E N V I R O N M E N T A L   L A W   I N S T I T U T E

Lasting Landscapes: Reflections on the Role of Conservation Science in Land Use Planning

"Healing the land must begin with good planning, for there are so many ways we can go wrong— or at least waste time and money—if we do not proceed intelligently and on the basis of the best available information."

Reed F. Noss

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Bridging the Gap: Incorporating Science-Based Information into Land Use Planning

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Introduction

Land use planning, in one form or another, has been occurring since the colonization and establishment of the United States. Historically, planning has tended to focus on the allocation of land and other resources in a way designed to balance the protection and advancement of societal values, such as community health and well-being, with the rights of land owners to use and benefit from their holdings. Incorporating ecological considerations into this planning balance was a fairly late arrival on the scene, marked in a serious way by Ian McHarg's 1969 landmark book Design with Nature. This generally coincided with the public's broader interest in environmental protection, resulting from such things as the broad indictment of pesticides contained in Silent Spring (Carson 1962), an oil spill dirtying beaches in Santa Barbara, smog enveloping the Los Angeles basin, and chemical pollutants igniting on the Cuyahoga River. The launch of the modern environmental era was subsequently formalized in public policy through passage of milestone federal legislation, such as the Clean Water Act, Clean Air Act, and Endangered Species Act.

While some in the scientific community had long been involved in studying the effects of land use and other human activities on what is now known as biological diversity, most scientific work hewed closely to traditional disciplinary lines. Ecological researchers often worked specifically to avoid human influences, seeking to examine organisms or ecosystems untainted by interference from people. As an example, the Ecological Society of America's Committee on the Preservation of Natural Conditions — the predecessor to The Nature Conservancy — was chartered originally to identify pristine areas where ecological research could be carried out unhindered by human influence. Indeed, a difference of views as to whether that committee should retain a strict focus on research, or become more involved in preservation efforts and environmental advocacy, was at the root of its split from ESA and the eventual formation of the Conservancy.

Following the public's awakening to the environmental crisis, during the 1970s environmental science began to be recognized as a legitimate discipline in the nation's colleges and universities. It was not for another decade, however, that the discipline of conservation biology was formalized (Soule and Wilcox 1980). Unfortunately, academic traditions, at least in the life sciences, tended to discourage students and faculty from entering fields such as conservation biology that are perceived as having an "applied" rather than "basic" science focus. Work with practical applications often held a stigma that was not helpful for academic career advancement. As a result, conservation-oriented biologists often carried out their work as an addendum to a more mainstream research agenda, or left academia to work in government agencies, non-profit organizations, or private consulting firms.

The pendulum is now swinging in favor of recognizing the academic value of scientific research that has applied conservation value. The Society for Conservation Biology is now one of the fastest-growing professional societies, with more than 10,000 members around the world. Even the National Science Foundation, the primary federal funding source for non-medical life-science research, has adopted new proposal review guidelines that both recognize and encourage the broader impact of research, including its use for informing environmental protection and conservation efforts.

Despite the convergence in ecological interests over the past few decades between the land use planning community and the conservation science community, a considerable gulf still exists between the two groups. Many land use planning decisions still only incorporate ecological principles and biodiversity considerations in a cursory way, if at all. And many conservation scientists are still largely disconnected with how their research could have real-world application. What are the reasons for this continued disconnect, and what barriers exist that inhibit better integration of science-based information into the land use planning process? Conversely, where is the process working, and what opportunities are available for broadening such interaction and integration?

What are the most significant barriers to the integration of science-based information into land use planning?

At the heart of this disconnect are different cultural norms that characterize the two communities, exacerbated by differing communications styles. Land use planning involves the identification and balancing of multiple values — social, economic, and environmental — and usually takes place within a political framework where compromise is the norm. The scientific method places a premium on objective facts, and while a given hypothesis technically can only be disproved rather than proved, the focus is generally on identifying the "right" answer. Ideas and analyses are expected to stand or fall on their merits, and compromise is not a part of the scientific tradition. As a result, many natural scientists engaged in environmental management or planning processes are surprised (and often offended) when their fact-based "solution" is modified or ignored altogether.

