

SMITH MOUNTAIN LAKE, VIRGINIA-WATER QUALITY AND LAY MONITORING PROGRAM

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residents to measure water clarity at 45 sites using secchi disks. Measurements were made once a week between Memorial Day

INTRODUCTION.

Water quality monitoring in the United States is an overwhelming task for our environmental protection agencies, both federal and state, and because of the size of this task citizen volunteer programs are being developed and gaining acceptance by professional scientists throughout the country. Georgia with its many lakes, reservoirs, and rivers, and an active citizenry is a state likely to find a lay monitoring program, such as described here, a useful tool and partial solution to water quality problems.

Smith Mountain Lake is a 22,058 acre pump-storage hydroelectric reservoir located on the Roanoke River in Southwestern Virginia. The dam is located approximately 30 miles downstream from the City of Roanoke, Virginia. The other major tributary is the Blackwater River which drains a mostly rural area. Gills Creek, draining a rural area, and Craddock Creek, draining a residential area also provide significant inflows. The nearly 500 mile lakeshore includes portions of three counties in Virginia. Construction of the dam was completed in 1965 and the lake reached its present level in 1969. The submerged land was rural, primarily agricultural and timber land. As a result, agricultural activities still occur up to the immediate shoreline in some locations. Some portions of the lake shore have become residential and commercial with relatively high population densities while others remain wooded.

At present, water quality in Smith Mountain Lake is generally good. Smith Mountain Lake has become a major source of recreation for the region. Commercial and residential development along the shoreline has accelerated in recent years. Between 1970 and 1980 the area in Franklin County Virginia immediately surrounding the lake experienced an 81.8% growth in population, and the percent growth has increased since then based on indirect measures of population growth (such as number of building permits).

This intense growth around the lake has raised the concern of many lake residents and therefore the local government agencies about the present and future water quality of Smith Mountain Lake. Because of these concerns the Smith Mountain Lake Association (SMLA), Ferrum College, and the Virginia Environmental Endowment have organized and worked together to make this water quality program a program that will continue for many years.

Ferrum College scientists' research on Smith Mountain Lake began with a study conducted by Johnson and Leffler (1987) to assess land use impacts on the water quality of Smith Mountain Lake. In this project 16 sites were sampled in just one tributary of the lake and results indicated no significant correlation between land use and near shore water quality. The small number of sample sites and the lack of complete lake coverage prompted the implementation of the lay monitoring program described in this report

APPROACH AND METHODS

The water quality program is based on the participation of volunteers (lay monitors) to take samples of lake water for phosphorous and chlorophyll analyses and/or secchi disc depth measurements for turbidity values. During the first year (1986), the SMLA organized 15 lake

(May) and Labor Day (September). Ferrum College expanded the program in 1987 by increasing the number of sample sites (75 sites) and initiated collection of water samples for additional analyses at nearly half the sites (33 sites).

Sites where only water clarity is measured are referred to as basic monitoring sites. Those sites at which water clarity is measured and water samples collected are referred to as advanced monitoring sites. The water samples are collected with conditioned garden hoses lowered to twice the secchi depth and are therefore integrated samples. A portion of the sample is immediately passed through a glass fiber filter and the filter with residue is frozen and later analyzed for chlorophyll A. A second portion of the sample is poured into clean polyethylene bottles and frozen until analyzed for total phosphorous.

Detailed sampling procedures and equipment are described in the *Lay Monitoring Training Manual* edited by Thomas and Johnson (1988) and the *Vermont Lay Monitoring Manual* (Warren, 1980). The manual and the *NALMS Management Guide for Lakes and Reservoirs* by Moore (1987) were given to each monitor at their training session conducted by Ferrum College and the SMLA. The frozen samples are picked up each week by the Ferrum College scientists. In the Ferrum College laboratory the samples are prepared for analyses and are analyzed. The chlorophyll A in the algae retained on the glass fiber filters is extracted in acetone and concentration is determined fluorometrically. Nutrient samples are digested with strong acid and persulfate to release organically bound phosphorous which was then determined spectrophotometrically using the ascorbic acid reduction method. These analyses were performed and standardized according to standard procedures (APHA, 1984).

