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Dedicated to the Protection, Preservation and Management
of Cultural and Natural Parks and Reserves
Through Research and Education

The George Wright Society

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On the Cover:
The map *Draft Level I Ecological Regions of North America.* An explanation of the map is on p. 51, and it is also discussed in James M. Omernik's article beginning on p. 35. *Map generated by Sandra Azevedo, courtesy of the U.S. Environmental Protection Agency Research Laboratory, Corvallis, Oregon.*

Society News, Notes & Mail

We're Finally Where It's @: GWS on the Internet

After a few weeks of flailing around in the UNIX-based mists of our service provider (not easy for us here at the Mac-based—some would say Mac-impaired—GWS office), the Society is now out and about on the Internet. We are indebted to GWS Members Rolf Peterson and Ted Soldan, both of whom are affiliated with Michigan Technological University, for their generous help in making this possible. Our e-mail address is **gws@mtu.edu** and we urge you to use it to contact us. We are making a special point this year of trying to get as many of our members' e-mail addresses into our database as we can. If you have one, would you include it (clearly printed, please) on your membership renewal form? If your address is on an intra-agency (e.g., CCmail, DGmail) or commercial (e.g., CompuServe) network only, please so indicate. Down the road, we will be exploring various possibilities for electronic communication and publishing on the Internet. (A GWS Home Page on the World Wide Web? A moderated BBS? Special-interest mailing lists?) If you have suggestions or expertise to offer, let us know.

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Earthwatch Renews Call for Proposals

The Center for Field Research (CFR) invites proposals for 1996 field grants awarded by its affiliate Earthwatch. Earthwatch is an international non-profit organization dedicated to research and public education in the sciences and humanities. Earthwatch field grants average $20,000. These funds are derived from the contributions of Earthwatch members who pay for the opportunity to join scientists in the field and assist with data collection and other research tasks. Earthwatch field grants cover the costs of maintaining volunteers and principal investigators in the field, and may help with other field expenses. Preliminary proposals should be submitted at least 13 months in advance of anticipated field dates. Full proposals are invited upon review of preliminary proposals. For more information, contact: Dee Robbins, Life Sciences Program Coordinator, The Center for Field Research, 680 Mt. Auburn Street, Auburn, MA 02172 USA; e-mail: drobbins@earthwatch.org; telephone 617-926-8200; fax 617-926-8532. In Europe: Sean Doolan, Scientific Development Officer, Earthwatch Europe, Belsyre Court, 57 Woodstock Road, Oxford OX2 6HU, United Kingdom; e-mail: doolan@vax.oxford.ac.uk; telephone (0865) 311-600; fax (0865) 311-383.

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Master's Program in Protected Landscape Management; Classes Full-Time or as Continuing Education Via Distance Learning

The International Centre for Protected Landscapes (ICPL) is an independent organization which provides advice, training, and consultancy services to governments and non-governmental agencies around the world. ICPL receives visitors and researchers from all parts of the world, and organizes workshops, seminars, and site assessments. Now, in association with the

University of Wales, Aberystwyth (UWA), ICPL is offering a course in Protected Landscape Management that confers a MSc (Master of Science) degree. The course may be taken in person at UWA or as a correspondence course. It consists of seven modules:

- The Global Agenda: Sustainability and Biodiversity
- Protected Area Systems and the Protected Landscape Concept
- Integrating Conservation and Development Programs
- Policy Context, Appraisal, and Evaluation
- Management Plans and Management Systems
- Stewardship and Partnership
- Communication and Conflict Resolution

An eighth module offers various options suited to individual desires. The course is capped by a research thesis or major project based on the participant's own work experience. For more information, contact ICPL, Science Park, Aberystwyth, Dyfed SY23 3AH, Wales, United Kingdom; telephone (0970) 622-617, fax (0970) 622-619.

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Brief Notes

"Presenting Nature" Reprinted. Because of the popular demand for copies of Linda Flint McClelland's *Presenting Nature: The Historic Landscape Design of the National Park Service, 1916-1942,* the National Register of Historic Places, Interagency Resources Division, has made arrangements with the Government Printing Office to reprint the publication. Copies are available at a cost of $20 each ($25 foreign), postpaid, from the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. Refer to stock number 024-005-01140-4.

Nominations Open for Two GWS Board Seats, 1996-1998. The 1995 Board election, which will take place this October, will be for the seats of two incumbent board members: Russ Dickenson, former NPS director, and Jon Jarvis, superintendent of Wrangell-St. Elias National Park & Preserve. Both Dickenson and Jarvis are eligible for re-election to a second term of office. We are accepting nominations for these two seats through June 1, 1995. To be eligible, a nominee must be a GWS member in good standing; be willing to travel to Board meetings, which occur once or twice per year; and be willing to serve on Board committees and do other work associated with the Society. Travel costs and per diem for the Board meetings are paid by the Society; otherwise there is no remuneration.. The procedure is: members make nominations for the ballot to the Board's Nominating Committee, which makes a selection from these nominations to determine the final ballot. (It is also possible for members to place candidates directly on the ballot through petition; for details, contact the GWS office.) To propose someone for candidacy (and it's perfectly acceptable to nominate one's self), send her or his name, mailing and e-mail addresses, and telephone and fax numbers to: Nominating Committee, The George Wright Society, P.O. Box 65, Hancock, MI 49930-0065 USA. All nominees will be contacted by the Nominating Committee to get background information before the ballot is determined. Again, the deadline for nominations is June 1, 1995.

Research/Management Guidelines Win Praise. The recently published set of guidelines, *Coordinating Research and Management to Enhance Protected Areas,* which the GWS collaborated on, has been quite well received in several quarters. The GWS office has received requests for the book from correspondents in Central and South America, Europe, and Asia, as well as from Canada and the USA. Twenty-five copies were requested by the Centro Agronomíco Tropical de Investigacion y Enseñanza (CATIE), a Costa Rican agency, for an upcoming training course for park managers. We also hear from colleagues in the Science and Management of Protected Areas Association (SAMPAA) that the book is getting recommendations from senior-level personnel in Environment Canada and Parks Canada. We have a small number of copies left for sale to GWS Members and FORUM readers for the nominal postpaid price of $2.00. If you'd like a copy, send a check to the GWS office.

GWS to Help with NAOP Conference Proceedings. Current plans are for the Society to help publish the proceedings of the National Association for Olmsted Parks conference "Balancing Nature & Culture in Historic Landscapes: A Celebration of Biltmore's Centennial." The conference will be at Biltmore from April 20-23, 1995. The proceedings are due out in March 1996. We also will be publishing a selection of the conference's papers as a thematic issue of THE GEORGE WRIGHT FORUM (Vol. 13, No. 1), which will appear at about the same time as the proceedings.

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William E. Brown

Letter from Gustavus

A New Raid on the Tongass

February 5, 1995

AS WE MOVE TOWARD THE GEORGE WRIGHT SOCIETY'S 8th Conference—with the topic "Sustainable Society and Protected Areas"—I choose a vignette from Alaska to show how far we are ffrom making that topic the equation that it must one day become. Which is to say, protected areas will survive only if society survives—i.e., becomes sustainable. The connective "and" becomes an equal sign. And *all* areas, to one degree or another, are protected areas.

From another context, I remember the words of early scientists accompanying explorations into what became the Southwestern United States. Upon entering that arid, rugged, exposed region—so different from the wet and worn and forest-covered lands back East—the scientists uniformly explained that Nature there was like an open book, its rough-cut pages displayed for examination.

By analogy, modern Alaska is our open book for the study of exploitative political economy. Here is displayed a nearly naked boomerism that went out of style decades ago in more gentrified sections of the country. True, the alliance of money and politics is more sophisticated now than in earlier days, but Alaska's frontier mythos still rather admires the big stride of the robber barons. The shrugging off of niceties is perceived as a statement of independence from Washington, from the cloying requirements of environmentalism.

But behind that anachronistic mythos and the simple Main Street-boomer sentiments of the front men lurk industrial-scale devastations. The people who orchestrate these Alaskan melodramas are serious. They are after big stakes. Any they will use any plausible rationale—jobs for the working man, benefits to the Natives, you name it—to cover their sole object, which is to turn cheap, unfinished raw materials into big bucks for their home corporations Down Below or overseas. Alaskans have a penchant, even as they pop their buttons with declarations of independence, for perpetuating their boom-and-bust history as an economic colony.

Let's look at the current flap in the Tongass National Forest to illustrate all of the above. In 1990, to rectify a system of politically dictated timber quotas that was devastating the largest of our National Forests in a frenzy of taxpayer-subsidized clearcutting, Congress passed the Tongass Timber Reform Act. The vote was 99-0 in the Senate, 356-60 in the House. Now, to resurrect the substance of that old system by thinly veiled subterfuge, Alaska Senator Frank Murkowski prepares to re-introduce the Landless Native Land Allocation Act of 1994. In brief, this bill would create five new Native corporations in Southeast Alaska communities that did not qualify for land allocations under the 1971 Alaska Native Claims Settlement Act.

The bill would give these new corporations the right to select an aggregate of about 645,000 acres from Tongass National Forest—more total acreage, and three to seven times more acreage per new corporation, than was granted to the thirteen Tongass-area Native corporations established by the 1971 act. (Note that this inequity would spawn a host of remedial land claims by the old corporations, thus setting off a chain-reaction raid on the Tongass.) Moreover, these new-corporation land selections would be limited to parts of the Tongass now off-limits to logging, including roadless areas "permanently" set aside by Congress in the Reform Act of 1990 for their habitat, subsistence, and fishing and hunting values. And further, these new private timberlands would be exempt from sustained-yield requirements. And the final clincher, the timber from these new selections would have to be sold to the Ketchikan Pulp Company or another Alaska mill.

Other signs of the unmitigated nature of this logging bill include:

- The right of new corporations to select lands from one end to the other of the Tongass—without regard to traditional use histories, their own or others'. This provision, too, would ignite conflict between the Native groups, a classic divide-and-conquer ploy of colonial regimes.
- Guaranteed road access to the new selections, even across designated wilderness areas, with all such roads exempt from public review under the National Environmental Policy Act.

In sum, this naked raid, this model of robber-baron mentality and action, would go far toward rendering the Tongass National Forest and bodering seas a single-use system of timber mining. The broader constituency of interests in the Southeast Alaska region would be unceremoniously dumped if this bill were enacted: fisheries, subsistence, tourism, local wood-products industries, as well as *sustainable* logging. The national patrimony—natural resources, biodiversity, scenery—would be irrevocably damaged.

The putative beneficiaries, the landless Native people, would be mercilessly manipulated. They would become the logging agents for the mills, thus destroying their own land base, clearcutting their children's heritage—leaving wastelands, fouled streams, and sterile seas. This process would effectively destroy the subsistence base of their traditional cultures. Despite profound economic needs, many Native people are appalled by this bill, which is a logging bill, not a valid approach to Native land claims.

Senator Murkowski's bill, S. 2539, turns reasonable harvest and sustainability upside down and inside out. Nor is it unique. These kinds of assaults—better camouflaged in gentler regions—go on apace across the country and around the world, fueled by amoral and insatiable multinational corporations whose loyalty stops at the bottom line.

The places and the people next in the cross-hairs of these enveloping forces must stand and say "No," must view their *sustaining* lands as protected areas. In this struggle, preserved lands can serve as symbols, lines in the sand. But the principle of sustainability—sensible harvest—must roll back destruction and embrace the world for *any* lands and seas to be protected.

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The Greater Fundy Ecosystem Project: Toward Ecosystem Management

Stephen Woodley
Natural Resources Branch, Parks Canada, Hull, Québec KIA OM5

Bill Freedman
Department of Biology and School for Resource and Environmental Studies, Dalhousie University, Halifax, Nova Scotia B3H 4J1

Introduction

THE GREATER FUNDY ECOSYSTEM (GFE) PROJECT IS AN ATTEMPT to design and implement a plan to manage a landscape on an ecologically sustainable basis. The overall aim is to protect ecological structures, functions, and processes while providing a sustainable flow of goods and services for people. A key element of the GFE project is the integration of a protected area into its regional landscape as a single greater ecosystem. At the core of the GFE project is Fundy National Park, a small (206 sq km) national park located on the upper Bay of Fundy in New Brunswick, Canada.

The Greater Fundy Ecosystem project grew out of concerns, mainly by park managers and academics, that the ecological values of the park were not being adequately protected by managing the park in isolation from surrounding lands. A study of the ecological integrity of the park (Woodley, 1993) documented a history of losses of native species, invasions by exotic species, habitat fragmentation and conversion, and significant doubts that species associated with old-growth coniferous forests, such as American marten (*Martes americana*), would survive in the area.

The problems faced by Fundy National Park occur in many of the world's protected areas. Parks and equivalent reserves are often too small to protect viable populations of many species, especially large vertebrates and seasonal migrants. Most reserves are also too small to accommodate the dynamics of large-scale ecological processes, such as wildfire or insect epidemics. As a result, the integrity of many community types is at risk. In addition, protected areas are subject to a host of other stresses, including edge effects in highly fragmented landscapes; disease transmission from domestic animals, or other effects of introduced species; long-range transport of pollutants; and the effects of tourism, poaching and global climate change (Machlis and Tichnell, 1985; Woodley, 1992).

Character of the Greater Fundy Ecosystem

The Greater Fundy Ecosystem study area has known history of human use since the arrival of European settlers, circa 1750 (West and Sinclair, 1985). Although the area lies within the general area inhabited by the Micmac and Malecite nations, there is no evidence of any intensive human use of the area prior to circa 1750 (West and Sinclair, 1985). It was not until the 1830s that the area was intensively settled. Since that time, most of the GFE area has been logged or converted to agriculture. By 1870, a peak population of 1,262 people was recorded in the Alma Parish, which comprises the core of the study area. At that time, there were five towns, many farms, dams, and sawmills. After 1870, the area began to decline economically and the population of Alma Parish decreased to 600 by the 1940s (West and Sinclair, 1985). The study area currently has one village, Alma, of 350 residents, with a few farms and cottages scattered through outlying areas. Most of the farms have reverted back to forest, although several old-field sites remain in the area.

Fundy National Park receives approximately 200,000 visitors per year, and has a tourism-related infrastructure of roads and trails, three campgrounds, a golf course, and other facilities. The park is surrounded by crown and privately owned land, used primarily for intensive forestry. Presently, the only other major human activities in the area are tourism developments, and a small amount of agriculture, including intensively managed blueberry plantations. The forestry practice is mainly clearcutting, followed primarily by conversion to single-species plantations of black spruce (*Picea mariana*) or jack pine (*Pinus banksiana*). The plantations are harvested on short-rotation (40-50 years) for pulpwood. An extensive network of forestry roads is now established throughout the area.

There is no absolutely determined size for the Greater Fundy Ecosystem. A detailed biophysical data base exists for an area of 1,050 sq km, but this is a working area and does not define the size of the GFE. The project is an approach to integrating an ecological reserve into its larger surrounding landscape, and the ecosystem approach is the context for it all. There is no attempt to draw a boundary around the 1,050-sq-km area that either limits institutional partnerships or ecological understanding.

Institutional Arrangements

The Greater Fundy Ecosystem project was established in 1991. From the beginning, the project was conceived as a research and monitoring effort to provide the science support necessary to manage an ecologically sustainable landscape. This early research focus was essential to bring all parties together under a common, non-threatening agenda. The project was always conceived as multi-disciplinary, with members from industry, government, and academia. The aim of the GFE project is to be inclusive, and not to be interpreted as aligned with the aspirations of a particular group or agency.

The project is run on an *ad hoc* basis, without a formal constitution. Decisions are reached on a consensus basis, and management is accomplished by a chairperson and management committee. An office for organization and administration of the project was established in 1993, in the Faculty of Forestry at the University of New Brunswick. Funding for the office and a project coordinator comes from Parks Canada and the University. Research funds come from a variety of sources and granting agencies.

The GFE project was instrumental in applying for, and receiving, a "Model Forest grant" from the Government of Canada. The Model Forest program is a large national and international effort by Canada to promote research and demonstrate sustainable forestry. The achievement of a Model Forest grant led the GFE project into a partnership with over 20 other groups to form the Fundy Model Forest partnership. The other groups include forest companies, private woodlot owners, federal and provincial government agencies, universities, and non-government agencies such as environmental groups and clubs. The area of the Fundy Model Forest extends north and west of Fundy National Park to encompass approximately 500,000 hectares. A key partner in the Fundy Model Forest is the Southern New Brunswick Wood Producers Co-op, a cooperative of small private woodlot owners, who collectively own half of the forest lands in the Model Forest.

The ecological research agenda developed for the GFE project was adopted in full by the Fundy Model Forest. The Fundy Model Forest now acts as a key sponsor for research in the GFE and will use the results to develop a larger management plan, expected by 1996.

An Exercise in Ecosystem Management

The Greater Fundy Ecosystem project is an attempt to manage a reserve as part of a larger ecosystem. Ecosystem management is not a new idea. It has origins in a call to integrate biological, physical, and sociological information. Ecosystem management in protected areas was discussed as early as 1932, with the Committee for the Study of Plant and Animal Communities of the Ecological Society of America (Shelford, 1932). Committee members recognized that a comprehensive system of sanctuaries in the United States must protect ecosystems as well as particular species, represent a wide range of ecosystem types, manage for ecological fluctuations (i.e., natural disturbances), and employ a core reserve and buffer approach. The committee also discussed the need for interagency cooperation and public education to make the approach successful. These components remain as foundations for more recent approaches toward ecosystem management. More recently, Agee and Johnson (1988) published an edited volume on ecosystem management in protected areas. The modern application of ecosystem management was pioneered in Yellowstone National Park, and the Greater Yellowstone Ecosystem has been the subject of much literature and debate (see Keiter and Boyce, 1991). In Canadian national parks, the concept developed from the extensive use of biophysical land-use inventories in the 1970s. These biophysical inventories were an integrated examination of the natural world, including wildlife, topography, soils, and vegetation.

