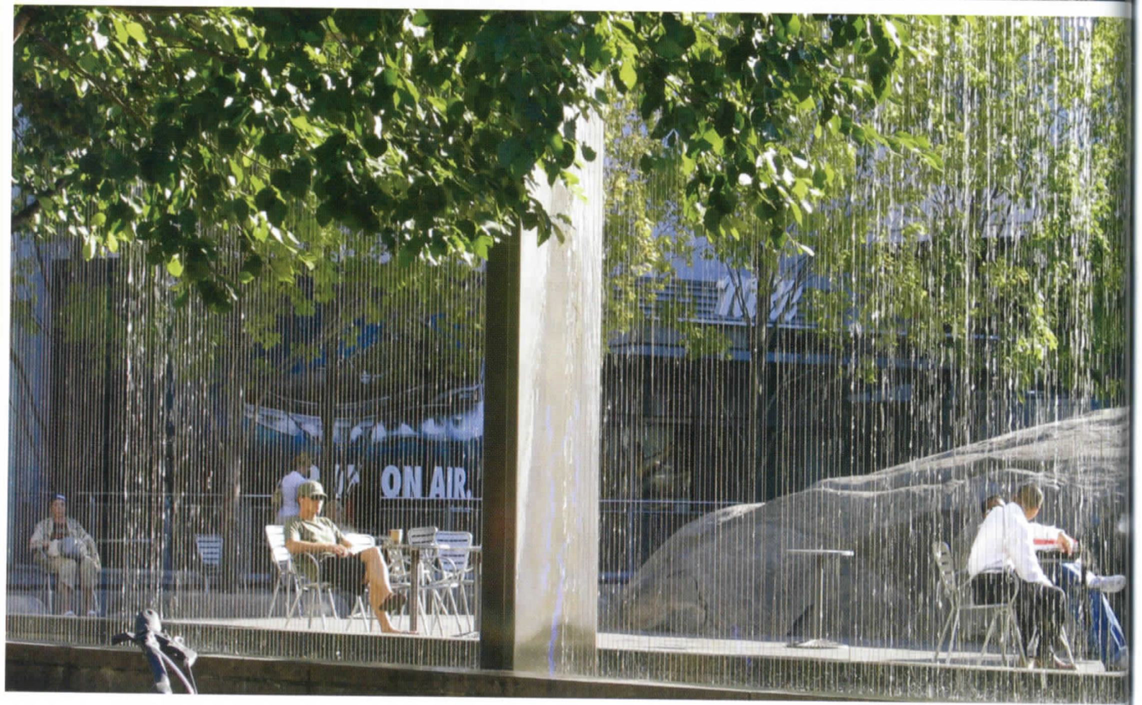


FIGS. 1, 2: Yorkville Park, Toronto, designer ecology, 2006.

SUSTAINABLE LARGE PARKS: ECOLOGICAL DESIGN OR DESIGNER ECOLOGY?

NINA-MARIE LISTER

Large parks are complex systems, and as such, parks with an area in excess of 500 acres within contemporary metropolitan regions warrant special consideration and study.[1] In particular, large parks pose specific challenges for long-term sustainability in terms of design, planning, management, and maintenance, principally due to their actual and potential biodiversity coupled with the complexity inherent in their ecology and program. Indeed, "largeness" is a singularly important criterion that demands a different approach to design, planning, management, and maintenance—one that explicitly provides the capacity for resilience in the face of long-term adaptation to change, and thus for ecological, cultural, and economic viability. This chapter explores such an approach to design as a response to issues of complexity and sustainability in the context of "large."

In parks of smaller area in urbanizing landscapes, ecological structures and functions are often significantly altered through habitat fragmentation, reduction and simplification, partial restoration, or even complete re-creation. Such areas usually require intensive management to maintain the ecology in place. Although ecological considerations do play into the design (and its contingent planning and management activities) in smaller parks, I suggest that this is *designer ecology*—an ecology that is vital, indeed essential, for educational, aesthetic, spiritual, and other reasons. Yet this is largely a symbolic gesture provided by such parks' designers to recall or represent nature in some capacity (see, for example, Toronto's Yorkville Park, FIGS. 1, 2). Designer ecology, while valid and desirable in urban contexts for many reasons, is not operational ecology; it does not program, facilitate, or ultimately permit the emergence and evolution of self-organizing, resilient ecological systems—a basic requirement for long-term sustainability.[2]

We ought to appreciate the role of designer ecology in small parks for the reasons stated above, as well as for punctuating and accentuating human agency in landscape. From an operational ecological perspective, however, smaller parks cannot reasonably be self-sustaining, nor thus resilient ecosystems, unless they are functionally connected through robust landscape linkages to other similar areas. Smaller parks typically have simpler programs that are less likely to conflict with ecological goals of conservation and protection. Although smaller parks may have any number of interested stakeholders, design, planning, and management processes continue largely to rely on traditional approaches using discipline-based teams of experts; they are predicated on certainty and control—two characteristics not associated with complex ecological systems.

But large parks are a different matter. Their size, coupled with a diversity and complexity of ecology and program, poses unique challenges for design and specific opportunities for sustainability. For example, they may contain a variety of habitats, some at odds in terms of natural evolution: fast-flowing streams that support trout spawning may eventually become stagnant warm-water ponds if beaver are allowed to do their work. The trout will die out while the beaver flourish. Which is the "correct" state for such a park? If sustainability is the goal, both are valid, but not at once. Design of large parks with conflicting habitats and uses calls for a long-term, bird's-eye view of the whole system, usually by a multidisciplinary team of stakeholders and designers working in collaboration, rather than domination by expertise. Specifically, these parks demand an approach I have generalized as *adaptive ecological design*. Long-term sustainability demands the capacity for resilience—the ability to recover from disturbance, to accommodate change, and to function in a state of health—and therefore, for adaptation.[3] This emerging approach, with some reference to the ecological science on which it is based, is postulated as a response to sustainability for large parks.

Adaptive ecological design is, by definition, sustainable design: long-term survival demands adaptability, which is predicated on resilience. But the discussion of sustainability must not be limited to merely "surviving" in an ecological context. Indeed, one might argue that resilient, adaptive, and thus sustainable ecological design is a fitting metaphor for "thriving," and therefore must include economic health and cultural vitality—two characteristics reflected in contemporary large parks.[4] For example, in contemporary urban areas, escalating land costs coupled with decreasing availability of suitable sites render new parks a costly (and less likely) endeavor. Widespread shrinking of public resources is echoed by demands for public parks to be revenue-generating, thus park planners are under increasing pressure to demonstrate long-term viability and therefore economic sustainability of parks.[5] Compounding these limitations is the demographic reality of the contemporary global city: large parks must be designed for more and different uses by a greater range of users. Thus large parks must be designed for both ecological and programmatic complexity, for both biological and sociocultural diversity, and, accordingly, for all facets of sustainability. Adaptive ecological design is a strategy that moves us toward this goal.