RESULTS, DISCUSSION, AND SUMMARY

The 1987 data were compared by week through the summer with the week 1 of data and sample collection being the last week in May and week 12 is the last week in August. The first year of Chlorophyll A and total phosphorous data indicates broad weekly fluctuations (see Figure 1 a,b,c). The overall mean value for secchi depth was 2.4 m, for total phosphorous concentration - 19.7 ppb, and for chlorophyll A concentration - 3.8 ppb. These are the means for 33 sample sites and 12 samples taken through the summer (n= 396). One of the conclusions drawn from a study of the data and sample sites in 1987 was that more sample sites needed to be included from the upper reaches of the Roanoke and Blackwater Rivers. This objective was accomplished by recruiting more volunteers in these two lake areas and moving some of our current sites upstream and thereby providing better sample coverage of the lake.

The 1987 and 1988 data fluctuate widely when compared week by week or when compared year to year based on their weekly means. The mean values of the three measures of water quality in 1988 are not significantly different than the 1987 means (see Figure 2 a,b,c). The mean value for secchi depth was 2.7 m, the mean value for total phosphorous was 20.9 ppb, and the mean concentration for chlorophyll A was 2.6 ppb in 1988. A statistical regression on the three parameters shows a significant decrease in all three measures through the summer.

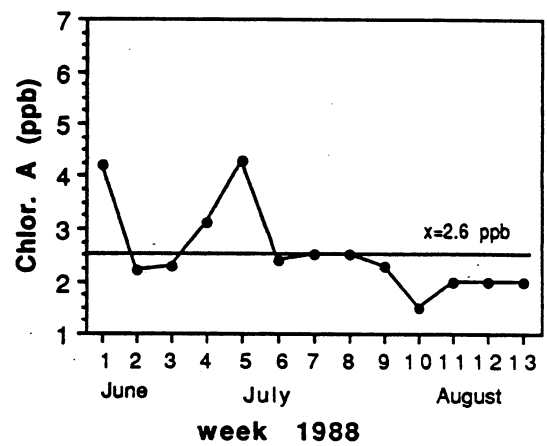
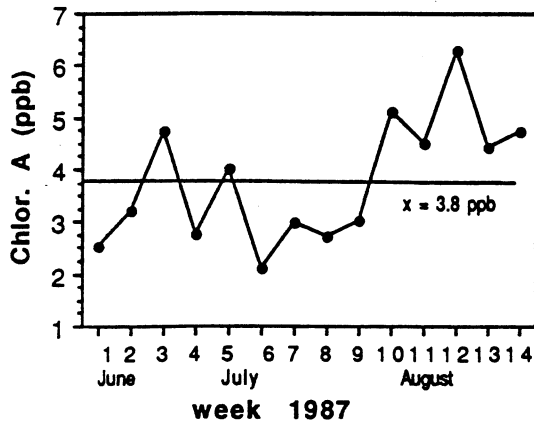
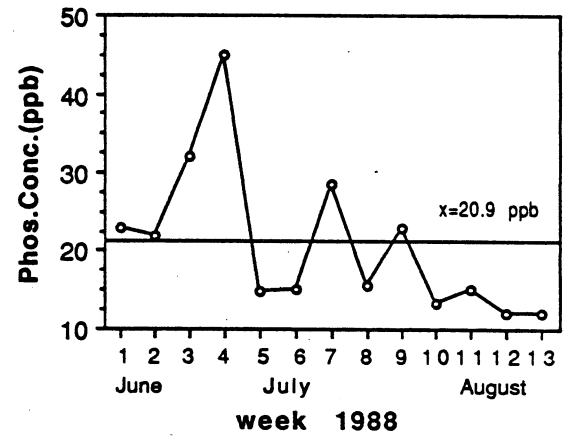
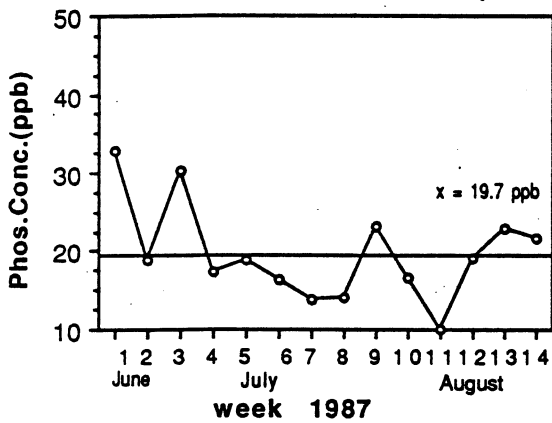
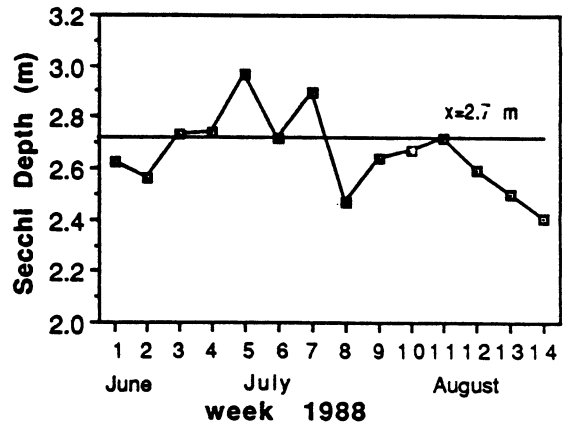
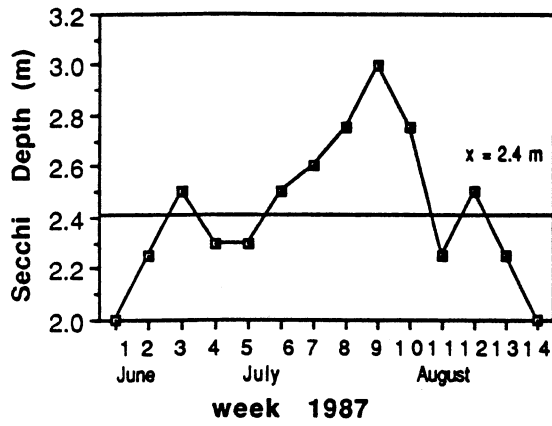


