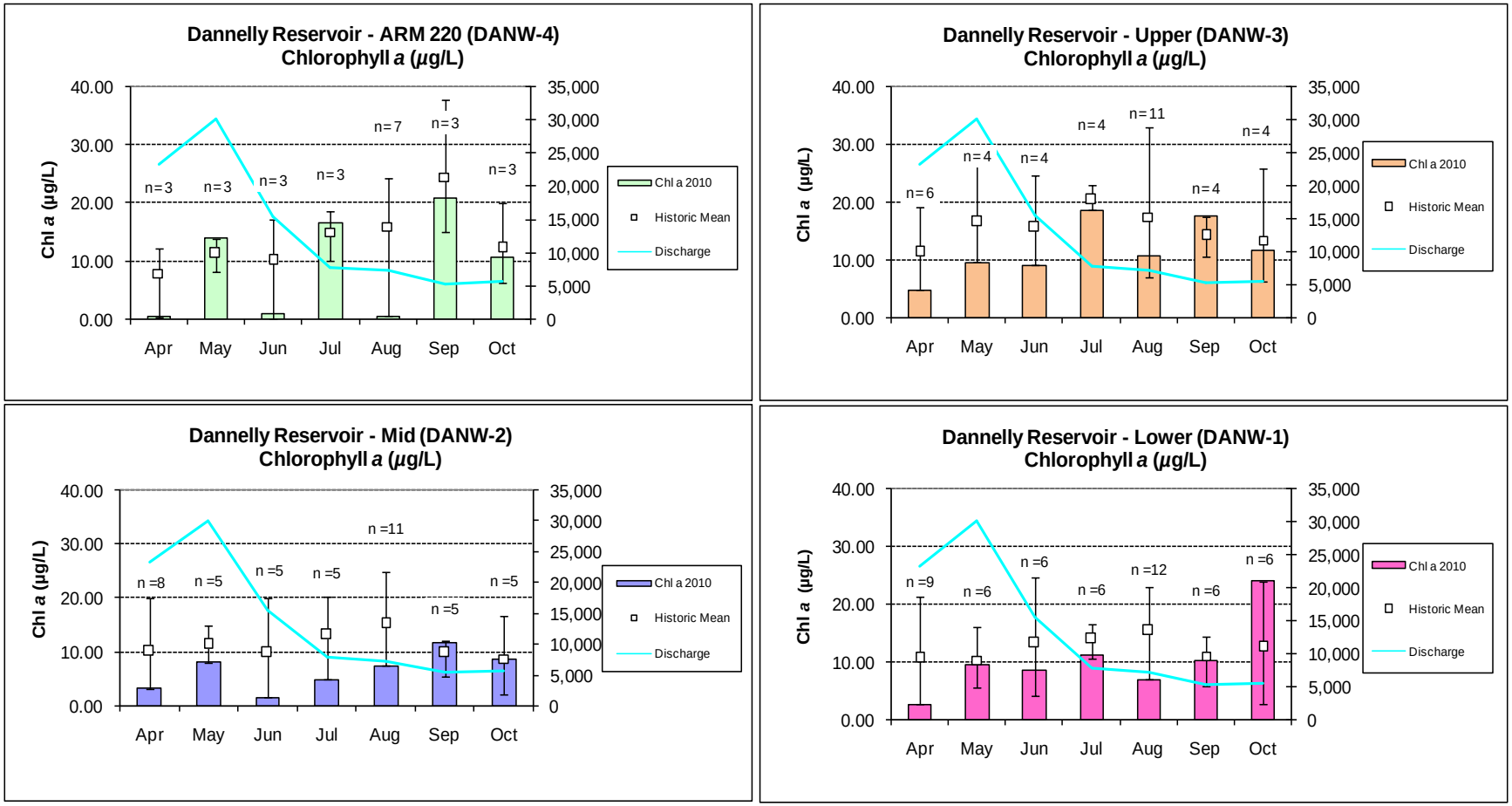


Figure 7. Monthly TSS concentrations measured in Dannelly Reservoir, April-October 2010. Each bar graph depicts monthly changes in each station. The historic mean and min/max range are also displayed for comparison. The "n" value equals the number of data points included in the monthly historic calculations. TSS was plotted vs. the closest discharge (COE Alabama River at Millers Ferry L&D near Camden, AL).

