ISSUES IN SCIENCE AND TECHNOLOGY

National Academy of Sciences

The Cecil and Ida Green Center for the Study of Science and Society at The University of Texas at Dallas

Reprinted from ISSUES IN SCIENCE AND TECHNOLOGY, Volume XIV, Number 2 © 1998 The University of Texas at Dallas

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# Preserving DOE's Research Parks

*Some of the nation's most irreplaceable outdoor labs for scientific research and education are at risk of being disposed of.*

When the federal government obtained land for the development of nuclear weapons technology during World War II, its acquisitions at many sites included large buffer areas for security. Protected from commercial disturbance and fragmentation over the ensuing five decades, these 2 million acres have evolved into ecological sanctuaries of remarkable size and diversity. Seven sites representing six major ecoregions are now designated as Department of Energy (DOE) National Environmental Research Parks and serve as irreplaceable outdoor laboratories for scientific research and education.

Now, however, as the national security rationale for maintaining buffer areas around DOE facilities diminishes, the use of these lands for large-scale ecological research is increasingly at risk. During the past decade, thousands of acres of research park land have been sold or transferred for residential and industrial development. In January 1997, a report from DOE's Office of the Inspector General recommended the disposal of nearly one quarter of the research park land holdings. The audit concluded that because these lands are undeveloped, they are not essential to carrying out the sites' current missions of environmental restoration and waste management, energy research and development, weapons dismantlement, and storage of nuclear material.

In some cases, the sale of research park lands would not affect environmental research and education, but in other situations the impact could be significant. The recent inspector general's report recommended the sale of 16,000 acres at Oak Ridge that contain most of the area designated for environmental research and monitoring. This area includes long-term, field-instrumented research sites and monitoring facilities such as the Walker Branch watershed, where scientists have studied the impact of environmental change since 1967.

The sale or transfer of critical portions of the DOE research parks would constitute an irreplaceable loss of land with significant research value. We believe that the ecological and scientific value of these lands should be carefully evaluated in decisions regarding future land use.

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## Unparalleled lands

The DOE National Environmental Research Parks are unparalleled among the lands owned or managed by the federal government. As islands of limited development in a sea of suburbanization, agricultural expansion, and industrialization, they preserve habitats and species that were once widespread. For example, the Savannah River Research Park in South Carolina boasts the greatest diversity of flora and fauna of any area in the entire southeastern coastal plain. It contains one of the few remaining islands of mature longleaf pine wiregrass ecosystems that support the endangered red-cockaded woodpecker. Similarly, the Nevada Research Park provides a habitat for the federally threatened desert tortoise. Los Alamos has five federally listed species on its research site. The Arid Lands Ecological Reserve at the Hanford Research Park contains the only sizable remaining fragment of shrub-steppe in Washington state, and at the Fermilab Research Park in northern Illinois, active management efforts have succeeded in restoring more than 1,000 acres of tallgrass prairie since 1985. Finally, the Oak Ridge Research Park contains mature hardwood communities supporting more than 1,100 vascular plants; 26 state-listed rare plant species that occur on the reservation in more than 50 locations; more than 315 wildlife species, of which 20 are listed wildlife species; seven state natural areas; and critical habitat for nesting and migration of neotropical migratory birds.

In addition to preserving rare or unique habitats and supporting some endangered species, the DOE research parks complement other federal land holdings by providing a unique laboratory for research on the environmental effects resulting from human activities. Here, scientists can conduct manipulative experiments, altering the physical or chemical properties of ecosystems and examining the results. The land use history of the research parks is well documented, which is a critical attribute for many large-scale or long-term experiments; and because it is similar to the history of many similar or surrounding areas, scientists can extrapolate their results with confidence. In addition, the parks are secure from access by members of the public, who might interfere with experiments. Finally, the parks include vast swathes of terrain, making it possible to conduct large-scale environmental research and monitoring projects.

No other federal lands possess all of these characteristics. For instance, the research parks are five times larger on average than the Long-Term Ecological Research sites (LTERs) administered by the National Science Foundation (NSF). Scientists have been gathering data at the DOE sites since the 1950s, whereas the LTER sites were established after 1979. In addition, the LTERs were established to study natural ecological systems, whereas the DOE Research Parks were designed to serve as outdoor laboratories for the study of human impacts on the environment. Although experiments can be conducted at both types of sites, the research park lands reflect a broad range of human impacts, with sites ranging from the pristine to the highly contaminated. This permits scientists to conduct a wide range of experiments on cleanup and restoration techniques, effects of climate change, and results of exposure to hazardous material, using sites whose ecological characteristics are representative of surrounding urban, agricultural, or industrial land.

## An evolving mission

Since their inception, the DOE research parks have significantly influenced the development of basic ecological concepts. Their environmental mission grew out of the sites' original focus on nuclear weapons technology. In the 1950s, the Atomic Energy Commission (which later became DOE) began to be concerned about the effects of radiation on humans and began to sponsor research on the environmental pathways by which radioactive elements reach human populations. In the 1960s, the national laboratories began to play a strong role in the development of studies that focused on the productivity, regulation, and persistence of ecosystems as part of the International Biological Program, an effort approved by Congress and funded by NSF to provide the scientific basis for dealing with environmental issues through an ecosystem approach. Experimental data from the research park sites enabled the development of new approaches to deal with complex ecological systems, including hierarchy theory, which facilitates integration of information from many scales, and systems analysis, which uses the power of computer modeling and systems engineering mathematics to solve ecological problems.