"Ecosystem management" is a term applied to the activities of many different agencies, and has been interpreted in a variety of ways. The following principles of ecosystem management are thought to apply to the GFE project. After each statement of principle, the related actions of the GFE project are given:

1. An integrated partnership. Institutional boundaries are never the same as ecological boundaries (Newmark, 1985). Thus, if management is to proceed on the basis of ecological boundaries, interagency cooperation is essential and not simply a desirable thing to do. Interagency cooperation implies some mechanism of joint decisionmaking and some mechanism to allow those decisions to be implemented.

The GFE project is explicitly organized to cross institutional boundaries and not let institutional frameworks influence ecological thinking. Membership in the group includes parks managers and researchers, academics from several universities, government research scientists, biologists from commercial forest companies, and provincial forest managers.

2. The importance of scale. All management issues are scale-dependent, with hierarchically related levels that include genes, organisms, populations, communities, and landscapes. For example, the management of a viable arthropod population may occur at a much smaller scale than management of the long-range transport of atmospheric pollutants. The choice of the appropriate scale at which an issue is to be managed is critical. Furthermore, scales must be constantly related to each other if issues are to be resolved successfully.

The GFE research group attempts to reflect issues of scale through its research agenda (see below), which ultimately will be translated into recommendations for management actions. Research projects are designed around a stress–response framework for several levels in the ecological hierarchy. These levels include gene, organism, population, community, and landscape.

3. A range of land uses over a broad scale. Over the longer term, ecosystem management must accommodate multiple uses at a regional scale, and restricted uses at a site or unit scale. Simply put, this implies that human activities may not be ecologically sustainable if spread over the entire landscape. Our best approach to conserving nature is to plan for a range of land uses: from concentrated human activity, such as towns or plantations, to large areas where humans have little impact, such as ecological reserves. The gradients between these extremes are critical to the conservation of natural areas and ecological integrity.

Parks and other protected areas must be managed as the extreme preservation end of the conservation gradient, and should not be compromised by other land uses. Moreover, all land uses external to protected areas must be compatible or the protection role will not be possible. At the heart of the GFE project is a core protected area, Fundy National Park. The GFE project aims to ensure that management actions on the surrounding landscape are compatible with the protection of the ecological values of the park.

4. A systems context for decisions. Social, political, and environmental issues must be viewed in a systems context and not as isolated issues. This is a basic principle of ecosystem management and it implies that actions, programs, and policies cannot be based on narrow sectoral perspectives.

The GFE research project is a partner in a larger institutional arrangement, the Fundy Model Forest. The Fundy Model Forest contains more than 20 partners, representing a broad cross-section of the community. Issues in the Fundy Model Forest span the range from the ecological to the economic and social.

5. Ecological boundaries are contextual. Ecosystem boundaries are elastic over time. This characteristic can be seasonal, as is found in migratory ungulates moving from summer to winter range, or longer term, such as the distribution of mature-growth forest, beaver ponds, and retreating glacial outwashes.

We have deliberately not drawn fixed boundaries around the GFE. Specific issues must be managed in their own dynamic context. For example, the park has two rivers with runs of Atlantic salmon (*Salmo salar*). One of the rivers was subject to a salmon reintroduction program, in which an old logging dam was removed and juvenile salmon were introduced. For that issue, the spatial boundary is the river basin. However, the adult salmon runs are far smaller than historical levels, possibly due to a fishery by-catch. For this issue of low returns, the ecosystem management boundary is much larger. It includes the Bay of Fundy and Gulf of Maine, where Fundy salmon stock are known to spend time.

6. Integration of data bases. Decisions in the context of ecosystem management are best made from common, integrated data bases. The term "data base" is used in the largest sense and includes the commonly used spatial information on vegetation, geology, landforms, soils, land use, animal movements and rare features. However, the data base should not be limited to biophysical data. It should also include information on cultural features, institutional arrangements, economics, and human living patterns. The use of an integrated data base puts all partners in ecosystem management on an equal footing.

For the GFE project, a common biophysical data base exists in a geographic information system, to which all members have unlimited access. A detailed protocol for data storage, acquisition, and cataloguing is being developed. This data base is housed in the GFE office at the University of New Brunswick.

7. Clear and appropriate goals are necessary. Ecosystem management best develops where there are clear objectives for the ecosystem. The setting of appropriate goals is one of the most difficult hurdles faced by groups attempting ecosystem management, in part because of the need to consider humans as part of nature. Human values and needs must be expressed clearly, and the implications then considered if ecosystem management is to be successful. The goals for the GFE project are as follows:

- To identify strategies to maintain viable populations of native species within the Greater Fundy Ecosystem by focusing on species whose population levels are perceived to be at risk.
- To quantify species–habitat relationships for select species in the Greater Fundy Ecosystem so that the information can be used in land-management decisions.
- To examine the environmental stresses in the GFE and understand how they affect valued resources.
- To identify operational management options that will ensure the ongoing sustainability of the Greater Fundy Ecosystem.

8. Monitoring is necessary. For ecosystem management to be successful in protected areas, a comprehensive monitoring plan must be established that examines the state of ecological integrity of the system on a regular basis. Results of the monitoring must be built into a management system so that management practices can be adaptively changed. Despite a general call for monitoring in the recent literature, it is difficult to find ecosystem management projects, in protected areas or elsewhere, where good ecological monitoring programs are in place.

The GFE project is part of a national program coordinated by Environment Canada to monitor the status of ecosystems on an ecozone basis. The first "state of the ecozone report" for the Fundy region is under preparation for release in March 1995. We hope that having an institutionalized requirement to prepare regular reports will provide the necessary impetus to conduct regular monitoring. We recognize the many failures that have occurred in attempts to carry out long-term monitoring.

9. Management must be adaptive. All management involving ecosystems is a long-term experiment that must be continually adapting to changing conditions and new knowledge. Our fundamental understanding of ecosystems is weak and our ability to predict cause-and-effect relationships in ecosystems is imprecise. Therefore, decisions regarding ecosystems must be open to modification on a short time horizon, and management structures must be designed to reflect this necessity.

The above is a management philosophy that we are attempting to instill in the management of the GFE and Fundy Model Forest projects. This will be difficult and will require substantial changes in the approaches to management taken by all partners.

Research Agenda

The GFE research agenda is based upon (1) a fundamental need to first characterize the ecosystem; (2) a stress–response framework that accounts for specific stressors, such as stand conversion or forestry roads, so they can be mitigated or the impacts avoided; and (3) the need to design a research program that accounts for the inherent hierarchical nature of ecosystems. These factors were used to design a research agenda through consensus, using a series of workshops. The basic elements of the agenda are given below.

Characterization of the Greater Fundy Ecosystem

The consideration of any ecosystem must begin with a basic understanding of the components and dynamics. Good existing data characterizing parts of the Greater Fundy Ecosystem already exist. For example, Fundy National Park has good data on vegetation and bird–habitat relationships. Outside the park, the Province of New Brunswick has a data base used to manage timber resources. In other cases, new data are being collected or data need to be collected at a finer resolution. In all cases, data characterizing the Greater Fundy Ecosystem need to be kept on a common up-datable data base. The main needs for ecosystem characterization are perceived as follows:

- Characterization of past and future landscapes and the dynamics of change, at both the community and landscape levels.
- At a community level, chronosequences of both natural and anthropogenic origin should be determined. This may be done for forest communities, including plantations, thinned stands, and budworm-origin stands as well as non-forest communities such as streams. The purpose of understanding community and landscape dynamics must be to forecast both temporally and spatially.

Research on Mitigation and Avoidance of Known Stressors

In some cases, research needs to be conducted on specific mitigation and avoidance techniques required to ensure that forest management, tourism, and other activities on the landscape are compatible with a sustainable landscape and the maintenance of ecological integrity. General descriptions of such research, with some specific examples, are as follows:

- A common mitigation for forest harvesting now used on the landscape is buffer strips around watercourses. However, there are few concrete data on the best configuration of buffer strips. How can buffer strips be managed to ensure that the integrity of stream communities is protected, including fish habitat? Questions remain on the required width of buffer strips and the types of forest management activities that might be compatible within the buffers.
- What are the specific ecological requirements to support viable populations associated with mature or old-growth forests? These requirements need to be quantified as both structural and functional elements. In some cases, it may be possible to duplicate certain habitat needs by modifying forest harvest techniques, for example by providing cavity trees, brush piles, or understory vegetation.
- Paleoecological studies may be used to reconstruct the past disturbance regime in the Greater Fundy Ecosystem.
- What are the effects of different disturbance regimes on nutrient cycling? The disturbance regimes should include budworm-affected forest, plantations, thinned stands, and mature reference forest. Nutrient input and output studies should be conducted on higher-order

streams and their watersheds, in addition to stand types.

- What patterns of forest harvest on the landscape are best suited to the maintenance of native biodiversity in the Greater Fundy Ecosystem? Because many native populations cannot be maintained in all stand types and ages, their sustainability must be considered at the landscape level.
- What are suitable indicators of environmental quality in the Greater Fundy Ecosystem, including indicators relevant to ecological and resource sustainability, ecological integrity, and biodiversity?
- What are the differences in carbon storage and dynamics in natural versus silvicultural forests and streams in the Greater Fundy Ecosystem, and what are the implications for long-term productivity and the survival of specific populations?
- What are suitable population-habitat models for selected game and indicator species? Experiments should be conducted on the relationships between populations and habitat. For example, forestry could be conducted to manage for a range of stand types and conditions. These conditions should be specified as part of an experiment to provide habitat for selected species at risk.
- What are the implications of increased access allowed by forestry roads on game and wildlife populations within the larger context of exploitation?
- What are the ecological implications of edges created by intensive forestry? How deeply do edge effects penetrate into the unharvested reference forest and what are the implications for habitat quality and quantity.

This general research agenda led to the development of more than 20 research projects. The first formal presentation of the initial results of these projects was given at a workshop in the fall of 1994.

Lessons Learned to Date and Future Directions

The GFE project has been successful in bringing parties together that previously had little dialogue or even an adversarial relationship. Most partners now agree that there has been an enormous increase in the common level of understanding and appreciation of each others' problems and contexts. The use of a research focus and an office in the non-aligned atmosphere of a university was an effective tool in bringing parties together. This accomplishment might have been impossible if left to bureaucracies to develop similar arrangements. The project has also been successful in bringing a research focus to the GFE and the Fundy Model Forest. With the publication of newsletters and word of mouth, there has been an increasing interest in research in the area. The research activity presently occurring has exceeded early expectations.

Despite the widespread adoption of the ecosystem approach to management, it should be recognized there are problems associated with it. First and foremost is the very idea that ecosystems can or should be managed. Ecosystems are complex, self-organizing entities that are dynamic in time and space. They respond to external and internal forces in both predictable and unpredictable ways. To say that humans can manage something as complex as an ecosystem, something of which they are part, is an expression of arrogance. Ecosystem management should be viewed as an effort to think holistically, to understand a range of interactions, and to be unconstrained by institutional boundaries. We can destroy ecosystems, or protect them from destruction, or even moderately influence them. However, managing ecosystems, in the sense of full control, is not possible.

Because the GFE project is only three years old, there is little to report in actual changes to management actions. However, there is an expectation within the GFE and the Fundy Model Forest that the comprehensive management plan under preparation will result in significant changes in the nature of human use of the region. Ultimately, the success of ecosystem management and the GFE project will be judged by what happens on the ground. Most operating examples of ecosystem management have had a difficult time pointing to actual changes in land-based operations that have taken place. We are hopeful that our efforts will result in a long-term management strategy that is adaptive and ecosystem-based, and which will provide a working example of humans living in harmony with the ecosystem that must sustain them forever.

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Naming and Knowing an Ecuadorian Landscape: A Case Study of the Maquipucuna Reserve

Fausto O. Sarmiento
Institute of Ecology, University of Georgia, Athens, Georgia 30601-2022

Resumen
LA MAYORÍA DE LOS ATRIBUTOS de la configuración del paisaje del piedemonte andino de la cuenca alta del río Guayllabamba son fácilmente descritos por sus nombres originales y su completa asociación cultural. Los ejemplos del cambio de nombres explican el efecto epistemográfico en esta área. Los paisajes tropandinos de los Andes del Norte son ignorados por la mayoría de los ciudadanos debido a la falta de versación geográfica y ambiental; los nombres indígenas de los atributos geográficos han sido reemplazados por nombres "cristianos" sin relevancia local ni significado ecológico alguno. Se presentan los datos de los atributos descriptivos de la Reserva Maquipucuna, en las montañas de Nanegal y la cuenca del río Alambi, en donde se inicia un ambicioso proyecto de agricultura sustentable y manejo de recursos naturales. La autogestión rural debida al conocimiento local es sugerida para incluir la nomenclatura geográfica como una herramienta educativa bicultural para la valoración del paisaje cultural para conservación.

Landscape Description

Epistemography—the study of how humans come to know a landscape—combines information from philosophy, cultural history, geography, and psychology. How the landscape features of a given region have been named provides important clues to the epistemography of the place. There are three avenues to landscape naming: toponymy, in which names are drawn from topography, orientation, and other terrain qualities (e.g., the term "deep hollow"); scientonymy, in which names are drawn from scientific attributes (e.g., the term "cave class 3"); and emotunymy, in which names are drawn from a description of attributes based on emotions (e.g., a term such as "lonely coldness") (see Figure 1).

As Christianity arose and the world began to be seen as a frontier to be conquered, the idea that humans were part of nature was replaced by the belief that humans are above nature (Jordan, 1995). Naming geographical features after humans instead of for their role in the landscape helped reinforce the idea that humans are above nature. Christianity brought new dimensions to landmarks and it became common to name them in honor of saints or religious figures. This is the case in the Upper Guayllabamba River Basin of northwestern Ecuador, where one finds places named Santa Marianita (Little Saint Mary), San Pedro (Saint Peter), or Santa Rosa (Saint Rose).

Epistemographic analyses can be performed by projecting the mental "inscape" of people onto a physical landscape (Dansereau 1975). This inscape—which is something of a mental shield harboring emotions—plays an important role in the way in which people relate to their surroundings and how they value natural areas worth protecting. Naveh and Lieberman (1994) point out the importance of fuzzy set theory and intelligent geographic information systems (IGIS), a type of expert system, to include no-quantitative attributes in the quantifiable analysis

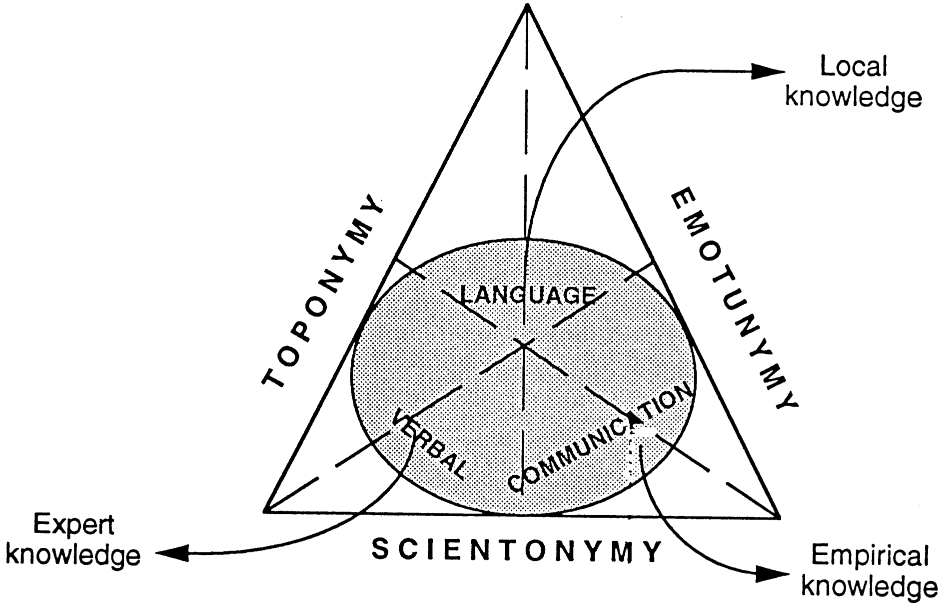

Figure 1. Methods of Landscape Naming

of nature, so emotional descriptors can be assimilated into landscape ecological analyses.

Every language has developed a set of words to reflect specific reactions to the landscape. Words created in this way deliver not just significance, but also sensation, feeling, and emotion (Sarmiento 1984). Therefore, analyses of landscape description can consider oral alongside written descriptors. As Troll (1968) pointed out in his "geoecology" concept, the cultural appraisal of the physical world also reflects the "character" of the landscape. Landscape character—whose importance was recognized long ago by the pioneering geographer Alexander von Humboldt (1845, in Jordan 1981)—is, for the Tropandean region, something that evolves along with the changing influence of humans and their modification of the natural world. A unique character will make the landscape distinguishable from closely related ones whose features evidence similar ecological, historical, and sentimental values.

The recovery of indigenous nomenclature is particularly useful for landscape conservation. The cultural attrition by the loss of language is delayed by revitalizing local toponymy and emotunymy. Also, the risk of "cosmopolitization" of the concept of the protected area—as if every park should offer the same rewards to the visitor—is minimized in favor of authenticity. Overall, the cultural component of the ecodiversity that is protected in the reserve becomes an issue in redefining the city-oriented trends against the peasantry in the developing world.

Tropandean Human Influence

The character of the landscape on the Tropical Andes has been shaped along the course of history by both active geological force and an intense human occupation of several thousand years' standing. Budosky (1968) analyzed the role of humans configuring the current landscape of the neotropical mountains of Central and South America. In a deeper analysis, Ellenberg (1979) explored the fact that some of the human-made ecosystems, such as the Llanos or the Páramos, are pulsing according to fire regime or grazing frequency. He went further to acknowledge that, with the European colonization, neotropical montane ecosystems have been "Mediterraneanized," and hence some profound changes in landscape function; for example, deforestation of Tropandean slopes has exacerbated the Föhn effect in the leeward and diminished the evaporation-to-precipitation ratio of most Interandean valleys in Ecuador (Sarmiento, 1993).

