Title
Workshop in Landscape Change: Proposal, Agenda, and Position Papers

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Introduction

The National Center for Geographic Information and Analysis (NCGIA) held a workshop in Santa Barbara from January 25-27, 2001. The workshop brought together representatives of the disciplines interested in landscape change, drawn from both the investigative sciences, such as geography, and the design disciplines, such as landscape architecture. Its purposes were to promote the building of a collaborative research community; to develop a joint research agenda; and to facilitate the exchange of ideas. It addressed its major objectives in the context of four themes: information technologies, decision making, landscape perception and assessment, and environmental and social sciences. The workshop was structured as a series of plenary presentations, breakout discussions, and plenary discussion following the model developed since 1988 by the NCGIA. Findings of the workshop have been published separately in the form of a final report.

The workshop was organized by a steering committee chaired by a geographer (Michael Goodchild, University of California Santa Barbara) and a landscape architect (Frederick Steiner, Arizona State University). Funding for the workshop was provided by the National Science Foundation and by Environmental Systems Research Institute.

This document contains:

- The workshop proposal
- Position papers submitted by participants
- The workshop agenda

Workshop Proposal

Summary

We propose to conduct a workshop in the late summer of 2000 that will bring together representatives of the disciplines interested in landscape change, drawn from both the investigative sciences, such as geography, and the design disciplines, such as landscape architecture. Our purposes are to promote the building of a collaborative research community; to develop a joint research agenda; and to facilitate the exchange of ideas. We present arguments for selecting this particular theme and combination of disciplines at this time. The workshop steering committee will be chaired by a geographer (Goodchild) and a landscape architect (Fritz Steiner of Arizona State University). It will address its major objectives in the context of four themes: information technologies, decision making, landscape perception and assessment, and environmental and social sciences. The workshop will be structured as a series of plenary presentations, breakout discussions, and plenary discussion following the model developed since 1988 by the National Center for Geographic Information and Analysis. Findings of the workshop will be published in the form of a report, and other methods of disseminating findings will also be exploited.

Introduction

Workshops that bring together 20 to 40 scientists for periods of 2 to 3 days have proven very effective at achieving a range of goals. They can be excellent mechanisms for cross-fertilization between disciplines, by allowing scientists with different perspectives to exchange ideas in an intensive mix of formal and informal settings. They can be useful mechanisms for community building, by facilitating relationships between scholars that often survive and evolve into productive long-term collaborations. They can also be effective tools for promoting the setting of research agendas, and for facilitating exchanges between the consumers and producers of research (for example, they have been used to exchange research results between scientists as producers, and software developers as consumers).

Since its inception in 1988, the National Center for Geographic Information and Analysis has organized roughly 30 such workshops, or *specialist meetings*. The model formula was defined in the original NCGIA proposal, and has evolved since then based on experience and feedback. 19 specialist meetings were held under the original NCGIA cooperative agreement (SES 88-10917), and a further 10 under the Varenius cooperative agreement (SBR 96-00465). The role of each meeting in community building and agenda setting is documented in the meeting reports, and summarized in the NCGIA Annual Reports, all of which are available on the NCGIA web site www.ncgia.org or in hard copy from NCGIA. Further details on the specialist meeting format are provided below.

We propose to conduct a specialist meeting focused on the design aspects of *landscape change*. Specifically, we wish to promote a dialog between practitioners in the landscape design disciplines, primarily landscape architecture, and researchers in a variety of related disciplines. All three of the motivations described above are relevant: we aim to foster cross-fertilization, by bringing together professionals with a range of perspectives on the same issues; community building, by initiating long-term collaborations; and agenda setting, by facilitating a negotiation between the design disciplines whose focus is on landscape *intervention*, and other disciplines whose primary focus is on the scientific *investigation* of aspects of landscape.

We believe that landscape change offers a timely and compelling opportunity to explore the relationships between scientific investigation, the development of policy, and the practice of intervention and design. Landscape change is high on the public agenda, in issues of urban sprawl, environmental sustainability, and quality of community life. Landscape architecture and urban planning have long been recognized as academic disciplines, based on the systematic study of practice and the education of new generations of practitioners, and have a complex and evolving relationship to disciplines that are dominated by basic research rather than by a focus on normative implementation.

In 1967 Ian McHarg initiated an earlier dialog between landscape architecture and the environmental sciences, by obtaining funding from the Ford Foundation to recruit a faculty of natural scientists into the Department of Landscape Architecture at the University of Pennsylvania to "integrate their perceptions into a holistic discipline applied to the solution of contemporary problems" (McHarg, 1996, p. 192). The notion that one can practice landscape architecture by integrating the views of soil scientists, hydrologists, ecologists, climatologists, etc., echoes the multi-layered view of geography that McHarg did much to popularize with his *Design with Nature* (McHarg, 1969), and has been important in the building of many environmental programs.

Much has changed since 1967. First, the multi-layered model that McHarg experimented with using transparent overlays has evolved into the technology of geographic information systems (GIS; see Foresman, 1998, for a history of the development of GIS, and see Longley *et al*., 1999, for a comprehensive review of GIS), a collection of tools that support the handling and manipulation of vast amounts of digital geographic data. Landscape architects are now routinely trained in the use of GIS. Moreover, models and methods of analysis developed by researchers in related disciplines are now readily executed within GIS environments, providing a more effective connection between basic research and practice. For example, it is now easy for a landscape architect investigating the impacts of a project on groundwater to make use of an array of sophisticated groundwater modeling tools, all embedded in commonly available GIS packages.

Second, new disciplines and subdisciplines have emerged to conduct research in areas that are essential to the design process. They include environmental perception, landscape assessment, the human dimensions of global change, land use analysis, and land conversion modeling.

Third, the growth of information technologies has drawn attention to information as a commodity that is essential to the design process. Decision making is now seen as an enterprise involving many stakeholders, in which information plays a vital role. There is interest in developing GIS and spatial decision support systems that serve the needs of all participants in the decision process (see, for example, the work on Public Participation GIS under the Varenius project, Craig *et al*., 1999), and the Federal Geographic Data Committee's six Community Demonstration Projects are aimed at demonstrating the value of geographic information in planning at the community level.

These trends have shifted the research base significantly. Whereas in 1967 it was the environmental sciences that were seen by McHarg as the primary producers of research to support enlightened landscape architecture, by 1999 the relevant producers are as likely to be geographic information scientists, social psychologists, behavioral geographers, or decision theorists. The same basic need remains, however-to develop a dialog between basic researchers and design professionals, in the interests of cross-fertilization of ideas, development of collaborations, and negotiation of a research agenda that is both useful to design professionals and interesting and stimulating to basic researchers.

Specialist meeting format

We propose to hold a specialist meeting in the late summer of 2000 in Santa Barbara, to bring together specialists in the landscape design disciplines-landscape architecture and regional planning-with specialists in the environmental and social sciences, the decision and information sciences, and the landscape sciences (landscape perception, landscape ecology). The meeting will be organized by a Steering Committee of prominent practitioners and scientists whose interests represent many of the disciplines that will be represented at the meeting. The following individuals have already agreed to serve on the Steering Committee, and short biographical details are provided for each:

Susan Crow (Product Specialist with Environmental Systems Research Institute (ESRI), and faculty affiliate to the Community and Regional Development Division of the Institute of Government at The University of Georgia)

Jack Dangermond (President of Environmental Systems Research Institute, a leader in GIS software, with Masters degrees in Urban Planning and Landscape Architecture from the University of Minnesota and Harvard University respectively)

Tom Evans (Assistant Professor of Geography at Indiana University and Research Associate at the Center for the Study of Institutions, Population and Environmental Change, with research interests in modeling population-environment relationships, demography, GIS, and satellite remote sensing)

Susan Everett (Executive Director of the Landscape Architecture Foundation and a Fellow of the American Society of Landscape Architects)

Michael Goodchild (Professor of Geography at the University of California, Santa Barbara, and

Director of the Center for Spatially Integrated Social Science at the Santa Barbara site of the National Center for Geographic Information and Analysis)

Doug Johnston (Director of the Geographic Modeling Systems Lab, University of Illinois at Urbana-Champaign)

Mary Kihl (Associate Dean and Director of the Herberger Center in the College of Architecture and Environmental Design, Arizona State University)

Marguerite Madden (Associate Director of Environmental Science at the Center for Remote Sensing and Mapping Science, Dept. of Geography, University of Georgia. Her research interests are geographic information systems, remote sensing, and landscape ecology)

E. Bruce MacDougall (Professor of Landscape Architecture and Regional Planning, Adjunct Professor of Geography, and Director of the Office of Geographic Information and Analysis, University of Massachusetts, Amherst)

Laura Musacchio (Assistant Professor in the School of Planning and Landscape Architecture and Center for Environmental Studies (CAP LTER Project) at Arizona State University. Her research focuses on landscape change in urban watersheds and riparian systems)

Joan Nassauer (Professor of Landscape Architecture in the School of Natural Resources and Environment, University of Michigan, she conducts research in landscape perception, landscape ecology, and watershed management)

Forster Ndubisi (Professor of Landscape Architecture at Washington State University and President of the Council of Educators in Landscape Architecture)

James Palmer (Associate Professor of Landscape Architecture at the SUNY College of Environmental Science and Forestry, Syracuse, NY. His resesrch interests lie in public landscape perceptions, professional landscape assessments, and GIS models of these perceptions)

James Sipes (Landscape architect with Jones & Jones, Seattle, with extensive experience in academic positions and computing editor of *Landscape Architecture*)

Frederick Steiner (Professor and Director of the School of Planning and Landscape Architecture, Arizona State University. His research interests include applied landscape ecology, ecological planning and design, and land suitability analysis)

Carl Steinitz (Alexander and Victoria Wiley Professor of Landscape Architecture and Planning, teaching at the Harvard Graduate School of Design since 1966. His interests are reflected in his teaching and research on landscape change, methods of landscape analysis, visual quality, and landscape planning and design)

Monica Turner (Professor in the Department of Zoology, University of Wisconsin-Madison. Her research interests include landscape ecology, natural disturbance dynamics, land-use change, and simulation modeling)

Thomas Woodfin (Associate Professor of Landscape Architecture at Texas A&M University. His research interests include GIS in land planning decision-making, cartographic expression of economic landscape systems, and development of the capitalist world-system)

The Steering Committee will be co-chaired by Fritz Steiner and Michael Goodchild. It will be responsible for general oversight, and for selecting the participants in the workshop.

Participants will be selected by a dual process, following NCGIA practice. An open call will be issued at least six months prior to the meeting, through email list servers and open WWW sites, and in print media where possible. Respondents will be asked to provide a) a short resume and b) a two-page statement of their interests in and positions on the topic of the workshop. Responses will be circulated among the steering committee, and participants will be selected using the following criteria:

1. Ensuring representation of traditionally under-represented groups;

2. Providing opportunities for young scholars;

3. Ensuring adequate coverage of the disciplines and perspectives of relevance to the workshop; and

4. Ensuring a broad representation from the producers of decision support software (only ESRI is represented on the Steering Committee).

In addition, the Steering Committee will identify key individuals to be invited to the workshop, based on the same criteria, in order to supplement the open call. Invited participants will also be required to provide resumes and position papers.

Once the participant list is finalized, approximately three months before the meeting, it will be posted, along with the resumes and texts of the position papers received from all participants, on a public NCGIA WWW site, with cross-links to other key sites.

The meeting will last three full days, and will be organized according to the four themes discussed below: information technologies, decision making, landscape perception and assessment, and environmental and social science. Each theme will be allocated one half day; the first half day will be allocated to introductions, and the last to developing a final consensus.

The four major sections of the meeting will be structured along similar lines. Each will begin with a keynote presentation, given by an expert in the area of the theme and summarizing the state of scientific knowledge and design practice. If no single individual can be found to present both perspectives for a particular theme, then we will identify two, one an expert in design practice and the other in scientific knowledge. The keynote presentation(s) will be followed by open plenary discussion, and then the participants will break into smaller groups for more intensive discussion. The section will end with a plenary discussion for presentation of small group findings and further discussion.

Besides the plenary and small group sessions, participants will have ample opportunity to interact less formally during breaks and meals.

Following the meeting, the Steering Committee will develop a report, to be published on the meeting WWW site and made available in hard copy. Steps will be taken to ensure its widespread availability in the appropriate communities. In addition, we will define additional mechanisms for dissemination of workshop findings in abbreviated and elaborated form, through newsletters and special issues of journals respectively.

Objectives of the workshop

We wish to achieve a range of objectives at the workshop, within the three goals described above-cross-fertilization, community building, and research agenda setting-and in the context of the four themes. Of course many combinations of disciplines can make strong cases for workshops of this nature. We believe several points make a compelling case for this particular combination at this time:

- The workshop will bring the investigative sciences that deal with landscape change together with the landscape design disciplines. Thus the proposed dialog will be between disciplines already firmly established in the academy, but with very different perspectives on the same phenomena.
- As noted earlier, landscape change and place-based decision-making are currently high on the public agenda.
- The discipline of landscape architecture has long recognized the constructive tension that exists between investigative science and interventionist design, and its familiarity with these issues is valuable to scientists who do not normally address the normative implementation of their results.
- The topic of landscape change offers an excellent opportunity for a dialog of this nature.

Several general questions will be addressed at the workshop:

- What basic research issues are raised by the call for "smart growth", "sustainable communities", and "livable communities"? What do these terms imply about the need for knowledge in the relevant social and environmental sciences, the decision sciences, the information sciences, and landscape perception, and what gaps exist in our current knowledge?

- What are the roles of industry, government agencies, professional societies, and foundations in promoting, funding, and conducting research in landscape change? What mechanisms might foster greater collaboration with the academic sector?
- What are the best structures for conducting multidisciplinary research in this area, and for integrating multidisciplinary perspectives? Do adequate structures already exist, or is there need for new ones?
- What specific research needs to be undertaken under each of the four themes? What research issues should have highest priority?
- What previous efforts among the design disciplines have attempted to establish research agendas (e.g., Palmer *et al*., 1984), and are they in need of updating?
- What do we know about integrating basic research and scientific knowledge accumulation with prescriptive intervention and normative design? What do we know both in general terms, and specific to landscape change?
- What benefits would be gained from designating a set of communities as long-term research sites, comparable to the Long Term Ecological Research sites sponsored by NSF, and now extended to include urban and marine ecology?
- What changes should be made in the curricula of the design disciplines, notably landscape architecture, to reflect recent advances in the four themes of the workshop? What is the state of pre-college education in this area?

Specific issues related to the four themes are discussed in the next sections.

Information technologies

Geographic information technologies have had enormous impact on the process of decision making over the past two decades. One of their attractions is the creation of an *audit trail*- without a clear record of how a decision was made, it is easy to accuse the process of being arbitrary and capricious. Another attraction lies in the ease with which digital information can be communicated and shared with many stakeholders, through the WWW or simple map-making software. Of course there are many counter-arguments (see, for example, Pickles, 1995), but the popularity of GIS among regulatory agencies is indisputable.

By formalizing geographic data in a database and by capturing aspects of the decision process in an audit trail, GIS allows us to begin to address questions of the role of information in decision making:

- What levels of spatial, thematic, and temporal detail are needed to inform effective design?
- How can the benefits of data be estimated and compared to the costs of data acquisition?
- How do the limited representations possible in today's GIS, and in digital systems generally, impact the decision process and the ability of individuals and groups to express their views?

- How can alternative methods of data acquisition, sketching, and other design tools be incorporated into GIS?
- What changes are needed in today's GIS to facilitate public participation in decision making?

Many of these issues have already been discussed in GIS-centered workshops on public participation GIS and related topics. The workshop will bring experts in these research areas together with design experts to build better collaborations between the two communities, and to negotiate a research agenda that satisfies the needs of both. We will collaborate with the National Center for Geographic Information and Analysis to publicize the workshop and to ensure appropriate participation.

Decision making

The decision sciences focus on formal models of the decision making process, and their knowledge is clearly of importance in the design aspects of landscape change. We will solicit participation from this community in the proposed workshop, working through partnerships with appropriate agencies, including the National Center for Environmental Decision Making Research.

Specific questions to be addressed at the workshop include:

- What is the state of knowledge with respect to decision making by communities, and what has been the pattern of success and failure among the design disciplines in applying this knowledge to landscape change?
- What can be done to increase awareness of this knowledge among the design disciplines, specifically landscape architecture and regional planning?
- What gaps exist in our current knowledge that must be filled to improve the practice of landscape architecture and regional planning?

Landscape perception and assessment

Landscape perception is recognized as a significant subfield in several disciplines, notably geography. We will ensure adequate representation from this community at the workshop, working through partnership with the relevant specialty groups of the Association of American Geographers and noted leaders in the field.

Specific questions to be addressed include:

- What is the state of theory regarding human behavior in response to landscape change, and the role of landscape in perception and attitude formation? Do certain groups of people develop different attachments to landscape that affect their way of life?
- What economic effects are attributable to landscape change?

- What do we consider when deciding whether a landscape is "healthy", "livable", or "sustainable"?
- What is the stability of human landscape perceptions (e.g., Palmer, 1997)? How do changes in the environment affect our perceptions? Do we acclimate or adapt to such changes, or do they change our quality of life?
- Are there ways that landscape assessments are used by one cultural group to control another cultural group? To what extent are landscape assessments objective science or cultural interpretations?
- How can landscape assessments be used to help prepare for possibly catastrophic events, such as global climate change? What are possible scenarios in response to global climate change, and how do they affect various populations?

Environmental and social science

In the McHarg model of 1967, landscape architecture integrated reductionist knowledge in the environmental sciences into holistic design. We believe that the workshop can perform a useful function by updating this conception.

- What new areas of science have emerged in the past 30 years that are essential to the practice of landscape design?

- How effectively has the McHarg model been implemented over the past 30 years? What problems have been discovered in its implementation that can be addressed by new initiatives?

- Is the multilayer model capable of addressing questions of the complexity demanded by current conceptualizations? For example, do we know enough about the pathways by which biological and chemical agents generated by urban growth move, disperse, concentrate, etc? Are existing paradigms sufficient to address these questions?

Landscape ecology is one of the disciplines that has particular interest in investigating landscape change. We will work with the National Center for Ecological Analysis and Synthesis to publicize the workshop, and to identify appropriate participants.

Relationship to other activities

The proposed workshop is linked to a number of other activities. Reference has already been made to the FGDC's Community Demonstration Projects, which are investigating the role of information in community decision making with limited funding from the Reinventing Government initiative, and to the NCGIA's Varenius project, which has sponsored efforts to promote the redesign of GIS to meet the needs of communities and to encourage public participation.

Other related activities include the Aurora Partnership, an effort to promote a new generation of GIS tools designed for spatial decision support, and the Open GIS Consortium, a grouping of corporations, agencies, and universities dedicated to the development of open specifications for the next generation of GIS.

Perhaps the most relevant activity is a proposed study by the National Research Council's Committee on Geography and Mapping Science Committee, "A Framework for Place-Based Planning and Design" (see www.nas.edu under Earth Science, Board on Earth Science and Resources, Current Projects). At the time of writing the project was under review by the NRC's Governing Board. As currently proposed, it "will examine the conceptual, scientific, technological, social, and organizational framework for place-based environmental and community planning and design, and will provide guidelines and procedures for successful place-based planning." The proposed work plan includes background papers solicited by the study panel from experts; a workshop to "provide a broader community overview of the topics", and a final meeting at which the panel will review the results of the workshop and develop conclusions and recommendations.

The NRC study's emphasis on the development of guidelines and procedures is clearly complementary to this proposal's emphasis on cross-fertilization, community building, and research agenda setting. Should both projects be approved, they will be fully coordinated, with cross-appointments to the steering committee, cross-participation in the workshop, and other efforts designed to achieve maximum complementarity.

Results of prior NSF support (Goodchild)

Collaborative Agreement SES 88-10917 between NSF and the University of California, Santa Barbara (with subcontracts to the University at Buffalo and the University of Maine) provided funding for the National Center for Geographic Information and Analysis through the end of 1996, with a no-cost extension through 1997. Its objectives were to conduct research in geographic analysis utilizing geographic information systems (GIS); to promote the use of GIS throughout the sciences; to increase the nation's supply of experts in GIS; and to provide a national focus of research, with links to related efforts in other countries. Goodchild was PI on this award. Under this award NCGIA researchers addressed 18 topics, known as Research Initiatives; published 54 books, 646 refereed journal articles, and 734 other articles, and gave 1006 research presentations; developed extensive materials in support of instruction at all educational levels, including the 1990 NCGIA Core Curriculum in GIS; developed and distributed software and data sets; and organized successful international conferences in rapidly advancing areas of research.