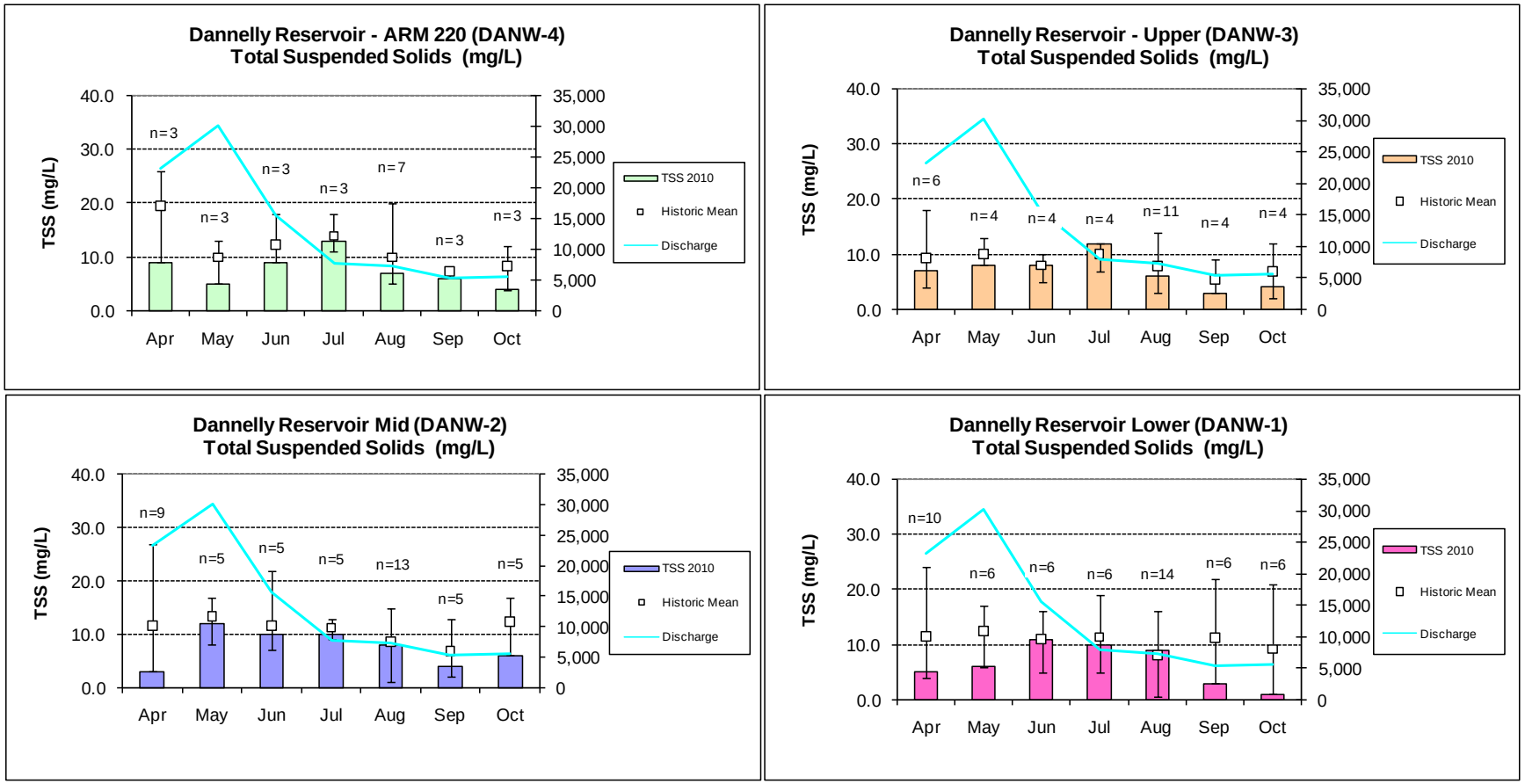


Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective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

Station	ARM 220		Upper		Mid		Lower	
	MSC	Limiting Nutrient	MSC	Limiting Nutrient	MSC	Limiting Nutrient	MSC	Limiting Nutrient
2000	2.01	Nitrogen	2.82	Nitrogen	4.34	Nitrogen	2.94	Nitrogen
2005	9.79	Phosphorus	9.71	Phosphorus	8.12	Phosphorus	6.61	Phosphorus
2010	---	---	8.91	Co- Limiting	---	---	---	---

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for Dannelly Reservoir stations collected April-October 2010. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2010). In tributaries, when total depth was less than 3 m, criteria apply to the mid-depth reading.

