Objective

This is the third of four subprojects under the Atlantic Slope Consortium (ASC) center. The goal of this subproject is to develop and test indicators of the biogeochemical health and integrity of watersheds, relate those indicators to environmental conditions, assess the predictability of landscape characteristics to indicator responses, and use those predictions to characterize the effects of watershed discharges on downstream riverine and estuarine health.

Progress Summary

Several interactive teams are working on this multi-institutional subproject. Their activities in 2004 are discussed below.

SERC Watershed and Spatial Analysis Team

As part of the overall objective to develop and verify geographical indicators to predict water, sediment, and nutrient losses from watersheds, this team’s primary goal is to improve existing statistical models predicting nutrient and sediment losses from geographic data. A secondary goal is to quantify the impact of wetlands and riparian conditions on watershed discharges. Our approach involves (1) exploring the efficacy of additional geographic data (beyond physiographic province and land use/land cover) in predicting nutrient concentrations, and (2) incorporating information about the spatial arrangement of landscape features, particularly source areas and riparian forests, to test hypotheses about nutrient and sediment transport.

Research activities for Year 4 included:

• Explored the effects of different land cover data sets on predictions of nutrient discharge. Results suggest that choice of landcover data has a significant impact on the relative proportions of landcover classes and resulting relationships with measured nutrient concentrations.
• Explored the relationship between soil properties and nutrient discharge, using soils data at two different levels of resolution.
• Explored the effects of improved hydrologic characterization on watershed predictions of nutrient export. A variety of geographic datasets were compiled and analyzed for this purpose.
• Evaluated the influence of wetlands in watershed predictions of nutrient discharge. We used model-based predictions of saturated area to model wetlands and predict nutrient concentrations, then compared these results to our NWI predictions.
• Developed and tested new methods for automated watershed delineation and flowpath modeling.
• Developed a novel geographic method to examine effects of stream map resolution on buffer characteristics. Stream map resolution had a highly significant impact on the areal extent of near-stream lands considered in our riparian metric analysis (and thus the measured patterns of riparian buffers), though the effect of increasing resolution differed across physiographic regions. These results have implications for indicator studies that use stream buffers as predictors.
• Developed GIS routines and a computer program for evaluating the effects of transport distance from source landscapes to streams and watershed outlets. Distance weights were found to improve assessment of biotic thresholds in watersheds, and improve nutrient discharge predictions by 22% in Coastal Plain watersheds. This technique also was applied to data developed by other ASC researchers on PCB concentrations in White Perch and Bird Integrity Index.
• Explored the effects of improved mapping/characterization of riparian buffers. Developed GIS routines for identifying and mapping contiguous riparian forests, mean buffer width, proportion of gaps, and crop loadings to specific buffers to improve accuracy of riparian buffer characterization. Refined metrics and improved analyses to illustrate patterns of riparian buffers as well as unique effects on nutrient concentrations.
• Finally, we developed a novel method for estimating subsurface connectivity among landcover, riparian areas, and stream channels for further analysis.

**ECU Watershed Team**

Data from the three ASC watersheds in NC (60 sites) were analyzed to determine which of the measured indicators are most applicable for estimating condition of headwater ecosystems in NC. Results of the preliminary analysis were presented at the all hands ASC meeting in March 2004. In 2005, ECU took the lead in using the indicator data from the 3 NC watersheds to test the application of the data in conducting reach and watershed assessments. A paper is in its final stages of preparation, for eventual submission to Ecological Indicators (see reference list below).

During the 2004-05 project year, ECU worked with the other members of the ASC Watersheds working group in analyzing watershed data. ECU took the lead in analyzing canopy vegetation data to determine how composition varies across physiographic provinces. Ordinations have been produced and ECU is has taken the lead in writing-up the results either for the final report and/or as part of a paper to be submitted for peer review.

ECU developed a final version of an integrative riparian assessment procedure for the North Carolina Ecosystem Enhancement Program (NCEEP). The procedure was based on the ASC indicator effort and adapted for use in coastal plain watersheds. The procedure was then tested in
three NC watersheds chosen by NCEEP. We trained environmental consultants contracted by NCEEP on how to use the method before they applied the procedure in randomly chosen reaches in six watersheds. We used the collected indicator data to diagnose problems in the watersheds, compare conditions among watersheds, and determine the precision of users in scoring indicators.

Penn State Watershed Team and Multi-Institutional Activities

Development of a Stream, Wetland, Riparian (SWR) Index: Data were collected the previous year using a rapid assessment protocol for sampling Streams – Wetlands – and Riparian areas (“SWR” protocol) that was developed as part of this project. In Year 4 these data were used to create a composite assessment of condition (the “SWR Index”) for these three interrelated components of aquatic ecosystems. Steps in index development included extraction of metrics by summarizing measurement data, selection of a subset of metrics, conversion of each metric to a scale of 0 to 1, refinement of a conceptual model of how these components of the stream system relate to each other, and combining the metrics into an index based on the conceptual model.

Values of the Index were then compared with Index of Biotic Integrity (IBI) values collected as part of the Maryland Biological Stream Survey for fish and benthic macro-invertebrates in selected watersheds of the study region. For the most part, the SWR Index agreed well with these more labor-intensive biotic indices when compared on a site-to-site basis.

The SWR Index was also compared with two landscape-level (GIS-based) indices of condition: the first based on landscape characteristics in a 1-km radius circle around each SWR sample point, and the second based on landscape in the entire HUC-14 watershed. Agreement was better for the former than the latter. In cases where there was disagreement between the two indices, specific components of the indices were examined to diagnose the causes of degraded condition and to reconcile differences. Work continues to develop better methods for scaling the SWR index from the site to the watershed level.

Contributions to EaGLE’s Data Committee: The ASC has been working with the EaGLes data committee to develop protocols for long-term storage of data, data organization, data catalogues, metadata creation, and backup of this system. The ASC is in the process of compiling metadata (data about data) describing each of the datasets developed over the course of the project. The datasets and associated metadata will be archived in a central location along with that from other EaGLes projects, and made accessible to future researchers at an appropriate point in time. The target date for compilation of this information is October 1, 2005.

Future Activities

All three teams that comprise this sub-project will be working together to improve integration of the various components. Specific analyses will include integration of distance-weighted landscape measures developed by the SERC team with the landscape metrics used in the SWR component of the study; and comparison of these combined measures with biotic indices (IBIs) and the SWR Index. We will also be exploring an alternative method for ranking watersheds.
according to condition, that takes into account the degree of agreement (or disagreement) of metric scores and expresses this as an uncertainty measure.

The SERC Watershed and Spatial Analysis team will be testing the effect of additional watershed descriptors such as impervious surface, septic density, and population density, and using improved statistical models to provide expectations for the estuarine sub-project.

Members of all three teams will be making presentations and working on additional publications, as well as contributing to the final project report.

Publications and Presentations

Publications


Brinson, M., R.P. Brooks, R. Rheinhardt, M. McKenney-Easterling. Stream and riparian condition of Atlantic Slope watersheds, USA. (In prep.)


Brooks, R.P., M. Brinson, R. Rheinhardt, M. McKenney-Easterling. Selection of indicators for assessing stream and riparian conditions of Atlantic Slope watersheds, USA. (In prep.)


Presentations