The Varenius project, NCGIA's project to advance geographic information science, was initiated in 1997 under Cooperative Agreement SBR 96-00465, with subcontracts to the University at Buffalo, the University of Maine, and the University of Minnesota, and with Goodchild as PI. The Varenius effort is organized into three Strategic Research Areas, each with a panel of internationally known experts: cognitive models of geographic space; computational implementations of geographic concepts; and geographies of the information society. An

Advisory Board oversees the entire project. During the period of the award (2/1/97-1/31/00) a total of nine Specialist Meetings were held, three on topics of the highest priority in each of the three Strategic Research Areas; in addition a workshop on Status and Trends in Spatial Analysis was supported through a supplement. Each meeting included approximately 30 scholars, drawn from all of the disciplines relevant to the topic by an international process of open selection and invitation. Following each meeting, continued collaboration was promoted by programs of seed grants and visiting fellowships. Each Varenius meeting resulted in a report summarizing the state of knowledge in the area and prioritizing a multiyear research agenda. It also resulted frequently in substantial redirection of the interests and collaborative links of the participants, thus helping to advance GIScience.

References

Craig, W., T. Harris, and D. Weiner (1999) *Report of Varenius Workshop: Empowerment, Marginalization and Public Participation GIS.* Santa Barbara, CA: National Center for Geographic Information and Analysis.

Foresman, T.W., editor (1998) *The History of Geographic Information Systems: Perspectives from the Pioneers.* Upper Saddle River, NJ: Prentice Hall PTR.

Longley, P.A., M.F. Goodchild, D.J. Maguire, and D.W. Rhind, editors (1999)*Geographical Information Systems: Principles, Techniques, Management and Applications.* New York: Wiley.

McHarg, I. (1969) *Design with Nature*. Garden City, NY: Natural History Press. McHarg, I. (1996) *A Quest for Life*. New York: Wiley.

Palmer, J.F. (1997) Stability of landscape perceptions in the face of landscape change.*Landscape and Urban Planning* 37: 109-113.

Palmer, J.F., R.C. Smardon, and J. Arany (1984) Summary of the landscape architecture research needs survey. *Agora* (Winter 1984): 17-19.

Pickles, J., editor (1995) *Ground Truth: The Social Implications of Geographic Information Systems.* New York: Guilford.

Position Papers

Participants were requested to submit short position papers for posting in advance of the meeting. These submissions are reproduced here as part of the resource base on Landscape Change. They are included in alphabetical order, as follows:

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Donna Erickson
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L. Susan Everett
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Susan Goltsman
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Doug Johnston
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Jim Palmer
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POSITION STATEMENT

My thoughts and comments on the themes and objectives of the workshop derive primarily from an integrated perspective of landscape planning/design and landscape ecology. I define landscape planning and design here as interventions that fundamentally engage *landscape pattern* - the spatial configuration of landscapes at many scales. In addition, landscape design is informed by scientific knowledge and challenged to provide creative expression and meaning. Landscape ecology is the study of the reciprocal effect of landscape pattern on process, across heterogeneous landscapes, at a range of spatial and temporal scales. This integration of landscape planning/design and landscape ecology is central to the workshop's theme of landscape change, in particular to agenda setting between the *intervention* of landscape design and the scientific *investigation* of landscape ecology. I argue that the integration of landscape design and landscape ecology can be understood as an evolutionary process, with three stages: theory and principles, questions and dialogue, and reciprocal integration (Ahern 1999). I suggest that this process is currently in the second stage and is poised to move to the third stage of full and reciprocal integration in which principles, theory, knowledge and applications flow in both directions. Science informs design and design informs science. A number of challenges remain to achieve this full integration and are included in the following perspectives on the four specific themes of the workshop.

1. Information Technologies

The availability of GIS technology and data to support planning and design activities is outpacing professional's ability to understand or to use it effectively. New methods, tools, and/or interfaces, which operate between GIS and the end-users in planning and design could help by providing:

- Models for simulating, predicting, and visualizing how landscapes can, or might, change in response to alternative: planning, regulatory, management, or design strategies or actions. These models can directly support greater citizen participation in planning for landscape change.

- Tools to locate and use time-series data for specific geographical location(s) including suggested metrics for articulating trajectories of landscape change over time and space (e.g. land cover, species diversity, population, water quality).

- Strategies to "close the loop" on GIS data base development and distribution, to enable data from professional projects to "feed back" into a common spatial data, and knowledge base.

2. Decision Making

A key issue relating to decision making in ecologically-based landscape planning is the dilemma of uncertainty of place-specific information and knowledge. By definition, ecological systems are place-specific, that is, their structure and function is determined by the specifics of the locus, in its most particular physical, biological and cultural sense. While place-specific knowledge is often incomplete, routine planning and design decisions must still be made. These decisions in the aggregate are profound agents of landscape change. Adaptive management is a concept that views this dilemma of uncertainty as an opportunity - to generate new knowledge and data by re-conceiving design and planning decisions as experiments with the distinct potential to contribute new knowledge to science. Clearly, adaptive management is fundamental to achieving a reciprocal integration of landscape planning/design and landscape ecology.

Further discussion on adaptive management should include the following questions:

- What are the limits of the available knowledge and data for a particular decision?
- What assumptions or options can be reasonably based on the available knowledge, if excused from the necessity to be scientifically proven in advance?
- In what situation(s) is adaptive management inappropriate?
- What monitoring protocols are needed to implement and conclude the experiment?
- How can the risks of such "landscape" experiments be understood and minimized?

3. Landscape Perception and Assessment

Much of contemporary environmental planning is strategically conservative. I argue that this perspective is rooted in prevailing public perceptions and reflected in professional assessment procedures in which landscape change is presumed to be a "net loss" in terms of environmental quality, biodiversity, or aesthetic quality. These perceptions are naive, or professionally irresponsible, in a context of global population increase. This defensive posture attempts to "put on the brakes" against the inevitable process of land use change - which is perceived as being fundamentally negative. Resting change *a priori* maintains a polarization between the "doers" and the "protectors" and denies opportunities for more creative and proactive solutions in both landscape planning and design. This polarization needs to be resolved to achieve a full and reciprocal integration of landscape design and landscape ecology.

4. Environmental and Social Science

I argue that the McHargian model of integration of reductionist knowledge to support landscape planning/design has been advanced by landscape ecology. Many theorists characterize McHarg's model as vertical, or topological. It assesses the spatial heterogeneity *of places*, as an informed basis for planning and design decisions. It has been accepted worldwide as a sound and essential analytical process. In landscape ecology, McHarg's topological model is complemented (not replaced) with a horizontal, or chorological model, emphasizing the flow of energy, species and nutrients across landscapes - *between places*. When integrated, the complementary topological and chorological models achieve a deep understanding of landscape pattern and process, at multiple scales of space and time. This understanding is the most promising tool available to understand, analyze and plan creatively for landscape change.

References

Ahern, Jack. 1999. "Integration of Landscape Ecology and Landscape Design: An Evolutionary Process" in *Issues in Landscape Ecology*, John A. Wiens and Michael R. Moss, Eds. International Association for Landscape Ecology, Snowmass, Colorado. 119-123. 1.

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POSITION STATEMENT

Introduction

Understanding land use and associated landscape change is an inter-disciplinary endeavour that requires an holistic approach. The geographic component of land use, recognition of local places as an important element of decision-making, and indivisible role of economic, social, legal and environmental factors adds to the challenge facing communities concerned with landscape change and underpins the recent growth in place-based decision support. Currently Geographic Information Systems often provide the means for information management and visualization in place-based decision making, although the potential for use of spatial information and GIS is much greater. These opportunities include addressing decision-making as a social process and developing technological elements of geographic information use that are sensitive to these social processes.

I elucidate some of these opportunities and associated research based on my involvement with a wide variety of land use issues over the past 21 years, primarily as an interdisciplinary scientist using geographic methods to engage in and manage inter-disciplinary research but also from experience in providing technical support to a decision-makers and communities ranging from supporting government decisions for land use in Scotland, planners and land managers involved in regional and local planning, and citizens and other groups involved in local land use planning and watershed management activity.

Decision-making as a social process and supporting development of technologies

The activities of predicting land use change and developing information to support decisions in land use management and planning, at any geographic scale, are only partially technical. Land use management and planning are primarily creative design activities that take place within prevailing social, legal, political, and economic contexts as well as being concerned with particular resources within specific geographic areas. The role of decision support technology and spatial information science developed for application to land use lies, therefore, within this social process of creation and design and the technological aspects of decision support are most properly designed and developed within this social context. A goal of a spatial decision support system in place-based decision support is thus to facilitate collaboration and communication as part of a developmental social process and thus to play an important social role beyond their construction as technology.

For example, Gallatin County, Montana is one of six Federal Geographic Data Committee's Community Demonstration Projects aimed at demonstrating the value of geographic information in planning at the community level. The Montana State University Geographic Information and Analysis Center (GIAC), for which I am Director, has provided geographic information handling support to this project. A model I personally developed for land use change for Gallatin County based on the recent trends in landscape change is used as the basis for growth projections and to compare with alternative scenarios. The work on this project uses ESRIs ArcView and Modelbuilder to both develop alternative land use scenarios and present results in an easily understood way to different community groups. Increasing access to the technologies and fostering communication between groups while making the GIS easier to use allows discussion to focus on issues rather than technology.

Similarly, the NSDI/NBII Greater Yellowstone Area Data Clearinghouse (GYADC) project, a practical initiative to provide wide public access to spatial data for the Greater Yellowstone Ecosystem, is managed at GIAC. The GYADC has been involved in developing decision support tools as part of the Aurora Partnership, an effort to promote a new generation of GIS tools designed for spatial decision support. One of the first outcomes of the Aurora Partnership was the GYADC working with ESRI and USGS to produce a 2CD Digital Atlas of the Greater Yellowstone Area containing over 400 datasets. This is distributed through the GYADC. It is also on-line at the GYADC and received over 17,000 hits in its first six weeks of operation. The aim of the Atlas is to make geographic information accessible to as wide a community concerned with the Greater Yellowstone Area as possible. The GYADC is now a key center in an initiative to create a Yellowstone to Yukon Data Clearinghouse in collaboration with Canadian colleagues.

As decision support and other systems of analysis and evaluation are developed to contribute to land use management and planning in projects such as the Community Demonstration projects, the study of complete sequences of decision processes, and the role of objective information in support of decisions, is needed. A goal of such studies will be to facilitate links between objective place-based information and the legal, cultural, political, and socio-economic context within which this information is interpreted and used. The presentation and interpretation of scientific information also needs to be considered in these studies, including interpretation and use by a wide variety of communities and groups. For example, experience with the Gallatin County project shows the use of digital spatial information in a planning department is very different than its use in a community meeting or focus group. Greater appreciation of the use of geographic information (and the role of technologies) in these varied social settings needs to be fostered to ensure appropriate use of technology in providing access to information.

Technological elements of geographic information use: data sources, spatial analysis, modeling.

Spatial data, and both spatial analysis and environmental modeling linked with GIS will be increasingly important tools in decision and management processes. Success in addressing land management issues requires integration of technological and methodological approaches to geographic data with understanding of biophysical and socio-economic processes in the landscape across many spatial and temporal scales. Models attempt to encapsulate many of these processes. Geographic information must also contribute to appreciation of the way in which these general processes apply in specific geographic locations to make place-based decision making responsive to local conditions.

There are opportunities to enhance the value of spatial data through spatial analysis, taking account of geographic relationships. The outputs of analysis may be complex and difficult to represent with clarity and simplicity; computational advances create an opportunity for dynamic visualization of spatial processes and temporal effects in a form that the different groups (eg land managers, planners, community groups) are readily able to assimilate.

Technical and methodological developments that will help to address land use issues and decision-making processes include improved spectral, spatial, and temporal resolutions in remote sensing, increased quantity and quality of data from existing and new remote sensing platforms, movement toward interoperability in GIS, and construction of novel modeling methods that focus on provision of integrated understanding of land use systems. The increased availability of software on desktop computer systems and development of the Internet has also led to advances in both accessibility and use of data, advances in applying technology for operational land management, and increased opportunity for wider citizen participation and involvement in decision-making.

The differences in timescales over which decisions have to be made, usually relatively short, and the timescales over which scientists can produce decision support systems or construct and run models, usually relatively long, are also of concern both for successful development of decision support systems and applying models to particular land use issues. Understanding the types of models produced by different groups and the way the models are used to support their concerns will help lead to developing modeling approaches that can be integrated with other tools in GIS. A goal of this integration is to provide tools to a diverse user community and help to reduce the influence of different timescales for model building and decision-making. Developing modular spatial decision support systems containing models, interfaces, and links with geographic databases will reduce the time taken to construct models and any analysis environment needed to address land use issues as they arise. This may take place on a single computer system although the Internet also has a role to play in this form of modular development (as at the GYADC). Increasingly data can readily be found and retrieved from data warehouses and other sources on the Internet. Data clearinghouses provide Internet-based geospatial data libraries with many datasets available online in GIS format. A corresponding catalogue and toolbox of models and other analytical tools would be beneficial. Internet map server technologies may also be developed to provide appropriate analytical results through WWW browsers. This server-based analysis could also facilitate increased participation in land use management and planning through provision of data and derived information to anyone with WWW access and browser software. An example of this is in progress for a geohydrological database of well and septic systems in the Gallatin Valley based on work being carried out between GIAC and the Department of Earth Sciences at Montana State University.

Although such access to information can encourage wide involvement in decision-making, it will require increasing attention to the processes and management of electronic participation.

Scientific community

Establishing and maintaining close links with a variety of scientists working on different aspects of land use is fundamental to these objectives. My own collaborative research experience includes working with plant, soil, and animal scientists, geographers, ecologists, hydrologists, planners, agricultural economists, and sociologists. These links have fostered and encouraged my interests in interdisciplinary land use science and demonstrated the ability of geographical information to act as a catalyst for interaction and communication. This role for geographic information requires attention since it adds to the need for careful management of geographic information resources and scientific programs that have implications for organizational structures.

Integration of biophysical and socio-economic models within GIS is potentially a powerful analytical and management tool with many applications in land use science. This integrated approach to land use issues provides a powerful interdisciplinary link. The theme of land use change and land use management is also central to a book 'Spatial Information for Land Use Management" that I have edited in collaboration with Dr Michael Hill from Australia (to be published December 2000). This advanced level text is designed as a reference based on a series of case studies that document methods and approaches to solve particular land use management problems. The book provides a state of the art description and discussion of the issues involved in use of spatial information for land use management and provides detailed examples of the resolution of these issues in a series of case studies.

Summary

Developing spatial information as part of the process of land use management and planning requires advances in four main areas:

1. A need for improved understanding and framing of the issues involved in land use management. What are the issues involved? What is the contribution of spatial information at different stages of the process?

2. Focusing technological and methodological developments on the data, tool and information needs of land use decision-makers within the decision process. What information is needed to facilitate decision-making? How can technology facilitate wide participation in, and during, the decision-making process?

3. Developing a greater awareness and understanding of decision-making processes, including information needs and use, and the timescales of decision-making. How can development of decision support be part of the decision process? How can development be inclusive? How can the research and development be integrated with the decision process?

4. Developing monitoring and feedback systems that more tightly link the consequences of decision-making with the information provision and analytical processes of technical and methodological developments. How do monitoring and evaluation link with the goals and objectives of a decision? How is the comparison and evaluation of alternatives carried out in an objective and inclusive way?

Focusing on these uses of technology as an integral part of the social process of decision-making will facilitate both technical improvements in data handling and information processing and also lead to decision support systems that are collectively the 'property' of the decision makers and communities.

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POSITION STATEMENT

Introduction

I seek participation in the workshop because it represents a nexus of a number of my experiences and interests. Although I will delineate specific issues below, my overall orientation, in common with the workshop proposal, is that landscape level changes and challenges require collaboration between landscape designers and planners (and others, as demonstrated by I-19 and Project Varenius work on Public Participation GIS) working to envision and guide change and those investigating landscape change. I hope that my twenty years experience in applying spatial technologies to analyze and propose landscape change will allow me to contribute positively to the workshop. Additionally, my role in my new position with the Interdisciplinary Design Institute at Washington State University is to develop and apply GIS and allied spatial technologies to the full spectrum of design scales, from building interiors to regional landscapes. By participating in the workshop, I hope to share and absorb ideas regarding this challenging and exciting opportunity. Below, I briefly outline several more specific interests with respect to the themes and purposes of the workshop, centering on IT technologies. I hope that the selection committee will refer to the included CV for a more general overview of my interests.

Information Technologies

As acknowledged in the workshop proposal, information technologies (IT), particularly Geographic Information Systems (GIS) are fairly commonly available and applied in landscape planning and design. And, in consonance with its inherent capabilities, GIS is useful in all phases of the landscape design and planning process, from project data gathering to data analysis and final output. As a participant in 'public participation' GIS (PPGIS) work in an number of venues and in some of the NCGIA workshops on the topic, I agree that there are issues in common between IT/GIS use in the planning and design process, and their use in PPGIS. But there are differences also. IT/GIS Topics that I see as particularly important in relate to both the substance and the process of the landscape design and planning process include:

GIS for Scenario Development, Analysis and Visualization
Developing and comparing planning and design alternatives is an important part of the planning and design process. Issues include:

- As noted in the Proposal, the availability in IT of 'audit-trails' documenting and justifying proposals is important. Improved IT abilities in this respect are needed and welcome.

- More important still are technologies and methods of developing design and planning proposals and alternatives. Important in this regard are links to various 'objective' databases and models that influence spatial, quantitative and qualitative decisions regarding the intervention. Also important is an understanding of the spatial aspects of environmental and visual quality so that they may be modeled and visualized.

- Additionally, improved collaborative methods of both developing and comparing proposals in different temporal and spatial venues are needed. And in design fields where individual expertise and design skill is valued, how do the dynamics of group collaboration and/or criticism work? Would these dynamics be different between professionals collaborating on projects as opposed to the general public collaborating with professionals? How do we actualize the possibility of 'planning together?' Can or will new WWW and wireless technologies positively affect the design process?

- n additional key ability of IT/GIS is to express and communicate design proposals. I am particularly interested and working on links between GIS based, model or criteria driven scenarios and their expression in 2.5D, 3D and animated modes. Technically, how is this best accomplished? Theoretically how do we understand and evaluate these outputs and their effects on decisions?

Data and Representation.
Landscape designers and planners depend upon micro and meso scale spatial datasets often generated by field and spatial scientists. A number of issues and opportunities exist relevant to their needs:

- A major data need at the micro scale is high-resolution data sets. These include terrain and detailed land use and soils information. Of interest here is the ability to employ new technologies such as multi-return LIDAR to develop needed datasets. Are such data useful and under what circumstances? Can they be employed to populate z and t dimensional micro scale datasets useful to site level planners?

- And, there is an opportunity for designers who conduct fieldwork to employ new portable IT for field mapping, sketching and assessments that can be directly related to existing databases and shared with collaborators. How useful are portable light (PDA, e.g.) computing, imaging and scanning devices for this 'designer data collection' process?

- Finally, I believe it is important to consider classification and representation schemes for data relevant to design. Is the new Land Based Classification System with its multi-valent, objected oriented structure useful? Now that we can, what types of 'smart' landscape representation IT/GIS components might we build, and what sort of smarts should they possess that are relevant to intentional landscape change.

Margaret Bryant

Margaret Bryant
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POSITION STATEMENT

As a landscape architect and environmental planner, I am very excited about the upcoming Workshop in Landscape Change. For the past ten years, my specialization has been ecologically-based planning and design. My experiences have fueled my interests in the functioning of multidisciplinary teams, the use of scientific information in land use decision making, and the role of the landscape architect as a synthesizer and communicator of information.

I recently made the transition from professional practice to academic practice, and, as a junior faculty member, I am in the process of developing my research agenda. I would like to focus on planning communication, and, in particular, communication of scientific information between members of a multidisciplinary team or between such a team and interested stakeholders or the general public. Information technologies, especially data visualization techniques, will be an important component of this research. The vehicle for examining these communication patterns will most likely be case studies of ecological planning projects.

Upon review of the Landscape Change proposal, I was surprised and pleased to learn that my research interests are very similar to the questions identified with the four major themes of this workshop: information technologies, decision making, landscape assessment, and environmental and social science. In fact, many of the issues identified with the environmental and social science theme are directly related to the dissertation that I am completing this winter.

The Landscape Change proposal identifies 1967 as a pivotal point in the history of landscape architecture - the year in which Ian McHarg received a Ford Foundation grant to recruit a multidisciplinary, natural science faculty to the Landscape Architecture Department at the University of Pennsylvania. What has happened since 1967 is the focus of the environmental and social science theme. The proposal asks "what new areas of science have emerged that are essential to the practice of landscape design?" It also questions how the McHarg model has been implemented and asks about problems that could be addressed by the new initiatives. These questions are nearly identical to the questions that I am exploring in my dissertation.

