MANAGEMENT OF BIODIVERSITY IN A LANDSCAPE ECOLOGICAL PERSPECTIVE

Ph.D.course, Søminestationen, 5. - 10. September, 1999
Report and contributed papers
Landskabsøkologiske skrifter
Landscape Ecological Papers

8. Ikke udkommet.
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Conservation of biological diversity as landscape architecture

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6th to 10th September 1999

The Management of Biodiversity from a Landscape Ecological Perspective

Lecture notes & contribution to the
inhouse working paper, Landskabsøkologiske Skrifter

abstract
Most habitat protection efforts, before the coalescence of the emphasis in conservation of biological diversity a decade ago, emphasized acquisition of area over site quality and landscape processes. With the focus on conservation of biological diversity, in protected area planning and design, maintenance of habitat at a range of scales, for a full range of organisms and landscape processes, has become central to most programmes. As part of this shift in conservation priorities, landscape ecology principles and research frameworks have been recognized as increasingly key. The core of the management of biological diversity, from a landscape ecological perspective, is linking information on dynamic biogeographical, successional, and cultural processes to decision-making at various scales. Such process-oriented conservation and land use regulation are often less focused on relatively fixed and singular boundaries for protected areas that has been the preoccupation of habitat protection in the nineteenth and twentieth centuries. Established notions of national parks are being increasingly critiqued for relevance to conservation of biological diversity. Earlier park programmes are being augmented with a wider range of locally relevant modes of conservation interventions. A new form of landscape architecture is emerging that links and begins to integrate such disparate conservation measures as site planning, park allocation, boundary design, zoning inside and outside of units of protected habitat, management prescriptions, monitoring, legislation and enforcement, and community education — to name but a few categories. Out of such landscape ecology-based and district-level management frameworks can be constructed more functional and secure networks of protected areas, corridors, and programmes, at (bio)regional, national and international scales, for habitat conservation for preservation of ecosystems and species. Such a biodiversity conservation-oriented landscape architecture can lead to identification of a range of alternative strategies and regimens of measures, some of which could be more compatible with local priorities for social development and a wide range of ethics and values as well as aesthetics.

Biodiversity conservation as landscape architecture
It is through landscape architecture grounded in landscape ecology that the wide range of requirements for conservation of biological diversity can be assessed and operationalized. In most landscape architecture departments in North American and Europe, this is statement
has almost been accepted as an axiom in recent years. But so far, there have been only a few explorations of the crucial links between landscape architecture and the requirements for preservation of local biological diversity (Ingram 1989, Romme 1997). Joan Nasauer went as far as listing the need for fuller research and professional links between landscape architecture, landscape ecology, and biodiversity diversity conservation as one of a handful of "urgent realities" (Nasauer 1997: 5). Romme argued that landscape ecology provides the framework for "mapping" and then conserving biological diversity (Romme 1997: 144) — though the proposed links with landscape architecture are unclear in that discussion. Foreshadowing forms of design, landscape ecology provides opportunities for more coordinated sets of interventions involving various ecosystems and human communities across dynamic landscape mosaics. And it is through study past landscape (ecology) dynamics and making projections for the future that we can begin to envision alternative futures that might maintain basic levels of local biological diversity.

There are some other reasons why landscape ecology is an increasingly key field of inquiry for and landscape architecture crucial for prospects of conservation of biological diversity. But what kinds of developments are necessary in conservation programmes to allow landscape ecology principles to be more readily applied and to take shape as a new field of landscape architecture? This paper reviews the need for links between conservation regimens and more established forms of landscape architecture and planning. I argue that for efforts for the conservation of biological diversity to be viable, in the middle and long-terms, they must be integrated into forms of landscape architecture and design (as well as broader-scaled regional and environmental planning and policy development). Such more aggressive forms of habitat protection in landscape architecture and more site-specific and design-intensive conservation programmes (Shafer 1990, Ingram 1996) have emerged in the last decade and promise to transform both science and design.

Viable and sustainable efforts for the conservation of biological diversity across landscapes requires allocation, design, management, and coordination at a wide range of spatial and temporal scales. Landscape ecology holds the key for linking ecological requirements with options for institutionalizing conservation. Conservation of biological diversity, especially in regions with extensive habitat degradation, fragmentation, and subsequent insularization, requires precise and highly coordinated sets of interventions. In deed, one of the greatest obstacles to effective and sustainable maintenance of local natural diversity has been political economic and institutional resistance to both holistic approaches to habitat protection along with precision in decision-making (and implementation). Living attributes within the landscape, including populations and ecosystems, must be sufficiently understood, assessed, linked to successional and biogeographical processes, and monitored that specific requirements for their survival must be understood and integrating into decision-making frameworks.