In part, this is a result of different views of the role of science in public policy. Despite the popular notion that science drives decision-making, it is clear that even under the best circumstances science informs but does not dictate policy. Rather, scientific evidence serves as one of several inputs. This is most evident in the field of risk assessment, where scientific studies may quantify environmental degradation or human health effects (e.g., number of deaths), but these factors are weighed against economic cost and other social values in the development and adoption of policies and regulations. And ultimately, these factors are balanced within a political context.

Differing Values

In many ways, the issue is less about the role of science, and more about conflicts, real or perceived, among values. For instance, while there is an emerging body of knowledge that demonstrates that healthy ecosystems are important to long-term sustainability and economic prosperity (e.g., Millennium Ecosystem Assessment 2005), the classic clash among values gets simplistically articulated as "jobs versus environment." A more nuanced conflict in values is even emerging within the smart-growth community. Smart growth is generally viewed as a more environmentally sustainable and socially responsible development style than traditional land use patterns. Nonetheless, different stakeholders within the broader smart-growth community may value different things — say, open space protection or affordable housing — which at times can represent conflicting goals.

Understanding the values that different parties bring to the table is not always straightforward, since people often are not clear or honest about their own underlying values. This lack of transparency can complicate efforts to better incorporate science-based information into planning processes, and can undermine trust relationships. Because many in the conservation biology field come to the profession out of a profound sense that too much of our natural world already has been lost, they often bring an implicit set of values that focuses on the protection or preservation of natural features. While this may be a perfectly rational (and indeed, laudable) set of values, working productively with planners who are attempting to balance a variety of values requires that, at a minimum, this be made explicit. It also means that conservation scientists must be willing to constructively engage with parties that hold very different values in order to ensure that ecological considerations get incorporated into economic and social decisions.

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Uncertainty and the Dynamic Nature of Ecosystems

The nature of scientific uncertainty creates another barrier to collaboration between planners and scientists. While uncertainty exists in all aspects of business, the development process thrives on certainty and tries to avoid surprises. Unfortunately, our scientific understanding of the natural world is imperfect, and even what we do know often comes with large caveats. Planners and other policymakers are often looking for definitive answers, when scientists can often only provide qualified guidance. Even the language used to describe uncertainties can be a major impediment to clear communication across communities. Expressing uncertainty and error bounds is good scientific practice, and is a means of quantifying the accuracy and reliability of information. To users in the planning and other communities, however, the focus on uncertainty can have the oppo-

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site effect, undermining rather than strengthening reliability, even when strong evidence exists.

A related barrier has to do with static versus dynamic notions of the natural world. Conservation scientists increasingly view natural processes as highly dynamic, responding not only to long-recognized ecological factors, such as succession, but to a host of new forces, including the spread of alien species and global climate change. And while biodiversity science historically has focused on documenting what exists, how species interact, and how ecosystems function, the science is actively moving towards a predictive and forecasting mode. As a result, conservation scientists generally have moved away from equilibrium-based models of natural stability (the so-called "balance of nature"), and are focusing more on understanding such things as natural ranges of variability and landscape-scale processes. Recognizing the dynamic nature of ecosystems is at the heart of the scientific communities' general unease with the "no surprises" policy for Endangered Species Act implementation.

Most land use plans still have a fairly static view of the landscape, assuming that in the absence of direct human intervention, what currently exists on the landscape will continue to exist. Interestingly, incorporating dynamic change models into planning efforts is actually something that is routine. Traditionally, however, these models have focused on projections of such factors as population growth and economic performance, rather than ecosystem change. An example of how dynamic ecosystem processes are important for planning relates to vegetation dynamics and fire management in the so-called "urban-wildland interface." As increasing numbers of homes are being built in and abutting naturally vegetated wildlands, long-term changes in vegetation structure have implications for such public safety issues as fire protection. Indeed, the very presence of homes in formerly unpopulated areas can constrain the use of fire management for vegetation maintenance, leading agencies instead to focus exclusively on fire suppression. In turn, such suppression efforts can lead to an unhealthy build-up of fuels, degraded wildlife habitat, and the potential for catastrophic conflagrations from both public safety, economic, and ecological perspectives.