With the advent of Western civilization, the Tropandean landscape has changed towards traditional European styles of agriculture and land management. Boundaries soon appeared as linear features and hedges now form corridors connecting remnants of native vegetation isolated by a matrix of pasture or cropland. For instance, the Equatorial Andes now show an exotic mixture of grasses, weeds, tree plantations (Knapp, 1993) and architectural features, to the point that the original landscape is gone (Sarmiento, 1987), giving the region an "anthropophilous" character which is present within the montane belt of the Tropandean biome (*sensu* Acosta-Solis, 1977). Sarmiento (in review) emphasized the fact that habitat modification was present already before the Conquest, but the epistemographic effect—the replacing of indigenous geographical names with Christian ones lacking local significance—became evident only with the advent of Spanish rule and its Catholic beliefs.

In the Upper Guayllabamba River Basin, the same pattern has emerged, becoming a driving force for the landscape dynamics of the Tropandean Piedmont of northwestern Ecuador (Sarmiento, 1994; 1995). Connecting both the Transandean domain (the western windward of the Andes cordillera) and the Interandean domain (the central leeward plateau), the Guayllabamba drains about 500 sq km before it joins the Blanco River to form the Esmeraldas, the second largest river on the Pacific coast of South America (see Figure 2). The mosaic of different habitat types and different land-use regimes endows the Basin with what may be the highest biodiversity per unit area in the world (Bennett, 1994). It encompasses one of Myers' (1990) "hot-spots": areas critical to the preservation of global biodiversity. The Basin also harbors great cultural variety, including native groups, Afro-ecuadorians, mestizos, mulattoes, and whites.

The Maquipucuna Reserve and Current Research

The Maquipucuna Reserve is a privately owned and managed 4,000-ha protected area on the Andean Piedmont near the town of Nanegal. Its elevation ranges from 1,200 m to 2,800 m, thus encompassing two distinct biotic provinces: the lower and upper montane. In the lower area, abandoned pastures and old farms create an ideal setting for successional studies since cultivation has stopped and natural recovery is being monitored with permanent plots. In the upper area, pristine old-growth forest covers the steeper

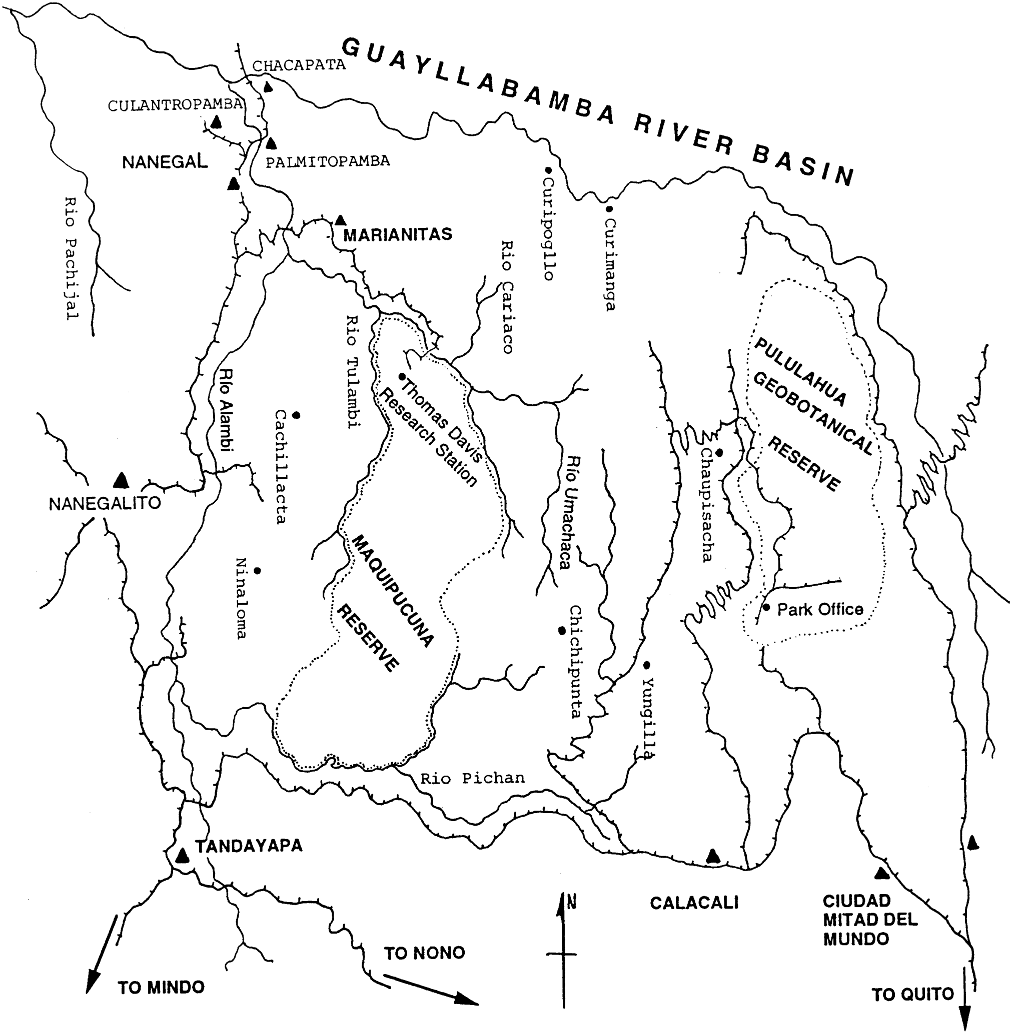

Figure 2. Upper Guayllabamba River Basin

slopes in a unique display of cloud forest ecology. In most of its buffer zone, active agriculture is ongoing, especially sugar cane cultivation and cattle ranching. Isolated patches of old growth are sparcely distributed among this anthropogenic grassland, offering restoration loci.

The Quito-based Maquipucuna Foundation, a non-profit Ecuadorian nongovernmental organization, coordinates the management of the reserve. The Foundation, a member of the World Conservation Union (IUCN), receives donations and grants to promote proactive conservation and restoration in its land for perpetuity. IUCN now is helping to develop a Rapid Assessment Program (RAP) for the Upper Guayllabamba River Basin, in which the Maquipucuna Reserve plays a key role. The Thomas Davis Research Station for Cloud Forest Ecology in the reserve has started biological and ecological work as baseline information for conservation and restoration purposes (Sarmiento 1992). Another program, the Bellow Ground Ecology Project (funded by the MacArthur Foundation through the University of Georgia Institute of Ecology and the Maquipucuna Foundation in Quito), is currently underway. It aims to understand the role of soil ecology and its application to restoration and conservation of the region.

Because of its strategic location and biotic richness, along with the history of land cultivation, the Alambi River, one of the main tributaries within the Basin, was chosen as the Ecuadorian field site for the International Project on Sustainable Agriculture and Natural Resources Management (SANREM-CRSP) which is now beginning to test landscape–lifescape interactions following the assumption of a "farmer first" concept within a "bottom-up" approach to economic development within a landscape ecological framework.

Some Examples of Local Landscape Terminology

Here follows a selection of local names analyzed etymologically to demonstrate the need to recover the indigenous nomenclature of Tropandean sites that has been replaced by European-influenced terminology (refer to Figure 2). Recovering the indigenous nomenclature would help bring about an understanding of the role of selected features in the native culture.

Some of the geographic names are rooted in the pre-Inca language of the Yumbos that may have a Chibcha origin, such as "Tulambi" or "Alambi." Some others are rooted in the Quichua language and are commonly used even with a Spanish-like phonology, e.g., "Culantropamba" (Cordero, 1992). Others maintain their Spanish root.

Alambi. If the term is Chibcha, then it can be translated as "the river of the plain"; but if it is Quichua, *Allag-lambi*, then it can be translated as "the river that digs by licking."

Cachillacta. It can be translated from Quicha as "the land of salt."

Calacali. The Spanish version of the word *callig* with the Spanish suffix *cali.* It can be translated as "short-lived limestone hedges."

Cariaco. The Spanish version of the word *cari-yacu,* which describes the quality of a brave white water; it can be translated as "the river for men" or "male water."

Chacapata. It can be translated from Quicha as "the bridge on the flat small hill"; however, if the Spanish version can be used, then it may mean "the foot bridge" or "the beach bridge."

Chaupisacha. It can be translated from Quicha as "the semi-wilderness."

Chichipunta. The Spanish version to describe *chichi jahua.* It can be translated as "the ridge of the phantom," or as "the peak of the gnome."

Culantropampa. The Spanish version for *rushcu bamba.* It can be translated as "the land of cilantro."

Culunco. The Spanish version of *cullcu.* It can be translated as the "fallen log." Locally, it is used to describe a mountain trail, perhaps because of the trees that have fallen on the path.

Curimanga. It can be translated from Quicha as "the pot of gold."

Curipogllo. The Spanish version of the word *cury-pugllu,* a place where gold was so common as to appear to be flowing from a spring. It can be translated as "the source of gold."

Guayllabamba. It can be translated as "the oscillating plains." However, it has been suggested that the name is a deviation of *Huayra,* "the wind," and *Bamba,* "the plains" or "the field of." If this is correct, then the meaning of the name would refer to the "windy fields," or to the "land of winds."

Maquipucuna. The term can have more than one translation. If we assume that comes straight from *maqui-pucuna,* it can be translated as "the handy blow" as when dispersing seeds by blowing. However, the blowing connotation with "hand" has more of a tendency to refer to a good omen for harvesting or a good backing; therefore my initial translation of "the caring hand." But, if we assume that the term comes from *maquipa-cuna,* it can be translated as "the place of salutation" or "where you have to give your hand." Lastly, if the term comes from *Ma-quipus-cuna,* then it can be translated as "knotting great" or "happily writing with knots."

Mindo. If the term is of Chibcha origin, then it can be translated as "the corner," but if it comes from the Quichua *Mingay* with the Spanish suffix *-do,* then it can be translated as "the place to store with custody."

Nanegal. The Spanish version of *nina,* "fire" or "flares." It can be translated as "the place of a lot of fires."

Nanegalito. The Spanish version of "little Nanegal." Actually, being the roadside town selected for the highway construction, it grew bigger than Nanegal.

Ninaloma. The Spanish version of *nina pata.* It can be translated as "the hill of fires or flares."

Nono. Spanish for the ninth ordinal number. It refers to the place where traditional pilgrimage or "novenas" for the "El Cinto" Virgin were concluded.

Pachijal. The Spanish version of *pachicuna.* It can be translated as "the river that crosses a lot of Paches," a montane tree species (Lauraceae: *Nectandra* sp.).

Palmitopamba. The Spanish version of *chunti bamba,* It can be translated as "the palm fields," or "the land of small palm trees" (possibly *Euterpe* spp.).

Pichan. It can be translated as "the broomer." It is suggested that the term is a deviation of *pichana,* the broom.

Pupulahua. The Spanish version of *pullu-lahuay.* It can be translated as "the sheets of wheat" or "the wheat cover."

Tandayapa. It can be translated from Quicha as "the bread is plentiful."

Tulambi. If the term is of Chibcha origin, then it may mean "the river of the mountain"; but if is Quichua, *tula-lambi,* then it can be translated as "the river that licks the burial mount."

Umachaca. It can be translated from Quicha as "the headwater bridge."

Yungilla. The Spanish diminutive of *Yunga.* It can be translated as "the little warm place of the mountains."

Yumbo. The Spanish version of *yunga,* a "thing from the warm lowlands." It can be translated as "the people of the montane jungle," since the term was applied to the people that inhabited the area from 1,500–500 BP. It is also the local name from the barbet toucan (*Semnoris ramphastinus*), which may reflect the fact that it is endemic to northwestern Ecuador and southwestern Colombia, i.e., a typical representative of the montane Tropandean forest areas.

Discussion

After the onset of European domination of indigenous cultures, Spanish names replaced the local toponymy and emotunymy which had described the prominent features of the Tropandean landscape. Since the understanding of "soft" landscape values is determined by different tools of conservation education (Naveh and Lieberman, 1994), rescuing the indigenous geographic lexicon of the Upper Guayllabamba River Basin can illuminate not only the history of land occupation through time, but can also provide environmental awareness (Western, 1989).

The Ecuadorian government has no clear policy for naming landmarks or other geographical attributes. On occasion, civic fervor has prompted the naming of places for dates of military victories or special events. In Quito, the capital city, the main avenues reflect an array of historic dates. In other instances, religious or civil powers hold sway, and towns, rivers, hills, or lakes are named for famous citizens or respected saints. It is easy to find at least a couple of dozen different towns with the name of San Rafael, and several rivers have the name of Santa Rosa.

By recovering the toponymy and emotunymy of a place, it is possible for managers to develop conservation education programs in their protected areas. Local names will bring immediacy and topological meaning to geographic attributes. To use the example of "Maquipucuna" itself, the explanation of the meaning of this word to visitors becomes a way for them to understand the human impact on Tropandean landscapes. By referring to the place-name "Cachillacta," for instance, visitors are encouraged to form an image of an important trading post for the salt supply that was a key to the highland–lowland dynamics of societies in the Equatorial Andes. Finally, by talking about the bird-name "Yumbo," visitors are encouraged to retain the idea of a mystic mountain people and its legends. So, the inference of early land-use practices reflected in the name of landscape features plays a role in the education of visitors to the protected area, to the benefit of both.

Conclusion

Now that humans have basically conquered the wild frontier, we must turn our attention to conservation and to recovering the relationship between nature and us. What better tool for such teaching than to name streams, mountains, and other features of the landscape for their ecological significance? It is imperative to reevaluate the policy of geographical naming of landscape features in Ecuador and elsewhere in the Tropandean region. Maintaining a local toponymy and emotunymy unique to the montane area will help continue the cultural tradition. This, in turn, will help identify unique landscape characteristics for conservation. Therefore, recovery of indigenous landscape nomenclature is needed to reinforce protection of cultures and their resource bases alike.

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Toward an Inventory of North American Protected Areas

Introduction and Comment

In this issue of THE GEORGE WRIGHT FORUM we explore the steps that already have been taken, and remain to be taken, to produce a comprehensive inventory of protected areas in North America. Canada, Mexico, and the USA have joined together on what might be called a "voyage of self-discovery." In 1993, the three countries convened a North American Workshop on Environmental Information. The result of the workshop was, in essence, a long-term commitment to gathering the information needed to identify and understand the ecosystems of the entire continent. A number of working groups have been created to tackle aspects of the project. The one which concerns those of us in the GWS is the Working Group on Ecosystem Frameworks and Analysis, which has as one of its goals the creation of a North American Protected Areas Database. Ed B. Wiken and Kenneth Lawton describe the genesis of the project in the following article. Then James M. Omernik reviews the conceptual background of categorizing the continent into ecoregions.

Needless to say, the task is monumental. Canada's National Conservation Area Data Base has more than 14,000 entries and is by no means complete. A similar inventory of U.S. protected areas would undoubtedly produce even higher numbers, and work on quantifying Mexico's protected areas has only just begun. The figures could become staggering, depending on how small one wants to go in terms of size and how broad one wants to get in terms of defining "protected area." As GWS member Craig L. Shafer recently pointed out in a fascinating article called "Values and Shortcomings of Small Reserves" (published in the February 1995 issue of *BioScience*, Vol. 45, No. 2, pp. 80-88), in this era of rampant habitat fragmentation we can ill afford to offhandedly dismiss the conservation value of small reserves, even ones as small as, say, 0.01 hectares. Consider a recent inventory in Illinois which looked at almost 4,000 cemeteries and all 11,000 miles of railroad rights-of-way in the state–and found 910 locations with rare species. No one is claiming that the local graveyard equates with Yellowstone, but Shafer argues persuasively that vest-pocket reserves are not without value. Throw them into the continental inventory mix and pretty soon you're looking at very big numbers.

And all these considerations refer to protected *natural* areas alone. Counting and categorizing protected cultural areas and sites is currently outside the purview of the trilateral Working Group. This is, no doubt, partly a matter of feasibility and partly a reflection of the tendency to view protected cultural areas as being somehow genetically different from protected natural areas. Now, no one can deny that there are vital differences. For example, organizing a continental inventory by ecoregions makes good sense for large natural areas, but doesn't necessarily work for cultural areas. And there are special problems associated with inventorying cultural resources, such as the need to conceal (or at least avoid publicizing) the exact location of certain sensitive archeological sites, and similar considerations that attach to native religious and spiritual sites. Nonetheless, as we have stressed many times in GWS publications, there are real benefits to integrated management of natural and cultural resources, and these benefits extend to inventorying *all* protected areas, natural and cultural–at least in tandem if not within a single monolithic database. In the third and final article under this theme, Thomas

J. Green and W. Frederick Limp give us an idea of how complicated a task it is to inventory archeological sites within a region, let alone a whole continent.

As Wiken and Lawton ask, if we are to know the ecosystems of North America, we must ask ourselves "What is happening to them? Why is it happening? Why is it significant? What is being done about it?" The same things need to be asked about our cultural sites. These are vital questions of self-discovery, and it is both right to ask them and right to seek the answers in the parks and protected areas of our continent. This is, unfortunately, no longer a self-evident proposition. Here in the USA, we face a politicized backlash against the very idea that publicly funded research and resource management in protected areas are valid and valuable endeavors. (The tortuous birth of the much-maligned National Biological Service—its mission twisted and distorted by various politicians and interest groups—amply testifies to this.) In the face of the backlash, all of us in the GWS need to renew our commitment to the spirit of "knowing thyself" that lies at the heart of park management and research, and defend this value against its detractors. One way is by contributing your knowledge to this trilateral inventory effort. Let us hear from you!

– David Harmon

For contact addresses, see pp. 33-34.

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North American Protected Areas: An Ecological Approach to Reporting and Analysis

Ed B. Wiken

Canadian Council on Ecological Areas, 2067 Fairbanks Avenue, Ottawa, Ontario K1H 5Y9

Kenneth Lawton

25 Rongal Street, Nepean, Ontario K2G 0K6

A Widening Ecological Perspective

FOR DECADES, ECOLOGISTS HAVE BEEN COMMUNICATING THE NEED for an integrated, all-in-one understanding of the places in which we and many other organisms live. Visual evidence of what ecologists had been saying—"our planet is one island of life in the void of space—one ecosystem"—seemed to become a self-evident truth with the early photographs of Earth from the moon. The distant view of Earth from space was compelling. It forced us to think of ourselves as part of the Earth's ecology, not apart from it. Yet three decades later, this integrated way of thinking about the ecosphere is still an emerging concept.