Over the past two decades, there has been a gradual but fundamental shift in the way we understand ecosystems (and thus landscapes) in terms of their structure and function. The perception of ecosystems as closed, hierarchical, stable, and deterministic structures functioning according to a linear model of development has been replaced by the recognition that living systems are open, complex, self-organizing, and subject to sudden but regular periods of dynamic change that are, to some degree, unpredictable.[6]

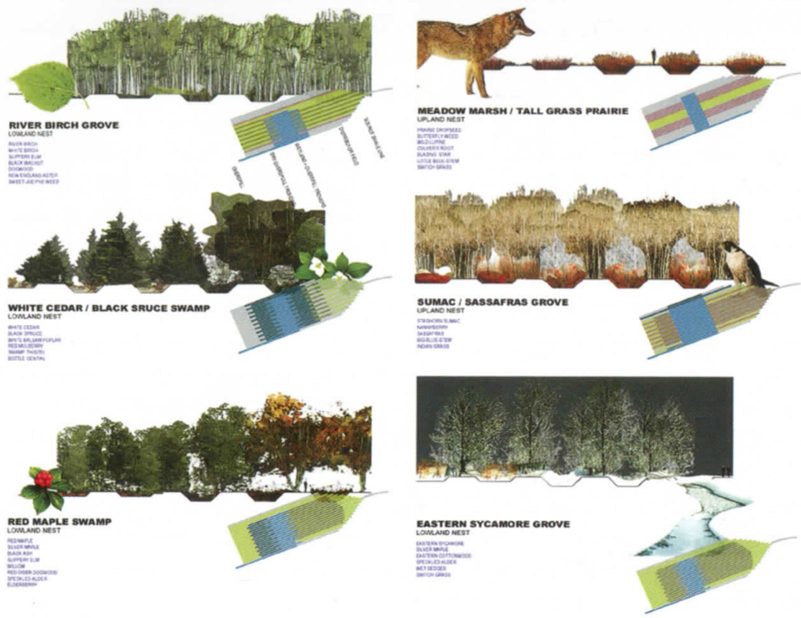


FIG. 3: James Corner + Stan Allen et al., "Emergent Ecologies," Downsview Park, Toronto, diagrams of habitat nests.

The implications of this change in understanding have been variously considered for the planning, design, and management of natural areas and more recently for urban ecosystems.[7]

How might an adaptive, systems-based, ecological design approach be applied to urban and urbanizing ecosystems, or cultural-natural landscapes that characterize this confluence? Despite an emerging discourse in the theory of adaptive management and related literatures—the ecosystem approach,[8] ecosystem health,[9] designed experiments,[10] collaborative environmental planning,[11] etc.—there are few tangible projects. One early prototype of adaptive design in the context of large parks was the design competition held in 2000 for Downsview Park in Toronto. The brief specifically called for an interpretation of ecology consistent with an adaptive, self-organizing, open system, and at least four of the five finalist teams responded with designs that were crafted using language and program resonant with this condition.[12] "Emergent Ecologies," proposed by a team led by James Corner and Stan Allen, depicted an explicitly adaptive plan, which included "seeded evolution" of various habitat "nests," placed in a circuit of both organizational and programmatic ecologies (FIGS. 3, 4). Corner went on to further develop this idea with his team's winning entry for Fresh Kills Park in New York.[13] Yet progress has been slow outside of major design competitions; there has been little substantive exploration of adaptive design, in practice or in empirically supported theory.

work of Laurie Olin, or in Ian McHarg's Staten Island study, for example; it is therefore considered a surrogate model for sustainability.[16] In this sense, ecological design has been associated with "modeling nature"; but this comes with the risk of ecological myopia, in that too much emphasis on strict replication of nature's processes leaves little room for creative synthesis of cultural and natural elements of complex ecologies. Yet there is a far richer interpretation of ecological design, wherein nature is an analog for design, and through such inspired design, a metaphor for human learning. This implies room for a more creative design practice allowing for synthesis with human culture, aesthetics, and ingenuity. And this is critical, reflective space when considering large urban parks.

Outside of several major park design competitions (Downsview, Fresh Kills, and most recently, Orange County), ecological design is principally concerned with the realistic emulation of ecological form, function, and, where possible, process. As an outgrowth of (and to some degree, a fusion between) landscape architecture, ecology, environmental planning, and the building-science aspects of architecture, there is a distinctive functional emphasis in the discipline.[17] Ironically, aesthetics has not been a priority in a discipline that bears the label of "design"; until recently, landscape architecture has been more concerned with applied ecology for reactive remediation—a phenomenon well documented by Corner.[18] The traditional practice of landscape architecture, along with related environmental technologist professions concerned with ecological restoration, have been the progenitors of the new discipline of ecological design, largely as a response to global environmental crises. This is evident in the works of McHarg, Michael Hough, John Tillman Lyle, and others who emphasize that good design should follow the dictates of nature's form and process, often at the expense of creativity and originality.[19] As adaptive ecological design evolves, and as its practitioners seek to define their disciplinary roles, several are beginning to argue fervently for a new creative space for the practice, calling for reconciliation of falsely polarized aspects of art and science, culture and nature.[20]

Despite significant new understandings in ecology over the past twenty years, the field is still largely characterized by a deep schism. As a discipline, the science of ecology is still in polarity: divided between reductionist and holistic perspectives, largely at the expense of a nondualist, integrative systems perspective. This polarity exists in practice and in theory, and is well substantiated in the ecological literature (e.g., the conflict between species and population-scale studies and whole-system studies such as ecosystem energetics).[21] Still, the dominant interpretation and application of modern ecological science is reductionist: decision makers routinely invoke science-based "environmental management," founded on the notion that nature can be counted, measured, and taken apart, a mechanical entity not unlike Newton's outdated notion of the clockwork universe. By extension, conventional wisdom says that nature can to some degree be predicted and

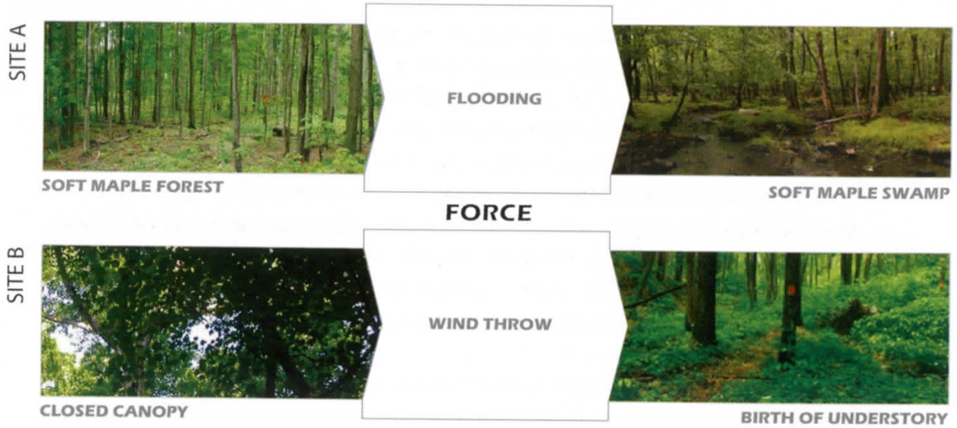
controlled, and therefore ultimately managed. But what of more recent insights in systems ecology? What have these to do with design?