Local Capacity

The scale at which most planning is carried out represents yet another challenge. Land use planning in the United States largely takes place at the local level, through county planning departments and city and township planning offices and commissions. While some of these planning offices are extremely sophisticated, particularly in large, wealthy jurisdictions, many local planning offices have small professional staffs or are run by volunteer commissioners. As a result, in many places planning staffs have relatively limited expertise in ecological sciences and limited capacity to maintain and run sophisticated software tools. The combination of a large number of such planning offices (there are more than 3,000 counties alone in the United States), and the small size and limited capacity in many of these creates an additional barrier to the incorporation of science-based information into the planning process.

Compounding this is the general lack of purpose-built tools and information products designed specifically to help planners understand and access relevant ecological information, and to analyze that information in a way that meets their specific needs. Many of the existing tools and scientific databases have been developed by scientists primarily for use by other scientists, and lack the type of cross-community translation and outreach functions needed to meet the needs of the planning community's large and geographically diffuse constituency. As a result, many planning offices rely on environmental consulting firms for the expertise to address ecological issues when the need arises. And while such firms may provide high-quality service, due to cost and other considerations they usually are only engaged in special circumstances, losing the opportunity for ongoing incorporation of biodiversity and ecological considerations into routine planning decisions.

What are the most significant opportunities for advancing the integration of science-based information across communities?

Despite the barriers that exist, a great deal of progress is being made in increasing the degree to which ecological information is being incorporated into the land use planning process. The divide between the planning and conservation science communities increasingly is being bridged by individuals and projects that are committed to understanding the other's needs. In part this reflects a maturing of the conservation science community, and a greater willingness of many scientists to get involved in the lengthy and often frustrating planning processes that end up shaping much of our natural landscape. It also reflects the planning community's response to an increasing interest among the public in open space, and its link to quality-of-life issues. Indeed, one of the most impressive political trends of the last decade has been the large number of bond issues passed at state and local levels, in which citizens are opting to increase taxes in order to protect habitat and preserve other open space.

Another major policy shift is at work that is encouraging greater collaboration and integration at the local level. The policy framework for conservation and environmental management is increasingly moving from the top-down, "command-and-control" regulatory approaches that were initially adopted to deal with such issues as water and air pollution, toward more flexible outcome- or incentive-based approaches that often include local involvement. Regulatory approaches have been extremely successful in dealing with certain types of problems, and will remain needed and relevant. Other problems, ranging from non-point source water pollution to the cumulative impacts of habitat fragmentation on wildlife, have proven to be resistant to top-down command-and-control approaches. As a result, emphasis is now increasingly being given to empowering local communities to be creative about the way that they bring diverse stakeholders together and solve problems.

As an example of this approach, Washington State's Nisqually River is the focus of a locally based effort designed to sustain ecosystem health and promote economic vitality in the region. The Nisqually River Council has served as an umbrella for a host of watershed-based recovery activities, while local groups such as the Stewardship Partners have successfully enlisted broad-based landowner and citizen support for watershed activities. Such locally based efforts involving planners, scientists, farmers, ranchers, and environmentalists, among others, was at the heart of an August 2005 White House Conference on Cooperative Conservation (CEQ 2005). A notable element of many of the successful initiatives highlighted at that conference was the close collaboration between scientists and planners, and the way in which scientific data, tools, and expertise were brought to bear in the planning and implementation of these efforts.

Data

The availability of reliable data is essential for helping to incorporate biodiversity considerations into planning processes. When dealing with a contentious project, clearly separating the fact base from the interpretation of those facts can help clarify where issues exist, and where they don't. Detailed mapping of a sensitive ecological feature, for example, will sometimes reveal that a potential conflict is not as serious as initially thought, providing more options for resolving the problem.