North America seen from space shows no boundaries, no languages, no politics, and no people! The continent is simply a whole entity surrounded by three major oceanic systems. Large stretches of the continent are occupied by distinctive patches, such as the prairies and the Arctic. There are large freshwater bodies and over 15% of the world's forests. Gigantic reserves of mineral and petroleum riches lie in the ground and under the continental shelves. El Niño, the Gulf Stream, and other weather and climate patterns affect the whole continent. And on the ground, there are assets virtually invisible from space: tens of thousands of species of plants and animals, richly varied regional ecosystems, and, indeed, 370 million human beings.

Shared North American Values

Why should Mexicans care about the Arctic? Why should Inuit care about Baja California? Why should city people be concerned about the hinterland lakes and forests? North Americans are often insulated from the varied ecosystems upon which they depend. After all, water comes from the tap, papers appear on the newsstand, and birds come and go with the seasons.

Even though people don't often think about it, ecological events and processes can often affect them over long periods of time and great distances. Prevailing continental patterns of winds, migratory bird routes, and ocean currents respect no borders. Perhaps most importantly, recent observations of stress-exposure-response cycles have shown that large parts of North America are vulnerable to detrimental impacts and that the assessments of those impacts can have complex sets of environmental and socio-economic implications. Studies on acid rain, forest renewal, Arctic haze, and cod fisheries are examples.

In North America, our cultures and languages are regionally distinct. However, we share many similar values. As global citizens, Canada, Mexico, and the United States have shared interests in environmental matters concerning ozone depletion, acid rain, Agenda 21 of the United Nations, the Biodiversity Convention, the North American Commission on Environmental Cooperation, the North American Waterfowl Management Plan, the North American Forestry Commission, and others. Whether the level of effort and means by which we address these matters will improve North America's situation over the coming decades will be a matter of record. However, there is already ample evidence that if integrated approaches do not include ecology, environmental conditions in North America will continue to get worse.

The countries of North America have similar and growing administrative needs with regard to cross-border cooperation and consensus building. Having information on national and continental scales would markedly improve decision-making capabilities. All three neighbors—Mexico, United States and Canada—can make significant contributions to the fuller understanding of North America as an ecosystem by further integrating information and expertise in a more structured manner. Some governmental and non-governmental groups in North America are incrementally responding to these needs.

The State of North America

Objective reporting on the state of North American ecosystems is the first line of analysis in consensus building and action-plan development. Finding a consensus must be structured broadly to capture information on varied interest groups, different types of concerns and levels of scientific understanding. The approach to information gathering and then reporting on the findings in North America is to ask these fundamental questions: What is happening to the North American ecosystems? Why is it happening? Why is it significant? What is being done about it?

In 1993, a workshop on North American Environmental Information and Reporting (Ezcurra et al., 1993) brought together professionals from governments, non-governmental organizations and academic institutions in Mexico, Canada, and the United States. Workshop members were asked to examine the application of an ecosystem approach to North American reporting and then to propose actions that would lead to the development of an integrated information base for North America. Such an information base would ideally cover the overall stress–exposure–response continuum and must be seen from the local, national, international, and global scales.

Recommendations from the workshop led to the creation of a North American Steering Committee, which in turn created six tri-lateral working groups with representatives from the three countries. Each country was assigned to lead in two areas related to its current expertise. Canada coordinates the working groups looking at (1) Ecosystem Frameworks and Analysis and (2) Environmental Accounts. The USA takes the lead on (3) Data Issues and (4) Training. Mexico leads the groups assigned to (5) Environmental Indicators and (6) Institutions and Organizations.

A Concept, a Model and an Application

The Working Group on Ecosystem Frameworks and Analysis was given three objectives:

- Review the concept of an ecosystem approach to the state of the North American reporting and provide a philosophic and scientific basis to integrating ecological information.
- Portray major continental-scale ecosystems. Maps at three different regionalized scales and integrated biological and physical data would be used to build the

initial model-framework for depicting ecosystems.

- Analyze the types and distribution of protected ecological areas and use this as an initial basis for promoting work on other topics of North American interest.

Of the work which has been undertaken on these three objectives, only the latter will be discussed in any detail in this paper. But the first two provide the context for the work; they are discussed in Omernik's article, below. With any of these objectives, we must capitalize on existing information and initiatives that already exist in Canada, the United States, and Mexico. This is in part why we are attempting to use THE GEORGE WRIGHT FORUM to canvass for additional input.

An Ecosystem Framework

Working within an ecosystem model or framework requires more than just a conscious decision by individuals to change the way they think, plan, and act. At all levels of society, people need to be educated about the reality and extent of their partnership with nature. Building a capacity to operate within an ecosystem context cannot work without well-developed coordination mechanisms amongst countries, agencies, and professionals.

It is only in the last few decades that the world community has begun to express an understanding of and a means to deal with large ecosystems. Applying an ecological model (Figure 1) means seeing North America not just as a system in space; it also requires a vision of North America in time as well. An ecosystem approach realizes that environmental, social, and economic changes don't occur in isolation, and that relatively pristine ecosystems are not isolated from the influences of those which are strongly modified by human activities. Therefore, attention must be given to identifying important linkages and relationships. In each country, descriptive information on existing and past conditions, as well as emerging social, economic and environmental issues, need to be assessed. This information provides clues as to national and global implications and provides a basis to evaluate the consequences of current and future actions.

But the various internal agencies and departments in all three countries have different and perhaps conflicting mandates. Environmental and socioeconomic data have often been collected independently by various agencies for different purposes. Typically, data are not integrated, and are not always comparable. With protected areas as an example, the work is not the singular responsibility of any one agency or group in a country. The responsibilities, information sources, mandates, roles, and jurisdictions involved are very fragmented across many agencies. Judging the overall adequacy or merely the state of a country's network of protected areas can, paradoxically, only be assessed through the sum of the parts.

The comprehensive picture for North America must grow from protected area information bases like those of the World Conservation Monitoring Centre (WCMC, 1994) and Canadian National Conservation Area Data Base (Turner et al., 1992). The NCADB grew, for example, from a national-government-based registry of 400 protected ecological reserves in the mid-1980s to a registry which currently contains over 14,000 protected areas of various types. Broadly based forums such as the George Wright Society and the Canadian Council on Ecological Areas (CCEA, 1994) are also vital mechanisms in building the larger country and continental perspectives.

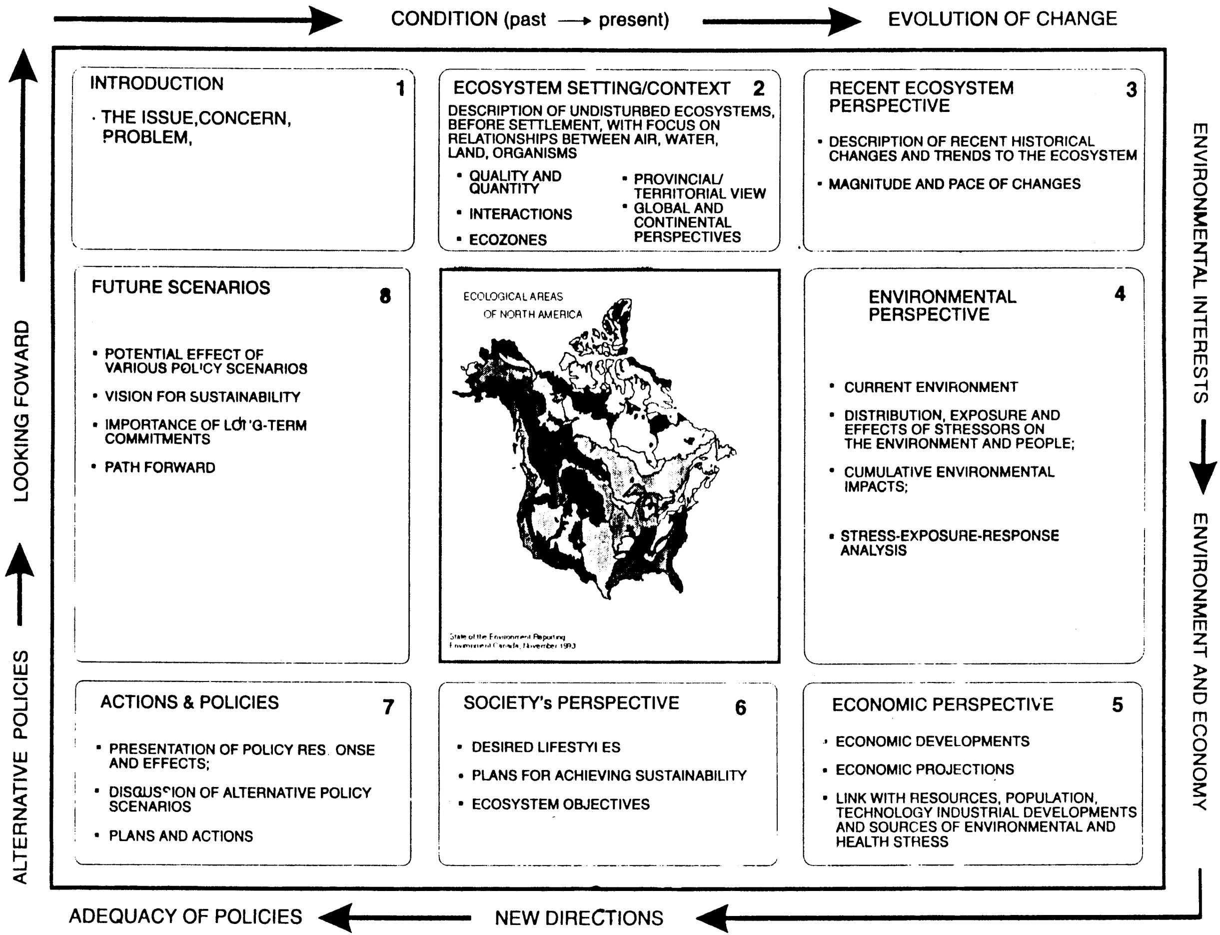


Figure 1. Ecosystem Analysis: Action Plan-Science-Policy Links

Regionalizing Ecosystems

There is a clear recognition that the complex and all-encompassing nature of the ecosystems can not be simply translated into units on a map. Formal decision-makers through to the concerned public, however, commonly plan and act in terms of spatial units—lots, townships, lease areas, properties. Regional depictions showing the mapped extent and variation of ecosystem types are very useful communication devices and convenient instruments in fostering the integration of biological and physical data. The need for a uniform and broadly based ecological regionalization of countries has had a long history (Wiken, 1986; Omernik, 1995). To be of wide value, the approach to regionalizing ecosystems units must be hierarchically based to respect different levels of planning needs and be founded on the integration of abiotic and biotic factors.

Ironically, many natural-region maps and ecosystem maps are not based on a holistic view. When the criteria for mapping and classification are examined, it often turns out that the map units are thematic delineations of a particular ecosystem component (e.g., depiction of the climate component or the vegetation component). Recognizing this fact is strategically important. The underlying notion of a comprehensive network of protected ecological areas is to secure and protect representative types of ecosystems. The key benchmark reference for such work must be a comprehensively based ecosystem map. The concepts behind the map and the units it characterizes constitute the cornerstones in assessing whether representativity has been achieved and how ecological integrity can be maintained.

An integrated classification of ecosystems is a challenge. The Working Group's challenge is to make the existing data that each country brings to the process fit together in a manner that is useful to as many interests and stakeholders as possible. Canada and the United States have already been successful in this regard and work is being undertaken by the group to apply a similar classification to Mexico.

Protected Area Analysis

Inside our borders, we have set aside areas as national parks, wetland conservation areas, forest reserves, wildlife sanctuaries, biosphere reserves, ecological reserves, marine parks, critical habitat areas, and so on. With some of the earliest designations, it was thought that protecting areas was largely a case of bringing the city to the wilderness. Parks, for instance, provided visitors with picnic tables, roads, and campgrounds so that the wilderness could be experienced with the remnant comforts of city life. Now, protecting areas is more closely equated with managing a future. Protected areas are increasingly being viewed as our remaining stock of ecological capital—nature's original venture capital and each person's biodiversity assets.

The extent, status, and trends related to North American protected areas are unclear. There is no easy way to provide a continental summation. Existing monitoring efforts have largely been set up to look at specific agency needs or at specific ecosystems, and existing protected areas efforts are not cross-indexed in some form of overall system. And consistent and comparable descriptions of data base variables don't yet exist. Canada is perhaps is the most fortunate of the three nations at present.

Owing to the production of two national State of the Environment Reports, and the public interest in comprehensive and objective reporting, extensive cooperation has already taken place between agencies to build a central information base.

Of particular interest to readers of this issue is the Working Group's proposal of a North American Protected Areas Database (NAPAD) with a set of standard attributes. From the outset, the NAPAD database must address the scientific goals of representativity and ecological integrity. It should be designed to meet the needs of North American reporting. But it should also have value in terms of its ability to address work on indicators and issues of biodiversity. The data base should also be able to address the needs of various industry-based sectors (e.g., forestry, agriculture), but at the same time assist in the development of systems-planning needs for particular conservation authorities.

The working group proposes that the North American Protected Areas Database contain the following variables as a minimum and be linked to a GIS.

- Designated or common name of the protected area (e.g., Banff National Park, Yellowstone National Park).
- Centroid (latitude and longitude).
- Size in hectares.
- IUCN category (under the new classification system).
- Location according to province, state, territory, and country. Protected areas can span jurisdictions, therefore a multiple designation capability is needed.
- Ecoregion/Ecozone. This variable should reference particular types of units.
- Jurisdiction: Ownership and management authority.
- Type or designation: A name which reflects the main rationale for establishing the area (national park, wildlife refuge, forest reserves–what's being protected).
- Boundary file: Polygon file describes boundary.
- The year the protected area was established or deleted.
- Change Indicator: Points to a file that keeps information on changes in size of the protected area, its designation, the date the record was last updated.
- Land cover information.
- Source(s) of attribute data.

The following points were considered to be of moderate priority for inclusion in the NAPAD:

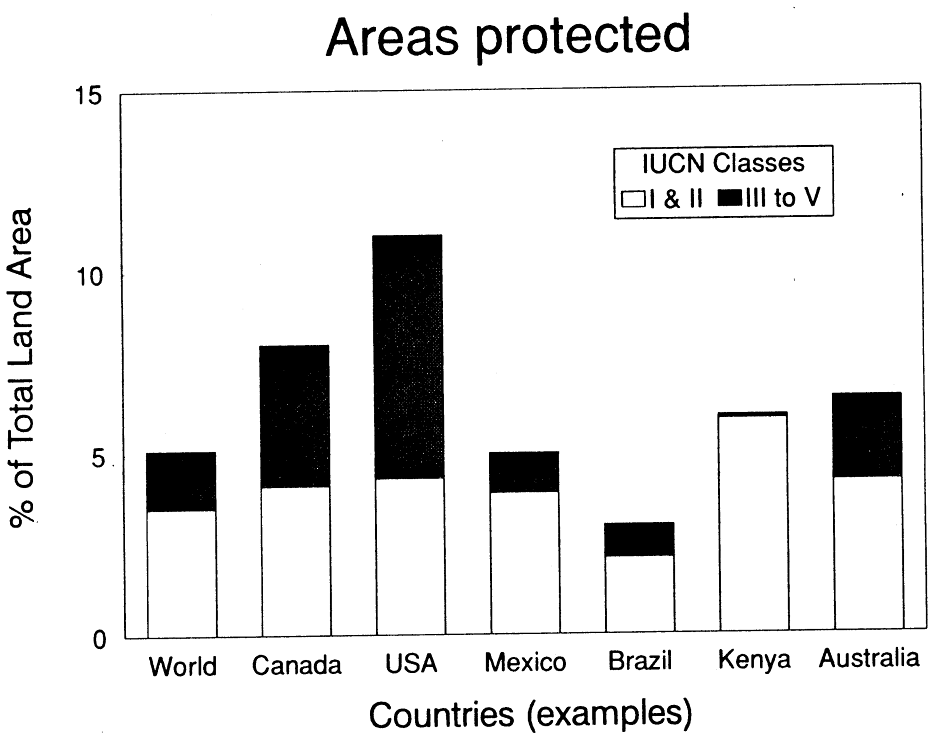
- A memo field. It might include whether the protected area spans more than one ecological unit; comments about surrounding land use, such as zoning; special features and attributes, e.g. biological, physical, cultural.
- Assessed economic value.
- A recognition that changing technologies and the penetration of CD-ROM equipped multimedia computers may lead to the ability to include maps, videos, pictures, and sounds to the data base in the future.

Clearly, each country must designate central authorities to maintain and update this database. The Working Group could assist jurisdictions by providing guidelines on how existing categories of protected areas should be coded. The use of wide currency codes like the IUCN's categories should be mandatory so that there is a consistency across jurisdictions.

The Working Group acknowledges that initiatives to attempt some of this work are already in progress, some for many years. For example, the World Conservation Monitoring Centre (WCMC) in Cambridge, England, has been acting on a world level as a repository for data on protected areas, and the World Bank is conducting work in the Latin American countries. The North American Protected Areas Data Base would need to capitalize on existing country-level data sets, and to build on initiatives that have shared goals. For example, the North American Forestry Commission (NAFC) has recommended the fomration of a Canada–USA–Mexico joint commission to draw up, develop, and coordinate a Unified System for the management of forested protected areas in North America (USM-PRONA). The U.S. Gap Analysis project is working on related classification schemes.

Current Status of North American Protected Areas

What progress has been made in North America? According to the WCMC (1992), roughly 5 percent of the world's land mass is protected in IUCN management categories I to V. This figure parallels what is protected in Mexico; the USA and Canada exceed the average (Figure 2). North America itself would be slightly above the world average. Some agencies feel that the appropriate target for protected areas should be based on general percentages (e.g., 12%) of the Earth's surface, some feel it should be based on representation of regional ecosystem types, some feel it should be based on integrity considerations, and still others advocate the use of all of these factors.



Taken from WCMC (1992) data

Figure 2. Some Examples of Protected Area Coverage

How many protected areas do we have in North America? Oddly, the most accessible and comprehensive source of such information was held by the WCMC in Cambridge, England. While Canada had recently integrated data from many sources into the NCADB, Mexico and the USA did not appear to have a singular and authoritative source for all of the major protected area interests; the WCMC had indirectly merged some of the data for these two countries by acting as a host agency for contributions coming from different sources.