I am examining the evolution of landscape ecological planning from the golden years of the late 1960s and early 1970s to the present day. As part of this critique, I identify the new scientific specialties that have emerged in the last 30 years and explore the relationships, existing and potential, between these fields and landscape architecture.

My dissertation focuses on the recent history of landscape ecological planning, primarily the last ten years, because I have found that most literature about this field addresses the "classic model" of McHarg and his contemporaries and does not address the changes that have occurred since that time. My research suggests that the development of landscape ecological planning has stalled in recent years, and that several new specialties have arisen that share, but do not necessarily duplicate, some of the intent or mission found in the "classic model."

I suggest that landscape ecological planning never responded to the criticisms of rational planning that have dominated planning theory since the 1960s. The failure to recognize the political nature of land use planning is one of the most significant problems with the application of what might be called the "McHarg model." For the most part, the specialties that have risen to prominence in the last two decades, including landscape ecology, have continued to ignore the social and political side of landscape assessment. Addressing the science of landscape change without also addressing the needs and values of people severely limits our ability to influence the pattern and direction of land development.

The need for landscape ecological planning is certainly as great as it was 30 years ago. The rate of landscape change throughout the world is greater than it has ever been. I think that the weaknesses of landscape ecological planning can be overcome, especially through collaboration with fields having similar interests. That is what is so promising about the community-building focus of this workshop. Future progress is dependent on an honest evaluation of where we have been and a clear sense of where we need to go.

The Landscape Change proposal calls attention to today's increased emphasis on information and decision making. The involvement of stakeholders in environmental decision making has definitely increased in the last 30 years. There is a need for research that bridges the gap between the science of the landscape and land use decision making. I think that there is no greater time for this than now, because the very nature of the problems that we are facing has changed.

The environmental problems that we face today are very different than the problems we faced in the early days of the environmental movement. In North America, we have made much progress toward the resolution of major pollution problems. As we move from the problems of point sources to problems that are much more geographically pervasive, like nonpoint source pollution or urban sprawl, we also move away from solutions that are primarily science-based to those that must accommodate the interests of large numbers of people. After all, any proposed solutions to these more widespread problems will affect people in their own backyards to a greater extent than ever before. In short, the complexities of this kind of problem solving place a much greater emphasis on decision making processes and the balance between technical expertise and political negotiations. These changes suggest that this is an excellent time for the kind of dialogue proposed by the Workshop in Landscape Change.

If I am selected to be a participant in the workshop, I can offer an in-depth understanding of landscape intervention both from the perspective of academic research and from professional practice experience. As an environmental planner working primarily in the Atlanta metropolitan area, I have first-hand knowledge of landscape change on a grand scale. Most of my work there involved planning for large-scale municipal infrastructure, including determination of environmental impacts. For example, I was the assistant project manager for an $8 million study of a possible second beltway (circumferential interstate highway) to be located in the Atlanta metropolitan fringe. My work experience has given me a good understanding of multidisciplinary problem solving, the role of science in land use planning, public involvement, and the political nature of land development.

Views on Riparian Buffers: Which Streamside Plants Provide Essential Ecosystem Services? by Alan Covich

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POSITION STATEMENT

Today rivers are more often viewed as complex habitats rather than just pipelines to convey water. The public views streams as providing water supply and recreation as well as fish and wildlife habitat. However, most people do not understand how different types of streamside plants function to modify non-point sources of nutrients from agricultural, suburban, and urban runoff. Nor do many natural resource managers or urban planners fully understand the importance of riparian inputs of leaf litter and woody material that sustain many stream food webs. Yet, riparian restoration and management of plants along streams is one of the most obvious ways that planners can directly influence how streams function. Values and attitudes regarding the roles of native and non-native riparian plants vary widely and are often based on minimizing economic costs and losses rather than optimizing benefits from sustainable ecological functions. Views of the natural landscape, as depicted in photographs and paintings, generally portray streams running through meadows or forests. Parks are designed to simulate these "natural perspectives" while urban and suburban areas often have structured elements to reduce bank erosion, enhance downstream flow, and lower risks of over-bank flooding. But channelized streams are increasingly being viewed as both unattractive and unmanageable. For example, tributaries of the Los Angeles River are almost completely paved but still create problems during periods of El Nino rains. In many regions, wherever roads and rivers intersect there are major problems of culverts being clogged with debris that result in property losses and washout of roadways. Planning to create networks of travel corridors within natural drainage patterns is increasingly incorporating green belts and parkways. These buffer zones can protect floodplains and restore native riparian vegetation. Yet, more specific analysis of large scale, long-term impacts is needed to manage long-lived tree species and many types of aquatic organisms.

Our views on urban and suburban planning are including major efforts to create river walks and to improve or restore rivers. For instance, retaining more natural elements of channel morphology, meander bends, and natural riparian plant communities is becoming more acceptable. "Soft engineering" approaches are being tested along riparian habitats in Europe and North America. Removal of low-head dams is now viewed in many cases as being good management for sustaining native fish stocks even if some loss of hydroelectric power results. Stream ecologists are examining the importance of species-specific roles of riparian plant communities in terms of their ecosystem functions. These studies of riparian plant communities can contribute to a wider view of the value of native plant species and their ecological roles. For example, non-native plants such as tamarisk ("salt cedar") are spreading in western states and often displacing native cottonwoods, willows, alders, and poplars. These native species are also under stress as a result of river regulation and reduction in peak floods that influence riparian tree germination and regeneration. Does the elimination of some native species alter the ways the stream ecosystem functions? Are there measurable values of native species that indicate both their economic and ecological values? There is evidence that the entire hydrology of some drainage basins is being altered by spread of deep-rooted, invasive non-native riparian species. These changes in evapo-transpiration rates by different plant species may be especially important in the future if changing patterns of precipitation result from more frequent El Nino-La Nina events or from global warming. Scarce freshwater resources will require increased riparian management as the continued rapid increases in human populations in arid and semi-arid regions further stress rivers and streams. Flow regimes regulate rates of nutrient cycling and transport of organic materials in streams. Water temperatures are also of critical importance because warmer waters alter growth by different types of stream microbes that recycle nutrients and, in some case, can produce natural toxic substances. Water temperatures are extremely important to determing which types of fish and invertebrates can live in flowing water habitats. Shade from riparian trees influences water temperatures throughout the year so that evergreen or deciduous species have different effects on streams. Different types of trees also alter the kinds and the timing of leaf and wood inputs to streams that are critical to the ecological integrity of these ecosystems. In general, the quantities and types of riparian plants can alter hydrologic and ecological cycles and thereby affect fish and wildlife communities.

A variety of tools are being used to examine these spatial and temporal relationships in planning riparian buffer zones. For example, geographical information systems (GIS) are increasingly effective in relating physical terrain to landuse and the effects of flooding and drought within planning scenarios to seek optimal locations of new development projects and to provide for riparian protection. Terrain analysis provides a basis for examining sustainable riparian habitat because most species respond to different frequencies of flooding and drought that often reflect physical differences in elevation, infiltration, sub-surface geology, groundwater flows, and landuse. The distributions of these riparian communities across the micro- and macro-topography have major effects on runoff and hydrologic connections with groundwater storage. The spread of non-native riparian species is also being modeled to examine how terrain alters rates of dispersal. Numerous digital elevation models (DEMs) already exist that have been created for other uses. These DEMs can also be used to visualize alternative scenarios for riparian habitat preservation or restoration. DEM-base studies illustrate that low-gradient rivers are prone to prolonged and extensive flooding and drought effects while high-gradient rivers are especially vulnerable to drought. The linkage of floodplains, marginal wetlands, and riparian buffers along tributaries requires a hierarchical approach to consider the entire drainage network. Because plant and animal communities often use these drainage networks as corridors for dispersal and maintaining sustainable populations, both upstream and downstream movement patterns typically regulate riparian communities. Road development, housing, and the general increase in impervious surfaces within the drainage area all affect peak runoff and sustainable recharge of aquifers.

Defining how catchments can be better viewed from anthropogenic, biotic, hydrologic, and geomorphic perspectives will provide for an integrative approach for managing ecological integrity of rivers and their drainage basins. Examples of recent studies of public attitudes towards rivers illustrate how visualization techniques and landscape modeling can be incorporated from different disciplines. The Environmental Protection Agency's Community Based Ecosystem Management Program is beginning to use a comprehensive planning initiative to incorporate suggestions and concepts from local community groups on how to define and to achieve goals for improving water quality. The importance of non-point sources of pollution coupled with increased regulation of river flow regimes makes a comprehensive approach essential. Wide acceptance of new methods for enhancing water quality will continue to require integrated methodologies for planning and managing riparian communities. As societal demands for fresh water increases, more storage and river regulation are anticipated. Consequently, the availability of sufficient flows to maintain ecological integrity of entire drainage networks in many areas will likely diminish. Determining equitable allocations for fish and wildlife communities as well as sustainable ecosystem services will require enhanced cooperation and creativity. Understanding how species-specific differences affect riparian communities and how multi-species assemblages are limited by hydrologic variability are just beginning and can be useful. However, resolving social conflicts over alternative uses of fresh water will be an ever-present challenge, especially in the arid and semi-arid western states. A multi-disciplinary effort will enhance success for creating some new concepts to meet these challenges.

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POSITION STATEMENT

Compelling evidence suggests that in recent years human intervention has changed local and regional landscapes and the global environment at an unprecedented rate. That landscapes will continue to change is undeniable. That landscapes will change in ways that support quality of life for human communities and sustainability of natural resources is far from certain. Yet the importance of these goals to the public is documented in various national polls. What is not clear from polls or other sources is exactly what is meant by concepts such as, "quality of life" and " sustainable natural resources," and what "trade offs" people are willing to make to achieve these goals. Given past experiences and expectations for future landscape change, as well as the apparent public interest in related issues, dialog and collaboration between environmentally based research and design communities is both needed and timely. In general, my interest in this area is in how various technologies may be applied to improve natural resource planning and management, environmental decision-making and design, and public policy related to landscape conservation.

It is clear that landscape change is driven by complex social, political and economic interactions occurring within a legal context of local, state, regional, and national regulation and policy. Planning for change typically involves a collection of interest groups or stakeholders. Various actors ranging from individual private landowners and land developers to state and federal land managers implement changes. Those who plan for change often are not those who implement changes in the landscape. All of these factors affect the temporal and geographic scale at which landscape changes occur. Given the complexity of the drivers and actors affecting landscape change the need for interdisciplinary collaboration seems apparent. Planning and design professionals often are responsible to develop and guide decision processes affecting landscape change (comprehensive, land use, regional and urban planning activities). These professionals require the benefit of interdisciplinary collaboration to develop better understanding of how complex natural and social systems function and may be sustained, as well as how people understand the complex interrelationship between humans and their environment and how they behave in accordance with that understanding.

In my experience there are some major disconnects which undermine public needs and desires to maintain and enhance quality of life while ensuring sustainability of the natural resource base. We need tools, approaches, and interventions to bridge gaps between planning activities at the community level (place-based planning activities) and regional planning efforts (especially when the planning boundaries are defined by natural resources, such as watershed rather than jurisdictional boundaries), between planning activities and implementation of those plans in the landscape, and between public land use polices and realization of landscape conservation goals underlying those policies. I believe that we need to promote the concept of environmental planning and design as a comprehensive problem solving process that extends from problem definition through implementation of design in the landscape. Given this context, interdisciplinary collaboration could address some of the following seven issues and concerns.

1. Support an integrated science approach to better understand the structure and function of "more natural" and "more human influenced" ecosystems, and to support the efforts of environmental designers attempting enhancement, restoration, and recovery of these systems. Design of adaptive resource management programs calls for better understanding of natural systems requirements and limitations.

2. Encourage better documentation and dissemination of information regarding current projects, particularly those implementing new technologies or new applications of existing technologies, as exemplified in some current federally funded community building and place-based planning projects. Case studies of this work with stakeholders, land manager, and decision makers could document landscape design principles and demonstrations that accomplish conservation goals and meet human needs and aesthetic desires.

3. Acknowledge and address land use and regional planning processes as ones driven by social concerns that often override environmental matters. Improved understanding may lead to education or design interventions that bring social and environmental concerns into closer alignment. Joan Nassauer's work with farmers in the Midwest to design aesthetically acceptable farming systems supporting landscape conservation is an example of such interventions. In addition, better understanding of these complex interactions would allow development of better landscape conversion models.

4. Establish a better understanding of the effectiveness of public policy initiatives, particularly incentive-based programs, in natural resources management and landscape conservation; and a better understanding of how environmental designers may support these landscape conservation efforts.

5. Beyond research in landscape perception, examine how people behave in various landscapes, the implication of those behaviors, and, as appropriate, potential interventions. Work by Sally Schauman assessing human behavior in urban riparian corridors suggests the importance of such research.

6. Ensure general access to information, develop better understanding of how and when to introduce relevant and meaningful information in decision processes, and provide better assessments of degree of confidence in decisions.

7. Expand the use and effectiveness of existing decision support processes and technologies. Presently advanced technologies allow sophisticated geographic analysis, modeling, and data visualization; however, these tools often are inaccessible to local decision makers. Applying methods from social and behavioral sciences would allow better understanding of how users interact with tools and how technologies impact decision processes. Future efforts should explore methods, technologies, and incentives that facilitate a systems approach to land use and regional planning. Such an approach would emphasize holistic problem solving, create a context for exploring community issues in an appropriate natural resource context (such as a watershed), and incorporate mechanisms for multijurisdictional cooperation.

   The intent of future research in this area would be to develop, apply, and evaluate technologies, planning theory, and environmental decision making processes to support planning and design professionals engaged in processes affecting landscape change. This should be done in ways that: support and enhance stakeholder involvement in decision processes; encourage framing local issues, problems, analyses within a regional context based on natural resource boundaries (rather than jurisdictional boundaries); support multiple use and sharing of data, as well as analysis, and modeling efforts; apply relevant information to enhance understanding, visualization, and alternative scenario development; document the decision process; and make explicit to participants how their values are incorporated in the process and how to evaluate trade-offs.

   To support such efforts, we need better understanding of when and how data and models inform the decision process-how are information and technology used effectively to educate and engage stakeholders in the decision process. How might new tools promote systems thinking, encourage communication and creative problem solving, support exploration of alternatives to meet individual, community, and regional desires and needs? How might existing tools be enhanced to support extension of conceptual planning activities (research and analysis) to design (synthesis, graphical composition, and iteration)? What tools might be employed effectively to support the various actors engaged in landscape change from individual land owners and developers to large scale public land managers?

My interest and commitment to the landscape change workshop is based on both employment and education experiences. For more than eight year as a faculty member in the Institute of Community and Area Development at the University of Georgia I worked with local governments, federal and state agencies, nonprofit organizations and communities throughout Georgia in areas of natural resource planning and management and environmental decision making. In addition, I conducted applied research and taught GIS in the School of Environmental Design. For about the past year and a half, I have worked at Environmental Systems Research Institute (ESRI) as a Program Specialist in software research and development. I have worked with the ModelBuilder and ArcModel design team and am responsible for technology assessment in the field of environmental modeling. Also, I consult on application of spatial modeling strategies and technologies and serve as the team's liaison to

ESRI's user community by participating in various meetings and conferences regarding tools for community decision support. In addition to my work at ESRI, I currently am engaged in dissertation research involving land use conversion modeling and incentive-based public policy initiatives for landscape conservation in a small and rapidly urbanizing watershed north of Savannah, Georgia.

Donna Erickson

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POSITION STATEMENT

Landscapes change in response to natural systems, in response to the actions of individual humans, and in response to socio-political structures. In turn, natural systems, individuals and social groups are affected by changing landscapes. This complex cycle creates dozens of intersections where the social and natural sciences meet the design and planning professions. This model is admittedly weighted toward the 'people' part of landscape dynamics, but is not meant to suggest that an anthropomorphic view is superior. It is merely one perspective on the interface of*intervention* and *investigation*.

As a landscape architect, in collaboration with a number of social and natural scientists, my academic work has drawn me into these three domains of natural systems, individuals, and socio-political groups over the past fifteen years. Large-scale landscape change has been at the core of those pursuits. My research has examined landscape structure, change and decision-making in the rural and urbanizing landscapes of North America and the Netherlands. I have conducted a number of studies that help explain both land-use change and stakeholder factors within a typical midwestern agricultural watershed. Recent work has involved greenway corridor planning, design and implementation, with an emphasis on comparative institutional structures in metropolitan regions. I am particularly curious about the range of disciplines that can inform decision-making, especially at the land-use planning scale. My premise is that the disciplinary 'landscape' has changed dramatically, especially since Ian McHarg's model of the late 1960s.

Natural Systems and Landscape Change

Over several decades, a number of disciplinary areas have emerged to help inform the natural systems and landscape change nexus. Research in landscape ecology, conservation biology, restoration ecology, and ecosystem management is forwarding the science of landscape change and the practice of landscape planning. However, we are only in the first stages of applying the knowledge from these disciplines.

Landscape ecology is especially important for understanding landscape dynamics and for informing the way we design and plan landscapes at all scales. As depicted by a number of scholars, landscape ecology helps us understand the structure, function, and change over space and time in heterogeneous landscapes. While this science has profound relevance to sound design and planning, we have only begun to merge landscape ecology into the routine practice of landscape architecture and planning. We need further research that relates findings in landscape ecology to land-use decision making. This research can influence the rate, type, location and pattern of landscape change in various contexts. Clearly, information technologies have an extensive role in this inquiry.

Individuals and Landscape Change

The social sciences have been critical for helping designers and planners understand relationships between individuals and landscapes. For example, the fields of environmental psychology, conservation behavior, environmental education, human ecology, and cultural geography have contributed significantly to our understanding of human needs, attitudes, motivations, perceptions, participation, actions, and health.

The connection of individuals to the landscape has a considerable influence on spatial patterns and processes. We know that humans are intimately tied to the land. Has this connection weakened in an information age? What meaning does that have? How do people understand and organize the spatial world? Building on the lessons from the socio-behavioral disciplines, we need work, like that of William Whyte (1980) and others, that critiques and analyzes built landscapes at all scales, according to criteria that emerge from humanistic knowledge.

Socio-Political Groups and Landscape Change

Environmental work in the social sciences has come of age over the last thirty years and landscape/land-use change is one important context. Research in environmental justice, environmental policy, environmental sociology, land-use law, and cultural theory all have been related to changing landscapes. These disciplines, while not solely interested in spatial impacts, provide critical insights about the physical landscape, especially with the application of new information technologies. However, these connections need to mature and develop.

Through my teaching and research in recent years, I am drawn to questions that probe the connection between human groups and landscape decision-making. For instance cross-cultural comparisons help us understand the relationships between cultural norms and landscape change. Work that examines other cultures' expectations, and the landscape outcomes of those expectations, helps put into context intrinsic assumptions about North Amerians' rights and responsibilities.

Furthermore, there is a clear need to document and model the outcomes of innovative land-use planning programs at all levels in a domestic context. For instance, where we know a great deal about the effects of particular planning tools and techniques in community decision-making, we know very little about the *combinations* of characteristics and tools that achieve positive landscape change. Research is needed which links landscape planning more explicitly to the legal and political frameworks for change, in a climate where almost no intervention is spatially neutral. Interdisciplinary work with scholars in law and environmental policy will be particularly important. In states, such as mine, with a poor capacity for land-use planning (i.e. weak legal and political structure for proactive growth management), landscape architects and planners are particularly handicapped.

In addition, we have only begun to develop collaborative possibilities among various actors, decision-makers, and stakeholders in landscape change. Some of my work has attempted to model the institutional structures that influence landscape change objectives (in the context of metropolitan greenway networks). Much more research needs to be done to explore collaborative planning for landscape change. Working with political scientists and environmental sociologists, we will develop innovative contexts and methods for collaboration.

As I consider the charge of this workshop on landscape change, I retrace a link from Ian McHarg to his Scottish predecessor, Sir Patrick Geddes. In the study of urbanization, Geddes believed that social processes and spatial form are intimately related. A self-proclaimed generalist, Geddes' excelled in relating biological knowledge to civic welfare, focusing closely on the spatial relationships of the city and country. "His widespread interests were not the result of a pursuit of pure knowledge, but an attempt to clarify and emphasise - in an increasingly specialised world - the inter-relations between all branches of knowledge for the benefit of human life" (McGrath, 1996). Sir Patrick Geddes' goals of a century ago - holistic, interdisciplinary, experiential, problem-solving approaches - may be needed to merge *intervention* and*investigation* in the new century.

REFERENCES CITED

McGrath, J. (1996) 'The Life of Sir Patrick Geddes', The Papers of Sir Patrick Geddes at Strathclyde University Archives, University of Strathclyde.

Whyte, W. (1980) *The Social Life of Small Urban Spaces*. World Wildlife Fund.

