Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

North Sauty Creek Embayment Guntersville Reservoir Intensive Basin Survey 2015 & 2018

GUNM-5: North Sauty Creek immediately upstream of AL Hwy 79 bridge (Jackson Co 34.59347/-86.09138)

BACKGROUND

The Alabama Department of Environmental Management (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 the Rivers and Reservoirs Monitoring Program (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, to 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 2017 Monitoring Strategy (ADEM 2017).

In 2015 and 2018, ADEM monitored the North Sauty Creek tributary embayment of Guntersville Reservoir as part of the intensive basin assessment of the Tennessee River under the RRMP (Figure 1). This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the North Sauty Creek embayment (GUNM-5) during the 2015 and 2018 growing seasons (Apr-Oct). These are the fourth and fifth intensive basin assessments of the Tennessee River since ADEM began sampling on a basin rotation. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (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.

Figure 1. North Sauty Creek at GUNM-5.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. North Sauty Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Sequatchie Valley ecoregion (68b). Based on the 2016 National Land Cover Dataset, land use within the 71 mi^2 watershed is predominantly forest (54%) (Figure 3). As of January 28, 2016, ADEM has issued a total of 24 NPDES permits within the watershed. Eight of those permits are located within 10 mi of the station (Figure 2).

SITE DESCRIPTION

The North Sauty Creek embayment at GUNM-5 is located just west of Scottsboro, AL. It is a fairly large embayment joined by Blue Spring and Archie Creeks before flowing into the Tennessee River near river mile 377. North Sauty Creek has a mean bottom depth of 5.7 meters (Table 2) at the sampling location. Except for the main channel, the embayment is dominated by grasses much of the year.

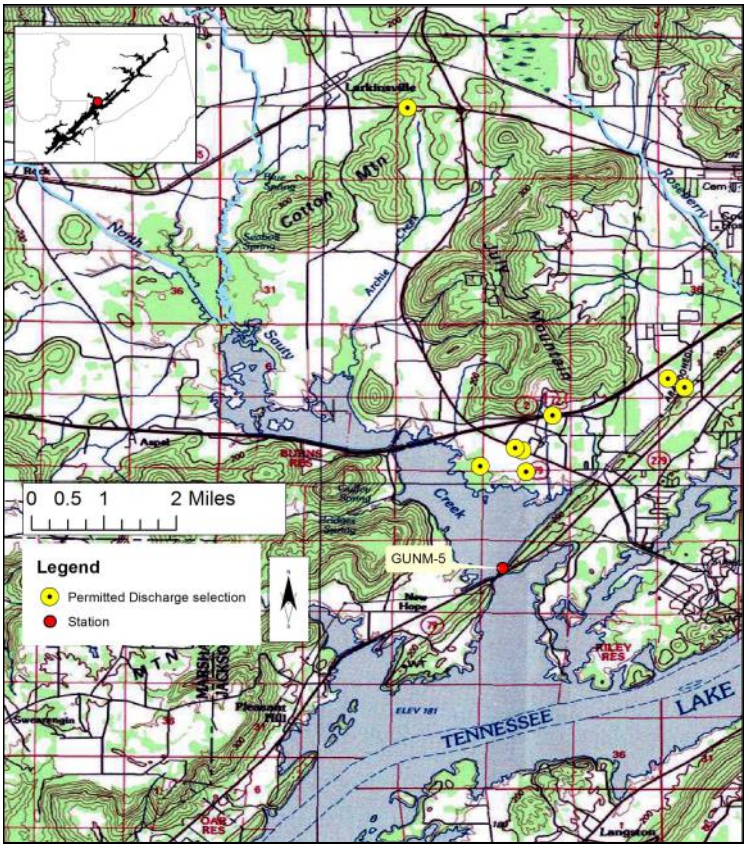


Figure 2. Map of the North Sauty Creek embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

METHODS

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 2018a), Surface Water Quality Assurance Project Plan (ADEM 2018b), and Quality Management Plan (ADEM 2018c).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with discharge data, if available, and ADEM's previously collected data to help interpret the results. Carlson's TSI was calculated from the corrected chl *a* concentrations (1977).

