The Humane Metropolis: People and Nature in the 21st-Century City

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Part Three: Restoring Urban Nature: Projects and Process

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Part III turns from urban "open spaces" (green or paved, local or regional) to the ecological functions and biodiversity that such spaces may support, with a little human assistance. The opening essay is by plant biologists Steven E. Clemants and Steven N. Handel, collaborators in the Center for Urban Restoration Ecology (CURE), a joint venture of Rutgers University and the Brooklyn Botanic Garden. Their contribution first distinguishes the perspectives of landscape architects and plant ecologists in terms of what makes up a "successful" urban plant community. They then summarize some results from their ongoing program to establish (not "restore") ecological habitats on such barren land features as sanitary landfills. The gigantic Fresh Kills landfill on Staten Island, New York, is the "laboratory" for Handel's students to nurture biodiversity amid a literal landscape of death (Fresh Kills is where the World Trade Center debris was deposited).

Much restoration of plant and wildlife in urban areas is conducted under the rubric of stream restoration. Laurin N. Sievert is a Milwaukee native, a geography graduate student at the University of Massachusetts Amherst, and project manager of the Ecological Cities Project. Her essay is based on her master's thesis research, which examined stream and wetland restoration programs in the Milwaukee River watershed, one of several case studies of urban watershed management conducted by the Ecological Cities Project under a grant from the National Science Foundation.

Industrial brownfields in urban areas are inherently ugly, dangerous, and often ecologically barren. Nevertheless, urban planners, environmental engineers, and natural scientists are collaborating in efforts to restore many such sites to productive human and natural uses. Geographer Christopher A. De Sousa at the University of Wisconsin–Milwaukee summarizes findings of his ongoing research drawing on brownfield remediations in Toronto, Chicago, and Pittsburgh.

Quixotic as some ecological restoration work may seem, potential benefits are not purely numerical, that is, acres replanted, threatened species recovered, salmon returning, or salamanders counted. Andrew Light, geographer and ethicist at the University of Washington, identifies important nonnumerical benefits of ecological restoration, namely the fostering of social contact among people who engage, usually as volunteers, in litter cleanups, clearance of invasive species, and nurturing of more robust biodiversity. Light's concept of "ecological citizenship" also postulates that individuals who engage in such restoration activities gain a strengthened psychic bond to the place and to nature (somewhat akin to Robert L. Ryan's concept of "park adoption" discussed in Part II).

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Restoring Urban Ecology

The New York–New Jersey Metropolitan Area Experience

Steven E. Clemants and Steven N. Handel

Interest in restoring urban ecological services and biodiversity is a growing part of modern biology. To protect and restore ecological services in urban areas, two approaches are being tried. *Conservation biology* seeks to keep relatively intact remnants of our plant and animal communities from being destroyed. This conservation tradition dates back about one hundred years and is now a significant academic and public policy pursuit. *Restoration ecology,* a new strategy, seeks to restore and expand ecological services. Restoration aims to restore plant and animal species to areas where they have been eliminated or degraded.

Conservation and restoration share biotic knowledge and theoretical frameworks. Clearly, though, conserving existing biotic conditions at a site is a different matter from attempting to restore the site to some previous "natural" biological state. The latter is a much more difficult task in part because landscapes do not change overnight. Human activities have gradually transformed the landscape and ecological conditions over several centuries in the northeastern United States (including native land use changes) (Cronon 1983), and over millennia in cities of the Old World, as documented by George Perkins Marsh in his seminal 1864 treatise, *Man and Nature* (Marsh 1864/1965), and in recent reviews (Goudie 2000). At what point in this evolving process of change are ecological conditions considered to be "natural"? (For that matter, the natural world itself is also in constant state of evolution.)

Thus, restoration biology pursues a moving target that is very poorly defined for any particular period. Biotic conditions have differed from one time period to another, and our knowledge of biological conditions of any past period is fraught with scientific uncertainty. Furthermore, the present biogeographic context of the site—its physical habitat and biotic milieu—may have changed so radically that "native" species may not be sustainable, and the retention of nonnative ("alien") biological species and communities may be unavoidable and perhaps desirable.

This essay summarizes some examples of restoration efforts that involve the botanical and ecological communities in and around the New York–New Jersey urban complex. Our approach to urban restoration ecology involves applying skills from modern botany and community ecology. The sample pilot studies discussed are teaching us the limits to restoring this historic biodiversity in modified modern urban habitats.

Restoration Ecology versus Landscape Architecture

A caveat is in order concerning the distinction between restoration ecology and landscape architecture, a field that shares some superficial similarities with the former. Landscape architects design and install plant communities and often use native species. The goals of landscape architecture, however, are aesthetic and social, and usually involve management over many years to keep the original landscape design intact. In restoration ecology, the fundamental goals are ecological services and functions, namely the processes and dynamics that are typical of a complex living community. Birth rates and death rates are fundamental to such communities.

In restoration projects, we expect many species to reproduce and spread, even changing their location in the habitat over time. We expect some of the installed species to die out over time because successional forces favor new species. Also, in restoration, we expect plants and animals to be closely associated when determining stable population levels. In these ways, restoration relies more on function than on appearance: after a couple of decades a restored plant and animal community may look very different from the original installation. This outcome would be a success because change is a healthy part of ecological function. By contrast, in most landscape architecture designs, little change is expected or wanted, other than growth of individual plants. Consequently, restoration ecologists study ecological dynamics more than design and construction techniques, and landscape architecture programs rarely include advanced modern ecology. The products of both professions are important and wanted by society, but these products have different settings and goals.

Biodiversity in urban areas provides many benefits (Naeem et al. 1999; Costanza 2001). First, natural habitats serve the social need for a more aesthetic and healthy environment. Second, living plant communities modify the physical world in constructive ways: they clean and moderate the microclimate, promote groundwater infiltration, retard flooding and soil erosion, and provide habitat for wildlife (Daily 1997). Third, living plant communities enhance property values in locales where people wish to live near greenspaces (Daily 1997). Restoration activities, however, must address many challenges to creating historic and self-sustaining natural habitats. In urban areas, for example, the extensive infrastructure, homes, roads, industrial centers, and shopping areas fragment the landscape into small, oddly shaped patches. Unlike the dimensionless earlier theories of ecology, contemporary urban ecology focuses on such spatial constraints to understand what is feasible in reestablishing biodiversity.

The Hackensack Meadowlands (New Jersey)

In one of our first studies, on a landfill in the New Jersey Meadowlands (Robinson and Handel 2000), we are trying to bring back many tree and shrub species to a derelict landscape covered only with alien weeds. Although this landfill had been left alone by the responsible municipality, the Town of Kearny, New Jersey, for almost twenty years, no early successional or native species were found there. Surrounded by highways, dense urban communities, railroad yards, and saline marshes, this landfill was isolated from sources of native plants and animal species. Birds, which serve as agents of species introduction, had no reason to visit the barren site: there were no nesting areas, no perches, and no food. On all sides of this landfill were paved and hot surfaces that deterred the appearance of new species on the landfill. Vegetation in nearby areas was primarily alien and invasive species, predominantly mugwort *(Artemisia vulgaris)* and phragmites *(Phragmites australis)*, rather than those associated with natural early successional habitats in this region. Finally, the soil structure and horizons so important for healthy plant communities were lacking. The engineers who designed and closed the landfill did not have ecology in mind; their only goal was to concentrate and cover solid waste.

In urban areas, deficiencies in plant community are matched by peculiar and incomplete animal communities (McKinney 2002). Many of the large predators, wolves and large felines, originally found in the New York–New Jersey regions are long gone. Suburbia favors large deer populations, which destroy many plants and plant communities that restoration ecologists seek to nurture (Waller and Alverson 1997). The interplay of animals and plants is a critical part of modern restoration ecology.

Apart from the familiar problem of rampant deer herbivory, other less obvious plant-animal interactions are also important (Handel 1997). Mutualisms between plants and animals are critical for sustainable and healthy natural communities. Even healthy plants cannot reproduce and species populations cannot grow unless pollinators and seed dispersers, which in this region are usually animals, are present. We are just learning how to bring back populations of these animals as partners to the plants.

Although many plant species are found in commercial nurseries, most animals that are needed for plant reproduction are not commercially available and must be attracted to a restored plant community from the surrounding region. In urban area, that is a great challenge, and many animal species may never be encountered. Living species in the soil are similarly important (Allen 1991). Invertebrates and fungi are necessary for long-term biotic health but also cannot be obtained from commercial sources. Some mycorrhizae fungi, on plant roots that facilitate nutrient and water uptake, are available from suppliers, but the full complement of necessary species required natural functioning are not (Dighton 2003).

Experimental Restorations at Fresh Kills Landfill

Our first test case of restoration in the New Jersey Meadowlands suggested the need for a much more comprehensive experimental approach to urban restoration. With the support of the City of New York Department of Sanitation and the National Science Foundation, we have attempted a wide series of experiments at the Fresh Kills landfill in Staten Island, the largest landfill in North America, covering almost 1,100 hectares. After being closed in 1999, Fresh Kills was reopened in 2002 to receive debris removed from the destruction of the World Trade Center on September 11, 2001. It is now closed again, awaiting its transformation into a public parkland.

Closed landfills are usually capped by clays or heavy plastic, which is then covered by a layer of clean soil fill to protect the barrier layer against damage from sun and precipitation. The clean soil, obtained from local sources, is stabilized by hydroseeding a dense cover of fast-growing perennial grasses. The design goals are to protect the solid waste from being exposed and the protection of groundwater from chemicals leaching down from the landfill; no biotic or natural habitat goal is reflected in the engineering design. To realize the potential for Fresh Kills someday to serve as a huge urban park or natural refuge, engineering design must be tempered with a strong contribution from restoration ecology.

Project Design

For about a decade, we have conducted a multifaceted experiment in urban restoration ecology at Fresh Kills. The original salt marsh is now covered by almost sixty meters of solid waste, so recreation of the historic marsh community is impossible. A reasonable goal for restoration would be meadows and woodlands, typical of the coastal plain of New York. We are accumulating records of exactly which species used to grow on the upland coastal plain. Details of this data set, *New York Metropolitan Flora* (Moore et al. 2002), are mentioned below. An experiment testing the performance of native trees and shrubs was installed on the site to learn which species can grow on the shallow engineered soil.

We also want to learn whether the scale or intensity of planting affects ecological function and long-term success. Four sizes of woody plant patches were installed at the site. Each patch type had seven, twenty-one, forty-two, or seventy woody plants installed. Only seven species were used, so the patches represented one, three, six, or ten individuals in each species. Each patch size was replicated five times, and all twenty patches were planted on a slope of this landfill (figure 1).

An economic issue parallels the ecological question: because landfill managers

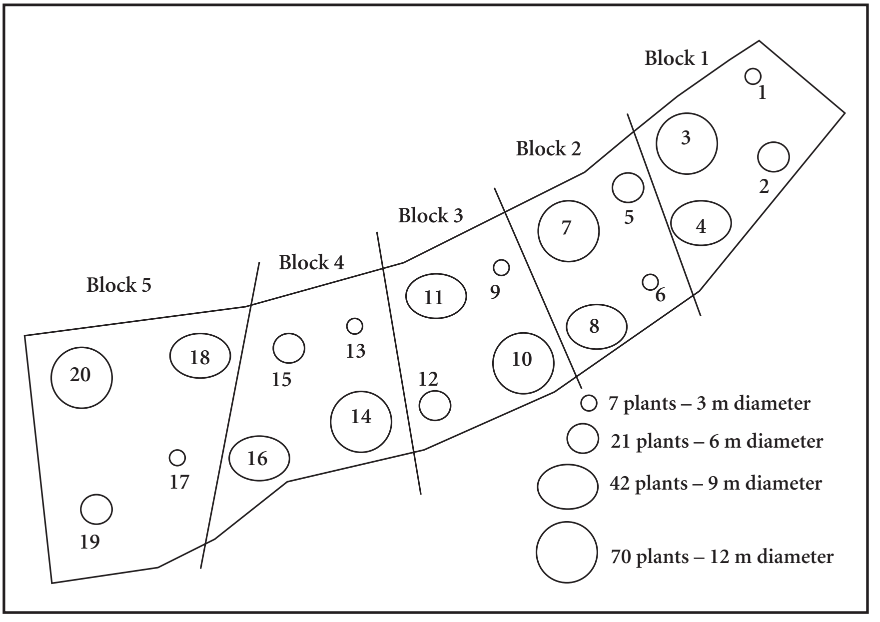


Figure 1 Arrangement of experimental patches of woody plants at Fresh Kills landfill, Staten Island, New York. Twenty patches of seven species vary in size, containing seven, twenty-one, forty-two, or seventy plants. These patches test how scale of restoration planting may change ecological functioning.

have limited funds, we are investigating whether small patches of plants would survive and spread across the large landscape spontaneously. In other words, is it more cost effective to plant many small, scattered patches or fewer but much larger patches of plants for long-term success? This coalescence of ecological and economic questions can be critical for future restoration ecology research.