Landscape Change/Landscape Dynamics
by Stephen Ervin

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POSITION STATEMENT

Landscape Change/Landscape Dynamics

Landscape Change

Landscape Change is important to model, and study, because its inevitable. Landscapes are dynamic. Indeed, their dynamism is one reason why the disciplines of landscape architecture and planning have been slower and less able to adopt basic computer-aided technology (CAD, GIS, others) than fellow professionals concerned with modeling buildings, bicycles, and other static objects. But modern computer technology is getting better at modeling dynamic systems, and landscape ecologists, planners, designers, geographers et al. Need access to these techniques.

Landscape change takes place across scales of time and space. Diurnal change includes light and shadow variability, and attendant plant motion, as the sun makes its way across its path. Instant-scale motion of the landscape ranges from leaves rustling in the breeze, to cataclysmic landslides and flash floods. Seasonal variation colors the landscape with foliage and precipitation-induced colors including snow and dust. Longer-term changes include vegetative succession, erosion and dune-motion, and even longer term may include sea-level rise and glacial approach.

In the built environment, we see analogous dynamics: instant, daily, seasonal, annual and longer term, both cataclysmic and gradual. City streets bloom with cars, crowding out and killing trees; agricultural fields sprout single family dwellings; small mountain ranges give way to large subdivisions.

To model and study these changes, we need better digital laboratories. Object-oriented models of interactions need to be augmented by 'field-oriented' systems that can handle the relationship between trees and forests, individuals and species, water droplets and streams. Spatial models are notoriously lacking in temporal features; GIS software needs a few extra dimensions, and a lot of new operators. Basic science, whether in landscape ecology or economic geography must be coupled with new insights in regional planning, transportation systems and landscape design, among other disciplines, to inform the models that form our best ways of testing hypotheses and evaluating alternatives.

Landscape Dynamics

Landscape dynamics can be approached and studied through three major forms of dynamics:

- motion *through* the landscape
- motion *of* the landscape
- interaction *with* the landscape

Motion *through* is perhaps the easiest to model with digital computers, as in the ubiquitous walk-through's and fly-overs now produced by designers and planners as a matter of course. In this sense, landscape change is a perceptual/phenomenon. Motion *of* is harder, but we now have software and data structures capable of modeling inverse kinematics, and new techniques for embodying physical laws (gravity, friction, etc.) in digital models. Modeling plant growth and succession is possible; doing the same for suburbs is a bit more daunting, but is part of the challenge. *Interaction -with* is an open area of investigation with respect to modeling landscape change. What are the interactions; who are the players? As we explore these questions we increase the store of models, data types and algorithmic techniques.

Modeling landscape change is an enterprise uniquely well suited to digital computers and computing techniques. Time and space can both be made elastic, as with the levels of detail in representation. All these techniques are necessary.

Gary W. Evans

Gary W. Evans
Cornell University

POSITION STATEMENT

A frequent concomitant of landscape change is poorer quality of life produced by increased exposure to chaotic living conditions as manifested in exposure to multiple stressors. The traditional approach to the study of environmental stressors has been to examine their individual, unique impacts. Just as Ian Mc Harg discovered many years ago, the distribution of suboptimal physical and social conditions is not random. Moreover it is possible to examine the convergent impacts of multiple stressor exposure.

For example, low income children and their families are exposed not only to higher than average levels of crowding, noise, inadequate housing, deteriorated neighborhood conditions, air pollution and hazardous wastes, they are also substantially more likely to face multiple combinations of these environmental problems. Analogously the poor are much more likely to have fractious family settings characterized by turmoil, separation, and exposure to crime and violence. Recent research also indicates that some of the negative impacts of poverty on child development are conveyed by exposure to multiple physical and social stressors. Specific studies also show that when one is exposed to multiple versus single stressors that the effects are cumulative. Two recent studies of crowding for example show that the negative psychological distress effects of high residential living are exacerbated by the presence of social stressors in the home. Families with more social demands (e.g. poor housing quality) or those with more tumultuous interpersonal relationships suffer greater psychological distress from crowding than those who face crowding alone. Parallel multiplicative effects have been noted for chronic exposure to noise and air pollution respectively and psychosocial stressors.

Chaos or the convergence of multiple, largely uncontrollable stressors has multiple psychological, social, and physiological impacts, many well characterized by stress. Psychological distress, particularly anxiety and depression, are elevated in concert with chronic stressor exposure. Interpersonal relationships are strained and a typical response is social withdrawal. There is also evidence that social withdrawal may help explain elevated psychological distress among those exposed to higher levels of environmental stress. People who are exposed to chaos also appear to have difficulty regulating their emotions and seem more helpless. Low income children, for example, show markedly lower ability to delay gratification in return for a more positive but subsequent reward. When provoked, low income children have a harder time restraining aggressive responses. Helplessness in the face of chronic stressor exposure has been documented in numerous studies of motivation in task or achievement situations. For example, children chronically exposed to noise are more likely to give up and not sustain effort on challenging, age appropriate puzzles that other children find fun and enjoyable to work on. Individuals with chronic experiences of chaotic living environments also manifest elevated neuroendocrine hormones (e.g., cortisol, epinephrine) as well as heightened cardiovascular activity (e.g. blood pressure) that appear to reflect sustained efforts to cope with demands from the environment. The body is capable to sustaining prolonged exposure to the demands accompanying chaos, but the costs are substantial.

There are at least two ways in which landscape change and chaos are related. First, as indicated above, decreased landscape quality likely is accompanied by elevated chaos. I suspect that low income families as well as ethnic minority individuals on average are exposed to poorer quality landscapes and are more apt to experience rapid, unpredictable, and uncontrollable landscape change. Second, high quality landscapes may provide some counter forces to help buffer the harmful effects of social and physical stressors. Both laboratory and a few field studies suggest that the restorative effects of nature include enhanced coping with stressors. A good view of nature, access to a nearby park, or the presence of other positive environmental elements may help counter the well documented adverse impacts of stressors. One of the things we do not know is whether such experiences, analogous to multiple stressor impact, are cumulative nor do we understand whether they have chronic impact. Acute stress is diminished in the presence of quality landscapes.

Another important and largely unresearched topic is the developmental consequences of early and sustained experiences with landscapes of varying quality. Does an early bond with nature lead to more biocentric values and ethics which in turn appear to be related to pro-ecological behavior? Do children who grow up in settings largely bereft of nature suffer greater vulnerability to the harmful effects of chaos that may also surround them? How are parent-child interactions affected by the environmental quality of the parent's immediate setting? Teachers in noisy schools report more exhaustion, less patience, and greater difficulty motivating themselves and their students to learn. Parents in crowded homes are less responsive to their children.

On a brief methodological note, we need to be more cautious about controlling for income and other indices of social class in landscape perception and assessment research. If some of the negative impacts of poverty are mediated by exposure to chaotic social and physical environments, by controlling for SES we may be missing an important dynamic. Rather than eliminating or treating SES as a nuisance in our models, we might, instead, consider what role landscape plays in mediating or moderating the well documented negative impacts of poverty on physical and psychological health.

Tom Evans

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Indiana University

POSITION STATEMENT

Landscape change is a highly complex process driven by interactions between numerous social, biophysical and institutional factors. Research conducted through the Center for the Study of Institutions, Population and Environmental Change (CIPEC) at Indiana University examines the affect these different drivers have on deforestation and afforestation across sites in North, Central and South America. CIPEC approaches the process of landcover change from a inter-disciplinary perspective drawing on theories and methods from geography, ecology, anthropology, political science, demography, psychology, economics and environmental science among others and the CIPEC research team has representatives from each of these disciplines.

Several research themes form the foundation of CIPEC research. The core methods of CIPEC involve the integration of social survey data with remotely sensed landcover data and, critically an attention to the impacts of spatial and temporal scales in data collection and analysis (Evans et al. 2000, Moran et al. 1999). Previous research has shown a scale dependence to social-biophysical interactions, including landcover (Walsh et al. 1999). CIPEC research draws upon this foundation to understand the context of local-level phenomena within regional-level dynamics.

Landcover change modeling can provide insights to the process of landcover change where empirical research is limited (Evans et al. forthcoming). There are a large number of modeling approaches and these have been summarized in a forthcoming CIPEC/USFS working report (Agarwal et al. 2000). This review of over 100 publications of landcover change modeling research evaluated models in terms of how they address space, time and human-decision making. What is critical is to develop landcover change models that adequately address human-decision making, an area of research that is under-represented and relatively undeveloped compared to other areas of landcover change modeling. This gap will in part be addressed through a NSF funded initiative at CIPEC titled "Agent-Based Models of Land Use Decisions and Emergent Land Use Patterns". This research will use agent-based modeling techniques to construct spatially explicit landcover change models that address different agent or landholder behavior. The economic and ecological function of these modeled landscapes will be evaluated through spatial pattern and compositional metrics.

This research explicitly addresses each of the themes of the workshop: information technology, decision making, environmental landscape perception and assessment and social science. Other activities by myself with other CIPEC researchers that address these themes are a recently completed Social Assessment of the Hoosier National Forest (Welch et al. 2000). This social assessment involved a historical survey of socio-economic dynamics in south-central Indiana and a survey of key stakeholders involved in the use of Hoosier National Forest (south-central Indiana). This research explored several research questions including how different individuals view the management of public lands differently and view other users of the Hoosier National Forest. GIS techniques were used to address differences in the region and how these sub-regional characteristics complicated the management of the Hoosier National Forest.

Lastly, Indiana University and UCSB have recently been conducting a series of video-conference meetings in coordination with a seminar Jim Proctor is teaching on Environmental Social Science. We have held two of these video-conference sessions and have already explored interesting new aspects of the theoretical foundations of population-environment research and the science of conducting multi-disciplinary research. These discussions have included theories from geography as well as political science, anthropology, environmental science, demography. What is particularly interesting is how to apply multiple theories in a single research project composed of team members from several disciplines.

The goals of the workshop are ambitious but important. In particular, a means of facilitating multi-disciplinary research are critically needed. More research funding explicitly addressing multi-disciplinary research is one way to fill this need. Disciplinary boundaries certainly do not help the cause of multi-disciplinary research. Additionally, there a variety of incentive structures that serve as obstacles to multi-disciplinary research in some fields. These incentive structures will hopefully be addressed and explored in the workshop.

PUBLICATIONS

Agarwal, C., G. L. Green, M. Grove, T. Evans, and C. Schweik. 2000. A Review and Assessment of Land-Use Change Models: Dynamics of Space, Time and Human Choice. CIPEC/USDA Working Paper. Center for the Study of Institutions, Population and Environmental Change. Indiana University.

Evans, T. P., Manire, A., De Castro, F., Brondizio, E. and McCracken, S. (forthcoming). A Dynamic Model of Household Decision Making and Parcel Level Landcover Change in the Eastern Amazon. Ecological Modeling.

Evans, T. P., Green, G. and Carlson, L. (2000a) Multi-Scale Analysis of Landcover Composition and Landscape Management of Public and Private Lands in Indiana. In *Remote Sensing and GIS Applications in Biogeography and Ecology*. A. Millington, S. Walsh and P. Osborne (editors). Kluwer Publications.

Grove, J.M., C. Schweik, T. Evans, and G. Green. (2000). "Modeling Human-Environmental Dynamics." In Geographic Information Systems and Environmental Modeling. Clarke, K. C., B.E. Parks, and M.P. Crane (Editors.) Prentice-Hall.

Hoffman, M., Kelley, H. and Evans. T. 2000. Micro Behavior and Macro Landcover Change: Simulating Deforestation and Reforestation in Indiana over Two Centuries. Paper presented at Microbehavior and Macro Results conference Coralis, Oregon. Sponsored by International Institute of Fisheries, Economics and Trade (IIFET). July 11-14, 2000.

Moran, Emilio, Elinor Ostrom, and J. C. Randolph. In press-a. Ecological Systems and Multitier Human Organization. In *UNESCO Encyclopedia of Life Support Systems*. Oxford, UK: EOLSS Publishers.

Walsh, S. J., Evans, T. P., Welsh, W. F., Entwisle, B., Rindfuss, R. R. (1999). Scale Dependent Relationships between Population and Environment in Northeastern Thailand. Photogrammetric Engineering and Remote Sensing. Vol. 65, No. 1. pp. 97-105.

Welch, D., Croissant, C., Evans, T. and Ostrom, E. 2000. A Social Assessment of the Hoosier National Forest. CIPEC/USFS Technical Report. Center for the Study of Institutions, Population and Environmental Change. Indiana University.

John A. Gallo

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POSITION STATEMENT

I believe that our society is at a crossroads regarding landscape change. We have the option of preserving ecological integrity while accommodating human needs, or of simply accommodating human needs. Fortunately, many people are working towards the fist option. I believe combining landscape change modeling and public participation GIS within a decentralized, regional-based paradigm will be essential for success.

The tenets of regionalism and bioregionalism are central to my philosophy. Namely, the people of a place have the greatest stake on how it is managed, know the most about it, and will attain regional solutions if empowered to do so. Regional solutions can then be connected towards global protection. The Presidents Council on Sustainable Development has found that this movement is underway, as the U.S., and much of the rest of the world, moves toward more decentralized decision-making. President-elect Bush is emphasizing his decentralization plans. However, there are central dilemmas to regionalism that must be addressed if this shift is to be successful. Perhaps the most pressing issue is whether locals have the expertise and values to make land-use decisions that are wiser than those offered by our current bureaucratic and political system. How can local communities be empowered with knowledge to create wise decisions? How can higher government provide knowledge, as well as checks and regulation to communities?

As a result of the trends in regionalism, I believe that there must be a generation of landscape change models that do two things and do them well: 1) incorporate local expert knowledge while being easy to teach and pass off to locals, and 2) provide adequate mechanisms for explaining, assessing and preserving ecological integrity. I will be examining both of these components in the upcoming years.

The key to the first component is Public Participation GIS (PPGIS)-- the integration of GIS within participatory research and planning, leading to local knowledge being incorporated into GIS production and use. I will work with a committee of local experts-biologists, planners, and conservationists-to identify the thresholds/parameters of the landscape change model we use, to identify new data sources, and to evaluate and improve upon the model and data outputs. Involving the locals will decrease the delay between scientific understanding and public implementation by facilitating the creation of a long-term regional vision.

Ecological integrity, the subject of the second component, can be defined in many ways, including "the protection of total native diversity (species, populations, ecosystems) and the ecological patterns and processes that maintain that diversity". An accepted landscape for protecting ecological integrity is the reserve design concept of having core protected areas, connective corridors, and multiple-use buffer areas. I agree with Reed Noss that the best mechanism for protecting ecological integrity is to merge three "streams" of analysis: 1) representation analysis 2) focal species modeling, and 3) special element mapping. Representation analysis identifies a landscape that would protect at least a minimal amount of all habitat types. Focal species analysis identifies the areas and connective corridors necessary for protecting focal species-- organisms used in planning and managing reserves because their requirements for survival represent factors important to maintaining ecologically healthy conditions. Special element mapping is the identification of those areas that are biodiversity hotspots but are not addressed by the previous analyses, due primarily to scale and data availability issues.

In summary, I believe that ecoregional planning via local communities will soon be an essential driver of landscape change. Thus, we need to improve the techniques for including local experts in the modeling exercise, and we need to improve the technique for assessing and conserving ecological integrity. I am attending this workshop in order to insight towards my research goals and to share my ideas with people pursuing a similar strategy.

Karen C. Hanna

Karen C. Hanna
Utah State University

POSITION STATEMENT

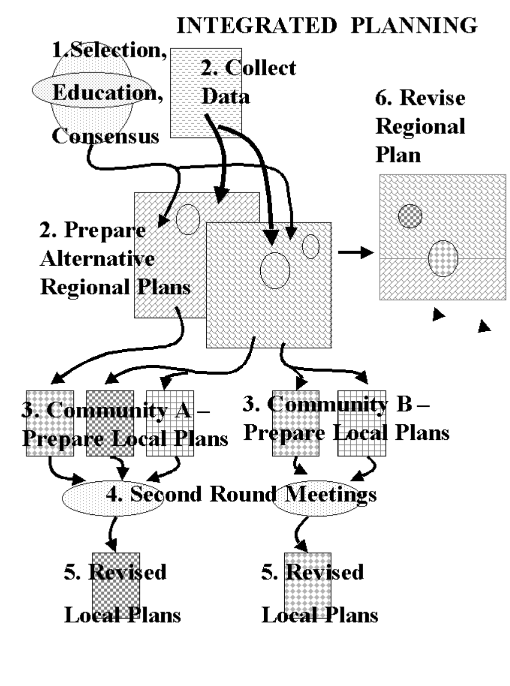
Consider the following:

1. Large scale planning addresses natural systems, cultural resources and infrastructure, but these regional plans can seldom be implemented in the US due to a lack of enabling legislation.

2. Community scale planning and related design projects can be implemented, but there is no incentive for communities to incorporate elements of regional planning proposals.

3. Communities often do not follow through on planning efforts because support is not widespread enough, and proposals change with administrators and politicians.

Can these statements serve as the basis to improve the effectiveness of planning? An alternative approach puts more emphasis on community inputs to the overall process and integrates more diverse experts than are currently used. This model provides linkages between regional and community scale planning, as well as informed input by citizens and stake-holders.



1. Educate the citizens and the stake-holders: hold preliminary community meetings and broadcast documentaries that:

a) Educate citizens about natural systems in the region (broad brush), and about demographics and economics of the community and the region. Produce video and on-line materials showing opposing or multiple points of view.

b) Arrive at consensus on goals without regard to particular parcels. Focus groups, charettes, and/or community forums need to precede facilitated consensus sessions (Hitchcock and Willard, 1995). Where appropriate utilize preference studies. Allow citizens to complete questionnaires on-line about attitudes, and let the questionnaires serve as summary guidelines for consensus meetings, to be attended by the stake-holders.

2. Collect data and prepare regional scale plans that identify critical portions of natural systems (nodes, corridors, basins for water sources and recharge, flood protection, soil protection, wildlife habitat, visual resources, historical resources, agricultural integrity (Lewis,1996, Arendt, 1994). Where alternatives exist test several in the community scale plans noted below (feedback loop).

3. Prepare preliminary community master plans incorporating critical areas identified in regional plans. Adopt conservation easement programs, development rights swaps, land trusts, etc. in order to facilitate protection without punitive measures to public and private landowners. Incentives for local communities could include funds (for planning and design services, serving those who apply and proceed early), selection from alternative critical zones at the regional level by those who engage early in community planning, federal and/or state appropriations to those who incorporate regional proposals in their community plans.

4. Conduct second round of community meetings during local planning exercises to identify specific issues: changing demographics, community growth rate, response to economic conditions. Most people will opt for a balance of environmental protections and economic activity, but the mix will vary among the population. Since the precise mix of environmental and economic protections is difficult to describe, quantify, and predict outcomes for, planners must develop better models, monitor land supply and capacity (Moudon and Hubner, 2000), utilize the most up-to-date data when applying the models.

5. Revise community plans to include goals for economics and natural conservation. The key to success at this step is to offer better solutions: more innovative solutions based on informed decision-making. How can we improve our models to accurately respond to the stated goals of the community? By making the models more interdisciplinary, by inputting better data through more sophisticated monitoring of changing conditions, doing field checks and common sense checks throughout. Develop phasing and action plans, ongoing monitoring programs and operating proposals.

6. Complete the planning loop by incorporating community plans into regional plans.

References:

Arendt, Randall, 1994, Rural by Design: Maintaining Small town Character, Planners Press, American Planning Association, Chicago, IL

Hitchcock, Darcy E. and Willard, Marsha L., 1995, Why Teams Can Fail, and What To Do About It, Chicago, Irwin Professional Publishing

Lewis, Phillip H. Jr., 1996, Tomorrow by Design: A regional Design Process for Sustainability, John Wiley & Sons, Inc. New York, NY

Moudon, Anne Vernez and Hubner, Michael, Monitoring Land Supply with Geographic Information Systems, Theory, Practice, and Parcel-Based Approaches, John Wiley and Sons, Inc., New York, NY

Kristina Hill

Kristina Hill
Department of Landscape Architecture
University of Washington

POSITION STATEMENT

In general, my work with landscape change has addressed problems and issues that arise in the context of urbanizing landscapes. I am primarily interested in thinking about spatial strategies as they might be used for various purposes: conserving biodiversity, maintaining or increasing human health, and making investment decisions that affect the development of urban infrastructure. I have been involved in both the analysis of landscape patterns as they change over time, and in proposals for landscape change -- particularly involving the ecological performance of urban landscapes. My research has addressed empirical models of landscape change, theoretical bases for landscape pattern analysis, applied models for landscape pattern classification, and urban infrastructure design.