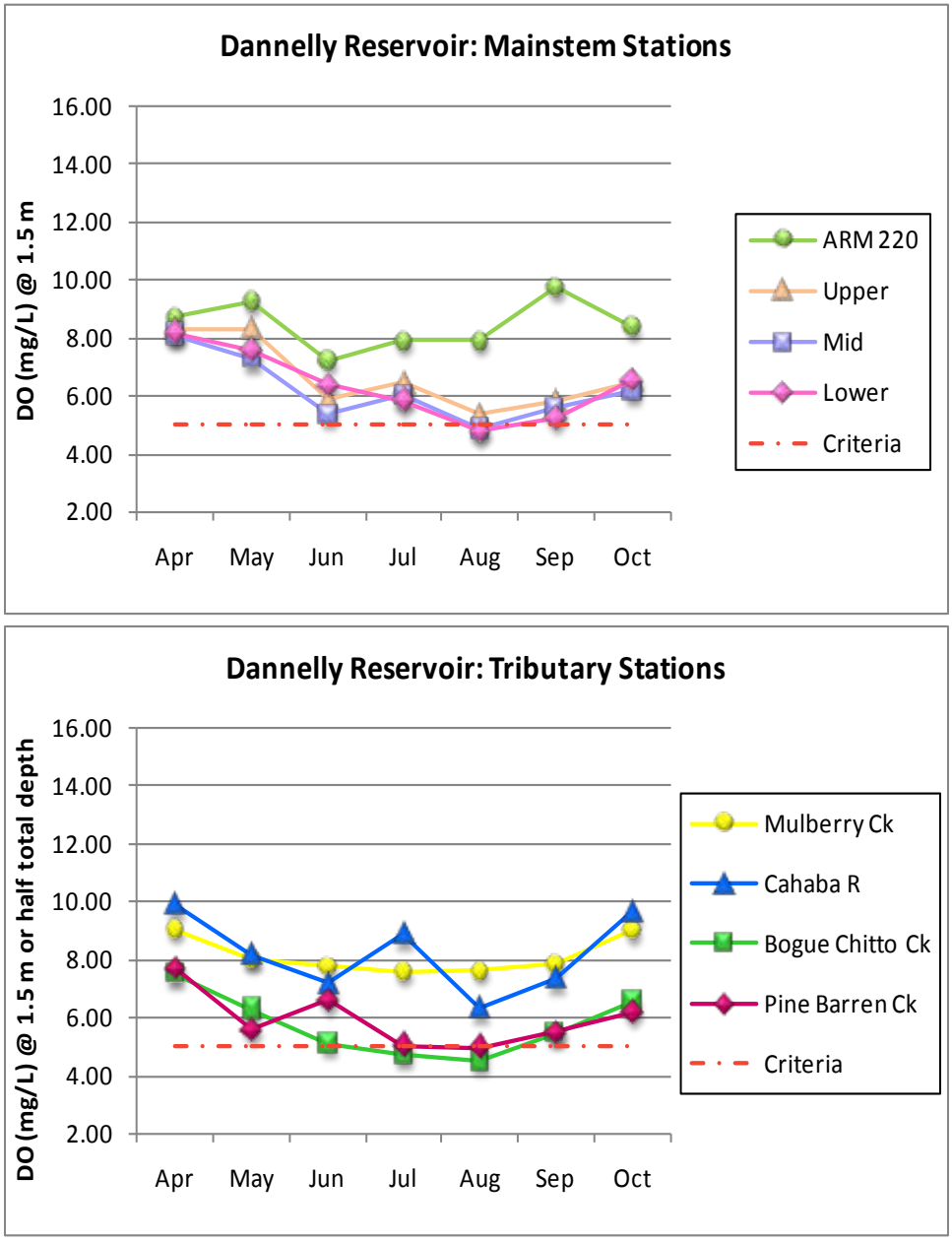


Figure 9. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Dannelly Reservoir station, April-October 2010.