Table 1. Summary of Watershed **GUNM-5**

Basin		Tennessee R
Drainage Area (mi^2)		71
Ecoregion[a]		68b
Assessment Unit		AL06030001-0605-100
% Landuse		
Open Water		6%
Developed	Open Space	3%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	44%
	Evergreen Forest	4%
	Mixed Forest	6%
Shrub/Scrub		3%
Herbaceous		2%
Hay/Pasture		19%
Cultivated Crops		7%
Wetlands	Woody	4%
	Emergent Herb.	<1%
# NPDES outfalls[b]	TOTAL	24
Construction Stormwater		2
Mining		3
Small Mining		0
Industrial General		15
Industrial Individual		4
No Exposure		0
Municipal		0
Underground Injection Control		0

a. Sequatchie Valley
b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.

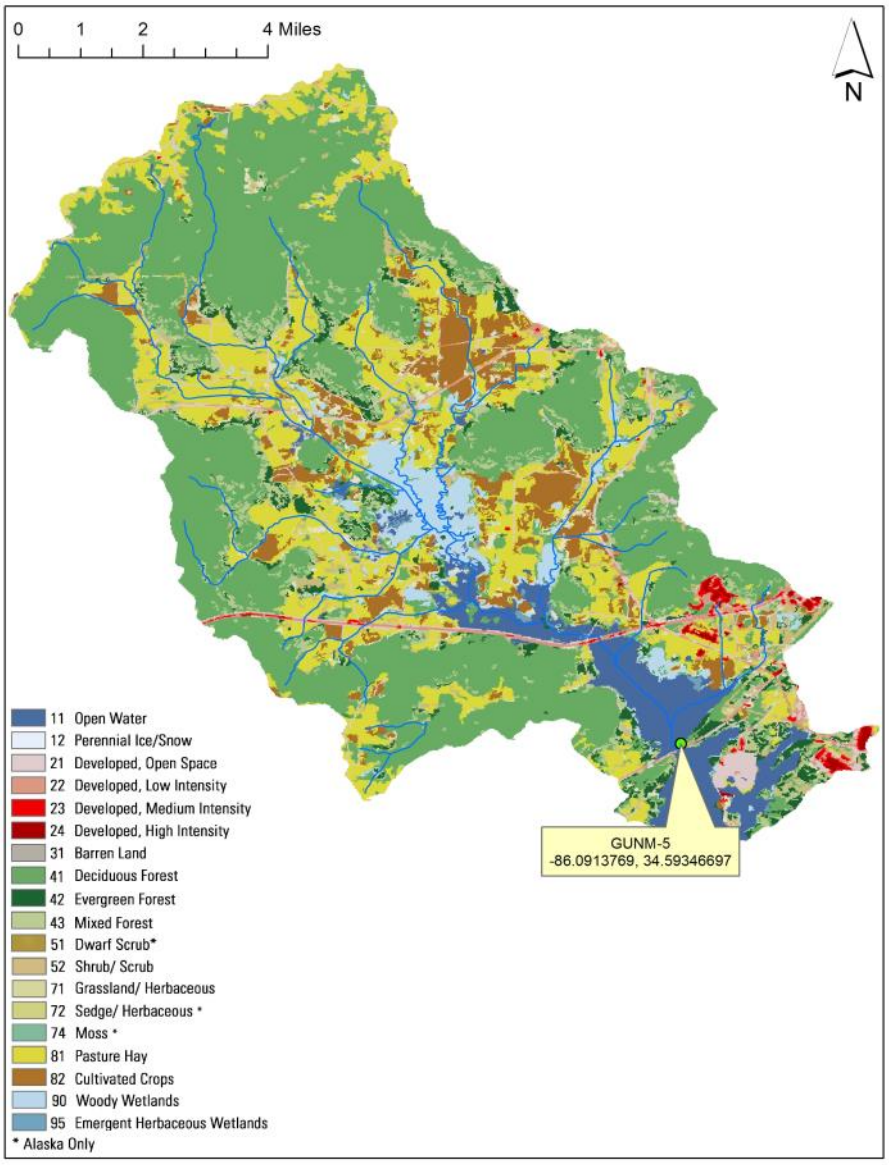


Figure 3. Land use within the North Sauty Creek watershed at GUNM-5.

RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. A summary of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figures 4-6 were set to maximum values reservoir-wide so that all embayment reports on the same reservoir could be compared.

The mean growing season TN value increased 2003-2015, but then declined in 2018 (Figure 4). Monthly TN concentrations were highest in August of 2015 and May of 2018.

The mean growing season TP concentration decreased 2003-2018 (Figure 5). The highest monthly TP concentration was measured in August of 2015 and in April of 2018.