As well as arguing that conservation of biological diversity constitutes a new form of landscape architecture, the purpose of this paper is to outline some generic functions in successful programmes and designed protected areas. Typically, such conservation efforts are considered forms of environmental planning, as part of larger scaled set of efforts, rather than design exercises. In addition, I argue that conservation of biological diversity is taking on a central, almost transformative position in contemporary landscape architecture. A related development is the emergence of the field of "ecosystem management" (Grumbine 1998) and a shift towards more precision in terms of space and time. The resulting "landscape architectures" suggest a kind of postmodern blurring of the lines between public and private property as well as between institutional jurisdictions (Ward 1998). Yet none of the resulting requirements for both science-based and socially driven design process are significant departures from twentieth century landscape architecture.

While conservation of biological diversity as landscape architecture might seem like largely a semantic argument, such a conception provides some key opportunities to overcome some of the most daunting institutional and social obstacles to protection of these landscape resources.
In contrast to overly reductionist scientific decision-making, landscape architecture provides a more fluid arena for dealing with questions of cultural landscapes, social priorities, and the inevitability of aesthetic dimensions of pressures and decisions. Like landscape architecture, biodiversity conservation must satisfy a number of socially defined priorities that effectively interpret and operationalize social standards and contexts, aesthetics, cultural memory, and individual idiosyncrasies and dreams. Landscape architecture typically functions across a range of scales from 1:500 to 1:5,000 — that must be coordinated. Decision-making over biodiversity increasingly requires implementation strategies at a wide range of scales from 1:500 to 1:1,000 to 1:50,000. Implicit in landscape architecture is the acceptance that designs will be revised, discarded, and reworked every decade and generation. Similarly, biodiversity conservation has shifted from an emphasis on master plans to contemporary incrementalism (and ongoing crisis). Effective biodiversity conservation requires a wide range of design and planning measures that on paper, at least, have numerous affinities.

The following discussion outlines some divergent notions of conservation of biological diversity within the context of landscape (ecosystem) management. Different culturally and political rooted notions of conservation, and protection of biological diversity in particular, are discussed in terms of experience of and decisions over space. Ecological and biogeographical information on population requirements can then be related to possible conservation interventions. Possible regimens of measures, for minimum levels of conservation, can then be assessed in terms of social, political economic, legal, and institutional viability. Sets of possible regimens of diverging, and sometimes overtly conflicted strategies, for both conservation and social development, can be evaluated in terms of social (and politicized) priorities.

Problem statement:
Making coordinated decisions over time & space

The sciences and arts of protected area planning, design, and management have only been codified in recent decades. A small number of texts have been central to the emergence of ecological planning and design but curiously none of them have dealt, directly, with the issues of conserving local biological diversity. There was a visionary synthesis of ecology and regional policy by Canadian, Pierre Dansereau (1957), the influence of which has not been fully appreciated in recent years. Ian McHarg’s 1969 Design With Nature was highly influential but had few new ideas. Design With Nature essentially codified science-based approaches to decision-making over the land echoing some of the themes of American, Aldo Leopold (1933, 1939, 1949) without the scepticism and critical thinking. Since then, there have been a small number of texts. Some such as Steiner (1991) have been integrative while Van der Ryn and Cowan (1996) which have been more prescriptive. And there have been discussions of applied conservation biology which tend to avoid questions of integration into broader planning and design frameworks (Shafer 1990). But identification of alternative options and scenarios for biodiversity conservation (in relation to other aspects of land use) (Ingram 1989, Romme 1997: 157), especially as part of exercises in landscape design, has been neglected. McHarg, pushed a reductionist form of what he called "ecological determinism" tended to search for one truth and conservation / land use narrative — what seems naive when not opportunist from today's vantage point.

In constructing conservation frameworks based on principles of landscape ecology, the following emerge as typical categories of research, synthesis, and decision-making:

- inventorying of biological diversity,
- determination of focal species and other entities,
- determination of minimum requirements
- goal-setting for conservation,
- designing and planning as decision-making,
- implementation,
- management,
monitoring,  
evaluation, and  
redesign and revised planning.

All of this work is conducted at various scales which are integrated through “biological scaling” (Peck 1998: 11 - 15) involving landscape, community, population, intraspecific (genetic) diversity and subsequent “adaptive management”(Peck 1998: 143 - 162).

**Conservation planning requirements for protection of biological diversity**

All planning is based on forms of predictive models. A land use plan is the product of objectives, criteria and data. How these things are worked to form a certain plan is the result of a particular set of predictions resulting from perpetually incomplete data. In comprehensive planning exercises, an array of quantitative models of specific relationships are linked and structured. Predictions of cumulative outcomes are ultimately qualitative. For the in situ conservation of local biological diversity, the question becomes one of whether or not respective indicators of the amenity can persist together. Determination of different sets of possible measures, which could maintain minimum levels of biological diversity, can employ a powerful but structurally simple model. The paradigm which is proposed relies on trade-offs between land allocation, habitat quality, management and mitigation and is based on three possible tradeoffs.

