MAKING NATURE WHOLE

Fifty Years of Ecosystem Restoration at the University of Wisconsin Arboretum

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Talk and thinking about the protection of natural resources is often highly conservative in the sense that it is directed toward the conservation of something that is already there, that is valuable and threatened, and that is considered irrecoverable if lost. This, I think, is as it should be. And I am certainly not here to argue in any way to the contrary, or to make light of the value and urgency of protecting natural areas, many of which in fact may indeed turn out to be quite beyond our power to restore, at least in any reasonable length of time.

At the same time I think everyone will agree that there are times when plant and animal communities are damaged or even completely detroyed, and where the best one can hope to do is to try to put them back together again. This happens all the time. It happens on a large scale — in mining, for example — and it is going to continue to happen. What is surprising, to me at least, is how long a time passed before serious commitments were made to repairing ecosystems damaged in this way, or to finding out how to do this. Tough legislation in this area has appeared only during the past decade or so, and concerted attempts to restore ecosystems on naturally occurring models goes back, so far as I know, only about 50 years.

I am here to talk about what I believe to be the first large-scale, systematic attempt to restore a damaged landscape to its natural, presettlement condition, and to offer some reflections on the present-day significance of the questions and ideas raised by that early effort.

The project I am referring to is not widely known outside Wisconsin, except perhaps by a small circle of ecologists and managers who have had contact with it during the past half-century. It was the creation of the University of Wisconsin Arboretum at Madison, beginning about 1934.

Acquisition of land for the UW Arboretum began in July 1932, with the purchase of 245 acres of derelict farmiand on what was then the outskirts of Madison, less than a mile from campus. Additional acquisitions during the following decade brought the area of the Arboretum to 1,260 acres, or nearly two square miles. This of course makes the Arboretum a magnificent scientific and cultural resource — a semi-wilderness area, now nearly surrounded by the city.

What I am interested in here, however, is not so much the land, or the place, as the idea behind its development, which I

think was novel when it was put forward in 1934, and which I think is deeply relevant to the interests of The George Wright Society.

Pioneer conservationist Aldo Leopold, who was at Wisconsin at the time, was deeply involved in development of this plan, and as I have learned more about the early years of the Arboretum, I have come to think of its development as one of Leopold's most interesting — and least widely recognized — contributions to the modern conservation movement. Leopold, who in 1933 had left the US Forest Service to establish the country's first department of wildlife ecology at the University, had immediately become deeply involved in the young arboretum project. Within a year he would purchase the farmed-out acreage north of town where he would carry out the decade-and-a-half of low key experiments in the healing of degraded land that became the setting and background for his *Sand County Almanac*. What he proposed for the new Arboretum was similar, though conceived on a far more ambitious scale.

Speaking at the dedication of the Arboretum in June 1934, Leopold told the assembled supporters of the project that what he and his colleagues had in mind for the Arboretum was something entirely new. The Arboretum, in fact, was not going to be an arboretum at all in the traditional sense. Arboreta had always been collections of plants. This one was going to be not a collection of *plants*, but a collection of plant and animal *communities*. What Leopold proposed, in fact, was complete restoration of the degraded farmland of the site to its presettlement condition.

"Our idea," he said, "is to reconstruct...a sample of original Wisconsin — a sample of what Dane County looked like when our ancestors arrived here during the 1840s.

"Obviously," he went on, "it will take 50 years to do this..."

There were two things that were novel about Leopold's plan, and that make it relevant to some of the problems people are facing today — in the National Park System, for example.

The first thing was the very idea of making a collection of ecosystems. No one had ever tried to do this before. People had collected nearly everything else, but no one had ever looked on whole ecosystems as something one might set out to collect. So this was a novel idea, and, as it turned out, a spectacularly successful one. As a result, the Arboretum today is just the kind of ecological museum Leopold had in mind in 1934.

What interests me even more, however, is the second part of the idea — the notion, implicit in the idea of collecting ecosystems, that one might actually set out to restore an entire ecosystem, and that it might in fact be possible to succeed at such a task, even if, as Leopold suggested, it took as long as 50 years.