The mean growing season chl *a* value declined 2003-2015 then increased in 2018 (Figure 5). In 2015, the highest monthly chl *a* concentrations were measured in June, July, and August. In 2018, the highest monthly chl *a* concentration was measured in September.

The mean TSI in North Sauty Creek decreased to mesotrophic conditions in 2015, but returned to eutrophic status in 2018 (Figure 5). In 2015, monthly TSI conditions began as oligotrophic (April-June), increased to eutrophic (July-September), and declined to mesotrophic in October. Monthly TSI conditions remained eutrophic throughout the 2018 sampling season.

Table 2. Summary of water quality data collected (April-October, 2015 and 2018). Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), Mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

GUNM-5 2015	N		Min	Max	Med	Avg	SD
Physical							
Turbidity (NTU)	8		4.4	9.8	6.4	6.9	2.0
Total Dissolved Solids (mg/L)	8		104.0	151.0	119.0	120.6	14.8
Total Suspended Solids (mg/L)	8		5.0	10.0	5.5	6.4	1.1
Hardness (mg/L)	4		53.1	88.1	80.8	75.7	15.1
Alkalinity (mg/L)	8		35.4	112.0	59.9	66.1	22.7
Photic Zone (m)	8		2.22	4.12	3.22	3.23	0.68
Secchi (m)	8		0.89	2.29	1.23	1.32	0.45
Bottom Depth (m)	8		4.5	6.3	5.9	5.6	0.7
Chemical							
Ammonia Nitrogen (mg/L)J	8	<	0.007	0.092	0.010	0.023	0.031
Nitrate+Nitrite Nitrogen (mg/L)J	8	<	0.002	0.440	0.026	0.084	0.150
Total Kjeldahl Nitrogen (mg/L)J	8		0.368	1.030	0.520	0.596	0.217
Total Nitrogen (mg/L)J	8	<	1.239	3.108	0.642	0.680	0.239
Dis Reactive Phosphorus (mg/L)J	8	<	0.003	0.011	0.004	0.005	0.003
Total Phosphorus (mg/L)	8		0.014	0.051	0.022	0.024	0.011
CBOD-5 (mg/L)	8	<	2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)J	8		2.5	6.9	5.1	5.5	1.4
Biological							
Chlorophyll a (mg/m³)J	7	<	1.00	16.00	4.81	6.84	6.83
E. coli (MPN/DL)J	4	<	1	3	1	1	1

GUNM-5 2018	N		Min	Max	Med	Avg	SD
Physical							
Turbidity (NTU)	7		4.4	12.1	8.1	8.0	2.6
Total Dissolved Solids (mg/L)	7		91.0	136.0	105.0	107.6	13.9
Total Suspended Solids (mg/L)J	7		6.0	18.0	10.0	10.4	4.2
Hardness (mg/L)	4		67.8	75.7	69.0	70.4	3.7
Alkalinity (mg/L)	7		62.4	110.0	69.7	76.3	17.0
Photic Zone (m)	7		2.06	3.19	2.74	2.66	0.41
Secchi (m)	7		0.95	1.71	1.00	1.15	0.28
Bottom Depth (m)	7		5.4	6.4	5.8	5.8	0.3
Chemical							
Ammonia Nitrogen (mg/L)J	7	<	0.015	0.043	0.008	0.013	0.013
Nitrate+Nitrite Nitrogen (mg/L)J	7	<	0.007	0.108	0.004	0.019	0.039
Total Kjeldahl Nitrogen (mg/L)	7		0.164	0.774	0.581	0.568	0.207
Total Nitrogen (mg/L)J	7	<	0.502	2.346	0.672	0.587	0.212
Dis Reactive Phosphorus (mg/L)	7	<	0.004	0.004	0.002	0.002	0.000
Total Phosphorus (mg/L)J	7		0.007	0.043	0.016	0.020	0.012
CBOD-5 (mg/L)J	7	<	2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)J	7		2.8	5.2	4.4	4.3	0.9
Biological							
Chlorophyll a (mg/m³)	7		6.94	20.30	18.20	15.56	5.06
E. coli (MPN/DL)J	4		1	3	1	2	1

J= one or more of the values is an estimate; N= # samples.

