A Probability-based Monitoring Program for Assessing Status and Trends in the Biological Condition of Maryland Non-tidal Streams at Multiple Spatial Scales

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Biographical Sketches of Authors

Dr. Jon Vølstad is the Versar Leader for Statistics & Fisheries. He has directed the development and implementation of many large-scale research surveys and monitoring programs for local, state, regional, national, and international institutions. Dr. Vølstad played an integral role in the development of the Maryland Biological Stream Survey, a nationally recognized ecological assessment program, developing the survey design and the analytical methods for evaluating stream condition. He also helped the Maryland Department of the Environment develop and implement biological criteria for streams and the Chesapeake Bay.

Dr. Mark Southerland is a principal ecologist with Versar, Inc. He was the primary author of the 1990 EPA program guidance on the use of biocriteria in surface waters and drafted the first summary of state efforts to develop and implement biocriteria. Dr. Southerland now directs Versar's support of the Maryland Biological Survey, including the development of biological indicators for fish, benthic invertebrates, amphibians and reptiles, and physical habitat. He also recently completed development of biological criteria for the Hudson River.

Nancy Roth is a senior scientist and program manager with Versar, Inc. Since 1996, she has been the lead author of comprehensive statewide reports for the Maryland Biological Stream Survey. Ms. Roth was instrumental in developing and validating the fish IBI for Maryland streams and has assisted the state in developing biological criteria for streams. Ms. Roth also develops assessments and management plans for priority watersheds in Frederick County, MD, Fairfax County, VA, and other local jurisdictions.

Paul Kazyak has been an aquatic scientist with Maryland DNR since 1993. He oversees the Maryland Biological Stream Survey and also serves as Training and QC Officer for the program. Since 1994, he has taught several courses in aquatic ecology to graduate students at Johns Hopkins University.

Dr. Ron Klauda joined the Maryland Department of Natural Resources in 1990. He is currently Director of the Monitoring and Non-Tidal Assessment Division, a group that is responsible for monitoring and assessing the condition of Maryland's surface waters from the mountains to the sea. Ron is an aquatic ecologist who received his Master's and Doctoral degrees from Penn State University.

Abstract

The Maryland Biological Stream Survey (MBSS) is a statewide probability-based survey for assessing the status and trends in the water chemistry, physical habitat, and biological condition of wadeable, non-tidal, streams in Maryland. The MBSS evolved into a statewide survey in 1995, following pilot studies in 1993 and 1994 to develop sampling methods and identify management objectives. Field data are collected from a representative sample of 75-meter stream segments across the state over a three to five-year cycle to facilitate cost-effective use of field crews. During the first (1995-1997) and second (2000-2004) rounds, a lattice sampling design was used to select watersheds randomly in time and space, while sites along the network of streams within each watershed were selected by stratified or simple random sampling. In the second round, changes in management objectives resulted in a design focused on the assessment of smaller Maryland 8-digit watersheds. Using this design, biological indicators for fish and benthic invertebrate communities from the MBSS provided the basis for the State's biocriteria framework and 303d listing of impaired waters under the Clean Water Act. In this paper, we discuss how past and future changes in monitoring objectives have been and can be accommodated in a long-term MBSS. For example, a panel design could be used for scheduling future sampling of watersheds over time. In addition, sampling with partial replacement could be conducted within watersheds to improve the ability to detect trends in watershed condition.