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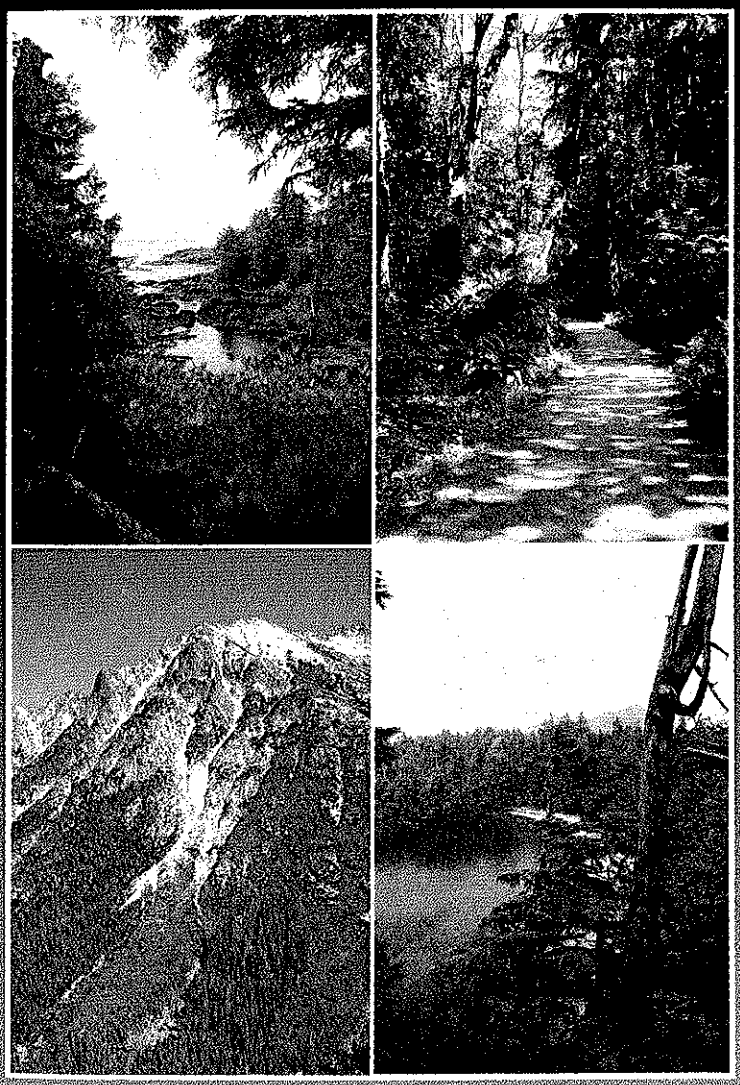

Special Issue
The Social Aspects of Landscape Change:
Protecting Open Space Under the Pressure of Development

LANDSCAPE AND URBAN PLANNING

An International Journal of Landscape Ecology, Planning and Design

Aims and Scope. A journal concerned with conceptual, scientific, and design approaches to land use. By emphasizing ecological understanding and a multi-disciplinary approach to analysis and planning and design, it attempts to draw attention to the interrelated nature of problems posed by nature and human use of land. In addition, papers dealing with ecological processes and interactions within urban areas, and between these areas and the surrounding natural systems which support them, will be considered. Papers in which specific problems are examined are welcome. Topics might include but are not limited to landscape ecology, landscape planning and landscape design. Landscape ecology examines how heterogeneous combinations of ecosystems are structured, how they function and how they change. Landscape planning examines the various ways humans structure their land use changes. Landscape design involves the physical strategies and forms by which land use change is actually directed. *Landscape and Urban Planning* is based on the premise that research linked to practice will ultimately improve the human made landscape.

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Special Issue

The Social Aspects of Landscape Change:

Protecting Open Space Under the Pressure of Development

Guest Editors

Paul H. Gobster, Susan I. Stewart, David N. Bengston

USDA Forest Service
North Central Research Station

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Introduction

The social aspects of landscape change: protecting open space under the pressure of development

The extent of developed land in many parts of the world has increased rapidly in recent decades, posing significant challenges to the protection of forests, agricultural lands, and other natural and culturally modified green areas in urban and rural settings. Sustaining these open spaces has long been seen as a critical issue economically, and it is now increasingly being seen as integral for sustaining our psychological health and our ethical relationship to the non-human world as well. As human population spreads across the landscape, natural resource managers and policymakers need to better anticipate and respond to the widespread changes and increasing pressures affecting open spaces. Social science research can play an important role in providing answers to address these vexing management concerns.

In October 1998, the USDA Forest Service, North Central Research Station (NCRS) launched a program of integrated research examining issues of development-related landscape change within the seven-state region of the North Central US (Gobster et al., 2000). In early discussions about the program, NCRS scientists representing the wide range of disciplinary expertise came to recognize that many of the issues underlying landscape change—problems and effects as well as solutions—were human in nature, and that in order to address them a solid research grounding in the social sciences was needed. As part of a small group of social scientists in the station, this gave us a unique opportunity to provide leadership and substance on this new NCRS initiative. Working with station scientists, university scholars, and natural resource practitioners, we began a research program aimed at understanding change in our region as well as establishing linkages to ongoing efforts that extended beyond it.

To begin bringing the fruits of these efforts together, in June 2002 we organized a series of four sessions for the Ninth International Symposium on Society and Resource Management at Indiana University to examine current research and management experiences dealing with the social aspects of landscape change. Many of the talks focused on the North Central US, with contributors sharing local case studies and regional analyses that characterized the trends and challenges facing this varied landscape. These were complemented by talks describing national level assessments and work from other regions and countries. Together, the sessions spanned a diverse range of issues affecting urban, rural, and wildland settings.

As editors we have helped bring 10 of the original 18 talks from these sessions into paper form for this special issue, along with 2 additional papers (Vogt and Marans, Sullivan et al.) that stem from landscape change work sponsored in part from our station initiative. While the set collected here by no means covers all of the aspects of social science research relating to landscape change, it is our intent to provide researchers and practitioners with a solid representation of the issues.

Dwyer and Childs begin the discussion by showing how problems and opportunities stemming from people's movement across the landscape defy traditional means of categorization, challenging natural resource managers to understand and develop programs and policies that bridge urban, suburban, and rural areas and constituencies. Through examples and ties to other papers in this special issue, the authors provide

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a useful overview of key substantive topics regarding the social aspects of landscape change. By focusing on private forestlands in Wisconsin's "Northwoods", Gobster and Rickenbach provide an overview of another sort. Using a process model of landscape change as a framework for asking questions, the authors examine how natural resource oriented stakeholders view parcelization and development patterns, causes, and effects, as well as the effectiveness of strategies aimed at stemming their negative consequences. By using this framework, the authors are able to identify the critical boundaries of landscape change issues for this group of stakeholders.

This same process model of landscape change is used to organize the remaining papers in this special issue. To better understand the patterns of landscape change in the North Central region, Hammer et al. use cluster analyses of housing density and housing growth data from the US Census for 1940–1990 to identify areas of the region with high growth potential. With parallels to the topical analysis by Dwyer and Childs, the authors' numerical methods reveal patterns of concern at the periphery of metropolitan areas, in smaller urban centers, and in rural recreation areas throughout the region. Palmer analyzes land use patterns in a different way, through the use of landscape metrics derived from landscape ecology and tied to people's perceptions of changes in scenic quality. Looking at a portion of the Cape Cod, Massachusetts landscape over a 20-year period, Palmer's analysis shows both the stability of perceptions over time and how landscape metrics can be used to predict the effects of land use changes on those perceptions. Alig and his colleagues complete this section with a look at some of the critical causes of landscape change, using National Resource Inventory data spanning 1982 and 1997 to look at changes in urbanization across the US and its regions. The authors find population density and personal income to be the most effective predictors of urbanization, and from their results project continued urban expansion over the next 25 years, with the magnitude of increase varying by region.

While the effects of landscape change are many and usually talked about in a negative way, there can be significant positive benefits to people and nature. This may be particularly true for new homeowners and suburban fringe areas, as a series of papers focusing on subdivision design in the rapidly developing area of southeast Michigan attest. In a survey of new homeowners in traditional and open space conservation subdivisions, Kaplan and Austin find a strong preference among their sample for nearby natural settings, particularly forested ones. Following up on their work, Austin suggests that the protection of these settings may be more likely if they are in communal ownership as part of an open space conservation subdivision. A third, independently executed work by Vogt and Marans concurs with these findings, but also suggests that for some people the protection of natural areas and other open spaces faces stiff competition among the full range of considerations that go into home purchase decisions. While the researchers show that buyers of homes in conservation subdivisions place a high value on the natural, open characteristics of the landscape, buyers in general tend to put their highest priorities on home and neighborhood features, schools, and access to transportation in their purchase decisions for new homes in suburban fringe areas. As conservation developments are still a small proportion of the new home market in fringe areas of the US, the authors argue that this type of development needs broader support among consumers and policymakers before it can become an effective strategy for protecting open space.

Strategies for open space protection are the central focus of the final set of studies included in this volume, and here a variety of approaches to public policy, planning, and management are represented. Bengston et al. begin with a review of public policies for managing urban growth and protecting open space. In a systematic assessment of recent acquisition, regulatory, and incentive approaches instituted across the US, the authors glean some key lessons for improving policies with respect to their evaluation, implementation, complementarity, coordination, and stakeholder involvement. While the authors lament that little in the way of empirical policy evaluation has been accomplished, the following paper by Williams et al. demonstrates the value of doing so. The authors take an economic approach and show that the incentive-based Tennessee Forest Greenbelt Program has been ineffective in stemming the conversion of forestlands to other users. Sullivan et al. conduct an evaluation of another kind, looking at the perceptions of stakeholders toward vegetative buffer strips as a management strategy to ameliorate conflicts between farmers and residents at the rural–urban fringe. Using visual simulations of

alternative management scenarios, the authors show how buffers of various types can be designed to meet the approval of concerned stakeholders. Stewart et al. conclude this section by describing an effective approach to planning that uses photo elicitation as a public involvement tool. The authors focus on a large federal prairie restoration project taking root within a rapidly developing area of the Chicago urban fringe and identify themes about community learning, enactment, and improvement that can serve as a basis for establishing community visions for landscape change.

Since its inception, *Landscape and Urban Planning* (and its forerunners *Landscape Planning* and *Urban Ecology*) has been concerned with issues of landscape change as addressed by diverse perspectives from planning, ecology, and design. The human dimensions of landscape change holds an important place in this discussion and it is hoped that through this special issue we have contributed to the dialogue.

This theme issue is dedicated to Dr. David S. Shriner (1945–2003), who as Assistant Director of the North Central Research Station provided a sustaining leadership and an endearing enthusiasm for landscape change research.

Reference

Gobster, P.H., Haight, R.G., Shriner, D., 2000. Landscape change in the Midwest: an integrated research and development program. J. For. 98, 9–14.

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Movement of people across the landscape: a blurring of distinctions between areas, interests, and issues affecting natural resource management

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Abstract

The spread of development from cities into surrounding forests and farms continues to receive a great deal of attention from the media and resource managers in the US and other countries. However, suburban sprawl is just one of many inter-linked components of the movement of people across the landscape that influence resource management. Substantial changes are taking place in urban areas, fringe areas, and rural recreation/amenity areas. In this paper, we describe these changes, explore their commonalities and interconnectedness, and discuss the implications that they may have for natural resource management. What emerges is a blurring of the distinctions between what have traditionally been considered "urban" or "rural" problems with respect to natural resource issues, interest group concerns, and resource management strategies. Our findings suggest prospects for substantial changes in resource management and the public and private programs designed to support it. Among the emphasis areas for natural resource management that emerge with the changing distribution of people over the landscape are changes in management situations, management processes, and research needs. The changing management situations include increased emphasis on interface and intermix areas, restoring human-impacted natural areas, and addressing complex ecosystem problems. Changing management processes include adaptive forest management, working collaboratively with diverse landowners and other partners, interacting with citizens on a regular basis, and taking a landscape perspective on natural resources and their management. Questions for policy and program development and for research focus on a better understanding of linkages among management activities across the urban to rural landscape.
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1. Introduction

Recent changes in preferences, technology, transportation, jobs, and costs of desirable housing have all influenced the migration of people across the landscape. Although much of the attention has been on suburban sprawl, people are moving to and from many areas of the landscape ranging from the inner city to remote rural areas. At the same time that opportunities for desirable housing are increasing, working people are less tied to public transportation, standard office hours, and office presence. This gives people more flexibility than ever in determining where they want to live. In addition, the baby boomer generation is

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retiring or considering impending retirement—often with more disposable income than past generations. Many are building permanent or seasonal homes in amenity areas near mountains, lakes, and other aesthetically pleasing, recreation-oriented settings. Others choose to purchase or renovate homes in urban areas closer to cultural resources and medical services.

This changing distribution of people across the landscape has important implications for the management of natural resources. Some implications are tied to specific areas of the landscape, such as expanding fringes of urban areas or the growth of rural recreation/amenity communities. However, there are important linkages between these and other changes that are taking place across the landscape, as well as common resource management themes and issues. The differences between what has traditionally been considered urban and rural are tending to blur over time. Many of the changes affect public and private programs that support resource management.

Our purpose here is to explore the possible implications of these changes for the management of natural resources. Our observations draw heavily from our own experiences and those of our colleagues represented in this volume, and while this body of work is based largely in the midwestern US, much of what we present has wider applicability. We begin with a look at some areas that are often "hotspots of change," where people/natural resource interactions are likely to undergo significant changes. We then examine some key linkages and commonalities among these hotspot areas. We close with possible implications and questions for natural resource management, policy and program development, and research.

2. Hotspots of change

Patterns of human movement across the landscape have been identified through the study of US Census data on population and housing density (e.g. Hammer et al., in press) and land use and land cover data (e.g. Alig et al., 2004). While there are often significant regional differences in the rates of this movement (Alig et al., 2004), three within-region hotspots of change are also apparent. These include urban areas, suburban fringe areas, and rural recreation/amenity areas.

2.1. Urban areas

A dominant pattern of landscape change in many metropolitan areas continues to be movement of people from the central city to outer suburbs and adjacent non-metropolitan areas. In some instances, people may leave behind vacant housing, and where the closing of a factory or business precipitated or followed their move, there may be vacant commercial property as well. This creates opportunities for converting vacant urban areas to natural areas, providing a range of benefits such as biodiversity, open space, storm water storage, and wildlife habitat that were not considered in the initial development of these areas. However, these conversions can also bring challenges associated with establishing, rehabilitating, or restoring natural resources on sites that generally have been highly impacted. These include highly modified and sometimes impervious soils, large amounts of invasive and non-native vegetation, and, in some cases, toxic materials. Adding to these management challenges is the lack of widely accepted goals for these areas. What emphasis should be placed on restoring natural resources and ecosystems relative to other goals such as economic revitalization through development (Westphal, in press)? How can these newly created areas help fill in the gaps in the existing urban forest (Nowak et al., 2001)? Government officials and developers are often willing to take on these challenges, and increasingly see trees, parks, and natural areas as keys elements in reducing "urban flight" and attracting people and economic activity back into urban areas. "Mayor Daley's Greenstreets" program in the City of Chicago and other urban greening programs in cities around the US are noteworthy examples of efforts to improve the livability of urban residential areas by upgrading the green infrastructure. Examples of efforts to restore natural resources in commercial and industrial areas in central city areas include the corridor of the Chicago river (Gobster and Westphal, 1998) and the Lake Calumet area of southeast Chicago (City of Chicago, 2002).

In contrast to the dominant pattern of movement outside the city, an increasing number of individuals in search of a new home are choosing to renovate or rebuild older structures within cities. In other instances, new structures are being built on vacant city land. In both cases, this renewed interest for living

in the city can help to rebuild the urban tax base and restore vitality to existing neighborhoods. However, without careful planning there can also be losses to the green infrastructure of these areas. Renovation and rebuilding efforts almost always increase the size of the structure originally occupying the site, and result in the removal of existing trees and a loss of space for vegetation, leisure use, and absorption of storm runoff. Overdevelopment of city lands that were formerly vacant can also result in lost opportunities for neighborhood space for parks, greenways, community gardens, and the like. In both situations, the operation of construction equipment, compaction of the soil, changes in drainage, and the addition of fill generally impede the ability of existing trees and plants to thrive, and lengthen the establishment period for new plants. Protecting existing vegetation during the construction process, and establishing additional vegetation around a new or renovated home are major challenges for homeowners and resource managers (Watson and Neely, 1995).

2.2. *Suburban fringe areas*

A second hotspot of change in metropolitan areas lies with the newer suburbs at the outer fringe. Here the major issue is sprawl, the spread of low-density residential developments into previously undeveloped areas (Dwyer and Stewart, 1998). This growth is attributed, in part, to the attractiveness of the natural and social environments, access to good transportation and schools, and financial advantages (Vogt and Marans, 2004). Concerns sometimes associated with urban sprawl include the loss of forests and farms to housing and related development. The cost of infrastructure in sprawling areas can be a major concern to local units of government. Visible impacts of urban sprawl on natural resources include the loss of large trees and remnant forested areas, and the planting of new trees and restoration of natural communities on former agricultural lands as a part of the creation of new residential environments.