RESULTS (con't)

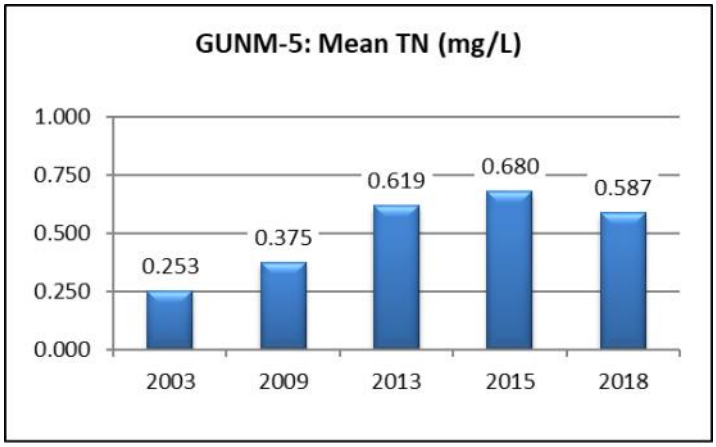
The mean growing season TSS concentration decreased from 2003 to 2009, but it has steadily increased since then (Figure 5). Monthly TSS concentrations were highest in September of 2015 and in July of 2018.

AGPT results show that GUNM-5 was nitrogen limited 2003-2013 (Table 3). Raschke and Schultz (1987) found that maximum standing crop (MSC) values below 5.0 mg/L are considered to be protective of reservoir and lake systems. The MSC value has been less than 5.0 mg/L in all years that AGPT was sampled. AGPT samples were not collected at North Sauty Creek during the 2015 or 2018 sampling seasons.

The DO concentration at the North Sauty Creek was at or above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) for all months sampled in both 2015 and 2018 (ADEM Admin. Code R. 335-6-10-.09) (Figure 6).

Table 3. 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 (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
2003	2.14	NITROGEN
2009	2.41	NITROGEN
2013	3.38	NITROGEN