The modern conception of nature conservation has been dominated by the island metaphor (Cole 1981). This has usually involved a dichotomous approach where there are areas which are natural and those which are not. Emphasis for in situ conservation is usually on space and general characteristics, such as area, as derived from interpretations of the theory of island biogeography (MacArthur and Wilson 1967). The insulate concept laid the basis for examination of the regional context of fragments of natural habitat and respective, landscape change and ecological impacts. Unfortunately, it has often allowed for a preoccupation with area, rather than with the inter-relationships of sites and the more subtle aspects of local environmental quality. This is not to suggest that spatial criteria are not important in planning networks of protected areas. Rather, these are only superficial indicators of a number of habitat factors for which it is less easy to generalize.

It is the identification of these more qualitative requirements which provide flexibility for formulation of a range of potentially satisfactory conservation programmes. The island paradigm, as the guiding approach for habitat protection, is declining in relevance - especially in the developing world. The ineffectiveness of established reserves and the difficulty with which Third World governments have reconciled their colonial era-derived park systems with needs for rural development have lead to new approaches. It is difficult to work concerns, for the comprehensive conservation of biological diversity, with the island approach. The metaphor of the reserve as an island is giving way to that of the boundary of a reserve as part of an assemblage of membranes or filters (Schonewald-Cox and Bayless 1986); ones which are highly sensitive to the interplay of external and internal forces. In their essay on the role of national parks in Italy, Giacomini and Romani (1978) described a shift from parks as “protectionist instruments” to “elements of total planning.” They view parks as open systems and stated that, “attempts to create or operate on a park considering it as a closed system are destined to failure.”

Along with allocation of space, two other sets of planning interventions determine the performance of protected natural areas: management of both human influences and biota within reserve boundaries and regulation of external land use activities which could degrade potential habitat. The nature of particular membranes results from the contrast between either side of the boundaries and the landscapes which link and separate networks or clusters of reserves. In their “multidisciplinary boundary model”, Schoewald-Cox and Bayless 1986 developed the concepts of the administrative boundary and the generated edge. The former is a mapped construct while the latter is an ecological gradient either inside and outside the reserve. The generated gradient has width in contrast to the administrative boundary and is
often degraded wildland or the buffer zone around a natural core. Too often this edge zone is usually well within the administrative boundaries. Different combinations of allocation, management and mitigation could be ascertained to satisfy a set of objectives for maintenance of biological diversity (Slayter 1974). Protected area membranes are part of the regional, landscape mosaic where habitats and populations are perpetually expanding or diminishing. In ideal situations, it is possible to confine impacts of land use activities to levels which are similar to those of dynamic, natural factors. The research on ecotones by Hansen, di Castri and Naiman (1988) suggests that regional networks of protected habitat can function as

"differentially-permeable membranes that facilitate some ecological flows but impede others."

Recognition of the inter-relatedness of management, mitigation and allocation for reserve performance has emerged over the last two decades. In a paper on conservation of macropods in reserves in western Australia, Main and Yadov (1971) emphasised the relationship of reserve size to requirements for management. Almost a decade earlier, Leopold et al. (1963) provided the rationale for active management by suggesting that few of the national parks in the United States were sufficiently large to be self-regulatory ecological units. This biological concept was expanded by Pyle (1980) to include social contexts when he stated that,

"The fewer and less intense the hostile pressure from outside the reserves, the larger the area set aside, the lower the number of visitors and the friendlier the social climate in which the reserve exists, the greater its defensibility and manageability."

Implications of influences, which are external to membranes, have only recently been explored. Soulé (1984) suggested reserve designs which make interiors “immune to changes in land use practice in the surrounding regions” such as where entire watersheds are protected. The equally promising possibility, of making land use activities compatible with conservation requirements, through mitigation of negative impacts of practises, provides another set of opportunities for generation of alternatives for biological conservation. The island paradigm for habitat conservation has probably never provided the basis for effective conservation. It is impossible to confirm this though numerous historical accounts suggest that early reserves, which have remained protected into the modern period, were once more diverse in species. The intended capabilities of protected habitat have become more explicit through modern biology.