Basic types of data relevant to this need include information about the species and habitats that exist in a region, their condition or conservation status, the location of sensitive or other important features, and how these resources are likely to be affected by proposed activities. Fortunately, there are some excellent sources of data that are directly relevant to the needs of the planning and environmental management professions. For more than thirty years, state natural-heritage programs have focused on gathering biological data for use in land planning and resource management. By carrying out inventories and managing their data according to consistent national standards, these programs offer planners a reliable source of detailed data on plants, animals, and ecological communities in each state, with particular focus on those of conservation concern.

NatureServe, a non-profit organization that provides national coordination and technical support for these programs, integrates much of this data into a national view that can be accessed online through the NatureServe Explorer website (www.natureserve.org/explorer). Building on these core biodiversity databases, an increasing number of natural-heritage programs are developing planner-friendly analytical products that map out environmentally sensitive areas. The Massachusetts BioMap project, for example, identifies sensitive biodiversity

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areas statewide, and has established a program designed to work with local planning offices in the application of these maps and the underlying data (Massachusetts Natural Heritage and Endangered Species Program 2001).

State- and regional-scale conservation plans have been a particular focus of activity in recent years, and these plans provide important ecological context for planners. Federally funded State Wildlife Action Plans were completed for all states in 2005, and should serve to help chart the course of wildlife conservation efforts across the country. All of these plans identify animal species in need of special attention, and many include maps of priority habitats or areas for wildlife conservation. Another important effort has been The Nature Conservancy's work to identify and map out important biodiversity areas within each ecoregion of the country. These "ecoregional plans" offer another view of conservation priorities, and have the advantage of including both plants and animals of conservation concern. Still another regional planning approach focuses on what is variously termed green infrastructure, or green-printing. Such green-printing plans generally focus on identifying major remaining habitat areas, together with existing or potential connections among these core areas. Green prints can cover a single state, such as Maryland (www.dnr.state.md.us/greenways/greenprint/), or can include multiple states, as in the case of EPA's Southeastern Ecological Framework (http://www.geoplan.ufl.edu/epa/).

A variety of other data sources exist within individual states, although locating these sources can sometimes be difficult. Links to other state-based sources of information can be found through the NatureServe website (www.natureserve.org), Defenders of Wildlife's Biodiversity Partners website (www.biodiversitypartners.org), and through the U.S. Geological Survey-sponsored National Biological Information Infrastructure (www.nbii.gov).

Tools

A variety of technological tools now available to planners, some generic and some purpose-built, make ecological data, analyses, and expertise more accessible than ever before. It is hard to overstate how the Internet has revolutionized and democratized access to information in just over a decade. Not only is the Web the primary means for scientists to communicate and share findings, but it provides planners in offices large and small with access to resources once available only to the privileged few. While the first generation of web-based resources took the form of static documents or information products, a new generation of mapping and visualization tools is now being deployed online. The current tools mostly provide opportunities to view the landscape (e.g., Google Earth), as well as to add user-defined features. It will not be long, however, before fully web-enabled analytical GIS packages are available through this medium. The Web also has proven to be a social force, fueling the emergence of numerous virtual communities that address a variety of scientific and planning-related issues, and providing unprecedented opportunities for citizen participation in scientific endeavors and planning processes.

Several important concepts emerge in considering how technology can enable the integration of scientific information into planning processes. Transparency and accountability are key for information and analyses to be credible, and to stand-up to legal and political scrutiny. Such transparency is essential to create a trust relationship among parties that may have divergent and strongly held views and values; "black-box" solutions can undermine this trust. Because planning involves a balance among competing values, analytical tools should allow explicit recognition of the values underlying them, or accommodate different value sets. Finally, identifying alternative scenarios for meeting ecological needs, if possible, is preferable to producing a single "right" answer. Such alternatives allow planners flexibility where possible, and conversely show where there is little or no "wiggle room." A whole class of optimization techniques are becoming available to help evaluate the efficiency and effectiveness of these alternatives, and to help users decide among them.