Ecological Design is Adaptive Design

Until recently, most ecologists believed that ecosystems follow a linear path of development toward a particular biologically diverse and stable "climax" state. Within the past twenty years, however, research has shown this view to be incomplete.[22] Although ecosystems do generally develop from simple to more complex states, they evolve along any of many possible paths, or even flip suddenly into entirely new states. Ecosystems are self-organizing, open, holistic, cyclic, and dynamic systems, marked by often sudden, unpredictable change. Diversity, complexity, and uncertainty are normal.

It has long been assumed that there is an inherent "balance" or stability in nature, which biological diversity helps to maintain. But this notion of stability is hard to defend in scientific terms. Merely defining what is meant by "stability" is difficult, as living systems experience many fluctuations, such as in weather, populations, and biomass. More recent ecological ideas, based in part on complex systems science, provide a revised perspective of living systems, in which the idea of a single "stable" state is replaced with that of a "shifting steady-state mosaic."[23] In a forest, for example, there are different patches or stands, each of which is a different age. Each patch will grow to maturity, and then fire, windstorm, pest outbreak, or some other disturbance will cause the trees in the patch to die, and growth to start again. Which pieces are at which age changes with time. The patchwork mosaic is shifting constantly over the landscape, even though the landscape remains a forest.[24]

Thus ecosystems have multiple possible operating states and may shift or diverge suddenly from any one of them. In a closed soft maple swamp within a wetland community, for example, changing flows of water can radically alter this state. Extended drought could force a relatively rapid evolution to an upland forest community or grassland. If, in contrast, extended periods of flooding cause high water levels, it would likely become a marsh ecosystem. Red maple (*Acer rubrum*) and silver maple (*Acer sacharrum*) will tolerate floods lasting as long as 30–40 percent of the growing season. Left longer than this, the trees will die, giving way to more water-tolerant herbaceous marsh vegetation.[25] The feedback mechanism that maintains the swamp state is evapotranspiration (i.e., water pumping) by the trees. Too much water overwhelms the pumping capability of the trees, and not enough shuts it down. The current state of the ecosystem is therefore a function of its physical environment coupled with the accidents of its history and the uniqueness of its local context (FIG. 5). Each of these ecosystem states is as ecologically healthy and appropriate as the others, and perhaps more important from a design, planning, or management perspective, there is no single "correct" community for this landscape. This mutability poses both challenges and opportunities for park planners and designers, who have been trained to "choose"



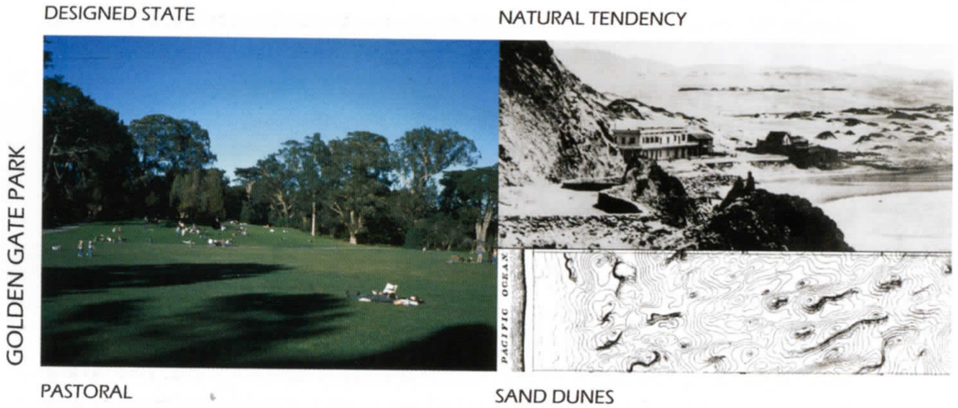


FIG. 5: Ecosystem state change in two sites (top).
FIG. 6: Designed state versus natural tendency (bottom).

a future and design for it, with an implicit expectation of permanence. The pressing question is: How should designers respond to this challenge? One strategy may be to anticipate several possible future states, based on the local system history and the social narratives that support it, and to design alternative scenarios that take place temporally as well as spatially. For example, in an ecosystem where localized flooding is a seasonal but not precisely predictable occurrence, park designs can accommodate several ephemeral habitats that appear and disappear based on fluctuating water levels, with minimal management intervention. Indeed, designers might readily embrace the challenges and opportunities posed by the paradox of dynamism: a dance between ephemerality and permanence.

An appreciation of this paradox is important because ecosystems may flip into a new state relatively suddenly. Such flips, properly called bifurcations, have been identified in the Great Lakes, where the dominant ecosystem moves from one characterized by bottom-dwelling (or benthic) species to a deep-water, fish-dominated (or pelagic) state quite quickly, and without warning.[26] Change in an ecosystem as a result of natural catastrophe, such as fire, pest outbreak, or other perturbation, is a normal and usually cyclic event, although it is typically considered catastrophic, even tragic.[27] Consider the forest fires that ravaged Yellowstone National Park, or the windstorms that recently decimated Halifax's Point Pleasant Park or, more famously, Paris's Bois de Boulogne: none of these parks were designed to withstand, let alone accommodate and adapt to, such violent and sudden change. Certainly most large urban parks are characterized by ecological states that are artificially maintained to some degree, in that they require significant inputs (economically and ecologically) to remain in an apparently stable state. Such parks are rarely designed to accommodate either short-term disturbance or long-term, cyclic ecosystem change. In the New World in particular, many of the most prominent and iconic urban parks were designed to emulate Old World landscapes, complete with an introduced ecology that, while comforting and familiar to the colonists, was often functionally at odds with and potentially devastating to native ecosystems. A characteristic example of this phenomenon is Sydney's Centennial Parklands, a system of three large parks covering 890 acres, situated between the city core and the eastern beachfront suburbs. Created as a public open space in 1888 to celebrate Australian Federation, the park was clearly intended to introduce an ecology resonant with the British tradition of grand, formal parks, despite the site's once-dominant but now endangered native *Banksia Scrub* ecology consisting of sand dunes interspersed with coastal swamps.[28] Yet despite this ecological discrepancy, the public perception remains that the area was "transformed from a bleak and sandy area" into the crown jewel of Sydney's greenspace.[29] Similarly, Golden Gate Park in San Francisco is another example of designed ecology that has become problematic and costly to maintain—at least from the perspective of sustainability (fig. 6). While the park is renown for its pastoral landscape of verdant meadows, botanic gardens, arboretum, and lush forests, the dominant ecosystem and native ecology to which much of the park's 1,017 acres would naturally tend is a coastal dune ecosystem. The park is widely appreciated for its deliberate arcadian topography and the variety of habitats and features it incorporates, yet there is a growing awareness of the cost and risks associated with maintaining the created landscape. Still, the public perception is that the park transformed "barren dunes into a forested parkland."[30] In future designs for these and related parks, more emphasis could be placed on ensuring a diversity of plant communities and habitats, with the important inclusion of those that are naturally adapted to normal but cyclic perturbations, including flooding, fire, and wind. Indeed, adaptive (rather than suppressive) strategies are increasingly implemented in parks where seasonal floods or fires are normal, and in some cases necessary, to maintain particular ecosystem types. For example, in Toronto's High Park, annual small-scale controlled burns are undertaken to maintain the oak savannah and prairie ecosystem, deemed culturally significant and ecologically unique to the region.