The WCMC information base, which mainly concentrates on larger properties, indicates that there are nearly 7,000 areas held by federal, state, and provincial governments. Canada and the USA have a similar numbers of sites according to this information base. In the last issue of THE GEORGE WRIGHT FORUM (Vol. 11, No. 4, p. 12) we attempted to plot the distribution of these areas. The plot of the centroids of these areas corresponds to a population map or, alternatively, a map closely tied to the cultural patterns of each nation. In Canada, the centroids hug the 49th parallel, where most people live. The U.S. pattern shows increasingly dense westerly waves. In Mexico, centroids are heaviest around the Mexico City area and radiate outwards; the region surrounding the city has been the core of human activities and culture for centuries.

The WCMC information base, like other information sources, occasionally lacks key but simple codes (e.g., geographical references). About 17% of the Canadian centroids for sites (Table 1) were not coded, and 85% of the sites have missing data in the U.S. portion. Geographical coordinates are highly valuable in cross-checking the linkage between protected areas and ecosystem units or between protected areas and administrative boundaries. When the latitude and longitude are missing, the utility of the data becomes very limiting. Agencies should be encouraged to provide WCMC with complete data sets.

Many people associate protected areas with parks alone, but the types and, in effect, the interests are much broader. This is reflected in the range of "types" which have been identified. They are most varied in the U.S., with 85 types. General type designations such as wildlife area and nature reserve or other designations such as IUCN's management categories, can be confusing when used in isolation. IUCN category II (Amos, 1994) is typically associated with parks.

Particular parks may also serve as areas protecting key forest ecosystems, critical wildlife habitats, wetland ecosystems, and nature reserves. It is important to critically review how designations of any kind are applied and what they mean to the development of a comprehensive network of protected areas for a particular country or North America as a whole.

	No. of areas	Coded for reference	No. of types of protected areas
Canada	3,423	17%	52
Mexico	214	48%	30
USA	3,100	85%	85

Table 1. Examples of available North American data held by the WCMC

How do we evaluate some of the simple aspects of representativity? Some examples from the Canadian NCADB work are used here. There are roughly 3,500 government properties listed that amount to about 78,000,000 ha. Surprisingly, nearly 98% of this area is covered by just 628 of the properties (personal communications with Tony Turner, State of the Environment Directorate, Canada). These same 628 sites are also the properties which are greater than 1,000 ha—a figure which many feel is essential to have any hope of maintaining ecological integrity. The majority of these large areas are contained within only four geographical divisions—Alberta, British Columbia, Ontario, and the Northwest Territories. In the USA, Alaska would account for many of the larger areas. Canada has fifteen major terrestrial ecozones and five marine ecozones. Only two of these twenty units have greater than 12% secured in protected area status; most average below 3%.

What of the remaining 2,872 protected areas which are smaller than 1,000 ha? Because they largely consist of small areas, many of which are in the southern, populated parts of Canada, it places a great deal of importance on protected area strategies that are designed for fragmented landscapes. Beyond the 3,500 government properties, there are approximately 9,500 other sites held by non-government groups, and these sites amount to about 1,000,000 ha in total. Many of these are small areas as well.

Continuing Cooperation

In the end, there is a vast amount of information available to decision makers and researchers in North America. Equally, there is a growing acceptance of the need for a broader view to the development of ecological approaches to issues of land use and management, and protection of biodiversity. The long-term goal should be to integrate data from numerous sources within all three countries in a consistent and comparable way. These actions are necessary to construct a foundation for ecosystem analysis and to promote basic operational efficiencies.

A continental network of protected ecological areas will ultimately depend on the synergy from widely different agencies and information sources. Decisions need to be connected with the data holders and knowledgeable professionals who have the information to support making informed choices. Integrating data, increasing the understanding of linkages, looking to the future, and recognizing differing perspectives all add up to the key principles of an ecosystem approach. The working group would welcome the help from agencies or individuals in furthering a comprehensive North American perspective on protected ecological areas.

From the Editors: How You Can Help

The GWS has offered to help the Working Group on Ecosystem Frameworks and Analysis by acting as a clearinghouse for information that will further the inventory. We are also committed to communicating with our members and other readers about the inventory, and possibly assisting in other ways as well. The papers in this issue, and the introduction to the project which appeared in the last issue (Ed Wiken, Tony Olsen, and Miguel Esquiha-Zamora, "The 'Status of Protected Areas in North America' Project: An Introductory Note," Vol. 11, No. 4, pp. 10-11), are a first contribution to what will be a long-term project.

But of course the "we" of the GWS really means *you*. So we are asking for the help of all readers of THE GEORGE WRIGHT FORUM. If you have ideas for organizing the inventory of North American protected areas (both natural and cultural), suggestions of data sources, insights into the process of inventorying protected areas—in fact if you have any suggestions at all—we want to hear from you. Send your thoughts to:

The George Wright Society
ATTN: North American Protected Areas Inventory Project
P.O. Box 65
Hancock, Michigan 49930-0065 USA
E-mail: gws@mtu.edu

In Canada, you may contact:

Ed B. Wiken
Canadian Council on Ecological Areas
2067 Fairbanks Avenue
Ottawa, Ontario K1H 5Y9
E-mail: ewiken@soeree1.sid.ncr.doe.ca

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Ecoregions: A Framework for Managing Ecosystems

James M. Omernik
U.S. Environmental Protection Agency, Environmental Research Laboratory, 200 SW 35th Street, Corvallis, Oregon 97333

Ed. note: A longer version of this paper, entitled "Ecoregions: A Spatial Framework for Environmental Management," is a chapter in Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making, *Wayne S. Davis and Thomas Simon, editors (Lewis Publishers, an imprint of CRC Press, Boca Raton, Florida, 1995). With permission. For ordering information, call CRC Press at 800-272-7737.*

Background

IN RECENT YEARS THERE HAS BEEN AN INCREASING AWARENESS that effective research, inventory, and management of environmental resources must be undertaken with an ecosystem perspective. Resource managers and scientists have come to realize that the nature of these resources (their quality, how they are interrelated, and how we humans affect them) varies in an infinite number of ways, from one place to another and from one time to another. However, there *are* recognizable regions within which we observe particular patterns (Frey 1975). These regions generally exhibit similarities in the mosaic of environmental resources, ecosystems, and effects of humans, and can therefore be termed "ecological regions" or "ecoregions." Definition of these regions is critical for effectively structuring biological risk assessment, which must consider the regional tolerance, resilience, and attainable quality of ecosystems.

There is general agreement that these ecological regions exist, but there is considerable disagreement about how to define them (Gallant et al. 1989, Omernik and Gallant 1990). Some of this disagreement stems from differences in individual perceptions of ecosystems, the uses of ecoregions, and where humans fit into the picture. Most, however, agree with a general definition that ecoregions comprise regions of relative homogeneity with respect to ecological systems involving interrelationships among organisms and their environment. Rowe (1990, 1992) has argued that ecoregions subsume patterns in the quality and quantity of the space these organisms (including humans) occupy. He implied that the organisms as a group, or singly, are no more central to the system than the space they occupy. Each is a part of the whole, which is different in pattern in space as well as time. This more holistic definition appears to be gaining acceptance (Barnes 1993).

Canadian resource managers have been at the forefront of developing ecoregional frameworks and stressing the need for an ecoregional perspective (Government of Canada 1991). They have argued that the lion's share of environmental research is of the single-medium or single-purpose type (Figure 1), whereas much of the focus and concern of environmental management has recently been on the entire ecosystem, including biodiversity, effects of human activities on all ecosystem components, and the attainable conditions of ecosystems (Wiken, pers. comm.). The problem is that little effort is being expended on studying ecosystems holistically and attempting to define differences

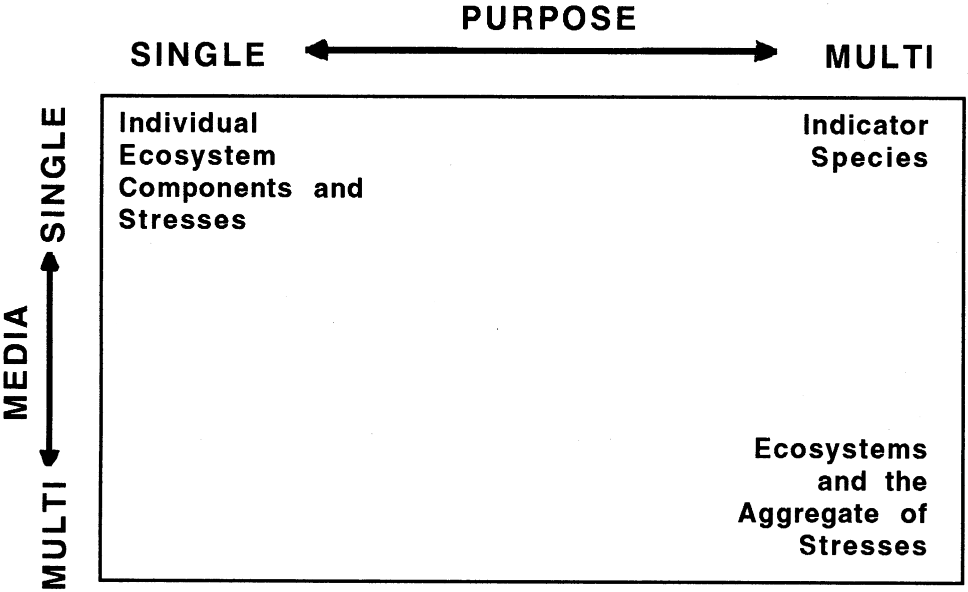


Figure 1. Types of Environmental Research

in patterns of ecosystem mosaics. Wiken is not suggesting, nor am I, that this is an "either–or" situation or that the balance should be reversed. Certainly we must continue basic research on processes and the effects specific human activities (and human activities in aggregate) have on environmental resources. However, to maximize the meaningfulness of extrapolations from these studies and the use of data collected from national or international surveys, we must develop a clearer understanding of ecosystem regionalities.

A large barrier to developing this understanding is the common belief that to be scientifically correct, regions must be quantitatively developed and that they are objective realities (Hart 1982a). Although this belief is being defused with increased understanding of ecosystems, the need to combine art with science in regional geographic research, including the development of ecoregions, continues to meet resistance (Golledge et al., 1982; Hart 1982a, 1982b, 1983; Healey 1983). This resistance is not universal, however, particularly in applied areas such as military intelligence. Military geographers, when tasked to define regions within which broad-scale military operations or specific types of operations may be conducted, have long employed qualitative techniques to filter such aspects as the relative inaccuracies and differences in levels of generality in mapped information (Omernik and Gallant 1990). In this case, the focus is on defining areas within which there is likely to be similarity in general or particular combinations of conditions regarding such factors as physiography, climate, geology, soil type, vegetation, and land use. Knowledge of spatial relationships between geographic phenomena, the relative accuracy and level of generality of mapped information, and differences and appropriateness of classifications on maps of similar subjects, allow the geographer to screen each piece of intelligence (data source) and delineate the most meaningful regions. The test of these regions is in their ultimate usefulness, rather than in the scientific rigor of a particular qualitative mapping technique.

Ecoregion Definition

Ecoregions occur and can be recognized at various scales. If one is viewing the conterminous United States from a satellite, one can recognize broad ecoregions, including the semiarid-to-arid basin, range, and desert areas of the West and Southwest, and the rugged mountains of the West. The latter typically contain a mosaic of characteristics ranging from alpine glaciated areas at or above timberline, to dense coniferous forests, to near-xeric conditions at lower elevations and in rain shadow areas. Other such broad ecological regions include the glaciated Corn Belt and associated nutrient-rich intensively cultivated areas in the central United States and Upper Midwest, and the contrasting nutrient-poor glaciated regions of forests and high-quality lakes and streams in the Northeast and northern Upper Midwest. At a larger scale (closer to the earth), one can recognize regions within these regions, and at successively larger scales, regions within those regions.

The recognition of these regions is nothing new. They have long been perceived by people from all walks of life—from the earliest explorers in whose diaries we read descriptions of the flora, fauna, climate, and physiography in the different regions they traveled, to present-day ecologists and resource managers who are attempting to understand the effects human activities are having on ecosystems. The problem has been in defining the regions. Although most resource managers have a general understanding of the spatial complexities in ecosystems and how they can be perceived at various scales, they tend to use inappropriate frameworks to research, assess, manage, and monitor them. One reason is that until recently there have been no attempts to map ecosystem regions, so rather than make interpretations, managers have chosen surrogates. These surrogates have often been single-purpose frameworks of a particular characteristic believed to be important in causing ecosystem quality to vary from one place to the next. The most commonly used single-purpose frameworks have been potential natural vegetation (e.g., Küchler 1964, 1970), physiography (e.g., Fenneman 1946), hydrology (e.g., U. S. Geological Survey 1982), climate (e.g., Trewartha 1943), and soils (U.S. Department of Agriculture 1981). Another reason for using single-purpose frameworks stems from the belief (mentioned in the preceding section) that a scientifically rigorous method for defining ecological regions must address the processes that cause ecosystem components to differ from one place to another and from one scale to another.

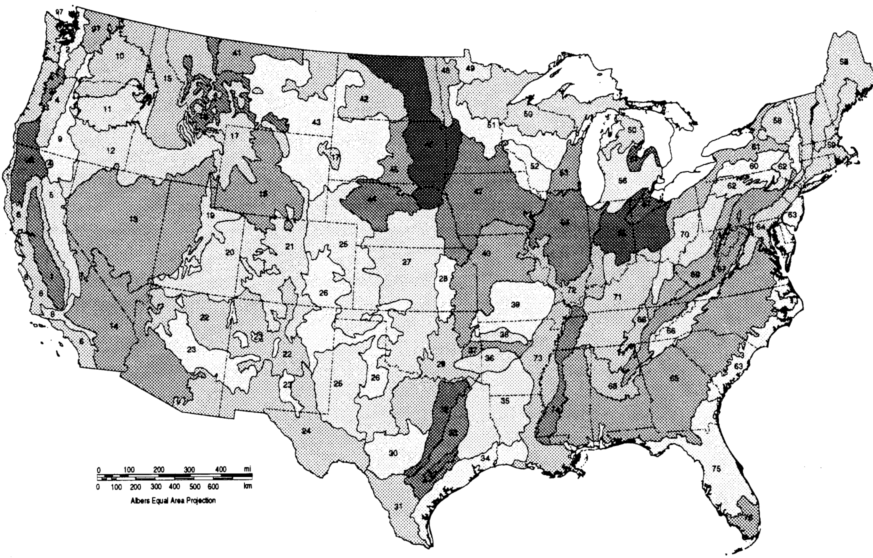
Several classifications have been developed to address biotic regions, or biomes, but with the implication that these classifications define ecosystem regions as well. This is understandable, because the perception that ecosystems comprise more than differences in biota and their capacities and interrelationships, although not new, has gained wide acceptance only relatively recently. Most of these mapped classifications reflect patterns in vegetation and climate and have been regional in scale (e.g., Dice 1943; Brown and Lowe 1982; Brown and Reichenbacher, in press; Holdridge 1959). Very few have been global (e.g., International Union for Conservation of Nature and Natural Resources 1974; Udvardy 1975). Bailey's ecoregions (Bailey 1976, 1989, 1991; Bailey and Cushwa 1981), although based on a number of landscape characteristics, rely on the patterns of a single characteristic at each hierarchical level. These regions have been developed at regional and global scales.

The first compilation of ecoregions of the conterminous United States by USEPA was performed at a relatively cursory 1:3,168,000 scale and was published at a smaller 1:7,500,000 scale (Omernik 1987) (Figure 2). The approach recognized that the combination and relative importance of characteristics that explain ecosystem regionality vary from one place to another and from one hierarchical level to another (Gallant et al., 1989; Omernik and Gallant 1990). This is similar to the approach used by Environment Canada (Wiken 1986). In describing ecoregionalization in Canada, Wiken (1986) stated:

> Ecological land classification is a process of delineating and classifying ecologically distinctive areas of the earth's surface. Each area can be viewed as a discrete system which has resulted from the mesh and interplay of the geologic, landform, soil, vegetative, climatic, wildlife, water and human factors which may be present. The dominance of any one or a number of these factors varies with the given ecological land unit. This holistic approach to land classification can be applied incrementally on a scale-related basis from very site-specific ecosystems to very broad ecosystems.

Hence, the difference between this approach to defining ecoregions and most preceding methods is that it is based on the hypothesis that ecological regions gain their identity through spatial differences in a combination of landscape characteristics. The factors that are more or less important vary from one place to another at all scales. One of the strengths of the approach lies in the analysis of multiple geographic characteristics that are believed to cause or reflect differences in the mosaic of ecosystems, including their potential composition. All maps of particular characteristics (e.g., soils, physiography, climate, vegetation, geology, and land use) are merely representations of aspects of that characteristic. Each map varies in level of generality (regardless if at the same scale), relative accuracy, and classification used. Subjective determinations must be made in the compilation of all maps regarding the level of generality, the classification to be used, and what can be represented and what cannot, whether the map is hand drawn or computer generated. Everything about a particular subject cannot be shown once the map scale becomes smaller than 1:1. Hence, an ecoregion that exhibits differences in characteristics such as physiography or soils may not be depicted by a map of one of those subjects because of the classification and level of generality chosen, as well as the accuracy of the author's source materials. On the other hand, because ecosystem regions reflect differences in a combination of characteristics, use of multiple sources of mapped information permit the detection of these regions. It is simply a matter of safety in numbers.