Recognition of the loss of biological resources in national parks is so recent that little has yet been done to counteract detrimental forces. The long-term impacts of fragmentation and adjacent land uses were not understood and therefore not considered in reserve design. In addition, a growing number of impacts of land use activities and technologies have become impossible to control. The island paradigm was sometimes satisfactory as an approach to habitat conservation until the rise of the movement for decolonisation in the mid-Twentieth Century. The notions of the wilderness park and preserve have quickly been transformed as the interest groups for conservation have expanded beyond the European and neo-colonial elites and as high population densities and new technologies have threatened to intrude and irreversibly degrade protected habitat. As the expanded military and police apparatuses of the late Twentieth Centuries have proven ineffective and expensive at keeping out of reserves the rural poor, the old notions of social control have become outmoded.

**Identification of alternative regimens of conservation measures**

Assessment of the management field The institutional basis for in situ conservation of biological diversity results from political economic, organisational and cultural factors which are highly particular to each country, province or state, and region. In every setting, the pools of interventions, which are available to conserve habitat, are expansive. Configurations can extend from the state, with its various legislative and administrative ‘tools’, to the actions and proposals of non-governmental organisations and private economic entities. A fine mesh
of political economic and cultural factors determine the types of habitat conservation programmes which are viable. The interaction of these factors in the economic context underlays institutional change. Analysis of management fields, in order to devise effective strategies for the *in situ* conservation of biological diversity, first requires a list of components, then a grouping of planning instruments and eventually determination of the most effective sets of interventions for particular settings. Because situations are changing rapidly, time becomes a qualifier. Interventions are only effective in terms of the continued existence of certain conditions and as these change so too must programmes for habitat conservation.

To assess the management field, it is necessary to inventory the measures that could affect habitat conservation and then reaggregate them in a number of groups such as:

- spatial allocation of natural habitat in protected areas;
- management of protected habitat; and
- mitigation of impact of adjacent land use.

These categories of interventions can then be examined in terms of the apparatuses of:

- the state;
- non-governmental economic, research and advocacy bodies;
- the cultural and local factors which include patterns of land tenure; and
- local management for habitat conservation.

A third dimension involve the varying effectiveness of such possible measures under various and unpredictable political economic conditions.

Land use planning for habitat conservation emerged with the rise of the modern state. While alternatives to the current structural problems of nature conservation in development planning, often embody critiques of the ineffective and contradictory roles of the State, particularly in the Third World and in the frontiers of the developed regions, coordinated decision-making in land use must first be viewed in terms of government programmes. Fields of management are highly variable even between provincial and national governments with similar systems of administration. An initial examination of governments can begin with an investigation of the conservation programmes and the underlying legal and administrative powers. These tools can be linked to relevant legislative and administrative priorities. The political economic variables, which most often determine the effectiveness and appropriateness of components of conservation programmes over time, can be highlighted. The level of cohesion of programmes, in terms of the conservation of biological diversity, can be evaluated through chronicles of recent historical events as related to resources use conflicts, government decisions and accomplishments of existing conservation programmes. Virtually all state agencies in the Twentieth Century have been hampered by bureaucratic compartmentalization in attempts to respond to concerns for conservation of natural ecosystems in land use planning.

**Requirements for management of protected habitat**

All planning and design for conservation of biological diversity is highly provisional and must be revised on an ongoing basis. Reserve management is the activity which is required to sustain assemblages of organisms in natural areas once sites are protected. For purposes of conservation of biotic diversity, management is defined as any on-going regulation or manipulation for maintenance of populations and ecological functions within a reserve. Those activities which are external to reserves will be covered in the following section on mitigation measures. A broader definition for management of protected areas was proposed by Pyle (1980) first appears simple and straightforward.

"A nature reserve can be thought of as an area of land which has effectively been removed from the development stream for the purpose of perpetuating natural conditions. Management in this context is the set of means by which that purpose is realized."
In contrast, Namkoong (1983) suggested a more focused approach to management for biological conservation, which was “to stabilize species for a variable and uncertain future.” Management is made necessary in reserves because of the largely indirect impacts of surrounding land uses, fragmentation and degradation of the regional environment. Other detrimental influences are produced by past and present activities within reserves and which are incompatible with conservation goals. Modern wildland management originated from game conservation. There are also older traditions of landscape manipulation associated with hunting and wood and food gathering. These activities were originally performed by local inhabitants where management was tied to exploitation. Modern protected area management for biological conservation has involved two inter-related targets: “ecosystem management” (Grumbine 1994) and social control of activities within reserves.

With reserve management, we are confronted more fully with the dynamic nature of landscapes and ecosystems and by the vagueness of most goals for habitat conservation. In their evaluation of the effectiveness of conservation in national parks, Machliss and Tichnell (1985) spoke of the “historical lack of ecological management” which threatens the capacities of protected areas to maintain local biological diversity. However, the underlying lack of clear, comprehensive, and precise ecosystem management criteria threatens to be a more persistent problem.

