QUALITY CONTROL IN A VOLUNTEER MONITORING PROGRAM

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Abstract. The volunteer monitoring program on Lake Lanier was established in 1987 to provide baseline data on water quality. The program was designed with 100 stations for several reasons: to provide volunteers with the information about their area of the lake, to obtain baseline data about a large and diverse water body, and to provide quality control measures. The stations are sampled by volunteers once a year in late summer and, in many years, by professionals at three other times during the year. The laboratory techniques of weighing filters, measuring conductivity, analyzing for chlorophyll *a* and total phosphorus, and the field technique of measuring Secchi depth were compared for groups of volunteers, professionals, and volunteers and professionals. The results showed significant differences due to changes in equipment used, the method used, and seasonality, but no significant differences due to type of personnel.

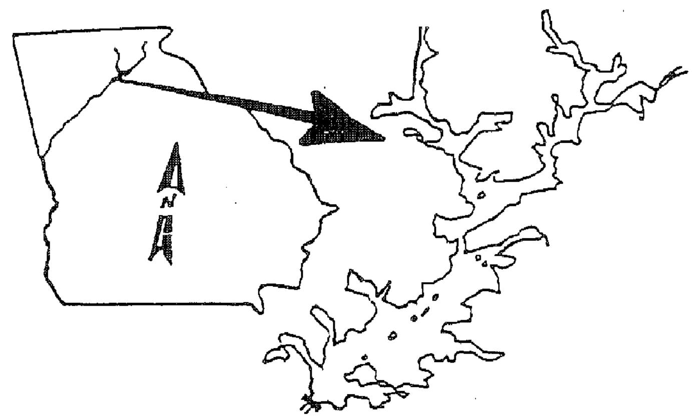

Figure 1. Location of Lake Lanier.

INTRODUCTION

Lake Lanier is a large reservoir (38,000 acres) in northeast Georgia with an irregular shoreline (Figure 1). Concern about water quality lead to the initiation of a volunteer monitoring program in 1987. The program was designed with as many stations as possible for several reasons: to provide the volunteers with the information they desired about their area of the lake, to obtain much needed baseline data about a large and diverse water body, and to provide Quality Control (QC) measures. Although volunteer monitoring had been underway in other parts of the US since the 1970s (USEPA, 1994), it was a new approach in the southeast. Credibility was important; therefore QC was necessary if data collected by non-professionals was to become accepted.

METHODS

Sampling Program

One hundred stations were established covering all regions of the lake. Secchi disc transparency was measured, and water samples were collected at three depths, the surface, thermocline and bottom. All stations have been sampled annually in August or September since 1987, giving a total of 100 transparencies and 265 water chemistry samples each year. Volunteers do most of the field work and much of the lab work for this sampling program. Also starting in 1987, 35 of the stations were sampled quarterly during the rest of the year; most of the field and lab work during these periods was done by professionals.

The Quality Control Program

The QC program has a number of components built into the field and laboratory procedures: (a) classroom and field training, (b) field work is done by teams that have at least one experienced volunteer or professional, (c) lab work is broken up into steps with directions for each step and is always done under the supervision of a professional, (d) all instruments and methods are calibrated and standardized, (e) some sampling programs (summer) are done almost entirely by volunteers and some by professionals (other quarters of the year), and (f) the large number of stations and samples.

Most of the QC assessment is done by comparing the range and variability of field and laboratory data collected by volunteers and professionals, rather than by the more common method of having a professional and a volunteer collect or run duplicate samples. There are several reasons for this. One is that duplicate samples take manpower, equipment, and time, all of which are at a premium. Another is that having a professional collect beside a volunteer introduces a bias; the volunteer understands the purpose of the parallel sampling and may not perform as usual. The QC program described here includes a traditional comparison, the duplication of tests for NO_2-NO_3, however most of the QC is based on comparisons of large blocks of data collected by professionals and volunteers on the same parameter at different stations or times.

RESULTS

Non-traditional QC Comparison of Field Data

Secchi disc depth is measured in feet and converted to meters. It was noted that some volunteers rounded off the depth in whole or half feet rather than reporting it in inches. Therefore a comparison was made of the Secchi depth, converted to meters, measured by a team of professionals, a team of volunteers, and a mixed team. A measurement was considered rounded if it was reported in whole or half feet, and not rounded if reported in inches. The actual depth in feet was ignored, thus allowing comparisons between stations and seasons. Table 1 shows the average fraction of a meter measured by each team. The volunteer teams were much more likely to report rounded measurements, 80% as compared to 35% for the professional groups. The mixed teams showed a rate of rounding intermediate between the professional and volunteer teams. In spite of the less precise measurements by volunteers, there is little difference in the data converted to meters.