Migration of people to the suburban fringe can also mean that more and sometimes different people become involved in planning and development activities, as well as in managing natural resources in these areas (Austin, 2004). New owners can redirect a community's long-held land use goals, making planning a major challenge. Development and homeowner associations can serve as a forum for discussions among these diverse residential interests. The increasing number of local and non-local individuals, groups, and interests involved often complicates and burdens public assistance efforts aimed at working with landowners and managers.

Alternatives to the expansion of traditional housing developments in suburban fringe areas sometimes involve large lots and open space subdivisions. Extensive developments with lots ranging of 5–10 acres (2–4 ha) and larger spread people and infrastructure over a large land area, require the substantial expansion of infrastructure, and create more individual landowners responsible for considerable amounts of open space. The challenge for resource managers is to provide appropriate guidance and assistance to these owners, many of who may not readily visualize their property as a natural resource to be managed.

In other instances, an open space subdivision may be created where the new residential lots are smaller, clustered in a development, and natural features become an integral part of the development, held jointly by community residents (Kaplan and Austin, in press). These commonly held areas may be managed jointly—sometimes by community volunteers, and often with the help of a professional natural resource manager or management firm—or not managed at all (Austin, in press). In addition to management responsibility, issues of conflicting ideas over use, desired level of maintenance, and appropriateness of plant materials may parallel those associated with community-held areas in more urban settings, such as community gardens.

2.3. *Rural recreation/amenity areas*

In rural recreation/amenity areas, hotspots of change are often associated with the development of residential and recreational enclaves, as well as the influence of these developments on adjacent public lands. Homes developed in vacation or amenity areas include both seasonal and permanent homes (McGranahan, 1999; Stewart, 2001), with many of the former converted to permanent status as owners retire or move their job to the area (Stynes et al., 1997). Homes that are replaced or upgraded to meet new needs can lead to resource management challenges

similar to those discussed previously for reconstruction in urban areas. In other instances, infilling may take place, particularly where choice sites are concentrated within an area, such as lakeshores or hillsides with exceptional views. These developments pose many of the same opportunities and challenges that have been associated with infilling in urban and suburban areas. Fire management can also be an important issue in these environments, given strong owner preferences for a home "in the woods."

The movement of people across the landscape can also affect the management of public lands that are near new or changing residential and recreation developments (Gobster and Rickenbach, 2004). Homes and subdivisions in recreation/amenity areas are often built in close proximity to public lands to take advantage of the natural and scenic environments that these lands provide. In fact, proximity to public natural resources is often a key marketing message for nearby homes and subdivisions. Expanding nearby development presents public land managers with a multitude of opportunities and challenges as they must respond to the increasing influence of residents, landowners, and developers; often with strongly held and diverse views of appropriate land use and management (for example, see the Urban National Forests website at http://www.fs.fed.us/recreation/permits/urban/). Conflicts over access roads, fees, hunting, and timber cutting, as well as disruption of access to public lands and trails, can be important concerns with nearby public lands.

3. Linkages and similarities across the landscape

Our previous discussion has outlined three areas of the landscape where people/natural resource interactions are likely to undergo significant changes. Interactions in urban, suburban fringe, and rural recreation/amenity areas tend to be interrelated due to significant physical, biological, and social linkages and similarities. Thus, there are important implications for natural resource management policies and programs as well as educational activities that span the boundaries of location, stakeholder interests, and issues.

The most obvious similarities and linkages are associated with the direct movement of resources such as water, air, and wildlife. Residential and associated commercial/industrial development and infrastructure can have significant impacts on water quantity and quality, air quality, and the number and diversity of wildlife. These influences may extend across the landscape to varying degrees depending on the type, location, and extent of residential development, the landscape in which it occurs, and the natural resources affected. The implications of resource management activities in one area of the landscape for the management of other areas may be substantial. Examples include damage to trees in northeastern US forest areas from ozone generated by automobile commuters in sprawling midwestern metropolitan areas, threats to urban surface water supply from increased development in headwater areas, and the proliferation of urban wildlife such as deer (*Odocoileus virginianus*) and coyotes (*Canis latrans*) due to urban park naturalization efforts and the development of long distance metropolitan greenway corridors.

Development may also influence the visual character of the landscape over substantial areas. Depending on topography, a particular development may alter the view from a number of important vantage points across the landscape. Alterations to scenery may generate significant public attention and create significant management challenges, especially in close proximity to public lands and amenity developments (see Palmer, 2004).

People can be important agents of change across the landscape in other ways. Many people move between several different landscapes over the course of their lives, and thus may experience a number of different ways in which natural areas are managed and used. At the same time, increasing media coverage of natural resource issues, from timber harvesting in remote forest areas to farmland preservation at the suburban fringe, exposes people to a wide range of values and perspectives. With this acquired knowledge and experience, people may transfer ideas and practices from one landscape to another. Sometimes this can result in promising insights and actions, while at other times the transference can be problematic. Either way, these efforts can have a significant effect on resource management. While surprisingly little attention has been given to documenting these important linkages in people's experiences, perceptions, and activities across landscapes, the following examples,

drawn largely from the authors' experiences, illustrate some of the possibilities:

- Many people in the Chicago area have been observed trying to grow non-native trees such as white birch (*Betula papyrifa* Marsh), mountain ash (*Sorbus americana*), and spruce (*Picea* spp.) in their yards, in part because they want to re-create the look of the "North Woods" (i.e. forested areas of northern WI, MI, and MN) where they have vacationed or lived. But with different climate, soil, and disease conditions, these efforts often meet with mixed success.
- In a reversal of the previous example, some seasonal homes in the "Northwoods" are owned by urban residents who landscape their vacation property much like their yard back home. This may include a manicured lawn mown right to the property line or lake edge and horticultural varieties of shrubs and flowers planted around the foundation of the home. To some long-term residents of northern Wisconsin this is sarcastically referred to as an "Illinois lot," given that many of the homeowners with these landscapes are seasonal residents who have permanent homes in Illinois (personal communication with Susan I. Stewart, USDA Forest Service North Central Research Station, Evanston, IL).
- In equating the starkness of a forest management activity to a more familiar urban setting, a person from the Chicago area who participated in research that evaluated people's responses to photographs of various tree-cutting methods likened a clearcut area to a burned out urban neighborhood (personal communication with Joanne Vining at the University of Illinois, Urbana-Champaign, IL).
- When responding to questions about forest management options in the Upper Peninsula of Michigan, another person from the Chicago area participating in a research project recalled the controversy that had ensued over ecological restoration of forest preserves in the Chicago area (personal communication with Deborah Carr, University of Michigan, Ann Arbor, MI).
- In a study of the owners of homes in open space subdivisions in Michigan, some respondents indicated that the ample nearby natural environment and opportunities for outdoor recreation made it less likely that they would purchase a second home in the Northwoods (Marans et al., 2001).

As these examples show, the transference of knowledge and experience across the landscape can have positive and negative consequences. In the context of policy to protect natural resources, it is critical that decision makers consider the direct and indirect effects of different options at the regional landscape level.

4. Emphasis areas for the future

Changes in the distribution of population over the landscape are likely to increase the importance of several areas of resource management. These are grouped into the following categories: management situations, management processes, and questions for programs and policy development and for research.

4.1. Management situations

4.1.1. Managing interface and intermix environments

The movement of people across the landscape and the creation of homes, associated developments, and infrastructure, as well as the restoration of natural resources on former commercial and industrial areas, increases the interfaces and intermixes between people, development, and natural resources. Interfaces between developments and natural resources are found at scales that range from a single home and an adjacent urban park, to a community or subdivision and an adjacent National Forest. An intermix environment is created where homes and other developments are interspersed among natural environments. Interface environments differ from intermix environments in that homes and other developments are immediately adjacent to natural resources, and there tends to be a higher density of residential development than with an intermix. In both cases, however, people tend to congregate at these interfaces and intermixes as residents and visitors. High levels of use, plus involvement of a wide range of managers, users, and uses, generates a need for special management strategies for interface and intermix areas which tend to be expanding in many areas.

While creating preferred environments for home sites, some types of outdoor recreation, and some

species of wildlife, interface and intermix areas often restrict other forest uses that require an uninterrupted forest environment. This in turn may place stress on forest health due to high levels of use, soil compaction, introduction of exotic invasive plants and animals, and other activities. Indirect impacts brought by development may take the form of changes in air and water quality, as well as in the surrounding landscape and its flora and fauna. Fire can be a particularly troublesome issue in some interface and intermix areas.

Forest health can be a significant challenge amid stresses brought on by disruption from developments and high levels of use, as well as associated problems with insects, diseases, fire suppression, and invasive plants and animals in interface and intermix environments. Close scrutiny by nearby residents concerning these problems and their solutions complicates management. The difficulty of trying to address such problems, particularly when a significant residential population is present, makes it especially desirable to avoid the creation of these problems in the first place. This can be accomplished by emphasizing efforts to enhance forest health and thereby reduce the prospects of damage by pests and associated problems (Dwyer et al., 2001, 2002).

4.1.2. Restoring human-impacted natural areas

Restoration of natural areas, processes, and health is a critical challenge that is often associated with change across the landscape, from abandoned inner city residential and industrial areas, to marginal rural agricultural and rangelands, to mismanaged and overused forests in remote wildland areas. The goal of restoration (e.g. ecological restoration) efforts is generally to restore the natural functions, processes, and health of these areas. Invasive plants and animals that may accompany past land use practices often add to the issues associated with restoration. When residential or recreational populations are nearby, management practices are likely to receive close public scrutiny, particularly those that involve removal of vegetation and use of fire or herbicides (Gobster, 1997). Important management questions include the effectiveness of various management practices, the costs involved over time, what and how to restore particular areas (including priorities for restoration efforts), and how to maintain/sustain the restored areas over time (Dwyer and Childs, 1998; Gobster and Hull, 2000).

Rehabilitation of industrial sites, while often associated with central city areas, can and does occur across the landscape. Important examples in the Chicago metropolitan area include the conversion of the 15,000 acre (6000 ha) Joliet Arsenal into the Midewin National Tallgrass Prairie (USDA Forest Service, 2002; see also Stewart et al., 2004), and the ongoing work to restore the ecology and economy of the Calumet Region (a total of 100,000 acres or 40,500 ha) (City of Chicago, 2002). Both the Midewin and Calumet efforts are being replicated around the country as former military and industrial areas are being converted to natural areas, and their ecological processes are at least partly restored. Other re-developments of commercial and industrial areas are occurring across the landscape on a smaller scale.

4.1.3. Addressing complex ecosystem problems

The movement of people across the landscape and the creation of new residential development often triggers complex issues related to the management of ecosystems. Residential development is often undertaken in areas with significant natural resources such as forests, water, and wetlands. In these instances, development can have far-reaching implications for the natural environment. Implications for water (Wear et al., 1998), air, wildlife (Theobold et al., 1997), land cover (Turner et al., 1996; Johnson, 2001; Radeloff et al., 2000), wood supply (Wear et al., 1999), and scenery (Sullivan, 1994; Ryan, 2002) may extend across the landscape and are often poorly understood. The social component of the ecosystem is also changed by development as well (Egan and Luloff, 2000; Smith and Krannich, 2000), and this affects both the characteristics of management problems and the possible solutions. Resolving important issues calls for a wide range of expertise, and often the coordinated involvement of a number of public and private agencies working together on collaborative approaches to resource management problems across the landscape. In many cases, these efforts tax the resources of local governments and public and private agencies.

4.2. Management processes

4.2.1. Practicing adaptive forest management

Adaptive forest management will be critical in dealing with complex issues and continuous changes

over time in the physical, biological, and social environment of areas where populations are changing. Change is the rule with the shifting of people across the landscape, and these changes can affect a wide range of attributes of the natural environment and the quality of life. This calls for rigorous efforts to monitor change over time, and to adapt management strategies when there are prospects for changes that are seen as undesirable by residents and other important stakeholders. Furthermore, limited knowledge of complex interface situations and processes creates uncertainty about management practices and programs, and makes it especially critical to monitor decisions to see if they result in the expected outcomes. Adaptive management is often the watchword in interface and intermix areas, and it is critical that there are regular and comprehensive resource inventory programs to guide and support that management. Adaptive management is often a challenge to local governments, given a scarcity of funds and expertise necessary to carry it out. An analysis of the Northwest Forest Plan (Stankey et al., 2003) identified a number of barriers to adaptive approaches to management: an institutional and regulatory environment that stymies innovation, increasing workloads coupled with declining resources that constrain learning-based approaches, and lack of leadership. These barriers may well extend to other efforts to encourage adaptive management (for additional discussion of adaptive management see, e.g. Holling, 1978; McLain and Lee, 1996; Chavez, 2002).

4.2.2. *Working collaboratively with diverse landowners and other partners*

Natural resource specialists in urban and rural areas often find that with new residential developments they are working with different landowners than in the past, as well as with other agencies and groups that are concerned with the development of natural resources and associated impacts. These "new" groups include regional planning agencies, transportation planners, and environmental protection agencies. Many of the new landowners, concerned individuals, or involved groups may not be particularly easy for natural resource specialists to contact, and with new situations and challenges many may be unaware of where to go for information and assistance concerning management of natural resources. Many small communities lack the time, expertise, and information systems necessary to deal with growth, and may not be within states where land use planning is a priority, well funded, or creatively handled.

Many state natural resource agencies and extension organizations were designed to provide one-on-one assistance. Since there were historically a few large landowners in rural areas, this method worked relatively well. As land is increasingly subdivided, with more "novice" landowners holding smaller tracts of land, one-on-one assistance may not be feasible. Furthermore, these new clients may expect different types of information and methods of communication than what is ordinarily provided by those who are available to help them. Some clients may need help in visualizing their land as a resource to be managed. Collaborative management approaches involving diverse individuals and groups are likely to be critical to address significant issues concerning the management of natural resources across the changing landscape. Sustaining forests and associated resources across the landscape is likely to require a combination of collaborative and adaptive management (Aplet et al., 1993; Selin and Chavez, 1995; Clark et al., 1997; Dwyer et al., 2003).

4.2.3. *Interacting with the public on a regular basis*

Public interaction is a key part of managing natural resources, but particularly in interface and intermix situations, given changes in the environment over time and the increasing numbers of people who may live, work, and play there, or otherwise know and care about the area and its development. There are likely to be significant shifts in the individuals involved in resource management over time, as well as changes in values across the population (Bengston, 1994; Bengston et al., 1999). Some of these changes are likely to be associated with demographic changes, while others are likely to extend across most demographic groups (Dwyer, 1994; Chavez, 2000). Economic changes also have a significant influence on decisions to buy land and to develop residences and other structures. A continuous dialogue with a wide range of changing partners is an integral part of collaborative and adaptive management of changing areas (Dwyer et al., 2000). Maintaining a dialogue with the public under these situations is likely to be a major challenge and require new methods and approaches. That dialogue is critical to mutual trust

in management. Natural resource organizations may need additional staff to keep up with their increasing clientele and with their diverse and changing needs. Interacting with part-time or seasonal residents can be a huge challenge for local land managers.

When working with public groups it is critical to recognize that individuals may influence and be influenced by forest environments and associated issues across the landscape, and that they are likely to have information needs generated by a wide range of issues and environments beyond the ones that they are currently involved with (for a discussion of communication with urban groups, see Chavez, 2001).

4.2.4. Taking a landscape perspective on natural resources and their management

A landscape perspective is often critical for planners, managers, and researchers since residential developments are linked across the landscape by important physical, biological, and social ties. The management of natural resources on one holding should consider the possible interactions with the management and use of other holdings across the landscape. Key landscape level concerns range from mitigating urban heat islands to blocking sun for gardens and solar collectors, to restricting access for hunting and maintaining trail linkages, as well as the availability of timber. Residential developments also can block access to public and private lands. With the creation of subdivisions, linkages across the landscape are particularly far reaching when it comes to quantity and quality of water, air quality, the amount and diversity of wildlife, and aesthetics.

The relevant scope for the analysis of a natural resource issue in developing landscapes depends on the resources and the landscape involved, as well as the issue being addressed. In the past, we have often tended to look at issues on a site-by-site basis and have overlooked the significant physical, biological, managerial, and social linkages across the landscape. Of particular importance are the human linkages between different parts of the landscape, in that people experience and are influenced by activities in various parts of the landscape. How the landscape is managed may affect where people choose to locate their home(s) and outdoor activities, and their involvement in landscape stewardship. Such a landscape perspective is critical to effective natural resource policy and management amid the changing distribution of the population across the landscape.

4.3. Some questions for policy and program development

What are the implications of the changing distribution of people across the urban to rural landscape for programs such as urban forestry, rural development, rural community assistance, environmental education, and public outreach? With residential developments and associated infrastructure being created or changed in a number of areas across the landscape, many of the concepts and techniques developed in urban natural resource management programs could have widespread application, although some adaptation would be required. At the same time, new residents from urban areas and new residential developments, both seasonal and permanent, and associated infrastructure may become increasingly important components of rural community development. Given the prospects for these interrelated changes, some important questions concerning future policies and programs are as follows:

- Should programs that provide resource management assistance to landowners in rural areas expand to include helping open space and amenity subdivisions manage commonly held natural resources?
- Should urban forestry programs extend their efforts to include open space subdivisions and recreation/amenity subdivisions?
- With the fragmentation of forest ownership on the urban–wildland interface, should agencies that provide assistance to rural landowners orient a portion of their programs to these owners with smaller acreages? Should there be a minimum acreage below which assistance is not given?
- Should urban forestry programs assist with efforts to restore rural communities that are losing population and economic activity?
- Should our natural resource programs, which are traditionally classified as urban or rural, work towards blurring the urban/rural boundaries?
- Given that urban residents increasingly interact with natural resources across the landscape and are aware of resource management issues across those settings, should public outreach and environmental ed-

ucation programs in urban areas take a comprehensive view of natural resource management across the landscape?