Management consists of those conservation measures which are done after protected areas have been established within clearly delineated boundaries. Management is modification of human-induced disturbance, substitution of natural processes, and as Usher (1973) noted,

“is itself concerned with intervention within ecosystems, either to alter the status quo in a wanted direction, or to prevent the status quo, from altering in an unwanted direction.”

Control of human activities within protected areas is grounded in a long history of social conflict. Park management has often involved policing and restraining activities inevitably favouring some social groups and “stakeholders” (Ingram 1994) over others.

In landscapes with dynamic landscape cycles, often associated with polyclimax vegetation, mosaics of numerous successional stages and vegetation types are required to maintain the local biotic diversity. Management in these settings might involve insuring a balanced, though dynamic, set of patches. For example, ecosystems where fire is a frequent occurrence contain species which are dependent on resulting edges or ecotones and subsequent seral stages. These areas are constantly changing shape and location. Ecosystem manipulation for maintenance of species diversity in landscapes with long histories of human disturbance, such as The Netherlands, can involve maintenance of low levels of biomass with vegetation at early stages of succession (van der Maarel 1970). Such artificial disturbance is often a necessary management practice in small reserves in which then exists possibilities of temporary loss of species with specific requirements for. Management to replicate or restore relationships in order to compensate for large-scale landscape alterations may only require minimal or laissez-faire interventions. (Schonewald-Cox 1983). Control of more fundamental changes in ecosystems, such as countering invasions of alien species, may require activities which are more intensive. Since policing and surveillance are generally labour intensive and expensive, resolution of local conflicts before they manifest within reserve boundaries, is preferable. Preventative approaches, which function to keep the necessity of this form of intervention to a minimum, are necessary for the sake of cost and respect for local needs. No amount of internal or external management can maintain populations when certain numerical and habitat requirements, which inevitably have spatial dimensions, are unmet. Relatively early on, Janzen’s work in the tropics (1983) confirmed this and he noted that,

“As areas of conserved pristine forest are reduced in size they are increasingly susceptible to significant immigration of animals and plants from nearby anthropogenic secondary successional habitats.”
Network design through regional planning

In his essay on the range of legal tools for preservation of genetic diversity, De Klemm (1985) states that existing protected areas, in themselves, are not sufficient for effective nature conservation. There are a number of types of supplementary activities which can support habitat protection including general land use controls, permits, legal constraints, and administrative and economic incentives and disincentives. Interventions external to actual and intended protected areas, involve the same dimensions, progressions of activities, and levels of implementation as protected area allocation and management. However, the legal basis for mitigation, and thus its potential use and effectiveness is often unresolved especially in terms of restrictions argued to be unfair taking. This is especially the case where there are questions as to what constitutes the line between publicly and privately owned resources. Mitigation measures are underemployed in contemporary efforts for biological conservation. This is, in part, because the national park ideal has emphasized creation of supposedly secure and invulnerable islands of natural habitat even though, given the porosity of most landscapes, such discreetness rarely exists.

In integrating biodiversity conservation into regional development, the importance of employment of a "spectrum of land uses, ranging from strict protection to total development," was highlighted by Garrat (1984). He noted that,

"Protected areas must be seen as the most obvious and direct part of an integrated system of actions for environmental care in a region. They cannot be seen as islands which exist in isolation from their surrounding. They are important parts of the regions in which they are situated and the mutual relationships and linkages between them and adjacent lands must be understood and applied to management."

Mitigation measures have tended to be incremental and grounded in local approaches to conservation. They are often established along with protected areas as in the case of easements and buffers. There is a trend toward more extensive use as an administrative structure for multi-purpose wildland areas. The following two examples are very different uses of such measures. The idea of a protected area as a cluster of mitigation measures can be illustrated by the planning of Australia's Great Barrier Reef National Park. In a sense, the entire area, which is primarily marine, was first established as a buffer. Restriction on human activities were zoned for particular sites. Few activities are prohibited, throughout the park, but there is regulation of use, which produces undesirable impacts, on a zone-by-zone basis in relation to specific ecological sensitivities and management objectives. A contrasting form of mitigation measure is the Endangered Species Act, of the United States, and this can be employed to regulate land use activities through declaration of critical habitat and prohibition of involvement of Federal agencies, including denial of permits and funds, in projects where significant portion of this habitat could be destroyed. Declaration of critical habitat status for non-designated natural areas can be employed as a device for control of land use outside of reserve boundaries. It is usually only a temporary activity to precede subsequent land acquisition. Mitigation is usually the least tangible and most contentious category of measures are which employed in environmental planning for biological conservation. Measures can produce substantial institutional and popular resistance if formulated and implemented incorrectly. However, extension of habitat conservation into use zones is key to planning at the district and regional level and to formulation of alternative development / biological preservation strategies.