FIGURE 1 A, B, &C. Smith Mountain Lake, Virginia: Lay Monitor Data - 1987.

FIGURE 2 A, B, &C. Smith Mountain Lake, Virginia Lay Monitor Data - 1988.

This trend indicates an increase in lake turbidity , a decrease in total phosphorous, and a decrease in chlorophyll A , a measure of the algal population.

A second correlation found in the 1988 data relates the three parameters measured on Smith Mountain Lake to the distance to the Smith Mountain Lake Dam from the sample site. Secchi depth demonstrated a decreasing trend as the sample locations move toward the upper reaches of the Roanoke and Blackwater Rivers. The farther from the dam the more river-like the lake becomes as the sediment input per volume of water increases. The trends indicated by secchi depth (decreasing), phosphorous (increasing), and chlorophyll (increasing) with distance from the dam increases indicate somewhat lower water quality in the upper reaches of the two major tributaries of Smith Mountain Lake.

CONCLUSIONS

A final comparison made with the 1988 lay monitor data was a comparison of the two major tributaries of the lake. The means of all values for each parameter for the Roanoke River and the Blackwater River are very similar. The general trends are the same for each tributary as they were for Smith Mountain Lake as a whole.

As we have learned more about the dynamics of Smith Mountain Lake we have become increasingly convinced that careful water quality monitoring is important and that this monitoring must be done on a frequent and regular basis and must provide adequate coverage of the lake. In this case this could only and will only be possible by the participation of lay volunteers. The growing importance and stature of lay monitoring is made apparent by a national workshop in 1988 on *The Role of Citizen Volunteers in Environmental Monitoring* (EPA 1988) sponsored by the Environmental Protection Agency and the Rhode Island Sea Grant Program. We have also learned that lay monitor collected data and samples can exhibit good quality control and quality assurance. This Lay Monitor Water Quality Monitoring Program could serve as a model for other lake associations or interested citizens.

Lakes and reservoirs in Georgia which already have lake resident associations, could adopt this program with very few changes. The association would need to make contact with college or university scientists to arrange lab analyses of phosphorus and chlorophyll. Lakes or reservoirs with no resident association could have a lay monitoring program through the local planning district organization.

LITERATURE CITED

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