HIGH SCHOOL STUDENT INVOLVEMENT IN NATIONAL PARK SERVICE AQUATIC RESOURCES MANAGEMENT

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REFERENCE: Proceedings of the 1995 Georgia Water Resources Conference, held April 11 and 12, 1995, at The University of Georgia, Kathryn J. Hatcher, Editor, Carl Vinson Institute of Government, The University of Georgia, Athens, Georgia.

Abstract. The national park system contains many small units which were originally created for reasons other than outstanding water resources. One such unit, Kennesaw Mountain National Battlefield Park (KEMO) receives only minimum funding levels for water resources management activities despite supporting stable aquatic ecosystems and impressive natural assemblages which differ drastically from developed areas just outside of the unit boundaries.

In recognition of the important aquatic resources at KEMO the Southeast Regional Office of the National Park Service supports a high school student-assisted water resources monitoring program there and at four other parks in the region. The program aids in developing baseline aquatic biological and water quality information for a holistic treatment of threats to these resources.

Reports are generated on a semi-annual basis which suggest possible problems and discuss what "normal" conditions and seasonal variations at the park appear to be. Thus far, the work of high school students has proved to be an invaluable resource for the investigation of threats and the implementation of corrective actions.

INTRODUCTION

Kennesaw Mountain National Battlefield Park (KEMO) is a small unit of the National Park Service (NPS) primarily managed to interpret certain key battles of the Civil War. KEMO is located in Kennesaw, Georgia and receives hydrologic input from a major urban area. Despite the primary management objectives at KEMO, the NPS has acknowledged the fact that the park also plays a role in the preservation of area natural resources by virtue of being protected from internal development. This acknowledgement has lead to the development of a water resources monitoring program at KEMO (and four other parks in the southeast) which is aimed at detecting threats to park water resources and making recommendations to park managers as to how protection of those resources may be better accomplished.

This paper will describe how the program at KEMO works and, in doing so, will offer a potential tool for water resources protection elsewhere in Georgia. A key element of the program is the enlistment of biological monitoring assistance from local high school students which fosters hands-on educational opportunities while bringing useful recommendations to managers.

The volunteer services of the students are essential to a park the size of KEMO which has great interest in preserving and protecting water resources in accordance with the mission of NPS but which also does not have a great degree of funding or excess staff time to administrate such a program. It seems likely that a program which can effectively operate with very little funding or staff time may be useful in other situations as well.

Small Parks Water Resources Monitoring Program

The effort at KEMO serves as the prototype for a larger Small Parks Water Resources Monitoring Program designed and administered by the Water Resources Program Manager for the Southeast Region of the NPS. Currently, four other parks (all in states other than Georgia) have implemented or plan to implement the program. Each new "installment" of the program is modelled after KEMO but some aspects may differ since the program is intended to be flexible and is tailored to the needs of each park on a case by case basis.

The main focus of the program is to design a monitoring program which is capable of detecting impacts to park water resources (water quality and stream biota) on a gross level. This low level of resolution is necessary in order to keep the program running with very little funding or staff time and this type of long-term, low resolution survey is perceived as far more valuable to a small park than a highly detailed survey over an extremely short duration. If the program should send up any "red flags", grounds may exist to seek funds for a more powerful, issue oriented monitoring effort or develop community education schemes.

RELATED PROGRAMS

At KEMO, high school students perform the Izaac Walton League's Stream Quality Survey (SQS) technique. Admittedly, the SQS is among the least powerful method available.

Other programs intended to monitor the overall status and health of aquatic systems do exist. However, the level of complexity, funding, or staff time required preclude these

from operating at KEMO. For example, the United States Environmental Protection Agency has published a guidance for the development of rapid bioassessment protocols and "users" are encouraged to modify these suggested protocols to improve them or better suit individual needs. Unfortunately, all but the simplest of protocols require species identification down to the genus and species levels, a task which high school students are not qualified to perform. In addition, the time required at each site for some of the more comprehensive protocols is prohibitive.