The ability of ecosystems to recover, reorganize, and adapt in the face of regular change, rather than stability, is critical to their survival. The essence of this primordial ability is resilience. Biological diversity is vital to ecosystems as the basis of resilience, and of the ability of an ecosystem to buffer itself from being pushed into another (potentially less desirable) state, and to regenerate itself following a systemic shift or other disturbance. Biodiversity could be considered analogous to a library of information (some recorded long ago, and some only now being written) that provides not only a wide range of possible pathways for the future development of life but also learned repertoires for responding to environmental change and disturbance.[31]

C. S. Holling's dynamic cycle of ecosystem development is a foundation of the systems view of ecology, which considers ecological organisms and their relationships at multiple scales in time and space (FIG. 7).[32] (Studies include, for example, analyses of ecosystem energetics or the energy flows between trophic levels in a food web.) Living systems evolve discontinuously and intermittently. Following a sudden disturbance, an ecosystem reorganizes to "renew" itself or regenerate to a similar or perhaps different state—one that may be more or less desirable to the humans that inhabit it. Immediately after a disturbance, biodiversity at many scales is critical: the abundance, distribution, and diversity of an ecosystem's structures (e.g., species) and functions (e.g., nutrient cycling) determine its ability to regenerate and reorganize itself, and influence its future pathway.[33] Biodiversity is vital to the normal, healthy functioning of ecosystems because the information it contains and the functions it serves constitute the key elements that determine how an ecosystem will self-organize. In effect, biodiversity forms the palette of future possibilities for an ecosystem.[34]

Most design, planning, and management in an environmental context is based on the assumption that more knowledge leads to certainty, and therefore

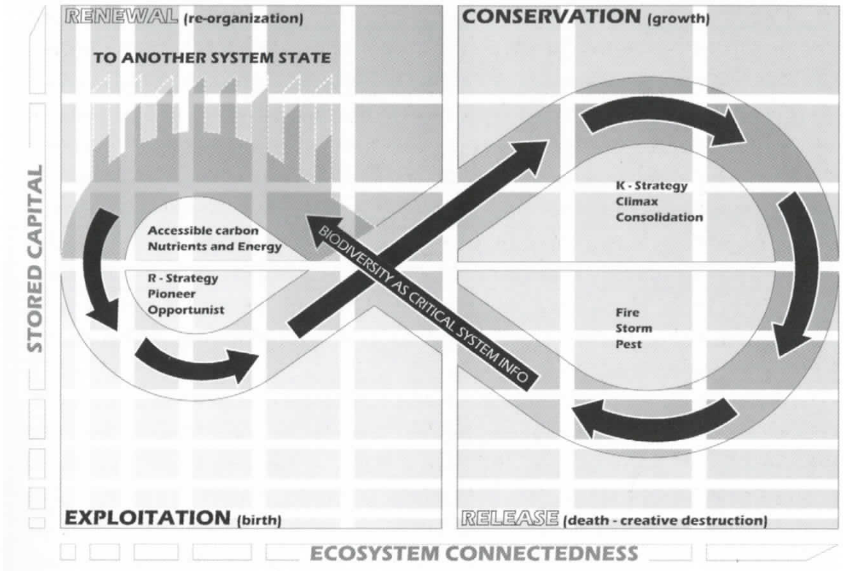


FIG. 7: Ecosystem dynamics: C.S. Holling's modified figure eight.

predictability and the success of the design or plan. Although this is resoundingly true in certain deterministic science and engineering applications, it is not the case with complex living systems. We cannot predict how ecosystems will evolve, change, and behave because they are complex systems that are inherently unpredictable. Of course this does not mean we should fall into the trap of postmodern nihilism and give up trying to design, plan, and manage; rather, we must accept and embrace change as a normal part of life and, through our designs and plans, adapt to it in a more flexible and responsive manner.[35]

This recent view of ecosystems, and of nature more generally, as open, self-organizing, holistic, dynamic, complex, and uncertain has significant implications for ecological design and other applications in planning and management.[36] We can never determine with precision the consequences of our actions. The current and widely accepted concept of "environmental management" is an oxymoron, because we can never truly "manage" living systems. Instead, we can refocus our energies on those human activities that provide the context for the self-organizing processes in ecosystems. This implies a profound change in environmental decision making and has concomitant implications for design, planning, and management of ecosystems in general and large parks in particular.

If uncertainty and regular change are inevitable, then we must learn to be flexible and adaptable. Although there is a steadily growing literature on what has been called "adaptive management," there is little empirical and functional understanding of what this means in practice.[37] Given the importance of multiple perspectives at various ecosystem scales (essentially a systems approach), one of the first steps toward flexible, adaptive, and responsive design, planning, or management is to use a diversity of approaches.[38] In general, this means emphasizing small-scale and explicitly experimental approaches that are safe-to-fail, rather than fail-safe.[39] Because ecosystems may change in any number of ways, there may be an infinite number of possibilities for design (and ultimately, management). "Good" ecological design requires a diversity of tools, techniques, and methods. Learning becomes a central goal, leading ideally to continual improvement in design, planning, and management—to long-term adaptation (FIG. 8).

Thus, in developing best practices for ecological design we might consider demonstration projects that emphasize "learning by doing"[40] and "designed experiments."[41] For example, the Huron Park, a medium-sized (325 acres) community cooperative project in Waterloo, Ontario, approved a master plan explicitly designed to accommodate native and non-native species in various and naturally conflicting ecological scenarios, some of which would inevitably disappear, being out-competed by others for nutrients or perhaps management resources.[42] Such projects should be small enough that if they are not successful, they can fail safely, without endangering an entire community, ecosystem, watershed, or habitat. "Failures" or mistakes may provide experiences that can be used in the future. In this way, the "surprising" nature of ecosystems can be turned into a learning opportunity rather than a liability. As Kai Lee observes, "experiments often bring surprises, but if resource management is recognized to be inherently uncertain, the surprises become opportunities to learn rather than failures to predict."[43] I am not aware, however, of any parks planning or management branch that is paid to fail. In the pursuit of accountability, our public agencies consider mistakes or perceived failure a reason to cease funding and remove those in charge—managers and designers who take with them any record of learning, leaving the organization likely to repeat design mistakes rather than learn from them.[44]