Overall, I am most concerned about two issues related to landscape change, both of which I see as "on the horizon" -- i.e., they are likely to be more important in 25 years than they are today. The first, biodiversity loss, is a common issue that many of us are concerned about. But in urban areas, this concern is more complex than it might seem at first glance. Some academics and policy makers feel that it is not possible, and perhaps not desirable, to conserve the characteristic biodiversity of a region within its urbanized areas. They wish to focus conservation efforts on the least disturbed habitats first, to ensure that those will be present in the future. Yet urbanization is spreading so quickly in some metropolitan regions that it is difficult to imagine the possibility of conserving biodiversity without addressing it in urbanized areas. I am interested in using physical planning to conserve biodiversity in urbanized (and urbanizing) areas by building infrastructure in new ways, and by developing new prototypes for marketable housing that "perform" better ecologically.

The second issue I am most concerned about is the connection between the health of organisms, both human and non-human, and the degradation of ecosystems. Human health has, in some famous examples, been affected by the degradation of other species' habitat (here I refer to arguments that (1) the AIDS virus originated in monkey populations in West Africa, and that it gained strength in part because the habitat resources of those monkeys were reduced by human land use, and (2) that Lyme disease is widely carried by ticks on the eastern American deer population in part because of a historical shrinkage in deer habitat). The health of humans and other organisms has also been affected by the disposal of human wastes in marine and estuarine environments, and by contamination of groundwater. We know so little about microbial diversity and ecology that we are currently unable to detect trends in their diversity that may be driven by human land uses, the complexity of their role in ecosystem functioning, or the risks they pose to humans. I am therefore interested in a re-examination of human health concerns in a genuinely ecological context, one that considers the relationships between landscape change and host-parasite dynamics.

My current research work is structured so that I will, with luck, be able to eventually address those complex issues using empirical data. Together with several other researchers, I am working to classify and map the spatial patterns of vegetation and urban development in the Seattle metropolitan region. As we gain a better understanding of those patterns, and experiment with alternative techniques for classifying and analyzing that landscape, we hope to draw some conclusions about the influence of particular urban patterns on ecosystem functions. In order to examine these influences, we are tracking specific bird population dynamics and indicators of the ecological "health" of aquatic ecosystems in locations that represent our desired range of variability in urban spatial patterns.

In my applied work, I operate as a consultant with policymakers at several jurisdictional levels to identify opportunities to map and measure landscape change that is relevant to processes which are regulated, such as stormwater runoff and non-point-source pollutant discharges, or the costs of urban infrastructure expansion, or the conservation of habitat for threatened and endangered species. I see these efforts as a significant factor in the development of my research agenda, and in the evolution of the conceptual models I use to frame empirical investigations of changing landscapes. The applied policy settings remind me of the need for strategic decision making, and the need for research results that can aid in making strategic decisions. That returns my focus to the question of whether there are some landscape processes, and some landscape patterns, that matter more than others. If so, then change over time in those strategically-significant patterns and processes may matter more than change in other patterns and processes. And interventions that restore or strengthen those patterns and processes may be easier to justify in an environment of limited budget resources.

The skills and experiences I bring to my work are eclectic. They include a theoretical background in the logic of category formation and the use of different kinds of categories in computation, experience in measuring landscape ecological pattern using widely-published metrics, experience working with remotely-sensed images to classify urban landscapes, and practical experience as an advisor to land developers and policymakers on identifying strategically-important landscape patterns. Meanwhile, the philosophical issues that frame my priorities include an ethical position that the continued existence of non-human species, of all kinds, is critical in part because their existence helps us learn what it is to be human beings; that it is unethical to promote landscape change as a historical necessity, at the expense of particular human groups; and that all humans have a right to live in environments that support human health, regardless of their economic status. I consider it critical, given these influences on my own thinking, that we approach the description, analysis, and prescription of landscape.

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University of Illinois at Urbana-Champaign

POSITION STATEMENT

My interest in landscape change is an aspect of my interests in planning support systems: 1) representations of plans and consequences that incorporate time, space, and uncertainty, 2) modeling environments that can work with different models of the same and related phenomena, 3) interfaces for sketching and collaboration.

1. Landscape Change as Distributions Contingent on Proposed Actions

Zoning affects landscape change, but does not determine a unique spatial temporal pattern of landscape change. A transport or sanitary waste network plan implies a contingent set of actions, which parameterize a distribution of patterns of landscape change. When considering the implications of alternative plans, however, all actions are taken as determined rather than contingent and one pattern of landscape change is predicted. Zoning regulations should be evaluated with respect to a distribution of patterns of landscape change that might result. Transportation network plans should be evaluated with respect to contingencies in how the network actually develops given the plan, which implies a contingent actions interacting with a distribution of patterns of landscape change.

The ability to model and visualize landscape change in relation to plans should show how contingent actions relate to uncertain consequences. How can properties of distributions of landscape change scenarios be presented for interpretation? How can similarities and differences among such distributions be measured and interpreted?

2. Modeling Environment

Models are representations that inherently focus attention on some things and not others. Large, integrated models are so difficult to create that if such a model is created there is no way to test it or use it because there is nothing to contrast it with. As a general principle, if it is not possible to build at least two different models then it is not worth building any such model. It is therefore important to create computing environments in which several different types of models can be run as complements, replicates, or contrasts. If landscape change is modeled as plant succession, it should also be modeled human activity. If ecological change is modeled with cell based differential equation models, it should also be modeled in a different way, such as continuous surface models. Computing environments for such modeling require data structures through which different types of models can interact and translations that allow models to share inputs (as complements focused on different processes or replicates modeling the same phenomena in different ways), covert outputs to inputs (to link models), and translate outputs for valid, comparative interpretation.

3. Interfaces for Sketching and Collaboration

Current computer interfaces are imitations of typewriters not drawing boards. A keyboard is a familiar direct interface for writing words but not for sketching ideas or phenomena as diagrams or spatial patterns. Even a mouse or pointing device is still indirect because drawing is in one place while display is in another. This separation and the precision of pointing requires too much concentration to think while drawing. It is not surprising, therefore, that most graphic input to computers is description after the fact of ideas generated on pencil and paper or on whiteboards. GIS has brought data manipulation capabilities but there is not a sketch interface to take advantage of such capabilities while thinking.

At the University of Illinois at Urbana-Champaign, we are developing a drawing board interface using a rear projection, 36" by 48" horizontal or drawing board tilt, touch sensitive Smartboard. This interface enables direct sketching by finger or marker, without the indirect pointing or required precision of a mouse, on a drawing board that can display anything that can be shown on a computer screen. We have built the physical device and have begun development of a much simplified, direct drawing interface that feels like sketching rather than like manipulating a computer GUI. This interface is a major opportunity to reunite the design approach, from which much of current GIS work arose, with the analytical capabilities of our current GIS and simulation software.

We are also using this interface as the basis for research on collaboration that includes small group use of the graphic interface in combination with voice. The principle is to add computers to human conversations about sketches by enabling the communication among humans, both voice and sketching, to communicate simultaneously with computers.

David W. Hulse

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POSITION STATEMENT

For the past fourteen years my research and teaching have concerned larger areas of land, typically hundreds to thousands of square miles, and the complex natural and cultural processes that shape them. My research is centered on the creation and application of tools and methods which seek to make this complexity more comprehensible, to lead to scientifically-grounded land use decisions more open to input from those people whose lives are effected by these decisions. The need to involve researchers with expertise in other academic disciplines means my work is necessarily collaborative.

The main area of my investigation and instruction is a spatially-explicit integrative procedure for connecting the understanding of landscape processes from the sciences (e.g. hydrology, geomorphology, terrestrial and aquatic ecology, agronomy, forest sciences, economics) with the value-laden public policy-making and land planning processes that shape and influence land use. I have refined this procedure through application in research and teaching projects ranging from Chernobyl, Ukraine to the Willamette River Basin, Oregon. In each project the particular cultural issues and physiography of the landscape being studied require a process in which the highly focused knowledge of scientific experts can be, first, made comprehensible to the lay public and official policy makers and, then, used as evaluative tools. This evaluative portion of the process allows interested groups to compare and contrast the effects of various alternative plans for organizing and managing the set of land uses endemic to the place. Developing ways for people effected by land use decisions to participate directly in shaping these alternative land use futures has been a specific focus of my work. In part through these efforts, this approach has come to be known as "alternative futures analysis", and is becoming more widely embraced and employed by governmental agencies and organizations from national to local levels.

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POSITION STATEMENT

The magnitude of landscape change taking place today is such that Earth is experiencing the onset of its sixth major reduction in the biological diversity of life forms (Lawton and May 1995). This event is being caused by a rapidly expanding human population (Ehrlich 1995) that has radically altered the planet's biota over the past two centuries and has come to dominate its physical processes (Vitousek et al. 1997). It is manifested in complex interacting ways and compounding biophysical processes (Tilman 2000), many of which are expressed by and observable from patterns of vegetation (Austin 1999). The exact consequences of this event for humans are unknown but could severely disrupt the existing economic and social systems (Chapin et al. 2000). The information and related research needed for ongoing management choices that could mitigate possible effects is generally lacking (Andelman and Fagen 2000, Jennings 2000) although there has been significant recent progress in developing a capability to produce such information (Scott and Jennings 1998). Sustaining biodiversity today requires management of land and water units in ways that predictably and cohesively interface with biotic organization at the levels of genetics, populations, species, and landscapes, as described by the Convention on Biodiversity.

A key concept for preventing the erosion of biodiversity is that each political jurisdiction, from local to national and extending to international organizations, must maintain the existing complement of life forms that occur within that jurisdiction. To begin this requires two fundamental elements of social and technical infrastructure: (a) individual citizen and institutional (nongovernment as well as government) understanding of the issues and the process for implementing the concept; and (b) a base of spatially explicit technical information that can inform people and their institutions about the distribution and status of their existing biological resources as they are distributed throughout their ranges, as well as providing information about possible outcomes from various land use choices within and among jurisdictions.

In the USA there is general agreement about the need to manage the nation's biological resources with an understanding of (a) any particular biotic element significantly affected by some management decision, and (b) the biogeographical and ecological context of any given management decision affecting some particular biotic element (National Environmental Policy Act of 1969, National Research Council 1993, 2000). Additionally, there are numerous international treaties under which the USA and other nations commit to maintaining elements of biodiversity which requires an understanding of a given element of biodiversity per se as well as the context in which that element occurs (e.g. Migratory Bird Treaty Act of 1918). There is, however, no policy on the development of the most basic information needed to achieve this: spatially comprehensive and time series information of species distributions. This information is fundamentally necessary if public choices in landscape design are to be successfully applied to solving problems of biodiversity loss. Without such information the context for a broad public understanding of particular consequences of landscape change, such as foretelling the likelihood of a given species becoming extinct or extirpated, will remain limited, and conflicts relating to this issue will continue to increase.

A multidisciplinary discussion treating research on landscape change as it relates to sustaining biodiversity should begin first with an examination of the existing institutional basis for not only funding and carrying out the research that is needed, but for implementing successful research results as well. Second, the conceptual, methodological, and technical capabilities and current deficiencies relating to the production of adequate biological and social information should then be assessed. Finally, a unified approach should be developed to deliver such information to a broad array of sectors through social dissemination and technical tools as well as fostering appropriate applications to public processes.

LITERATURE CITED

Andelman, S.J., and W.F. Fagan. 2000. Umbrellas and flagships: efficient conservation surrogates or expensive mistakes? Proceedings of the National Academy of Sciences of the USA 97: 5954-5959.

Austin, M.P. 1999. The potential contribution of vegetation ecology to biodiversity research. *Ecolography* 22: 465-484.

Chapin, F.S., E.S. Zavaleta, V.T. Eviner, R.L. Naylor, P.M. Vitousek, H.L. Reynolds, D.U. Hooper, S. Lavorel, O.E. Sala, S.E. Hobbie, M.C. Mack, and S. Diaz. 2000. Consequences of changing biodiversity. *Nature* 405: 234-242.

Ehrlich, P.R. 1995. The scale of the human enterprise and biodiversity loss. Chapter 14 in *Extinction Rates*, Oxford University Press, Oxford, U.K. p214.

Jennings, M.D. 2000. Gap analysis: concepts, methods, and recent results. Landscape Ecology 15: 5-20. Lawton, J.H., and R.M. May, eds. 1995. *Extinction Rates*. Oxford University Press, Oxford, U.K. 233p.

National Research Council. 1993. A biological survey for the nation. National Academy Press, Washington, D.C. 224p.

National Research Council. 2000. Ecological indicators for the nation. National Academy Press, Washington, D.C. 180p.

Scott, J.M., and M.D. Jennings. 1998. Large-area mapping of biodiversity. *Annals of the Missouri Botanical Garden* 85: 34-47.

Tilman, D. 2000. Causes, consequences and ethics of biodiversity. *Nature* 405: 208-211.

Vitousek, P.M., H.A. Mooney, J. Lubchenco. J.M. Melillo. 1997. Human domination of Earth's ecosystems. *Science* 277: 494-499.

Transportation and Landscape Change
by Mary Kihl

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POSITION STATEMENT

Transportation and Landscape Change

Landscape change is both evolutionary and precipitated by human intervention. While natural forces shape the overall land-form, human intervention can either undermine or design and plan alternative futures. The efforts of teams of landscape architects and regional planners are often neither reinforcing or single directional. While some monitor human incursions into natural areas with concern, others focus on guiding development and minimizing impacts on the natural environment. In the name of livability some land planners can urge compact contiguous development while others argue for enhanced freeways to reduce congestion and minimize concentrations of air pollution. While some urban planners call for limiting expansion of infrastructure to minimize intrusions into fragile lands, others build scattered home sites far outside the urban fringe so that they can be close to nature. An increasing number of landscape architects and planners decry uncontrolled urban growth, but most lack effective mutually reinforcing strategies to direct it.

This divergence in perspective is apparent in the differences between the orientation of land planners and transportation planners. While land planners begin with focus on site and a concern about quality of the environment, transportation planners begin with a focus on people and their movement through space. As such transportation planners become a vehicle for introducing landscape change. Traditionally transportation projects have been regarded as intrusions into the natural environment. Environmental impact statements seek to minimize the impacts, particularly of highway construction. On the local level land developers are assessed impact fees to accommodate major increases in traffic congestion. While the broader impacts associated with redirecting land development patterns have been generally acknowledged, the potential for linking transportation planning with land planning to affect positive change has not been realized. Too often the transportation planning and land planning are pursued in different agencies, with limited cross-checks. Even the literature is segmented. For example, even a recent major study on the costs of sprawl sponsored by the Transportation Research Board (TCRP Report 39) devoted separate chapters to land change and to transportation enhancements. The result of this type of disconnect is often ineffective cross-purpose planning.

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1992 signaled the recognition on the part of the federal government of a potential positive interface between transportation and land use. Ten per cent of highway construction costs were to be directed to "enhancements" including trails and bicycle routes and highway rest stops. The subsequent TEA21 legislation interpreted enhancements more broadly to include upgrading facilities and neighborhoods adjacent to major arterials. The term "livability" was introduced to reflect the range of eligible projects-new day care centers, upgraded store fronts, traffic calming devices. Particular attention is directed to neighborhoods impacted by the intrusion of a freeway or other major highway. This focus still is, however, on dealing with impacts rather than guiding land development in the future. Much more attention is needed to joint transportation-land use planning. Enhanced land use computer models are being introduced into urban planning agencies to assist in simulating the future land development patterns with the introduction of major activity centers and transportation projects. The key is to use these powerful tools not just to monitor landscape change but to guide it in ways that further sustainability on the regional and local levels.

RELEVANT REFERENCES

- Diamond, Henry and Noonan Patrick 1996, *Land Use in America*, Washington, D.C. Island Press, 1996.
- Landis, John, "Imagining Land Use Futures: Applying the California Urban Futures Model,' *Journal Of The American Planning Association*, 61, 4 (Autumn) 438-457.
- Arendt, Randall et al. 1994 *Rural by Design*, Washington, DC American Planning Association.
- Ewing, Reid.1995. *Best Development Practices*, American Planning Association.
- Handy.S. 1995. "Understanding the Link Between Urban Form and Travel Behavior," paper presented at the 74th Annual Meeting of the Transportation Research Board, January.
- Handy, S. 1992. "Regional Versus Local Accessibility:: Neo-Traditional Development and its Inplications for Non-Work Travel." *Built Environment*, 18 4: 253-267
- Cevero, Robert, 1998, The Transit Metropolis, New York: Island Press. Moore, Terry and Paul Thorsnes. Transportation/Land Use Connection, American Planning Association, Planning Advisory Serive, #448-449.
- *The Costs of Sprawl-Revisited*, Transit Cooperative Research Program, TCRP Report 39,Washington, 1998.

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POSITION STATEMENT

I am delighted that a workshop like this is happening. The workshop is special in two aspects. First, this is the first workshop that is planned to bring scientists, researchers, and planners from two different groups of disciplines, investigative scientific disciplines versus design disciplines, together to study landscape change. The workshop provides a forum for intellectual exchange among these two groups of individuals, thus it should lead to better understanding of the issues and challenges surrounding landscape change and ultimately better design strategies down the road. Second, when the word "change" is used, it involves an additional temporal dimension, which makes the presentation, analysis, and modeling of landscape data more complex, more uncertain, dynamic, but it is also more challenging. So I look forward to learn more from the workshop that will provide a good start, recognizing also that a 3-day workshop might not be able to define all the agenda or solve all the puzzles we might have among ourselves.

Two other points come to my mind. First, what is landscape? Natural landscape generally has physical objects and is visible, such as forests, buildings, and roads. Traditional studies such as land use/land cover change studies using remote sensing imagery, landscape ecology, and urban landscape change will fall in this category. On the other hand, human or social landscape that are not easily visible, such as the landscape of health, poverty, and crime, is equally important. Detecting the change of the human landscape as well as the interplay between natural and human landscape and its change will be a great challenge. But is it too broad?

Second, scale matters. What should be the appropriate scale of observation for landscape and landscape change studies? How much scale issues do we want to inject before we are all fed up? Traditional land use/land cover change studies often involve satellite imagery and focus on larger study areas (i.e. large observational scale). On the other hand, landscape architects and planners usually focus at community level that is of smaller observational scale. Lately, the availability of one-meter satellite imagery has led to a basic methodological problem in remote sensing-instead of classifying land cover, the fine pixel resolution will identify the detailed surface cover (e.g. concrete parking lot, roof top, car), not land cover defined in traditional ways. On the other hand, the fine-resolution imagery will provide useful tools for landscape planners that were unavailable before. How to utilize this technology will be an interesting area to explore.

Ultimately, I would like to see by the end of the workshop that we will be able to identify the following: (1) What are the key issues or type of landscape change studies that researchers from the investigative science disciplines have identified that are also of high societal relevance? (2) What had been done before (i.e. what are the typical landscape change studies)? (3) What are the obstacles for not being able to conduct the research or solve the problem? What are the challenges? (4) Looking forward then, what would be the future problems or possibilities? We need concrete examples. At the same time, the same set of questions and answers derived from the design disciplines are needed. For example, what are the key issues and challenges that landscape planners are facing? Is it the lack of methods for assessment and evaluation, or is it the lack of good database, or others? I am optimistic that once the issues and possibilities are laid out, we can find some common threads.

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POSITION STATEMENT

The science community's recognition that landscape change is a fundamental agent of environmental change is clearly reflected in the recent report by the National Research Council (NRC) on Grand Challenges in Environmental Sciences, and in the upcoming ten year plan of the U.S. Global Change Research Program (USGCRP). Information on the rates, driving forces, and consequences of land use and land cover change, for example, are important in studies addressing issues ranging from the health of aquatic resources to climate change. Because landscape change at local scales have dramatic, cumulative impacts at broader scales, the assessment of landscape change must be addressed in a multi-scale framework. Both the NRC and USGCRP recognize landscape dynamics as having significant social and environmental consequences. Unfortunately, our ability to develop a sound scientific understanding of the rates, causes, and consequences of change is confounded by the lack of information on landscape dynamics at all scales.

There is a paucity of information on landscape change except at very local levels. For example, there is no single program, or suite of programs, in the United States that provides definitive information regarding rates of national land use and land cover change. As a result, we have an incomplete understanding regarding how the landscape changes over time and space. Therefore our ability to make substantial progress in predicting and understanding both the connections between landscape change and environmental and social processes, and our ability to forecast change in the future, is hampered by our lack of understanding of the spatial and temporal characteristics of landscape dynamics.

We are in an era where we have archives of multi-resolution remotely sensed data that can be used to assess and monitoring of change. However, change analysis with remotely sensed data is often problematic since the phenomena we are trying to map and monitor occur at scales too fine for consistent identification. Certainly, in order to improve our ability to use the data we have, and to design future remote sensing systems and interpretation methods, we must have a far better understanding concerning the scale of the landscape spatial units we are trying to identify, and we need an objective and systematic understanding of how these changes vary from place to place and from sector to sector. To do this, we need to build a detailed national land use history on a region by region basis. In addition, to better understand the consequences of change, we need to understand the scale linkages, causal factors, geographic connections, and feedbacks between local change and local, regional, and global consequences.