Although the approaches used by EPA and Environment Canada are remarkably similar, particularly regarding their use of qualitative, or subjective analyses, the initial compilation of ecoregions maps in both countries was completely independent. Authors of the maps in both countries were unaware of the oth-



1 Coast Range, 2 Puget Lowland, 3 Willamette Valley, 4 Cascades, 5 Sierra Nevada, 6 Southern and Central California Plains and Hills, 7 Central California Valley, 8 Southern California Mountains, 9 Eastern Cascades Slopes and Foothills, 10 Columbia Plateau, 11 Blue Mountains, 12 Snake River Basin/High Desert, 13 Northern Basin and Range, 14 Southern Basin and Range, 15 Northern Rockies, 16 Montana Valley and Foothill Prairies, 17 Middle Rockies, 18 Wyoming Basin, 19 Wasatch and Uinta Mountains, 20 Colorado Plateaus, 21 Southern Rockies, 22 Arizona/New Mexico Plateau, 23 Arizona/New Mexico Mountains, 24 Southern Deserts, 25 Western High Plains, 26 Southwestern Tablelands, 27 Central Great Plains, 28 Flint Hills, 29 Central Oklahoma/Texas Plains, 30 Edwards Plateau, 31 Southern Texas Plains, 32 Texas Blackland Prairies, 33 East Central Texas Plains, 34 Western Gulf Coastal Plain, 35 South Central Plains, 36 Ouachita Mountains, 37 Arkansas Valley, 38 Boston Mountains, 39 Ozark Highlands, 40 Central Irregular Plains, 41 Northern Montana Glaciated Plains, 42 Northwestern Glaciated Plains, 43 Northwestern Great Plains, 44 Nebraska Sand Hills, 45 Northeastern Great Plains, 46 Northern Glaciated Plains, 47 Western Corn Belt Plains, 48 Red River Valley, 49 Northern Minnesota Wetlands, 50 Northern Lakes and Forests, 51 North Central Hardwood Forests, 52 Driftless Area, 53 Southeastern Wisconsin Till Plains, 54 Central Corn Belt Plains, 55 Eastern Corn Belt Plains, 56 Southern Michigan/Northern Indiana Till Plains, 57 Huron/Erie Lake Plain, 58 Northeastern Highlands, 59 Northeastern Coastal Zone, 60 Northern Appalachian Plateau and Uplands, 61 Erie/Ontario Lake Plain, 62 North Central Appalachians, 63 Middle Atlantic Coastal Plain, 64 Northern Piedmont, 65 Southeastern Plains, 66 Blue Ridge Mountains, 67 Central Appalachian Ridges and Valleys, 68 Southwestern Appalachians, 69 Central Appalachians, 70 Western Allegheny Plateau, 71 Interior Plateau, 72 Interior River Lowland, 73 Mississippi Alluvial Plain, 74 Mississippi Valley Loess Plains, 75 Southern Coastal Plain, 76 Southern Florida Coastal Plain, 77 North Cascades, 78 Klamath Mountains

Figure 2. Ecoregions of the Conterminous United States (from Omernik 1987)

er's ongoing work until after the maps had been compiled. This situation has subsequently changed and those responsible for the design and development of both ecoregion frameworks are now collaborating in a multi-country, multi-agency effort [including the U. S. Geological Survey/Earth Resources Observation Satellite (USGS/EROS)] to develop an ecoregional framework for the circumpolar Arctic-Subarctic region. At the time of this writing, a draft of ecoregions of Alaska, consistent with the ecoregions of Canada, has been completed. Publication of this map is planned for 1995. An additional goal of this group is to develop a consistent ecoregional framework for North America.

Needs for ecoregional frameworks exist at all scales. Global assessments require the coarsest levels, such as the Level I Ecological Regions of North America illustrated on the front cover of this issue. National assessments require more detailed regionalizations such as are provided by the Level II Ecological Regions of North America [Figure 3, reflecting Environment Canada's Ecozones (Wiken 1986) and a revision of aggregations of Ecoregions of the Conterminous United States by Omernik and Gallant (1990]. The scale of state-level needs is more appropriately addressed using EPA's Ecoregions (Omernik 1987) or subregions (Gallant et al., 1989, Clarke et al., 1991), and Environment Canada's Ecoprovinces or Ecoregions. Because of the possible confusion with other meanings of the terms province, zone, district, etc., EPA has not adapted that scheme of naming different hierarchical levels. Instead, EPA is adopting the Roman numeral scheme used by the North American collaborative effort [for which see the article by Wiken and Lawton in this issue], with the lowest numerals being the most general regions and the highest, the most detailed. Regions are simply regions regardless of their scale, but some means of identifying different hierarchical levels is no doubt needed. More detailed ecoregions that would be helpful at local levels, such as defined by Thiele (pers. comm.) for a part of the Grande Ronde Basin in Oregon, have not been developed for the United States. Obviously, the more detailed the hierarchical level (the larger the scale), the more time-consuming the chore of completing ecoregions on a per-unit-area basis.

Refinement of Ecoregions and Delineation of Subregions

A number of states—notably Ohio, Arkansas, and Minnesota—have used the first approximation of ecoregions published in 1987 to develop biological criteria, and to set water quality standards and lake management goals. Most states, however, found the resolution of regions delineated on Omernik's (1987) 1:7,500,000-scale map to be of insufficient detail to meet their needs. This has led to several collaborative projects with states, EPA regional offices, and the EPA Environmental Research Laboratory in Corvallis, Oregon, to refine ecoregions, define subregions, and locate sets of reference sites within each region and subregion. This work is being conducted at a larger scale (1:250,000) and includes the determination of ecoregion and subregion boundary transition widths. These projects currently cover Iowa, Florida, and Massachusetts, and parts of Alabama, Mississippi, Virginia, West Virginia, Maryland, Pennsylvania, Oregon, and Washington. Results of much of this work is in varying stages of completion; some maps with accompanying texts have been submitted to journals for consideration of publication and others are being prepared for publication as state and EPA documents.

The process of refining ecoregions and defining subregions is

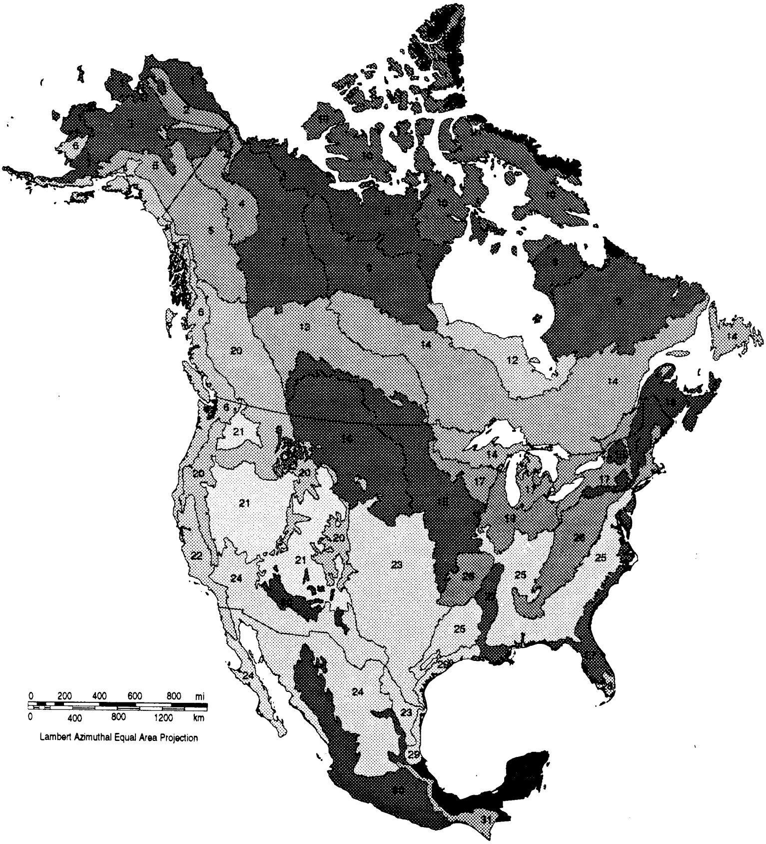


Figure 3. Level II Ecological Regions of North America

similar to the initial ecoregion delineation. The main difference, besides doing the work at a larger scale, is in the collaborative nature of the projects, which include scientists and resource managers from the states and EPA regions covered (and, in many cases, other governmental agencies), as well as geographers at the EPA Environmental Research Laboratory in Corvallis, Oregon. This particular mix of expertise is necessary to maximize consistency from one part of the country to another and to ensure that the final product is useful. The process merely documents the spatial patterns that effective resource managers already recognize. Therefore, interacting with scientists and resource managers who know local conditions is essential in the delineation of ecoregions, particularly at lower hierarchical (larger-scale) levels.

Although some of these ecoregionalization projects have involved only one state, a number have focused on delineation of subregions within one or more ecoregions covering more than one state. One such project encompasses the portions of the Blue Ridge, Central Appalachian Ridges and Valleys, and Central Appalachian Ecoregions that cover Pennsylvania, West Virginia, Virginia, and Maryland (Figure 4). The advantage of this type of project is that it encourages data sharing across state lines and calibration of sampling methods by ecoregion rather than political unit. It also provides a reality check regarding the quality of data collected by different states within the same region. Because natural ecological regions rarely correspond to spatial patterns of state boundaries, or to any other political unit, there are numerous cases where a state covers only a small portion of an ecoregion or subregion that has its greatest extent in neighboring states. The distinctly different subregions of the Central Appalachian Ridges and Valleys

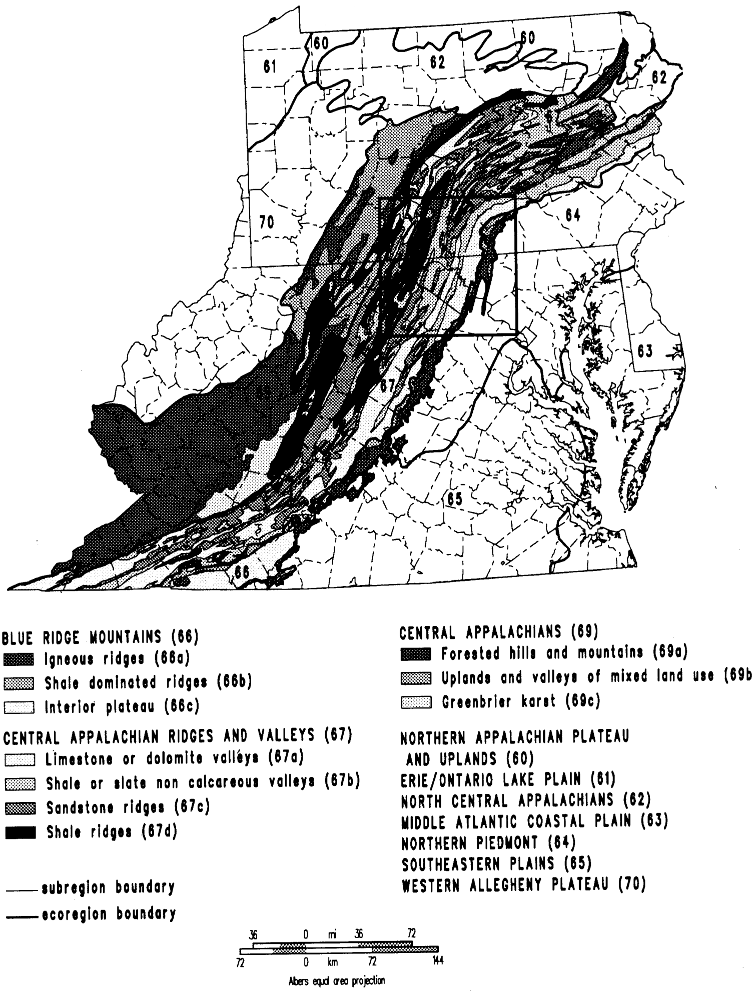


Figure 4. Ecoregions and Subregions of the Blue Ridge, Central Appalachian Ridges and Valleys, and Central Appalachians of EPA Region 3

ecoregion provide a case in point (Figures 4 and 5). Most of these discontinuous subregions are in Pennsylvania and Virginia, with only small parts of each in West Virginia and Maryland.

Reference Sites for Aquatic Ecosystems

Upon completion of the initial revision of ecoregions and delineation of subregions, sets of reference sites are identified for each to get a sense of the regionally attainable conditions regarding aquatic ecosystems. "Attainable quality" refers to those conditions that are realistic, rather than "pristine," which implies the unrealistic turning back of the clock and the absence of humans in the ecosystem. Candidate stream sites must be "relatively undisturbed" yet representative of the ecological region they occupy. (Hughes, 1995; Gallant et al., 1989; Hughes et al., 1986).

An initial selection of reference sites is normally accomplished by

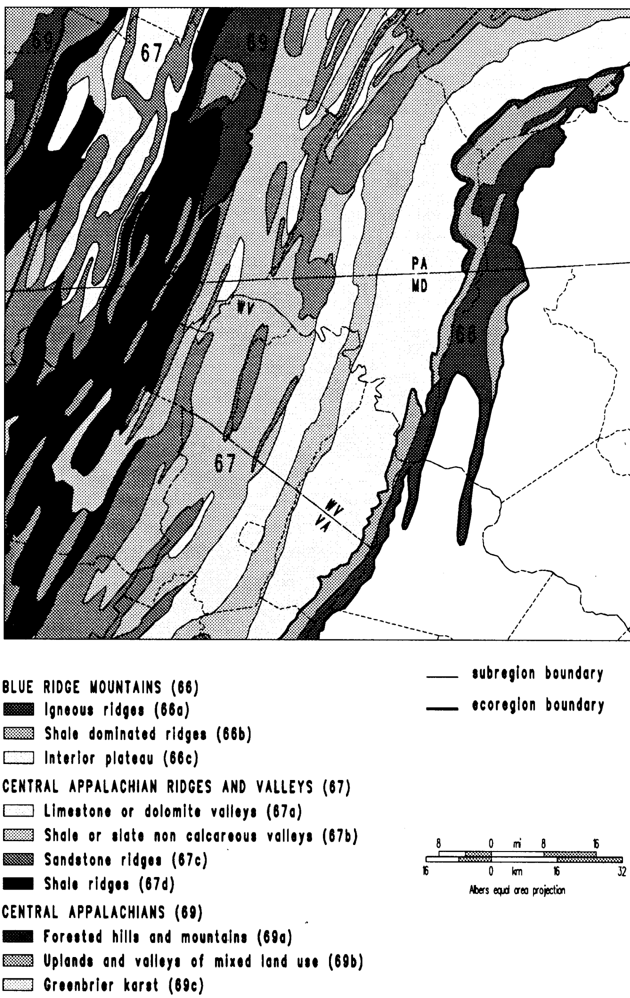


Figure 5. A Portion of the Ecoregions and Subregions of EPA Region 3

interpreting 1:100,000- and 1:250,000-scale maps with guidance from state resource managers as to minimum stream sizes for each subregion and locations of known problem areas and point sources. The probable relative lack of disturbance can be interpreted from topographic maps, particularly the recent 1:100,000-scale series. General determinations of the extent of recent channelization, woodland or forest, urbanization, proximity of roads to streams, and mining and other human activities can be made using these maps. U.S. Geological Survey (USGS) flow records can be consulted to approximate the minimum watershed size necessary for each subregion, but state water resource managers and regional biologists generally have a better idea which streams are of interest because of their intimate understanding of their own areas. Intermittent streams are often considered valued resources if the enduring pools are of sufficient size. State and regional experts should also be consulted regarding the minimum number of sites necessary for each region or subregion. The minimum number is generally a function of the size and complexity of the subregion. For some small or very homogeneous regions, the point of diminishing returns may be reached with a number of five or six, whereas in other complex regions and in areas where reference sites representing different stream sizes are a concern, a much larger number would be desirable.

Field Verification of Reference Sites, Ecoregions, and Subregions. Once sets of candidate reference sites have been identified for each region, they should be reviewed by state biologists and regional experts. Based on their personal knowledge of the region, these regional experts may choose to add or delete potential sites. Then field verification of the ecoregion and subregion delineations is conducted, coupled with visits to representative sets of reference sites within each ecoregion and subregion. Ideally this field work is conducted by the entire group collaborating on the particular regionalization/reference site project. Hence, it should include the geographers responsible for delineating the regions, subregions, and boundary transition widths, as well as compiling the initial list and map of candidate watersheds. The regional biologists and water resource managers who provided information used to define the regions and locate sets of reference sites, and who will eventually use the framework, should also be included. The best test of the regional framework and sets of reference sites is their ultimate usefulness. The regions must make sense to those who know and manager the resources in the area and are developing the biological criteria. Lastly, it is useful to include in the field verification exercises experts from other agencies and biologists from adjacent states who are considering use of the ecoregion/reference site approach in their assessment and regulatory programs.

The Concept of Pristine and Least-Disturbed Conditions. It must be understood that reference sites do not represent "pristine" condition—those which would exist if humans were removed from the scene, or pre-European settlement conditions. To select such sites is impossible. There are no pristine areas in the United States, or in the world for that matter, if the term implies an absence of human impact. The idea that conditions were pristine in North America prior to European settlement has been convincingly challenged recently (Denevan 1992). Humans have probably played a major role in shaping landscape pattern and molding ecosystem mosaics for thousands of years.

Reference sites representing least disturbed ecosystem conditions are a moving target of which humans and natural processes are a part.

Like the mosaic of geographic conditions that shape ecosystem patterns, that which can be categorized as "least disturbed" is relative to the region in which a set of reference sites is being selected. In the Boston Mountains Ecoregion (in Arkansas and Oklahoma), minimally impacted reference sites include streams having watersheds without point sources, little grazing activity, and a relative lack of recent logging activity and road building. In this region, stream reference sites and their watersheds come close to mirroring the present perception that most people have of high-quality stream conditions. In the Huron/Erie Lake Plain Ecoregion (in Ohio, Indiana, and Michigan), on the other hand, there are no streams with watersheds that are not almost completely in cultivated agriculture. Many are also heavily affected by urbanization and industries, and all streams relative to watersheds whose extents are 30 square miles or more have been channelized at one time or another. However, there are some streams that are relatively free of impact from point sources, industries, and major urbanization, that have not been channelized for many years so that the riparian zones have been allowed to grow back into woody vegetation with the channels becoming somewhat meandering. These types of streams and watersheds would constitute relatively undisturbed references for the region. Although the quality of the set of streams reflects the range of best attainable conditions given the current land use patterns in the regions, this does not imply that the quality cannot be improved. An analysis of the differences in the areal patterns of water quality from reference sites (the biota in particular) with patterns in natural landscape characteristics (such as soil and geology, and human stresses including agricultural practices), should provide a sense for the factors that are responsible for within-region differences in quality. A measure of how much the quality can be improved can then be derived through changing management practices in selected watersheds where associations were determined.