Of course good ecological design, such as that required for the long-term sustainability of large parks, must be rooted in rigorous empirically testable science, some appropriately reductionist; it must draw continuously on new knowledge in biology and ecology, among other related disciplines. But adaptive, resilient, and responsive design must also proceed on a broader scale, linked to experience as well as research. Learning through experimentation and action also requires local knowledge for context, as well as field-trained specialists with a range of expertise and research. Fundamentally, adaptive design demands a stronger connection between knowledge and action. "Learning by doing" implies profound changes to our tradition of design, planning, and management, especially in the context of parks. It is still widely assumed that with enough research and knowledge,

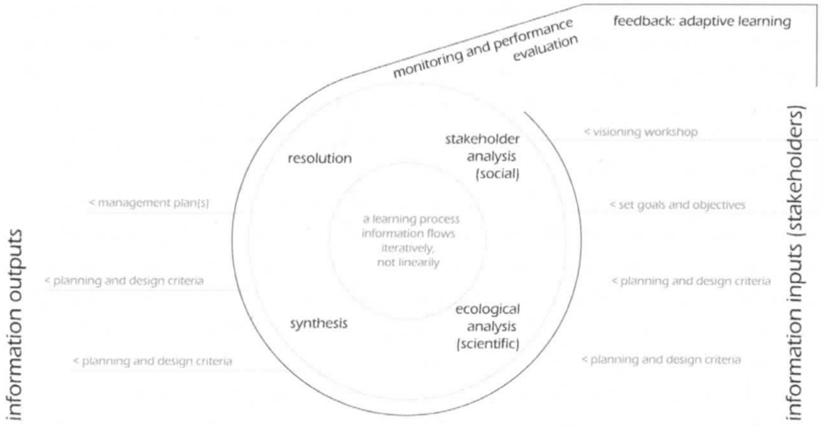


FIG. 8: Adaptive design: a learning process.

ecological systems will somehow be "well-behaved," and that outcomes can be predicted and ultimately controlled. But this is not how the real world works. Adaptation, responsiveness, and flexibility are essential traits, and humans must relearn to live within nature, and perhaps, through design, to reinterpret our relationship with it. If we wish to manage our interactions within nature, we must learn to look to multiple perspectives through a diversity of voices and values, at different scales and in different contexts.[45] To do so in the context of large parks would necessitate meaningful engagement of varied constituents and would force a dramatic reconsideration of parks' values, functions, programs, and ultimately form.

Yet rather than including a diversity of expertise, voices, and professions on our design teams, we tend to favor design and planning processes that are top-down, rigid, homogeneous, and static. The more speculative international design competitions, such as Downsview and Fresh Kills, encourage strongly interdisciplinary teams of artists, scientists, writers, and designers, but the same cannot be said of routine design practice and management structures.

Ecological design, despite the dramatic paradigm shift in ecology, continues to emulate an ecologically deterministic model of nature. As the self-professed "father of ecological design," Ian McHarg defined ecological determinism.[46] His *Design With Nature* was not a suggestion but an imperative, a command to follow the lay of the land in each design. This mandate could be viewed in the broader context of adaptive, resilient, flexible, and responsive design, although his interpretation of ecological "fitness" for good design meant that the correct (truthful) reading of the landscape would necessarily prescribe appropriate design, where form and function are indivisible. His imperative has rarely been interpreted as a call for more open, diverse, or flexible planning and design processes, nor does it typically bring forth a diversity of perspectives, voices, or professions participating on design teams. We can appreciate and understand McHarg's deterministic approach in the context of the 1960s, when science was perceived as a global panacea. But environmental planners should not continue to follow the imperative without some critical reflection on what this means today. The tangled implications of ecosystem complexity, uncertainty, and diversity are significant; these phenomena characterize the dual contexts of large parks and the contemporary urbanizing landscapes—many of which are being reinvented with entirely new ecologies. Well-intentioned but uncritical acceptance of environmental platitudes leaves little room for creative interpretation in the face of ongoing change—and even less for meaningful, adaptive, and responsive design for long-term sustainability of the parks we struggle to make and maintain.

Ecological Design for Engaged Learning

So how do we cope with dynamic change in our urbanizing landscapes and the large parks within these ecosystems? How can we design adaptively, responsive to context and the uniqueness of local conditions, some of which are abused, derelict, or otherwise fundamentally altered, and now far from "natural"? If we can no longer follow McHarg's ecological imperative, certain that "nature will show the way," there must be a new role for humans as creative agents in the process of unfolding, as interpreters of change, as designers once again. As a process of discovery, design implies intentional shaping, manipulation, and (re)creation. In the urban ecological context, it also means recovery of something that has been lost—if not the precise forms of ecologies past, then an attachment to landscape, to nature's rhythms, to place. This process must necessarily be creative and engaging of local people, collaborating in a learning journey based on continual adaptation. Such a process of ecological design might yet move us toward the reconciliation of Dale's imperatives for sustainability.[47]

Sustainability is of course about making choices, in light of necessary limits to growth and a compelling need for equity. As an integral component of sustainability, ecological design incorporates aspects of science and art, culture and nature. Ecological realities should be largely determined through scientific inquiry and learned experience, but in a complex world this knowledge illuminates not "solutions" but choices and trade-offs; decisions are guided by human social choice, by our values. Yet very often in the context of park making in contemporary global cities, there is conflict over these values. Indeed, the sometimes painful process of identifying, revealing, and acknowledging differences in values is essential to achieving a workable design solution. What programs to foster at the expense of others? Which species to protect

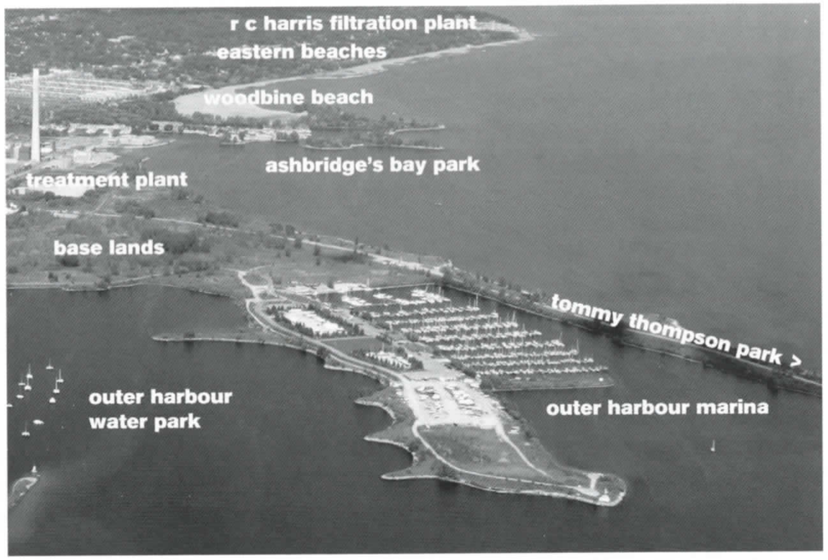


FIG. 9: Lake Ontario Park, Toronto, aerial photo of the eastern end of the site (top).

FIG. 10: Double-crested cormorant colony in defoliated trees on western peninsula of Tommy Thompson Park, adjacent to Lake Ontario Park (bottom).