Several preliminary conclusions can already be reported from the Fresh Kills experiment. Although it was a very dry and physically stressed site, the plants chosen grew relatively well on the landfill slope. Many of the patches are much larger than at installation, and individual plants have grown and are reproducing. Clonal growth, the vegetative spread of individual plants, in contrast to seedling additions, has characterized plant and patch growth. The native roses and sumacs in the patches now have many stems and cover many square meters. The plants have produced larger clusters that offer better habitat for both vertebrates and invertebrates. The patches are also slowly changing and improving the soil beneath the plants. Each year, leaves and woody litter from the plants scatter on the ground and decay, adding to the organic matter in the final soil cover. This process enriches the site and facilitates survival and growth of these plants into the future.

We have learned that the larger patches accumulate relatively more litter. The many stems in the large patches act as traps, preventing wind from blowing away dead leaves. In smaller patches where many plants are near the patch edges, dead leaves scatter across the site and away from the installed plant individuals. In addition, the larger patches have developed a deep shade like a natural thicket, and the original hydroseeded grass cover is dying, which is desirable because the heavy grass cover impeded germination of seeds and growth of new seedlings of woody plants. This negative interaction has been seen for many years on mining sites where reforestation is the preferred end use (Burger and Torbert 1992, 1999). Heavy grass cover kills woody plant seedlings directly by shading and competition for space, and indirectly by harboring large populations of rodents that eat woody seedlings as they appear. The developing shade of the large patches kills grass, which facilitates the opportunity for new woody species and individuals to succeed.

Seed Propagation and Pollination

Growth and flowering of our originally installed plants is only one part of the demographic process of restoration. All natural communities interplay with the surrounding landscape. On Staten Island—a densely populated and industrial area—few remnants of nonurban landscapes are left. Would seeds from additional species ever be carried into this large landfill? We tested this premise by placing seed traps under many of the trees in the twenty patches, and we also placed some traps in the open grassland. We found that birds, even on densely populated Staten Island, would bring in thousands of seeds of native woody species (Robinson, Handel, and Mattei 2002).

These extraordinary results suggested that this critical link in nature could be reestablished despite even the most stringent landscape conditions. Seeds of more than twenty new plant species were added to our site in each year of the first three years of study. The number of seeds, however, changed from year to year. In dry years, fewer seeds were available and spread to our site. In another year, a large part of an adjacent small woodland was cut down for commercial development. This habitat destruction was also correlated with few seeds coming into our site, *suggesting that even small urban and suburban woodlots play a very important role in the future restoration of healthy habitats.* In addition to numbers of seeds, urban remnant habitats represent plant survivors of urban stresses. Seeds from these remnants may represent genotypes that can best succeed in today's stressful urban physical conditions (Handel, Robinson, and Beattie 1994).

The growth of our planted individuals was encouraging, as was the addition of other seeds and species from surrounding habitat remnants. Self-sustainability of our plantings, however, must mean that the installed individuals themselves make seed. For many native trees and shrubs, native pollinators must visit flowers on these plants (Handel 1997). Would native bees visit these relatively few plants surrounded by hundreds of hectares of grasslands and urban infrastructure?

To address this question, a study was conducted involving bee species at the experimental planting in comparison with bees visiting the same plant species in urban parks surrounding Fresh Kills (Yurlina and Handel 1995; Yurlina 1998). This study produced very optimistic findings. More than seventy native bees species were found on flowers at Fresh Kills landfill. This number was similar to that of bee species found in old native habitats on Staten Island. More critically, the number of flowers on the landfill planting that set seed was statistically the same as the percent of flowers on same plant species in natural parks that set seed. This finding suggests that this link in nature–pollinators invading a large restored site and facilitating seed set–can occur even in the largest city in the United States.

Germination of Seeds

Finally, we tested whether seeds on the ground would in fact germinate and emerge, starting large populations of woody plants (Robinson, Handel, and Mattei 2002). We planted thousands of seeds of twenty-seven native species in another part of Fresh Kills landfill and followed their fate for three years. Very few of the seeds succeeded. The poor soil conditions and the competition from the dense fescue grasses challenged reproductive success. For restoration on landfills, soil quality, competition from grasses used for erosion control, and fate of introduced seeds form a trio that cannot be separated. Success of new species invading the sites requires microsites in the soil and a lack of competition from plants planted solely for engineering needs.

The Long View

A final requirement of restoration on urban engineered sites is adequate time for biotic success. We define it in three ways.

First, time is needed for more native plant species to reach to restored patches, find a microsite to begin their growth, and reach reproductive age before being eliminated by enemies such as herbivores and diseases. Virtually all natural communities through successional time change. Restorations in urban areas need significant time for the slow processes to occur. Very often, restoration project contracts are written that are only monitored for three years before success is measured and rated. A modification of this usual construction procedure will be necessary to make our urban restorations truly successful.

Second, our studies have shown that there is a long-term need for management of the projects. Invasive species often come in from the surrounding areas and can destroy the biodiversity we wish encouraged (Mack et al. 2000). Depending on the quality of the surrounding habitat remnants, these invasions may come in quickly or slowly. For example, in a forest fragment north of Philadelphia, alien vines destroyed much of the native forest and crippled attempts to restore new native trees to this preserve (Robertson, Robertson, and Tague 1994). Some labor is needed to destroy small populations of invasive species before they overwhelm the native species we wish to encourage (Sauer 1998).

Third, mature communities often include many more species than those found in early succession areas. To bring back species that require deep, rich soil or heavy shade for survival, restoration plantings may have to be added several years after the initial site treatment. Thus, there must be an *administrative organization* in place that remembers the original goals of the restoration and has the administrative ability to return to the site several years later. Funds must be reserved for this later stage of restoration. Many urban land managers do not have a long-term perspective. In fact, fiscal needs are often defined for only short time periods. Ecological restoration needs time for an organization to work on one site. Some private organizations that run urban parks have the institutional memory to keep working on a site for decades (e.g., Toth 1991). Civic organizations using public funds must design institutional methods to supply the time needed for realistic results.

New York Metropolitan Flora: Patterns of Urban Biodiversity

New York Metropolitan Flora is a project of the Brooklyn Botanic Garden (Moore et al. 2003). The plant occurrence database amassed by this project represents an important record of the local environment over the past 150 years. We have been working with these data to determine how we can analyze them and what the changes in range of various species mean in terms of the urban environment and its changes. (A more extensive account of the origin of the data, biases in the data, and the statistical analysis is presented in Clemants and Moore 2005.)

The data used here come from the New York Metropolitan Flora database, AILANTHUS (figure 2). We currently have more than two hundred thousand records of plant occurrences in the metropolitan region. These data have come from a variety of sources but particularly from herbarium specimens housed at eleven herbaria of the Northeast, extensive published and unpublished lists from literature, and five years of field work in the region. The woody plant data are represented by nearly one hundred thousand nonduplicated records and at least one hundred records per year for each year in the past century.

Two characteristics of the data are *distribution* and *change in range* (change index) over the past century. The distribution of species often indicates which environmental parameter might be most important restricting the range of a species. For instance, staggerbush (*Lyonia mariana*) (figure 3) is nearly restricted to the coastal plain of New York and New Jersey, which suggests that the soils or other characteristic of this physiographic province are critical to the limits of its range.

The change index is calculated using the methods presented in Telfer. Preston,

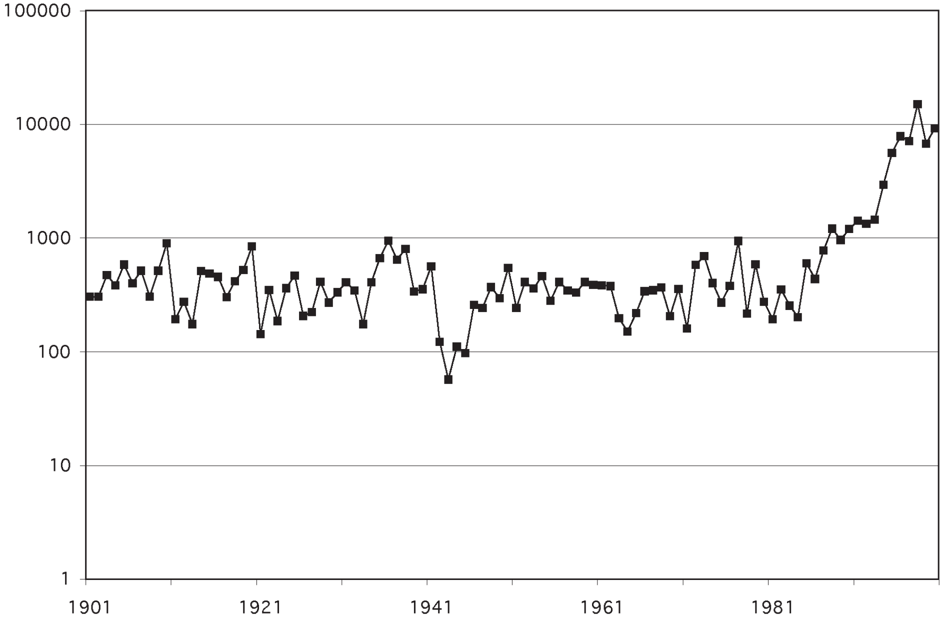


Figure 2 Number of records of plant species' occurrences per year in the database. Note that this graph is a log scale. Over the century, the number of records per year was less than two hundred per year, but there is a flurry of intense data collection since 1990, when NYMR was supported for intense fieldwork.

and Rothery (2002). The basic idea is to select two periods—in our case 1901–50 and 1951–2000—with available comparable data blocks for both periods. Counting the number of blocks in which a species occurs for both periods and graphing the early period's species counts against the later period will give an average change in number of blocks, which would represent the changes in sampling density. The divergence of a species from this average can therefore be attributed to *changes in the range of the species* (plus error). The magnitude of this divergence represents the magnitude of range change over the century.

The change index represented the direction and magnitude of this difference (see Telfer, Preston, and Rothery 2002 for actual calculation). For instance, *Celastrus orbiculata,* oriental bittersweet, is a highly invasive species introduced into the New York area in the early 1900s that spread rapidly after the middle of the twentieth century. Its change index is +3.34, the highest for any species studied. On the other hand, the related native species, *Celastrus scandens,* American bittersweet, has apparently declined, with a change index of –1.05. These data can now be used to examine some of the characteristics of the urban environment and how they affect various plant species.

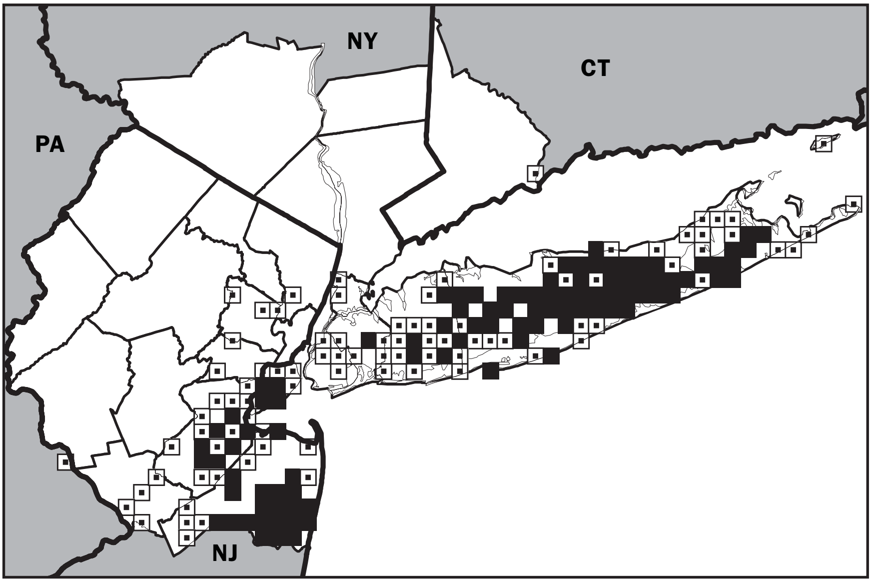
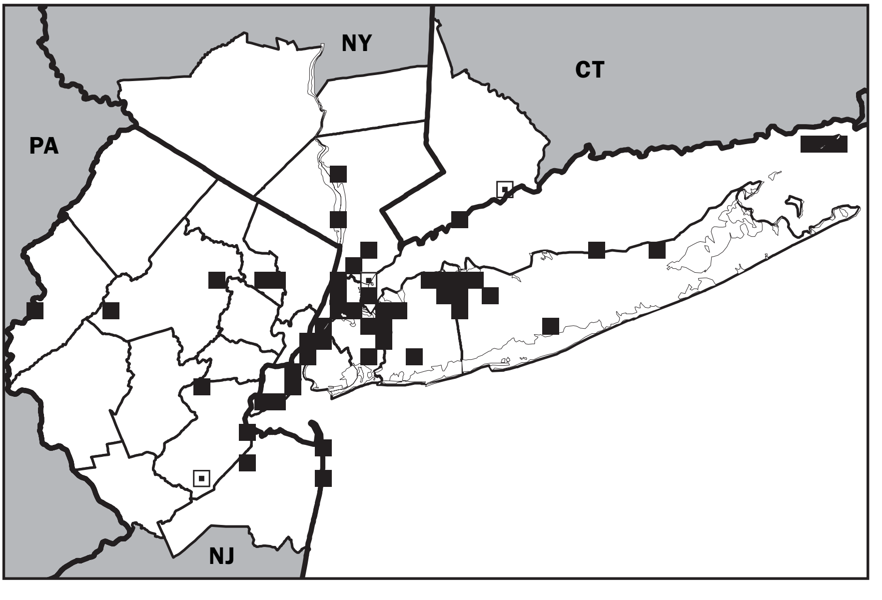


Figure 3 Distribution of staggerbush, *Lyonia mariana.* Filled squares indicate the species was found within the square in the past twenty-five years. An open square with a dot in the middle indicates that the species was found within the square before 1980 but not seen since.