In order to provide a starting point for understanding the spatial and temporal characteristics of contemporary land use and land cover change in the U.S., the U.S. Geological Survey has initiated a four-year research project to:

- Develop a comprehensive methodology for using sampling and Landsat MSS and TM data for measuring regional land cover change across the U.S.
- Characterize the spatial and temporal variability of change from the 1970's to 2000.
- Document major regional driving forces of change.
- Prepare a national synthesis of land cover change from the early 1970's through 2000.

Specifically, the estimates of change are being developed for each of the 84 ecoregions defined by Omernik of the U.S. Environmental Protection Agency. Using random sampling, a set of 20 km by 20 km sample blocks have been selected for each of the 84 ecoregions. The nearly 850 sample blocks covering the conterminous U.S. were selected using a probably sampling procedure that considered the expected spatial variance of land cover change between sample blocks, a one-percent margin of error and an 0.85 confidence level. The analysis of change is based on five dates of Landsat MSS and TM data (nominally 1973, 1980, 1986, 1992, and 2000). Land cover data and change analyses are being developed for each ecoregion and will ultimately be summarized for the conterminous U.S.

Preliminary results from eastern U.S. ecoregions show that the rates and characteristics of change are relatively consistent within each ecoregion but vary significantly from one ecoregion to the next. For example, northern Appalachia in Pennsylvania has experienced very little change while the Piedmont ecoregions have changed significantly. While urbanization in the Piedmont has been significant, that rates of change do not match the rapid transition from cropland to pine plantations and subsequent cyclic forest harvesting underway in the Southeastern Plains.

While this study may not provide all of the details needed to understand change, we expect that it will provide the following:

- A starting point for developing a comprehensive land use history of the U.S.
- A improved understanding of the spatial and temporal pulses of contemporary change that occurs across the country.
- A clearer understanding of the relationship between local, national, and global driving forces.
- An improved ability to model and predict future landscapes based on a clearer understanding of past rates and driving forces of change.

The 1970's to 2000 study will be completed in 2003.

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POSITION STATEMENT

My interest in the science and design of landscape change stems from my interests in four specific areas: 1) the philosophy of design, 2) whole systems planning and design, 3) environmental modeling and simulation, and 4) the development and application of information technologies, specifically GIS, to the field of environmental planning.

1. Philosophy of Design

How we think about design conditions how we approach our lives as individuals, as members of our society, and perhaps even more importantly, relative to the scope of this workshop, as professionals. I believe the schism between environmental science (those who investigate the landscape) and environmental design (those who create or change the landscape) stems, in part, from the lack of a shared/comprehensive definition of design.

On the one hand, scientists see themselves as investigators and critics, but not as creators (designers). On the other, professional designers see themselves as creators, but often lack the scientific knowledge required to make informed decisions. Our philosophy of design must embrace both groups, or points of view, so the contributions of each (working both individually and collectively) can lead to the formation of landscape management plans that facilitate and support life.

This idea is delineated more fully in a presentation I made two years ago at the Tools for Community Design and Decision Making Conference titled Place-Based Community Planning: Philosophies, Trends, and Technologies.

2. Whole Systems Planning and Design

We face today, as perhaps never before in the history of mankind, a wide variety of complex problems that have the potential to seriously threaten the quality and even the existence of life on this planet. These problems are dynamic in nature, in that they change over time, and are often highly interrelated with other problems. Many of them are, in one way or another, also spatial problems. Solving these problems will require an understanding of the behavior of complex systems, a combination of skills and knowledge that have traditionally been found in separate disciplines, and an awareness of spatial information systems. Throughout this coming decade, we will need to cultivate a new type of problem solver, a true systems thinker, an individual with multidisciplinary skills, with the expertise to analyze spatial problems, and a relentless ability to collaborate with others as co-creators in a larger design process.

I am deeply concerned that our educational institutions, by and large, do not teach systems theory at an operational level or address the subject of whole systems design. Most universities with environmental studies programs teach systems thinking at a values level, that is, they teach their students to understand and value life as a system. However, few of these institutions teach systems design, systems analysis/engineering, or operations research at an operational level where students are directed to apply the systems precepts and methodologies to real problems.

Further readings on this topic can be found at the Buckminster Fuller Institute and the Rocky Mountain Institute.

3. Environmental Modeling and Simulation

The subject of environmental modeling has been maturing over the past few years and is now slowly finding its way from the confines of academic research to the workrooms and design studios of environmental planners. Most of this type of modeling is based on the "system dynamics" concepts developed by Jay W. Forrester and Howard T. Odum. These concepts, which have been embedded in a number of simulation programs including Extend, PowerSim, Stella, and VenSim, are now being used by environmental scientists to model/simulate real world problems.

Environmental planners and designers, however, are slow to adapt these tools, partly because they don't have the mental budget to take on a whole new subject field, and partly because they are not being taught how to use these tools in our design schools. One other aspect pertaining to the slow adoption of these tools by design professionals is due to the fact they do not work with spatial data. Environmental planners, landscape architects, and other designers thus find it difficult to apply these tools to the spatially/geographically explicit problems.

Further readings on this topic can be found at the MIT System Dynamics Group, at Pegasus Communications, the Informs College on Simulation, and in the Proceedings of the Fourth International Conference on Integrating GIS and Environmental Modeling.

4. Development and Application of GIS Technologies Two years ago I served as the principal architect and project manager for ModelBuilder, ESRI's existing technology suite for building grid-based spatial models with ArcView GIS. I am currently the team leader for ArcModel, which will be one of the core applications in a future release of ArcGIS.

Conceptually, ArcModel will combine the geo-processing features of ArcToolbox, ESRI's existing application for performing geographic analysis in ArcInfo, with the modeling capabilities of ModelBuilder. Initially, ArcModel will provide advanced modeling features for building static (cartographic) models and for performing various types of geo-data processing. It will support all geo-processing functions and geo-data types supported by ArcGIS.

In the long run, ArcModel is envisioned to incorporate an extended set of modeling capabilities, including:

Dynamic Modeling

Dynamic modeling extends the ability to construct and run various types of iterative models: including those that are not time dependent, such as those including "what-if" assessments, and optimization functions; and those that are time dependent, including feedback loops, interactive simulation, and multi-player games.

3D Modeling and Visualization

3D modeling will extend the ability to construct 3D spatial models with 3D fields (using voxals) and solids (using tetrahedra and polyhedra). 3D visualization will add the ability to create scenes and movies as a means to visualize both static and dynamic environments.

Geo-Statistics

Geo-statistics will be integrated to provide a suite of surface and field generation functions and for doing exploratory analysis. Geo-statistics can also serve as the basis for creating shadow surfaces and fields indicating the statistical reliability of input data and confidence measures depicting the reliability of the output.

Decision Theory

Decision theory and the general body of knowledge associated with psychometrics, decision analysis, and group-based decision strategies (such as the Delphi process) will be used to create decision support interfaces for many of the process wizards, property sheets, and web-based decision forms.

Agent Technology

Agent technology will provide ways to setup various types of information-bots (information robots), such as message agents, service agents, and object agents. In general, all agents monitor information and act in accordance to a set of rules defined by the user. Message agents acquire information from multiple sources and suggest action. Service agents provide expertise about a particular domain and have the ability to make logical inferences and then initiate actions within the domain of their expertise. Object agents have the added ability to collaborate and negotiate with other agents.

Interactive Design

Interactive design tools, such as freehand sketch tools and object based construction sets (similar to Visio), will make it possible for users to create their own spatial concept plans, as well as other types of landscape plans, and then compare how will those plans "fit" with the objectives of their model. Alternate plans can also be compared to determine the relative utility of each plan.

Online Collaboration

Online collaboration will make it possible for users to work together in asynchronous time and in distributed locations via the Internet. This will most likely involve both data and application sharing, the utilization of virtual meeting rooms, discussion forums, instant messaging, online chat, video conferencing, and the use of electronic whiteboards.

The Influence of Globalization and Technology on
Integrated Landscape Restoration Policies, Interventions and Investigations
by Laura R. Musacchio

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POSITION STATEMENT

The Influence of Globalization and Technology on Integrated Landscape Restoration Policies, Interventions and Investigations

Globalization as a Driver

All living systems are interconnected and interdependent networks (Capra 1996). Given that natural and human processes can influence these networks, they are powerful enough to change the state of living systems such as landscapes. The process of globalization, facilitated by public policies, is one of the most powerful. One of the benefits of this technology is the communication door it opens, providing a real-time conversation via e-mail with colleagues around the world. One of the negative consequences is seen in the landscape degradation found along the U.S.-Mexico border. However, globalization has also influenced the development of new institutions and partnerships in design and scientific disciplines for example, the multi-national planning and design firm and the International Long Term Ecological Research Network which attempt to solve existing problems.

Computer Technology as a Driver

The revolution in computer technology permits unprecedented opportunities for the study of change in living systems. For example, GIS and remote sensing technology allow the observation of landscape change at the global scale. However, the human experience of the landscape through GIS is second hand rather than experiential, different from the evolutionary origins of the species in the savannas of Africa. One of its benefits is seen in the growing knowledge about distant places, which are not easily observed. One of the consequences is less knowledge about local places because people spend more time on-line.

Hierarchy, Scale and Complexity in Public Policies

Public policies in the United States usually address issues from the economic perspective at the international or national level. Yet, an essential component is often missing from most policies:

the link with the landscape and its inhabitants. Well-intentioned international or national policies often have unintended consequences on landscapes, places, and people. Environmental issues at the international scale frequently have important antecedents at the landscape scale. A complex system of economic, social, cultural, ecological, aesthetic, and political feedbacks exists between scales. Landscape patterns that are evident in aerial photographs are a manifestation of these feedbacks. Policymakers need to address the relationship between public policy, landscape pattern, and land use planning (see Musacchio 1999).

Past results, for example, the degradation of the Everglades bear witness to why most policies are short sighted in the long term (Holling 1995). Restorations of degraded landscapes and watersheds resulting from past policy failures are high on the public agenda as seen in the highly publicized the Clean Water Action Plan, and such local problems represent one of the best opportunities for the use of international institutions and partnerships. An example of this is the Rio Alamar River Corridor Restoration Project in Tijuana, Mexico (see Cook et al. 2000). Researchers from Arizona State University, San Diego State University, and Universidad Automata de Baja California are collaborating on this project.

The Need for Integrated Landscape Restoration Policies, Interventions, and Research

The challenge for researchers and practitioners alike is to find integrated approaches and models that can represent the restoration of living systems as interconnected and interdependent networks. The importance of this cannot be underestimated. Ironically, these endeavors will utilize the benefits of globalization and computer technology including international partnerships and GIS, in order to address the negative consequences of globalization and computer technology, degradation of the environment and isolation. The goal of this approach is the incorporation of knowledge from all scales in order to develop better integrated policies, more adaptive institutions, and more resilient landscapes.

References

Capra, F. 1996. The Web of Life: A New Scientific Understanding of Living Systems. Anchor Books, New York, 347 pp.

Cook, E., Ewan, J., and Musacchio, L. 2000. A hierarchical application of sustainable river corridor restoration: Rio Alamar, Tijuana, Baja California, Mexico. Proposal for the Southwest Center for Environmental Research and Policy and the Environmental Protection Agency.

Holling, C. 1995. What barriers? What bridges? In L. Gunderson, C. Holling, and S. Light (Editors), Barriers and Bridges to the Renewal of Ecosystems and Institutions. Columbia University Press, New York, 593 pp.

Musacchio, L. 2000. A Landscape Ecological Planning Process for Wetland, Waterfowl, and Farmland Conservation. Ph.D. dissertation. Texas A&M University, 216 pp.

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POSITION STATEMENT

This paper will focus on a three critical conceptual junctures for landscape architects and geographers working together to investigate landscape change:

- Moving between site scale and landscape scale analysis of landscape change
- Moving between analysis of land use and analysis of landcover
- Moving between projection of current trends and prospects for future design innovation.

We will discuss our methods for bridging these junctures. The project in which we are collaborating is a link between an NSF funded "Watersheds" project (Grant no. EAR 9900679. Development and Testing of a Decision-Support System for River Restoration. D. Allan, A. Brenner, G. Helfhand, J. Nassauer) and a USDA Forest Service funded "Landscape Change" project (North Central Research Station #00-JV-11231300-021. Landscape Level Analysis: Linking Urban Sprawl and Aquatic Ecosystems. D. Brown, J. Nassauer, and D. Allan). These projects include our colleagues in aquatic ecology, environmental economics, and hydrology and model watershed wide effects of design and planning decisions. The study area shared by both projects is the urbanizing environment of the Huron and Raisin River watersheds in southeast Michigan.

We are combining web-based survey research to determine public perception of proposed ecological design innovations with GIS-based characterization of the spatial composition and pattern of land use and land cover at multiple scales. Our goals are:

- To design future ecologically innovative landcover scenarios at the scale of landscape change in exurbanizing areas: sites and subdivisions.
- To use web-based public perception surveys to determine what forms of ecological innovation are likely to be plausible, given real estate market expectations.
- To use spatial simulation of landcover change and translate site-scale scenarios into plausible future landcover patterns at the watershed-scale.

- To compare current trends and plausible ecological alternative scenarios for future land use patterns, given urbanization trends and plans across both watersheds.
- Address the question: what types of plausible ecological design innovations for sites and subdivisions might affect ecological impacts of development across the watersheds?

Bernard J. Niemann, Jr.

Bernard J. Niemann, Jr.
University of Wisconsin-Madison
National Consortium for Rural Geospatial Innovations in America (RGIS)

POSITION STATEMENT

Context

Three decades of interdisciplinary inquiry, adaptation and use of a range of geospatial concepts and technology have been inbestigated to address the land use planning and management concepts and theory set forth by Warren Manning (early 1900s), Hideo Sasaki (1950), Stanley Whyte (1953), Philip H. Lewis, Jr. (1964), Kevin Lynch (1962), and Ian McHarg (1969). The impact of this work using geospatial concepts and tools has resulted in the following:

- realignment of an Interstate highway (Miller and Niemann, 1972);
- the joint sharing of a new 345 KV electrical transmission line with an existing railroad right-of-way (Murray and Niemann, 1975);
- the development of critical resource-quality indexes and resultant data and communication needs (Kusler et al., 1975; Niemann and McCarthy, 1979);
- the incorporation of modernized land records systems and GIS concepts to assess and model non-compliant erosion practices at the property parcel/field level (Niemann, et al., 1987; and Ventura et al., 1988);
- the economic requirements, benefits and social restraints of implementing and using geospatial technologies (Larsen et al, 1978; Portner and Niemann, 1983; and Niemann and Moyer, 1991);
- the use of photographic geospatial analysis to engage citizens (users) to help spatially identify and record aesthetic resources for incorporation into natural resource agency acquisition and management plans and provide more compensation in a USFS takings case (Chenoweth and Niemann, 1985);
- in 1989 the Legislative implementation of the Wisconsin Land Information Program which, over the decade, has generated $70 million to help modernize local governmental land and geographical information systems to address various geospatial data management responsibilities and procedures including the recently (2000) legislated comprehensive and smart growth land use planning requirements at all local governments(Tulloch and Niemann, 1996);
- and most recently, this collective past work resulted in being selected by Vice President Gore's Reinventing Government efforts as one of six community demonstration sites to show how information technologies such as the Internet and geographic information systems help support decision that lead to "livable communities." This effort has demonstrated that it is possible, using geospatial tools to involve and engage citizens in a community-oriented process of suggesting and evaluating land use choices.

Understanding, visualizing, and predicting the consequences of land use alternatives has resulted in more informed decisions that have been embraced by a citizen planning task force. Along with the other five demonstration sites, in recognition of these results, our project, "Shaping Dane: Citizen-based Land Use Planning," received the Vice President's "Hammer Award."

Impact

This work provides the opportunity to help address the specific research questions raised by the steering committee in the prospectus as follows:

- What levels of spatial, thematic, and temporal data are needed for effective design (including land us planning and management)?

For example, our work suggests that large-scale data (e.g. property parcel-level resolution) is necessary to facilitate decision-making and design. The work suggests that traditional data themes (e.g. parcels, land and tax value, centerlines, elevation, demography, soils, wetlands, building infrastructure) are fundamental and new data capture technologies such as orthophotography, satellite images provide a spatial context for the less-experienced. Also, the work suggests that transactional-based databases (e.g., Register of Deeds, permitting systems, tax assessment records) are the most efficient and effective means by which to obtain up-to-date temporal data.

- How can the benefits of data be estimated and compared to the costs of data acquisition?

For example, our work suggests that benefits can be estimated using conventional economic measures such as increased efficiency (doing tasks faster) and effectiveness (doing new tasks) are measurable. Also, measures of equity require different social science measurement techniques such as interviews and surveys, but are possible to identify and record.

- How do limited representations impact the decision process?

For example, our work suggests that, at least for some social cohorts, existing geospatial tools and software can both engage citizens to participate in place-based land use planning and expand their knowledge about the resultant allocation decision and its social, economic and environmental impacts, while reducing their reluctance to express their views and concerns. This is not to say that new tools could not expand this capacity, but it's evident that the current state of geospatial technology does result in expanded engagement resulting in citizen planners.

- How can alternative methods of data acquisition - input - be incorporated into GIS?

For example, our work suggests that this area of tool development is important to gain participation of the wary citizen planner. They want to be able to control the type, extent and location of various use allocations. Through the use of large-scale data sets and the design and development of an allocation tool we developed called "Place It," we can accommodate individually based interactions.

- What changes are needed in today's GIS to facilitate public participation in decision-making?

For example, our work suggests that it may not be the current technology that inhibits involvement. It may be more an issue of the state of current and traditional state of geospatial education vs. training (i.e., the steering committee asserting that "Landscape architects are now *routinely trained* in the use of GIS," p.2, emphasis supplied). Our work suggests that it takes patience, a considerable level of comfort with the technology, and thorough knowledge of the data (meta data) and the array of available possible geospatial queries. It also takes an ability to understand the planning question being addressed. This suggests and education process that is much more demanding than "routine training."

- And in what respect to another question raised by the steering committee, "What benefits would be gained from designating a set of communities as long-term research sites..?", the RGIS consortium sites would be most interested in sharing their collective experiences in geospatial technology transfer and partner as a potential long-term research site(s).

Summary

Our past work bridges the four themes of the workshop. We have considerable experience in the use of geospatial information technology for a variety of large-scale planning and resource management issues. We have used these tools to engage a variety of governmental, private sector and citizen participants in the planning and decision-making process including using these and other tools to facilitate citizen participation in the identification and location of natural beauty. We have also used various empirically based models to assess rural and urban water quality outcomes based on various land use and management schemes. We have also assisted in the actual testing and implementation of these tools and technologies. We have monitored their diffusion and documented costs and the benefits. And, we have demonstrated that it is possible to use geospatial tools to engage citizens and, with the guided assistance of geospatial literate planners and designers, it is possible to create citizen planners who are capable of producing supportable land use plans.

References

Manning, W., early 1900s. "A Plan for Bellerica," unpublished.

Sasaki, H. 1950. "Thoughts on Education in Landscape Architecture: Some Comments on Today's Methodologies and Purpose," *Landscape Architecture Quarterly*, Vol. 40, pp. 158-160.

Whyte, S. 1953, reviewed in 1955. "Landscape Architecture Theory: A Systematic Procedure for Developing a Landscape Design in Plan Aspect." Champaign: University of Illinois, Dept. of Landscape Architecture, unpublished.

Lynch, K. 1962. *Site Planning*, MIT Press.

Lewis, P.H., 1964. "Quality Corridors for Wisconsin." Landscape Architecture Quarterly, January 1964, pp. 100-107.

McHarg, I. 1969. *Design With Nature*, Natural History Press. Garden City, New York.

Miller A. and B. Niemann. 1972. *Interstate Corridor Selection Process: The Application of Computer Technology to Highway Location Dynamics*, Madison: Dept. of Landscape Architecture.

Murray B. and B. Niemann. 1975. "A Landscape Assessment Process," In*Landscape Assessment: Values, Perceptions and Resources*, E. Zube, R. Brush and J. Fabos, editors, New York: Halsted Press, pp. 220-254.

Kusler J., J. Ross and B. Niemann. 1975. "Data Needs and Data Gathering for Area of Critical Environmental Concern," Part I: Summary Report; Part 2: Selected papers from state programs; Part 3: Executive Summary. Madison: Institute for Environmental Studies, University of Wisconsin.

Niemann, B and M. McCarthy. 1979. "Spatial analysis and Information Communication," In *Planning the Uses and Management of the Land*, M. Beatty, C. Peterson and L. Swindle, editors, Madison: American Society of Agronomy, Crop Science Society of America and Soil Science Society of America, pp. 220-254.

