

Envisioning the Future for Ecosystems and People

"In nature there are neither rewards nor punishments, there are only consequences." This thought was penned in 1899 by attorney R.G. Ingersoll. While Ingersoll's statement implies that nature itself is amoral—knowing neither right nor wrong—society is beginning to view and manage ecosystems like the precious natural resources they are. Scientists at EPA and elsewhere are working to assess the economic value of services provided by nature and attempting to incorporate ecosystem services into resource management decisions. Scientists at EPA are working to protect and restore the goods and services provided by nature.

Water is among the life-sustaining benefits that are included in the group of ecosystem services provided to us by the natural processes and intricacies of our environment. Over the past century, policy-makers, water-resource managers, and scientists have realized the value of ecosystem services to human health and well-being. We've also come to realize that ecosystem services are limited and that they are often undervalued or treated as being free. Instinctively, and through science, we are learning that this may not be the case.

The EPA Ecological Research Program is currently engaged in a major new national project that is centered on ecosystem services, a core international theme that was brought to the global forefront by the *Millennium Ecosystem Assessment*, published in 2005 (see www.millenniumassessment.org/documents/document.356.aspx.pdf). Between 2001 and 2005, the *Millennium Ecosystem Assessment* was carried out to assess the consequence of ecosystem change for human well-being and to establish the scientific basis for actions that are needed to enhance the conservation and sustainable use of ecosystems and their contributions to human health and well-being.

To describe the impact on ecosystem services from various environmental scenarios, scientists at EPA in Las Vegas, at the USDA–Agricultural Research Service (USDA/ARS), and at the University of Arizona have developed a geographical information system computer interface to readily enable the application of sophisticated watershed-simulation models. By creating and analyzing alternative scenarios related to changes in the environment, the interface, called the Automated Geospatial Watershed Assessment (AGWA) tool, gives scientists and resource managers the ability to peer into the future and assess the consequences of land-use changes on flooding, water quality, and water supply.

The AGWA tool combines capabilities from the Soil and Water Assessment Tool (SWAT) and the KINematic Runoff and EROSION 2 (KINEROS2) with soil, land cover, and rainfall information for a realistic prediction and visualization of the various alternative land-use scenarios on watershed responses. Simply stated, realistic alternative-future scenarios can be developed and analyzed at the watershed and regional scales to help identify and prioritize

big-picture actions that are protective of water quality and water quantity.

A key feature of the AGWA tool is that it uses commonly available spatial or geographic information systems data layers to fully parameterize, execute, and spatially display results from both SWAT and KINEROS2. Through an intuitive interface, users select a watershed outlet from which AGWA derives the watershed-contributing area and forms watershed-model elements using a digital elevation model. The watershed-model elements are then merged with soils and land-cover data layers to derive the requisite model-input parameters. The AGWA tool currently uses national (e.g., State Soil Geographic [STATSGO]) and international (e.g., United Nations' Food and Agriculture Organization [FAO]) soils data and available land-cover/use data such as the National Land Cover Data. Users are also provided the functionality to easily customize the AGWA tool for use with any classified land-cover/use data. The chosen hydrologic model is then executed, and the results are imported back into AGWA for visual display.

In a recent example, scientists applied the AGWA tool to the San Pedro River Basin on the U.S.–Mexico border. Based on three development scenarios—conservation, existing land-use trends and planning, and full, open urban development—AGWA generated land-use options and projected them to the year 2020. Using the AGWA tool, scientists evaluated the impact on water quality and quantity that resulted from these options. The results clearly demonstrated that land-cover changes that were associated with full, open development (e.g., additional roads, parking lots, other impervious surfaces) would significantly alter the watershed response to storms. The results from this study were published in the *Journal*





of *Environmental Monitoring and Assessment* (2004, 94; 115-127; see www.epa.gov/nerlesd1/land-sci/pdf/scenario_spedro.pdf).

This and other studies illustrate that the AGWA tool can help resource managers conduct watershed assessments at multiple scales, in time and space at the federal, state, and local levels. This allows decision-makers to visualize and identify potential problem areas and to determine where additional water-quantity and water-quality monitoring should be undertaken or mitigation activities should be focused.

Coupling EPA landscape science expertise with data from satellites and process models enables policy-makers and resource managers to visualize the result of today's decisions on the availability of ecosystem services tomorrow. The AGWA tool is a powerful approach to quantify and forecast the impacts from changes in the environment to ecosystem services.

EPA provides techniques, methods, models, and tools that are freely available and easy to use by any entity that wants to understand the cost and benefits that are associated with using and protecting ecosystem services, especially those that are provided by water. There are currently two versions of the AGWA tool available. Both are free of charge from the EPA (www.epa.gov/esd/land-sci/agwa/index.htm) and USDA/ARS (www.tuscon.ars.ag.gov/awga) Web sites.

The research described here is being conducted by William Kepner, EPA, National Exposure Research Laboratory; and David Goodrich, USDA/ARS. **em**

For more information on the research discussed in this column, contact Deborah Janes, Public Information Officer, U.S. Environmental Protection Agency (B205-01), Office of Research and Development, Research Triangle Park, NC 27711; phone: 1-919-541-4577; e-mail: janes.deborah@epa.gov. Disclaimer: Although this text was reviewed by EPA staff and approved for publication, it does not necessarily reflect official EPA policy.

Meetings Announcements

Intercouncil Meetings

Saturday, January 24, 2009

Section & Chapter Council Meeting 8:00 a.m.–5:00 p.m.

Sunday, January 25, 2009

Joint Councils' Meeting 8:00 a.m.–12:00 p.m.

Marriott Detroit at the Renaissance Center
Renaissance Center
Detroit, MI 48243
Phone: 1-313-568-8000

Room rate: US\$149/night (cut-off date: December 21, 2008)

All Section & Chapter chairs are invited. Make sure your Section or Chapter is represented!

Leadership Training Academy

Friday, April 24–Sunday, April 26, 2009

Renaissance Pittsburgh Hotel
107 Sixth Street
Pittsburgh, PA 15222
Phone: 1-412-562-1200

Room rate: US\$149/night (cut-off date: April 2, 2009)

Are you a newly-elected chair to your Section or Chapter or just need a refresher? Sign up now for this newly formatted leadership training session. Contact Stephanie Glyptis at sglyptis@awma.org with questions.



Members in the News

A&WMA Past-President Joseph A. Martone, Ph.D., CIH, QEP, has been inducted into the Society of American Military Engineers (SAME) Academy of Fellows, in recognition of his efforts on behalf of SAME and the military engineering profession. Dr. Martone will be formally inducted into the Academy of Fellows on May 12, 2009, during SAME's annual Investiture ceremony. The Investiture is being conducted in connection with the 2009 Joint Engineer Training Conference & Expo in Salt Lake City, UT.