This idea grew naturally out of the first simply because the site Leopold and his colleagues were dealing with had next to nothing left in the way of native vegetation. Moreover, some of the communities the planners set out to create — pine forests, for example — had flourished several hundred miles north of Madison and had not been present on the site even at the time of settlement. Thus the plan to create a microcosm of presettlement Wisconsin, or even of Dane County alone, clearly implied restoration of communities on a large scale. And this, too, was something that had never been done before — at least not systematically or on such a large scale.

Now let me turn to the Arboretum itself, to say a few words about its development and what we have to show for ourselves as we approach the end of our first half century.

The first thing to keep in mind — the first thing we tell visitors at the Arboretum — is what I have already said: this is not a natural area. By 1934, most of the native prairies that covered the site had been destroyed by the plow. Patches that had escaped the plow, in the absence of periodic fires, had grown up to oak forests, and these in turn had been logged and grazed. Adjacent Lake Wingra and the wetlands around it had been disturbed by diking, dredging and lowering of water in an abortive attempt at housing development. Overall, the area that Leopold envisioned as a future replica of the presettlement Wisconsin landscape was in fact a fairly representative sample of the post-settlement landscape, scarred by plow, cow and ax.

The plan was to put all this back together. And this was not only a new kind of plan; it was a wildly ambitious one. It had never been done before; it has never been done since. It was circumstance that made it possible. The '30s gave us the land at prices the University could pay — usually with gift money. It gave us the environmental disasters of the Dust Bowl and the deforested north that set the stage for development of the idea of revegetation, of reforestation, of land reclamation, and finally of ecosystem restoration.

And it gave us the means, in the form of the Civilian Conservation Corps, to realize the idea.

The first contingent of CCC workers arrived at Camp Madison in August 1935, and by November they were out in Charlie Nelson's old horse pasture, turning over the sod with shovels, preparing the ground for the first attempts at prairie restoration. During the subsequent 10 years CCC boys, working under the supervision of University of Wisconsin and National Park Service staff completed the initial planting of the 60-acre John T. Curtis Prairie, which we now believe to be the oldest restored prairie in the world.

As a result of these efforts, and of continued work through the 1940s and '50s, the Arboretum now includes samples of all the major plant and animal communities native to Wisconsin and the upper midwest. These include the prairies, southern and northern maple forests, pine and boreal forests, and various wetland communities. Altogether, there are more than 30. Only a few minor wetland and cliffside communities for which the Arboretum offers no suitable sites are missing from the list.

The Arboretum has become what Leopold and his colleagues envisioned: a microcosm of presettlement Wisconsin and an ecological laboratory and classroom for the University.

What I want to concentrate on though is not the laboratory and classroom, nor the Arboretum as an ecological museum, nor the collection of plant and animal communities, but on the *process of restoring them.*

This seems to have been a matter of secondary interest at the beginning. The initial idea seems to have been to create the communities in order to have them for ecological study and research along traditional lines. The emphasis was not on the process of restoration, but on the expected product. What happened, however, is that as soon as the developers of the Arboretum set themselves the task of creating these communities, they found the project they had dreamed up for themselves offered some big practical and intellectual challenges. The fact was that, even with the CCC to do the work, no one really knew how to restore ecological communities. In fact the attempt to restore communities raised all sorts of questions about their composition, structure and dynamics, about succession and the way ecosystems come together naturally. In short, restoration turned out to be a way of raising questions, not only about how to assemble communities in a technical sense, but about how communities come together naturally and how they work. And so, as development of the Arboretum progressed, it was not just the communities themselves, but the process of restoring them that became most deeply absorbing.

And this brings me to what all this has to do with problems we are facing today, and can anticipate in the future.

During the past few decades it has become clear that attempts to reassemble ecosystems are of far more than academic interest. Ecosystem restoration, in fact, has become an important, if embryonic, technology for dealing with a variety of environmental problems.