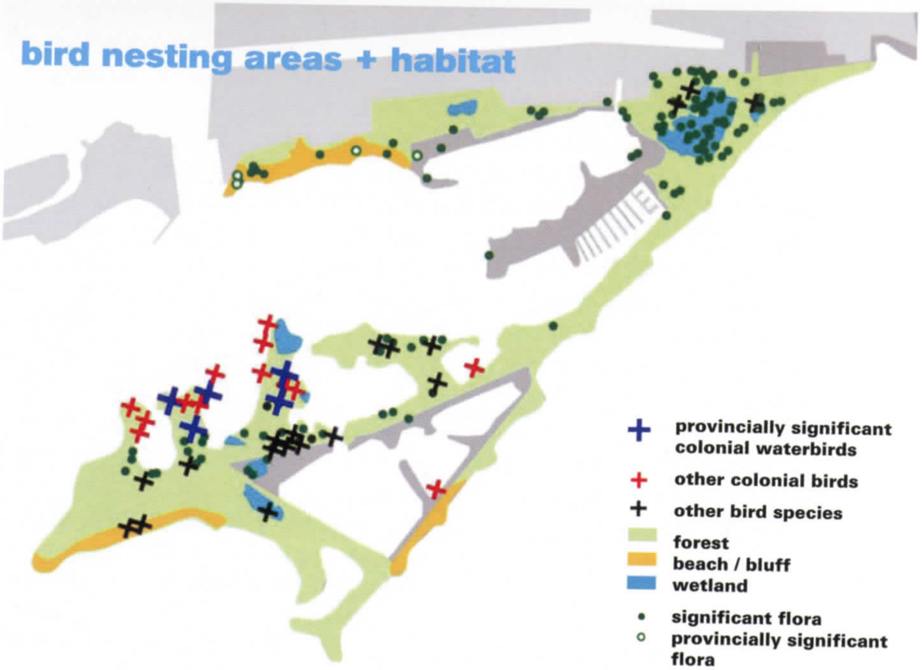


FIG. 11: James Corner/Field Operations et al., western end of Lake Ontario Park, Toronto, preliminary site study drawing of bird habitat.

and which to sacrifice? But without the fundamental acknowledgment of difference there can be no respect for diversity, either cultural or ecological, and no reconciliation of Dale's imperatives. And this puts us, as designers, some distance from embracing sustainability.

Yet much of institutionalized planning—the basis for a considerable portion of architectural and landscape design—is still rooted in the science-based deterministic tradition. Ecological science is an essential tool, but when employed without contextual knowledge or social values, science is an insufficient basis for park design. Science-driven bureaucratic approaches nonetheless abound in large parks management and in the implementation of designs and master plans. (Indeed this approach characterizes the National Parks systems in North America.) Planning and design function as top-down, expert-driven, rational activities, relying on management through control. Yet in its social, cultural, economic, and political dimensions, the "nature" of our large parks has very much to do with socially constructed landscape values, and this must be reflected in the design, planning, and management of our parks. Local people should collectively decide which of the many possible futures they want, attainable through choices, trade-offs, trial and error, learning by doing, and flexible management. The designer's role in such a process becomes one of wise facilitator.

Design processes can be potent agents of change. In becoming more open, flexible, and receptive to a diversity of perspectives, and adaptive and responsive to local conditions, they are potentially powerful vehicles for shared, experiential learning by their participants. In several design exercises that have involved a diversity of professions, a range of experts, and meaningful collaboration with local people, I have seen indicators of transformative change among the design team and community members alike. For example, in community meetings leading to Toronto's 925-acre waterfront Lake Ontario Park, bird enthusiasts have fought bitterly with environmentalists who want wind turbines; ecological restorationists want non-native cormorant colonies culled, while others see them as rightful occupants of the park; dog owners, rollerbladers, and joggers have opposed the closing of trails to protect rare plants or breeding birds, while nudists have demanded more clothing-optional beaches. These and other seemingly irreconcilable differences have sometimes been resolved, but more often, simply voiced, heard, understood, and eventually appreciated through facilitated dialog. The public agency overseeing park planning has run a three-year campaign of citizen engagement: public meetings, community workshops, and finally, with the master planning team, design charrettes. Given the complexity of this and other large urban parks, consensus is rarely possible, but compromise is likely. By holding a series of design charrettes in which community members work closely with the design team, social and ecological choices and consequences are articulated, visualized, and prioritized. In many cases, personal and collective changes have emerged from the shared learning experiences (FIGS. 9–11).

In a similar example, the Toronto-based environmental group Evergreen has collaborated with the city of Toronto and the local Conservation Authority to take over the management of a publicly owned industrial and natural heritage site in the center of the city and situated on the banks of the Don River. The Don Valley Brickworks is a 40.7-acre site containing a former brick-making plant, including fifteen heritage buildings and a public ravine and park. The site features a significant geologic formation within the old quarry (considered one of the five most important in North America), industrial buildings (kilns, brick presses, and railyard), and a series of constructed wetlands for stormwater management, habitat protection, and natural heritage enhancement, as well as wildflower meadows, hiking trails, nature interpretation, and a cultural events pavilion. The site is currently being programmed to offer a range of activities and services, from gardening workshops, heritage tours, clay-making, and organic food markets, to a retail nursery, demonstration gardens, and what Evergreen calls "leading-edge green design techniques." According to Geoff Cape, the executive director, the Brickworks is not a park in the traditional sense but a "unique and creative social enterprise that will model sustainability."[48] In 2005, supported through active and creative community partnerships (with some clearly visionary leadership), Evergreen launched their "Rethink Space" campaign to undertake a master plan, completed by Architects Alliance, in which the Brickworks is revealed as a center to connect "culture, nature and community" in the city—and thus manifests the mandate of this nonprofit organization (FIG. 12).[49] Although juxtaposing elements of wild nature with groomed gardens, and arts and cultural activities with the old industrial buildings, the Brickworks does not suffer from conflicting land use goals as one might expect. Rather, the site is engaging creative ecological design as a manifestation of both cultural and natural heritage within the urban context. Not unlike Peter Latz and Partner's Landschaftspark Duisberg-Nord in Germany, the Brickworks site moves the notion of "park" well past nature preservation and into the realm of a learning landscape, designed to teach sustainability by example. Although not a large park in size, the site nevertheless offers a rich palette for both ecological design and designer ecology—both essential strategies of sustainable place-making in the urban condition.

As these examples suggest, ecological design is a useful tool in the learning-based process of park making. In empowering a diversity of voices, values, and participants, this approach may also help to overcome the culture/nature dualism that is a fundamental barrier to sustainability in large parks. This is arguably a potent challenge in the urbanizing landscapes of North America, where layered values—social, ethno-cultural, economic, political, religious, and ecological—collide, split, fuse, and metamorphose. Ecological design holds the potential to navigate the interface of culture and nature in a way that has not yet been part of modern Western history. It may provide

FIG. 12: Evergreen Brickworks, Toronto, 2006.

the intellectual and psychological space to create entirely new, emergent, or hybridized cultural/natural ecologies.