The passage of the National Environmental Policy Act in 1969 led the national laboratories to focus on quantitative evidence of environmental impacts and led to new approaches to analyzing risk assessment. Shortly thereafter, the first DOE research park was set aside at Savannah River. Although experiments had been conducted on the research park lands since the inception of the national laboratories, this formal recognition was a clear public acknowledgment of the importance of these lands to research.

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Today, work at the DOE research parks emphasizes interdisciplinary research that involves field facilities, laboratory analysis, and models. Because of their association with national laboratories, the parks have access to expertise and advanced equipment, including computing, chemistry, robotics, laser technology, and remote sensing. For example, scientists working on research park lands have developed a digital caliper system for measuring tree growth under the influence of diverse environmental conditions. In another study, research park scientists are developing techniques to use lasers to monitor atmospheric conditions. The close proximity of some of the largest computers in the world allows researchers to develop and run extremely complex computer models, such as those used to simulate the movement of contaminants in groundwater.

It is this combination of field, laboratory, and modeling approaches that has allowed researchers at the DOE national laboratories to play an instrumental role in the development of ecological concepts—not only hierarchy theory, systems ecology, and risk assessment, but also nutrient cycling, landscape ecology, global change assessment, and integrated assessment. For example, information from long-term research on park streams in combination with new models led to the concept of nutrient spiraling in streams: the understanding that nutrients do not merely move downstream with gravity but rather are retained by a diverse set of organisms involved in the cycling of nutrients as they pass downstream. This understanding is critical for formulating procedures for environmental remediation of contaminated streams to satisfy human health requirements.

Current activities at the DOE parks include large-scale experiments such as the Throughfall Displacement Experiment at the Oak Ridge Research Park, a large-scale simulation of changes in precipitation such as may occur in future decades with projected global climate change. Scientists and students from around the world come to Oak Ridge to study short- and long-term effects of changes in rainfall on such diverse components of forest ecosystems as soil organisms, seedlings, and fungi. This experiment is just one example of numerous studies of the research parks investigating energy impacts, ecosystem dynamics, contamination transport, and bioremediation; others include long-term monitoring of climate, flora, fauna, and other ecosystem attributes.

The research parks also serve as training grounds for future researchers. Educational opportunities at the parks, enhanced by their association with the national laboratories, include programs that teach specific techniques or subjects, research partnerships on specific projects, and the provision of facilities for individual research initiatives. Participants in these diverse programs include students from kindergarten to graduate school, as well as faculty and community members. At Idaho Research Park, for example, more than 150 high school students, high school teachers, thesis and doctoral students, postdoctoral fellows, and professors participated in educational research in 1997. The Oak Ridge Research Park has sponsored a variety of educational programs, including an unusual program that focuses on younger age groups and has reached more than 85,000 precollege students and teachers during the past five years.

## Easing the threats to the parks

In recent years, there has been increased pressure to dispose of research park lands. In 1992 and 1993, the federal government sold 640 acres of the Hanford Research Park to the state of Washington. In 1994, it transferred 1,120 acres of the Idaho Research Park to the Bureau of Land Management, which subsequently sold it to the county for use as a multicounty landfill. In 1986, a 1,200-acre tract of the Oak Ridge Research Park in eastern Tennessee that included long-term environmental research plots was sold. The inspector general's 1997 report brought the issue to the forefront of public debate, recommending the disposal of 309,000 acres of land at the Hanford site in Washington state, 16,000 acres on the Oak Ridge Reservation in Tennessee, and 155,000 acres at Idaho National Engineering Laboratory. Despite the potential impact of these changes, the inspector general's report did not make decisions based on the research value of the land in setting forth the criteria and process for disposing of unwanted DOE land holdings.

Some of these lands, such as the Oak Ridge acreage, are extremely valuable research sites. In other cases, the sale of noncontiguous parcels of land—even those not directly involved in research—may diminish the environmental value of the research parks by transforming a single type of land cover into a patchwork of different covers (for example, forest lands that become a mosaic of housing, agriculture, and forest). This loss may pose threats to already endangered species or limit the ability of researchers to undertake large-scale environmental monitoring projects. Many DOE-sponsored research programs, such as those designed to monitor air quality in areas where the topography is hilly, require large, uniform, undisturbed acreage; others may require assessing the impact of environmental change throughout an entire watershed. Industrial and urban development in and around some research parks has already adversely affected suitability for research requiring large natural landscapes in controlled settings. For instance, globally declining populations of cerulean warblers once nested on the Oak Ridge Research Park, but the dwindling land base is no longer thought to provide an adequate extent of native forest for this species. The loss of ecologically important land is the most pressing threat to the research parks.