Figure 4 Kudzu distribution. Black squares indicate the species was found within the square in the past twenty-five years. An open square with a dot in the middle indicates the species was found within the square before 1980 but not seen since.



It is well known that the *urban climate* is distinct from surrounding rural areas. Cities are warmer, particularly in and near their downtowns, a condition known as the "urban heat island" (Pickett et al. 2001). One species that flourishes in warmer climates is Kudzu (*Pueraria lobata*), which has been predominately collected in the denser urban areas (figure 4). Kudzu is a short-day plant, becoming reproductive only when nights are relatively long and blooming very late in the fall. Under normal climatic conditions in the New York region it would rarely set seed. Under the heat island, however, frosts are delayed and the plant will make seed more frequently.

Equally well known is the effect of *urbanization on soil.* Particularly apparent are reduced soil organisms and the heightened alkalinity as water drains off of concrete pavements and other hard surfaces. These two effects have markedly reduced the populations of acid-loving mycorrhizal members of the Ericaceae, the heath family. Table 1 shows all woody members of the Ericaceae and their corresponding change index.

The change index data can also illustrate the risk posed by *invasive species* and which species have shown the greatest increase in range. The average change index for the 47 nonnative species is +0.75, whereas the average for the 215 native species is –0.16. These numbers suggest that nonnative species became much more abundant over the past century and that native species are in general slightly declining during the same period.

Examining the species with the highest and lowest change index scores shows a similar trend. Table 2 gives the top-ten scoring species; only one species is native. Table 3 gives the lowest-scoring ten, and only one species is nonnative.

Developing Restoration Goals

These efforts to restore small native communities are grounded on the assumption that we know what we want the biodiversity to be in the future area. A restoration team cannot design appropriate plant communities that can nurture native animals unless it knows with some accuracy what was there in the past. A critical foundation for all ecological work is the accurate floristic record of which plant species were once present in the landscape (Egan and Howell 2001). Partnership between modern botanists and restoration ecologists must occur before a spade is put into the ground. In the New York–New Jersey region, detailed botanical research has occurred for over a century, and the results of this work are being collated for an understanding of past biodiversity. These data are also critical to understanding what is feasible and practical to restore in our urban habitats.

A new academic and practical approach to enhancing urban biodiversity is emerging. One organization that seeks to promote this synergy is the Center for Urban Restoration Ecology (CURE), a joint project of the Brooklyn Botanical

Table 1 Change Index Values for Ericaceae (Heath family) Species

Andromeda glaucophylla	–1.80
Arctostaphylos uva-ursi	–1.35
Chamaedaphne calyculata	–0.61
Chimaphila maculata	–0.61
Chimaphila umbellata	–2.07
Epigaea repens	–0.85
Gaultheria procumbens	–0.45
Gaylussacia baccata	–0.39
Gaylussacia dumosa	–1.96
Gaylussacia frondosa	–0.66
Kalmia angustifolia	–0.43
Kalmia latifolia	–0.08
Kalmia polifolia	–0.20
Leucothoe racemosa	–0.54
Lyonia ligustrina	–0.60
Lyonia mariana	–0.54
Rhododendron canadense	–1.73
Rhododendron maximum	+0.13
Rhododendron periclymenoides	–0.39
Rhododendron prinophyllum	–1.45
Rhododendron viscosum	–0.46
Vaccinium angustifolium	–0.83
Vaccinium corymbosum	–0.55
Vaccinium macrocarpon	–1.06
Vaccinium oxycoccos	–0.74
Vaccinium pallidum	–0.14
Vaccinium stamineum	–0.17

Table 2 The Top Change Index Scores, Indicating a Growth in Range

Celastrus orbiculata	3.34
Lonicera morrowii	2.79
Rosa multiflora	2.79
Elaeagnus umbellata	2.47
Ampelopsis brevipedunculata	2.34
Morus alba	2.30
Acer negundo	1.92
Ailanthus altissima	1.90
Rhamnus frangula	1.76
Berberis thunbergii	1.75

Note: Only *Acer negundo* is a native species.

Table 3 The Lowest-Change Index Scores, Indicating a Contraction of Range

Rubus argutus	–2.62
Rubus canadensis	–2.62
Salix serissima	–2.62
Rubus setosus	–2.51
Rhamnus alnifolia	–2.38
Lonicera dioica	–2.23
Crataegus uniflora	–2.10
Symphoricarpos albus	–2.09
Salix pentandra	–2.09
Chimaphila umbellata	–2.07

Note: All except *Salix pentandra* are native species.

Garden and Rutgers University (jointly administered by the authors of this essay). CURE has four broad goals:

1. To understanding patterns of urban biodiversity
2. To provide protocols for successfully restoration projects
3. To encourage urban restoration
4. To train students and professionals in urban restoration.

Some outgrowths of this collaboration have been the New York Metropolitan Flora Project, ongoing research at the Fresh Kills landfill, lectures, press releases, and demonstration projects. Environmental education is teaching the public, especially schoolchildren, that ecological services are needed in urban areas where most citizens live. As academic restorationists begin to collaborate with governmental entities to improve environmental health, progress in restoration ecology may become more rapid and noticeable.

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Urban Watershed Management

The Milwaukee River Experience

Laurin N. Sievert

A National Resource Council study, *New Strategies for America's Watersheds,* reports, "Successful watershed management strives for a better balance between ecosystem and watershed integrity and provision of human social and economic goals" (NRC 1999, 270). That is, contemporary urban watershed management must recognize and achieve balance between multiple goals, strategies, and interests, including those of both people and nature.

To achieve these ends, new approaches to watershed management necessitate innovative partnerships and collaborations among scientists, resource practitioners, and public interest groups. Further, basinwide management strategies are needed to manage watersheds as systems and to optimize geographic distribution and connectivity of ecological restoration projects (Franklin 1992). In cities, restoration, rediscovery, and celebration of waterways can be effective in reuniting urban neighborhoods (Rome 2001).

Although the degradation of many urban watersheds in the United States is well documented, there have been fewer studies investigating their recovery. Furthermore, although antidotal evidence indicates that some urban watersheds are improving as a result of coordinated watershed management, more research is needed to identify and document new approaches to managing these systems. This task is complicated by a lack of consistent data at the national level documenting the physical, chemical, and biological status of our water resources (NRC 1992).

This essay summarizes a recent study of innovative approaches to upgrading the Milwaukee River basin in southeastern Wisconsin at multiple scales. This appropriate mix of management strategies and objectives is helping improve water quality and ecosystem health while promoting a greater sense of community in the medium-sized watershed.

To assess the various public and private programs designed to protect and restore watershed health in the Milwaukee River basin, a survey of the root causes of degradation of water resources and synthesis of available data for recent regulatory and management programs, grassroots initiatives, and academic research was undertaken. Throughout the study, both ecological function and the development of a greater sense of community are considered. It is hoped that recent experience in the Milwaukee River basin will inspire and inform comparable efforts elsewhere.

The Milwaukee River Watershed

The Milwaukee River basin in southeastern Wisconsin consists of a network of four adjoining waterways: the Milwaukee, Menomonee, and Kinnickinnic rivers and Cedar Creek. Owing to the basin's size and drainage pattern, it is further divided into six subwatersheds. In sum, the basin covers a land area more than 850 square miles in size with more than six hundred miles of perennial streams, eighty-seven lakes and ponds larger than five acres in size, and thirty-five miles of shoreline along Lake Michigan.

The basin's landscape is diverse (figure 1). Its northern headwaters are largely undeveloped and protected as part of the Kettle Moraine State Forest, and the western portion of the basin is an amalgamation of suburban development and agricultural lands. In contrast, the southern basin is almost entirely metropolitan, with more than one million residents (WDNR 2001a).

The basin is also complex politically. Laying within portions of seven counties in southeastern Wisconsin (Dodge, Fond du Lac, Milwaukee, Ozaukee, Sheboygan, Washington, and Waukesha counties), it encompasses part or all of thirteen cities and twenty-four villages. All surface waters from these communities ultimately discharge into Lake Michigan at Milwaukee's downtown harbor.

Since 1970, the population of the Milwaukee River basin has increased by only 2.2 percent, although this population change is unevenly distributed. At the same time, the City of Milwaukee has experienced a decline in absolute population as residents have sprawled into adjoining suburbs south, west, and north of the central city. Hence, population in nearby counties has changed dramatically, and urban sprawl reaches into once rural hinterlands. For example, whereas in 1970 Milwaukee County accounted for 82 percent of the basin's total population, today it accounts for only 74 percent. In contrast, nearby Washington, Ozaukee, Fond du Lac, Sheboygan, and Waukesha counties grew by 89, 64, 25, 24 and19 percent, respectively, over the same period (WDNR 2001b).

Management Issues and Stakeholders

Because of its natural and population structure, the Milwaukee River basin faces a wide variety of water quality and quantity problems typical of suburbanizing watersheds in the United States. Water quality concerns in the Milwaukee River basin include point and nonpoint pollution, habitat degradation, and diminished recreational opportunities. Of these issues, combined sewer overflows and public beach closings are the most controversial. Water quantity concerns include flooding and groundwater depletion connected to regional drinking water supply issues.

To confront these issues, watershed organizations at various scales have joined

Figure 1 Map of the Milwaukee River Basin. (From University of Wisconsin–Extension Environmental Resources Center).

forces and focused their attentions away from individual problems and are thinking more holistically about the watershed. This change has occurred at federal, state, and local levels of government as well as in the private and nonprofit sectors.

At the federal level, the U.S. Environmental Protection Agency (EPA) began refocusing its efforts through the implementation of section 303(d) of the federal Clean Water Act. This legislation requires states to identify polluted waters that do not meet specific water quality standards for inclusion on the EPA's list of impaired waters. For each site listed, states must establish a comprehensive cleanup plan specifying a total maximum daily load (TMDL), which determines the amount by which all sources of pollution need to be reduced to meet the state water quality standards. Although TMDLs must account for both point and nonpoint sources of pollution, implementing them in watershed management increasingly requires focusing efforts on reducing nonpoint sources of pollution, such as nutrients, bacteria, and sediments that are typically transported in urban and agricultural runoff. In addition, TMDLs have increased attention placed on other factors affecting water quality, such as stream channel alteration, habitat degradation, and other physical modifications to the watershed. Point sources of pollution are largely regulated through the National Pollutant Discharge and Elimination System permitting process (U.S. EPA 2004).

In the Milwaukee River basin, eighteen impaired water bodies have been identified and included on Wisconsin's 303(d) list. The majority of pollutant sources for the river segments listed are associated with urban land uses, including bacteria, wetland loss, and sediments. Of the water bodies identified in the watershed, no TMDL plans have been established (WDNR 2001b).

Many problems have been identified with the TMDL approach to watershed management. To begin, the EPA is ill equipped to process and evaluate the number of proposals it receives for inclusion on its 303(d) list. Many states do not have adequate water quality data to evaluate the status of many water bodies within their boundaries. Moreover, funding is not available to assist states in developing TMDL implementation plans.

In 1995, the Wisconsin Department of Natural Resources (WDNR) began managing its land and water resources by twenty-three geographic map units (GMUs) according to major drainage basins. GMUs, more commonly referred to as "basins," emphasize the natural boundaries, structure, function, and interconnectedness of land and water resources (WDNR 2001a). This organizational restructuring reflected a significant shift in state and federal policy toward implementing new "eco-region" approaches to resource management.

In each of Wisconsin's GMUs, local partnerships involving a variety of governmental and nongovernmental stakeholders have been established. These partnerships serve in an advisory role to the WDNR and foster local work groups and improved communication between all interests and activities in a basin. Ultimately, the goal of WDNR's basin initiative is to facilitate more citizen-driven, participatory, decision-making processes in land and water resource policy.

Many watershed organizations are looking toward public-private partnerships to solidify goals and work cooperatively to address watershed goals, set priorities, and initiate projects. Drawing on the knowledge and resources of multiple organizations, partnerships allow for broader visions and a larger network of ideas.

To this end, the WDNR and the University of Wisconsin–Extension initiated the Milwaukee River Basin Land and Water Partners Team in 1998. Members of the partnership include businesses, nonprofit groups, public agencies, educational institutions, organizations, and individuals sharing an interest in the environmental and economic health of the Milwaukee River basin. Their initiatives are comprehensive and include research and project implementation, environmental education, and public policy recommendations.

New Directions in Watershed Management

New watershed approaches may be contrasted with earlier, more "traditional" watershed approaches, where watershed management was largely defined by many fragmented structural projects initiated by centralized governmental authorities. This approach is often referred to as a top-down approach, as direction was given by an overreaching government agency. In addition, this approach traditionally addressed only a single problem at a time, such as flooding.

New approaches to watershed management are more "organic" in nature. Characteristics of the new approach include a decentralized structure of governmental and nongovernmental stakeholders sharing in decision making. In addition, the new approach involves creative partnerships to establish and oversee common goals, share resources, name priorities, and exchange information. The goals of watershed management continually evolve to address issues that were largely ignored in the past, such as public participation, environmental education, and environmental justice (Born and Genskow 2001).