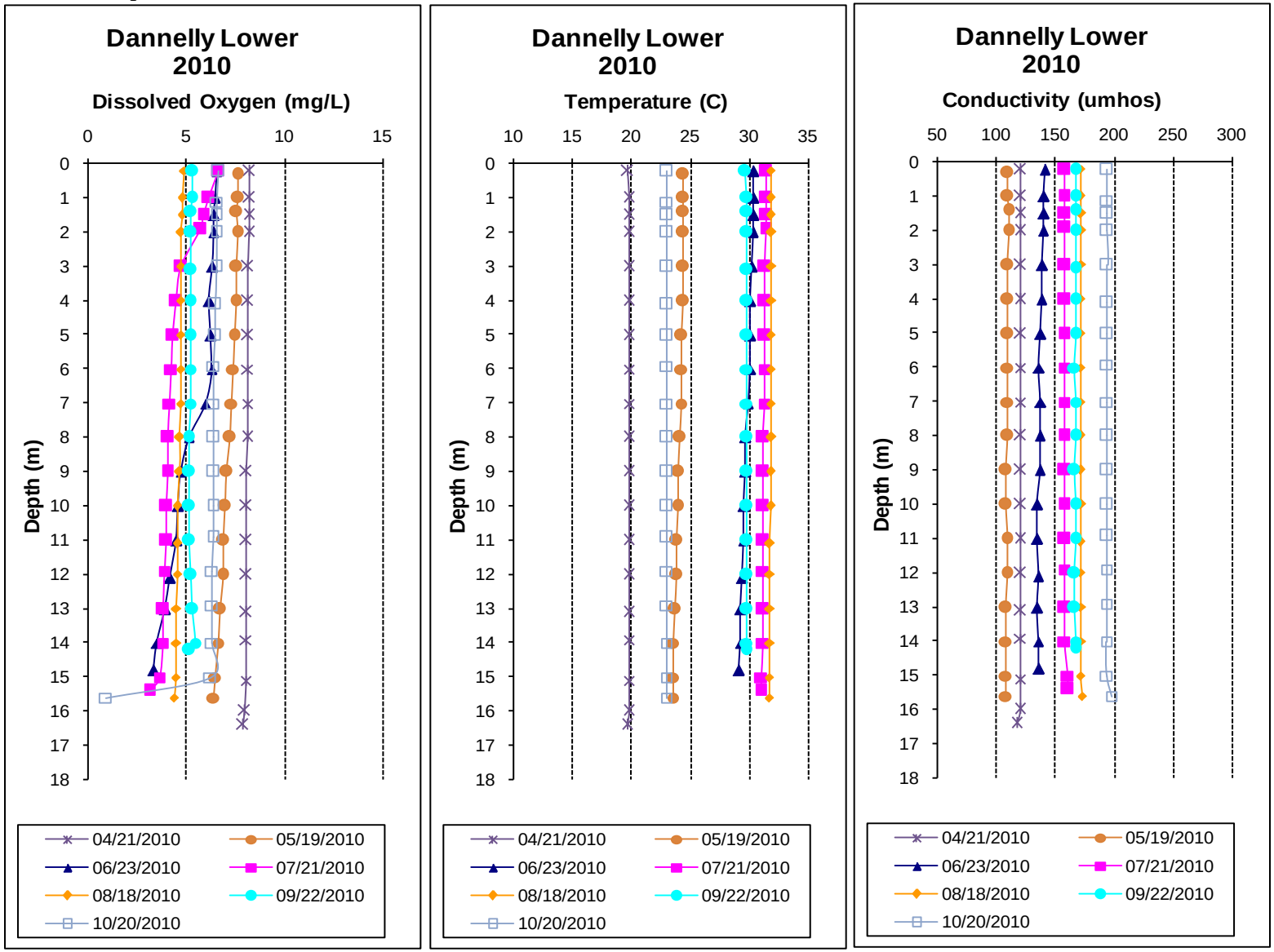


Figure 10. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the mid Dannelly Reservoir station, April-October 2010.

