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Statistics in EPA's STAR Program, Learning Materials for Surface Water Monitoring

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Data occupies a central role in many of the actions taken by EPA and its affiliates in the Tribes and States. For data to provide suitable information for these actions, it needs to be appropriate for the situation. The scientific discipline of statistics focuses on gathering and analyzing data so that relevant questions may be answered in an unbiased way, including environmental questions. This article describes the development of some individualized materials designed to help water quality personnel in the Tribes and States to learn how to apply statistical sampling and analysis to their monitoring work.

EPA's Office of Research and Development (ORD) has conducted monitoring research through its Environmental Monitoring and Assessment Program (EMAP) since 1989. In recent years, EMAP has focused on developing methods and approaches for aquatic resources. Statistics plays a substantial role in these methods especially for site selection and analysis. These new approaches are supported by the EPA's Office of Water. They are also being used by some States in meeting the reporting requirements of section 403(b) of the Clean Water Act. Several Tribes have begun using these methods to evaluate the status and trends in their aquatic resources, and at least one of EPA's regional offices is strongly encouraging Tribes in that Region to use these methods.



ORD sponsors extramural research under the auspices of the Science to Achieve Results (STAR) program in the National Center for Environmental Research. The statistical research conducted for the STAR program focuses on developing innovative methods that are important for protecting human health and the environment.

In 2000, STAR issued a Request for Applications (RFA) to develop two research programs on Statistical Survey Design and Analysis for Aquatic Resources. The RFA included the specific wording "Proposals should specifically address the extension of expertise on design and analysis to States and Tribes. Such a component should consider the level of statistical training that may be extant in State and Tribal environmental management and resource agencies. Research on and demonstration of distance learning concepts that allow individuals with basic statistics training to study and understand the concepts of design and analysis statistics are encouraged." The successful applicants, Colorado State University (CSU) and Oregon State University (OSU), submitted

coordinated proposals that included a specific plan for responding to this requirement. The CSU program is called "Space-Time Aquatic Resources Modeling and Analysis Program" (STARMAP); the OSU program is called Designs and Models for Aquatic Resource Surveys" (DAMARS).

As part of these two research programs, learning materials are being developed to help educate people on how to use statistics in collecting and analyzing water quality data. This research on outreach investigates two concepts in knowledge transfer: method of delivery or presentation, and relevance of content. Usable learning materials must address both of these concepts. The requirement for distance learning in the RFA is satisfied by developing individualized materials usable at a remote site. Currently, most learners are familiar with web browsers and the Internet but Internet use has some substantial limitations for learning. STARMAP and DAMARS proposed, among other things, to develop, test and distribute learning materials on a CD ROM(s) that are based on web-browser technology and incorporate several types of actions that may be individually selected which are termed as individualizations. The approach does not use the Internet for several reasons:

- Learners can become very frustrated by download delays due to Internet traffic and/or slow connections to the Internet;
- Parts of the anticipated materials could be useful in remote field sites, especially for training, which precludes their availability on the Internet for the foreseeable future;
- Internet accessible materials need to be composed to accommodate all versions of major browsers, including legacy ones of much more limited capabilities than current ones;

- Some of the anticipated individualizations may be executed more simply and accurately in a controlled software environment than in a general one.

Using the Director's experience, discussions with staff in the regions who conduct monitoring, and a limited study of Tribal needs, researchers for STARMAP and DAMARS began to investigate possible content for these learning materials by relying on the Directors' experience in working with resource managers in the target organizations, with discussions and communications with EPA regional personnel that have monitoring responsibilities, and by conducting a limited study of Tribal needs by using Water Quality Technology, Inc. (WQYI). Steven Johnson of WQTI, works closely with about 15 western Tribes, mainly in EPA Region 9, on water quality issues, and prepared a personal interview form in collaboration with the Director of STARMAP. Because a high response rate was not expected for an impersonal mail form, Steven filled out the form during in conversations with Tribal water-quality personnel as a part of his regular visits. His report included these recommendations:

- Tribes need regulatory guidance to develop water quality monitoring plans in the form required for Section 305(b) reporting which is currently required for states only.
- Tribes voiced the need to have the monitoring and protection of cultural uses of waters addressed in instructional materials.
- Tribes voiced the need for temporal trend and water-quality database management software that is user friendly.
- Tribes voiced the need for geographical information system (GIS) training.
- Tribes voiced the need for

educational materials on the appropriate use of statistics in aquatic water-quality monitoring assessments.

- Tribes voiced the need for a user-friendly statistical analysis program.

A copy of the WQTI report is available at:

<http://www.stat.colostate.edu/starmap/wqti.final.report.pdf>

A first draft of the learning environment has been developed in collaboration with CSU's Office of Instructional Services. This environment implements several forms of individualization, but it is incomplete at this time. However, this first test version has been designed to eventually support individualization for diversity in perspective - from the monitoring administrator, to field personnel and data analysts, geographic context of the learner - (many ecoregions), a dictionary detail, and even, if needed, different languages. If research with the intended user community reveals other needed features, flexibility for their incorporation will be included in the environment, and perhaps implemented in the test materials. The presentation environment identifies and presents information for learners based on choices they make. The environment also will assemble pdf files suitable for printing.

Two of six eventual learning units have been drafted by Gerald Scarzella, a graduate student in statistics at CSU and a Native Alaskan. A preliminary evaluation of both the learning environment and early materials was conducted and several state environmental agencies, a sub-state regional agency and two EPA regional offices attended. Several people from Tribal agencies were invited, but weren't able to attend. All of the evaluators were extremely supportive of the interactive

environment and the draft content. They wrote pages of suggestions which are being studied for future changes in the learning environment. They volunteered potentially valuable material from their experience and identified an important new audience - river councils. The original plan for these new learning materials included a few case studies but the recent evaluation makes it clear that there should be perhaps 30 case studies to illustrate a range of design and analysis topics.

As these new learning materials evolve, future evaluations will be conducted. Tribal input is critical if the materials are to be useful to Tribal water quality personnel and managers. We will seek Tribal volunteers to participate in future evaluations. Contact the STARMAP Director, Dr. N. Scott Urquhart at nsu@stat.colostate.edu if you have suggestions for content or delivery methods. For more general comments, contact starmap@stat.colostate.edu.

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