Although it is difficult to articulate a "one size fits all" definition of new watershed management approaches, researchers at the University of Wisconsin–Madison have found that such approaches generally share the following characteristics (Born and Genskow 2001):

1. Organize by watersheds and subwatersheds as their primary analytical and management units
2. Address a broad spectrum of issues
3. Exhibit a systems orientation
4. Incorporate multiple means and include goals pertaining to healthy ecosystems, economic returns, and resource management

5. Assess decision-making processes based on a combination of biophysical-science, social, and economic factors as well as local knowledge
6. Include interactions among multiple agencies and multiple levels of government
7. Emphasize influential and voluntary participation of multiple local and nongovernmental interests
8. Demonstrate collaborative, problem-solving, planning, and management orientations.

Because of the organic nature of this broader type of watershed management approach, evaluating its effectiveness presents new challenges. Moreover, whereas the ultimate goal of coordinated watershed management may be to achieve a measurable environmental outcome, the nature and breadth of the new "systems approach" requires a combination of both quantitative and qualitative indicators of progress. Finally, at different stages of this evolving management system, various indicators may become more or less relevant (Born and Genskow 2001).

Despite the challenges, many innovative projects throughout southeastern Wisconsin are contributing to an ecologically, economically, aesthetically, and socially enhanced Milwaukee River basin. The remainder of this essay examines a few of these projects initiated by a range of stakeholders to demonstrate the various levels of complexity in which watershed issues are being addressed throughout the basin. Many of these examples apply to the urbanized downstream portions of the watershed where population densities are highest and modification of the natural environment has been most pronounced.

Toward Collaborative Watershed Management

Resource managers and their partners are improving the Milwaukee River basin through a variety of efforts. These initiatives address both ecological and economic needs of the communities they benefit.

Economic Opportunities

In the 1930s, to protect citizens against flood losses, the Milwaukee County Parks Commission adopted a river parkway system recommended by Frederick Law Olmsted. This early foresight left Milwaukee with a rich legacy of parks, and public access to the waterfront in downtown Milwaukee that remains today (Riley 1998, 13).

In keeping with its responsibility to protect navigable waters and public commons according to the Wisconsin Public Trust Doctrine and to create better public access to the river, the City of Milwaukee Department of City Development initiated the Milwaukee RiverWalk system in 1994. Its goals were to improve public access to the downtown Milwaukee River by providing funds to establish and upgrade a network of waterfront trails, promenades, and pedestrian bridges. The system developed from a public-private partnership between property owners and the city. In exchange for permanent public access to the river, the city matches funds for private RiverWalk improvements.

The establishment of the Milwaukee RiverWalk system has attracted thousands of visitors to the downtown area and has spurred economic development along the waterside. In addition to various recreational opportunities such as RiverSplash and the Milwaukee River Challenge, property values in the RiverWalk business improvement district increased from $335 million (1994) to $517 million (2002). In addition, more than $118 million in new residential development has occurred, attracting new residents to the downtown (Milwaukee Department of City Development 2002).

Ecological Function

Much of the river corridor in the densely urban Milwaukee River South Branch watershed has been channelized, paved, or diverted underground to alleviate flooding concerns and quickly convey floodwaters downstream. These modifications have caused a marked decline in its biological diversity and ecological health. To reverse some of this damage, the Milwaukee Metropolitan Sewerage District (MMSD) is currently restoring the meandering flow of the river corridor and returning natural flood storage capacity in portions of this and other watersheds in the Milwaukee River basin.

MMSD is a state-chartered government agency providing wastewater services for twenty-eight municipalities. The district's 420-square-mile service area includes all cities and villages (with the exception of the City of South Milwaukee) within Milwaukee County and all or part of ten municipalities in surrounding Ozaukee, Washington, Waukesha, and Racine counties.

In addition to providing wastewater services, other MMSD functions include water quality research and laboratory services, operating household hazardous waste and mercury collection programs, and involvement in various environmentally focused partnerships. MMSD, in conjunction with area stakeholder groups, is charged with planning and overseeing projects to reduce the risk of flooding and protecting its sewer infrastructure and ultimately, the health of the watershed. In 1993, the EPA recognized the MMSD as a Clean Water Partner for the 21st Century in recognition of its efforts to improve the health of Milwaukee-area watersheds.

One MMSD project has focused on Lincoln Creek, a nine-mile tributary of the Milwaukee River draining a land area of approximately 21 square miles within portions of the Cities of Milwaukee and Glendale and the Village of Brown Deer (WDNR 2001a). The Lincoln Creek Environmental Restoration and Flood Control Project relocated approximately 2,025 homes and businesses out of the hundred-year (1 percent probability flood occurrence) floodplain and removed over two miles of concrete channels to restore a more natural, meandering flow (MMSD 2002).

In the 1950s, the stream was lined with concrete to convey flood surges away more quickly. MMSD has removed the concrete and restored a more natural stream. The overall habitat has improved as a result of increased natural storage capacity, and more species of fish and macroinvertebrates are gradually returning to the stream. Detention and retention basins in the watershed have increased this capacity. MMSD has done or is planning similar work along Oak Creek, Root River, and Menomonee River. Substantial changes were made along the nine-mile-long Lincoln Creek besides the removal of two miles of concrete lining, including construction of two large detention basins, improved bypass culverts and bridges, and the deepening and widening of creek segments (MMSD 2002). Although the main focus of the project is to reduce the risk of flooding, it also aims to enhance the attractiveness of the corridor; improve water quality; restore, stabilize and protect eroding banks; and provide a suitable habitat for fish, birds and other wildlife. The result is a waterway that is being viewed as a successful model for urban flood management and habitat restoration.

In addition, MMSD has implemented a land conservation plan to preserve natural ponding and undeveloped floodplain areas to help reduce the risk of future flooding. Through the assistance of a conservation fund, MMSD is working to acquire or secure easements on properties identified as critical to protecting against flooding in local watersheds (MMSD 2004).

Watershed managers are now seeking to return waterways to more natural flow regimes and allow floodwaters to disperse high-energy flows across the floodplain. This approach is particularly gaining acceptance in the downstream, urban portions of the Milwaukee River basin, where the cumulative effects of decades of structural adjustment projects such as dams, large-scale water diversions, and habitat alteration have degraded water quality. In addition, preserving or creating wetlands and protecting riparian vegetation allow for sediments and toxins to be captured and filtered before entering surface or groundwater systems. To this end, municipalities within the Milwaukee River basin are being encouraged to adopt the Regional Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin (SEWRPC 1997).

Future Concerns

Despite the many innovative partnerships and successful collaborative experiences in the Milwaukee River basin, there remains a need for a more comprehensive water policy management framework at a regional level to address issues confronting the entire Great Lakes region. Several agreements already exist among the eight states and two Canadian provinces adjoining the Great Lakes. One is the Great Lakes Charter, which requires the permission of all other states and provinces before allowing water withdrawals over a specified volume from the Great Lakes; another is the 1985 Toxic Substances Control Agreement between the eight states agreeing on common environmental standards to avoid unfair economic competition between them based on lax environmental regulations. In addition, the National Oceanic and Atmospheric Administration, EPA, International Joint Commission, U.S. Fish and Wildlife Service, Great Lakes Commission, and Great Lakes Fisheries Commission all have jurisdictional roles in the Great Lakes (Wisconsin Academy of Sciences, Arts and Letters 2002).

Likewise, watershed management objectives in the Milwaukee River basin must consider the entire region because the fate of the watershed's headwaters, shared aquifers, and downstream areas are inextricably linked. In the Milwaukee River basin, oversight is divided among federal, state, and local government agencies with overlapping layers of authority. The development of public-private partnerships may be of use in these circumstances. Although participation in the Milwaukee River Basin Land and Water Partners Team is currently voluntary, the group has been able to bring diverse interests together to address common concerns and improve conditions throughout the basin.

Problems still exist when considering metropolitan Milwaukee as a region, however, such as when considering regional water supply issues. While residents of Milwaukee and its older suburbs enjoy access to the abundant, fresh water from Lake Michigan, residents of burgeoning western suburbs in Waukesha County lay outside both the Milwaukee River and Great Lakes basins. Hence, they are prohibited from withdrawing water from Lake Michigan for their drinking water supply. Instead, municipalities in this area have been pumping groundwater for their drinking supply from both the shallow aquifer (approximately twenty-five to three hundred feet below ground) and from a deep sandstone aquifer. Over the past century, reliance on groundwater for household and industrial use has drawn down the latter more than six hundred feet. Of even more immediate alarm, however, is that water from this deep aquifer is enriched with naturally occurring radioactive radium, which has been linked to bone cancer, thereby threatening the health of residents in Waukesha County (Feinstein et al. 2004).

This situation is not unique to Milwaukee area residents alone. Similar circumstances exist in suburban neighborhoods within the Chicago metropolitan area. Although residents of Chicago and nearby municipalities enjoy water rights to Lake Michigan water as the result of a Supreme Court ruling, their withdrawal is limited to 2.1 million gallons of water per day. Currently, their daily intake averages 2.0 million gallons per day and frequently exceeds this allowance. In their case too, surrounding suburbs are depleting groundwater aquifers and confronting issues of high radium and other mineral concentrations.

In short, a stronger commitment to long-term regional planning and addressing both ecological and social issues within a watershed context is needed to sustain the relative health and vitality of the entire Milwaukee River basin. Together, however, the initiatives and partnerships described in this essay are indicative of steps toward this end.

Although the Milwaukee experience has followed the same historical course of watershed degradation as other U.S. cities that developed during the Industrial Revolution, new directions in watershed management, planning, and implementation focused on watershed integration are all steps in the right direction. Notably, in the case of Milwaukee's watersheds, government agencies, nonprofit organizations, and private landowners are mutually developing and implementing watershed-scale goals, management plans, and restoration projects. This involvement is significant because, although the benefits of watershed-scale restoration and management strategies are increasingly recognized throughout the United States, they are still not commonplace in practice (Dombeck, Wood, and Williams 2003).

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Watershed management efforts cannot succeed without public support of new watershed initiatives. Thus, there is a need for the public to be educated and understand the complex issues facing aquatic ecosystems. Therefore, the role of environmental education in the Milwaukee River basin is critical.

Milwaukee's commitment toward sustainability through an informed public is clear in the outreach of two remarkable environmental education and outreach programs within the city, the Urban Ecology Center and Growing Power, Inc.

The **Urban Ecology Center** is a leader in environmental education efforts in southeastern Wisconsin and is a model for other centers throughout the United States. Essentially once an abandoned park, the center was created as a part of a community revitalization effort in 1991. Situated on twelve acres of woods and riparian habitat on the east bank of the Milwaukee River and located between the most populated and diverse Riverwest and East Side communities in Milwaukee, the Urban Ecology Center is a neighborhood-based, nonprofit community center located in Milwaukee's Riverside Park.

As an outdoor laboratory, the center provides environmental education programs to local schools, promotes community environmental awareness, preserves and enhances the natural resources of Riverside Park, and protects the adjacent Milwaukee River. Each year, more than ten thousand students and teachers from twelve neighborhood schools within a two-mile radius of the center participate in the Neighborhood Environmental Education Program. Students explore their local ecology through hands-on learning experiences developed by the center's staff to complement and enrich the existing K through 12 science curriculum. In addition, the Urban Ecology Center has developed a Citizen Science Program in coordination with partners from nearby universities to conduct research within an urban environment. These programs strive to turn Riverside Park into a vibrant field station and educational facility.

Through a vigorous fund-raising campaign, the Urban Ecology Center, under the direction of executive director Ken Leinbach, has recently constructed a $5 million state-of-the-art community center (figure 2). This facility replaced a trailer that had been the center's home for over a decade. The new facility incorporates various green building technologies, such as photovoltaic and rainwater catchment systems and a green roof. (For more information, please visit the Urban Ecology Center's website at http://www.urbanecologycenter.org.)

Another Milwaukee-based organization, **Growing Power, Inc.**, is working both locally and nationally to promote increased sustainability urban agriculture (figure 3). Growing Power is a national nonprofit organization and land trust supporting people from diverse backgrounds and the environments they live in through the development of community food systems. The program provides high-quality, safe, healthy, affordable food community residents. Growing Power develops community food centers, as key components of community food systems, and offers training, active demonstration, outreach, and technical assistance. Community food centers are local places where people learn sustainable practices to grow, process, market, and distribute food.

The Growing Power Community Food Center in Milwaukee Center is the oldest working farm and greenhouse in the city. This two-acre urban farm has been continuously farmed for nearly a century. Through disseminating technical training to thousands of visitors each year, Growing Power hopes to establish local community food centers in other neighborhoods around the United States. (For more information about the program, please visit Growing Power's website at http://www.growingpower.org.)

Figure 2 The new Urban Ecology Center, Milwaukee, Wisconsin. ([*left*] photo courtesy of Sean Berry; [*below*] photo courtesy of Mark J. Heffron.)

Figure 3 Students from Chicago learn about urban agriculture from the director of Growing Power, Will Allen. (Photo by Laurin N. Sievert.)