PROGRAM DESIGN

The small parks water resources monitoring program is designed to detect resource degradation at a gross level and the stakeholders include KEMO staff, KEMO visitors, adjacent landowners, and controllers of upstream land use. If the program reasonably demonstrates that adverse impacts to KEMO aquatic resources may be occurring, the intent of the program is to work with individuals who may be at the source of the problem(s) to take corrective actions. In cases where responsible parties are cooperative, the problem(s) should improve. In other cases, the parties may not be willing or may not be able to take immediate corrective action and more detailed studies could be undertaken to further substantiate findings.

The decision to pursue a potential problem rests with the park superintendent in consultation with water resources professionals. Criteria which may factor into this decision may include the level of evidence (e.g., direct or indirect), the violation of local, state, or Federal water resources protection laws, the perceived willingness of a party to take corrective actions, the likelihood that reasonable corrective actions will be effective, and political considerations. All of the above criteria are rooted in the degree of certainty or uncertainty that a particular problem is truly resolvable by the gross nature of the monitoring program. If warranted, uncertainty may be addressed by commissioning a higher powered study.

METHODS

Water Quality

All water quality parameters mentioned below are evaluated once per month at each of four permanent water quality stations within KEMO. These water quality stations are located at the entry and exit points into/from the park on both Noses and John Ward Creeks (the two principal streams in the park). All water quality data are entered into a spreadsheet for subsequent interpretation. In addition, rainfall amounts are recorded daily at KEMO as part of another program.

Several parameters including water temperature, dissolved oxygen, pH, conductivity, total dissolved solids, and turbidity are measured directly in the field using a Hydrolab H20 submersible data sonde with a Scout II display unit. This instrument is calibrated before each use using commercially available, NIST-traceable standards and is re-checked for accuracy at the end of the sampling day. All calibration data are permanently documented in a calibration log book.

Other parameters including fecal coliform, nitrate, phosphate, sulfate, chloride, and fluoride must be measured in the laboratory and samples are delivered to program partners who have agreed to provide in-kind analytical services. The samples are drawn after rinsing pre-cleaned bottles and whirlpaks with ambient stream water and are then placed on ice in a cooler and transported to the Cobb County Water System, Marietta (fecal coliform) and the United States Geological Survey (USGS), Atlanta (all other parameters) within six hours after collection. EPA and/or USGS approved methods are used at these locations to generate the data which are transmitted directly to the park.

Water Quantity

Stream discharge is evaluated at each of the water quality stations by dividing the width of the stream into equal segments using a pre-marked line stretched from one bank to the other. Each of the segments represents some distinct part of the stream's total cross sectional area (CSA) which is approximated by a polygon with vertical sides equal to the water depth on each side of the segment. A velocity measurement is taken in the center of each segment at 60% of the stream's depth (from the surface) using a Marsh-McBirney model 2000 electromagnetic flow meter. The velocity value (ms^{-1}) for a particular point is multiplied by the CSA (m^2) of the polygon about that point to yield the volume flux or discharge of water through that segment (m^3s^{-1}). The total discharge for the stream is the sum of the discharges for its component segments. All calculations are performed automatically using a spreadsheet program and the total discharge is entered into the water quality spreadsheet for subsequent comparison and interpretation.

Rainfall amounts (inches) are recorded daily at KEMO using a standard rain gauge.

Biological Integrity

The Izaak Walton League of America's Stream Quality Survey (SQS) is conducted at two sites along each of the creeks (Fig. 1) to track the distribution and diversity of benthic macroinvertebrates. These sites are evaluated by VIP's six times per year under the direction of local educators, KEMO staff and SERO staff. The SQS has been approved by EPA Region III and is currently in use by natural resources bureaus in several states. The exact method for the SQS is described in *Save Our Streams: Stream Quality Survey Instructions* (Izaak Walton League of America, 1992) and a cooperative effort among park staff, regional staff and local educators fosters consistent application of this method. The SQS protocol generates a numerical index of aquatic "health" based on the diversity of several groups of taxa (sensitive, somewhat-sensitive, and tolerant to pollution). The index

value is entered into the master database for subsequent comparison and analysis. An index of <11 is considered "poor", 11-16 "fair", 17-22 "good", and >22 is considered "excellent".