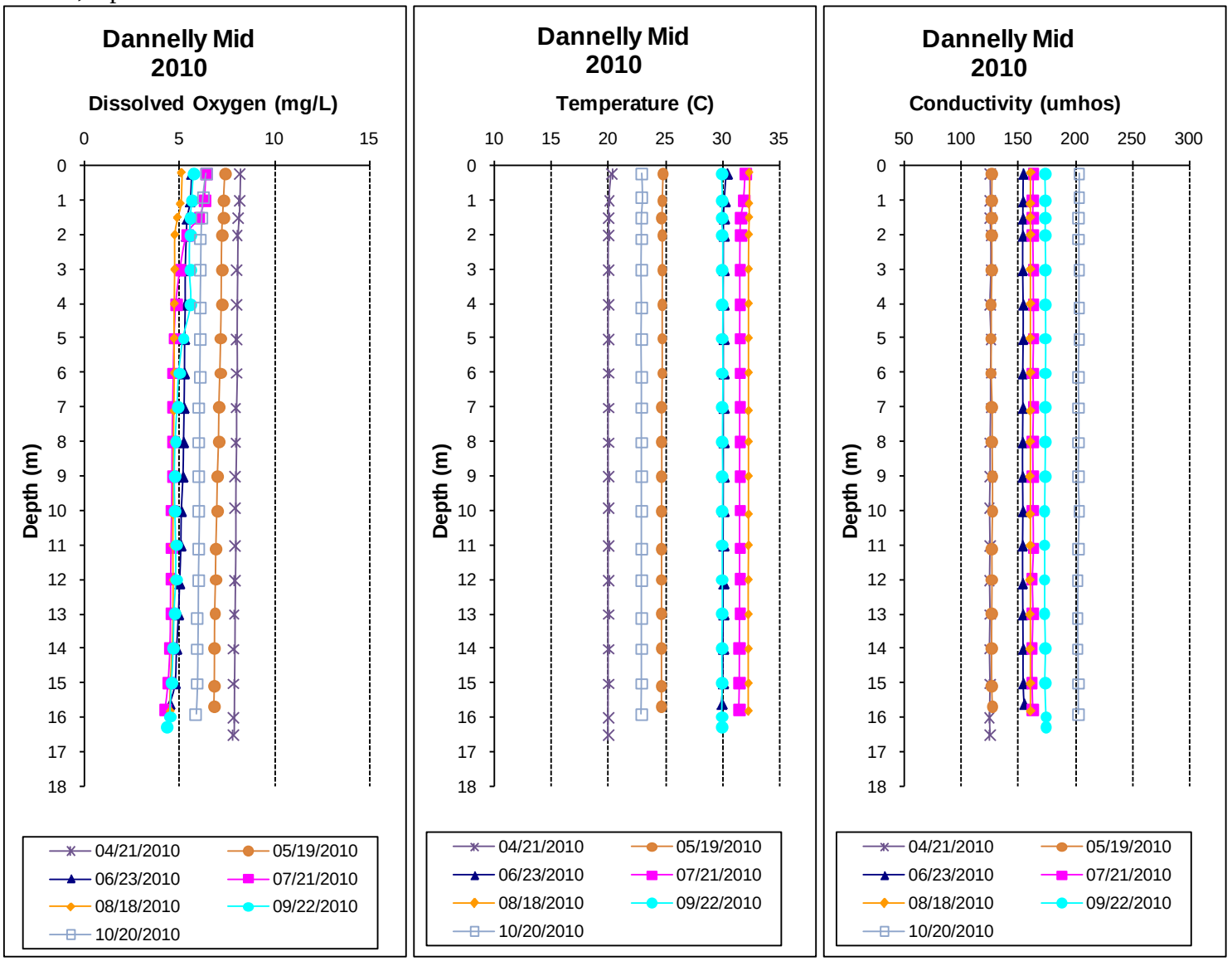
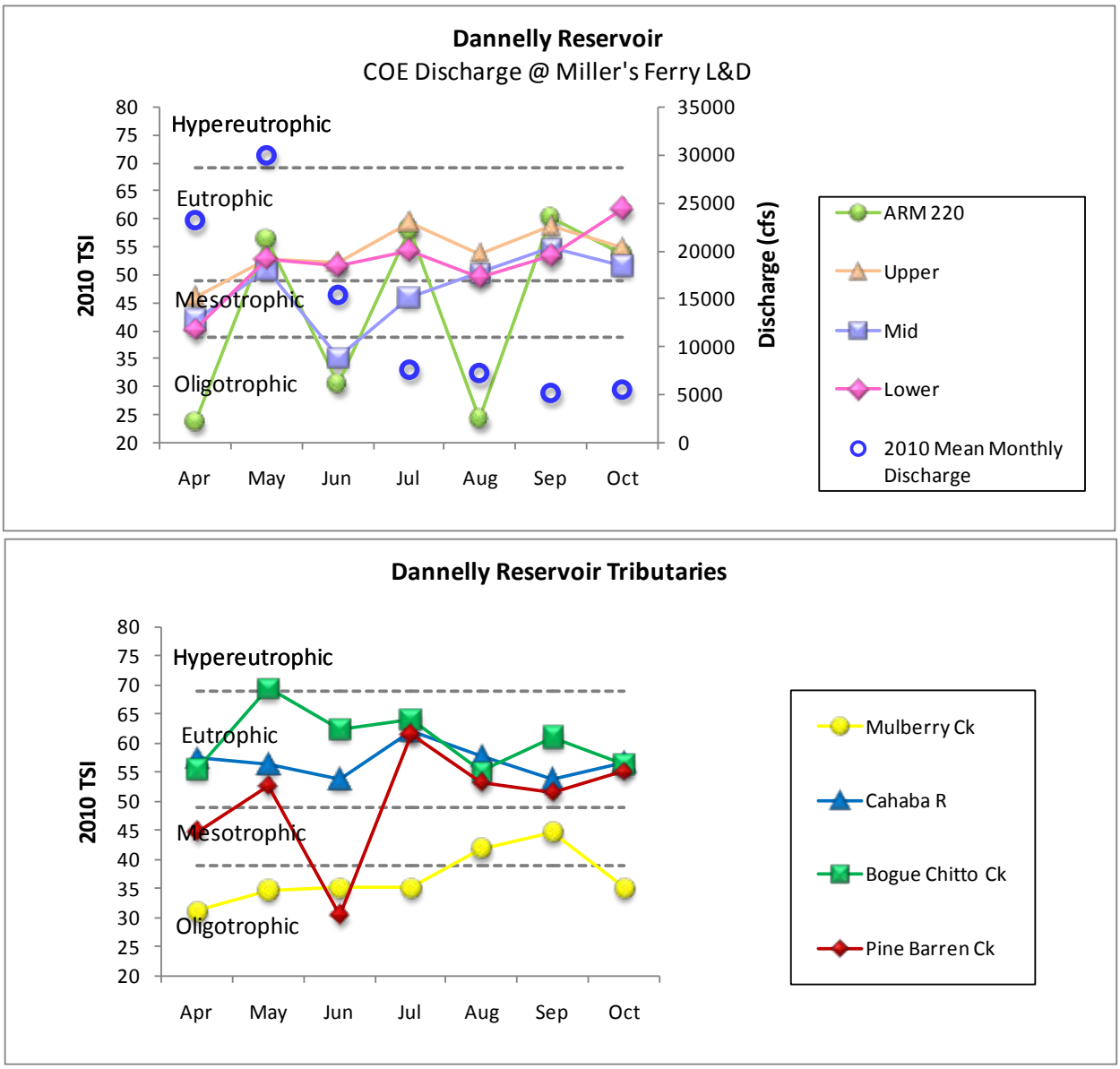