It is now clear, for example, that effective techniques for restoring disturbed land are needed whenever land is broken for mining or construction. They are needed along rights-of-way, and in parks. Often these problems call for creation of a non-natural landscape — suitable for farming, for example, or recreation. But sometimes it is appropriate to go all the way, as it were, and

to attempt the ecologically more ambitious task of restoring a native community. Clearly this is often the case in parks. It is also often the case in landscaping. My point here is the fairly obvious one that ecosystem restoration pertains in various important ways not only to habitat conservation and conservation of rare and unusual native plants and animals, but to conservation of labor, materials and energy in the form of water, fuel, fertilizer and pesticides.

For all these reasons, more efficient, more effective and faster techniques for restoring and managing plant and animal communities are urgently needed. We have become reasonably adept at restoring a few communities. Prairies, for example, lend themselves to restoration in a reasonable amount of time, and managers out in the midwest have gotten fairly good at prairie restoration. But other communities are more challenging. Important as oak forests are, from a purely economic point of view, UW botanist Grant Cottam tells me no one really knows how to make one. He quotes the late John Curtis as saying that the way to make an oak forest is to plant jack pines. The point is that restoration from bare ground or bedrock up is a complex and challenging kind of forestry, and the best way may be neither the most direct nor the most obvious. We have a lot to learn.

My key point, however, is that restoring ecosystems has turned out to be not only a challenging technical problem, but an exciting intellectual opportunity as well — a technique, in fact, for basic ecological research.

In 1959, in his classic *Vegetation of Wisconsin,* Curtis, then an ecologist at Wisconsin, reflecting on his experiences at the Arboretum, wrote that the restoration of the plant communities there had "demonstrated the complexities of community integration in a way no other experience could provide."

This, it seems to me, is an intriguing and provocative idea, and I am interested in seeing what we can make of it, beginning with a consideration of just what kind of activity ecosystem restoration is. Note that the restoration of ecosystems is essentially a form of agriculture. Like agriculture it deals with nature aggressively. It breaks the soil, introduces plants, and is concerned with the control of weeds and other pests. At the same time, however, it is a form of agriculture that, by a kind of marriage with ecology, is completely transformed from an enterprise committed to taking nature apart and simplifying it on models that in some ways prefigure the machine, to one that deals with nature synthetically, and is committed to replicating nature in all its diversity and complexity. This makes ecosystem restoration radically different from traditional agriculture, not only in its objectives but in the kinds of questions it raises about the subject under study. While agriculture, working with simplified and artificial ecosystems, has concerned itself primarily with questions at and below the level of the organism or species — with selection and breeding and physi-

ology and pathology—ecosystem restoration deals with higher levels of organization, with the assemblages of organisms we call communities. And this, I think, gives restoration its great value as a way of both raising and providing means of answering basic questions about this higher level of organization.

In turn, this suggests the analogy between ecology and medicine that Henry Rapport and his colleagues at the University of Toronto have recently developed in detail. Rapport's idea is that the relationship between the ecologist and the ecosystem is in some ways very much like the relationship between a physician and a patient. And of course this suggests that attempts to heal damaged ecosystems may well be as challenging and as intellectually fruitful as attempts to heal or to assist at healing have proved to be at the level of the organism. Specifically, just as dealing with injured and diseased organisms has led physicians to important insights into anatomy, physiology, the regulation of growth, and so forth, it seems likely that attempts to heal damaged ecosystems ought to provide ecologists with occasions for new and deeper insights into the ways plant and animal communities are integrated, about how they change, and about their relationship with their environment.

This seems to me a reasonably straightforward idea. Damage or injury creates stress, and stress brings into play deeper levels of organization and response. Physicians, for example, discovered the immune system as a result of their efforts to deal with contagious diseases. Ecologists like John Cairns at Virginia Polytechnic Institute have argued strongly that very much the same thing will happen in ecology if ecologists will study damaged ecosystems and pay more attention to attempts to repair them. As a matter of fact ecologists like Cairns have already learned a great deal in this way. And in some cases this has been a direct result of restoration efforts. There are many examples, and more are appearing all the time. But my favorite example is the rediscovery of fire as a tool for prairie restoration and management, and the establishment of the role of fire in prairie ecology, which grew directly out of the early attempts to restore prairie at the University of Wisconsin Arboretum.