- Should public and private resource management programs give increasing attention to ecological restoration activities as strategies for managing disturbed lands across the urban to rural landscape?
- Should programs to reduce sprawl and its effects include efforts to encourage and enhance urban re-development, rebuilding, and infilling?
- How can urban re-developments make existing urban neighborhoods more livable?
- Should urban greening programs such as urban forestry, ecological restoration, and urban gardening be grouped together into comprehensive efforts that focus on greening the urban landscape (Dwyer and Childs, 1998)?

A new "Backyard Woods" program being developed by the USDA Forest Service Northeastern Area, State and Private Forestry in St. Paul, MN is beginning to address some of the challenges of fragmentation by providing technical assistance to the 6 million forest land owners in its jurisdiction who have 1–10 acres (0.4–4.0 ha). This group comprises 60% of all forest owners in the US (personal communication with Tom Dilley, USDA Forest Service, Northeastern Area State and Private Forestry, Evanston, IL).

4.4. Some questions for research

There are a number of questions for research that emerge from a discussion of the management of natural resources in response to the movement of people across the landscape. Some that are particularly significant deal with the implications of management and policy options across the landscape and include:

- To what extent will improving the green infrastructure of urban areas make it more likely that individuals will stay in or move their residences and businesses to these areas?
- To what extent can trees and other vegetation help make more "compact" housing developments (i.e. smaller lot sizes) more attractive residential environments?
- What are the best planning and management strategies for commonly held natural resources in permanent and seasonal subdivisions?
- How do private landowners in wildland–urban interface and intermix areas make decisions concerning the management and use of their holdings? How likely are they to respond to suggestions concerning resource management that would contribute to achieving objectives at the landscape scale?
- What strategies show the most promise for effectively managing small forest holdings in wildland–urban interface and intermix areas?
- What are the promising approaches for building coalitions of landowners, managers, and other interested groups in managing urban–wildland interface and intermix areas across the landscape?
- What are the prospects for effective education and outreach programs for urban residents that focus on resource management issues across the urban to rural landscape?

This brief sample of program, policy, and research questions underscores the importance of social science approaches in understanding how we can protect, enhance, or minimize negative impacts to natural resources in situations dealing with people's movement across the landscape. To the extent that we can integrate these "human dimensions" along with efforts aimed at understanding the physical and biological dimensions of landscape change, we will be more successful at meeting our natural resource planning, design, and management goals.

5. Summary and conclusions

The changing distribution of people across the inner city to rural landscape has important implications for the management and use of forests and associated resources throughout that landscape. Hotspots of change are often found in central cities, suburban and urban fringe areas, and recreation/amenity areas. Changes across the landscape are often linked in that what happens in one area may influence and be influenced by what takes place in other areas. Similar issues and concerns often emerge in different areas across the landscape.

A common component of landscape change is the movement of urban people. They may have learned and come to care about an area as permanent or seasonal residents, tourists, or visitors. With these movements of people across the landscape may come

residential development and associated infrastructure in a number of forms that range from urban re-development and suburban sprawl to seasonal homes in high amenity rural areas. These changes raise many of the resource management issues associated with residential development that have traditionally been associated with the expansion of urban areas. At the same time, ecological restoration of natural areas in and near urban areas brings to urban environments many of the issues that have traditionally been most closely associated with resource management in rural areas, including the use of fire, herbicides, and timber cutting. These and other changes have tended to blur traditional urban/rural differences in resource management.

The changing distribution of people across the landscape also brings more people into contact with forest resources and their management. Many of the associated people/forest interactions are in interface and intermix areas where people live in conjunction with natural resources. These are often areas where the forest is under stress due to high levels of use and development, invasive plants and animals, the influence of nearby developments, and outbreaks of insects and disease. Experiences in these areas, often through outdoor recreation, can acquaint individuals with many aspects of resource management.

While urban populations have been moving out into rural areas and influencing the management of nearby public and private lands, many management efforts have been "moving in" to urban areas to restore ecosystems. Movement along this "two way street" is bringing increased involvement by residents in natural resource management across the urban/rural spectrum.

Resource management issues involving large numbers of people tend to attract significant media attention; these issues include fires approaching interface communities, insect and disease outbreaks in urban areas, and the loss of trees due to construction and pollution. Through this attention, large numbers of individuals become acquainted with resource management issues, and some may become directly involved with them. That involvement can take the form of volunteering to work with resource managers and planners, or it may involve political activity or willingness to change management on private property.

Among the emphasis areas for natural resource management that emerge with the changing distribution of people over the landscape are changes in management situations, management processes, and questions for policy, program development, and research. The changing management situations include increased emphasis on interface and intermix areas, the restoration of human-impacted natural areas, and addressing complex ecosystem problems. Changing management processes include adaptive forest management, working collaboratively with diverse landowners and other partners, interacting with citizens on a regular basis, and taking a landscape perspective on natural resources and their management. Questions for policy and program development and for research focus on a better understanding of linkages among management activities across the urban to rural landscape.

The lines between what was traditionally considered as urban and rural are tending to blur over time and space. This blurring is reflected in the landscape, the interests around which stakeholders rally, and the resource management questions that are being addressed. These changes have important implications for natural resource management programs, many of which have traditionally been broken down into urban and rural efforts, such as urban forestry and rural community development. It will be increasingly critical to look across the urban to rural landscape in evaluating policies and programs for natural resource management.

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Private forestland parcelization and development in Wisconsin's Northwoods: perceptions of resource-oriented stakeholders

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Abstract

Increases in the parcelization and development of private forestlands in the US and other countries have become a major concern of natural resource agencies and groups. This concern is particularly heightened in heavily forested areas such as Wisconsin's "Northwoods," where private lands make up a majority of the forest area and play a critical role in supplying economic, ecological, and quality of life values. As a part of the Forest Fragmentation Education Initiative, we assisted the non-governmental group 1000 Friends of Wisconsin in identifying the range of perceptions and concerns about parcelization and development held by public land managers, conservation and environmental organizations, forest industry groups, non-industrial woodland owners, and other resource-oriented stakeholders ($N = 182$). Employing a qualitative methodology involving facilitated workshop discussion and thematic analysis, we identified critical themes in four main areas: (1) *Patterns*—parcelization and development are exhibiting a range of patterns on the forest landscape in terms of movement, distribution, size, and rate of change. (2) *Drivers*—the attractiveness of the Northwoods and people's concept of the good life, combined with changes in the economic, demographic, and technological aspects of society, are seen as causal agents behind increased parcelization and development. (3) *Effects*—while some aspects of parcelization and development might benefit residents and nature in the Northwoods, most effects are seen as negatively impacting recreation opportunities, forest health, local communities, the timber-based economies. (4) *Solutions*—an integrated strategy is needed to guide future growth and ameliorate the negative impacts of parcelization and development, including planning and regulation, taxes and incentives, acquisition and funding, and education and ethics. Implications for planning, research, and program development are noted.
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1. Introduction

There is a tension in the air across the forestlands of the US and many other countries, an uncertainty among resource-oriented individuals and organizations about the future role private lands will play in supplying wood fiber and products, providing recreation opportunities, and maintaining ecosystem values such as biodiversity. Parcelization, the subdivision of larger landholdings into smaller ones (e.g., Fig. 1), is a major factor feeding this tension. Although the process of parcelization has occurred on private forestlands in the US since at least the 1900s, its rate and extent have increased in recent decades (Sampson and DeCoster, 2000). National woodland owner surveys conducted by the USDA Forest Service in 1978 and 1994 show

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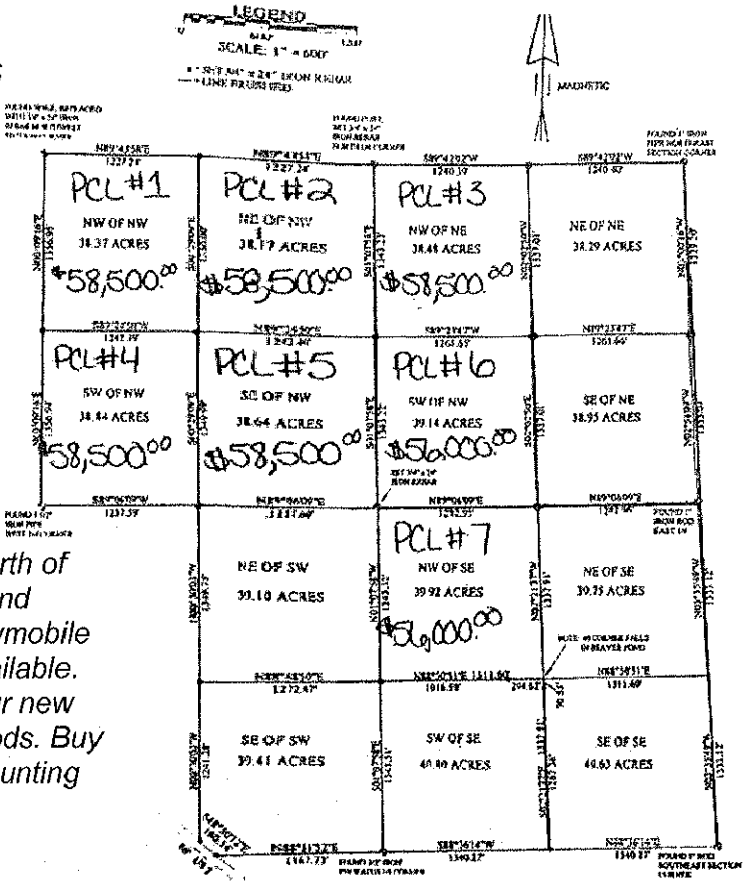

Fig. 1. Parcelization and development of private forestlands in northern Wisconsin is exemplified by this description and illustration seen in a recent advertisement from Wild Rivers Realty in Florence, WI (http://www.wildriversrealty.com).

that between these years the number of private owners of small parcels 10–49 acres (4–20 ha) in size has more than doubled, from 1.2 to 2.8 million owners (Birch, 1996). The bulk of this change was among individual (non-industrial) private owners, whose average parcel size from 1978 to 1994 shrunk from 27 acres (10.9 ha) to 25 acres (10.1 ha). If these trends continue, Sampson and DeCoster (1997) estimate that by 2010 average parcel sizes will be reduced to 17 acres (7 ha).

While a key aspect of people's concern about parcelization is that smaller parcels may no longer be economically viable for timber production (Luloff et al., 2000; Mehmood and Zhang, 2001), perhaps an overriding concern is that parcelization will lead to development, the conversion of forested and other open land to built-up uses. While this successional relationship is not a foregone conclusion, development raises an even broader range of concerns about impacts on forest values (Wear et al., 1998; Odell et al., 2003). Here, US National Resources Inventory data mirror parcelization trends, showing that more than 10 million acres (4 million ha) of non-federal forestland was converted to developed uses between 1982 and 1997. These data also indicate that the average yearly conversion for 1992–1997 of nearly 1 million acres per year (0.4 million ha/yr.) was more than 1.5 times that of the previous 5-year period (USDA Natural Resources Conservation Service, 2000; see also Alig et al., 2004). Development trends at the national level are being offset somewhat by the increases in

Fig. 2. The Wisconsin "Northwoods" study area lies north of an ambiguously defined biophysical–psychological tension zone shown as the dark band in the figure. Stars denote workshop locations and circles denote major metropolitan areas mentioned in the paper.

forestland due to abandoned pasture and cropland reverting to forest. Nevertheless, for some parts of the US these changes have been dramatic and the concerns of local citizens, forest industry and preservation groups, and other stakeholders are warranted.

One such place where both parcelization and development are a concern is in the "Northwoods" of Wisconsin (Fig. 2), where forests cover more than two-thirds of the 14 million acre (5.7 million ha) land area and are a critical timber, ecological, and tourism resource (Marcouiller and Mace, 1999). Private timberland ownership (60%) dominates over public (40%), with non-industrial private forestland (NIPF) owners making up more than 90% of all private owners and holding 44% of all timberlands (Schmidt, 1998). While different measurement methods prevent an accurate assessment of changes, available statistics point to increases in parcelization in recent years. Woodland owner surveys conducted in 1984 and 1997 estimated that the number of owners increased from 95,600 to more than 102,000, while the average size of parcels owned decreased from 44 to 41 acres (17.8–16.6 ha) (Roberts et al., 1986; Leatherberry, 2001). Supporting these trends, other studies show sharp increases in forestland values in popular Wisconsin Northwoods counties (Klase and Guries, 1999), a Northwoods population growth significantly larger than the state average (US Census Bureau, 2002), and major increases in housing density in recent decades (Radeloff et al., 2000, 2001; see also Hammer et al., this issue), especially around resource amenities such as lakes (Laas, 1996).

These data raise important questions about how parcelization and development are perceived by the public and key stakeholder groups. A survey of state residents conducted by the Wisconsin Department of Natural Resources (DNR) (2001a) pursuant to their statewide Forestry Assessment (Finan, 2000) showed that three of the top 10 concerns about the forests in the state focused directly on parcelization and development issues: that the forest was becoming more fragmented by temporary and permanent land cover and land use changes, that development was encroaching on rural forestlands, and that the number of non-industrial private owners of forested land has increased due to the division of forested lands into smaller parcels. While the DNR study provides a good indication of the perceived importance of these issues relative to other forestry concerns in the state, further information is needed about *how* parcelization and development is perceived, especially for critical forest areas.

In this paper, we attempt to provide this detail for the Wisconsin Northwoods. We sought information on a broad spectrum of parcelization and development issues ranging from where such changes are happening and why to what their impacts might be and how they might be ameliorated or prevented. As an initial foray into this area, our aim was to uncover and describe the perceptions that exist among a critical group of well-informed stakeholders in Wisconsin. As a first step our main goal was to understand the phenomenology of parcelization and development in order to identify questions and hypotheses for future research, locations for the implementation of planning and extension efforts, and priorities for education and policy development.

In contrast to the DNR study, our research examines how parcelization and development issues in Wisconsin's Northwoods are perceived by forest resource-oriented stakeholders—those who play an active role in managing or protecting forestlands for

utilitarian and non-utilitarian resource values. As a composite group, these individuals and the organizations they represent hold diverse and often conflicting views on forest resource issues. Their expertise and shared concern about parcelization and development issues, however, provided a good reason to bring these key informants together to discuss their collective knowledge and experience (Elmendorf, 2000).

2. Background and methods

The Northwoods generally refers to a region of northern Minnesota, Wisconsin, and Michigan that is predominantly forested as opposed to the southern portions of these states that are of mixed woodlots and agriculture or more urban in nature. In Wisconsin, forest statistics used to describe the Northwoods usually include the northernmost 22 counties, but for other purposes the region is more ambiguously defined (Fig. 2). The forests of the Northwoods generally fall above a vegetative and climatic tension zone that separates northern forest stands of maple–beech–birch, aspen–birch, white–red–jack pine, and spruce–fir from central hardwood stands of oak–hickory (Curtis, 1959; Powell et al., 1994). This tension zone also tends to be a psychological one, and many residents of the state look to the Northwoods for high quality outdoor recreation experiences in the numerous public and private forests and lakes.[1]

Concerns about parcelization and development issues among Northwoods' stakeholders compelled the non-profit group 1000 Friends of Wisconsin (Friends) to establish a Forest Fragmentation Education Initiative in late 2000. While the group has taken an advocacy position to minimize forest parcelization and development, the Friends and its research and education arm, the Land Use Institute, were also interested in obtaining a comprehensive understanding of the issues. To this end, they formed an advisory council composed of diverse members from resource-oriented organizations with the charge of implementing three objectives of the initiative: (1) develop awareness of the impacts of parcelization and unplanned growth on local forests, (2) provide data on the location and extent of parcelization and forecast growth trends by county and sub-region, and (3) provide a forum for discussion of concerns and recommendations.

Working as a part of a consultant team, we assisted the Friends in carrying out this initiative by providing data for objective two and helping design and facilitate stakeholder discussion forums under objective three. During the spring and summer of 2001, the Friends convened a series of four regional workshops in Spooner, Ashland, Eagle River, and Wisconsin Rapids followed by a statewide summit meeting in Wausau (see Fig. 2) to bring stakeholders together for presentations and discussion. While participation in these forums was open to the public and widely advertised, most attendees came as a result of invitations sent out to groups and individuals suggested by the project's advisory council. Participants ($N = 182$) included resource managers from public agencies at the county, state, and federal levels; legislators and policy makers; representatives from forest industry and non-industrial private forest owner associations; staff from non-profit resource use, conservation, and protection groups; and some individual woodland owners and other non-professionals who had an interest in the topic. While the sample thus encompasses a diversity of resource-oriented individuals, it should be recognized that it does not include stakeholders such as real estate agents, developers, or second-home owners who may have different views on parcelization and development issues.