Because these lands are so valuable, we suggest that DOE develop a plan for protecting the environmental values of the parks. We propose a four-pronged approach: (1) identify the lands that best represent the diverse values of each research park, (2) protect those sites from incompatible development or other activities, (3) continue to establish alliances and partnerships with other interest groups that recognize the value of the land, and (4) manage the lands so as to allow continued scientific research and education.

At each park, we suggest that DOE select and support a team to identify the unique attributes that lend value to the site and to delineate areas that maintain these values. The team should represent all of the different constituencies that use the park. Together, they should take a hard look at the diverse, often conflicting, uses of the research park lands and make potentially difficult choices among them. For example, experiments intended to monitor the flow of agricultural herbicides in groundwater are likely to result in site contamination. Thus, the assessment team can weigh the benefits reaped from research that could contribute to the development of cleanup technologies against those of maintaining a pristine site. Furthermore, some areas may be especially valuable for environmental monitoring—for instance, a gradient area, where scientists can examine how differences in elevation, temperature, and moisture affect nutrient absorption or response to climate change—whereas others may be better suited to manipulative experiments. And of course the types of terrain best suited to research may vary with the scientific questions being posed, which requires the team to anticipate future concerns as best they can.

Already managers at some parks, such as the Oak Ridge Research Park, have identified the critical areas for preservation. Other parks have not yet begun this kind of process. After each team has completed its recommendations, park managers from the network of all seven sites should meet to identify "critical lands" that together best represent the unique characteristics of the research parks and that should be set aside for long-term protection. For instance, they can ensure that different bioregions are well represented among the preserved sites and that the sites complement one another in contributing to a broad range of goals. Sites with more land area and less ecological diversity may be in a position to dispose of a larger proportion of their lands than smaller or more diverse parks.

Once the teams have prepared their assessments and recommendations, the question is how to make these binding. Currently, there is no formal or consistent requirement that research values of park land be taken into consideration in land use decisions. The DOE Savannah River Operations Office has drafted legislation to protect its site under federal law. Similar or other unique arrangements to protect the research and educational values should be explored at other research parks. Moreover, it is essential to protect the lands in a way that will permit scientists to continue to perform manipulative experiments and to sample the environment in a variety of ways. Transferring the lands to the National Park Service, for instance, would prohibit their use for manipulative experiments.

One solution is for Congress to designate the research parks as national monuments. Current law permits Congress to specify the agency responsible for administering each newly designated monument and to create an appropriate management plan for it. Existing national monuments fall under the jurisdiction of the Department of the Interior or the Department of Agriculture, but any existing agency, including DOE, could be designated as administrator. This strategy could serve as a powerful tool to preserve the parks as scientific and educational resources.

*Designating the parks as national monuments could help preserve their scientific and educational resources.*

One way to ensure that the research and educational value of these lands is protected is to continue to supplement federal land titles with additional land designations. Already the Oak Ridge Research Park lands are designated by the U.S. Man and Biosphere Program as a biosphere reserve, and parts of the Savannah River Research Park are registered with the Society of American Foresters' National System of Natural Areas. DOE is also a member of the Southern Appalachian Man and the Biosphere Cooperative, as a function of its ownership of the Oak Ridge Research Park. These special designations emphasize the environmental value of research park lands and call attention to their mission. In addition, partnership with regional, state, or local environmental groups can help build political constituencies that support the research and educational use of DOE park lands and can help parks address local or regional issues, such as industrial and residential development along their borders.

Finally, research park managers together with external partners and allies should promote and expand the use of park lands for world-class science and education at all levels. DOE continues to support innovative and large-scale environmental research at the parks. In recent years, however, DOE funding for long-term environmental monitoring and educational programs has fluctuated and in some cases declined. The research parks have much to offer new long-term monitoring programs such as the Environmental Report Card. By gaining public support for these missions and increasing outside participation, the research parks can demonstrate and enhance the value of their lands. Therefore, we encourage park management practices that allow manipulative experiments, maintain long-term monitoring, develop educational amenities, and ultimately acquire lands as necessary to support the goals of the research parks. It is only by taking steps today that we can expect our children's children to benefit from future research and educational opportunities at DOE research parks.

*Recommended reading*


L. D. Mann, P. D. Parr, L. R. Pounds, and R. L. Graham, "Protection of Biota on Nonpark Public Lands: Examples from the U.S. Department of Energy Oak Ridge Reservation," *Environmental Management*, vol. 20, 1996: 207-218.

E. P. Odum, "The Savannah River Site as a National Environmental Park," in J. Carins and T. V. Crawford (eds.), *Integrated Environmental Management.* Chelsea, Mich.: Lewis Publishers, 1991, 79-85.

C. R. H. Shearer, and N. B. Frazer, "The National Environmental Research Park: A New Model for Federal Land Use," *Natural Resources and Environment,* vol. 12, 1997: 46-51.

U.S. Department of Energy, Office of Energy Research, Department of Energy National Environmental Research Parks, *Report number DOE/ER-0615P.* Washington, D.C., 1994.

U.S. Department of Energy, Office of Inspector General, Report on "Audit of the U.S. Department of Energy's Identification and Disposal of Nonessential Land," *Report Number DOE/IG-0399.* Washington, D.C., 1997.