The potential for ecological design to create viable large parks is significant: it lies in the explicit recognition of resilience and adaptation as critical system parameters, and through this, in its ability to elucidate and reconcile the social, ecological, and economic imperatives necessary for long-term sustainability. As a learning process that is adaptive, responsive, and inclusive, ecological design is more broadly insightful in rediscovering, reaffirming, recreating, and reconsidering our place in nature and within contemporary landscapes. The tapestry of the contemporary landscape is complex, woven from many threads, and we need large-scale, responsible ecological design, punctuated by pockets of inspired designer ecologies. The resulting hybrid ecologies of our large parks will likely be at once resonant and dissonant, familiar and unknown, anticipated and unimagined. The sustainable large park, and the landscape mosaic in which it lies, cannot be realized through dialectic argument but rather by creative dialog; it does not serve public space to struggle for either McHargian ecological determinism or postmodern relativism in park design. In learning our way to sustainable design, we must make brave choices. Our designs for large parks must reflect both ecological design and designer ecology, engaged in a relationship of complexity and diversity, and confident in their inevitable uncertainty. This is a key challenge for ecological design and to the successful design and long-term viability of large parks in the contemporary urbanizing landscapes in which we increasingly dwell.

NOTES

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1. "Complex systems" are interconnected networks of processes (or functions) and structures (or elements) whose behavior is generally described as nonlinear, unpredictable, dynamic, and adaptive, and is characterized by the regular emergence of new phenomena and the ability to self-organize. In ecological systems, "complexity" implies a balance between chaos and order within any living system; as such, living systems are said to thrive on the "edge of chaos" or, as Robert Ulanowicz has termed this, "the window of vitality" (conversation with the author, University of Waterloo, 1996); for example, the human body temperature has a very narrow band of optimum performance at 36° C; even a small change in temperature can put the body into a chaotic or disordered state.

2. "Sustainability" here means the inherent balance between social-cultural, economic, and ecological domains that is necessary for humankind's long-term surviving and thriving on the earth. Ann Dale, in *At the Edge: Sustainable Development in the Twenty-first Century* (Vancouver: UBC Press, 2001), has eloquently referred to this balance as a necessary act of "reconciliation" between personal, economic, and ecological imperatives that underlie the primordial natural and cultural capitals on the earth. With this definition, Dale has set the responsibility for sustainability squarely in the domain of human activity, and appropriately removed it from the ultimately impossible realm of managing "the environment" as an object separate from humans—the latter is the conventional implication of "sustainable development." In this chapter, I use the term "management" in the context of Dale's definition of sustainability; that is, in the context of managing human activities within the environment, rather than the environment as object.

3. "Resilience" is used here in the ecological context, as a term developed by the Canadian ecologist C. S. (Buzz) Holling at the University of British Columbia in the mid-1980s. In the general ecological sense, resilience refers to the ability of an ecosystem to withstand and absorb to some degree the effects of change, and following these change events, return to a recognizable steady state (or states). These change events (which Holling has referred to in the vernacular as "surprises"), while usually normal ecosystem dynamics, are also unpredictable, in that they cause sudden disruption to a system: for example, forest fires, floods, pest outbreaks, etc. More specifically, resilience can also mean the rate at which an ecosystem returns to a single steady or routinely cyclic state following a sudden change. The ability of the system to withstand sudden change assumes that behavior of a system remains within the stable domain that contains this steady state in the first place. However, when an ecosystem shifts from one stability domain to another (called "reorganization" via a "bifurcation" or "flip" in system states), a more specific measure of ecosystem dynamics is needed: that of "ecological resilience," which in this context is a measure of the amount of change or disruption that is required to move a system from one state to another, and thus, to a different state being maintained by a different set of functions and structures than the former. Holling's work in resilience has been instrumental to ecosystem managers and ecologists alike in exploring the paradoxes inherent within living systems—the tensions between stability and perturbation, constancy and change, predictability and unpredictability—and the implications of these for management. For a summary account of Holling's work on resilience, see Lance Gunderson and C. S. Holling, eds., *Panarchy: Understanding Transformations in Human and Natural Systems* (Washington, D.C.: Island Press, 2002).

4. See also Julia Czerniak, "Legibility and Resilience," in this volume.

5. See also John Beardsley, "Conflict and Erosion: The Contemporary Public Life of Large Parks," in this volume.

6. See, for example, C. S. Holling, "The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change," in William Clark and R. Ted Munn, eds., *Sustainable Development of the Biosphere* (Cambridge: Cambridge University Press, 1986), 292–320; Gunderson and Holling, eds., *Panarchy*; and David Waltner-Toews, James Kay, and Nina-Marie Lister, eds., *The Ecosystem Approach: Complexity, Uncertainty, and Managing for Sustainability* (New York: Columbia University Press, in press).

7. For the former, see Gary K. Meffe, et al., *Ecosystem Management: Adaptive Community-Based Conservation* (Washington, D.C.: Island Press, 2002); for the latter, see Alexander Felson and Steward T.A. Pickett, "Designed Experiments: New Approaches to Studying Urban Ecosystems," *Frontiers in Ecology and the Environment* 3, no. 10 (2005): 549–56.