In keeping with the title of the Friends' initiative, the focus of the workshop discussions was to center on "forest fragmentation." During early planning sessions for the workshops, however, advisory council members quickly recognized this term was problematic. Some individuals, particularly those representing timber interests, did not want the workshops to deal with forest fragmentation resulting from harvesting methods such as clearcutting, which is a major issue of concern among some environmental groups (e.g., DeGraaf and Healy, 1990). To divorce that issue from the initiative's main concern on the division of forestland ownership, the council defined forest

[1] The geography of the Northwoods, or simply "up North," is a frequent topic of discussion and humor among Wisconsinites. For a sample of this discussion, see the Wisconsin Public Television "Weekend" Website archives at: http://www.wpt.org/npa/transcripts/weekend/062201tran.cfm, which includes a transcript of a special on the Northwoods that in part describes the Forest Fragmentation Education Initiative from which this paper is an outgrowth.

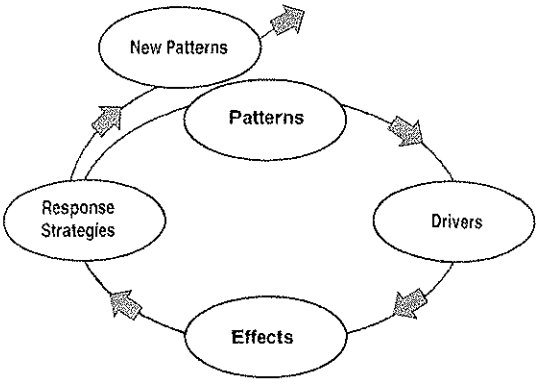

Fig. 3. A process model of landscape change (adapted from Gobster et al., 2000).

fragmentation as parcelization and used the terms interchangeably in the workshop discussions. In this paper, we favor the term parcelization because of its less ambiguous meaning (Mehmood and Zhang, 2001).

With this understanding, we identified a set of discussion questions for tapping stakeholder perceptions of parcelization based on a process model for understanding landscape change (Gobster et al., 2000). This model (Fig. 3) conceptualizes landscape change as a process where patterns of change result from one or more driving forces of social, economic, or technological origin. These changes may have effects on people and ecosystems, sometimes for the better, but the changes that concern most resource-oriented stakeholders are often expressed as negative impacts. As depicted by the looped model, strategies undertaken to address the consequences of change feed back into model, resulting in new patterns and altering the trajectory of the landscape change process.

Applying the model to the issues of parcelization resulted in the following set of questions:

- *Patterns*: What patterns and sizes of parcelization (fragmentation) have you seen? Where are they occurring? To what extent is parcelization resulting in fragmentation or land development?
- *Drivers*: How or in relation to what is parcelization (fragmentation) occurring? What are the causes?
- *Effects*: Do you see any problems resulting from parcelization (fragmentation)? Any benefits? Impacts on communities? Ecosystems? Impacts to you personally?

Table 1
Parcelization and development categories and themes derived from forum discussions

Patterns	Movement; distribution; size; rate of change
Drivers	Socio-economic; demographic; values and motivations; globalization and technology; natural capital; policies
Impacts	None or benefit; recreational; forest health and fire; community/infrastructure; timber productivity
Solutions	Planning and regulation; taxes and incentives; acquisition and funding; education and ethics

- *Response Strategies*: What do you see as the most effective solutions to parcelization (fragmentation) issues? What more can or should be done? By whom?

In each of the workshops, participants broke out into a number of subgroups for these discussions, which lasted approximately 1 h. Using the notes and tape transcripts from these sessions, we identified the prominent themes relating to each of the four elements of the landscape change model. For presentation purposes, these themes were grouped into a smaller number of more general categories listed in Table 1. In the following sections, we highlight the major themes we uncovered, and include representative quotes from workshop participants to illustrate how participants viewed particular issues.[2]

Although the primary focus of the Friends' initiative was on parcelization issues, in planning and carrying out the workshops development issues became an integral and in many cases dominant part of the discussions. Thus, while parcelization does not necessarily lead to development, because of the importance and close association between the two in the eyes of our participants, we discuss the two together in the results below. However, as parcelization is an important issue in its own right and a topic of growing interest among resource professionals (DeCoster, 2000), we also attempt to deal solely with it as a topic in a companion paper (Rickenbach and Gobster, 2003).

[2] In a few cases, the quotes from participants were slightly edited to improve readability. Ellipses were used to shorten a comment, and unless names of a participant are given, the quote shown is a single statement given by a single person. If multiple names are given, the participants are each responding to the same question or adding to the original response.

3. Patterns

In asking participants about recent patterns of parcelization and development they had witnessed by living and working in various places throughout northern Wisconsin, we received a vivid picture not only of the extent and rate of change across the landscape, but also a feeling of where some of the "hotspots" of change were occurring and why. While the focus of the forums was on northern Wisconsin, this part of the discussion often ranged outside this region in comparing patterns with other parts of the state and the US. This information provides a basis for determining which locations in the state could be the focus of outreach efforts. Our analysis yielded four major themes and a number of sub-themes relating to patterns of spatial and temporal change.

3.1. Movement

Participants described three different patterns of how parcelization and development move across the landscape. The most common pattern, often called urban sprawl, is the development of permanent residential and commercial properties in forested and other open areas at the fringe of urban centers: "... It's really sad when I go home now because some of those beautiful places like Holy Hill and some of these places that were very scenic kettles and moraines, now, there seems to be one large home on top of each hill." Several participants pointed to the northern Wisconsin population centers of Wausau and Green Bay as well as Milwaukee and Madison to the south as major places experiencing urban sprawl. They also emphasized that similar patterns were occurring in many smaller northern centers with populations well under 10,000.

A second pattern of movement participants discussed was parcelization and second-home development in rural areas. Such patterns have been occurring for many decades around the lake areas of northern Wisconsin, but what concerned some participants was that new development and parcelization were now occurring in places far away from these obvious tourist attractions: "I'm from Bayfield County, and ... of course we're getting a lot more growth around Bayfield and Washburn and Ashland. But I live in a very rural township, and in the last five years we've noticed a lot more people moving in and things are breaking up." In the solidly forested northernmost parts of the state, these locations tend be to around rivers and smaller, more marginally recreational lakes that have not yet been developed. This contrasts with the more mixed landscape of north central Wisconsin, where parcelization and development tended to be happening within and adjacent to forested tracts.

While these two patterns of movement are well documented (e.g., Heimlich and Anderson, 2001), a third, less often noted pattern of movement observed by participants was permanent home development in attractive rural enclaves once thought to be far removed from urban centers: "We're 75 miles (120 km) from Madison and 75 miles from LaCrosse, but in the last few years there have been many new homes going in within a few miles where I live. All of a sudden they just blossomed, some on wooded, some on open land. The prices they charge, they boggle your mind ... They're not building houses as big as they're building around Madison, but they're building very nice houses. Where they come from, where they go, I have no idea." Participants tended to mention enclaves beyond the traditional commuting radius of large urban centers such as Milwaukee, Madison, Chicago, Minneapolis, and some felt these once isolated areas were now being used as people's principal homes because improvements in technology or roadways made such living arrangements feasible.

3.2. Distribution

One pattern that became very apparent from the discussions was the perception of a distinct north–south gradient in the intensity of parcelization and development. Most felt that while a significant amount of private forest acreage in northern Wisconsin has been parcelized and in some cases developed in recent years, the extent of activity was nothing like what was happening in the southern half of the state. This gradient also extended beyond the state, with some looking south to northern Illinois as a worst case scenario and north to the Upper Peninsula (UP) of Michigan as a place that has not yet been significantly affected by such changes: "I'm from the Upper Peninsula of Michigan, and Wisconsin to me is already highly fragmented and I'm horrified of that trend moving farther north to the UP ... And the northern Wisconsin

people are scared of what's coming toward them. So it's just interesting from that aspect to see what's coming and, you know, have time to be scared about it until it gets there." In some ways these differences are as much temporally distributed as they are spatially; with parcelization and development spreading out incrementally over time from southerly population centers, participants often compared the Northwoods to what southern Wisconsin was like 20–30 years ago.

3.3. Size

Along with distributional patterns, participants also observed a north–south gradient with respect to the size of forest parcels. In many counties in the southern and central part of the state today a wooded parcel of 40 acres (16 ha) is considered large, while 40–80 acres (16–32 ha) parcels are still rather common in the north half of the state. These standards, however, are in flux in the north as new owners move in who may have different ideas about what parcel size is acceptable for their intended uses of the land: "It seems that most people were, are, and will be happy at the point they move into ... Whether that's 30 years ago and they bought 100 acres (40 ha) with a house, or it's ten years from now and they're buying two acres [0.8 ha] with their house, they're going to be happy coming to northern Wisconsin at that point in time. The real dilemma to those of us that are here now is, how much change do we want to accept?"

In some cases, participants observed parcel sizes in the north increasing rather than decreasing. These initially surprising observations, however, often make more sense when looked at over time as part of the parcelization and development process. For example, one participant noted several large adjacent forested parcels had been purchased by a single person, and suspected this was a real estate developer who likely will then subdivide the holdings into small parcels for housing development. Another person observed consolidation by owners of small lots who were purchasing parcels adjacent to theirs on tracts of lands that had been previously subdivided, a phenomenon that some might view in a positive light while others have referred to in a derogatory sense as outsiders' attempts at "kingdom building" (Holyoke, 2003). Together, these examples demonstrate that the processes of forest parcelization and development can be complex.

3.4. Rate of change

A final theme under patterns concerns the rate of change in forest parcelization and development. As mentioned at the start of this paper, these are longstanding processes across most of the US. What concerned many participants in our forums, however, was the rapid increase of such changes in the forests of northern Wisconsin: "I think we need to realize that we are in exponential change in many ways. And just as exponential curves start out at a very prolonged and slow rate at first, then suddenly accelerate, we need to be cognizant of the fact that we are in an upward spiral or just about there. Change is about to happen, and our landscape is in jeopardy of being changed by our lifestyle." With the current economic uncertainty some may question whether the concerns expressed by participants in these pre-September 11, 2001 forums are still warranted. Here, however, participants with a memory of historical patterns of development and parcelization may provide a clue. A few participants mentioned that similar patterns and concerns surfaced during the 1970s when rural areas in Wisconsin experienced a population increase for the first time in decades, due mainly to in-migration. During that brief period, second-home development surged in many lakeshore areas, only to be squelched by a major economic recession in the early 1980s. These observations agree with cyclical fluctuations in forestland values in two northern Wisconsin counties documented by Klase and Guries (1999). Thus, while growth patterns may not be exponential over the long term, there may be a cyclic pattern from which we can learn (see also Hammer et al., this issue).

4. Drivers

Why is parcelization and development occurring to such an extent now? For Wisconsin's Northwoods, participants cited a number of forces they felt were driving change, many that are common to those being experienced elsewhere in the US and beyond (see, for example, Alig et al., 2004), and some that may be unique to the combination of social, political, and resource conditions in the region. We grouped these drivers of change into six broad thematic categories.

4.1. Economic

The two economic forces driving parcelization and development most often cited by forum participants were the booming economy and rising property values. The newly created wealth predating 2002's stock market slide gave many people the disposable income to purchase forestland for vacation or investment purposes. This demand for property has increased the value of forestland, creating an incentive for owners to sell—whether by choice or necessity—to realize profits not available in less prosperous times. While participants recognized the co-dependence of these drivers, many also tended to view those who lived and worked outside northern Wisconsin as the main beneficiaries and longstanding residents as victims, particularly with respect to increased property taxes: "Our property tax system in the State of Wisconsin is made strictly on the basis of property value, and that's it. Not on income level. And what's happening in the north, there are a lot of probably not quite as wealthy older people ... who can't afford the land because they don't have the income, but they have the value."

Not everyone was quick to lay blame on rich outsiders, however. In some areas, particularly near cities where parcelization and development of nearby forested areas were evident, some participants said it was local residents themselves who were most to blame: "As a lifelong forester I'm tremendously concerned about forest fragmentation. I live in Wausau and ... the urban sprawl/forest fragmentation I see around here is mostly coming from people who live here. I have friends who get sick of living in the city and they want this place out in the country and off they go."

4.2. Demographic

Participants cited a number of demographic-related trends as partly responsible for parcelization and development. One of these was the sheer growth in population; with the 2000 Census recording more than 5.63 million residents, the state grew by nearly 10% in the last decade and gained almost 500,000 new residents in its biggest increase since 1960–1970 (Forstall, 1995). While some of this growth at the state level was from natural increase in births over deaths, for northern Wisconsin much of the growth is likely due to in-migration (Johnson and Beale, 2001). This may especially be the case with popular, vacation-oriented counties such as Vilas and Burnett, both of which grew by nearly 20% in the last decade. Of the various demographic factors, however, participants most often cited the aging population as driving forestland parcelization and development in the north. A multiplicity of age-related patterns were identified: urbanites from the south moving up north as a retirement destination, native northerners coming back home to retire or buy vacation property, parents dividing property among their sons and daughters as inheritance, and farmers cashing out their holdings as part of their retirement income. Participants saw many of these as legitimate reasons for buying and selling forestlands; it was the cumulative effect of the individual decisions that often ended up being undesirable: "How do you recognize the property rights of individuals who really are not trying to make a profit from it? It's just a retirement nest egg type of thing. And they certainly have the right to anticipate doing that well into the future. They would have to be reimbursed somehow if the opportunity were denied them."

4.3. Values and motivations

A third set of driver-related themes dealt with values and motivations, and here many participants cited an ingrained desire among Wisconsinites to own a second home on a lake or in the forest; it is seen as an accepted part of "the good life" and a status symbol of making it in society. The outdoor lifestyle was also cited as a strongly revered trait among many Wisconsin residents—hunting, fishing, and camping are very popular outdoor recreation pastimes in the state (Wisconsin Department of Natural Resources, 2001b) and the Northwoods is the premier playground for such activities. Some noted a contradiction, almost to the point of resentment, that while many people claim to be environmentalist in nature, their awareness does not restrain their desire to buy and develop woodland property: "And a classic example is we've got—this is a true-life example ... They were collecting money from these second graders to save the rain forests in Brazil. And the teacher collects this money, gets in her big SUV [Sport Utility Vehicle] and drives 50 miles (80 km) out in the country and lives in a big,

humongous house with one other person in the middle of a pine plantation. You know?"

4.4. Globalization and technology

Globalization and improvements in technology were additional factors participants saw as driving parcelization and development. Forestry professionals in nearly every workshop mentioned the surprising number of transfers of industrial forestlands in the state in recent years; by some participants' accounts, 90% of all corporate lands had changed hands in the last 5 years. These accounts agree with forestry statistics (e.g., Dresang, 2002), but while these transfers have not yet resulted in radical changes in land use, participants were very concerned that land ownership was going from longstanding, locally owned companies with strong community ties to large, multinational corporations with little local history and few qualms about selling off prime real estate to the highest bidder: "I'm with the electric and gas utility, and we are involved in fragmentation in a couple of different ways. One, we have some land along the Menominee and Peshtigo Rivers that we're looking at divesting ... because, if you look at what's happening in different corporations now, the different buyouts and consolidations and stuff like that, you don't know what's going to happen. And this makes us more of a target, but being a good steward of the land, we still have an opportunity now to ... sell it to the state or something, and that block will stay somewhat intact. If somebody else buys us out, there's no way that we can—you know, we don't know what's going to happen with it. It may be developed or whatever."

Globalization was also seen as having an effect on recreational land purchases in the Northwoods. A few participants remarked that while second-home ownership in northern Wisconsin is largely confined to those in the upper Midwest, particularly those within a 6 h maximum drive, with bargain airfares and better road travel the Northwoods could become a national destination like Florida or Aspen, CO. On a more regional level, many participants saw recent highway improvement projects in various parts of the state as responsible for increases in forest parcelization and development both on the urban edges and in the Northwoods. Significantly reduced commuting time has allowed many people who formerly would not have considered driving that far, to now do so.

Lastly, one other significant change in technology has been the use of mound septic systems and holding tanks, innovations in private sewage treatment that allow people to build in areas of shallow soil characteristic of many areas in northern Wisconsin. Two participants ("Jim" and "Ralph") conversed on this point. Jim started: "there's been a change in some of the state building code requirements for new septic systems ... that allows you to build on previously unbuildable lots ... And that in itself is going to have a huge increase in parcelization, maybe not the forestry lands but maybe those areas that are adjacent to wetlands. You know what I'm talking about? There's a change in ..." Ralph continued: "Yes, it's opened up about 40 percent more land in the State of Wisconsin as a result."

4.5. Natural capital

A key set of drivers relate to the natural resource assets of the Northwoods, particularly the high density of lakes in areas such as those near the Eagle River and Spooner workshops. But as lake property gets harder and harder to find, the region's other natural assets are being looked upon with an eye toward parcelization and development: "And one of the trends I see is limited water resources. You know, they can't all have lakeshore, so we're getting the second ring effect around lakes and then further from that, looking for wooded acreage in instances where the lakeshore is either priced too high or not available."