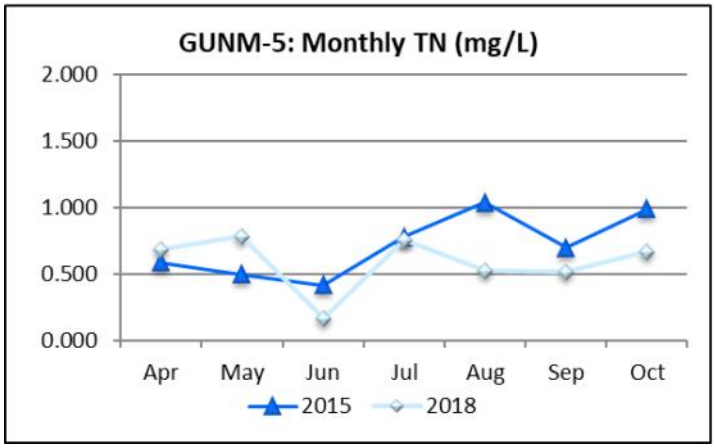
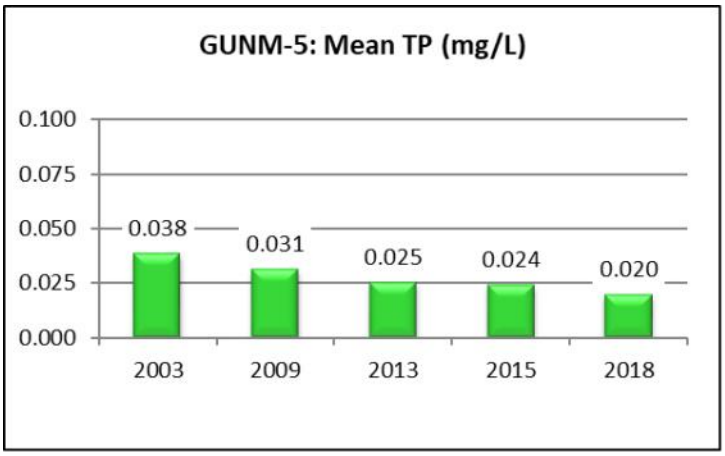
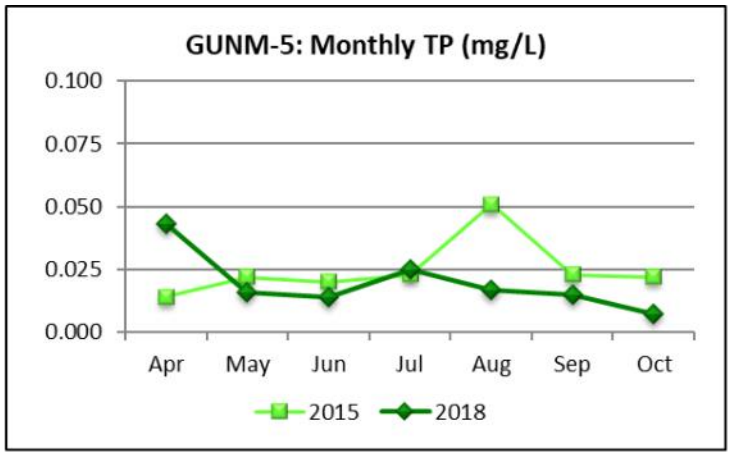
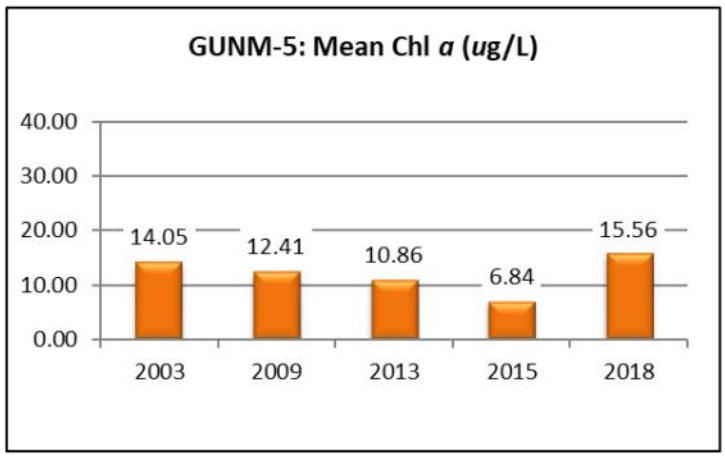
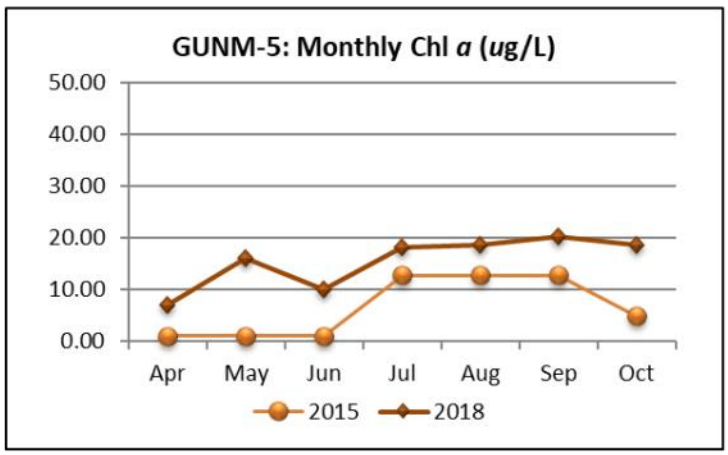


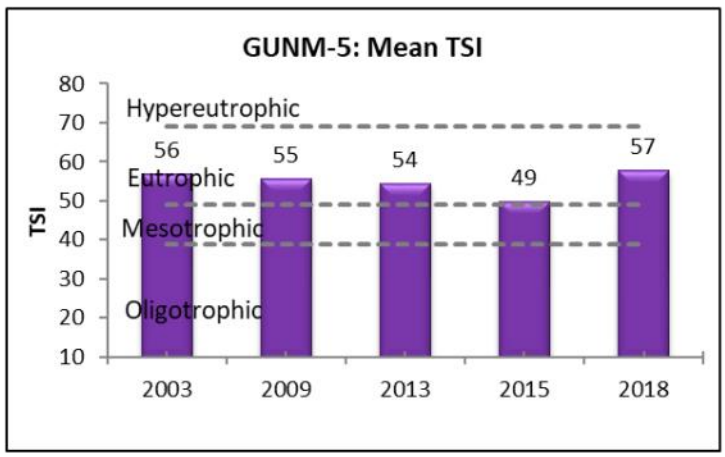
Figure 4. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TN measured in the North Sauty embayment (GUNM-5) of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