Selecting Reference Sites For Small and/or Disjunct Subregions. The approach for selecting sets of reference sites for subregions is the same as for the larger ecoregions. The maximum stream and watershed sizes of sites representative of subregions are normally smaller, of course, because the subregions are smaller and in many cases discontinuous, such as subregions of the Central Appalachian Ridges and Valleys (Figures 4 and 5). Where subregions represent bands of different mosaics of conditions, as is the case in some western mountainous ecoregions, it may be necessary to choose reference sites that comprise watersheds containing similar proportions of different subregions.

Anomalous Sites. In selecting reference sites, care must be taken to avoid including anomalous stream sites and watersheds. This can be particularly difficult when such streams are very attractive and represent the best conditions in a region. For example, an ecoregion or subregion typified by flat topography and deep soils, where minimally impacted streams with low gradients, no riffles, and sand or mud bottoms are the norm, may also include a small area of rock outcrops and gravels in which streams have some riffles and gravel substrate. Obviously the habitat in these streams is different than elsewhere and therefore the quality regarding biological diversity and assemblages cannot be expected in other parts of the region. Certainly streams such as this one should be protected and not be allowed to degrade to standards and expectations set for streams typical of most of the region, but neither should the typical streams be expected to attain the quality of an anomaly.

Watersheds and Ecoregions

One of the most common spatial frameworks used for water quality management and the assessment of ecological risk and nonpoint source pollution has been that of hydrologic units (or basins or watersheds). The problem with using this type of framework for geographic assessment and targeting is that it does not depict areas that correspond to regions of similar ecosystems or even regions of similarity in the quality and quantity of water resources (Omernik and Griffith 1991). Patterns in Major Basins and USGS Hydrologic Units (USGS 1982), which comprise groupings of major basins with adjacent smaller watersheds and interstices, have no similarity to patterns of ecoregions, which do reflect patterns in aquatic ecosystem characteristics (Figure 6). Many, if not most, major basins drain strikingly different ecological regions.

The recent stress on "a watershed approach," although an excellent idea in that it changes the focus from dealing with predominantly point types of environmental problems to including those of a spatial nature, carries the implication of geographic targeting. The perception is that, by looking at ecosystems and individual environmental resources within a watershed context, we are taking a giant step forward toward understanding ecological risk, ecosystem potential, and, ultimately, more effective ecosystem management. Although the rhetoric may be better, in reality what is being done may be little different than what has been done before. We now call case studies "watershed studies." The real problem is that we may be fooling ourselves into be

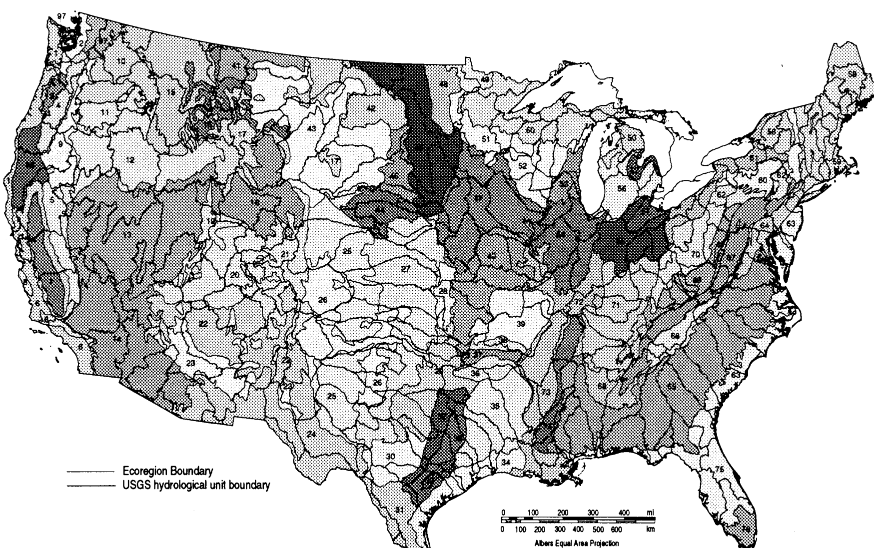


Figure 6. Omernik Ecoregions and U.S.G.S. Hydrologic Units

lieving that by adopting a "watershed approach" we are providing a spatial context within which to better understand and manage ecosystems. Use of watersheds is critical for ecosystem research, assessment, and management, but it should be done within a natural ecoregional framework that subsumes patterns in the combination of geographical characteristics (e.g., soils, geology, physiography, vegetation, land use) associated with regional differences in ecosystems. We must develop an understanding of ecosystem regionalities at all scales, in order to make meaningful extrapolations from site-specific data collected from case studies or watershed studies, or whatever they are called.

Evaluating Ecoregions

As with any new tool, the usefulness of ecoregions must be evaluated. However, the evaluation of a framework intended to depict patterns in the aggregate of ecosystem components is not an easy task. Although commonly done, an appropriate test is *not* how well patterns of a single ecosystem component, such as fish species richness or total phosphorus in streams, match ecoregions. The work of Larsen and others (1988) in Ohio showed that the patterns of any one chemical parameter often do not demonstrate the effectiveness of ecoregions in that state. However, when the chemistry portion of water quality was illustrated for the Ohio reference sites using a principal components analysis, with a combination of components comprising nutrient richness on one axis and a combination of components comprising ionic strength on the other axis, the ecoregion patterns became quite clear. Similarly, methods of grouping biotic characteristics to express biotic integrity, such as the index of biotic integrity (IBI) (Karr et al., 1986), have effectively shown ecoregion patterns (Larsen et al., 1986). Because of the nature of ecoregions, the ideal way of evaluating them would be through use of an ecological index of integrity. Such an index has yet to be developed and would need to be regionally calibrated. Hence, there is necessarily some circularity in the evaluation process.

It must be recognized that the concept and definition of ecoregions are in a relatively early stage of development. The U.S. EPA Science Advisory Board (1991), in their evaluation and subsequent endorsement of the ecoregion concept, strongly recommended further development of the framework, including collaboration with states regarding the subdivision of ecoregions, definition of boundary characteristics, and evaluation of the framework for specific applications. They saw the need for research to better understand the process by which the regions are defined, and how quantitative procedures could be incorporated with the currently used, mostly qualitative methods to increase replicability. To date, qualitative methods, although used for many applications where the usefulness of the results is more important than the scientific rigor of the technique used, have not been widely accepted. Research must be conducted to demonstrate how the two approaches are complementary. We need to examine the use of art in science, rather than assuming an "either–or" scenario. As we increase our awareness that a holistic ecosystem approach to environmental resource assessment and management is necessary, we must also develop a clearer understanding of ecosystems and their regional patterns. Essential to this is the development of ecological regions and indices of ecosystem integrity.

Acknowledgments

The ecoregion and reference site concepts have been developed through the efforts of many people, too many to acknowledge individually here. The strength and useful-

ness of the framework lies in the collaborative way it has been and is being developed - closely tied to its applications. State and federal resource managers and scientists who helped generate, carry out, evaluate, and otherwise contribute to the various "ecoregions" projects should receive much of the credit for the success of those projects. While not wishing to slight my fellow geographers, and the soils scientists and geologists who have all made invaluable contributions, I feel a special sense of gratitude to the biologists and ecologists for their ideas, mental maps, and understanding. Especially deserving of acknowledgment are the people my geographer colleagues and I have learned from and worked with at the EPA laboratory in Corvallis.

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Explanation of the Front-Cover Map: *Draft Level I Ecological Regions of North America*

MANY OF THE ENVIRONMENTAL ISSUES THAT WE FACE TODAY are ecosystem in scope and do not correspond to jurisdictional or administrative boundaries. Adopting an ecosystem approach to environmental resource management and risk assessment requires an understanding of the spatial nature of ecosystems as well as knowledge of their interrelationships, capacities, and resiliency to stresses caused by human activities. A descriptive ecoregional framework is an essential element for the ecological approach to be applied effectively across jurisdictional boundaries. An example of an intermediate application of the framework involves North American Free Trade Agreement (NAFTA) decisions that will have an effect on ecosystem quality and characteristics.

The map on the front cover of this issue, the *Draft Level I Ecological Regions of North America*, depicts the coarsest level of the hierarchical framework that has been jointly prepared by the State of the Environment Directorate (Environment Canada), the National Institute of Ecology (Secretariat of Social Development, México), and the Environmental Research Laboratory (United States Environmental Protection Agency). The approach used to compile the map is based on the premise that ecological regions can be identified through the analysis of the patterns and the composition of biotic and abiotic phenomena that affect or reflect differences in ecosystem quality and integrity (Wiken 1986; Omernik 1987, 1995). These phenomena include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another, regardless of the hierarchical level.

The map represents an approximation based on comments from numerous contributors and the source material listed below. To maximize consistency in the definition of ecological regions and thereby increase the usefulness of cross-boundary applications, revisions to the map are planned. These refinements will follow developments in the process of ecoregionalization, clarification of the meaning of the term "ecosystem" across agencies and countries, and the attaininment of a convention regarding the generalization and naming of regions.

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Archeological Overviews: The Southwest Division Overview and the Central and Northern Plains Overview and Their Use in Historic Preservation

Thomas J. Green
Arkansas Archeological Survey, University of Arkansas, P.O. Box 1249, Fayetteville, Arkansas 72702

W. Frederick Limp
Center for Advanced Spatial Technologies, Ozark Hall, University of Arkansas, Fayetteville, Arkansas 72701

ARCHEOLOGICAL SITES ARE NON-RENEWABLE RESOURCES, important to contemporary peoples for many reasons. Archeological sites contain information about past events and the development of our current society that cannot be obtained from any other source. They also contain important scientific information about changes in climate and ecological relationships over thousands of years. The management of these sites, sometimes called "cultural resource management" or "heritage resource management," is now an accepted part of the overall management of public lands in the United States and in most other countries of the world.

In the United States, federal agencies are required by the National Historic Preservation Act of 1966 and the Archeological Resource Protection Act of 1979 to actively manage archeological and historic sites on lands under their care, just as they manage any other resource. The management of these sites requires the same information needed to manage any other resource. One needs to know how many sites there are, where they are, which ones are significant, what effects are occurring to them, and what effects can be expected in the future. Using this information, detailed planning documents for the preservation of archeological and historic sites can be developed for any tract of land.

Since the passage of the National Historic Preservation Act in 1966, a tremendous amount of archeological and historical research has occurred in the United States. Much of this research is in archeological survey and excavation reports produced by government archeologists or by archeologists working for universities or private firms under contract with federal agencies. The information gathered by these efforts is quite significant and can substantially further our understanding of the past, if properly utilized. Unfortunately, most of these reports are not published and do not have wide distribution outside the state where they were produced. Few efforts have been made to synthesize this information for large regions of the United States, and this has hampered the development of detailed planning efforts in many parts of the country. The Southwestern Division Overview (SWDO) and the Central and Northern Plains Overview (CNPO) were initiated by the U.S. Army Corps of Engineers and the Department of Defense to alleviate some of these problems for archeological site management and planning.

The Overviews

The SWDO and CNPO are syntheses of archeological and bioarcheological knowledge gained by means of research in the Great

Plains of the United States and adjacent areas. The SWDO includes information concerning all the lands in the Southwest Division of the U.S. Army Corps of Engineers administrative unit. It encompasses the states of New Mexico, Texas, Louisiana, Oklahoma, Arkansas, and parts of southern Kansas and Colorado. The CNPO covers the area from Wisconsin to Montana and Wyoming, and from northern Kansas to the Canadian border (Figure 1). The SWDO, funded by the U.S. Army Corps of Engineers, was completed and published in eleven volumes in 1989 and 1990. The CNPO is funded by the Department of Defense's Legacy Program (Project No. 68). It is in the final stages of completion and seven volumes will be published in 1995 and 1996.

The structure of the overviews are similar, although changes have been made in the CNPO based on the reviews and experience gained in producing the SWDO. Each overview contains a number of technical reports, an annotated bibliography volume, and a management volume. Technical reports are written for each subdivision in the region. The SWDO was divided into six regions, and the CNPO into four (Figure 1). Each technical report is a substantial volume written by scholars who are experts in the region. The technical report summarizes the history of archeological research in its region, reviews knowledge concerning past environmental changes, provides a prehistoric and historic archeological summary, and collates and synthesizes information gained from

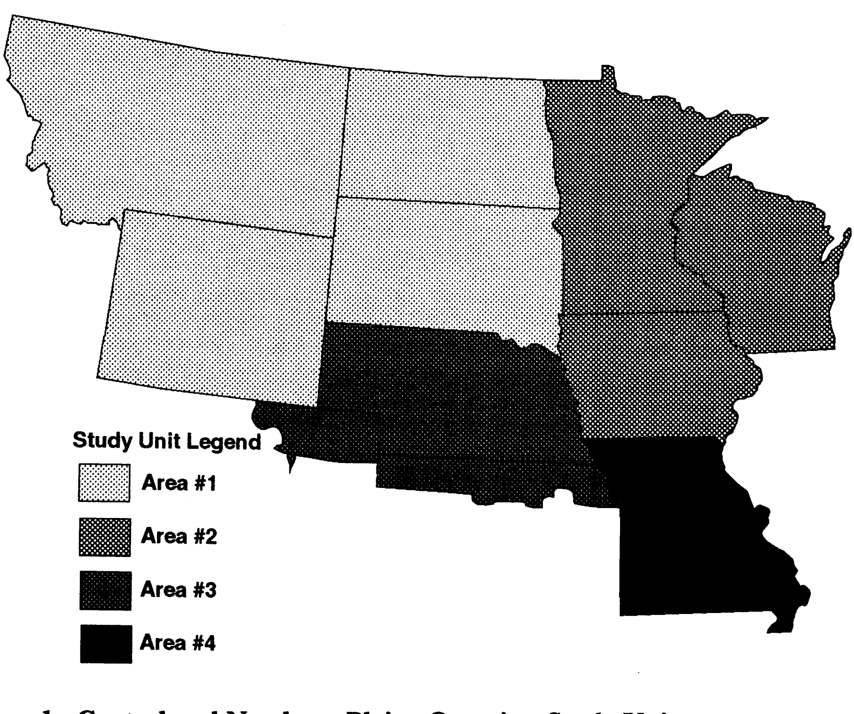

Figure 1. Central and Northern Plains Overview Study Units

studies of human osteology (bioarcheology). The final chapter in each overview attempts to synthesize the archeological, osteological, and environmental information using generalizing concepts borrowed from cultural ecological studies. The use of these concepts is intended to counter the tendency of archeologists to view all archeological cultures as unique entities bounded by a specific time period, and usually confined to contemporary state political boundaries. The technical reports provide the most recent summaries of archeological research in each region and many of them are the first-ever syntheses of the archeological research in a particular area.

The bioarcheology sections are written by leading physical anthropologists and pull together information concerning the numbers of excavated graves from archeological sites and the time periods they represent. Most importantly, these sections summarize information about the past learned from osteological studies of human skeletons. This information has never before been gathered and summarized. The SWDO bioarcheological sections are in great demand by physical anthropologists interested in American Indian populations. For this reason, the bioarcheology sections of the technical overviews produced for the CNPO project will also be published in a separate bioarcheology volume.

A key element in each overview is an annotated bibliography of the substantive archeological literature to facilitate access to unpublished or local and regional literature which is not widely distributed. These bibliographies are cross-indexed by state, county, time period, type of project, subject matter, cultural affiliation, and key words. Four volumes of citations and indices were produced for the SWDO region. It was clear that an automated bibliographic system was needed to manage the vast number of citations. The National Archeological Data Base (NADB), managed by the National Park Service, was being developed when SWDO was in production, and the SWDO citations were among the first included in this data base. All CNPO citations will also be included in NADB, and hence the substantive archeological literature for one-third of the nation will be available on-line. This is a major achievement.

Included in each overview is a management guidelines volume. The management volume reviews state and federal historic preservation laws, discusses federal regulations dealing with archeology and historic preservation, reviews the principles of historic preservation planning, and provides a guide for use of the technical reports, annotated bibliographies, and other information presented in the overviews.

Another major component of the overviews is the development of automated systems by the Center for Advanced Spatial Analysis at the University of Arkansas to facilitate archeological research and preservation planning. Two major systems were used. One is the National Archeological Data Base mentioned above. The other system is the development of GIS-based data sets to provide insights into the large-scale problems raised by the overview. Nation-wide maps have been produced showing the relationships between archeological site density and surficial geology, potential natural vegetation, EPA ecoregions, contemporary land use, and the Normalized Difference Vegetation Index. These maps allow archeologists and historic preservation specialists to look for the first time at large-scale regional patterns.

Management Use of the Overviews

The two overviews provide a detailed archeological summary of over one-third of the United States, and, through NADB, allow on-line access to the most important archeological and bioarcheological literature in this area. How can this information be used to facilitate the management of archeological sites at a federal wildlife refuge, a military installation, or a Corps of Engineers project? The easy answer to this question is that the overviews provide the general archeological context with which to interpret individual archeological sites and projects.

The legal context of a particular management action governs how the documents will be used. In the United States, the various historic preservation laws require federal agencies to take four basic actions. First, Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to "take into account" the effects of their projects on archeological and historic properties eligible for the National Register of Historic Places, and to afford the Advisory Council on Historic Preservation an opportunity to comment on the project (the Advisory Council is an independent federal agency that issues regulations on how to comply with Section 106 and advises federal agencies on ways to avoid adverse effects of their projects on significant sites). Second, Section 110 of the NHPA requires federal agencies to have an affirmative management program of inventory, evaluation, and treatment for the preservation of archeological and historic sites on lands they manage, even if no construction projects are planned on those lands. Third, federal agencies are required by the Archeological Resource Protection Act of 1979 (ARPA) to protect archeological sites on federal land from vandalism and looting, and to develop inventory plans for locating such sites. Finally, the Native American Grave Protection and Repatriation Act of 1990 (NAGPRA) requires federal agencies to protect Indian graves on lands they manage, and to repatriate any Indian skeletal material and associated cultural items to the appropriate tribal authorities.