Briefly what happened was this. Botanist Ted Sperry and the CCC boys brought in prairie plants and planted them on an old pasture at the Arboretum. Many of these plants took hold and grew, but so did the weeds inherited from the pasture. By 1940 it was clear that prairie restoration was going to be virtually impossible unless a practical way of controlling weeds could be found. And this led Sperry, and later John Curtis, to carry out a classic series of experiments with fire in the hope that reintroducing this event, which had been frequent on the prairies in presettlement times, might help tip the balance between native, fire-adapted plants, and less tolerant exotic weeds. As it turned out, it did. So the restoration of Curtis Prairie provided the occasion for the rediscovery of an ancient land management technology, and also

for an important early contribution to ecologists' appreciation and understanding of the role of fire in the ecology of grasslands.

There are other reasons, too, for suggesting that ecosystem restoration, which has so far generally been pursued for purely practical reasons, ought also to be developed as a way of carrying out basic studies in community ecology. The point I want to make here, however, is that the connection I am suggesting between ecosystem restoration and basic ecology is one that seems to me to be highly relevant to the management of the parks and natural resources that are the concerns of the members of The George Wright Society. First of all, it is obvious that technology for restoring or upgrading ecosystems is of great practical interest to people concerned with managing parks. Beyond that, though, as researchers like Durward Allen have stressed over and over again, the parks also provide splendid laboratories for ecological research. Moreover, they furnish an unmatched network of laboratories, including samples of virtually all the ecosystems native to North America. As a result they present superb opportunities for research in all aspects of natural history. I am particularly intrigued by the prospects they offer for research in restoration ecology. This is an area that, despite, or perhaps because of, its great practical value, has so far remained intellectually unfocused and unconsolidated.

One of the problems restorationists face is the problem of scale. Restoration of real ecosystems (as opposed to simplified laboratory communities) is so time-consuming and expensive that restorations can rarely be undertaken specifically as experiments designed to test hypotheses of community integration and dynamics. As a result, we have a situation very much like the one that prevails in clinical medicine. We have lots of patients, lots of experience, but we are usually working with small numbers of cases. We usually can't deliberately set up experiments. So we rarely get enough information to get good statistics and to move toward the formulation of principles.

One solution to this problem has been urged by Mike Gilpin, an ecologist at the University of California in San Diego. Mike has suggested the creation of an information pooling network comparable to those set up by hospitals in order to put together enough information from clinical data to produce meaningful results. We are now discussing ways in which this might be done. And I would hope that the researchers and managers in parks and natural areas would play an important role in bringing this about. We think that strengthening the relationship between restoration and management, conceived as an applied art, and between restoration and management, conceived as an approach to basic ecological questions, would benefit both sides. It would strengthen the conceptual foundations for the development of restoration and management as a distinctive discipline. And it would develop restoration as a potentially powerful tool for basic research. It would help make management what medicine now is—both science and art.

A final word in closing. It should be clear by now that I believe the attempt to restore ecosystems represents a novel kind of activity offering distinctive challenges and possibilities. This of course is only a guess, and it may turn out to be inaccurate. But to the extent it is true, and to the extent restoration turns out to be fruitful, both in practical and in intellectual terms, I think we should keep in mind some kind of historical perspective. Obviously, ecosystem restoration has deep roots. It is a hybrid discipline that has grown up by borrowing from a dozen areas — from agronomy, from horticulture, and from landscape architecture as well as from the natural sciences. At the same time it is astonishingly new. So new, in fact, that we have not yet recognized the whole idea of restoration as a novel idea and a distinctive kind of activity. In particular, I think there has been little recognition that this idea was clearly one of Aldo Leopold's major and most mature contributions to the environmental thinking of the 1930s and '40s. Leopold is remembered today for his work in game management, for his work in helping to create the Wildlife Society, and of course especially for his classic *Sand County Almanac*. What has not been clearly recognized is that the *Almanac* grew out of Leopold's own experiences in restoring vegetation to a derelict sand farm on the Wisconsin River, and that the commitment to restore was very much a part of the thinking that led to his articulation of the land ethic. The Arboretum, then, was Leopold's second sand county. Ecosystem restoration is more than technology. It is more than science. It is also ethics and a way of life.

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