

# INTEGRATING TIDAL AND NONTIDAL ECOLOGICAL ASSESSMENTS

Mark Southerland and Roberto Llansó<sup>1</sup>

The Maryland Department of Natural Resources (DNR) has a long history of conducting rigorous assessments of ecological conditions in both tidal and nontidal waters. The Long-Term Benthic (LTB) Monitoring Program and the Maryland Biological Stream Survey (MBSS) both use reference-based indicators of benthic invertebrate communities to provide areawide estimates of condition status and trends. While these programs are comparable in approach, their assessments have remained independent. The management goals for state agencies, U.S. Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), and other agencies are increasingly watershed based and would benefit from an integration of tidal and nontidal assessments. Small-scale studies have demonstrated that upstream land uses can have profound effects on both nontidal and tidal waters downstream, but the prevalence of these effects over large areas have not been effectively studied. We analyzed two decades' worth of synoptic data on the condition of Maryland tidal and nontidal waters to determine the range of concurrence in condition assessments between upstream and downstream waters. The results indicate that a consistent report card of ecological condition across tidal and nontidal waters is practicable, and has implications for improving our understanding of the dynamics of freshwater tidal and nearshore ecosystems.

As an example, we present an assessment of the Upper Eastern Shore of the Chesapeake Bay in Maryland. The Upper Eastern Shore is predominantly agricultural. Forested areas account for 31 percent of land cover, 8 percent of the basin is comprised of urban lands, and development is low intensity. As of 2000, agricultural sources contributed 72 percent to the basin's total nitrogen load, and 67 percent to the phosphorus load. Agriculture was also the largest source of sediment, contributing 88 percent of the basin's sediment load. The first 2 rounds of the MBSS (1995-1997, 2000-2004) showed stream benthic condition failing over 50 percent of the upper Chester River primary sampling unit (salmon shade), whereas a majority of the basin area had moderately good stream benthic condition (light green shade) (Fig. 1). The Upper Chester River exhibited the worst water quality in the region. An increasing trend in total nitrogen concentration was detected in the Upper Chester River and poor status was observed for chlorophyll *a*, total suspended solids, total nitrogen, total phosphorus, and Secchi depth. Over the same time period, benthic community condition was worst in the upper tidal fresh portion of the Chester River (100 percent fail), moderately good in the middle oligohaline portion (33 percent fail), and degraded in the lower mesohaline portion (60 percent fail). Except for the Northeast River, the other major basin tributaries had good to moderately good tidal benthic community condition (Fig.1).

The results of LTB agree well with those of the MBSS, and can be used to identify areas impacted by high nutrient and sediment runoff. Additionally, LTB shows the influence of the Chesapeake Bay mainstem. Low dissolved oxygen events are common and severe in the Maryland mainstem. Anoxia is a common feature of the mid-bay deep channel, and hypoxia typically affects benthic communities in mainstem waters. Eastern Bay and the Lower Chester River reflect benthic community condition influenced by mainstem hypoxia and, therefore, provide contrast to MBSS results (Fig. 1). While nontidal waters are affected by stressors in the watershed, tidal waters show upstream and downstream sources of stress. The integration of tidal and nontidal assessments thus provides a holistic picture of ecosystem condition.

<sup>1</sup>Mark Southerland, formerly Director of Ecological Sciences/Applications, Versar, Inc., Columbia, MD 21045; now, Vice President, AKRF Inc., Hanover, MD 21076  
Roberto Llansó, Senior Scientist, Versar, Inc., Columbia, MD 21045

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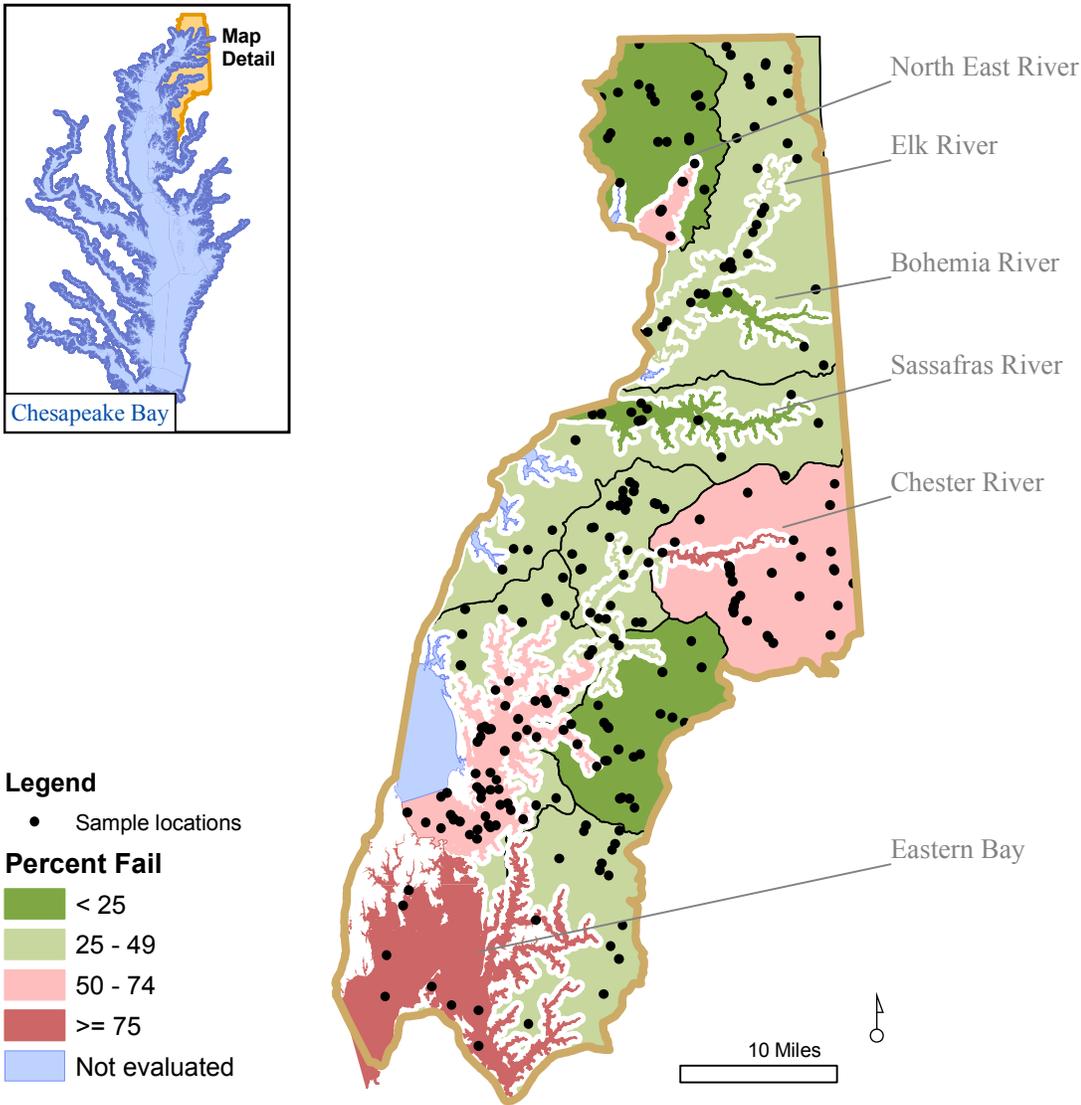


Figure 1—Maryland Upper Eastern Shore Basin tidal (rivers and bays) and nontidal (primary MBSS sampling units) assessment of benthic invertebrate condition. Shown is the percent area failing the LTB or MBSS benthic index of biotic integrity, 1995-1997 and 2000-2004.