Green Futures for Industrial Brownfields

Christopher A. De Sousa

Once viewed as symbols of urban economic power, older industrial brownfield districts located in inner cores are now perceived as little more than prime examples of urban decay. The list of socioeconomic and environmental ills associated with these districts and their surrounding neighborhoods is an extensive one and includes such "blights" as high levels of crime, crumbling infrastructure, contaminated soils, vacant buildings, "bottom-feeding" businesses, and poverty. Indeed, the physical extent of these districts and the range of the problems they face have left governments in a quandary as to what to do about them, while most city residents appear to have simply put them out of their minds.

While planners, economists, and community and business leaders discuss what can be done to revitalize these districts, a frequent theme is the increasing role that so-called greening must play in cleaning up such districts, enhancing their attractiveness for business and growth. This essay examines efforts being undertaken in three Rust Belt cities to use greening as a primary tool in the regeneration, revitalization, and restructuring of industrial brownfield districts: the Menomonee Valley in Milwaukee, the Port Lands in Toronto, and the Lake Calumet area in Chicago. These cases indicate the value of regreening as an overall strategy for the revitalization of brownfields in urban areas generally.

Brownfields

Since the early 1990s, older cities across North America have engaged in revitalizing their inner cores, most of which have been at least partially abandoned by industries, businesses, and residents. The reuse of these abandoned core districts is hampered by so-called brownfield sites, namely abandoned or underutilized properties whose past land uses have contaminated the soil or groundwater, or are perceived to have done so. Although these sites are found in all kinds of localities, both within and outside cities, they tend to be more concentrated in inner-core areas. They come in all shapes and sizes, ranging from abandoned corner gas stations to large industrial lots where manufacturing, petroleum storage, and commercial and transportation uses may have taken place. A comprehensive survey of thirty-one cities in the United States conducted by Simons (1998) estimated that in 1994 there were approximately 75,000 brownfields covering 93,500 acres and representing about 6 percent of a city's total area on average. According to a study by the U.S.

Conference of Mayors (2000), 210 U.S. cities reported having more than 21,000 brownfield sites ranging in size from a quarter of an acre to 1,300 acres. Each industrial district examined here is comprised of numerous "mixed-size" properties that cluster within single regions.

Concern over brownfields surfaced in the late 1970s. The initial focus was on finding an appropriate technology for cleaning them up and getting those responsible for creating the contamination to pay for the cleanup. Following such incidents as Love Canal, Times Beach, and Valley of the Drums, which were given broad media exposure, the federal government passed the Comprehensive Environmental Response and Liabilities Act in 1980 (CERCLA), also known as "Superfund." CERCLA made funds available for remediation and gave governments the authority to recover cleanup and damage costs from parties responsible for creating a brownfield. Fear of assuming liability, however, deterred private investors, especially banks, from becoming involved with redevelopment of any property that was remotely suspected of being contaminated. The strategy thus ended up being counterproductive, hindering efforts to remediate and redevelop many brownfield sites (Stroup 1997).

Progress was made in the mid-1990s when governments at all levels began experimenting with a range of new approaches for encouraging remediation and redevelopment (Meyer, Williams, and Yount 1995; Bartsch 1996; Simons 1998; Council for Urban Economic Development 1999). In 1995, the U.S. Environmental Protection Agency (EPA) proposed its Brownfields Action Agenda to provide funds for pilot programs, link brownfield redevelopment with other socioeconomic issues, and refocus its efforts on high-risk sites. State governments also began implementing so-called voluntary cleanup programs to promote redevelopment by offering more flexible cleanup options; giving more leeway to the private sector to oversee its own activities; and providing technical assistance, financial incentives, and protection from liability to developers and investors. At the federal level, such efforts led cumulatively to the recent passage of the Small Business Liability Relief and Brownfields Revitalization Act in 2002, which provides liability protection for prospective investors, property owners, and innocent landowners, and authorizes increased funding for state and local programs that assess and clean up brownfields.

In Canada, the federal government has always been less engaged in brownfield redevelopment, which has fallen largely under the aegis of provincial and municipal levels of government (De Sousa 2001). The general intent of governmental agencies has been to act as regulators and advisors, holding the private sector financially responsible for cleanup and redevelopment. In Ontario, the Ministry of the Environment can legally demand the remediation of a brownfield site under Canada's Environmental Protection Act. In actual fact, however, the assessment and remediation of brownfields unfolds largely as a voluntary process regulated by its Guideline for Use at Contaminated Sites in Ontario (Ontario Ministry of the Environment1996). In contrast to most U.S. jurisdictions, only in late 2002 did Ontario pass legislation designed to make investment in brownfield redevelopment more attractive to the business sector.

Overall, efforts to redevelop brownfields have produced some successes (Council for Urban Economic Development 1999; U.S. Conference of Mayors 2000). In the United States, the focus has been primarily on redeveloping brownfields for industrial and commercial uses, with residential and retail uses following closely behind. The opposite has been the order of priorities in Canadian and European redevelopment efforts (Bibby and Shepherd 1999; Box and Shirley 1999; De Sousa 2002). More recently, greater attention has been given the greening option, even though it does not directly generate significant employment or tax benefits but rather is perceived as playing an important role in improving the quality of urban life (International Economic Development Council 2001; Kirkwood 2001; De Sousa 2003).

Urban Regreening Case Studies[1]

Widespread interest in urban revitalization has led, in turn, to a resurgence of interest in greening the city (Garven and Berens 1997; Harnik 2000). So far, research on greening has focused largely on documenting the benefits and barriers associated with it. Landscape architects, for example, have focused on the aesthetic and environmental benefits that greenspace-oriented redevelopment can bestow on urban areas, such as improving environmental quality, restoring natural habitats, enhancing recreational opportunities, and improving the appearance of urban areas (Hough, Benson, and Evenson 1997; Thompson and Sorvig 2000). In addition, research has found that urban greening improves the well-being of city residents in a variety of ways, by reducing crime, reducing stress levels, strengthening neighborhood social ties, coping with "life's demands," and the like (Kuo, Bacaicoa, and Sullivan 1998; Kweon, Sullivan, and Wiley 1998; Kaplan 2001). Similar kinds of positive findings are also emerging from research conducted by environmental economists (Lerner and Poole 1999; Bolitzer and Netusil 2000). Summarizing the main implications, Lerner and Poole (1999) contend that greening projects in the United States tend to reduce costs related to urban sprawl and infrastructure, attract investment, raise property values, invigorate local economies, boost tourism, preserve farmland, prevent flood damage, and safeguard environmental quality generally.

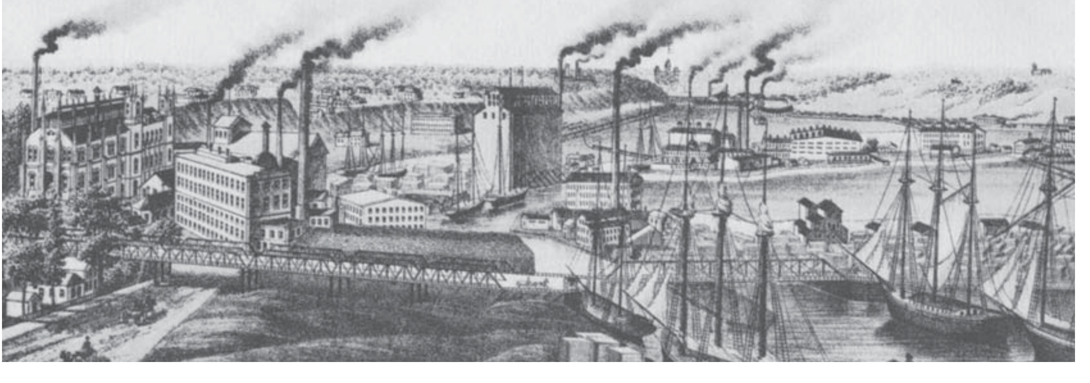
Identifying such benefits is essential for countering the barriers, real or perceived, that are often associated with such greening, including the high maintenance costs it entails, the safety concerns it raises, and the poor accessibility it creates (Garven and Berens 1997). It is particularly true in the case of the greening of brownfield districts, and brownfields generally, which are associated with a host of socioeconomic and environmental costs and risks. Nevertheless, greening projects on brownfield sites are on the rise throughout the United States, Canada, and Europe (Garven and Berens 1997; Harnik 2000; International Economic Development Council 2001; Harrison and Davies 2002). These projects not only provide models for implementing similar works, but also highlight the important role greening plays in fashioning a more humane metropolis.

The Menomonee Valley, Milwaukee

The Menomonee Valley is a fifteen-hundred-acre old industrial corridor close to downtown Milwaukee. Prior to European settlement, the area was a diverse marsh and wetland ecosystem that provided Native Americans with a plentiful supply of fish, waterfowl, wild rice, and other resources. Starting in the nineteenth century, European settlers were attracted to the valley by its transportation potential, given its location at the confluence of two major rivers, the Milwaukee and the Menomonee, that converge at the city center and flow into Lake Michigan. Canals, roads, and water and sewer systems were constructed which attracted industrial interests to the city (figure 1). By the 1920s, more than fifty thousand people were employed by these economic enterprises in the valley.

Industrial decline in the Menomonee Valley started during the Great Depression of the 1930s and became widespread by the late 1970s. In addition to job losses, the decline turned the valley into Wisconsin's largest brownfield site, laden with polychlorinated biphenyls, heavy metals, petroleum residue, and other contaminants typical of former industrial activities (State of Wisconsin Brownfields Study Group 2000). Although the remaining businesses in the valley still employ more than seven thousand people, its contamination problems, both real and perceived, continue to pose a daunting and complex challenge to any redevelopment scheme.

Figure 1 Milwaukee's Menomonee River Valley, 1882. (Source: Historic Urban Plans 1978.)



The City of Milwaukee and key stakeholders have joined forces to devise ways to rekindle the industrial potential of the valley and revitalize its natural resources. The Menomonee Valley Partners, a public-private partnership bringing together members of the business world, community organizations, and government agencies, was established to facilitate the implementation of the City of Milwaukee's Land Use Plan for the valley. On the whole, the Menomonee Valley Partners (2003: homepage) envision a redeveloped Valley that is as central to the city as it was in the past:

- Geographically central, with new ties to the surrounding neighborhoods;
- Economically central, with strong companies that provide jobs near workers' homes;
- Ecologically central, with healthy waterways and greenspace; and
- Culturally central, with recreational facilities for the community.

All levels of government in Wisconsin are now making available an extensive array of financial incentives to prospective developers. There is also an ongoing planning process designed to protect the valley's natural resources and restore some of its previous habitat and natural systems.

The first significant greening project initiated in 1992 was the Hank Aaron State Trail, which was officially opened in 2000 on the valley's west side. When completed, the trail will be a seven-mile urban greenway through the heart of the valley (figure 2). The primary objectives of the project are

- Protection and renewal of the riparian corridor
- Development of a multiuse pathway for commuting
- Provision of close-to-home recreational activities for adjacent neighborhoods
- Use of the valley for its historical value
- Linkage of the trail to other city, county, and state trail systems.

As mentioned, the Department of Natural Resources of Wisconsin is the lead agency in planning, implementing, and managing the project. The City of Milwaukee is involved primarily in raising funds, releasing land, and maintaining the trail itself. Various federal agencies have provided financial support for accessories such as signs and artwork. Local community groups and neighborhood associations such as the Friends of the Hank Aaron State Trail have helped raise awareness and funds while assisting with special events. Private landowners (e.g., Miller Park Stadium Corporation) are being contacted by the state to donate easements for the trail and help finance development and renaturalization activities. The Department of Natural Resources estimates that the total project costs will amount to slightly over $5 million, with open space costing approximately $450,000 and site

Figure 2 Hank Aaron State Trail, 2002. (Photo by C. De Sousa.)

assessment and cleanup $500,000. The remaining funds will go toward site acquisition, project planning, and site development.

One local nonprofit group, the Sixteenth Street Community Health Center, together with the City of Milwaukee and other sponsors, organized a national design competition, *Natural Landscapes for Living Communities,* to plan the redevelopment and greening of a 140-acre abandoned railroad property in the western end of the Menomonee Valley within the city. The aims of the competition are implicit in the criteria presented to the four finalist design teams (Sixteenth Street Community Health Center 2002):

- To design an industrial park accommodating at least 1.2 million cubic feet of development (proposed by the city)
- To extend Canal Street (a major connection road within the valley)
- To expand the Hank Aaron State Trail
- To interconnect the railroad property to Mitchell Park and neighborhoods to the north and south of the valley
- To devise site-specific storm and flood water management techniques
- To resolve site-specific environmental and geotechnical issues
- To landscape the area

- To establish community connections to the site by means of open space planning, educational opportunities, and signage.

The preliminary vision for the site put forward by Wenk Associates of Denver, Colorado (selected in the summer of 2002) incorporates the full range of criteria listed above. Their design includes an industrial park surrounded by a variety of natural and open space features, including a "storm water" park, trails, a community green space, and a renaturalized Menomonee River (figure 3). In all, the 140-acre site is slated to encompass 70 acres of light industry; a one-mile segment of the Hank Aaron State Trail; and 70 acres of streets, parks, and natural areas along the banks of the Menomonee River (Wenk Associates 2002). The city is currently in the process of preparing the site for redevelopment, while other stakeholders are raising both awareness and funds to ensure that the project continues to move forward.