Figure 11. Monthly TSI values calculated for mainstem and tributary Dannelly Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. TSI for mainstem stations were plotted vs. closest discharge (COE Alabama River at Millers Ferry L&D near Camden, AL).



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APPENDIX

Appendix Table 1. Summary of water quality data collected April-October, 2010. 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
DANW-1	**Physical**						
	Turbidity (NTU)	7	7.1	15.1	12.8	11.6	3.4
	Total Dissolved Solids (mg/L)[J]	7	56.0	136.0	92.0	88.9	26.2
	Total Suspended Solids (mg/L)[J]	7	1.0	11.0	6.0	6.4	3.7
	Hardness (mg/L)	4	42.2	56.8	49.0	49.3	6.0
	Alkalinity (mg/L)	7	40.9	60.4	55.1	52.8	7.2
	Photic Zone (m)	7	2.44	3.47	2.63	2.82	0.35
	Secchi (m)	7	0.65	1.38	0.78	0.94	0.30
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.037	0.207	0.092	0.106	0.058
	Total Kjeldahl Nitrogen (mg/L)	7	0.202	0.596	0.403	0.413	0.159
	Total Nitrogen (mg/L)	7	0.294	0.747	0.545	0.518	0.174
	Dissolved Reactive Phosphorus (mg/L)[J]	7	0.003	0.010	0.005	0.006	0.003
	Total Phosphorus (mg/L)	7	0.025	0.037	0.034	0.032	0.005
	CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7	3.8	9.5	6.1	6.3	2.2
	Biological						
	Chlorophyll a (ug/L)	7	2.67	24.03	9.61	10.45	6.61
	E. coli (mpn/100mL)[J]	3	< 1	2	1	1	1
DANW-2	**Physical**						
	Turbidity (NTU)	7	5.5	13.6	11.3	10.0	3.2
	Total Dissolved Solids (mg/L)[J]	7	78.0	128.0	100.0	98.6	17.3
	Total Suspended Solids (mg/L)	7	3.0	12.0	8.0	7.6	3.4
	Hardness (mg/L)	4	46.0	56.5	50.0	50.6	4.3
	Alkalinity (mg/L)	7	44.9	62.5	56.5	55.2	6.9
	Photic Zone (m)	7	2.55	3.62	2.73	2.93	0.39
	Secchi (m)	7	0.84	1.48	0.89	1.05	0.29
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.022	0.010	0.012	0.004
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.072	0.223	0.139	0.137	0.054
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.080	0.531	0.351	0.311	0.208
	Total Nitrogen (mg/L)	7	< 0.112	0.691	0.490	0.448	0.230
	Dissolved Reactive Phosphorus (mg/L)[J]	7	0.003	0.012	0.006	0.008	0.004
	Total Phosphorus (mg/L)	7	0.029	0.038	0.035	0.034	0.004
	CBOD-5 (mg/L)	7	< 2.0	3.9	1.0	1.8	1.3
	Chlorides (mg/L)	7	4.2	10.1	6.4	6.6	1.9
	Biological						
	Chlorophyll a (ug/L)	7	1.60	11.75	7.48	6.48	3.48
	E. coli (mpn /100mL)[J]	3	< 1	4	3	3	2