The best way to meet these obligations is to have an integrated cultural resource management program guided by good information and well-designed historic preservation plans. Historic preservation plans generally have four sections (Anderson 1992). The first is a technical synthesis, or an overview of all past archeological work performed and a summary of what is known about the archeology of a particular piece of land. The second is a compilation of all recorded archeological and historic sites, and a collection of the archeological reports written about the area. This can be as simple as collecting copies of all the reports and site recording forms, or it can be a computer data base depending on the size of the area, the number of sites recorded, and the number of projects conducted. The third section is a map volume. Again, this can be a simple folder with sites and project areas marked on USGS maps, or it can be a fully developed GIS system integrated with a site and project data base. It is critical to map areas where archeological surveys or projects have occurred, and not just the locations of known sites. The last section converts this information into a plan of action by analyzing what is known and not known about the significance and distribution of sites in an area, and the current and planned land use of the reserve or facility. This section contains priorities for future work, standards for conducting the work, and the managing agency's internal procedures for compliance with historic preservation laws and regulations.

Historic preservation plans facilitate compliance with federal laws by allowing archeological sites, or individual federal construction projects, to be considered collectively within an overall management context. This allows more accurate determination of the significance of archeological sites and the effects to them by individual projects. When archeological sites are dealt with on a case-by-case basis, they are almost always considered significant, and treatment plans are developed accordingly. It is far more cost-effective to deal collectively with the archeological resources in a particular management unit.

The SWDO and CNPO volumes provide essential information for the development of these planning documents by providing the historic context needed to develop these plans. The Secretary of the Interior's Standards for Preservation Planning (Federal Register, Vol. 48, No. 190, pp. 44716-44720) stress the use of historic contexts in preservation planning. These contexts, contained in the SWDO and CNPO volumes, describe the significant broad patterns of prehistory and history in an area that are used to determine the significance and management of individual sites. Historic contexts provide the background information needed to develop goals and priorities for future archeological work in a given area. Thus the information provided in the SWDO and CNPO volumes is essential for compliance with Section 106 and Section 110 of NHPA, and Section 14 of ARPA. The SWDO and CNPO volumes also provide critical information needed for compliance with NAGPRA by identifying the major human skeletal collections and by providing the archeological context for determining their cultural affiliation.

In conclusion, any federal management unit in the SWDO or CNPO regions, whether a military installation, a wildlife refuge, a national forest, or a Bureau of Land Management district, can use the SWDO or CNPO volumes to obtain basic information about prior archeological research in the region, past environmental change, and summaries of the regional prehistory. In addition, on-line access to the key archeological literature is available to anyone with a modem. These overviews are important tools that will contribute to the overall preservation of archeological sites in a large portion of the United States.

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Keweenaw National Historical Park: Nationally Significant or a "Slab of Pork"? A Rebuttal to *National Parks Compromised*

William O. Fink
a resident of Michigan's Keweenaw Peninsula

IN HIS RECENTLY PUBLISHED BOOK RECOUNTING HIS TENURE as director of the U.S. National Park Service, *National Parks Compromised: Pork Barrel Politics and America's Treasures* (ICS Books, Merrillville, Indiana, 242 pp.), James M. Ridenour gives a grossly inaccurate account of the creation of Keweenaw National Historical Park. Since there is a good chance this book will never be reprinted in a revised form, and since books with a false telling of history tend to resurface over and over in future decades, gaining credence through the ignorance of the true circumstances of the historic period, it is appropriate that Ridenour's account be firmly challenged at an early point.

The only explanation I can think of for Ridenour's account is that of exceedingly poor standards of scholarship on his part and that of his publisher. He makes serious charges of behind-the-scenes wheeling and dealing. He ignores not only an extensive legislative history, but testimony he himself gave before the Congress.

The following is Ridenour's account of the creation of Keweenaw National Historical Park. Certain phrases and sentences have been placed in bold type to facilitate later analysis and commentary about them.

> Congressman Bob Davis, with late support from Senator Carl Levin, added another slab of pork to the parks when he backed the addition of Keweenaw National Historical Park on the northern peninsula of Michigan. This park was established with the purpose of honoring the heritage of its copper mining industry. It has a lot of charm but I didn't think we should be adding it to the NPS list while we were hanging on by a shoestring.
>
> Congressman Davis had been trying to get this area added into the NPS stable for a number of years, I finally agreed to visit the area to unveil the plaques placing the town of Quincy and the world's largest steam hoist, as well as the town of Calumet, the site of one of the most productive copper mines in the world, on the **National Register of Historic Places**.
>
> It was hard for me to be less than supportive of this project as the people of the area were so enthusiastic about the possibility of having the area under park status.
>
> There were a number of problems. **The biggest was whether or not the area was sufficiently nationally significant to warrant park status.** Some would say that if an area is granted **National Historic Landmark status**, then it automatically passes the significance test for becoming a national park.
>
> I don't agree. I believe the area or building must be eligible for **national register status** to qualify it for park consideration, but I don't think being on the **na-**

tional register automatically qualifies a candidate for park status.

Another problem was that there are acres of old mine tailings in the area that are draining into a small lake near Quincy. I had visions of our accepting this park and then being commanded by the Environmental Protection Agency to spend millions and millions of dollars to clean up the environmental problems of the past.

The old mine shaft was dug on a slant that ran more than 600 feet under the surface. It was really an interesting place to see and to imagine what it was like in its heyday. I don't think I would have wanted to climb into those wooden cars that lowered those miners in the shaft day after day.

Quincy itself was a company town and a good example of what company towns were like in this country. It is still a very pleasant and interesting town that would make a nice tourist trip for those on an adventure to northern Michigan.

I don't know how Congressman Davis got support for this project. **This is one that went right over my head and,** like Congressman (Joe) McDade's Steamtown, **was moved along to national park status before going through the proper authorization channels in Congress.**

These things happen. I once had a congressman ask me how one of his colleagues got support from the Office of Management and Budget for a particular park project. I told him that I had heard a rumor that the congressman had given the administration support on an issue of great importance to the White House.

"Darn," the congressman replied. "I only got two tickets to the Kennedy Center in exchange for *my* vote."

I will guarantee that you will enjoy a trip to Michigan's upper peninsula if you work it into your vacation plans. When you visit Quincy and learn of the history of mining in the area, you can also work in a trip to Isle Royale, an existing, first-class national park just off the coast of the peninsula. The people will be glad to see you, and you will have an interesting look into the mining history of our country, but I still have doubts as to the national park stature of the copper country on the Keweenaw Peninsula.

When Ridenour came to the Keweenaw, he presented plaques designating the Quincy and Calumet areas as National Historic Landmarks, not their listing on the National Register. Yet in his book he says the biggest problem "was whether or not the area was sufficiently nationally significant to warrant park status."

Ridenour seems completely confused about the National Register of Historic Places and the National Historic Landmarks program, using the terms interchangeably. They are two very different levels of recognition. The National Register contains listings of places which may have national, regional or local significance. It is an extensive program, which normally relies on the states to decide whether it is appropriate to add a place to the list. Since many historic places listed on the National Register are only of local significance, it is obvious that National Register listing is not presumptive of eligibility for the National Park System.

The National Historic Landmark program has much more restrictive standards and procedures. Only those places which are found to have national significance—great importance to the heritage of all Americans—are eligible for designation as a National Historic Landmark. Landmark proposals are reviewed by a distinguished national advisory council, and upon their recommendation, designated by the Secretary of the Interior. Because they have clearly passed the test of national significance and professional review, National Historic Landmarks are considered to have automatically met the test of national significance for inclusion in the National Park System. Questions of the feasibility of protection and operation by the National Park Service still have to be addressed before the Congress decides to add a new unit, but the question of national significance has already been determined.

Ridenour relates the legitimate concerns he and the Park Service had regarding potential problems of hazardous wastes at these sites. He failed to note that the Congress asked EPA to review the proposed park area and to give it a report on potential environmental problems, before the Congress would give further consideration to the park proposal.

He also failed to note that on the same day he testified before the Senate Subcommittee on Public Lands, National Parks and Forests of the Committee on Energy and Natural Resources, to offer the Service's position on the proposed park, that Mr. Norman Niedergang of EPA gave testimony which indicated there were no unacceptable health risks associated with designating the area a unit of the National Park System.

Ridenour then wrote, "I don't know how Congressman Davis got support for this project. This is one that went right over my head and, like Congressman (Joe) McDade's Steamtown, was moved along to national park status before going through the proper authorization channels in Congress."

This is the most egregious of his gross misrepresentations of the facts. Keweenaw National Historical Park went through more detailed review and scrutiny by the Administration and the Congress than has been customary with most new units of the National Park System in recent decades. First was a feasibility study, done by the Park Service, but funded by local organizations. That study indicated that there were indeed nationally significant stories to be told in the Keweenaw. That study also led to actions to designate the Calumet and Quincy areas as National Historic Landmarks. After the first study was submitted to the Congress, the Congress directed and funded an additional study of alternatives for the management and protection of these nationally significant resources, and directed the EPA to complete its report on health and safety concerns before proceeding.

During the period, several bills proposing the establishment of the park were introduced in the Congress. After the study of alternatives and EPA report had been submitted, Ridenour was called to testify before the Senate parks subcommittee regarding the latest Senate version of the bill. On March 26, 1992, he testified that the Park Service could not support the bill as proposed, but would support an alternative bill he submitted. Most of the Park Service's discomfort with the proposed bill was quite technical in its nature, dealing with designation and powers of an advisory or operating commission, operation of an historic preservation grants program, and making specific decisions better left to the planning process.

In his testimony, Ridenour said:

> At the request of certain Members of the Michigan Congressional delegation and with funding assistance from local interests, the National Park Service initiated a study of alternatives in January, 1990 to provide Congress and the Administration information about the es-

tablishment of a national historical park on the Keweenaw Peninsula in northern Michigan. Earlier, in August, 1989, the Calumet and Quincy districts on which this legislation focuses were found to possess national significance in illustrating the development of the U.S. copper mining industry from the mid-1800's through the early 1900's.

The study of alternatives revealed evidence of not only the early mining industry of this area but the ethnographic conglomerate that resulted from the influx of immigrant laborers and their families from western and central Europe. S. 1664 seeks to celebrate this rich heritage through the establishment of a unit of the National Park System. We want to join in that effort; however we have serious concerns about how that should be accomplished.

Based on the legislative record and his own testimony, it strains credulity when Ridenour writes that he believes this park went right over his head and was moved to park status before going through the proper steps. Perhaps this is the key phrase in the passages quoted. It seems the entire process—a basic knowledge of the operations of the USNPS, the studies, the proposed bills, his own testimony of record—truly did simply go over his head.

In December 1994 the author sent Ridenour a letter detailing this allegedly wrongful depiction of the creation of Keweenaw National Historical Park. In a letter dated December 15, Ridenour responded to this criticism:

I will argue that my book is not grossly inaccurate as you describe. You are looking at the issue from your point of view and not from the vantage point I had in Washington.

No, I don't confuse the National Register with the National Historic Landmarks program. You may not know that I was a State Historic Preservation Officer for 8 years so I know the difference. I admit, as I re-read that paragraph it is confusing. My intention was to say that a site does not necessarily qualify as a park site by being on the national register or the historic landmarks list.

I don't back away from that statement. I believed it then and I believe it now. In fact, a major fight erupted over the National Natural Landmarks program when private landowners became concerned that gaining landmark status was the first step to having their lands taken away from them to become national park sites.

That is a dangerous jump to a conclusion. Fortunately, so far, it has only destroyed the natural landmarks program but I wouldn't be surprised to see it spread to the historical landmarks program.

You fairly accurately depict the "public" process that we went through with the Keweenaw site. What you don't know is what went on behind the scenes.

To this I can testify personally. The NPS was not supporting the addition of Keweenaw to the system. The support for this project was coming from above our level—probably the credit must go to Mr. Davis and some deal he had cut with O.M.B. [the Office of Management and Budget].

I questioned how the item got in our budget as we hadn't asked for it. My supposition is that it was put in by the O.M.B., for what reason I do not know....

Something was traded for something—that has been the congressional way and that is what gave birth to Keweenaw. I testified as a member of the administration—not on my own beliefs or the professional opinion of many park professionals who advised me.

Actually, Keweenaw is not nearly so bad a project as others I could name. I thought I was pretty kind in my remarks to the area. The people are super and there is lots of enthusiasm but that doesn't make the area a national park site.

We were scrambling to try to find a way to make Congressman Davis and his constituents happy without having the area become a park site. There was some thought that gaining the landmark status might be enough but it obviously wasn't. I still believe that the local enthusiasm for the area is built on tourism and economic development which they hope park status will bring. That is not a good enough reason for me to support it. I don't object to that. I just object to paying for it....

As it is, Keweenaw will get more publicity than it ever received before—and that is what many of the area leaders are hoping for.

Ridenour's comments seem to clarify his belief that the Keweenaw proposal had a strong political "air" to it. If he had merely stated these opinions in his book, he would have accurately portrayed his recollections and personal beliefs and the issue would be closed. However, he chose instead to say that Keweenaw "was moved along to national park status before going through the proper authorization channels in Congress." That is a false statement. In a climate of fiscal constraint and "park closure" efforts, such a false statement can have very damaging effects. Thus, this detailed rebuttal has been prepared in an attempt to set the record straight.

Some minor, additional points. The story of copper mining in the Keweenaw is one that goes back more than 7,000 years. There really is no village named Quincy. There are several scattered mining housing areas within that unit of the park. The Quincy unit concentrates on the process and technology of mining, with the Quincy Smelter and the Quincy #2 Steam Hoist and associated buildings. There were numerous mine shafts. Quincy #2 went down over 9,000 feet, well beyond the 600-foot depth Ridenour relates. The village of Calumet and its environs portray the social impacts of the mining heritage, corporate paternalism, labor-management interactions, the rich ethnic heritage of the area and much more. Together, these two units, combined with a dozen Cooperating Sites spanning over 100 miles of the Keweenaw Peninsula, tell a number of stories which are important to the heritage of all Americans. They make a first-rate unit of the National Park System. This park is a prototype for national parks of the new century. Through an extensive partnership effort, key resources will be protected and managed to portray a true living landscape. The role of the National Park Service is that of a skilled partner, not the driver of some sort of money wagon.

It is also appropriate to comment on Ridenour's oft-repeated criticism of Keweenaw and other new units of the National Park System as "thinning of the blood." America's great National Park System has continued to grow and diversify over the nearly century and a quarter since the creation of Yellowstone. His argument equates newness with insignificance, believing that new units suck off the resources desperately needed to operate older units.

Each unit of our Park System was once "new." And each new crop of parks has sparked criticism inside and outside the Service similar to Ridenour's "thinning of the blood" argument. The designation of the first National Monuments, in the early years of this century, prompted criticism from the old line, "real parks." The addition of historic sites and battlefields prompted heated criticism about diluting the true mission of the Service. The addition of the great eastern National Parks—Acadia, Shenandoah and Isle Royale—prompted the same criticism. The addition of the National Seashores and Lakeshores triggered the same old complaints. Would the System be better if it had stayed as limited as it was at the close of the nineteenth century? We have a good procedure for assuring the integrity and worth of new units of the System. Yes, that procedure has occasionally been circumvented. However, Keweenaw National Historical Park went through all the steps of that procedure—it is an important, proper unit of America's National Park System.

Ridenour has joined others in recent years in decrying the pariah-like taint of economic stimulus in USNPS activities. Now, more than ever, we must never lose sight of the fact that there is no guarantee of permanence for the protection of the national parks. There is nothing in the Constitution which says national parks are forever, despite the brash, misguided beliefs of some folks inside and outside the Park Service. For the national parks to be preserved into the indefinite future we, their stewards, must constantly strive to assure that the national parks are important to the people who pay for them. The economic value of the national parks thus becomes critical to their very preservation. There is nothing evil in acknowledging this basic fact of life. Especially in the area of cultural resource management, finding ways to have heritage preservation make money for people is finding ways to assure that those resources are preserved for the benefit and enjoyment of all.

One of Ridenour's predecessors, Newton Drury, once asked rhetorically, to the effect, "Are we as a nation so poor we cannot afford to protect these national treasures? Are we as a nation so rich we can afford not to?" I commend these questions to your careful deliberation.

(Ed. note: William O. Fink, the superintendent of Keweenaw National Historical Park, is writing here in his capacity as a private citizen.)

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A Reply to William O. Fink

James M. Ridenour
Eppley Institute, Department of Recreation and Park Administration, HPER Building, Room 133, Indiana University, Bloomington, Indiana 47405-4801

AT THE RISK OF CONTINUING TO TRADE INK with Mr. Fink I will add a few comments to my letter to him dated December 15, 1994. By and large, I think my letter speaks for itself. I had and still have serious concerns as to the eventual costs associated with the Keweenaw site.

My prediction—then and now—was that the federal government would be pulled, inch by inch, dollar by dollar, into environmental clean-up and very costly historic preservation projects. During the "inside the beltway" discussions, the concerns over preserving many of the lovely old buildings and homes in Calumet was a major point. I don't have to describe the potential costs for such a project to park people. They are enormous.

As to Mr. Fink's argument that the NPS has "a good procedure for assuring the integrity and worth of new units of the System," I would have serious doubt. My experience was that the most glowing reports could be made on most any project, if a sympathetic park planner had the pen in hand. To put it bluntly, our own park planners are occasionally our worst enemies. Too many park planners respond as if they are the lap puppies of local congressional representatives rather than employees of the National Park Service with a serious mandate to protect.

I have no objection to a park site being a local draw for economic development and tourism and would agree with Mr. Fink on this issue. Economic development and tourism must not be the primary objective, which would appear to be the situation at Steamtown. I don't object to Steamtown as an economic development project. I think it is a good one.

If the Congress wants to pay for such projects, that is their prerogative—but the payment should not come out of the hide of national parks. It burns me up to have members of Congress brag that they have met the budgetary requirements of the parks. They may meet or exceed the number of dollars requested, but the priorities are usually shifted dramatically. These disparities almost always show up in capital construction or land acquisition.

As to Mr. Fink's point that there are longer mine shafts in the area than I mentioned in my book, I stand guilty as accused.

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