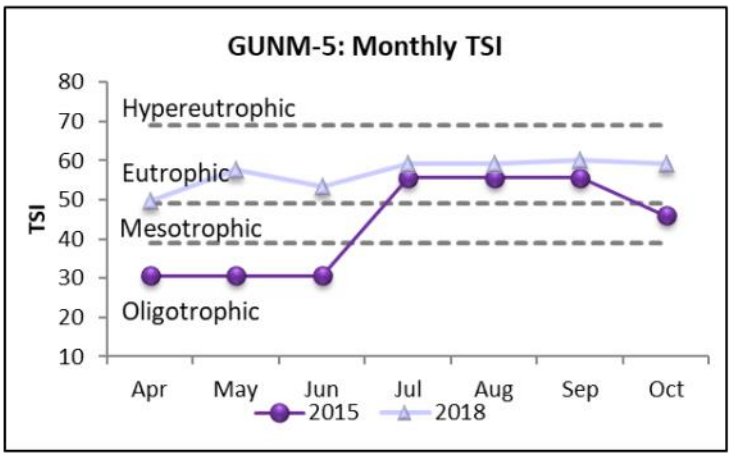


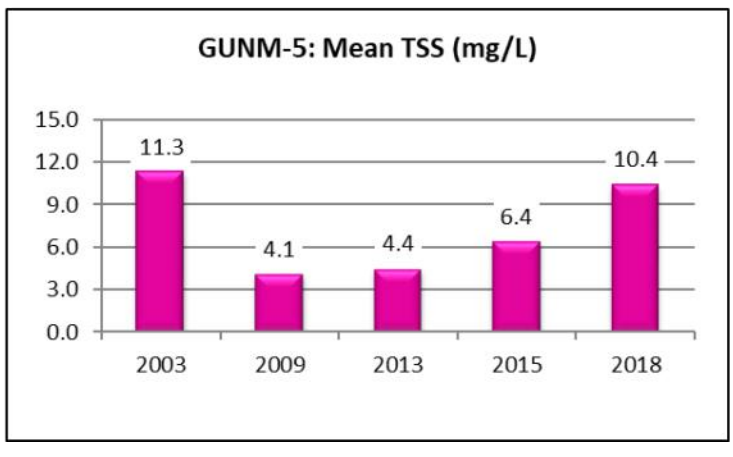












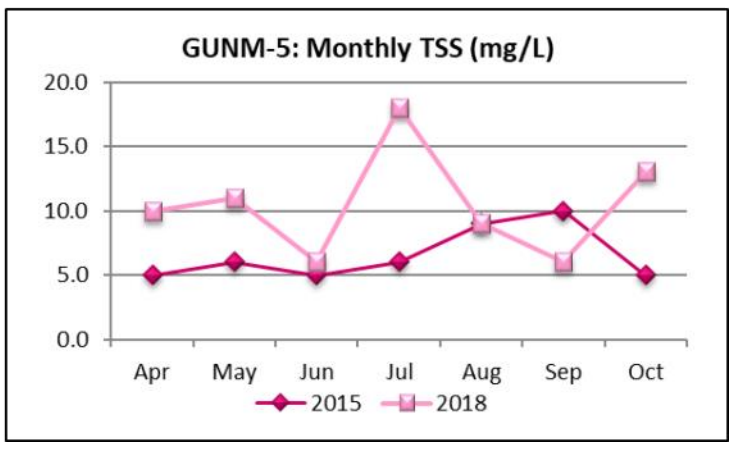


Figure 5. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TP, chl *a,* TSI, and TSS measured in the North Sauty embayment (GUNM-5) of Guntersville Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

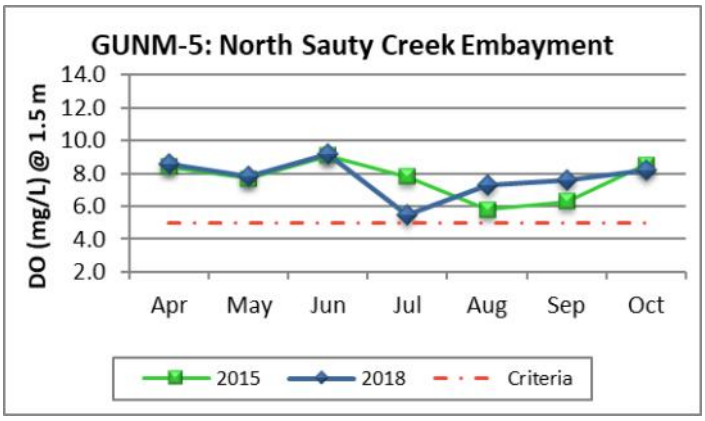


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for the North Sauty Creek embayment station (GUNM-5) of Guntersville Reservoir collected (April-October 2015 and 2018). ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

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