Station	Parameter	N	Min	Max	Med	Mean	SD
DANW-3	**Physical**						
	Turbidity (NTU)	7	5.0	11.6	9.2	8.6	2.7
	Total Dissolved Solids (mg/L)[J]	7	64.0	128.0	100.0	97.4	20.0
	Total Suspended Solids (mg/L)	7	3.0	12.0	7.0	6.9	3.0
	Hardness (mg/L)	4	47.4	54.8	51.4	51.2	4.1
	Alkalinity (mg/L)	7	48.3	63.8	57.4	56.8	6.2
	Photic Zone (m)	7	2.42	3.51	3.10	3.07	0.42
	Secchi (m)	7	0.87	1.44	1.04	1.11	0.22
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.028	0.010	0.013	0.007
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.057	0.213	0.158	0.144	0.055
	Total Kjeldahl Nitrogen (mg/L)	7	0.174	0.483	0.413	0.346	0.119
	Total Nitrogen (mg/L)	7	0.311	0.626	0.540	0.490	0.133
	Dissolved Reactive Phosphorus (mg/L)[J]	7	0.003	0.010	0.006	0.006	0.002
	Total Phosphorus (mg/L)	7	0.030	0.044	0.035	0.036	0.005
	CBOD-5 (mg/L)	7	< 2.0	2.8	1.0	1.5	0.8
	Chlorides (mg/L)	7	4.7	9.0	7.0	7.2	1.6
	Biological						
	Chlorophyll a (ug/L)	7	4.81	18.69	10.68	11.75	4.89
	E. coli (mpn /100mL)	3	2	3	3	3	1
DANW-4	**Physical**						
	Turbidity (NTU)	7	5.0	13.5	9.6	9.0	3.8
	Total Dissolved Solids (mg/L)[J]	7	62.0	116.0	76.0	80.6	18.3
	Total Suspended Solids (mg/L)[J]	7	4.0	13.0	7.0	7.6	3.0
	Hardness (mg/L)	4	34.0	46.0	42.9	41.4	5.5
	Alkalinity (mg/L)	7	38.7	62.1	45.8	49.0	8.0
	Photic Zone (m)	7	2.93	4.49	3.59	3.75	0.62
	Secchi (m)	7	0.74	1.62	1.10	1.13	0.30
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.044	0.259	0.165	0.156	0.076
	Total Kjeldahl Nitrogen (mg/L)	7	0.216	0.525	0.279	0.341	0.130
	Total Nitrogen (mg/L)	7	0.311	0.677	0.494	0.497	0.135
	Dissolved Reactive Phosphorus (mg/L)[J]	7	< 0.003	0.011	0.005	0.006	0.003
	Total Phosphorus (mg/L)	7	0.026	0.039	0.031	0.031	0.004
	CBOD-5 (mg/L)	7	< 2.0	4.6	1.0	1.9	1.4
	Chlorides (mg/L)	7	4.6	7.9	6.5	6.2	1.2
	Biological						
	Chlorophyll a (ug/L)	7	< 0.10	20.83	10.68	9.00	8.64
	E. coli (mpn /100mL)	3	3	9	5	6	3

