Ecoregions: A Geographic Advantage in Studying Environmental Change

One of the greatest challenges facing environmental scientists is separating environmental change due to human activities from change that would have occurred without human interference. Some scientists approach this research theme through deterministic reasoning, based on the belief that physical laws control the behavior of natural systems. Once these laws are understood and applied, the behavior of an environmental system can be predicted with a high degree of accuracy. Some success can be achieved using the approach for small size phenomena, for instance, in explaining movement of a single grain of sand in a laboratory flume. As the scale of inquiry broadens to the landscape or region however, environmental dynamics are sufficiently complex, or even chaotic, rendering a set of physically balanced equations as less useful and predictions as less reliable. Certainly one reason for complex behavior is the place-dependency of processes; cause-and-effect links and feedbacks differ from one location to another. What is the niche that geographers can fill in describing, explaining, and predicting environmental change?

Geographers recognize that the landscape functions differently as a whole than would have been predicted by multivariate analyses of the individual elements of geology, landforms, vegetation, climate, soils, land use, and hydrology. Physical geographers are not geologists, biologists, hydrologists, or atmospheric scientists. Instead, we provide the spatial perspective on biophysical systems. Staying true to the unifying theme of integration, geographers are enjoying some success in reducing the complexity in the world by developing ecoregions. Imagine a map overlay process involving rock type, soils, climate, landforms, and land cover. Ecoregions comprise distinct and mappable geographic units in which biophysical materials and processes combine in repeated patterns. These patterns reflect how biotic and abiotic components interact to create the characteristic structure and function (flow of energy and cycling of materials) of ecosystems. Ecoregion classification is hierarchical in that mapping is accomplished at different scales. Two of the most widely used ecoregion schemes have been developed by geographers Robert Bailey (U.S. Forest Service) and James Omernik (U.S. Environmental Protection Agency). An early version of Omernik's *Ecoregions of the Conterminous United States* was included as a map supplement in the March 1987 *Annals of the AAG*. In January 2006, the EPA released Omernik's *Level III and IV Ecoregions of the Conterminous United States* and larger-scale maps continue to be published of individual states.

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This is not your grandparents' regional geography. Ecoregion mapping schemes have been developed for a variety of purposes related to natural resource inventory and assessment, monitoring and prediction, and management. Geographer Denis White, with the U.S. EPA Western Ecology Division in Corvallis, Oregon is cataloguing the research applications of ecoregions state-by-state. The list is too long to reproduce in this space, but some examples include: choosing of reference sites for water quality monitoring in lakes and streams, assessment of ecological vulnerability, classifying native seed sources, studying how landscape characteristics affect the distribution of amphibians, choosing restoration sites and management actions for streams and wetlands, and modeling the abundance of fish and macroinvertebrates. Pat Bartlein is using ecoregions to stratify relationships between climate change and wildfire. Ecoregion maps and a bibliography of ecoregion-based studies can be found at the EPA ecoregion website. Others have used ecoregions to explain spatial differences in medical geography, avian ecology, forestry, and agricultural science.

My own students and I have used ecoregions to identify sites most susceptible to slope failures triggered by clear-cut logging. Our study in the Medicine Bow Mountains of southeast Wyoming demonstrated that clear-cut logging dramatically increased slope failures in only one out of twenty-six land-type associates, a more detailed level of classification in Bailey's USFS ecoregion mapping scheme. In another study comparing streams in the same ecoregion, we discovered the thresholds of clear-cut logging (timing and spatial extent) beyond which significant, irreversible impact occurs in forest stream morphology. If more than twenty percent of a watershed is clear-cut logged in a two-year period, stream channels grow in size as snowmelt runoff peaks increase. If less than twenty percent is clear-cut in a two-year period, or if more than twenty percent is cut over a longer period (say ten years), then no change in channel dimensions occurs. Geographer Dale Splinter is currently exploring how the upstream-to-downstream trends in stream morphology (width, depth, sediment size, large woody debris, etc.) differ by ecoregion in the mountains of eastern Oklahoma. Regional patterns of suspended sediment concentration can be nicely stratified by ecoregion for the conterminous United States.

These studies reveal the power of ecoregions in demonstrating the place-dependency of processes, including how the Earth has been transformed by human activities. Without understanding

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cause-and-effect linkages and feedbacks that are place-dependent, we take the risk of promulgating regulations that could exacerbate problems rather than mitigate or prevent them. Geographers at the U.S. Geological Survey—Tom Loveland, Gerard McMahon, among many—see the value of ecoregion analyses in land change science (see USGS Circular 1281). Geographers at the USGS are documenting the rates, causes, and consequences of land cover change in the eighty-four ecoregions within the conterminous forty-eight states. Darrell Napton has enjoyed a temporary appointment with the USGS EROS Data Center to collaborate with Loveland and others in this effort. EPA level III ecoregions have been adopted by the USGS National Water Quality Assessment Program (NAWQA) as a critical part of the design for studies on the effect of urbanization on water quality. A series of publications is starting to emerge on using ecoregions in gap analysis of the completeness of the National Wildlife Refuge System. Loveland is even teaching a geography course at South Dakota State University this semester titled "Ecoregions: Concepts and Applications."

Those familiar with Jim Omernik's procedure for drafting state ecoregion maps speak enthusiastically of the extra effort he expends in working with scientists from other disciplines, touring the state to field-check ecoregion boundaries. Jim reports: "Working with these state and regional resource managers and field scientists (biologists, geologists, soils scientists, limnologists, etc.) has been a wonderful, powerful learning experience." The process that Omernik and his colleagues have developed—basically a discursive meeting of the minds of disciplinary experts done in the context of an extended field trip—is a brilliant solution to the problem of forming and testing hypotheses about phenomena that cannot easily be reduced to deterministic terms.

Writing from the Flint Hills ecoregion, the largest remaining intact tallgrass prairie in the Great Plains...

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Editor Sought for The Geographical Review

The American Geographical Society is seeking applications and nominations for the position of Editor of *The Geographical Review*. The new editor will begin work in June 2006 with responsibility for producing three volumes.

An honorarium is provided. It is essential that applicants be able to secure office space at his or her home institution as well as at least a one-quarter time release from normal duties and the help of a university-supported editorial assistant, preferably half-time, year-round.

A description of the Editor's responsibilities, desired qualifications of applicants, and application instructions are available on the AAG website at www.aag.org/GREditor.cfm. The selection of an editor will be made by May 31, 2006.

The AAG staff congratulates AAG Communications Coordinator Heather Heimbuch on the birth of her daughter Ella Mereda Weide on January 27, 2006.

Meeting of UN Group of Experts on Geographical Names

Individuals are invited to participate as observers in the twenty-third session of the United Nations Group of Experts on Geographical Names (UNGEGN), taking place in Vienna, Austria, March 28 - April 4, 2006. The United Nations Regional Cartographic Conference for Asia and the Pacific (2000) and the Americas (2001 and 2005), as well as the Eighth United Nations Conference on the Standardization of Geographical Names (Berlin, 2002) recommended that standardized and consistent geographical names data should be considered as a fundamental data set of national and regional spatial data infrastructures and included in their design, development, and implementation.

Details on the venue, registration, and hotels are posted at: http://unstats.un.org/unsd/geoinfo/. The contact person for the conference is: Mr. Amor Laaribi, United Nations Statistics Division, 2 United Nations Plaza, Room DC2-1640, New York, NY 10017. Tel: (212) 963-3042; Fax: (212) 963-9851. Email: laaribi@un.org.