8. Waltner-Toews et al., eds., *The Ecosystem Approach.*

9. Ibid.

10. Felson and Pickett, "Designed Experiments."
11. John Randolph, *Environmental Land Use Planning and Management* (Washington, D.C.: Island Press, 2004).
12. Discussed in detail by Julia Czerniak, ed., *Downsview Park Toronto* (Munich and Cambridge, MA: Prestel and the Harvard University Graduate School of Design, 2002).
13. See Linda Pollak, "Matrix Landscape: Construction of Identity in the Large Park," and Czerniak, "Legibility and Resilience," both in this volume.
14. Sim Van der Ryn and Stuart Cowan, *Ecological Design* (Washington, D.C.: Island Press, 1996), 201.
15. Dale, *At the Edge.*
16. See for example Janine Benyus, *Biomimicry: Innovation Inspired by Nature* (New York: William Morrow, 1997), 308; and Ian McHarg and Fritz Steiner, eds., *To Heal the Earth: The Selected Writings of Ian McHarg* (Washington, D.C.: Island Press, 1998), 381.
17. See, for example, Timothy Beatley, *Green Urbanism: Learning from European Cities* (Washington, D.C.: Island Press, 2000), 491; William B. Honachefsky, *Ecologically Based Municipal Land Use Planning* (New York: Lewis, 1999), 256; Frederick Steiner, *The Living Landscape: An Ecological Approach to Landscape Planning* (New York: McGraw-Hill, 1991), 356; and Fred Stitt, ed., *Ecological Design Handbook: Sustainable Strategies for Architecture, Landscape Architecture, Interior Design, and Planning* (New York: McGraw-Hill, 1999), 467.
18. James Corner, "Ecology and Landscape as Agents of Creativity," in George Thompson and Frederick Steiner, eds., *Ecological Design and Planning* (New York: Wiley, 1997), 81–108, and James Corner, "Recovering Landscape as a Critical Cultural Practice," in James Corner, ed., *Recovering Landscape: Essays in Contemporary Landscape Architecture* (New York: Princeton Architectural Press, 1999), 287.
19. See Ian McHarg, *Design with Nature* (Garden City, NY: Natural History Press, 1969), 198; Michael Hough, *Cities and Natural Processes* (New York: Routledge, 1995); and John Tillman Lyle, *Design for Human Ecosystems: Landscape, Land Use, and Natural Resources* (Washington, D.C.: Island Press, 1999), 279.
20. See, for example, Louise Mozingo, "The Aesthetics of Ecological Design: Seeing Science as Culture," *Landscape Journal* 16, no. 1 (1997): 46–59; Corner, "Ecology and Landscape as Agents of Creativity" and "Recovering Landscape as a Critical Cultural Practice"; Charles Mann, "Three Trees," *Harvard Design Magazine* 10 (2000): 31–35; and more recently, Mohsen Mostafavi and Ciro Najle, eds., *Landscape Urbanism: A Manual for the Machinic Landscape* (London: Architectural Association, 2003), and Charles Waldheim, ed., *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006).
21. Explored in detail in Nina-Marie Lister, "A Systems Approach to Biodiversity Conservation Planning," *Environmental Monitoring and Assessment* 49, no. 2/3 (1998): 123–55.
22. See, for example, Holling, "The Resilience of Terrestrial Ecosystems"; Carl Walters, *Adaptive Management of Renewable Resources* (New York: Macmillan, 1986); C. S. Holling, David Schindler, Brian Walker, and Jonathan Roughgarden, "Biodiversity in the Functioning of Ecosystems: An Ecological Primer and Synthesis," in Charles Perrings et al., eds., *Biodiversity Loss* (Cambridge, MA: Cambridge University Press, 1995), 44–83; James Kay, "A Non-equilibrium Thermodynamic Framework for Discussing Ecosystem Integrity," *Environmental Management* 15, no. 4 (1991): 483–95; and James Kay and Eric Schneider, "Embracing Complexity: The Challenge of the Ecosystem Approach," *Alternatives Journal* 20, no. 3 (1994): 32–38.
23. Holling, "The Resilience of Terrestrial Ecosystems"; and Walters, *Adaptive Management.*
24. Frederick H. Bormann and Gene E. Likens, *Patterns and Process in a Forested Ecosystem* (Berlin: Springer-Verlag, 1979).
25. Nina-Marie Lister and James Kay, "Celebrating Diversity: Adaptive Planning and Biodiversity Conservation," in S. Bocking, ed., *Biodiversity in Canada: Ecology, Ideas, and Action* (Toronto: Broadview Press, 2000), 189–218.
26. James Kay, Henry Regier, Michelle Boyle, and George Francis, "An Ecosystem Approach for Sustainability: Addressing the Challenge of Complexity," *Futures* 31 (1999): 721–42.
27. Holling, "The Resilience of Terrestrial Ecosystems."
28. Prior to European contact, much of the eastern Sydney peninsula was vegetated with Eastern Suburbs Banskia Scrub species (ESBS), which are primarily comprised of various banksias, heath-type shrubs, grasses, and sedges, typically found on older, deep sandy soils in the eastern suburbs of Sydney, southward to Botany Bay. Today less than one percent of the original ESBS survives in isolated remnants, including four identified remnants within the Centennial Parklands—all of which have been modified over time by the introduction of non-native trees and grasses. The ESBS ecology has been formally listed as an Endangered Ecological Community in Australia. See Centennial Parklands, http://www.cp.nsw.gov.au/data/assets/pdf_file/718/remnant_bushland.pdf (accessed Oct. 13, 2006).
29. "Centennial Park," travelpromote.com.au, http://discoversydney.com.au/parks/centennial.html (accessed Oct. 13, 2006).
30. Nick Wirz, "Golden Gate Park," Project for Public Spaces, http://www.pps.org/great_public_spaces/one?public_place_id=74 (accessed Oct. 13, 2006).
31. Lister, "A Systems Approach to Biodiversity Conservation Planning."
32. Holling, "The Resilience of Terrestrial Ecosystems."
33. Holling et al., "Biodiversity in the Functioning of Ecosystems."
34. Lister, "A Systems Approach to Biodiversity Conservation Planning"; and Waltner-Toews et al., eds., *The Ecosystem Approach.*
35. Kay and Schnieder, "Embracing Complexity"; Lister and Kay, "Celebrating Diversity."
36. See, for example, Bruce Mitchell, ed., *Resource and Environmental Management in Canada*, 4th ed. (Toronto: Oxford University Press, 2004); Waltner-Toews et al., eds., *The Ecosystem Approach.*
37. See, for example, Gunderson and Holling, eds., *Panarchy*; Holling, "The Resilience of Terrestrial Ecosystems"; Carl Walters and C. S. Holling, "Large-Scale Management Experiments and Learning by Doing," *Ecology* 71, no. 6, (1990): 2060–68; Kai Lee, *Compass and Gyroscope: Integrating Science and Politics for the Environment* (Washington, D.C.: Island Press,1993), 243; Meffe et al., *Ecosystem Management*; Walters, *Adaptive Management*; Waltner-Toews et al., eds., *The Ecosystem Approach.*
38. R. Edward Grumbine, "Reflections on 'What Is Ecosystem Management?'" *Conservation Biology* 11, no. 1 (1997): 41–47; Carl Folke, Thomas Hahn, Per Olsson, and Jon Norberg, "Adaptive Governance of Social-Ecological Systems," *Annual Review of Environment and Resources* 30 (2005): 441–73.
39. Lee, *Compass and Gyroscope*; Felson and Pickett, "Designed Experiments."
40. Lee, *Compass and Gyroscope.*
41. Felson and Pickett, "Designed Experiments."
42. Lister and Kay, "Celebrating Diversity."
43. Lee, *Compass and Gyroscope*, 56.
44. This phenomenon is well documented in business and organizational literature, for example, in Peter Senge's *Fifth Discipline: The Art and Practice of the Learning Organization* (New York: Doubleday, 1990), and is growing in the environmental management literature. See, for example, Francis Westley, "Governing Design: The Management of Social Systems and Ecosystems Management," in Lance Gunderson et al., eds., *Barriers and Bridges to the Renewal of Ecosystems and Institutions* (New York: Columbia University Press, 1995), 391–427.
45. Jim Woodhill and Niels G. Röling, "The Second Wing of the Eagle: The Human Dimension in Learning Our Way to More Sustainable Futures," in Niels G. Röling and M. A. E. Wagemaker, eds., *Facilitating Sustainable Agriculture: Participatory Learning and Adaptive Management in Times of Environmental Uncertainty* (Cambridge: Cambridge University Press, 1998), 47–71.
46. McHarg, *Design with Nature.*
47. Dale, *At the Edge.*
48. Geoff Cape, conversation with the author, 2006.
49. Evergreen, "Evergreen at the Brickworks: Final Master Plan," June 2006, http://www.evergreen.ca/en/brickworks/.