Station	Parameter	N	Min	Max	Med	Mean	SD
DANW-5	**Physical**						
	Turbidity (NTU)	7	4.7	23.7	16.8	15.2	7.3
	Total Dissolved Solids (mg/L)[J]	7	26.0	60.0	34.0	36.6	11.1
	Total Suspended Solids (mg/L)[J]	7	6.0	96.0	16.0	26.0	31.6
	Hardness (mg/L)	4	9.0	11.6	10.9	10.6	1.2
	Alkalinity (mg/L)	7	8.0	13.9	9.8	10.0	2.1
	Photic Zone (m)	4	0.20	0.40	0.35	0.32	0.10
	Secchi (m)	4	0.20	0.40	0.35	0.32	0.10
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.058	0.175	0.135	0.130	0.038
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.080	0.313	0.192	0.168	0.125
	Total Nitrogen (mg/L)	7	< 0.098	0.434	0.367	0.297	0.140
	Dissolved Reactive Phosphorus (mg/L)[J]	7	0.005	0.012	0.011	0.010	0.003
	Total Phosphorus (mg/L)	7	0.015	0.058	0.023	0.027	0.015
	CBOD-5 (mg/L)	7	< 2.0	2.5	1.0	1.2	0.6
	Chlorides (mg/L)	7	2.4	2.7	2.5	2.5	0.1
	Biological						
	Chlorophyll a (ug/L)	7	1.07	4.27	1.60	2.12	1.16
	E. coli (mpn /100mL)	3	53	86	85	75	19
DANW-6	**Physical**						
	Turbidity (NTU)	7	8.4	28.0	18.8	19.1	6.5
	Total Dissolved Solids (mg/L)[J]	7	98.0	174.0	130.0	132.6	22.2
	Total Suspended Solids (mg/L)	7	9.0	27.0	16.0	16.3	6.6
	Hardness (mg/L)	4	74.9	115.0	94.4	94.7	17.2
	Alkalinity (mg/L)	7	71.8	112.0	93.9	90.0	15.7
	Photic Zone (m)	7	1.67	3.51	2.15	2.30	0.63
	Secchi (m)	7	0.44	1.00	0.73	0.70	0.19
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.002	0.402	0.042	0.134	0.170
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.080	0.625	0.447	0.305	0.255
	Total Nitrogen (mg/L)	7	< 0.041	0.649	0.448	0.439	0.202
	Dissolved Reactive Phosphorus (mg/L)[J]	7	0.003	0.011	0.007	0.007	0.003
	Total Phosphorus (mg/L)	7	0.020	0.042	0.034	0.031	0.008
	CBOD-5 (mg/L)	7	< 2.0	3.3	1.0	1.5	0.9
	Chlorides (mg/L)	7	3.2	7.2	3.8	4.5	1.5
	Biological						
	Chlorophyll a (ug/L)	7	10.68	25.10	14.26	15.16	4.87
	E. coli (mpn /100mL)	3	2	6	4	4	2

Station	Parameter	N	Min	Max	Med	Mean	SD
DANW-7	**Physical**						
	Turbidity (NTU)	7	7.5	31.5	16.2	16.2	7.6
	Total Dissolved Solids (mg/L)[J]	7	98.0	140.0	106.0	110.0	14.2
	Total Suspended Solids (mg/L)	7	5.0	26.0	13.0	13.7	6.3
	Hardness (mg/L)	4	49.5	65.2	57.4	57.4	6.4
	Alkalinity (mg/L)	7	51.9	78.0	65.3	63.5	8.8
	Photic Zone (m)	7	1.23	2.89	2.08	2.12	0.50
	Secchi (m)	7	0.46	1.20	0.64	0.72	0.24
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.033	0.010	0.014	0.008
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	< 0.003	0.184	0.059	0.077	0.071
	Total Kjeldahl Nitrogen (mg/L)	7	0.319	1.317	0.679	0.671	0.339
	Total Nitrogen (mg/L)[J]	7	< 0.378	1.482	0.708	0.748	0.367
	Dissolved Reactive Phosphorus (mg/L)[J]	7	0.005	0.014	0.008	0.008	0.003
	Total Phosphorus (mg/L)	7	0.037	0.106	0.058	0.062	0.022
	CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7	4.6	9.8	6.3	6.4	1.9
	Biological						
	Chlorophyll a (ug/L)	7	12.28	52.33	22.43	24.27	14.23
	E. coli (mpn/100mL)[J]	3	2	4	2	3	1
DANW-8	**Physical**						
	Turbidity (NTU)	7	8.4	23.0	13.5	14.6	4.9
	Total Dissolved Solids (mg/L)[J]	7	80.0	142.0	82.0	94.3	22.7
	Total Suspended Solids (mg/L)	7	7.0	12.0	9.0	9.3	2.1
	Hardness (mg/L)	4	47.1	56.5	50.2	51.0	4.4
	Alkalinity (mg/L)	7	39.8	59.2	52.8	52.6	6.4
	Photic Zone (m)	7	1.99	2.66	2.54	2.41	0.27
	Secchi (m)	7	0.61	1.24	0.77	0.84	0.22
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.154	0.074	0.073	0.052
	Total Kjeldahl Nitrogen (mg/L)	7	0.212	0.960	0.595	0.544	0.276
	Total Nitrogen (mg/L)	7	< 0.303	1.071	0.643	0.617	0.266
	Dissolved Reactive Phosphorus (mg/L)[J]	7	< 0.003	0.010	0.008	0.007	0.003
	Total Phosphorus (mg/L)	7	0.030	0.045	0.040	0.038	0.005
	CBOD-5 (mg/L)	7	< 2.0	2.6	1.0	1.2	0.6
	Chlorides (mg/L)	7	3.4	10.0	6.1	5.9	2.3
	Biological						
	Chlorophyll a (ug/L)	7	< 0.10	23.50	9.61	9.77	7.32
	E. coli (mpn/100mL)	3	< 1	6	4	4	3

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