Alternative strategies for conservation of local biological diversity

Some possible tradeoffs around planning for biodiversity conservation comprise three dimensions of variation in style for the planning of regional networks of protected areas: between area in protection and regulation whether interior or exterior; between area in protection and the quality of the habitat; and between internal and external emphasis in subsequent maintenance of protected habitat. The extremes of each axis can be combined to
form eight distinct strategies which maintain minimum levels of the requirements of the indicators of biological diversity. An infinite number of less extreme configurations of measures are also available. Such strategies provide opportunities for relating conservation planning back to social and economic policy. They force conservation and development planning to be viewed as one in the same. For a conservation plan to be successfully implemented it must support the chosen style of development. The policy issues which are embodied in this set of possible approaches to programmes of conservation and economic expansion, involve regulation of economic expansion. Insular strategies are predicated on the stance of minimum impingement on economic activities outside of protected areas. In contrast, mitigative approaches involve greater restriction in economic activities but could quite possibly allow for some exploitation over greater total area. The eight strategies provide a basis for determination of divergent approaches to links between decision-making for development and conservation. The island paradigm often involves a more laissez-faire approach to land use planning while the membrane requires structures for regional coordination and must influence, more directly, consumptive land use activities. If economic expansion is given earliest consideration in land use planning, the range of possibilities for biological conservation is narrowed. The opposite is also true.

Conservation strategy 1: minimum portion of district in protected habitat with high levels of regulation - random and often poor quality of sites - regulation largely within boundaries of protected areas

This situation has often resulted with national park establishment and is the most common manifestation of the island metaphor in nature conservation. Pressures for expansion of land use are great, the total area of the protected habitat is minimal, the quality of most of these sites is poor, networks of reserves are left with an on-going burden of requirements for heavy regulation and manipulation. This is the maximum management option which foists the costs of biological conservation on future generations.

Conservation strategy 2: minimum portion of area of district in protected habitat and with high levels of regulation - poor site quality - regulation largely of external land use

The configurations of protected areas in this strategy might be similar to that in strategy 1 but there would be a major difference in decision-making for regional land use. From the earliest phases of planning, regulation would emphasize preemptions of negative impacts from land use outside of the reserves and there would be minimal, direct manipulation of ecosystems within protected areas. This is the maximum mitigation option which would allow land use activities throughout much of the district as well as for laissez-faire approaches to management but would require heavy regulation of human activities.

Conservation strategy 3: minimum portion of area of district in protected habitat with high levels of regulation -high quality of habitat of sites - regulation largely within boundaries of protected areas

This strategy is similar to that of strategy 1 and its island metaphor but is less problematic for on-going management because the habitat which has been allocated is of better quality and tending to be smaller in area. Management activities can be more focused on particular sites. This type of high quality park system option has sometimes been proposed for the creation of systems of protected areas which are attractive for wildlife tourism.

Conservation strategy 4: minimum portion of area of district in protected habitat with high levels of regulation -high quality of habitat of sites - regulation is largely in areas outside of protected areas

This strategy is similar to that of strategy 2 but the requirements for mitigation might be more workable as the sites which are protected are less problematic. Land use expansion
could be relatively pervasive but regulatory measures for land use would be precise and well-monitored. This, the maximum area in mitigation option would require planning apparatuses which could maintain tight controls for an indefinite period.

conservation strategy 5: high portion of district in protected habitat as required with minimum regulation - poor quality of habitat of sites - regulation largely within boundaries of protected areas

In contrast to strategies 1 through 4, the ones which follow are viable in settings where pressures for expansion of consumptive land use are less severe. Highly site-specific land use expansion is envisioned as in the case of mining and infrastructure installation. Negative impacts of land use would bleed into reserves but, due to the extent of protected habitat, could be offset through management in edge zones. This is the maximum spatial management of internal buffer zones option.

conservation strategy 6: high portion of district in protected habitat as required with minimum regulation - poor quality of sites - regulation is largely outside of boundaries of protected areas

Conservation activities would emphasize control of large territories, often with inclusion of redundant or marginal habitat types and regulation of land use activities outside of protected areas. Of the 8 strategies, this one relies on the most fluid and least obtrusive boundaries between zones of habitat preservation and consumptive land use. This is the maximum spatial regulation of external use zones option.

conservation strategy 7: high portion of district in protected habitat as required with minimum regulation - high quality of habitat of sites - regulation largely within boundaries of protected areas

Strategy 7 may be the ideal approach to minimize the need for expensive management while still relying on the island metaphor. Needs for on-going manipulation and policing would be largely be preempted by the high quality core areas being surrounded by the extensive areas to accomplish this. Broad territorial monitoring is key to allocation of the scarce resources available for management. This approach can be thought of as the more viable island metaphor option.