The Toronto Port Lands

The revitalization of Toronto's Port Industrial District, often referred to as the Port Lands, has been the subject of intense debate for more than two decades. Located southeast of the central business district, the one-thousand-acre property was created largely by fill from dredging, demolition, and other such activities in the city. Currently, there is a range of industrial, commercial, and recreational uses on the Port Lands, including Toronto's port facilities. Historically, the energy companies occupied a large portion of the area, with oil tank farms making up almost a half of the total area (Hemson Consulting 2000). The energy crises of the 1970s and the subsequent switchover to natural gas for residential energy led to a decline in the need for oil, which led, in turn, to the migration of oil companies away from the port area. Although more than three thousand people still work for businesses located in the Port Lands, the site is becoming gradually abandoned and is extensively contaminated, containing more than one hundred individual brownfield sites (Hemson Consulting 2000; Groeneveld 2002).

The debate over the future of the Port Lands has always been a heated one. Some interests believe that it is best suited for residential redevelopment, bringing the district in line with other successful residential communities along the waterfront (Warson 1998). Others envision the area as a continuation of the larger greenspace renewal efforts that have been taking place in contiguous areas to the port (the Don River to the north, the Leslie Street Spit and Cherrie Beach to the south). Finally, some believe that the area should continue to be used for commercial and industrial uses. All agree, however, that some form of greening must take place as part of any viable revitalization scheme for the area.

The first comprehensive attempt at developing a greening plan for the Port Lands was undertaken by the Waterfront Regeneration Trust, an agency that grew

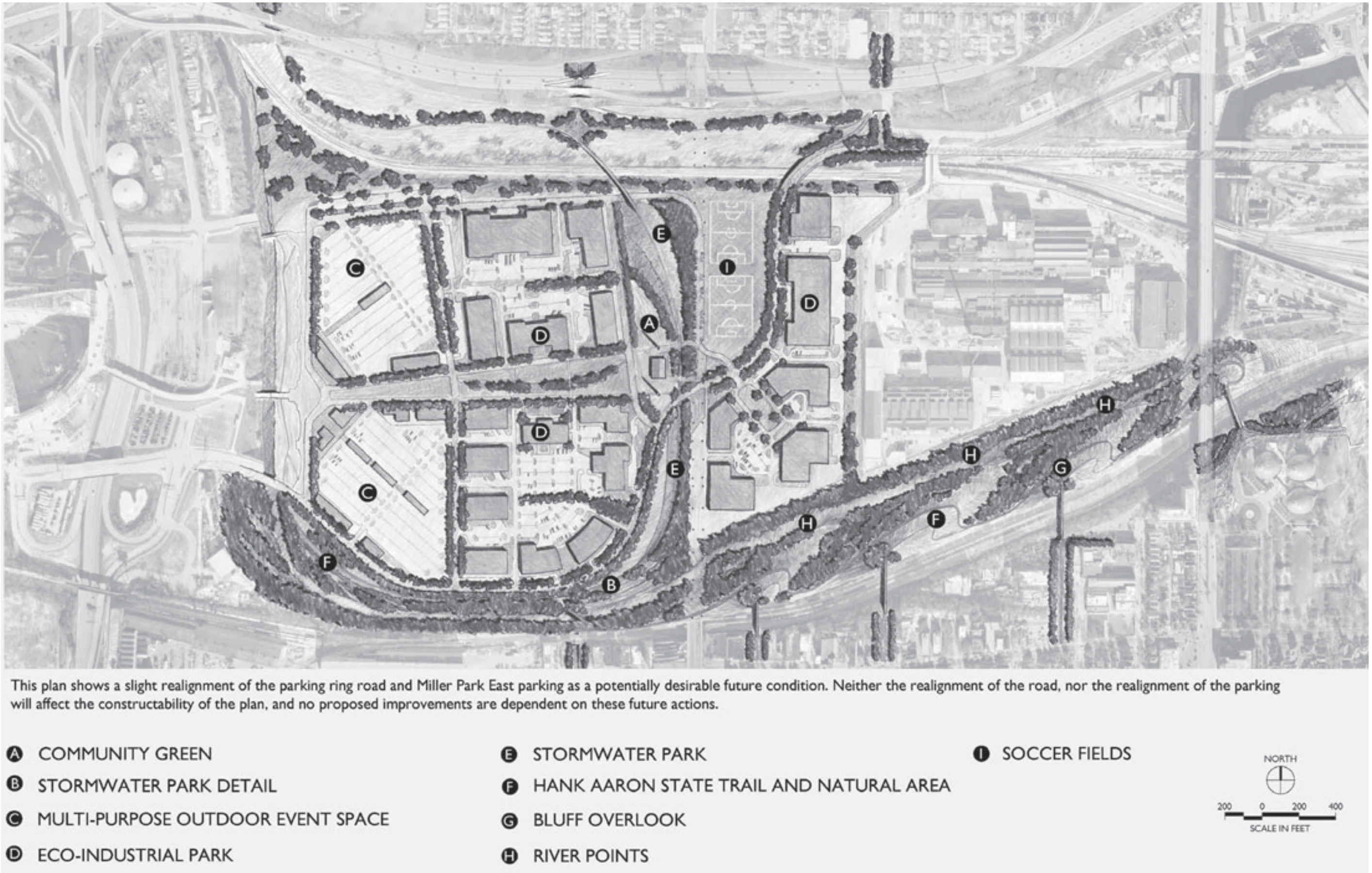


Figure 3 Landscape Concept Framework, Menomonee River Valley Design Competition, Wenk Associates, 2002. (Courtesy of Sixteenth Street Community Health Center, Milwaukee.)

out of a Royal Commission established in 1988 to study the future of the Toronto waterfront. The trust adopted an ecosystem approach that integrates community, environmental, and economic needs into the redevelopment of contaminated lands. In 1997, the trust published *Greening the Toronto Port Lands,* which contained a plan for green infrastructure for the Port Lands (Hough, Benson, and Evenson 1997).

More recently, greening of the Port Lands was used as a tactic by the City of Toronto in its bid for the 2008 Summer Olympics. Although the bid failed, a Waterfront Revitalization Corporation (WRC) was established nonetheless to move redevelopment and renewal activity forward. According to the plan developed (Toronto Waterfront Revitalization Task Force 2000), new public spaces will encompass 450 acres throughout the waterfront, and the WRC has pledged $500 million dollars specifically for park development. As for the port itself, the plan provides for an extension of its greenspace from 5 percent to 30 percent of the total area to provide more habitat, improve the ecology of the region, provide recreation, and manage storm water. A "green border" is slated to surround the port to renaturalize the waterfront and allow the public easy access to it. It is also anticipated that the port will accommodate approximately twenty-five thousand new homes and numerous "new economy"-oriented businesses (those involved in information technology, media, biomedical and biotechnology, and professional services). In total, the anticipated twenty-year renewal of the waterfront will cost an estimated $12 billion Canadian, of which over $5 billion will come from public sources to cover site acquisition, infrastructure, and business interruption/relocation costs. The WRC is responsible for raising the remaining funds via public/private partnerships. Thus far, the three levels of government have pledged $1.5 billion of initial funding for a variety of so-called priority projects, including the cleanup of contamination that is estimated to cost between $60 million to $500 million, depending on the approach taken.

One such priority project is "restoring" the mouth of the Don River, where the port and the river meet (figure 4). According to the WRC (2000, 1), "The green corridor is intended to serve as a welcoming entrance to the Port Lands and encourage private sector investment and future development." The project will connect Toronto's waterfront to greenspace in the Don River Valley, transforming vacant lots and concrete into fifty-two acres of new parkland, wetland, and marsh areas. It will also improve water quality and free up new land for redevelopment in the West Don Lands, an industrial brownfield area located just north of the port and often considered to be an extension of the Port Lands for planning purposes. Fulfilling this vision will require extensive soil and groundwater remediation, removal of current infrastructure, and the reconfiguration of the mouth of the Don River. The WRC has already set aside $2 million (Canadian) for the assessment, design, and planning process itself (Toronto Waterfront Revitalization Corpora-

Figure 4 The Mouth of the Don River. (Photo by C. De Sousa.)

tion 2000). The project is envisioned as being another successful brownfields-to-greenspace project that Toronto has undertaken within its central city and in areas surrounding the Don River since the early 1990s (see De Sousa 2003).

Chicago's Calumet District

The Calumet region on the far south side of Chicago is a classic example of a planning exercise that sees industrial and natural concerns as complementary. The area contains beaches, marshes, moraines, ponds, and slow-moving rivers (U.S. National Parks Service Midwest Region 1998). In the 1840s, railroads traversed the region and people started settling into the area. As shipping activity increased in the Great Lakes, industrialization and urbanization expanded in the Calumet area. Throughout the twentieth century, the steel industry was the main user of the land and shaper of the local culture. Inevitably, substantive quantities of wastes were deposited throughout the region. By the mid-1970s, the steel production industry in Calumet began to falter owing to a decline in steel use. The subsequent closing of mills in the area had a devastating effect on the local neighborhoods that supported them.

Alongside its industrial activities, the Calumet region has always retained, in part, a rich ecological and recreational character. Given its location in Chicago, the area has made for excellent hunting, fishing, and recreation for Chicagoans. Despite its industrial history, the region still possesses numerous natural areas: extensive prairie districts, dunes, and wetlands that provide a rich habitat for plants and wildlife, including many rare and endangered species. Calumet is also famous among birdwatchers because of the thousands of bird species that fly to the region during the spring and fall migrations (City of Chicago 2002; Darlow 2002). As the U.S. National Parks Service Midwest Region (1998) aptly put it, "Today, the Calumet region exists as a unique mosaic of globally rare natural communities and significant historic features in juxtaposition with heavy industry."

Renewal of the area has been the target of extensive debate and study since the 1970s (City of Chicago 2002). As in Milwaukee, a grant from the EPA helped initial efforts research and plan a sustainable future for the area. Of these plans, the *Calumet Area Land Use Plan and Calumet Open Space Reserve Plan* (December 2001) proposed by the City of Chicago received the most attention. This plan focuses on a five-thousand-acre section of the Lake Calumet bioregion that covers the city's south side. (In 1996, the National Parks Service initiated the Calumet Ecological Planning Study to examine the entire Calumet region for potential addition to the National Parks System. The study area encompasses portions of Porter and Lake counties in Indiana in addition to the area within Illinois.)

The objectives of the plan are as follows:

- To improve the quality of life in the Calumet area and the surrounding communities by creating greater economic opportunities and enhancing environmental quality
- To retain and enhance existing businesses and industries within the Calumet area
- To attract new industrial and business interests
- To create new job opportunities
- To protect and revitalize wetland and natural areas within the Calumet area and improve habitat for rare and endangered species.

Of the five-thousand-acre planning area, one thousand acres of largely former manufacturing brownfield sites have been set aside for industrial redevelopment. Such redevelopment will be supported through financial incentives from tax increment financing and from projects designed to upgrade the transportation infrastructure of the area. The remaining four thousand acres will be used largely as greenspace, habitat, and so-called reclaimed space (greenspace on land that was used formerly for waste disposal).

One of the plan's initial projects foresees linking greenspace with industrial and neighborhood renewal on the former South Works Steel Mill site. In its heyday, more than twenty thousand people worked at the 573-acre lakefront site located at the mouth of the Calumet River. The mill began shutting down operations in phases in the 1970s and closed completely in 1992. The owner, USX Corporation of Pittsburgh, voluntarily completed cleanup at the site in 1997 to meet residential standards. Planning started in 1999, with the main partners being the City of Chicago, the Chicago Park District, the Department of Transportation, USX, and various private developers. The plan envisions a lakefront park that will connect it to the system of open spaces, parks, and civic spaces along the Chicago waterfront. Extensive habitat improvements will be made to the mouth of the Calumet River, and active recreation facilities will be constructed in the northern portion of the site. At the same time, residential development and an industrial waterfront will be created on which modern manufacturing sites, warehouses, and offices will be constructed. Although costs are still being determined, the plan is anticipated to follow in the footsteps of other successful efforts to renew Chicago's waterfront.

Implications

The industrial brownfield districts described here are examples of emerging planning success stories in a postindustrial world. The brownfields of these districts are unique in that they present similar barriers and opportunities to planning for a humane metropolis. Once sought after for their resources and transportation linkages, the legacy of heavy industrial use on these lands has left deep scars in the landscape. The very contaminated soil and groundwater spoil that characterize these districts are extremely costly to remediate compared with other kinds of brownfield lands. In most of the cases, the costs must come primarily from the public purse because prior landowners either no longer exist or are bankrupt. The outdated buildings and infrastructure that have kept new businesses away for decades require costly removal or significant upgrading. Politically, efforts to plan a viable future for these sites have often been mired in jurisdictional clashes and in contrasting viewpoints on the part of numerous interested parties. And, on the environmentalist side, these districts have often been perceived to be barren wastelands that are beyond recovery, making it difficult to get funding for greening purposes.

The three case studies examined here, however, show that such barriers can be overcome. These examples constitute opportunities for turning wastelands into success stories. Above all else, they present contexts for partnership alliances that can be forged among the many disparate interest groups that make up the sociopolitical arena. Businesspeople, governmental agencies, community groups, landowners, and environmentalists are now starting to understand that renewal of such prime districts can only come about through a sharing of the burdens of redevelopment. In addition, from such brownfield redevelopment successes as those reported here there is a growing feeling among planners that the partnership model has broader applicability. The districts described are now becoming exemplars for redevelopment of brownfield districts on a larger scale.