Niemann, B., J. Sullivan, S. Ventura, N. Chrisman, A. Vonderohe, D. Mezera and D. D. Moyer. 1987. "Results of the Dane County Land Records Project,"*Photogrametric Engineering and Remote Sensing*, 53 (10): 1371-1378.

Ventura, S., B. Niemann and D. Moyer. 1988. "A Multipurpose Land Information System Approach to Conservation and Natural Resource Planning," *Journal of Soil and Water Conservation Planning*, 43 (3): 222-229.

Larson, B, J. Clapp, A. Miller and A. Ziegler. 1978. "Land Records: The Cost to the Citizen to Maintain the Present Land Information Base: A Case Study of Wisconsin," Madison: Wisconsin Department of Administration.

Portner, J. and B. Niemann. 1983. "Autonomous Behavior: Its Implications to Land Records Modernization in the United States," *Proceedings of the FIG Commission*7, pp. 402-431.

Niemann, B. and D. Moyer. 1991. "Economic Impacts of LIS Technology Upon Sustainable Natural Resource and Agricultural Management," *Surveying and Land Information Systems*, 51(1): 17-21.

Chenoweth, R. and B. Niemann. 1985. "What Price Beauty?" *Landscape Architecture*, 75(5): 78.

Tulloch, D. and B. Niemann. 1996. "Evaluating Innovations: The Wisconsin Land Information Program," *Geo Info Systems*, 6(10): 10, 40-44.

Esra Ozdenerol

Esra Ozdenerol
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POSITION STATEMENT

I am pleased to submit this proposal for your consideration, to be considered for inclusion in the Landscape Change Workshop that you are planning. I currently serve as an Assistant Professor in the Graduate Program in Landscape Architecture of the School of Architecture at Florida International University.

In south Florida, landscape change and place-based decision-making are issues high on the public agenda. The exploitation of natural resources, human impacts on The Everglades, unsustainable urban growth, and quality of community life are the essential framework of public concern. As an ever-changing laboratory, south Florida provides the unique opportunity that allows me to maintain a research focus on these current issues, and consider design aspects of landscape change as well.

Developing an integrated perspective that addresses such significant landscape change insures a greater understanding of the phenomena of change. Environmental problems rarely respect conventional subject boundaries. Appropriate solutions to such problems require both an understanding of the physical and ecological aspects of these environmental systems, and a recognition of their various interactions with economic, social, and political forces. Landscape patterns that have been largely stable or only slowly changing for generations, are now being rapidly altered. The consequences of landscape change may be too often unknown, but are always profound. The speed and scale at which landscape change occurs results in difficult - sometimes impossible- adjustments for these biological, social, and economic systems.

Until recently, one of the difficulties faced by landscape architects in considering landscape change resulted from limitations on the analytical tools available to assess such change. Too often, these tools did not match the scale of questions requiring answers. Fortunately, with the availability of geographic information systems (GIS) and their continued refinements, many of these challenges may now be effectively addressed. The information technologies currently available provide a bridge between basic research and the normative practice of landscape architecture.

With a PhD in geography and specialization in geographic information science, and a Master of Landscape Architecture degree, I am particularly interested in the information technologies theme of your Workshop. The specific aims in my dissertation project included a detailed case study of the relationship between industrial sites with environmental variables such as drinking water quality, toxic release inventory and health outcomes in Louisiana. I applied spatial analytical methods including spatial measurement techniques, cluster detection techniques, and the scale analysis integrated with GIS. The findings of my research helped communities to build their local community capacity and they also provided a mechanism for including local experience with resource management in planning public and private land management and for teaching new approaches to landscape analysis and ecosystem management. The challenge to integrate geographic research and scientific knowledge with both interventionist and normative design approaches within the landscape architecture discipline, offers unique opportunities for exploration and development of theories and models to address landscape change.

In both the Community Studio and Regional Studio that I teach, I am working with my students in applying design, theory, and methodologies to "real-world" projects, as these projects are most effective in providing the opportunity for these students to synthesize science, design, and human factors. Training landscape architecture students to utilize GIS applications through models and methods of spatial analysis, enhances and ultimately validates the design process. I am constantly seeking the means to incorporate design tools into GIS, seeking to determine how much spatial, thematic, and temporal detail is required to inform effective design. Recent advances in information technologies and the continued emergence of sub-fields such as landscape perception and landscape assessment, mark an exciting time in the design disciplines, creating both the opportunity and necessity for curriculum review.

The confluence of these challenges -with which I deal daily- has focused my desire to participate in the Landscape Change Workshop. By sharing my experiences and building collaborations with discipline-specific experts whose experiences and views on landscape change may differ from those I hold, will be both an essential and enlightening experience.

The combination of my knowledge, skills, and abilities in Geographic Information Science and my interests in the design aspects of landscape change, will complement the research agenda of the Workshop, bringing a topical and tropical diversity to it.

Janet Silbernagel

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POSITION STATEMENT

Characteristic landscape patterns are formed, in part, by specific cultural groups and through cultural processes. I am interested in how such cultural landscape patterning influences both ecological dynamics and changing cultural knowledge of place. It is from this bifocal lens that I view landscape change. My work may be described as *the study of reciprocal sequences of culture and landscape expressed in spatial form*.

I am particularly interested in applying a framework for cultural landscape change questions based on a normative systems approach coupled with quantitative tools from the spatial sciences. In other words, I am seeking to blend holistic models from applied landscape studies with scientific models from the investigative fields. I believe current technological and analytical methods are limited in their ability to integrate complex, but imprecise cultural and biological relationships with landscape change. Moreover, current inferential approaches from the design disciplines do not provide the means for rigorous comparisons or ready linkage to ecological models and planning scenarios.

For the past several years I have studied spatial dynamics in horticultural landscapes (vineyards, orchards, urban gardens, cranberry bogs, maple sugarbushes), examining both truly scientific questions such as environmental stress distribution and foraging behavior, and more qualitative landscape histories (vineyards in Washington, maple sugaring landscapes). More recently I have begun to explore connections between spatial patterns, wayfinding, and perception of place. Studies are initiated to examine how people settle, perceive, and move about their landscapes under different landscape structural characteristics. The work will then attempt to link concepts of human wayfinding and spatial perception with models of spatial navigation in pollinators.

In addition to the scholarship presented, I also teach courses in Regional Design and GIS. My classes address design issues confronting the urban-rural fringe and urban ecosystems. We explore ways of identifying and building regional identity, creating livable communities, and enhancing ecological literacy in urban and rural communities. We seek ways to incorporate inferential human data into the GIS or other analytical processes. Ultimately, the intent, an integrated understanding of cultural landscape relationships, is to richly inform urban, regional, and conservation design decisions.

Within the five themes selected for this workshop, I would particularly like to address ideas in three of those: Information technology, Landscape perception and assessment, and Environmental and social sciences. I have listed a few discussion bullets for each of these three themes below. Selected workshop themes:

- Information technology - integration of qualitative visual information such as; image analysis, repeat photography, sketches or cognitive maps, and fuzzy data.
- Landscape perception & assessment - concepts of sense of place, quality of life, and wayfinding (including use of landmarks and navigational theories from biology).
- Environmental & social sciences - broadening the multilayer model of McHarg to better address complexity, social meaning, and globalization/localization trends.

Salmon, Stewardship, and Digital Problem Solving
by James L. Sipes

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POSITION STATEMENT

Salmon, Stewardship, and Digital Problem Solving

In the Pacific Northwest, the salmon is king. In North America, the wild salmon is the only species capable of making the incredible 1000-mile journey from high altitude valleys of the continent's interior to the Pacific Ocean. All five strains of Chinook salmon make this journey, and they do it backwards. As the current sweeps them toward the sea, they float tail-first downstream and gaze at the constantly changing landscape, hoping to someday return and continue the cycle of life. Unfortunately, 99.75 percent of them won't live to see their birth stream again. (NY Times, 2000)

The Columbia and Snake Rivers combine to form only one of three great habitats for Chinook salmon. In the days before dams were constructed along the Columbia and Snake, it took around five days for the smolt to make it back to the Pacific; today that journey takes closer to five weeks. (Roche, 1998) Since the smolts fast on their long trip, the additional time required for the journey leaves them weak, vulnerable, and often unable to complete the trip. Slackwater caused by the dams can bring migration to a near standstill, or the turbines used to generate hydroelectric power crush the smolts that make it that far and try to get to the other side.

The federal government has spent $3 billion in recent years trying to save the species, building hatcheries and fish ladders to lift the smolts over dams, or trucking and barging them downstream. (Denver Post, 2000) These efforts haven't worked; salmon numbers continue to decline. Four species are listed as endangered, and the Snake River Coho was declared extinct in 1986. Forty years ago, more than 100,000 adult salmon migrated up the Columbia and Snake rivers for the annual spawning season, but today that number has dropped to a few thousand. (Denver Post, 2000) At this rate, the salmon will be extinct by the year 2017.

How do we save the salmon? Should we? There are some that feel that our endangered wild salmon are "just a fish," and a fish of diminishing commercial value. (Cone, 1996) But to most, the salmon is a symbol of the Pacific Northwest and an icon of the region. Losing the salmon means losing a little of who we are. How do we restore salmon habitat without destroying the economic base of the region? Who is going to take the lead in addressing these types of complex issues?

Landscape architects have long touted themselves as "stewards of the land." If we are going to maintain that title, the profession has to step forward and take a leadership role in addressing the most difficult and most complex issues involving our environment, such as that of the salmon.

Addressing problems of this scale and complexity will require landscape architects to develop new processes and new tools if we are to be successful. The digital tools needed to address these types of complex issues will require integrating geographic information technologies with advanced procedural modeling and visualization tools.

We need to explore the application of modeling and visualization tools for examining and interpreting scientific data. The more scientists conduct environmental oriented research, the more they will learn, and the greater the need to convey this newfound information to the public. Perutz (1988) writes about the need for "promoting the public understanding of science," and Hoffman (1990) pleads with scientists to not assume what he calls "a scientistic analytical stance." Previous research has shown that the answer lies not only in accurate scientific data, but also in conveying the essence of that data to stakeholders. When conveying scientific data, what we strive for is a rich texture of data, a comparative context, and an understanding of complexity revealed with an economy of means. (EESI, 1995)

Central to maintaining clarity in the face of the complex are graphical methods that organize and order the flow of graphical information presented to the eye. By exploring issues of design and data variation, graphic integrity, data density, high-information graphics, complexity, proportion and scale, parallel sequencing, dimensionality, and the layering and separation of data, we can determine the most appropriate ways to communicate visually with clarity, precision, and efficiency. In addition, we need to make sure that the methods we use do not represent a static point in time, but takes into account the environment's surrounding, engulfing nature, and reflects the animated, dynamic character that people ascribe to their surroundings. (Bishop and Leahy, 1989) We also have to be concerned about whatever psychological meanings may have become attached to physical elements as well as the nonvisual senses that occur in connection with ephemeral events.

The level of sophistication in computer graphics is often measured with the ruler of reality, that is, by how closely a 3D-simulated world fools people into believing they're seeing something real. Thanks to the sophistication of today's modeling tools, landscape architects and other designers or planners are able to create highly sophisticated digital environments and processes. Imagine being able to create and animate intricate three-dimensional landscapes containing vivid sunsets, turbulent clouds, sheer canyons, or cascading waterfalls. Now imagine you have a tool that lets people walk through a fully detailed 3D model of the project, over the Internet, without having to download the model. That technology is already available.

Procedural modeling programs make it possible to create strikingly realistic landscapes based upon reality. For landscape architects, these approaches are important because they are well suited for helping understand complex environmental problems such as that of the salmon. Procedural modeling routines can be developed specifically for building mountains, valleys, forests, and other landscapes that include landform, plant material, water, sky, and atmospheric conditions. (Alvarez, 1994) They do so by combining proprietary software with traditional object-oriented model techniques and advanced procedural modeling routines such as hypertextures, volume density functions, fractals, graftals, particle systems, artificial evolution, L-systems, and implicit surfaces that are designed for modeling landscape elements and natural phenomena. (Sipes and Sumption, 1992)

Building upon the fundamentals of procedural modeling, we need to continue to develop techniques for realistically modeling and animating living things. These include graphics techniques that emulate phenomena fundamental to biological organisms, such as biomechanics, behavior, growth, and evolution. Topics include modeling and animation of plants, animals, and humans; behavioral animation; communication and interaction with autonomous agents in virtual worlds; and artificial evolution for graphics and animation. (Sipes, 1994)

Has technology advanced to the level necessary to accurately and realistically model landscape changes? No, but there have been tremendous strides in the past few years. Even though current PCs can run about 30 million connections per second, they still are not able to "think." But by focusing a computer program intensely on a single task we can solve even the most complex problems. Researchers have developed holographic neural technology that applies the principles of holographic memory to solve a wide range of practical problems. This work builds upon brain research that focuses on the non-linear and multidimensional nature of memory. IBM's Almaden Research Lab has developed a working prototype of a holographic storage device, which enfolds information spatially. Holography superimposes information over the dimension of time and enables you to view a 3-D object on a 2-D plane. SGI's OpenGL Optimizer API provides a framework through which developers can simplify large 3D models, reduce scene complexity by removing objects that are hidden behind other objects, and make it easier to work with large, complex models. Haptic-feedback systems allow users to actually "touch and feel" computer-generated 3D objects and experience realistic force feedback from objects they handle in a virtual world.

Although there is still a lot we don't know, we are in the process of developing effective visualization paradigms for supporting such things as collaborative computing, science education, implementation of animation techniques, convergence of visualization methods with the World Wide Web, and the relationship of animation techniques and scientific information exploration. The question is not whether the tools and processes needed to address complex issues such as the wild salmon will be developed, but whether landscape architects will lead efforts to do so.

References

Alvarez, L. "The Nature of Fractals and The Culture of Euclidean Form." *Ecology, Aesthetics and Design*, ASLA, 1994, pp. 31-41.

"Breach Dams, Not Trust." Denver Post Editorial, May 19, 2000.

Bishop, I. D., and P. N. A. Leahy. "Assessing the Visual Impact of Development Proposals: The Validity of Computer Simulations." *Landscape Journal*, Vol. 8, No. 2, Fall 1989, pp. 92-100.

Cone, Joseph. A Common Fate: Endangered Salmon and the People of the Pacific Northwest. Oregon State University Press, Eugene, OR, 1996.

Hoffmann, Roald. "Chemistry, Democracy, and a Response to the Environment,"*Chemical and Engineering News*, 1990, April 23, pp. 25-29.

Perutz, Max. "Is Science Necessary?" *Essays on Science and Scientists*, London, UK, Barrie and Jenkins, 1988.

Policy Briefing by the Environmental and Energy Study Institute (EESI), May 1995.

Roche, Judith. (Editor) First Fish, First People: Salmon Tales of the North Pacific Rim. University of' Washington Press, Seattle, WA, 1998.

Sipes, J. L. "Simulating Natural Phenomena." *Landscape Architecture*, Volume 84, No. 5, May 1994, pp. 30-32.

Sipes, J. L., and B. Sumption. "Modeling the Landscape." *HIGH COLOR*Magazine, Volume 1, No. 3, September/October 1992, pp. 42-45.

Sunday Editorial. The New York Times, April 2, 2000.

Landscape Change: Models, Alternatives, and Levels of Complexity
by Carl Steinitz
Summarized and presented by Stephen Ervin

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POSITION STATEMENT

Landscape Change: Models, Alternatives, and Levels of Complexity

Prediction is difficult: especially about the future. - Niels Bohr

Everyone designs who devises courses of action aimed at changing existing conditions into preferred ones." - Herbert Simon

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Steinitz's Framework for Decision Making (1990, 1996)

Six interconnected models, which must be used by planners and designers at any scale or scope of problem:

- Representation: "How should the landscape be represented?"
- Process: "How doe she landscape function?"
- Evaluation: "Is the landscape functioning well?"
- Change: "How might the landscape be changed?"
- Impact: "What predictable differences might the changes cause?"
- Decision: "How should the landscape be changed?"

This framework help to make clear what kinds of data and models are required, and how they are used, in computer-assisted landscape planning (GIS analysis).

Evaluating landscape change means both predicting 'natural' changes and inventing 'built' change; their interactions are most important.

Kinds of Problems: Uses of Models (terminology from Karpus)

E = Excitement (stimulus, change)

S = System (process, model)
R= Response (impact, output)

Given E and S, determine R = ASSESSMENT / Analysis
Given E and R, determine S = MANAGEMENT / Synthesis
Given R and S, determine E = DESIGN / Control

Levels of Complexity in Process Models

Level I
Thematic
What, How much, Where... ?

Level II
+ Spatial
What If, How Much, Where…?

Level III
+ Temporal
When, What If, How Much, Where …?

Level IV
+ Adaptive
When, What If, For/To Whom…?

Level V
+ Agent behavior
What/Who caused it?

Increasing Complexity carries increasing cost, may not carry proportional increasing value/accuracy. Determining appropriate level of effort/complexity for any given problem is a design effort unto itself. Public understanding is probably greatest at least complexity; scientific precision is probably greatest at most complexity. It's a matter of balance.

And there is room for 'non-scientific knowledge', e.g. intuition, historic emulation, ideology, in determining the balance.

In studies of change, two major strategies may be followed

INVENT an alternative future, then devise strategies to get to it (DESIGN) PROJECT existing conditions, policies, trajectories, to predict the future (ANALYSIS)

In Design Invention, the strategy may be DEFENSIVE or OFFENSIVE: Defensive design protects, identifies constraints, minimizes risk, emphasizes supply; Offensive design develops, identifies opportunities, creates risks, emphasizes demand. In either case, the further into the future the plan or projection is applied, the more uncertain the result, and the more necessary to identify the possible counter positions.

Dana Tomlin

Dana Tomlin
Pennsylvania

POSITION STATEMENT

So who can argue? Such noble objectives. Can anyone disagree with a call to "promote the building of a collaborative research community"? Could there ever be any real opposition to the suggestion that we "develop a joint research agenda"? And what possible objection could one raise to the idea of facilitating "the exchange of ideas"? Is there ever a good reason not to encourage interactions between adjacent fields?

Well yes. Actually, there is. We are all busy people. We do not all speak the same language. And - even in today's world - our professional reward structures seldom favor those who are inclined to straddle multiple disciplines.

Then why the appeal? Why is it that a chance "to bring together the investigative sciences and the design disciplines" seems so engaging? From my own perspective, it's precisely because of the things that make this so difficult. It's the fact that we are all busy people, the fact that we do not all speak the same language, and the fact that - even in today's world - our professional reward structures seldom favor those who are inclined to straddle disciplines.

My hope for this workshop is that we busy people may actually be able to learn enough from one another to be more effective in our own respective disciplines. My expectation is that we who speak in so many different tongues professionally can take enormous advantage of the common language(s) we tend to employ in making use of information technology. And my conviction is that any professional recognition of the inter-disciplinary territory we're investigating can only help those hardy souls who have elected to wander within it.

I do not, however, mean to paint a picture of prospects that are entirely rosy. The territory we're exploring here is not merely inter-disciplinary; it's a territory that also spans two very different (though very familiar) types of intellectual activity. Call them the worlds of the Sciences and the Arts, the positive and the normative, the descriptive and the prescriptive, the analytic and the synthetic, the objective and the subjective, the head and the heart, or even research and development. While none of these pairs of terms is entirely satisfying, each suggests a common distinction between concerns for "what is" and "what should be." Having spent three decades now in academic settings that have attempted - with mixed success - to combine these two types of concern, I am convinced that the major problems in doing so relate more to the nature of people than to the nature of their work.

And so do the solutions to those problems. In the case of landscape change, I believe that the key to our success may have more to do with attitude than aptitude and more to do with a general perspective than specific tools or techniques.

As to whether or not the workshop's four themes will reflect that view, I think I am optimistic. But only guardedly so. If each of our themes is addressed in a manner that seeks to do justice to the theme itself, I honestly believe we will fail. On the other hand, I think may well be able to make real progress if each of these themes is addressed in a manner that seeks to relate that theme to some sort of shared understanding or common ground. What I have in mind is not any grand vision or philosophical epiphany; it is a simple construct that relates the work of the environmental scientist to that of the environmental planner in ways that enable each to be more useful to the other. Over the past two decades, landscape ecologists have been able to do this to an extent that I think have surprised both the landscapers and the ecologists among them.

My own position in this scheme of things is clearly among the design disciplines. Though my academic background has included plenty of environmental science, I have always regarded science as a means to an end and never as an end in itself. For me, the ends lay in landscape architecture, in forestry, and in regional planning. And even in these fields, I have never become a serious practitioner. Instead, I have remained an academic and have focused on the development of GIS-oriented tools and techniques in general rather than their particular use in any one setting. I have also tended toward to tools and techniques whose ultimate purpose is prescriptive. It is from this perspective that I fully expect to take from this workshop a good bit more than I bring. After all,

Description without prescription may be Science,
but prescription without description is malpractice.

