Urban Ecologist Uses GIS to Study Urban Forestry, Natural Systems, and Human Networks

by Barbara Shields, GIS Journalist

Gary Moll studies natural systems.

An advocate of using technology to integrate human and natural systems, Gary Moll has been a force in bringing the value of urban ecology to the attention of federal and local leaders. Moll is the senior vice president of the Urban Ecosystem Center at American Forests and is one of the nation's foremost authorities on urban forestry and urban ecosystems. ESRI recently recognized Moll as a GIS hero who uses GIS to apply solid scientific and engineering data to decision making.

Along his life path as a conservationist, Moll has successfully worked with Congress to increase funding for urban forestry and with the U.S. Forest Service (USFS) to expand urban forestry programs to 50 states. His work in the development of GIS software program CITYGreen helps local governments measure urban forests and harness their benefits.

"The human network needs to be built with the natural system in mind," posits Moll. "Urban forests and green infrastructure are part of the city ecosystem. GIS shows the relationships between social and ecological systems and offers a means for us to weave the city structure into the natural system."

Community leaders traditionally make their decisions about community structures based on dollar values. Sadly, they almost always overlook the value of the natural system on which these community structures are built. People need to be made aware that if the natural system remains intact, then it can do much of the work a structure does.

Moll and his team developed the ArcGIS extension CITYGreen. This program makes it possible for local communities to calculate the functions of their natural system, attach dollar values to storm water and air quality, and use this information to make better decisions about managing their communities.

Here is how it works. CITYGreen users classify remotely sensed data (satellite or aerial imagery) along with climate data from the National Oceanic and Atmospheric Administration (NOAA) and soils data from the Natural Resources Conservation Service (NRCS). This data drives the scientific and engineering models that produce accurate measurements of how land cover affects the movement of air and water in a particular place. Once these volumes or quantities are known, they are converted to dollar estimates that decision makers can use. The software includes models for storm water, air pollution, carbon storage and sequestration, land-cover breakdown, and alternate scenarios. Based on a current land-cover map, the Alternate Scenario model calculates the effects of future land-cover change before those changes are made.

				Percent Change		
	1986	2001	2008	1986–2008	1986–2001	2001–2008
Open Space	187.20	210.89	181.92	-2.90	11.23	-15.92
Trees	212.49	161.67	142.74	-48.86	-31.43	-13.26
Urban	126.90	155.18	202.69	37.39	18.22	23.44
Water	23.10	21.94	22.34	-3.40	-5.25	1.76

This table indicates that Mecklenburg's urban growth occurred at the expense of trees, as opposed to open space conversion in the more distant suburbs.

For example, Mecklenburg County, North Carolina, was the subject of a land-cover assessment that used CITYGreen. The county has undergone enormous growth in population. From 1984 to 2001, the county saw a 127 percent increase in areas covered by impervious surfaces (streets, parking lots, etc.). Moll's research team used Landsat imagery, high-resolution aerial imagery, and GIS to assess the region. They then calculated storm water runoff and air quality benefits of the tree cover in the city of Charlotte and the county as a whole.

Recently, Moll and his team studied the Piedmont Crescent, which lies north of Birmingham, Alabama; extends up into southern Virginia; and includes areas within North Carolina, South Carolina, the Appalachian Mountains, Tennessee, Virginia, and Kentucky. The task to collect the data and maps about the region's many different systems was long. and at times, tedious. Using GIS to analyze data from the USGS, NOAA, USFS, the Census Bureau, and the Army Corps of Engineers, the team found the area to be much different than expected. Ninety-nine percent of the southern forest of the Piedmont area is gone, and 93 percent of the forest of the Smoky Mountains is gone. The system is in total disarray. These findings have been published in the map book Piedmont Crescent. One of the study's biggest surprises was that all of the thousands of rivers in the Piedmont Crescent area had been altered—every single one. In reality, the area is not a natural system but actually an unnatural one.

A complex question is, If expansion of the human network is inevitable, how do we manage its impact? It is important to determine ways in which the human network can move through these places without destroying them. Questions need to be asked: What economic and social patterns are driving the development of a region? Where are the transportation corridors? Where are the economic corridors? What metro areas are nearby? How are they linked? How is expansion and change happening? How do air and water move through these ecosystems?

"The solution to building better communities in the future lies in learning how to interact the natural system with the human network," advises Moll. "The first step is to understand how the natural system functions, and the second is to understand the human network's real needs. GIS technology can help people understand how the two will interact and help guide them to better decision making."

Read more about American Forests at www.americanforest.org. Download a free PDF version of the booklet 2009 Co-Evolution at www.americanforest.org/Co-Evolution. Contact Gary Moll by e-mail at gmoll@amfor.org.