RESULTS & CONCLUSIONS

The program has been operating at KEMO since September of 1993 and the overall status of KEMO water resources has been established. Generally, Noses Creek is more ecologically intact than is Ward Creek. The difference may be rooted in Ward Creek's higher sediment loading from storm water runoff. No storm water sampling has been performed to date and this suggestion can not be directly confirmed. However, construction activities are more prevalent in the Ward Creek drainage basin and it is visually very evident that much of the vital riffle habitat has been silted in and effectively eliminated. Indirectly, the very low biological indices at the monitoring stations on Ward Creek do support the notion of sediment-induced degradation (Fig. 1).

In addition, water quality data collected thus far does not suggest that biological degradation would be so far advanced. This is most likely a product of only sampling at base flows and it is suspected that most degradation of the aquatic system is occurring during storm flows with associated decreases in water quality and increased sediment loadings.

DISCUSSION

Unfortunately, the potential exists for the same process to occur on the less impacted Noses Creek and biological indices for that creek are typically in the "fair" to "good" range which suggests that some impact has already occurred.

In an effort to prevent further degradation of Noses Creek, the high school students who usually perform the biological work at KEMO under the direction of Dr. Michael Petelle have proposed to lead the corrective action process. The students will be walking various reaches of the stream outside of and upstream from the park to detect obvious sources of sediment introduction. Much of the work will occur on private land and the students will obtain the permission of each landowner before any reconnaissance is initiated. Later, the students intend to produce a report to NPS and distribute brochures to landowners which suggest practices and actions which could be implemented to discourage additional sediment introduction.

The proposed corrective actions which have grown out of this seemingly "low-powered" program represent the type of positive steps which may be taken in other areas which do not have such a program. It is essential to highlight the fact that the work to this point has been accomplished on very little funding, an important factor which often governs the reproduction of programs in other areas.

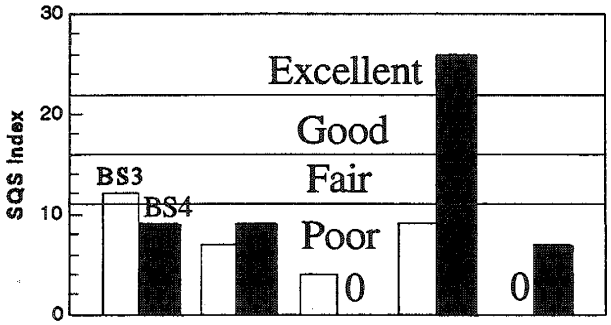

Figure 1. A profile of SQS indices at both Ward Creek Stations (9/93 - 5/94). Data at two month intervals.

RECOMMENDATIONS

The conclusions which this program has arrived at to date are based on an indirect realization that sediment introduction has lead to habitat degradation in KEMO streams. A more direct confirmation of this phenomenon would perhaps be possible if storm flows were monitored. Water quality is known to decrease sharply in urban streams during storm events and it has already been suggested to KEMO staff that storm water sampling be planned. As mentioned above, an analysis of water quality data thus far also does not indicate that biological stress is present. Storm water monitoring will serve to help delineate biological stress from contaminants as well as from sediment loading.

A second recommendation involves the continued support of the volunteer-based high school field teams. Without this resource, progress toward improving the situation at KEMO would not have advanced even this far. This program has demonstrated the effectiveness of the use of high school students under qualified instructor supervision and suggests that similar arrangements are both feasible and useful in other settings.

ACKNOWLEDGMENTS

The author gratefully acknowledges the dedicated efforts and continuing support of Dr. Michael Petelle and his students from North Cobb High School and Mr. Scott Schomer and his students from Harrison High School. In addition, the efforts of Ranger Richard Biurgren (KEMO), Mr. Steve Shelton (Cobb County Water and Sewer), and Ms. Judy Schultz (US Geological Survey) in the effective administration of the water quality aspects of the program are to be highly commended.