With respect to wooded acreage, some participants were particularly concerned that the mature condition of some Northwoods forest parcels would attract buyers, who would then no longer be interested in using that land for timber production. This perception appears to run contrary to the findings of Gobster and Schmidt (2000), who in their analysis of Northwoods forest inventory data between the 1980s and 1990s found no evidence of increases in parcelization for stand areas that had larger trees, and found that smaller parcels exhibited increased clearcutting activity compared to larger parcels. The meaning of these findings are difficult to assess, however, as inventory data shows that trees on all private lands in the Northwoods increased in size, regardless of the stand area class they were in. Furthermore, human disturbance

of forestlands through clearcutting or other activities could likely be signs that parcels are undergoing development, such as the significant proportion of forestlands in New Hampshire that Thorne (2000) found were "terminal harvests," that is, a liquidation of timber assets on a parcel prior to its conversion for housing development.

4.6. Policies

Innovations in on-site sewage treatment as described above did not have any effect on development until this new technology was accepted as policy in the Wisconsin Plumbing Code (LaGro, 1996). In this way, participants saw this and other policies such as large lot zoning and the granting of zoning variances as unintentional drivers of parcelization and development. For the Northwoods, the Managed Forest Law was mentioned by several participants in a positive light for helping to stem the tides of change. Some, however, faulted this statewide law—which provides a tax break to woodland owners who manage their lands for timber and other purposes—for not dealing more effectively with smaller woodland parcels: "If you look at our current state laws, once it gets below ten acres, you're not even eligible under the Managed Forest Law. The tax incentive doesn't apply to these parcels, so for new parcels of five acres [2 ha], there's a disincentive to manage it rather than an incentive."

5. Effects

Of the time spent in the breakout discussions, participants seemed to dwell longest on issues relating to the effects of parcelization and development. They talked about a diverse range of effects on the people and ecosystems of the Northwoods; we grouped their comments into the five general categories discussed below.

5.1. Benefits or no negative effects

Of the various effects, few of the participants saw anything benign or positive about such changes. Remember first, however, that most of the discussion group participants were predisposed toward forest protection; there were no developers in the groups, for instance, and most of the woodland owners were interested in some level of management of their forestlands. A few people felt that parcelization without development would not be a problem if owners were still motivated to manage their lands for timber and other forestry values and if there were the right conditions to make management and harvesting economical. European, particularly Scandinavian, countries were cited as models of small parcel management, and one person who had recently visited Finland related how undeveloped five acre (2 ha) parcels there were being economically harvested. One such model with a European heritage, the forestry cooperative (Kittredge, 2003), was seen as having high potential for small parcel management in the Northwoods: "More and more cooperatives have been forming; some of them haven't been what we would picture as the best way to go, but there are some that have been successful at bringing people together to do whatever type of management is needed. Not only do we need to teach people about ecosystem management and parcelization, but we need to teach them about sharing as well."

As for other benefits, some participants said land fragmentation through parcelization and development might increase some desired types of wildlife, particularly edge species—a justification often cited by those in the timber industry (e.g., Brenneman and Eubanks, 1990). The primary perceived benefits mentioned, however, tended to be social and economic ones. Life in the Northwoods can be pretty simple without the range of options in services and opportunities available to those in more urban areas, and some participants who were residents of northern communities said increased choices and business activity would be welcome: "We are a forest area and a lot of people, retirees, come up and they add a lot of income to our economy. We center a lot of what we do around our retirees, our medical facilities in our area in Minocqua and Woodruff ... They bring in professional people. They bring in people in service, professional people, and there's a considerable amount of building going on. So you have a definite economic impact."

5.2. Recreational and aesthetic

Participants mentioned many different effects on recreation and aesthetics, including that development intrudes on the beauty and the wildness of the forest,

and that more development and use reduce solitude and increase light and noise pollution. Several participants mentioned that as lands change hands and are parcelized, access to woodlands for hunting, fishing, and gathering has noticeably decreased. One person mentioned how private property that local residents had used for generations was now posted "no trespassing," motivating this person to buy and post his own land to ensure continued hunting. Reduced private land access has increased recreational pressure on public lands, and more recreationists seeking varied opportunities on a decreased land base has in some cases resulted in recreational conflicts. This exchange between "Ken" and "Jim" illustrates. Ken noted: "This forces people to go to public lands, county or state. And I think the other thing, too, is we're seeing as a result of that, increased motorized pressures, ATVs (All Terrain Vehicles) in particular, and that's partly due to this parcelization ..." Jim finished: "Yes, increased user conflicts related to quiet sports versus motorized sports."

Recreational and aesthetic impacts such as these were also among the top concerns of Wisconsin residents in the DNR forest assessment survey described earlier (Wisconsin Department of Natural Resources, 2001a), and while they may have not been directly associated with parcelization and development issues, there are certainly indirect links.

5.3. Forest health and fire

A number of issues related to forest health and fire were associated with parcelization and development, including decreased plant and animal diversity, increases in exotic invasive plants, and negative impacts on endangered wildlife, particularly those needing large, uninterrupted blocks of land. Similar to Thorne's (2000) finding of "terminal harvests" in New Hampshire as cited above, one participant mentioned how a local developer would severely cut the timber on the land prior to sale for development, in the participant's words "blasting it back to the Stone Age." Another forest manager mentioned how many of the mature pine plantations in north central Wisconsin were being parceled off and sold to exurbanites who built homes there and commuted to Wausau for work. These residents may see their plantation as secluded wilderness, but for forest managers it is more like a fire hazard: "I just want to reemphasize the increasing risks or difficulty in trying to provide both structural and wildland fire suppression on all these homes that are getting more and more remote. So not only wildland (fire) suppression but structural suppression is getting more difficult, bringing stress on the local communities."

5.4. Community/infrastructure

The fire suppression activities just mentioned were part of a host of perceived impacts that parcelization and development placed on local communities and their infrastructure. With ever-increasing property taxes, participants wondered how long many long-time residents—especially those who were retired and on fixed incomes or those with modest incomes from farming and timber harvesting—would be able to hold onto their lands. More development was also seen as increasing the demand and strain on community infrastructure: more roads, more services, and more maintenance. These "costs of sprawl" often end up being passed onto the community as a whole. As one representative from an electrical utility company stated: "Thirty-five years ago, we ... might have had ten customers on an existing transformer. Today, it's one transformer on a long line that goes to each of these customers because of all this fragmentation ... (These residents may be) paying the full cost of the line themselves ... But what really they don't pay equal cost on is the maintenance of those lines. You know, you have the winds blow through Northern Wisconsin and we've got one customer and it takes, you know, they might put five line crews on to get one customer back on line. When that happened in (the city of) Oshkosh, I had five line crews that were working on probably 100 customers. So that is quite a bit of a difference, and (fragmented development) does cost all of us more for that maintenance probably."

In a somewhat different vein, newer residents were seen as bringing different ideas and values to the community that sometimes clash with those of long-time residents. Such changes were not always perceived negatively by some discussion participants, who saw newcomers as often being more politically active in protecting the environment and more accepting of regulations to reduce the negative effects of development and parcelization.

5.5. Timber productivity

With timber a central focus of many participants' livelihoods, the effect of parcelization and development on timber productivity was a prominent topic. There was a general belief and experience among participants that as land is parceled and developed it is often taken out of timber production, and available studies in other places tend to confirm this perception (e.g., Barlow et al., 1998; Wear et al., 1999). Parcels that do remain in production for timber are often more difficult and costly to manage, resulting in lower profits and fewer incentives for continued management. Parcelization was also seen as resulting in maturation and succession of the forest base in northern Wisconsin from commercially valued aspen, pine, and oak to somewhat less valued species such as red maple. One person called this the "mapleization" of the Northwoods. These combined trends of smaller parcels and low valued species were seen as harming local mills that must increasingly rely on fiber sources outside their region or face closing down: "Where is the resource that wood fiber is going to come from when we build houses on the many tracts of land? I mean we're seeing that problem today and it's going to get worse."

6. Response strategies

Participants discussed various strategies for mitigating the negative effects of parcelization and development. Comments relating to this element seemed to be the most speculative; participants seemed to know what was broken but did not always know the best way to fix it. We grouped the solutions into four broad categories as described below.

6.1. Planning and regulations

In terms of planning and regulations, several people viewed the recently state-mandated "Smart Growth" planning positively, as each county will be forced to have a comprehensive land use plan in place by 2012 (see also Last, 2000). But within the Smart Growth context, some felt there was a need to develop more innovative planning strategies. Two such strategies include cluster development and conservancy zoning. Two participants mentioned places where these strategies have allowed higher housing densities within a planned development in order to protect remaining natural areas. One participant mentioned how Oneida County in the heart of Wisconsin's Northwoods established one of the first forestry zoning ordinances in the country in the 1920s, but as currently applied the law has no real teeth in preventing parcelization and development. Other participants concluded that to make any of these plans and regulations work, more effective participation was needed among the various forest stakeholders: "We need to look at conservation and land use planning in a very robust way. And perhaps that's what this Smart Growth legislation will do. Any good land use planning should involve effective public participation, and I think that if it's done correctly—it's timely and expensive—but it helps people identify the problems themselves. And if they're able to do that, which from my experience they generally are, they're likelier to buy into protection efforts."

6.2. Taxes and incentives

In terms of solutions, there was also a lot of talk about taxes and other incentive and disincentive mechanisms for protecting lands from parcelization and development (see also Bengston et al., 2004; Williams et al., 2004). The Managed Forest Law drew considerable attention in discussions, with many participants seeing it as a law with good intentions but with various loopholes that needed to be fixed. Other solutions looked at developing such things as a parcelization tax, fines for blatantly poor land use practices, and rewards for good land stewardship: "Now, if you manage your land in a way that's bad ... there's absolutely no penalty in our society for doing that ... And it makes me wonder if there aren't—I always like to think of incentives instead of regulations—ways that statewide or local comprehensive plans can look at private lands without threatening what people perceive as the rights you're talking about. If there are ways for them to be rewarded perhaps for management of lands that benefit certain aspects or certain values that we take kindly to, you know, right now, what we say is that if you have managed forestland, you get a tax break."

Finally, participants were often quick to place blame on urbanites from the southern part of the state and

elsewhere and offered suggestions like differentially higher property taxes for non-residents and seasonal residents and improving the quality of lakes and cities in the south so that people wouldn't move up north.

6.3. Acquisition and funding

Participants for the most part were cognizant that the prospects for increased funding for land acquisition were limited, and several felt that future land acquisitions should aim at moving large, private tracts into public ownership: "From my standpoint, we need to work at blocking in the public ownership. You have holes in the national forest system, the county forest system. There are some logical things that we're trying to acquire just to block in. Not trying to go outside and get more—you know, get bigger arms and pull it in—but instead to look at our boundaries and where it makes sense to try to buy some of these inside parcels. These are the ones that are getting bought up and subdivided and are causing us problems with management because people don't want to see the clearcuts or they don't want to see another road popped in here or whatever it might be, or the access problems."

Others said more effective use of easements and transfers of development rights was needed, and felt that the recent burgeoning of the land trust movement in the state could, in the long term, accomplish many land protection objectives. A few participants who worked for the Wisconsin Department of Natural Resources saw the recent flood of applicants for the Managed Forest Law program as an indication of the potential of the program for serving small parcel owners. They were also quick to note, however, that more funding for staffing was needed to keep the program on track and responsive to landowner needs.

6.4. Education and ethics

Last but certainly not least, participants strongly felt that a major key to resolving problems due to parcelization and development was through education and other means that could instill a more proactive land use ethic among woodland owners. On the bright side, a few saw how recent increases in ownership presented a marvelous opportunity for land stewardship education: "We may be able socially, however, to get to a point where people choose to live differently on land than they have ... and I think there is still a chance for a land ethic to come into being where people would say, 'a part of my owning this land means I can't do just what I want to. I need to be a member of society. I need, for example, to provide at least some of the fiber that's grown on forested land,' or it could be other land types ... I see a chance to help people in that sense to become better citizens, land citizens, so that all of the pressure for things like having clean water, saving endangered species, and producing wood fiber doesn't fall just on the large industrial landowners and the public landowners. There's the opportunity."

As a potential model to follow, some participants cited programs such as lake property owner associations that have been successful and could be used in a similar vein to teach woodland owners the knowledge and responsibilities of land stewardship. This work, however, could be accomplished in many different ways with different programs aimed at different stakeholder groups. Such programs should address problems in the short term, but must also work toward long-term ethical changes to protect forestlands, as one participant said, like Native Americans do for the seventh generation.

7. Conclusions and implications

The aim of this study was to identify the salient issues relating to landscape change in the Wisconsin Northwoods due to parcelization and development. Working with 1000 Friends of Wisconsin through their Forest Fragmentation Education Initiative, we were able to tap into the thoughts of a key segment of stakeholders and in doing so identified a broad range of their concerns. While it is important to note that our findings are based on participants' perceptions of parcelization and development patterns, drivers, effects, and response strategies, their comments often mapped closely with independently documented sources when we were able to make such comparisons. This was especially true with respect to patterns or trends of change and its effects at various locations. In some cases, their knowledge extended beyond such comparisons: with their fingers on the pulse of parcelization and development in the state, participants sometimes conveyed information that was not commonly known. This points to one of the

advantages of this method in that it can give planners and researchers an early and rapid assessment of the concerns and the locations where they exist for following up with more detailed study.

People's perceptions can also be colored by their values and attitudes. With many participants both long-term residents of the northern part of the state and professionally involved in natural resource issues, their comments at times seemed to reflect an anti-urban, anti-development bias. This is an important concern in terms of understanding and being able to generalize the findings of our research. Future work on this topic should seek to include a broader range of perspectives, including those of seasonal residents and visitors, those not tied professionally to natural resource issues, and those who may have an opposing interest in parcelization and development such as real estate developers and recent woodland owners or home builders. In this respect, some important questions include: Do stakeholders who are not directly tied to the forest resource base see a greater set of benefits to development than the discussion group participants we focused on in this study? Are long-time residents and newcomers at odds with one another in how they think and feel about parcelization and development, or are there shared concerns that could provide common ground for developing strategies for growth management? How are the effects of parcelization and development perceived differentially by residents in communities that have experienced high rates of recent change versus those who have not?

Along with population sampling issues, the results of this study also have implications and raise questions for understanding the critical topical issues related to parcelization and development. We found that the landscape change model, with its four elements of patterns, drivers, effects, and response strategies for dealing with landscape change, seemed to do a good job in both organizing topics for discussion and producing a wide range of responses from participants. While many of the perceptions of participants were expected and supported by local data or more generally in the literature, some findings stand out in terms of what they imply for future work.

In terms of the patterns of parcelization and development, one little talked about pattern of movement that deserves further attention is the growth of permanent home development in rural enclaves. In our study, we heard about a number of these around the state, attractive towns like Mineral Point or regions like the unglaciated "Driftless Area" that lie significantly outside traditional daily urban commuting distances yet are still reasonably accessible so that residents can maintain regular work or social ties to a large city, or maintain a household the lies in between two workplaces. Besides their relative proximity, one thing these enclaves seem to share is a set of cultural amenities that complements their natural assets. This unique combination of nature and culture may provide a desirable "middle landscape" (Pollan, 1998) for some people that cannot be found in either the city or the forest. Further examination of these growing enclaves may help planners identify future hotspots of development as well as expand our understanding of how nature and culture can contribute to "sense of place" (Williams and Stewart, 1998; Jorgensen and Stedman, 2001).

A second implication from our findings on patterns deals with the idea of gradients of development and parcelization. While the north–south comparisons made in the paper may not be strictly commensurable due to major differences in vegetation, topography, and other physical and social conditions, our study participants found the spatial and sometimes temporal gradients in parcelization and development useful as heuristics in visualizing and communicating the effects of change in the Northwoods. North–south comparisons are often made between lake lot development in the state (e.g., Bernthal and Jones, 1997), and it is possible that transferring this mental imagery to parcelization and development of forestlands could also be a very useful educational tool for planners. It may also be useful for future work in this area to compare perceptions and trends in parcelization and development from other places in the United States and beyond. Problems and issues such as those documented by Thorne (2000) in the Northeastern US are in some cases more acute than what is now being experienced in the forests of the Midwestern Northwoods, and thus contrasts and comparisons between such regions could be very instructive.

In terms of the drivers and effects of parcelization and development, one thing that our analysis may have failed to communicate was the stakeholders' acknowledgement of the interdependence of causes

and effects. The coding of comments into discrete categories can sometimes obscure the multidimensionality of people's responses; in a given statement a participant may have mentioned a number of different drivers or effects of parcelization and development, as well as the interaction between drivers and/or effects. For example: "A robust economy begets accumulated wealth, which begets the desire to own a piece of heaven, which begets fragmentation of the landscape. Human population growth also fuels the fragmentation fire. More people need more places to live, and the perception is that the good life is found outside of cities and towns. But of course curbing human population growth is more controversial than private property rights issues, so call me a dreamer."

As this comment also illustrates, while some drivers are constant, others are value driven and change slowly over time, and still others come into play only when conditions are ripe or when they interact with other drivers. In future research, more attention should be paid to how drivers and effects operate as singular entities as well as how they interact with one another.

While our research documented perceptions of a host of negative effects due to parcelization, we uncovered few perceived benefits. As mentioned in Sections 2 and 3, our sample of participants as well as the focus of our questions for this theme may have minimized opportunities to understand a fuller range of benefits the parcelization and development might bring to rural areas. However, a review of the Wisconsin Department of Natural Resources (2001a) open-ended survey responses for parcelization and development-related issues reveals a similar widespread negative perception of effects among the statewide sample of residents. Still, for the purposes of guiding future growth it would be useful to understand how and when parcelization and development can yield benefits, particularly in the economic and social realms. For this type of information, future research should target local chambers of commerce, new seasonal residents, long-time residents that are not particularly tied to natural resource issues, real estate developers, and other similar segments of the population.