Greening in particular is being perceived more and more as a way to restore such sites to what they were before industry polluted them. Unlike projects that aim to develop small brownfield sites on their own, as autonomous redevelopment schemes, the case studies reported here show that it is much more preferable to integrate such sites into a framework for redevelopment of the entire district that encompasses them. In this way, a multitude of economic, social, and environmental renewal objectives can be achieved simultaneously.

It has become clear that greening and brownfield redevelopment are two sides of the same coin in any effort to humanize the metropolis. Nowhere has it become more apparent than in the revitalization of industrial brownfield districts such as those in Milwaukee, Toronto, and Chicago. Along with comparable redevelopment projects in North America and Europe, they are particularly useful as models for helping cities develop appropriate renewal schemes for their previously designated industrial sites. In a postindustrial society, the individualistic approach to renewal is, simply put, not the way to go. Partnership among previously conflicting groups is the path to building the humane metropolis.

Note

1. Information for this section was obtained from a review of planning documents published by the cities of Milwaukee, Toronto, and Chicago and from site visits. The districts examined have been the target of extensive planning and some preliminary redevelopment and greening activity. For each district, information on a specific redevelopment/greening project was obtained through a survey questionnaire. Rather than provide an in-depth data analysis, the purposes here are to assess the potential effects of the three case study districts and derive implications from them in a more general way.

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Ecological Citizenship

The Democratic Promise of Restoration

Andrew Light

The writings of William H. Whyte do not loom large in the literature of my field: environmental ethics, the branch of ethics devoted to consideration of whether and how there are moral reasons for protecting nonhuman animals and the larger natural environment. Environmental ethics is a very new field of inquiry, only found in academic philosophy departments since the early 1970s. Although there is no accepted reading list of indispensable literature in environmental ethics, certainly any attempt to create such a list would begin with Henry David Thoreau, John Muir, Aldo Leopold, Rachel Carson, and a more recent handful of senior scholars who had been writing on these topics early on, such as J. Baird Callicott, Val Plumwood, Peter Singer, Richard Sylvan, Tom Regan, and Holmes Rolston III (for a review of contemporary environmental ethics, see Wenz 2001; Light 2002; and Palmer 2003).

Environmental ethics aims to be an interdisciplinary endeavor. As such, the required reading list in this field should be more open than the traditional philosophical canon, inclusive of those environmental thinkers who either were not philosophers or whose philosophical status is a matter of some dispute. Such a claim is evidenced by the short list just recited: included there are figures like Leopold who, while trained as a professional forester, arguably wrote one of the most important foundational works for environmental ethicists, the penultimate chapter of his autobiographical *A Sand County Almanac,* “The Land Ethic.” In thinking about the recent history of the development of this field of inquiry, however, the gaps in who is considered to be indispensable for those new to the field seem more important than who would be included.

Much of my own work in environmental ethics has been devoted to the claim that the field is failing as a discipline that has much to say about the actual resolution of environmental problems. A considerable amount of literature on environmental ethics is focused on questions of the abstract value of nature as it is found

This essay is a shortened and revised version of my “Restoring Ecological Citizenship” in *Democracy and the Claims of Nature,* ed. B. Minteer and B. P Taylor (Lanham, MD: Rowman and Littlefield, 2002), pp. 153–72. Consult the original version of this essay for the full prosecution of the argument presented here.

in its most pristine form, namely wilderness. Most of the contemporary philosophers listed above (excluding animal welfare advocates like Singer and Regan) have primarily focused their work on providing arguments for wilderness preservation, or at least on questions of natural resource conservation found outside of densely populated areas (see Light 2001). Rarely, if ever, do environmental ethicists discuss how to form better relationships between society and nature in human-dominated settings—namely cities or other urban communities—rather than simply considering the value of nature in the abstract. Surely the blindness to urban issues is arguably in part a reflection of the larger antiurban tendencies of the broader environmental community.

Thus, it is not surprising that the writings and ideas of William H. Whyte are conspicuously missing from the standard reading list of environmental ethics. If they were, then their inclusion would suggest that environmental ethicists pay attention to an entirely different set of questions than those that most of the senior scholars in the field are concerned with. The same applies to Lewis Mumford, Jane Jacobs, and other nonphilosophers who raise important ethical questions about the human habitat and the design of urban space.

I am convinced that Whyte should be on the reading list of every environmental philosopher, regardless of the focus of his or her work. There are many reasons, but perhaps most important is that Whyte was concerned more with the "nature," or, rather, the open spaces, that most of us will encounter in our daily lives—the strips of land here and there near our homes—than with the great wilderness areas that most people will never see. He did not have this focus out of mere predilection but because he knew that these smaller bits of land—"tremendous trifles" as he put it—were in the end more important to the everyday lives of people than the spaces farther afield. If Whyte is correct, and if environmental ethics as a discipline is concerned with our possible moral responsibilities to the land around us, then paying attention to Whyte's work could help redirect the geographical focus of environmental ethicists to a field of inquiry more relevant to the interests of most people.

Although Whyte was not an ecologist, his reasons for this focus are entirely consistent with a sound human ecology of how people should live in relation to the broader natural environment. Whyte was a preeminent champion of the importance of density as the only sane future for land use policy in America. He worked hard to try to show how density was better for us, and the land around us, and how it could be improved to make it more attractive as an alternative to the growing sprawl that he documented so well and countered in *The Last Landscape* (Whyte 1968). None of that was to argue that wilderness preservation, conservation of species biodiversity, or the like were not important environmental priorities, but rather to raise awareness that just as important is our relationship to one another as it is mediated by the nature closer to home.

Such concerns led Whyte to focus as much on the perception of open space as the physicality of it or, as he put it, two kinds of reality: "One is the physical open space; the other is open space as it is used and perceived by people. Of the two, the latter is the more important—it is, after all, the payoff of open-space actions" (Whyte 1968, 165). For Whyte, the brook by the side of the road was just as important, if not more important, than the grand plans for regional parks. This focus speaks to a fundamental insight by Whyte that most philosophers working in environmental ethics have forgotten or indeed never paid heed to at all: *that our relationship to nature is ultimately shaped locally.* It is therefore in our immediate backyards—streets, parks, stream banks, and remnants of woods, prairie, or desert—that we must demonstrate the importance of natural amenities to people if we ever hope to show them the importance of larger environmental questions. Eventually, there should be compatibility between the two; the local environment that comes to be cared for and loved by its neighbors becomes a reason for concern with larger scales of ecological phenomena. In our quest to articulate the value of nature itself, absent its modification by humans, however, philosophers at least have forgotten that the natural spaces that we do in fact inhabit make up the "last landscape" of most immediate importance.

Such intuitions have driven my work toward those environmental practices that tend to encourage a kind of stewardship or, more precisely, "ecological citizenship" between people and the land around them. Much of this work has focused on restoration ecology as one practice that can help reconnect people to the land. Regrettably, other environmental ethicists have decried restoration as "faking nature" (Elliot 1997) that either has no place in an ethical form of conservation or at best is secondary to larger schemes of preservation. Yet in restoration I have seen what Whyte saw in the tremendous trifles that he called our attention to so well.

In this light, I will first offer a brief explanation of what restoration ecology is, its importance, and the ethical dimensions of its practice. Next, the arguments for public participation in restoration will be reviewed. Then, one possible model for framing this participation—ecological citizenship—will be proposed. Finally, some relevant public policy implications will be identified. Although the original formulation of these ideas did not rely on a reading of Holly Whyte, I now see it as a consistent extension of important themes in his work. I do not think that this influence is accidental, but rather proof of the continuing influence of Whyte on the community of scholars, activists, and policy makers who have shaped the environmental context out of which this work has been produced.

Ethics and Restoration Ecology

Restoration ecology is the practice of restoring damaged ecosystems, mostly those that have been disturbed by humans. Such projects can range from small-scale urban park reclamations, such as the ongoing restorations in Central Park and Prospect Park in New York City, to huge wetland mitigation projects as in the Florida Everglades. Restoration ecology is becoming a major environmental priority, in terms of number of voluntary person-hours devoted to it and amount of dollars committed to it by public and private sponsors. For example, the cluster of restorations coordinated by the regional network, "Chicago Wilderness," in the forest preserves surrounding Chicago (discussed more below), attracted thousands of volunteers to help restore more than seventeen thousand acres of native oak savannah (Stevens 1995; Gobster and Hull 2000). The final plan for the Chicago Wilderness program is to restore upwards of one hundred thousand acres. In the same region, the City of Chicago is committing an estimated $30 million to restoring selected wetlands within the industrial brownfield region at Lake Calumet on the city's south side (see the essay by Christopher A. De Sousa, this volume).

In Florida, various government agencies have spent hundreds of millions of dollars on returning the Kissimmee River to its earlier meandering path (Toth 1993). Work on the Kissimmee and other watersheds in Florida has revealed that even more extensive restoration is needed to fully address the threats caused by channelization to water reserves, endangered species, and the Everglades ecosystem. A plan submitted by the Clinton administration and approved by Congress in 1999 appropriated $7.8 billion of funding over the next twenty years to restoring the Everglades, making it one of the largest pieces of environmental legislation in U.S. history (Wald 1999).

Ecological restorations can be produced in a variety of ways. Although the Chicago restorations have involved a high degree of public participation, others have not. Partly, the differences in these various projects have been a result of their differing scale and complexity. Dechannelizing the Kissimmee River is a task for the Army Corps of Engineers (which, after all, channelized it in the first place) and not a local community group. Many restorations that could conceivably involve community participation, however, often enough do not, and some that already involve community participation do not use that participation as much as they could.

The alternative to community participation is to hire a private firm or use a government service to complete the restoration. One need only scan the back pages of a journal such as *Ecological Restoration* (formerly *Restoration and Management Notes,* one of the main journals in the field) to see the many landscape design firms and other businesses offering restoration services.

One important question is, Which method should be used to conduct a restoration project where options are available: volunteers or professional contractors? The answer depends in part on what we hope to achieve in any particular restoration. Most restorations are justified in terms of increasing the ecosystemic health of a landscape or restoring a particular ecosystem service or function. In such a case, most people will argue that the ends should justify the means: we should use the most efficient scientific means to achieve a desired end, namely a professional firm or a government agency specializing in such work.

Such an approach, though, assumes that the only relevant criteria for what counts as a good restoration are scientific, technological, design, and economic factors. *There is also an important moral dimension to a good restoration, namely the degree of public participation involved in such projects* (Light and Higgs 1996; Light 2000c). This view argues that there are unique values at stake in any restoration that can be achieved only through some degree of public participation in a project, for example, the potential of restorations to help nurture a sense of stewardship or care between humans and the nature around them. Such social or moral values to the community augment the other values of restoring the ecological condition of a site per se.

To achieve these moral values, a good restoration should maximize the degree of hands-on public participation appropriate for a project, taking into consideration its scale and complexity. Ideally, volunteers should be engaged in all aspects of a project, including planning, clearing, planting, and maintenance. This public participation does not mean that expertise should be abandoned in restorations; it just means that whenever possible, restorations are better when experts help guide voluntary restorationists. Based on such arguments, I have claimed that the practice of restoration ecology is as much about restoring the human relationship with nature as it is about restoring natural processes themselves. Not to attempt to achieve both of these ends in restorations is to lose the potential moral benefits of restoration.

What kind of participation is best for a restoration? I suggest that a democratic model of participation, which I call "ecological citizenship," is the best model for achieving the full potential of restoration in moral and political terms. How we shape practices and policies involving restoration is a critical test for how deep a commitment to encouraging democratic values we have in publicly accessible environmental practices. Before explaining this point, though, let us consider the simpler participatory benefits of restoration.

Restoration and Democratic Participation

Several arguments have been put forward for the importance of democratic participation in environmental decision making. According to Sagoff (1988), access to environmental amenities should be understood in the United States at least as a right of citizenship rather than only as a good to be consumed. Public participation in the formation of environmental policy was given perhaps its strongest empirical defense in Adolf Gundersen's study (1995) demonstrating the positive environmental consequences of democratic decision making. Contrary to many expectations, Gundersen argued that opening environmental decisions to the public does not necessarily weaken those decisions and in many ways may make them stronger. More recently, other philosophers and political theorists have made specific proposals for democratic environmental reforms, such as environmental constitutional rights, environmental trusteeship, and methods for expanding environmental justice (see the essays in Light and de-Shalit 2003).

All these scholars—let us call them "democratic environmental theorists"—rely on a set of common premises. The first is that environmental ethicists and political theorists must accept the democratic context of environmental decision making in which we in the developed world (and largely in international institutions) find ourselves. There is no room among these scholars to consider Malthusian arguments that would force some form of "green totalitarianism" on people. Second, these theorists all assume that it would be better to go further and actively endorse and expand the democratic context of environmental decision making because in the end it will provide the basis not only for better forms of environmental protection but also better human communities as well, helping bring people together in stronger social networks.