David L. Tulloch

David L. Tulloch
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POSITION STATEMENT

All landscapes are dynamic, whether as a result of natural processes or human interventions. Traditionally, we have often distinguished between the two by the pace at which the change has occurred. However, under some circumstances, it is becoming increasingly difficult to discern between landscape changes caused by natural processes and those resulting from artificially constructed processes. This lack of distinction underscores the need to examine the physical manifestations of change in the landscape. Monitoring, measuring, mapping, interpreting and communicating landscape change are absolutely essential in order to describe and understand these phenomena in a comprehensible manner.

The relationship between landscape change and information technology has been explored by a number of researchers, but in limited ways that have not been well coordinated. A more focused research effort with coordinated reporting of research findings could dramatically accelerate the rate at which the academic and professional communities address landscape change issues. Addressing these issues in a timely fashion will certainly become important as so many different areas experience irreversible change.

One of the plaguing problems (and potential solutions) in addressing the issues shaping our landscapes is the relationship between information and landscape change. At the same time that sprawl is consuming countless landscapes, an increasing number of communities are adopting geospatial information technologies as a tool for addressing growth-related issues. As the most densely populated state in the nation - 8 million residents in roughly 8,000 square miles -- New Jersey has witnessed some significant landscape change. Between 1984 and 1995, the state saw developed areas grow by 17% (Lathrop, Hasse and Bognar 2000). However, the ability to describe and measure growth in New Jersey comes from innovative data production and distribution policies which have produced a wide variety of publicly accessible geospatial data, and have gotten non-government organizations involved in decision-making processes (Tulloch 1998). These two conditions combine to create some sophisticated discussions about the ways in which IT (including GIS, GPS, and remote sensing) is altering our ability to understand, research, and participate in shaping the process of landscape change.

Land Information Technology and the Land
Land information can be considered in a broad sense, but is meant here primarily as a reference to spatial data, and related products and abilities associated with land and geographic

information systems. The ways in which these data can be used are many, but have been explored only to a limited degree. In considering the umbrella of landscape change, five categories of research place a particular emphasis on the interrelationship between information and the land. These five categories should become high research priorities for all involved in landscape change research:
* measuring change,
* analysis of phenomena,
* communication of phenomena,
* prediction of future change and events, and
* altering future outcomes.

In discussing how these technologies impact the 5 different research priorities, 4 different aspects of the research will be described: (1) the problem, (2) the goal, (3) explicit examples, and (4) research agenda.

Measuring Change The potential relationships between geospatial technologies and the landscape are varied and, at times, complex. Perhaps the most basic interaction is the use of these tools to capture or measure changes within the landscape as well as measuring the landscape itself. Data capture techniques -- from scanning of historic maps to GPS to aerial photography to newly acquired satellite imagery to transactionally updated parcel maps - allow for the collection and representation of enormous amounts of detailed information about the condition of landscapes. These technologies further enable assessments of changes in the visible (e.g., land cover or shoreline change) or measurements of the invisible (e.g., mapping changes in land ownership patterns or attitudes towards development). As such, the technology can enable measures not only whether change has occurred, but also the rate at which it is occurring, dimensions of indicators of change, and assessments of the impacts of change.

A major problem comes in the rapidly advancing abilities of these technologies, often leaving little known about the potential applications and misapplications of these tools and techniques to landscape change issues. A significant goal should be that the landscape change community would promote research into new technologies and techniques supporting the measurement of landscape change. A simple hypothetical example would be rapid development of information about the IKONOS satellite data and its capabilities as a source of consistent longitudinal data regarding different types of landscape conditions and change, like land cover. In order to make this happen, the landscape change research agenda needs to make measuring change a research priority with a particular emphasis on the technologies that can improve existing measures or allow new measures of landscape change.

Sophisticated analyses of data One of the powerful implications of the technology is that it permits powerful analyses of various forms of land information. The analyses of data about the landscape reveal relationships, hidden patterns, and phenomena that exist within the landscape. A simple digital elevation map can be analyzed to reveal slope, aspect, drainage patterns, watersheds, and viewsheds. In many cases the problem stems from the small number of researchers able to debate the merits of (or even apply) both the technology and the theory necessary to support such sophisticated analysis. It should be a goal that more sophisticated analysis, using techniques like spatial statistics, be both developed and applied for an improved understanding or explanation of landscape patterns. Examples include analysis of a sewage system to demonstrate its relationship to new development patterns, habitat suitability analyses (e.g. Brehme 2000) or modeling of historical data to produce a longitudinal record of forest fires. Development of new techniques and validation of existing analytical methods should be a high research priority because this area can so quickly change the potential outcomes of landscape change research.

Communicate information Often overlooked is the ability of the technology to communicate information about the landscape and related phenomena. The simple improvements of quality and efficiency in map production have led to a plethora of maps (e.g. the USGS maps of the growth of major cities). More powerful, although much less exploited have been more complex representations of landscape change like 3-D visualization and animation (e.g. Taddei, David and Michl 2000 and Kovacic et al 1990 and 1998). The problem here is that while some creative applications have been offered, much remains to be learned about the effectiveness of such communication efforts and the development of new representation techniques. Goals should include accelerated exploration of potential communication media, development and dissemination of techniques for measuring cognition of land information communication, and improved evaluation of existing techniques. Examples include innovative applications like Taddei, David and Michl 2000 and computer animations of historic Yellowstone forest fires or a 3-D animation of clear cutting, and studies of how users interact with the digital representations of the data (e.g. Davies and Scott 1996). This needs to become a much higher research priority, especially because of the way that it connects landscape decision makers -- including planning professionals, elected decision makers, and citizens - with information about the land.

Prediction of future change and events Although it may be considered to simply be an extension of analysis, an important opportunity for employing technology is the prediction of future change and events. Based on understandings of causes of landscape changes, predictive models can be applied to forecast land use change, habitat loss, or land accretion. Research today is still limited by both the lack of many models, and others that remain insufficiently tested. The goal of this research priority would be improved predictive models with greater understanding of their validity. Examples include the application of biophysical and socio-economic data to forecast future areas of land development or to identify stands of hemlock most likely to experience significant loss from insect damage. Landscape change research should offer greater support for this research priority in a number of ways including development of substantial theory for change prediction, improved substantiation of existing models, and development of new predictive models.

Altering future outcomes The many applications of land information systems and knowledge about landscape change are of limited meaning, if they do not ultimately impact landscape change processes. A goal of much of this research is to alter future landscape change or transform public participation in the processes determining the outcomes of land resource decisions. Information can shape public decision making, either by informing decisionmakers or by shaping the nature of the public debate (Krygier 1999). Internet mapping and data servers (like Rutgers' MapGarden or Washington County Oregon's InterMap) or simpler GIS output in digital formats (like the Grand Portage Natural System Geographics web page) have the potential to dramatically alter the ways in which citizens understand and participate in the processes determining public decisions. Another category of altering future landscape outcomes is the use of IT products to guide private resource decisions. As speculative real estate investors access the increasingly available land records, they can use the technology to anticipate both physical and economic changes in the landscape. Perhaps this will lead to more calculated land grabs by developers, but it might also lead to more avoidance of potential trouble areas like wetlands and unstable slopes. A final research priority should be that more landscape change research be conducted in ways that can be applied to "real world" landscape problems, particularly with involvement from the organizations, agencies, and communities responsible for such changes.

So What?

The implications of the applications of geospatial technologies are still largely unknown. The five previously described categories of interactions between geospatial technologies and landscape change lead to a diverse set of potential research areas and questions. As such, they all deserve serious consideration as research priorities under the aegis of landscape change research.

How well do we really understand the patterns of landscape change? Researchers often generalize that development is occurring in certain ways (leapfrog versus tree-rings versus arterial) when remotely sensed data suggests otherwise. Similarly, much has been suggested about the negative impact of various forms of sprawl. For instance, a recent presentation by John Landis (2000) used GIS to counter the widely held viewpoint that "prime farmland" was disappearing due to sprawl in the San Francisco Bay area. Regardless of whether the understanding of the farmland consumption was entirely well founded, the introduction of spatial information contributed significantly to the study of development patterns and suggested that "conventional wisdom" is insufficient for shaping major policy decisions. In contrast to this example, many of today's discussions and decisions about impacts are based more on conjecture than any particular source of information.

Will the public embrace these technologies? Will citizens be willing and able to employ geospatial technologies in such a way as to participate in public processes? The technology and associated information have the ability to empower those who portend to speak for the landscape. When many parties assert their position in regards to landscape change, better application of information has the potential to alter, perhaps even reduce, environmental conflict. Will the study of landscapes and landscape change be fundamentally altered by the use of these technologies? Can a research agenda, or the lack thereof, change the future abilities of scholars and professionals to study and determine landscape change? It has been argued that the lack of a significant research agenda, and the lack of a sophisticated landscape-oriented GIS community, have led to a scarcity of necessary data (Tulloch 2000).

The need for a strong, coherent approach to landscape change research seems clear. Many elements will be needed to produce such a research agenda, but information technology should be treated as an important and distinct portion, not simply woven in or left to other researchers.

References

- Brehme, C. 1997. "A GIS analysis and model of suitable gray wolf habitat in the Northern rockies," paper presented at UCGIS 1997 Annual Assembly, online paper last checked 10/11/00 at http://www.spatial.maine.edu/ucgis/testproc/brehme/brehme.html.
- Davies, C., and D. Medyckyj-Scott, 1996. GIS users observed. International Journal of Geographical Information Systems 10: 363-384.
- Kovacic, D., W. Romme, D. Despain, and A. Craig. 1990. "Landscape Dynamics of Yellowstone National Park: The Role of Fire 1690 to 1990." Online Science Presentation available online at http://www.ncsa.uiuc.edu/SCMS/DigLib/text/geosciences/Landscape-Dynamics-Yellowstone-Kovacic.html.
- Kovacic, D. A., A. Craig, R. Patterson, W. H. Romme, and D. Despain. 1998. "Fire Dynamics in the Yellowstone Landscape from 1690-1990: An Animation,"*Landscape Journal*, Special Issue on Eco-Revelatory Design, 6-7 (see also http://www.gis.uiuc.edu/ecorev/).
- Krygier, J. 1999. "World Wide Web Mapping and GIS: An Application for Public Participation" *Cartographic Perspectives*, no. 33 (Spring 1999) available online at http://www.nacis.org/cp/cp33/NACIS_ppgis.html.
- Landis, J. 2000. "Beyond Sprawl: Using Today's Information Technologies to Build Tomorrow's Urban Communities," keynote presentation to the Annual Conference of the Urban and Regional Information Systems Association, Orlando, FL.
- Lathrop, R., J. Hasse and J. Bognar. 2000. Web page, "CRSSA Land Use/Land Cover Research," at http://www.crssa.rutgers.edu/projects/lc/, last checked on 10/13/00.
- Taddei, U., O. David, and C. Michl. 2000. "New Visualization Techniques" *ACM SIGGRAPH Newsletter* 34: 1(February 2000) online at http://www.siggraph.org/publications/newsletter/v34n1/contributions/Taddei.html.
- Tulloch, D. L. 1998. "Environmental NGOs: Community Access to Technology as a Force for Change," Workshop Paper for National Center for Geographic Information Analysis Specialist Meeting on Empowerment, Marginalization, and Public Participation GIS, available online at http://ncgia.ucsb.edu/varenius/ppgis/papers/tulloch/tulloch.html.
- Tulloch, D. L. 2000. "Data Shaping The Landscape: GIS and Stewardship," Landscape Journal, 19: 211-219.

The Importance of Landscape to Health and Well-Being
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The Importance of Landscape to Health and Well-Being

A. Premise: universal connection between man and the landscape
    1. Basic biological needs
    2. Culturally defined roles
    3. End result
        a. Healthy land supports healthy citizens & a healthy society
        b. Healthy societies and individuals promote good land stewardship practices
B. Recent and distant studies of support for the premise
    1. Galbraith and Westphal (2000)
    2. Ulrich, Cooper-Marcus and Barnes, Gerlach-Spriggs et al, Francis
C. Current issues affecting the health of landscape
    1. Global warming
    2. Fragmentation of ecosystems
        a. Urban sprawl
        b. Recreation development
    3. Resource consumption
    4. Population growth
D. Current issues affecting the health of citizens and society
    1. Depersonalization (due in part to computer technology)
    2. Loss of community identity
    3. Diminished value of societal institutions: the family, public schools, government, etc.
    4. Severed tie to the natural landscape and its normal cycles of birth, growth, reproduction, and death
    5. Removal of long-term land stewards from privately held land reserves: plight of the family farmer

The Importance of Landscape to Health and Well-Being

This position paper is predicated on the belief that a basic relationship exists between the health of a landscape and the health of the individuals who occupy that land. Conversely, it is believed that this same basic relationship operates in a diametrically opposed direction-i.e., that the health of an individual (and society at large) will determine the health of the receiving ecosystem on which it resides. The author maintains that these simple truths reside in the inherent natural biorhythms and energy transformations that unite all organisms on earth. They also reside in the learned behavioral norms of society that are created to promote stable, nurturing environments for reasons of survival (an issue that also depends on basic energy use and transformation).

Primitive cultures historically have followed traditional patterns of land occupancy. These patterns have evolved over time, often on a trial and error basis, but most certainly based on the ability to do work and reproduce as a species (Jones 1999). Almost never have primitive tribes exceeded the inherent carrying capacity of the natural ecosystems in which they existed. If they did they were forced to migrate to new areas, incite and/or fight wars over new territories, or cease to exist. Similarly ancient societies, like the Chinese, have developed complex rules for land development (e.g.,Feng Shui) based on energy flow in the landscape. In all cases, normal events in the cycle of life were tied closely to other cycles that marked the natural environment in which they lived and the flow of energy from one source to another.

Today's societies, particularly in developed countries, have severed many of the rituals that unite societal members to their environment. In severing these ties, many of the energy flow connections that marked primitive relationships with the landscape lay fallow or cease to exist. Man as a biological organism has inherent biorhythms that are reset, reinforced, and/or redefined by the inherent biorhythms that mark his external environment. A simple well-documented example is the medical phenomenon known as Seasonal Affective Depression-the incidence of mild cases of clinical depression secondary to the shortening of days during Fall in the Northern Hemisphere. When these mechanisms go unaddressed, stresses are introduced internally to the organism in the form of hormone imbalances, and homeostasis (the natural ability of the body to maintain a steady state through energy utilization) is threatened. Many other nature-induced phenomena are thought to influence the general health and well-being of humans through the transformation of sensory stimuli (again an energy dependent phenomenon) into hormonal changes in the body; these hormonal changes are thought to ultimately affect DNA and other genetic complements in cells. As research progresses on these phenomona, greater understanding of these cause and effect relationships will follow.

Recent studies by Galbraith and Westphal (2000), as well as older studies by Ulrich (1984, 1987, 1992, 1996), Francis (1994), Marcus-Cooper and Barnes (1995), and others have indicated measurable improvements in human health on the part of patients placed in, or having access to, natural environments. Studies of HIV-AIDS patients indicate high preferences for natural areas in hospital and home care settings (Westphal et al, 2000); this is particularly true as this patient group progresses to the terminal stages of life. Likewise, healthy individuals report improvements in affect (mood), attention deficits (focus), and task performance if placed in environments where natural settings predominate (Grahn et al, 1998; Cooper-Marcus and Barnes, 1999, 1995; Gerlach-Spriggs et al, 1998; Tyson, 1997). Finally, Aicher (1998) presents excellent documentation and case study work that shows the stressful environments can have significant health consequences in urban populations.

The discussion so far has focused on the health and energy needs/transformations that affect principally human organisms. However, these needs mark every living organism on earth and all natural processes. Therefore, if we consider current issues affecting the health of landscapes, surely we must view them from a homeostasis and energy transformation basis. Almost every major issue affecting the earth today (i.e., global warming; fragmentation of ecosystems through urban sprawl, recreation development and/or resource exploitation; resource consumption; or population growth) directly or indirectly involves balance and energy consumption. Energy transformed in the various life cycles of organisms; energy trapped in geothermal and natural processes/products; energy exchanged as a commodity. All of this competition for a relatively finite pool of energy (trapped from the sun in molecular bonds of plants and subsequently used by animals in their life demands) is becoming exacerbated by mans' removal from direct interactions with the landscape. Because of this removal, the consequences of decisions affecting the land are not experienced by the decision-maker. He/she avoids the direct consequences that many of these short sighted and selfish actions have as their intended outcomes. As a result, unhealthy physical and psychological conditions result. This situation is unhealthy from the standpoint that normal consequences of behavior go unchecked because of an absence of normal balancing mechanisms (social and pysical) that are a part of all natural processes. Because of new technologies, global economies of scale remove decision-makers even further from the receiving ecosystems. When one suffers no ill effects personally from a decision, then a likely reinforcement of the behaviors ensues. The culminating effects are disastrous. If Mother Earth were considered an organism from a medical standpoint, one would have to conclude that her homeostasis is markedly out of balance and she is in an advanced state of disease.

What courses of action must be pursued to rectify the situation? First, avenues must be found to counterbalance the depersonalization that has resulted from computer technology and the loss of accountability in a global society. Second, education that reinvests citizens in the value of community diversity, place identity, and social institutions is needed on a global scale. Third, an effort must be conducted to reconnect individuals with the earth; this may be achieved through meaningful reclamation activities that refocus our role as one species in a larger collection of species that are dependent on the health of the earth for survival. It also may involve the celebration and recognition of those, who through their occupations or vocations, serve as the primary land stewards for society (e.g. farmers, resource managers, etc.). Finally, reinforce in our school curriculums the importance of natural life cycles and their consequences for all living organisms. After all, if we do not place ourselves above the natural cycles of life and the processes that affect all living organisms, then perhaps we will regain a responsible perspective of our role in the greater scheme of the universe.

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POSITION STATEMENT

My graduate studies ended approximately a year and a half ago. Since that time, in my practice of landscape architecture, I have found it a challenge to continue broadening my understanding and knowledge about landscape change and urban growth. An ironic situation, since landscape architects are among the most qualified designers to assess landscape change at varying scales, from the site level up to regional impacts. My thesis work focused on looking at growth management in Washington state, and the impacts it has had on development at the urban fringe. In my current home state, Minnesota, I believe such a study could be beneficial to better understanding the pace and impact development is having on the landscape.

Several issues arise when one attempts to grasp the complicated nature of growth and its driving forces. Too often, land use policy is implemented, with little or no follow up to assess its geographical effectiveness. I believe this is the case in the area of urban sprawl. The policies exist to try to slow growth, but often they are misguided in their application and enforcement. The missing link is a thorough understanding of how local and state governmental decisions affect landscape fragmentation and land conversion across a metropolitan area. I believe that there needs to be a forum for geographers, policy makers, and designers to communicate their collective knowledge base to better understand how to get from our current situation to a beneficial and sustainable situation in the future. But how do we develop an arena for this discussion to take place? Such communication often takes place in academia, but in government structures and professional design practice, there are often institutional boundaries and time constraints that make such an interaction difficult if not impossible.

To have a positive effect on growth and landuse change, two major issues must be resolved. First, a broader understanding of geographical patterns, particularly the issues of landscape fragmentation and the pattern of sprawl, needs to become a part of the social conscience. We as practitioners have a responsibility to "speak the word" and share information amongst ourselves and with the general public in order to affect such a shift in social values. Second, with such a shift in values, we need to strive to understand how to manage and govern change across municipal, county, watershed and state boundaries. Too many examples exist of areas in which growth policy has been successful in one area, only to be a miserable failure across a county or state line.

I would like to have the opportunity to begin this discussion with other professionals and researchers in these complimentary fields. Perhaps we can begin a dialogue which will serve to guide our decisions for the coming decades.

Workshop Agenda

Upham Hotel, Santa Barbara, January 25-27, 2001

Program

Thursday January 25

- Introduction and Objectives of the workshop (Mike Goodchild, UCSB, co-chair; Fritz Steiner, Arizona State University, co-chair)
- Introduction of participants
- Technology Plenary Keynote speaker: Jack Dangermond, ESRI; Discussant: Stephen Ervin, Harvard University
- Technology Breakouts
- Technology Summary

Friday January 26

- Decision-Making Plenary Keynote Speaker: Ron Eastman, Clark University; Discussant: Joan Nassauer, University of Michigan
- Decision-Making Breakouts
- Landscape Perception and Assessment Plenary Keynote Speaker: Jim Palmer, SUNY; ESF Discussant: Jim Sipes, Jones and Jones
- Landscape Perception and Assessment Breakouts
- Decision Making and Landscape Perception Summary

Saturday January 27

- Environmental and Social Science Plenary Keynote Speaker: Helen Couclelis, UCSB; Discussant: Joanne Westphal, Michigan State University
- Environmental and Social Science Breakouts
- Summary
- Closing Plenary Conclusions, next steps (Steering Committee)