As for the last element in the landscape change model that we addressed, the response strategies mentioned by participants also closely paralleled the range of regulatory, acquisition, and incentive-based approached described by the literature (see Bengston et al., 2004). But unlike many policy-oriented analyses of solutions to parcelization and development, participants frequently mentioned that a range of educational approaches was also needed to change people's fundamental values toward the forest landscape. This, some felt, would lead to a realization of the "land ethic" called for by Aldo Leopold, an ethic that places the intrinsic values of nature on par with the instrumental values of people (Leopold, 1981). But while such an idea may resonate strongly with the natural resource professionals who dominated our sample (particularly as Leopold's home state was Wisconsin), attitude-behavior theory would argue that translating a land ethic into specific behaviors that prevent inappropriate parcelization and development can be a difficult thing to accomplish (Ajzen and Fishbein, 1980). As Jordan (2000) points out, fostering a love for the land has also led to the desire to live out on it in the way that Leopold did in his Sand County "shack" and Thoreau before him did in his cabin on Walden Pond. While such expressions in the days of Leopold or Thoreau had few negative consequences, Jordan argues that we are now faced with "10,000 Thoreaus" who are having a much greater cumulative impact. The challenge, then, for educators is to direct environmental behaviors in specific ways that work to improve cities as dwelling places (Cieslewicz, 2000) and encourage land stewardship restore lands damaged by past parcelization and development (Jordan, 2003).

Finally, while the Friends' Forest Fragmentation Education Initiative sought to understand how parcelization issues were perceived by Northwoods stakeholders, what we found was that as a topic of discussion it was not easily separable from development issues. Parcelization may be a conceptually distinct process in an intellectual sense, but on a perceptual level it cannot be readily observed in the landscape. And given that the resource-oriented professionals in our sample often tended to lump parcelization and development together, it is likely that less familiar stakeholders would do the same. Yet parcelization remains a vexing issue, and with further study of it resource professionals, policy makers, and other stakeholders can gain the wherewithal to reduce it, to stave off development as an inevitable consequence, and to guide future development on subdivided forest parcels in more appropriate ways. In these ways, our

increasingly parcelized landscape can more effectively balance ecological, economic, and social goals (Rickenbach and Gobster, 2003).

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Characterizing dynamic spatial and temporal residential density patterns from 1940–1990 across the North Central United States

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Abstract

The spatial deconcentration of population during the 20th century and the resulting expansion of human settlements has been a significant cause of anthropogenic landscape change in the United States and many other countries. In the seven-state North Central Region, as in other regions of the US, changing human settlement patterns are most prominent at the outlying fringe of metropolitan areas and in rural regions with attractive recreational and aesthetic amenities. This process of growth and change has profound implications for the ecology of the region that will require the reformulation of resource management policies.

We use attribute clustering of both housing density and housing growth for each decade from 1940 to 1990 to illuminate the dynamic process of housing density change in the North Central Region. While cross-sectional housing density maps display the uniformity of residential density within urban, suburban, and rural areas, historic density clustering demonstrates the spatial variability of density trajectories in urban and suburban areas, and the relative stability and homogeneity of more rural density trajectories. Clusters based on housing growth, without regard to absolute density, reveal similarities between urban cores and rural areas, where in both cases, housing growth has been very slow in recent decades. We identify density/growth clusters with high potential for future growth, which are spatially clustered on the periphery of metropolitan areas, in smaller urban centers, and in recreational areas throughout the region.
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1. Introduction

Housing development, along with its accompanying infrastructure, commercial, and industrial development, has been recognized as a primary cause of anthropogenic landscape change in the United States and many other countries. In the seven states of the North Central Region (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin), as in other regions of the United States, patterns of spatial deconcentration and expansion are receiving their greatest attention at the outlying fringe of metropolitan areas. But this predominant focus on "suburban sprawl" overlooks the importance of housing growth across the urban to rural spectrum, and fails to recognize the profound effects occurring in more remote rural areas with attractive recreational and aesthetic amenities where recent growth rates have been highest (Gobster et al., 2000). Rural zoning codes often

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require large-lot development in an effort to maintain their rural character, resulting in dispersed settlement patterns that have many negative ecological consequences (Heimlich and Anderson, 2001). Low-density development disproportionately increases road density on a per housing unit basis and contributes to forest fragmentation (Miller et al., 1996; Reed et al., 1996; Forman and Alexander, 1998). Because scenic natural resources attract development, rural housing growth is more likely to occur in areas of particularly high ecological value (McGranahan, 1999). Riparian zones, coastal areas, and lakeshores are particularly susceptible to environmental damage and are also preferred home sites (Bartlett et al., 2000; Schnaiberg et al., 2002).

Housing development and population growth in rural regions and the metropolitan fringe have major implications for the ecology of the region and for forest management practices (Ehrlich, 1996; Matlack, 1997). Housing growth on the edge of or within public forest lands has influenced allowable timber harvests and will, no doubt, become an even more important factor in the future (Wear et al., 1999). Likewise, housing development in the wildland urban interface has affected forest fire management efforts, especially in recent years (Cardille et al., 2001; Cleaves, 2001). Strategies for management of public lands must address not only the impact of increasing population and housing development in nearby communities but also the effects of changing characteristics of the resident population (Hull and Stewart, 2002). Newcomers to an area may have different environmental values and attitudes from other residents, and their views regarding how local forest resources are best managed are likely to differ accordingly (Green et al., 1996). In short, as land fragmentation due to housing construction continues, it will require reformulation of forest policies covering timber harvest, fire management, recreation, second home development, water quality, and biodiversity sustainability.

Data on housing development and population growth can thus be enormously useful in understanding the effects of landscape change and formulating policies to guide future growth. But our research, planning, and policymaking abilities have been severely hampered in this respect, as spatially detailed information on housing and population change in the US is virtually nonexistent for larger areas. Although the decennial census has provided population and housing data for sub-county areas for many decades, the reconstruction of historical trends at the sub-county scale is difficult. Population and housing characteristics for sub-county political entities (cities, villages, and towns/townships) are available, but this geography is too coarse for many types of analysis, and boundary changes are impossible to trace. Housing growth should be analyzed at a grain fine enough to capture its location-specific impact, but at a broad enough extent to put patterns and changes into a regional context. Extensive, fine grain analysis is required when analyzing spatial and temporal aspects of population change, as well as when integrating housing densities with ecological information such as land cover data (Radeloff et al., 2001).

Housing development, the resulting growth of human settlements, and the overall deconcentration of population are dynamic spatial and temporal processes. Nevertheless, changes in human settlement patterns are usually studied as either spatially or temporally static. Spatially detailed studies quantifying urban growth or suburban sprawl tend to select two or at most three points in time, principally due to the lack of longitudinal data. Studies that examine shifts in population over multiple time periods are most often non-spatial, examining the growth of municipalities or counties without reference to spatial dynamics occurring within boundaries. The limitations of cartographic and analytic techniques in quantifying and portraying spatially- and temporally-detailed change over large regions and long time spans also limits the scope of analysis.

However, physical phenomena are neither purely spatial nor purely temporal, but instead result from and exist within these interlinked processes (Blaut, 1961). Thus, changing human settlement patterns, like other spatial and temporal dynamics, need to be examined through the fundamental concepts of change and process (Hazelton et al., 1992; Dragicevic et al., 2001). In this paper, we describe and analyze the various spatial and temporal dimensions of housing development and human settlement in the seven-state North Central Region of the United States. To illustrate in more detail some of the patterns of change not evident in this expansive region, we also include analysis of the Minneapolis/St. Paul Metropolitan Area, along with its environs to the north and east. The fine

spatial scale and broad extent, along with the temporal dimension, make the methods introduced here for estimating housing density particularly appropriate for interdisciplinary landscape change research, with practical extensions to the planning and policy arenas.

2. Methods

2.1. Study area: the North Central Region

The land cover map of the North Central Region provides an important reference for understanding the observed patterns in housing density (Fig. 1). This map is based on the National Land Cover Dataset and results from a classification of Landsat Thematic Mapper satellite imagery with 30m resolution (Vogelmann et al., 2001). Differences in climate, topography, hydrology, soil conditions, and land-use

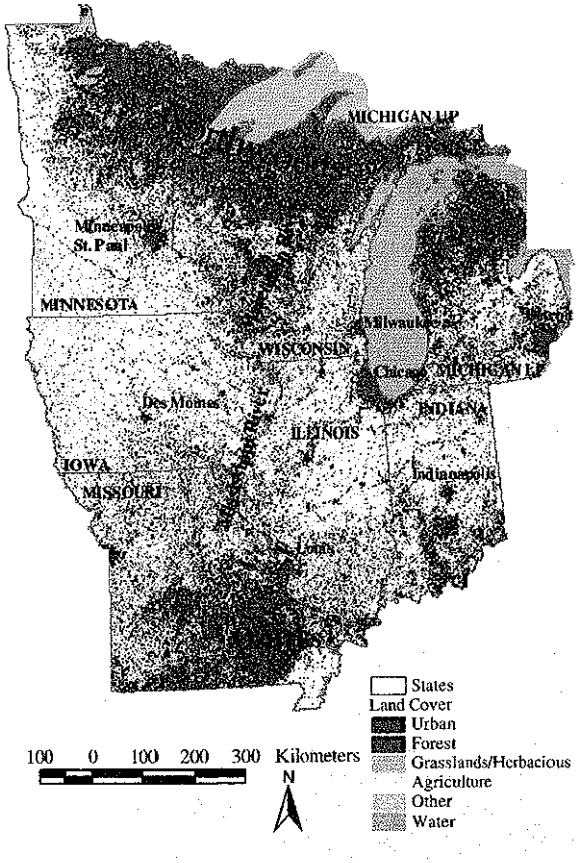

Fig. 1. Land cover, North Central Region.

history result in a readily apparent separation of forests and agriculture in the North Central Region. Forests are most abundant in the northernmost latitudes (Northwoods), and in southern Missouri (Ozarks). Agriculture dominates Iowa, Illinois, and northern Indiana and is also prevalent in the southern portion of Michigan's Lower Peninsula, the southwest quadrant of Wisconsin, western Minnesota, and the "boot heel" of southern Missouri. In the major metropolitan areas (e.g. Detroit, Chicago, Minneapolis, and St. Louis), urban land cover is both spatially clustered and intermixed with areas classified as forest or agriculture. Much of the area within this intermix of urban, forest, and agricultural land-cover types that the satellite classification interprets as forest and agriculture is undoubtedly urban open space and parks, forested neighborhoods, and the "crabgrass frontier" of large-lot residential developments.

Spatial patterns of housing density and land cover changed substantially over the past 150 years as European settlers began using this region intensively. Settlement patterns changed in response to shifts in the dominant employment opportunities; agriculture, mining, and lumbering declined in importance and manufacturing grew during much of the 20th century. In the latter part of the century, manufacturing waned and service industries gained prominence (Bluestone and Harrison, 1982). These trends resulted in population decline in rural areas and strong population growth in metropolitan cities and suburbs. However, the latter part of the 20th century, and especially the 1970s, witnessed an urban-to-rural migration turnaround resulting in stronger population growth in rural counties (Fuguitt, 1985).

The spatial pattern of housing density in 1990 (at the census partial block-group scale described later) is the result of these complex processes and provides an important context for analysis of density and growth from 1940 to 1990 (Fig. 2). Housing density in 1990 across the North Central Region exhibits the classic urban/suburban/rural pattern, with density declining with greater distance from the urban core or central business district (Clark, 1951; Mills, 1972; Batty and Kim, 1992). The large high density area and the relatively narrow periphery of medium density surrounding Chicago compared to that around many of the smaller metropolitan areas conforms to the observation that larger urban areas exhibit flatter density

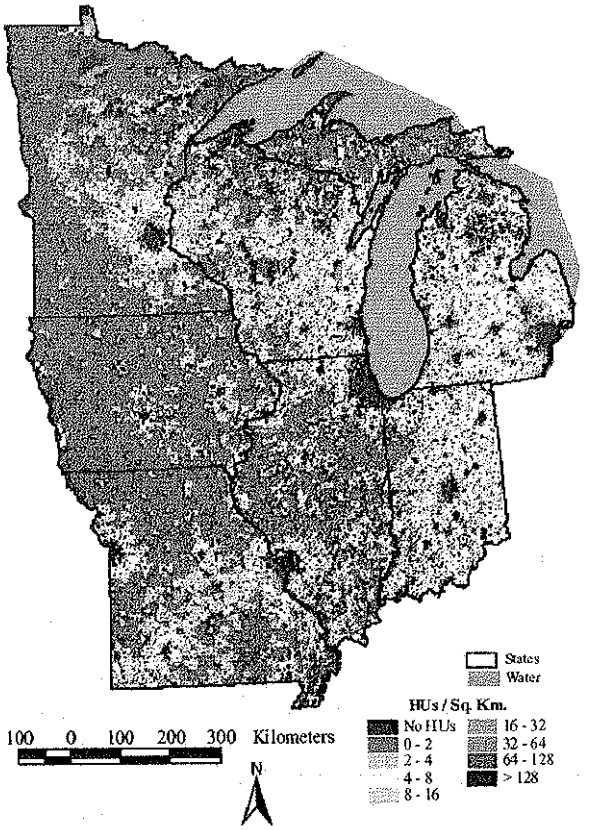

Fig. 2. Housing density, 1990, North Central Region.

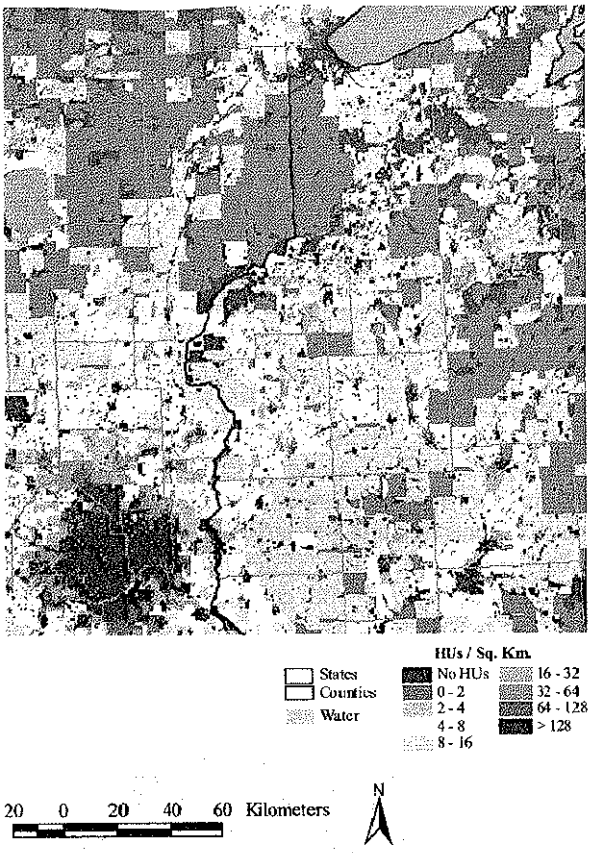

Fig. 3. Housing density, 1990, Twin Cities, MN and surrounding area.

gradients (McDonald, 1989; Wang and Guldmann, 1996). In the enlarged map of Minneapolis/St. Paul and surroundings (Fig. 3), both the radial density pattern of development following major arterial transportation routes and a multi-centric population density pattern are evident (McMillen and McDonald, 1997).

Areas with densities between 4 and 32 housing units per square kilometer encompass nearly the entire Lower Peninsula of Michigan, Indiana, the southeast quadrant of Wisconsin, the periphery of every city, as well as other parts of the region demonstrating the extent of low to medium density exurban development. The preponderance of this same low to medium density interspersed with both high and low densities is also the defining characteristic of amenity areas such as the recreational lake districts north and east of the Twin Cities (Fig. 3). The agricultural region of western Minnesota, Iowa, northern Missouri, and central Illinois, located along the eastern edge of the Great Plains, comprises a large expanse of territory with fewer than two housing units per square kilometer, with the exception of Des Moines and a few smaller urban centers. In the forested sections of the region, northern Minnesota and to a lesser extent northern Wisconsin, Michigan's Upper Peninsula, and also the Missouri Ozarks contain large tracts with fewer than two housing units per square kilometer. However, when looked at in its totality, the paucity of sizeable areas with no housing units illustrates the extent to which human settlement has affected the entire region.

The multitude of factors that contribute to settlement pattern changes make it difficult to depict complex past changes such that they can inform planning efforts aimed at influencing future development. The North Central Region is thus an ideal study area in which to develop and apply new methods to more

clearly depict and understand the changing temporal and spatial patterns of human settlement.

2.2. Estimating historic housing density

The decennial census is virtually the only source of information on historic population distribution and human settlement patterns across broad (i.e. multiple-county) regions of the US. However, spatial and temporal analysis of historic settlement patterns using decennial census data is greatly hindered by the ever-changing political (i.e. municipal) and tabulation area (i.e. blocks, blocks groups, and tracts) boundaries and the lack of GIS-compatible, digitized boundary information prior to 1990 (Theobald, 2001). To overcome these problems, we developed techniques to (1) subdivide census tabulation areas into smaller sub-county units that are more appropriate for landscape change analysis, and (2) estimate housing density change within these sub-county units for each decade back to 1940.