conservation strategy 8: high portion of district in protected habitat with high quality sites with minimum regulation - regulation largely outside the boundaries of protected areas

Like strategy 6, the edges between zones of habitat protection and land use expansion are subtle and often layered in numerous buffer zones. The higher quality of the sites and the relatively large portion of the district in reserves would mean that pressures for land use expansion need not dominate site selection and that, in turn, it is feasible to place restrictions on land use activities in areas outside of the reserves. This strategy is the conservation membrane with maximum security option. In the last decade of the Twentieth Century, this approach to habitat conservation seems the most efficient and secure in terms of long-term balancing of cost, benefits and risks. Unfortunately, it is also the most utopian for most situations, at the present time. Criteria for the mitigation of the ecological impacts of land use Criteria for mitigation for biological conservation within protected areas have been less articulated than those for reserve design and management. In most cases, there has not been a legal basis for mitigation and the creation of reserves has been as a response to unmanageable activities within use zones.
Identifying alternative regimens of conservation

Phases subsequent to noting possible alternatives for integration of conservation into land use planning involve greater specificity in terms of taxa, populations, sites and regional relationships - at scales from 1:1,000 to 1:50,000. The following is one of a number of possible procedures which can be constructed to employ these techniques.

Phase 1  Delineation of the Biotic District
Phase 2  Inventory of Species
Phase 3  Selection of Focal Taxa
Phase 4  Determination of Requirements of Focal Taxa and Ecosystems
Phase 5  Mapping of Distributions of Focal Taxa and Habitat and Population Factors Related to the Requirements
Phase 6  Inventory and Evaluation of Available Conservation Measures
Phase 7  Analysis of Capabilities of Any Existing Protected Areas in the District for the Conservation of Elements of Biological Diversity
Phase 8  Evaluation of Quality of Sites for Economic Activities
Phase 9  Evaluation of Quality of Sites for Habitat Conservation
Phase 10 Evaluation of the Possible Regulatory Measures in Terms of Effectiveness at Maintenance of the Minimum Requirements for Populations and Habitat
Phase 11 Impact Simulation for Initial Configurations of Conservation Measures
Phase 12 Expansion of Configurations of Conservation Measures to Include Trade-Offs Involving Regulation
Phase 13 Identification and Illustration of Alternative Strategies
Phase 14 Analysis of Alternatives and Choice of One Strategy or Ranking of Strategies in Terms of Compatibility with Objectives for Social Development

There are four principle roles which alternative combinations of possible conservation measures could play in comprehensive land use decision-making.

1. Different but equally viable conservation paths could be used to identify crucial sites for protected designation from those available for exploitation. This could be particularly relevant to pristine regions with pressures for large-scaled, economic development. In these frontier settings, with rapid infusion of human population and technology, comprehensive decision-making is key to averting degradation of environmental quality at the regional level.

2. Such a method for determination of possibilities for conservation could also be used as part of environmental impact assessment of whether certain development plans would allow for adequate conservation of biological diversity. If there is a sincere governmental commitment and accompanying institutional structure for habitat protection, and
economic objectives for a proposed development had already been set, generation of strategies could be used to ascertain whether a specific proposal would be acceptable.

3. For most rural areas in the world, some development, and subsequent habitat degradation, has already occurred. Another use of multiple strategies would be to evaluate the effectiveness of current networks of habitat and to identify remaining natural areas which are still priorities for habitat conservation. This is an expanded form of gap analysis.

4. A fourth use of this kind of biodiversity-conservation-as-landscape architecture could be employed for the identification of divergent styles of resource development and district programmes of protected areas. This design procedure could be employed where the overall style of development and conservation has not yet been set. This would be the most ideological and political use of the strategies: demonstrating that habitat conservation is workable as part of land use expansion and that certain options for economic development are more ecologically compatible than others. As well as for use in large-scaled land use and conservation decisions, such strategies could be used to identify measures for incremental expansion of systems of protected areas as part of finer-scaled exercises for maintenance of biological diversity.