Following from the first premise, it is proposed that only a democratic environmentalism can actually achieve long-term sustainability. Such a position conflicts with most approaches in environmental ethics by considering the traditional ways that humans value nature (e.g., aesthetic value, resource value, or the value of protecting the environment for future generations) in contrast with the view that nature only has moral status if it has some form of noninstrumental or intrinsic value. Something is said to have intrinsic value when it is valuable in and of itself without reference to its value for other ends. To attribute such intrinsic value to nature resembles classical ethical arguments for why humans are the kinds of beings to which we owe moral obligations. For example, Immanuel Kant (1785) famously argued that humans possess special properties such that we should never reduce them solely to the value they have to us to help achieve our own ends. We should try to respect all persons as an end unto themselves and so should grant them at least some minimal level of moral respect.

Most environmental ethicists postulate a similar value for nature, namely to esteem nonhuman species and ecosystems regardless of their instrumental or economic value solely to humans. Such a view resists appeals only to human interests as a basis for valuing some bit of nature, in part because such arguments cannot guarantee that nature will be protected against competing claims for a human interest in exploiting or developing nature.

One problem, however, is that such views may degenerate into the complacent assumption that compliance with a moral principle will follow if the principle can be shown to be theoretically justified. If traditional environmental ethicists can provide the rationale for the intrinsic value of nature, then it is assumed that people will eventually act accordingly and come to respect nature in a moral sense. Yet there are precious few good reasons to accept such a view. Just because a moral reason can be offered, and even defended as true, does not guarantee that it will be followed. The more important question is, What sorts of reasons would morally motivate someone to change his or her behavior for the betterment of nature? This question requires going beyond abstract discussions of the value of nature to consider instead, for example, which practices might encourage an embrace of the importance of the long-term sustainability of the environment. Another way of putting the same point would be to ask, What practices make people better stewards of the environment?

Encouraging a direct participatory relationship between local human communities and the "nature" around them is one way to elicit such a sense of stewardship. Communities that have a participatory relationship with the land around them are less likely to allow it to be harmed, in contrast with "top-down" regulations or mandates from a higher authority that may be ignored or opposed locally (see Curtin 1999 for some examples). Noting that three-quarters of the American people live in metropolitan areas, urban ecologist Steward T. A. Pickett (2003, 67) puts it this way: "If the public bases its understanding of ecological processes on its local environment, then extracting ecological knowledge from urban systems has the best chance of enhancing ecological understanding worldwide."

Restorations performed by volunteers arguably tend to foster these kinds of relationships. For instance, a study of 306 volunteers in the Chicago restoration projects reported that the respondents were most satisfied with a sense of meaningful action ("making life better for coming generations" or "feeling that they were doing the right thing") and fascination with nature ("learn how nature works") (Miles, Sullivan, and Kuo 2000, 222). Listed third behind those values was participation (e.g., helping people feel they were "part of a community" or "accomplishing something in a group"). This study also found that length of experience in restoration activities was not a significant factor in whether people gained such perspectives: Although the length of involvement of the 306 respondents ranged from two months to twenty-seven years, "the benefits an individual derived from restoration were the same whether the individual was a relatively recent recruit or an 'old hand' " (Miles, Sullivan, and Kuo 2000, 223).

This study and others (see, e.g., those in Gobster and Hull 2000) indicate that participation in restorations has the potential for promoting strengthened attitudes toward long-term sustainability through appeal to human interests and thus may produce better connections between people and nature in places closer to home. In the context of the views of the democratic environmental theorists, however, there is more work that could be done here. Restorations clearly have the potential for producing good environmental stewards who feel a close personal connection to the land that they have come to care for. But what about a more ambitious notion of participation than that implied by "stewardship"? Does participation in restoration provide a foundation for something like "ecological citizenship" as well? This question may seem odd because the distinction between stewardship and citizenship may be unclear. The point, though, is actually more simple. Stewardship describes a kind of relationship between people and the land around them, but the Chicago restorationists also indicated that they were involved in a form of participation with one another as much as they were involved in meaningful participation with nature. If one of the goals of a democratic environmental theory is to not only work within the confines of our democratic institutions but also use environmental protection or restoration as a justification for strengthening those institutions, then one question would be, Can we expand the notion of participation in restoration and other environmental practices to consider it as part of the duties we might have to one another as members of a community? In short, can we understand such participation as a kind of civic obligation as well?

Ecological Citizenship

The goal of encouraging public participation in restorations has been previously characterized as representing a new and more expansive "culture of nature" (Light 2000a). Beyond producing a bond of interest between local communities and the nature around them, restorations also stimulate the development of moral norms more supportive of environmental sustainability in general. If restoration helps to produce such a culture of nature, though, what kind of culture will that be? Twentieth-century fascists arguably had a strong cultural attachment to nature that justified some of their most extreme and antidemocratic practices. A preferable culture context for our relationship with nature would be a democratic culture, meaning that the practices that would serve as a foundation for that culture should also be democratic. Ideally, participants in such a culture should see themselves as ecological citizens working simultaneously to restore nature and restore the participatory and strong democratic elements of their local communities.

What, though, is ecological citizenship? At first blush, it involves some set of moral and political rights and responsibilities among humans as well as between humans and nature. Although I do not have the space here to fully flesh out the appropriate contrasts, on this view, roughly, one's duties to nature ought not be isolated from one's duties to the larger human community. The goal of ecological citizenship would then minimally be to allow as many members of a community as possible to pursue their own private interests while also tempering these pursuits with attention to the environment around them. A strengthened relationship with nature promoted in this way would then entail the development of specific moral, and possibly legal, responsibilities or expectations that all of us be held responsible for the nature around our community and respect the environmental connections between communities.

Notions of citizenship in general, however, have a long history of philosophical and political debate and disagreement. Which understanding of citizenship would be best for infusing it with a set of environmental responsibilities as well? Although space prohibits a full explanation of the view, one useful understanding of citizenship for this discussion is along what is known as "classical republican" lines (not the political party), which identify a range of obligations that people have to one another for the sake of the larger community in which they live (see, for example, Pettit 1997). Thus, a duty of citizenship on this view is not satisfied merely by something like voting, and it is not exhausted by describing citizenship only as a legal category that one is either born into or to which one becomes naturalized. Instead, it is something that we might call an "ethical citizenship," or a concept of "citizenship as vocation," whereby being a good citizen is conceived as a virtue met by active participation at some level of public affairs. As the political theorist Richard Dagger puts it, what sets apart the "good citizen" on this view is that he or she does not "regard politics as a nuisance to be avoided or a spectacle to be witnessed" (Dagger 2000, 28).

The good citizen is someone who actively participates in public affairs, someone who generates "social capital" by active engagement with fellow citizens on issues of importance. Dagger and others are quick to admit that such an expanded sense of citizenship has been in steady decline throughout the history of the Western democracies. Citizenship is something that most of us today see as only a guarantor of certain rights but not as demanding responsibilities of us, other than leaving one another alone. Yet the language of citizenship still resonates widely in our culture as a way of talking about the moral responsibilities that people should have toward one another in a community. Defining what it means to be a "good citizen" is something that influential pundits outside the academy care about. Thus, using the language of citizenship to describe our relationship to one another and to the natural world could be a way of making discussion of such relationships more important to the broader public.

To add an environmental dimension to this expanded idea of citizenship would be to claim that the larger community to which the ethical citizen has obligations is inclusive of the local natural environment as well as other people. That is not to say that all legal citizens of a community would be required to become environmental advocates or ecological citizens in this way, but, rather, that embracing the ecological dimensions of citizenship would be one way of fulfilling one's larger obligations of this thicker conception of citizenship. In the same way, some people in our communities already join local parent-teacher associations as a way of fulfilling what they understand to be their personal and civic duties. Along these lines, contemporary republican theorists such as Dagger have already written much that helps us conceive of this kind of citizenship as inclusive of environmental concerns. Using the example of urban sprawl, Dagger (2003) argues that ethical citizens would have a good reason to fight sprawl because it threatens both the environmental and the civic fabric of a city. A sprawled city, as Whyte certainly appreciated, will only exacerbate the demise of civic associations that connect people to one another in networks of moral and political obligation.

If Dagger and others are right, then an expanded notion of citizenship is incomplete without an ecological dimension. And, if the point of ethical citizenship is to encourage people to take on responsibilities for one another in communities, then these responsibilities can be expanded to include environmental dimensions as well. If we look at things this way, then the volunteer restorationists in Chicago were acting as good ecological citizens in their participation in this set of projects. If those restoration projects were conducted only by contractors and did not involve public participation, then an opportunity to foster such ecological citizenship would have been lost. When people participate in a volunteer restoration, they are doing something good for their community both by helping deliver an ecosystem service and also by helping pull together the civic fabric of their home.

Another good example is New York City's Bronx River Alliance, a project of the City of New York Parks and Recreation Department and the nonprofit City Parks Foundation. The alliance is organized by a few city employees who coordinate sixty volunteer community groups, schools, and businesses in restoration projects along the twenty-three miles of the Bronx River. The focus is not only on the environmental priorities of the area; it is also on the opportunities to create concrete links between the communities along the river by giving them a common project on which to focus their civic priorities. Literature from the alliance says that the purpose of the project is to "Restore the Bronx River to a Healthy Community, Ecological, Economic and Recreational Resource." The alliance, like the Chicago restorations, is thus both civic and environmental, and the geographic scale of the environmental resource, crossing several political lines, helps create a common interest between them. Again, the project makes the environment the civic glue between various communities. (See Thalya Parrilla's essay in this volume.)

We must recognize, however, that the Bronx River Alliance did not emerge merely out of civic goodwill; it was formed by the City Parks Department in an attempt to follow other successful models such as the Central Park Conservancy, which has dramatically improved the ecological viability of Central Park while expanding citizen involvement in the maintenance of the park. The alliance was encouraged by the Parks Department leadership partly in response to funding shortages, which would have made it impossible to allocate sufficient public resources to restore the Bronx River without the work of the volunteers. But if we were to see public participation in such projects as an opportunity to restore, first, some bit of nature, second, the human relationship to that bit of nature, and third, the cohesiveness of the community itself, then creating the alliance would not be seen as a last resort under the conditions of budget shortfalls. Instead, it would be seen as the first choice for maximizing the various natural, moral, and social values embodied in this particular site. If we took the idea of encouraging ecological citizenship seriously, then we would want to create opportunities for people to engage in voluntary alliances of restoration (or other community environmental projects) even when we had public funding to instead pay parks workers or a landscape design firm to do the job for us.

The democratic participation of citizens in restoration projects is about building a democratic culture of nature or, more simply, a stronger human community that not only takes into account, but is actively inclusive of, concerns over the health, maintenance, and sustainability of larger natural systems. Such concerns will be important for the goal of encouraging the evolution of a more responsible citizenry overall, given the role such healthy environments play in making human communities themselves sustainable.

Recommendations

This discussion leads to two general recommendations for restoration based on the citizenship model. First, the expanded notion of ethical and ecological citizenship involves a robust notion of participation as direct democratic participation. Mere participation in an environmental project by allowing community input on an environmental decision is not enough, but it should be accompanied on this model by the creation of opportunities for people to actively engage in these projects on the ground. Such a framework is more likely to create a relationship between people and nature beyond mere stewardship, inclusive of seeing care for nature as a way of being a good citizen in their communities. Other hands-on environmental practices, such as community gardening, may also yield social values of citizenship equivalent to those of restoration (Light 2000a).

Second, along the lines of the citizenship model, the rights and obligations of people in an environmental community should be institutionalized. When something is designated as a right or responsibility under any understanding of citizenship, then it is eventually given legal status. If participation in democratic decision making is a right attached to citizenship, then we must have laws to ensure that citizens will be able to exercise their right to vote.

In the same way, if we took the idea of ecological citizenship seriously, then laws should be encouraged that mandate local participation in publicly funded restoration projects whenever possible. Because restorations become opportunities for forming bonds of citizenship they therefore take on the mantle of a state interest. The Bronx River example suggests the value of institutionalizing alliances between citizens and government. Another approach would be to mandate that democratically organized local citizen groups have a "right of first refusal" to participate in government-funded restoration programs. Thus, a restoration project request for proposals might stipulate that priority for license of the project will be given to voluntary organizations, subject to expert guidance. This requirement would resemble contracting provisions relating to local, minority, or women-owned contracting firms in government-funded housing projects. These regulations not only create local jobs, but also are intended to build local interest in such projects.

If government does not promote partnerships such as the Bronx River Alliance, then environmentalists should encourage such participation themselves. For instance, the Chicago Wilderness has involved the leadership of The Nature Conservancy, which has purchased land for restoration as well as coordinated volunteer restorationists on public lands. Likewise, the Field Museum in Chicago has donated office space for the coordination of these projects.

Larger restorations such as the multibillion-dollar project by the Army Corps of Engineers to restore the Florida Everglades may be too unwieldy for significant voluntary efforts, at least in terms of hands-on public participation. Smaller-scale restorations, such as the Chicago projects and Bronx River restorations, are ideal for this purpose, however. Although some environmental organizations favor larger, "wilderness"-oriented projects of preservation or restoration over such smaller-scale urban projects (Light 2001), we must, again following Whyte, narrow our geographic focus to consider the benefits of less flamboyant, smaller-scale initiatives in cities. More important, we must take from Whyte's earlier observations that the push toward more democratic participation in such projects will better serve the long-term interests of sustainability, conceived not as a narrow environmental goal, but as a more complete project that better connects local citizens with their local surroundings.

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