Although the block group is the smallest tabulation area for which detailed social and economic census data are readily available, block groups are often divided, or transected, by a variety of political boundaries. In 1990, these boundaries included congressional districts, places, minor civil divisions (MCDs), American Indian/Alaska Native Areas, American Indian Reservation/Trust Lands, and urbanized areas. A block group transected by one or more of these boundaries is composed of multiple "partial" block groups. Housing unit density can differ significantly across the parts of a block group divided by such a boundary, particularly when the municipalities that comprise the block group differ in type. For example, one part of the block group might be a rural town (or township) while the other might be a more urbanized village or city. Using the complete block group level of geography creates an illusion of housing density homogeneity within block groups that are split by municipal or other boundaries. The use of partial block groups partially corrects this problem and distributes a higher proportion of the variance in housing density among, rather than within, the geographic units. The Summary Tape File (STF) 3A (US Bureau of the Census, 1992) includes tabulations for these partial block groups that can be used to improve the geographical and statistical precision relative to using data for complete block groups. At the time this research was conducted, Summary File 3 for 2000 had not yet been released for all states in the region.

In 1990, the "year housing unit built" question was coded in census tabulations with the following response options: 1989 or 1990, 1985–1988, 1980–1984, 1970–1979, 1960–1969, 1950–1959, 1940–1949, and 1939 or earlier. For consistency in our comparisons, we aggregated the initial three categories of the question into a complete decade. By adding the number of housing units built during each successive decade to the housing units constructed during the previous decades and prior to 1940, we created a preliminary retrospective estimate of the number of housing units at the beginning of each decade. Our housing estimates for the decades before 1990 are made within the 1990 partial block group geographies.

Retrospective estimates include only housing units that were present in April 1990 and were correctly enumerated in the 1990 census. Over time, houses have been demolished, destroyed by accidental or natural events, or fallen into disuse and become uninhabitable. These housing units, not present in the housing stock of 1990, are missing from the retrospective estimates. In addition, the substantial renovation of older housing units, conversion of nonresidential properties to residential use and vice versa, misreporting the age of a housing unit, and the upgrading of seasonal units for year-round occupancy also can result in the 1990 census reported age being more recent than the actual age. The extent to which each of these factors contributes to the underestimation of housing units is unknown, but their overall effect is an underestimation of the number of housing units present in earlier decades.

For each decade prior to 1990, we aggregated the partial block groups to obtain the estimated (i.e. retrospectively reported) number of housing units in each county. These county-level retrospective estimates were then compared to the number of housing units enumerated in the county by the actual census for each respective decade, providing a means to assess and correct for underestimation.

To correct for underestimation, we adjusted the partial block group estimates to equal, in the aggregate, the actual county-level census counts. As detailed in Appendix A, we used a three-step procedure to correct

the retrospective estimates. First, our estimate of the number of housing units in each partial block group was adjusted upward in proportion to the implied housing unit increase that occurred during the succeeding decade according to the estimate from the 1990 Census. Second, any residual missing housing units were allocated based on the number of housing units in each partial block group. Finally, blocks with zero housing units in 1990 were subtracted from the respective partial block groups. The adjustment procedure ensures that the 1990-based partial block group housing unit estimates match the county-level historic census enumerations. In summary, this adjustment method corrects the sample-based 1990 census data with the 100% count data from the previous censuses for each county.

In the North Central Region, partial block groups are, on average, about one tenth the size of block groups and three to five times larger than blocks. Their mean size varies across the seven states, with the largest in Minnesota (393 ha) and the smallest in Illinois (180 ha). Overall, they offer a substantial improvement in spatial resolution, when compared to block groups, while providing the full array of census population and housing attribute information normally available only at the block-group level.

2.3. Cluster analysis

We employed attribute cluster analysis to identify partial block groups with similar housing density characteristics over time within the seven-state North Central region. Given the vast number of partial block groups in the North Central region (480,762 total and 73,659 containing housing units in 1990), clustering observations into groups greatly facilitates the synthesis, interpretation, and comparison of housing density and housing growth characteristics across space and time. Cluster analysis procedures separate observations into distinct, relatively homogenous groups based on specified characteristics. Partial block groups were the units of analysis, and two clustering analyses were performed, one using housing density as the attribute, the other using housing growth, as described in detail in the appendix. The two clustering procedures identify meaningful similarities in decadal housing densities and growth patterns, and provide a means of identifying partial block groups with characteristics that suggest a high potential for housing growth in the future.

2.4. Future growth

The examination of past housing growth and density patterns provides insight into potential future growth. The results of the two clustering analyses were used jointly to identify partial block groups likely to experience future growth and landscape change. We selected features of the housing density trajectories and the housing growth dynamics that suggest a partial block group has both the capacity and the likelihood to grow in the future. We used a two-step process, first selecting partial block groups with the key density trajectory characteristics, then selecting those partial block groups that also have the key growth dynamics. Essentially we intersect promising density and growth clusters to identify those partial block groups with both the density and growth characteristics that indicate the highest potential for future growth resulting in significant potential for landscape change.

The key density characteristic that indicates high potential for future growth is a density trajectory that distinguishes the cluster from the more stable, lower density partial block groups to which it was previously similar. The slope of its density trajectory should be fairly uniform, especially in the most recent decades, indicating potential for sustained growth. A recent significant upward inflection in the density trajectory might indicate an unsustainable period of growth, while a downward inflection might indicate that densities are approaching a maximum density or ceiling. A relatively high final density in the urban to suburban range might also limit future growth.

Growth clusters can be used to further distinguish partial block groups with high potential for future growth from other partial block groups within the selected density clusters. Neighborhoods with high growth rates in recent years should be more likely to continue growing into the future, assuming that they also meet the density trajectory criteria discussed above. Ideally, this would involve selecting clusters that experienced their highest growth in the most recent decade, the 1980s in this case. However, because of the widespread downturn in housing growth in the 1980s, this mode of selection is not possible as there are no clusters dominated by 1980s growth. Instead,

clusters with high and/or sustained growth in 1960s and 1970s are selected. Partial block groups that fall into both the density and growth clusters chosen using these criteria are identified as those with the greatest potential for future growth.

3. Results and discussion

3.1. Housing density clusters

The housing density clusters capture the history of residential development in each partial block group, rather than portraying density for a single point in time, such as 1990. Because our focus is change over time, we will not discuss the very high density urban clusters that experienced little change or the lowest density rural clusters in which housing density on average remained below two housing units per square kilometer. This leaves 10 density clusters of interest. In the following description of findings, housing densities are given as housing units per square kilometer, and clusters are denoted by their mean 1940 and 1990 densities (e.g. 4 units/km^2 in 1940 and 14 units/km^2 in 1990 would be denoted as D4-14). The density clusters are presented in three groups of low, medium, and high density to facilitate graphic display and to organize discussion of results.

The three clusters with low densities in 1990 (D2-3, D3-6, and D4-14) all exhibit consistent decadal changes in density prior to 1970 with greater density change thereafter, represented by the slight upward inflections of the trend lines (Fig. 4). The 1970s marked the first decade in the history of the United States in which nonmetropolitan counties registered a net gain in population through migration (Fuguitt, 1985). The density trajectories among formerly homogeneous, very low density rural areas diverge over time, particularly after 1970. The medium-density clusters (D9-32, D26-72, and D64-159) exhibit the same upward inflection in the 1970s and divergence over time (Fig. 5). However, unlike the low-density clusters, the 1970s upward inflection is followed by more of an offsetting downward inflection in the 1980s that essentially returned the partial block groups to their pre-1970s density trajectories. The high-density clusters (D146-277, D9-290, D48-524, and D244-561) generally exhibit the same inflections in the 1970s and 1980s as the medium-density clusters (Fig. 6). The high-density cluster that experienced the greatest proportional change in density during the five decades (D9-290) did not return to its pre-1970s trajectory during the 1980s. In this regard it is similar to the faster-growth low-density clusters, but at considerably higher density levels. Interestingly though, this cluster

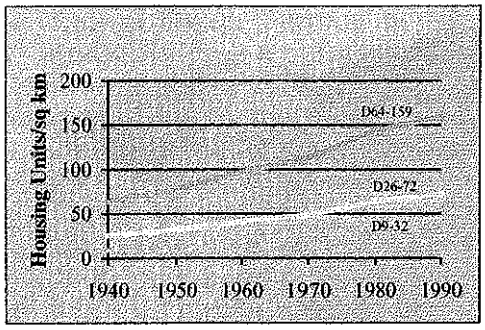

Fig. 5. Medium density clusters.

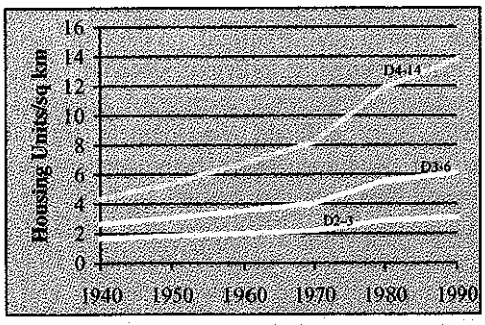

Fig. 4. Low density clusters.

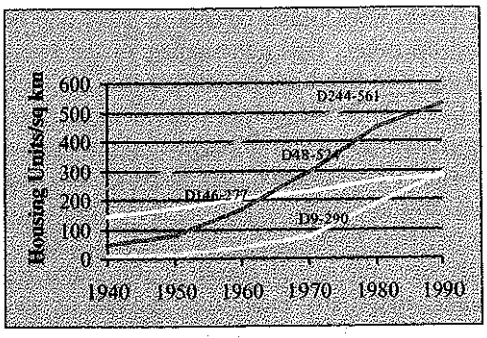

Fig. 6. High density clusters.

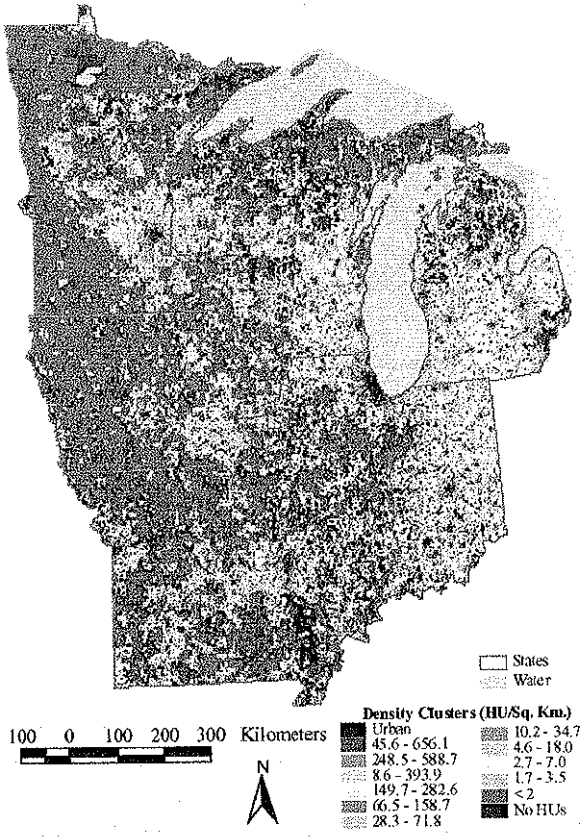

Fig. 7. Housing density clusters, 1940–1990, North Central Region.

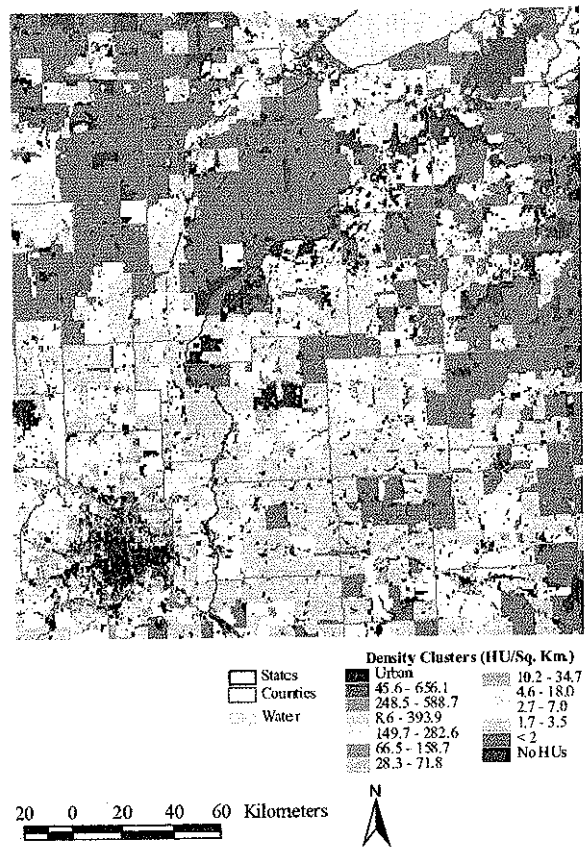

Fig. 8. Housing density clusters, 1940–1990, Twin Cities, MN and surrounding area.

had a very low housing density in 1940 but grew rapidly and surpassed one of the other high-density clusters (D146-277) that had an initial density nearly 20 times as high. The high-density cluster (D48-524) with the greatest absolute change in density began at an intermediate density of 48 units/km^2, but its development trajectory propelled it beyond one of the two clusters with higher density in 1940 and nearly beyond the other. This outstripping of the two clusters with relatively high initial densities by a cluster with much lower initial density demonstrates the heterogeneous character of residential development.

As would be expected, the maps of the housing density clusters (Figs. 7 and 8) look similar to the maps of 1990 housing density (Figs. 2 and 3), especially over the broad extent of the entire region. However, there are interesting deviations evident when one examines the detailed maps of the Twin Cities area (Figs. 3 and 8). First, the consistently very high-density urban clusters are much more confined than the highest density category (>128 units/km^2) in the 1990 density maps. This is most prominent in the Minneapolis-St. Paul metropolitan areas, but is also evident in the smaller urban center of Duluth at the top-center of Figs. 3 and 8. This demonstrates that the density clusters capture the highly variable spatial and temporal process of development that occurred in previous decades. Although these urban/suburban-core areas were homogeneous by 1990, very different development trajectories led to that condition. These heterogeneous density trajectories that converge toward uniform densities also underscore the observation that urban density gradients flatten over time (McDonald, 1989). A second major difference between density and density cluster maps can be seen around the edge of the Twin Cities (Figs. 3 and 8). While the very

high density urban area constitutes a fairly homogeneous core and the suburban clusters are arrayed in a ring or radiating outward along transportation corridors (see Fig. 3), the four high-density clusters, along with scattered very high-density clusters, are completely interspersed in Fig. 8. This mix of clusters indicates the highly varied density histories of metropolitan edges, reflecting both checkerboard or leapfrog development, and the incorporation of pre-existing small urban centers (Morgridge, 1985). In rural areas, 1990 housing density and 1940–1990 density clusters (Figs. 2 and 7) are more similar, due to the flatter density trajectories of rural areas. As will be seen in the next section, growth clusters are more useful for differentiating rural areas from one another.

It is somewhat surprising that the only clusters with limited or no density change during more recent decades were those at the very highest density levels, rather than at intermediate or low densities. It might be expected that partial block groups would asymptotically approach some local "density ceiling" imposed by land markets in response to consumer preferences, government regulation, and other factors. The slight downward inflection in the 1980s in the trajectories of clusters in the medium- and high-density groups might indicate the presence of local growth ceilings, or could merely indicate a momentary pause in density change following the rapid growth of the 1970s. The recession of the early 1980s may have played a role in density changes. It impacted nonmetropolitan areas heavily, but recovery from the recession differed with agricultural and mining-dependent counties lagging behind (Johnson and Beale, 1998). Incorporation of 2000 census data measuring density changes during the 1990s, a decade similar to the 1970s in terms of growth (Beale and Fuguitt, 1990; Johnson and Beale, 1994; Long and Nucci, 1998), may provide greater insight into this question.

3.2. Housing growth clusters

Although the density clusters portray each partial block group's trajectory across the decades, they do not adequately capture the decadal variability in growth rates. Growth clusters expose the temporal and spatial variability of residential development more clearly. Urban cores and rural areas with similarly slow growth rates could be expected to appear in the same cluster or clusters. Temporal effects become more apparent; for example, across all the clusters, the 1980s represented the slowest or nearly the slowest decadal growth during the 50-year-period. Growth clusters are labeled by the decade in which they grew fastest, and their maximum growth rate, for example, G40s-5 for the cluster experiencing its fastest growth in the 1940s at a maximum growth rate of 5%. Among the low growth clusters (Fig. 9), three clusters (G40s-47, G40s-19, and G40s-5) experienced their highest growth rates during the 1940s and then declined steadily to reach a negligible or even negative level of growth by the 1980s. One of those clusters, G40s-5 grew by only 5% during the 1940s and then did not experience any appreciable growth after 1950. Among the high growth clusters (Fig. 10), two clusters, G50s-184 and G50s-62, experienced their most rapid growth during the 1950s, although they both sustained relatively high growth rates during the succeeding decades as well. None of the clusters in either group experienced its highest growth rate in the 1980s.