As scenario generation occurs further along in the time-line of modification of the natural landscape mosaic, the irreversible ecological changes which result will preclude certain options. Consequently, the range of potential solutions for satisfaction of both pressures for conservation and certain forms of development will narrow. Where a number of divergent sets of social and conservation priorities can be compared, the ones which would be compatible with certain strategies for the conservation of biological diversity, could be linked. Such conservation-of-biological-diversity paths or transition strategies could become symbolic in local political processes. Where the first use of the procedure is district-oriented and the second is site-oriented, this focus is on economic and environmental policy. There are a number of possible steps between the strategies and local concerns for development. Key policy issues are inevitably viewed in terms of the benefits or costs especially for poor, rural people or revenue-hungry provincial governments. Yet the real advantages to local economies of the conservation of biological diversity are long-term in nature. In situations where the push for immediate economic benefits determines the nature of the land use decisions, strategies can become linked to concerns for specific biological resources such as totem species and community types with local and international identification. Choices of strategies become linked to more comprehensive, alternative planning strategies involving competing emphases such as tourism versus industrial development or community-based forestry as opposed to corporate logging concessions. As for settings with downward spirals of regional environmental deterioration, the whole process of strategy identification can seem a luxury. But it is only in the exploration of the widest set of options that we can sometimes find solutions to the inevitably “wicked problems” (Rittel and Webber 1973) of competition over resources and space.

Evaluation of the effectiveness of the existing network of protected areas and subsequent determination of priorities for expansion In many of the areas of the world, where large tracts of natural habitat remain, there are presently some kinds of protected areas. In some cases, these programmes have already been effective at maintenance of the biological diversity of a district under projected land use-induced disturbance. Scenarios can be used to determine whether present conservation programmes are effective. In this use of the procedure, as a basis for evaluation of the actual conservation within the protected areas, gaps identified lead to proposals for additions to park systems. In some instances, it might be determined that the existing networks of protected areas are so ineffective, that it might be better to establish whole, new parallel systems of ecological and genetic reserves. Some limitations on employment of multiple strategies for the conservation of biological diversity through comprehensive, land use planning “The model assumes some abstract planners with clear goals. But conservationists are themselves part of society, rooted in particular social groups
and self-selected by ideological/cultural criteria, with their own politics and vulnerabilities to external and internal pressures. The self-awareness of the conservation planning/managing community is a possible protection against built-in error. So, what will be the typical patterns of insights and blindesses, commitments and opportunisms?" (Richard Levine 1988)

Use of strategies to highlight a politically expedient development/conservation path could lead to simplistic interpretations which could inhibit programme development in the long-term. The linking of the most attractive scenario to a vision of development, in a manner which is cognizant of long-term environmental costs and benefits, is advantageous until such an approach, in turn, becomes orthodox, inflexible or loses public favour. While a project might allow for the survival of biological diversity, it could also be misused to justify a plan which could cause serious ecological impacts. For example, the prospects for sustainable production of natural resources and continued satisfaction of needs of indigenous communities, for traditional plant and animal resources, could be impaired. A land use plan, which neglects these broader ecological and social concerns, will be ineffective and divisive.

Conclusions:
Moving from designs to provisional conservation
Biodiversity conservation as landscape architecture is as much about using spatial and temporal exercise to identify a wider range of possible habitat proecion (and human development) options than the production of singular designs. In this essay, I have proposed a kind of biodiversity conservation as a landscape architecture - an appropriation of the field that some would argue is almost a kind of anti-aesthetic, a deconstruction of the vision of social needs for public and private outdoor space as a garden. In the form of landscape architecture, that I have outlined here, nothing is neat and most interventions are events rather than fixtures. Bernard Tschumi's (1994, 1996) notions of Event Cities and "counter-design" is useful here. Landscape and ecosystems, as living entities, are finite in time and space and all conservation efforts do is try to safeguard the spontaneity of this life (through restricting human certain activities). The landscape plan and site designs are short-hand and biproducts of far more supple experiences of nature, space, and time (Kaplan and Kaplan 1989). The line between science and aesthetics is always provisional and usually contentious (Mozingo 1997). And 'biodiversity' is one more metaphor for a complex and shifting set of metaphors (Eaton 1990), messy realities (Nassauer 1995), and social priorities.

As the imperatives for planning and design of networks of protected habitat for conservation of biological diversity intensify, how can we move to a landscape architecture intend on contesting and not simply accommodating the present? How to construct design processes intent on locating "alternative worlds" (Corner 1997: 98) through identifying a multiplicity of possibilities? How can we "de-fetishize" the plan and the map to "construct enabling relationships" (Corner 1997: 102). To some extent the almost internal logic of landscape architecture's expansion (Meyer 1997) in response to new aesthetic problems and scientific perspectives (such as those on biodiversity) provide some clues. And planning and design for biological diversity remains dominated by efforts to first understand and trace what is living out there — and to first and foremost, to respect the de facto designs that are already in the landscape.

Thanks to Professors Richard S. Meier, Jeff Romm, Thomas Dickert, and Peter Walker of the University of California, Berkeley, who over the years have sustained this conversation. Funding for this research came from a 1998 grant from the Chicago-based Graham Foundation for Studies in Advanced Studies in the Fine Arts and a 1999 mid-career grant in (landscape) architecture, entitled "Awkward Positions," from the Canada Council for the Arts of the Government of Canada.
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