During the winter samples were usually collected by aquatic scientists, scientists of other disciplines, and mixed teams. Table 2 shows a comparison of the fraction of Secchi depth measured by a team of limnologists, a team of other scientists, and a volunteer team. Other scientists were less likely to round numbers, 54%, than aquatic scientists or mixed teams, 63% and 60%. It does appear that aquatic scientists are more likely to report rounded Secchi disc depth in winter than in summer; probably because of the comfort factor in cold weather.

From these comparisons it appears that tendencies for rounding Secchi disc depth affects the results only at the second decimal place. The average Secchi disc depth in Lake Lanier is 2.44 m; precision to hundredths of a meter is not necessary for good results. There is little difference in Secchi depth measured by aquatic scientists, other scientists, and volunteers.

Non-traditional QC Comparison of Laboratory Techniques

Table 3 shows the results of Student's t-test for weights of control filters used in determining suspended solids, and for laboratory analyses of conductivity, chlorophyll a, and total phosphorus. Only eight of 45 pairs were rejected for the control filters, due to differences in equipment used. A range of 20 to 22 of the 27 pairs were rejected for the other analyses, due to seasonal and yearly variations in the parameters, and not to differences in personnel. Overall, far more variability was found due to changes in method, changes in instrumentation, and in-lake variability than between observers.

Table 1. Comparison of Precision in Secchi Depth Measurements by Professionals, Volunteers, and Mixed Teams in the Summer.

	Profs	Volun-	Profs & Vols
% Measurements Rounded	35.3	81.3	57.1
Average	0.0088 m (n=18)	0.0026 m (n=16)	0.0025 m (n=7)
Rounded Average	0.01 m	0.00 m	0.00 m

Table 2. Comparison of Precision in Secchi Depth Measurements by Limnologists, Other Scientists, and Mixed Teams in the Winter

	Limnol-ogists	Other Scientists	Limnol. & Other Sci.
% Measurements	62.5	53.8	60.0
Average	0.0046 m (n=24)	0.0080 m (n=13)	0.0049 m (n=25)
Rounded Average	0.00 m	0.01 m	0.00 m

DISCUSSION

Duplication of lab tests for every new volunteer is not feasible and duplication of field sampling is even more difficult since it must be simultaneous with volunteer sampling. Only spot checks are possible. It is much more convenient to use data that is already collected for QC, rather than making frequent duplications. The comparison of lab data on filter weight, conductivity, chlorophyll *a*, and total phosphorus show variation due to method used, instrumentation, and seasonality, but none due to the type of personnel. The comparison of rates of rounding Secchi depth show no variation due to personnel that is significant in the final Secchi depth measurement.

Long-term baseline data is hard to collect without a big budget and a large staff. Data collected by volunteers is one way to get sound data on a limited budget, and the easiest quality control tool to use in volunteer programs is large numbers of samples. This sample robustness means that bad

Table 3. **Results of Student's t-Test for Five Laboratory Analyses by Professionals (P) and Volunteers (V)**

Parameter	n	Accept H_o	Reject H_o	Reason for Rejection
Control Filter Weights for Suspended Solids	45	37 P = P, P=V, and V = V	8	Three scales used and mechanical scale differed
Conductivity	27	5 P = V, P= P	22	Seasonal and yearly variation
Chlorophyll *a*	27	5 P = P, P = V	22	Record keeping and seasonal and yearly variation
Total Phosphorus	27	7 P = P, P = V, and V = V	20	Change in method

No significant differences between the following comparisons: P=P: professional versus Professional, P=V: Professional versus Volunteer, V=V: Volunteer versus Volunteer.

data can be omitted, variability in equipment and methodology can occur, or personnel can differ intheir technique, and the data will still be of good quality. A large number of samples also gives a greater number of observations for QC testing. The major source of variability, other than seasonality or differences between years, was due to changes in equipment or methodology and not to whether the data was collected by a professional or a volunteer.

One of the functions of QC testing is to improve the design and execution of any activity. The QC program described here has resulted in changes in methodology and equipment that improved the study. In the future, changes will be made in training to improve the measurement and recording of Secchi disc depth.

ACKNOWLEDGMENTS

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