NatureServe Vista is an example of a decision-support tool specifically designed to help incorporate biodiversity considerations into land use planning (www.natureserve.org/prodServices/vista/overview.jsp). This GIS-based software allows a user to map out the biological features in their area of interest. Based on the condition and distribution of these features (and confidence in the source data), a "conservation value" landscape can be generated that displays areas of greater and lesser importance or sensitivity. In calculating this conservation value, the tool allows users to select and weight different classes of features depending upon their particular interests, requirements, or values. For instance, a user may choose to limit the analysis to legally protected species, or might wish to include a fuller array of species and habitats of conservation interest. With a basic understanding of how these features are distributed across the landscape, a user can then evaluate how alternative plans or proposals would affect biological features of interest, or examine the relative significance of a given site or tract of land.

A number of more general land use planning decision tools are also available, such as CommunityViz from the Orten Family Foundation (www.communityviz.com/). This GIS-based tool provides a means to visualize analyses of land use alternatives, and to understand their potential impacts from environmental, economic, and social perspectives. Through the use of 3-D simulation, scenarios can be visualized from different angles, a feature that promotes citizen participation in planning processes. As with the Internet, this approach helps to realize the Jeffersonian ideal of participatory democracy by enabling broader understanding, dialogue, and participation.

Expertise

Despite the ever-increasing amounts of information and the analytical tools available to planners, putting these to work still fundamentally requires human interpretation and application. As a result, many of the solutions for breaking down barriers to the use of scientific information in land use planning must involve building human capacity and expertise. In fact, with the Internet providing a conduit for vast quantities of unfiltered information, the need for knowledgeable people to parse this into useful bits will only increase.

Development of a cadre of cross-trained conservation scientists and planners — individuals who are capable of bridging the divide between the two worlds — is a particular need. Scientists must learn to translate their concerns and findings into language that can be readily assimilated by non-specialists in the planning professions. This does not necessarily mean "dumbing down" such works, but rather taking the time to clearly express relevant information in a scientifically sound yet publicly accessible manner. The Environmental Law Institute's Conservation Thresholds publication (Kennedy et al. 2003), which gave rise to the present publication and conference, is an excellent example of translating research results into a form that is intelligible and meaningful for a planning audience. Similarly, there is a need for planners to become more conversant in the language of the ecological sciences, both to help interpret and highlight important trends for their profession, and to provide input to the scientific community in terms of what would be useful for the planning profession.

Our experience at NatureServe over the years in providing biodiversity data to inform land use planning is that there is no substitute for one-on-one interaction with prospective users of the information. Often users know that they have an issue, but are unsure what the relevant questions are that they should be asking. Or they may know they have a need for data, but are either unaware of what exists, or what is appropriate for addressing their need. This is particularly true at the local level, where many planning offices are small, and staffed with individuals that must cover a wide range of activities. Several natural-heritage programs, including those in Virginia and Massachusetts, have established local liaison offices to help such jurisdictions understand what is available and how to apply it to meet their local needs. Other programs, such as those in Pennsylvania, Minnesota, and Colorado, have county inventory programs underway that work with individual counties to map out sensitive ecological resources and provide specific information and advice.

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Bridging the Gap

While barriers still exist between science and public policy, there are a number of developments that promise to bridge or shrink those gaps. Key to this is the growing public interest in maintaining quality of life, and the role that natural lands and open spaces play in this pursuit. To the degree that citizens have an expectation that wildlife conservation and open-space preservation are a part of their communities, the planning profession is likely to respond to these desires. And fortunately, there is an expanding suite of data sources, tools, and expertise available to planners to help inform and guide land use and natural-resource-management decision-making.

Land use planning is a process that takes place in the context of strong political, economic, and social currents, and there will always be contentious issues that arise out of competing values. The role of science is not to provide the answer in these situations, but rather to ensure that the issues are addressed and decided on a fair and level playing field. Traditional planning processes have long focused on what is referred to as “gray infrastructure” — roads, sewers, and other aspects of the built environment. The challenge is to ensure that biodiversity and other components of “green infrastructure” are actively and routinely considered as part of this process. Nearly forty years since the publication of Design with Nature, we are beginning to make real progress toward that goal.

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