A majority of the clusters in both groups experienced faster growth during the 1970s than during other decades. Cluster G70s-453 sustained a growth rate of over 350% during both the 1960s and 1970s, and then slowed considerably in the 1980s, though it still had the highest growth rate for that decade. This "hyper-growth cluster" was also unique in that its growth rate increased during each decade up to the 1980s (Fig. 10). For the other clusters that experienced their fastest growth during the 1970s, their growth rates prior to that decade were either stable or declining. One of these clusters, G70s-8, experienced a minimal growth rate in the 1940s that declined during the 1950s, 1960s, rose slightly in the 1970s, and declined again in the 1980s (Fig. 9).

The growth clusters are represented on the maps in Figs. 11 and 12 first by the decade of most rapid growth (color) and then by the rate of growth during that decade (hue). In urban/suburban areas, these growth clusters are almost like a photographic negative of the housing density clusters: whereas the high-density clusters seen in Figs. 7 and 8 dominate the urban cores and more moderate density clusters dominate the suburban periphery, in Figs. 11 and 12 the high growth clusters dominate suburban areas while the urban cores are comprised almost exclusively of low growth

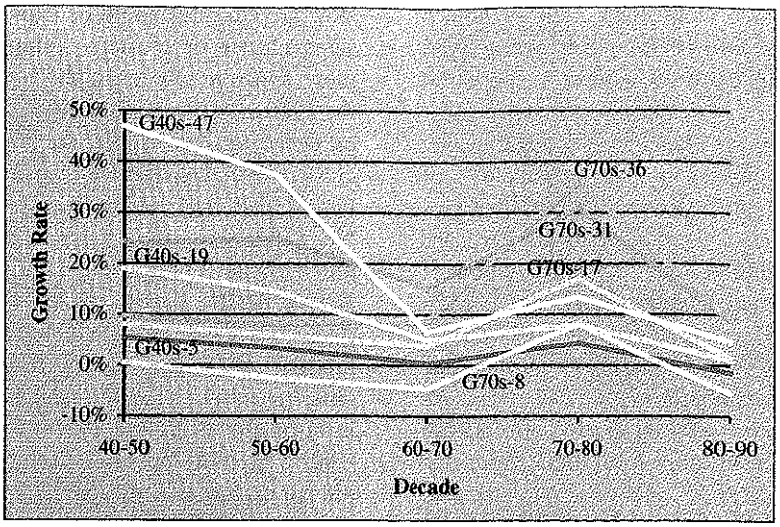

Fig. 9. Low growth clusters.

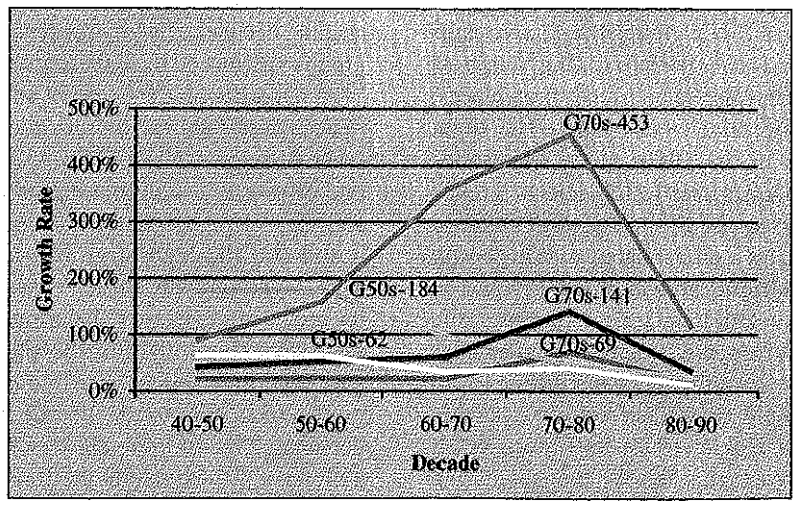

Fig. 10. High growth clusters.

clusters. Up to a certain point this same reversal in pattern also holds true when comparing the growth cluster maps with the 1990 housing density maps (Figs. 2 and 3) except that, due to the flattening of the urban to suburban density gradient over time (McDonald, 1989), only the older, previously-established high density areas experience low rates of growth, while the newer, more peripheral high density areas were experiencing high growth rates during preceding decades. Although some of the very high 1970s growth clusters lie on the periphery of metropolitan centers, this suburban ring is not the most prominent location of these high growth clusters. Instead, the high 1970s growth clusters are predominantly located in rural areas, especially areas with many scenic and recreational amenities (Johnson, 1999). Although clearly important in the North Central Region, forms of rural growth and the resulting density patterns have received much less research attention than suburban growth and urban density patterns (Fonseca and Wong, 2000).

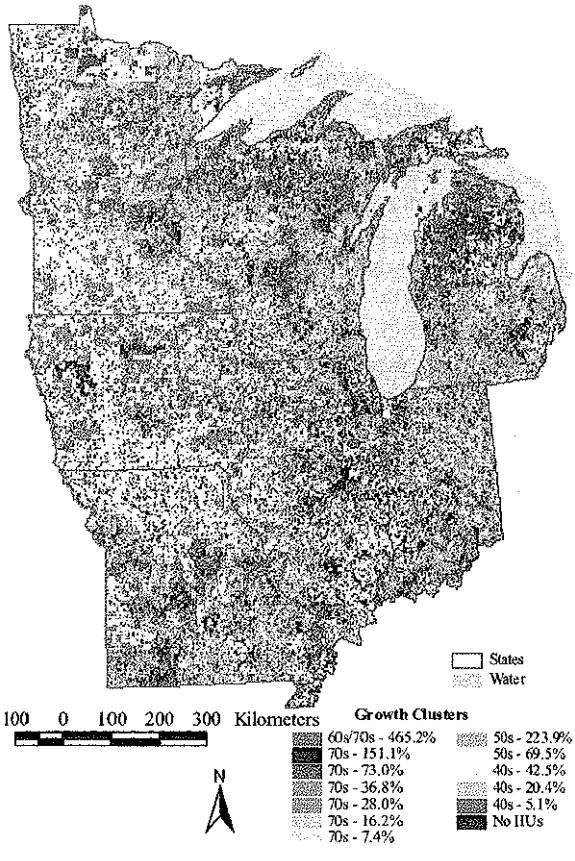

Fig. 11. Housing growth clusters, 1940–1990, North Central Region.

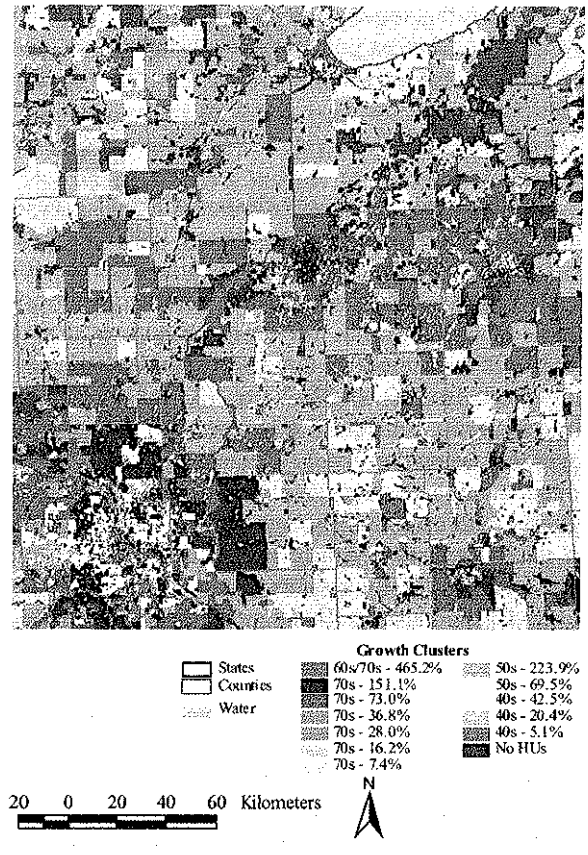

Fig. 12. Housing growth clusters, 1940–1990, Twin Cities, MN and surrounding area.

High growth rural clusters are extensive in the forested Missouri Ozarks, southern Indiana, the western portion of Michigan's Lower Peninsula (especially the far northwestern portion along Lake Michigan), and in the central portion of Michigan's Upper Peninsula. They are also arrayed along the Mississippi River and the Wisconsin River Valley in the central portion of Wisconsin. Finally, the lake districts of northern Minnesota and Wisconsin were very high growth areas during the 1970s (Fig. 12). Thus, the growth patterns in all of these ecologically sensitive forest, river, and lakeshore sub-regions equal those of metropolitan suburbs. Although the 1960s and 1970s sustained, very high growth cluster (G70s-453, bright pink) is not readily apparent on the map of the entire region, it does stand out on the enlarged map in the suburban periphery and along northern lakeshores (Fig. 12).

In contrast to the high growth characteristics of the areas just mentioned, the largely agricultural area of the North Central region that intersects the eastern portion of the Great Plains exhibits a low or very modest growth trajectory as shown by the growth cluster map. This is most evident in the nearly solid concentration of the G70s-8 (salmon) cluster in southern Iowa and northern Missouri, reflecting a steady decline in housing density except for limited growth in the 1970s. Just above this, a larger diagonal swath, extending from southern Minnesota through Iowa and central Illinois and into Indiana, is characterized by moderate 1970s growth clusters (G70s-17, orange) interspersed with very limited growth clusters (G40s-5, medium green). Together, these patterns of growth clusters make the eastern Great Plains even more obvious than it is on the 1990 density and 1940–1990 density cluster maps. Regardless of their density (some

areas are rural, some exurban, and some small urban areas), they share a common growth trajectory—one of very modest growth.

3.3. Future growth

We identified four density clusters with high growth rates, one with very low densities in 1940 and three with medium densities, as having high potential for future growth. The one low-density cluster grew from 4 to 14 housing units per square kilometer during 1940–1990, while the three medium-density clusters grew from 9 to 32, 26 to 72, and 64 to 159 housing units per square kilometer. All four exhibit ever-increasing density, distinguishing them from the other rural and exurban clusters. Another density cluster with an extremely high growth rate grew from 9 to 290 units per square kilometer, surpassing all the medium-density clusters and all but two of the high-density clusters. This cluster emerges in groupings of nearly contiguous partial block groups predominantly on the periphery of metropolitan centers. However, by 1990 the cluster had reached such a high level of density that its growth would not be likely to continue at a similar pace into the future, without a significant change in overall urban density gradients. Thus, we do not include it among our density clusters with high probability of future growth and landscape change. The other four clusters are more likely candidates for experiencing sustained future growth, and tend to be located on the far periphery of metropolitan areas, within the vicinity of smaller urban centers, and in rural areas with recreational and scenic amenities.

From all the partial block groups in our selected density clusters, we reselected only those that were also in one of the five high growth clusters (Fig. 10). Three of these high growth clusters experienced their most rapid growth during the 1970s (G70s-453, G70s-141, and G70s-69) including the extremely high growth cluster that grew by 453% that decade and by 357% the previous decade. Although the sharp fall in growth in that cluster during the 1980s might indicate that future growth is unlikely, we select it because even with its sharp decline relative to the previous two decades, it remained the fastest growing cluster in the 1980s. Moreover, we have already excluded those partial block groups that have reached very high density levels that might preclude future growth. The other two high growth clusters experienced their most rapid growth in the 1950s (G50s-184 and G50s-62), which would not seem to be an indicator of high potential for growth in the 1990s and beyond. However, the cluster with the lower 1950s growth rate of 62% declined much less than other clusters, even over the three decades subsequent to its growth nadir, and continued to grow at a rate of 13% in the 1980s. Although the higher 1950s growth cluster did slow more significantly, its final 23% growth rate made it the third fastest growing cluster during the 1980s.

From the intersection of density and growth clusters conforming to these selected characteristics, we were able to construct a map identifying the 1990 housing density of those partial block groups with high potential for future growth (Fig. 13). As expected, they are spatially clustered on the periphery of metropolitan areas and smaller urban centers, as well as in recreational

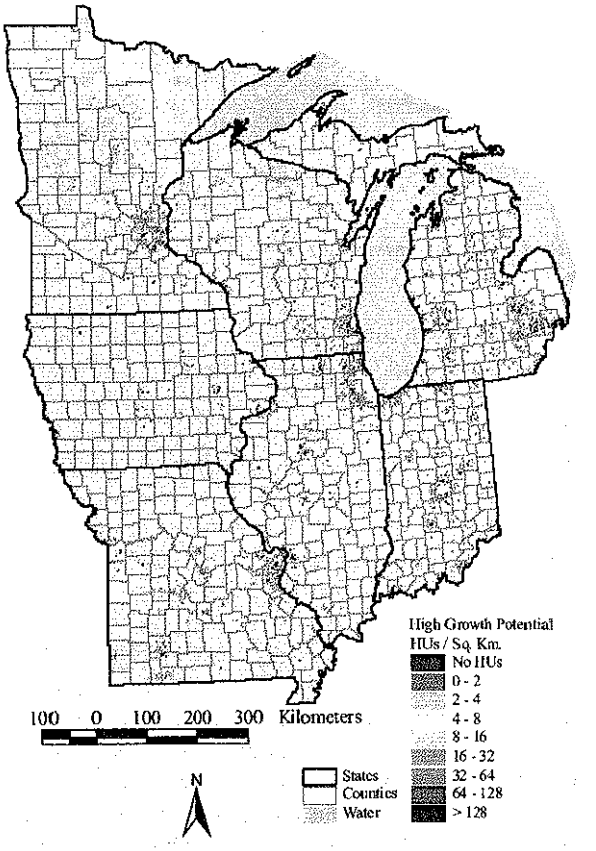

Fig. 13. High housing growth potential, North Central Region.

areas. The most prominent of these future growth areas is the northern suburbs of the Detroit-Ann Arbor metropolitan area. Recreational areas throughout the region emerge as future growth areas, especially in northern Wisconsin, along the northeast Lake Michigan coast in the Lower Peninsula of Michigan, and peppered across central Minnesota.

4. Conclusions

While fine-scale information about housing density over five decades provides an unprecedented wealth of information for the seven-state North Central Region, the sheer abundance of detail and extent of coverage makes comprehension difficult without the aid of tools to simplify and help visualize the patterns of difference that exist. Attribute clustering illuminates features of settlement patterns and their change over five decades that are not otherwise apparent. The clustering of density and growth data retains both temporal and spatial detail but generates a simpler outcome. When the data are reduced through clustering, the resulting maps highlight features of housing growth and density that cannot be seen on simple maps of current or historic housing density.

The prominence of the 1970s in the outcome of both clustering analyses reaffirms the demographic significance of that decade. Early indications from the 2000 US Census that migration and growth patterns of the 1990s resembled those of the 1970s give added importance to this finding, and argue against the claim that the 1970s were a one-time exception to long-term urban growth and rural decline in the United States. Density clustering demonstrates the variability of density trajectories in urban and suburban areas, and the relative stability of rural densities over time. Clusters based on growth rates without regard to absolute density reveal the similarities between urban cores and rural areas, where in both cases, housing growth has been very slow in recent decades. This is an important insight because the attention to growth, the factors to which it is attributed, and the policies designed to address growth—or in this case, the absence of growth—are traditionally separated into urban and rural constituencies, policy making groups, oversight agencies, and economic development programs. While there are no doubt more differences than commonalities between urban and rural growth dynamics, the similarity of outcomes illustrated here should prompt a renewed interest in problems and potential solutions these two types of areas might share. Where density maps display the uniformly high density of urban areas, growth rate maps highlight the differences across the urban area in rates of change. Similarly, the rural areas in the North Central Region clearly belong in different growth categories and are likely to have different growth patterns in the future. This finding is further impetus for re-thinking the way in which we approach growth management as an urban, suburban, or rural issue. Growth dynamics vary greatly within those categories and share characteristics across them. Furthermore, broad areas that share land cover characteristics also share growth characteristics, making the growth clusters map a rough analogue of the land cover map and highlighting the importance of resource management as a component of growth planning, and resource managers and specialists as experts whose involvement is essential to wise growth management.

Landscape change throughout the North Central Region has strongly affected commodity production, ecosystem integrity, rural communities, and recreation potential (Gobster et al., 2000). Housing growth is commonly recognized as a significant driver of landscape change. However, knowledge of its many reputed effects and the circumstances under which they do and do not occur is sorely lacking. This gap in understanding makes formulation of effective growth management policies a difficult undertaking. The methods introduced here to estimate housing density capture the pattern and history of housing at a scale fine enough to be useable in multi-disciplinary applications. For example, by examining the relationship between housing density and harvesting patterns over time, we are gaining insights into effects on forest productivity; and by adding overlays of vegetation data to current and historic housing density maps, we can map and trace changes in the wildland-urban interface. This research lays the groundwork for more extensive analysis of human/forest environment interactions in the North Central Region at a landscape scale, work that can be extended nationally and may have implications for those working in other countries as well. The spatially explicit information about landscape change that such research generates will

be crucial for scientists and resource managers alike in their efforts to identify critical areas for further research and for the implementation of resource plans and policies.

Acknowledgements

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Appendix A. Estimating historic housing density

As noted in the main text, actual county tabulations of housing units from the respective census years demonstrate that the initial historical estimates of the number of housing units by partial block group suffer from serious underestimation problems. The number of housing units in county j at time t enumerated by the census taken at time t is C_j^t. The number of housing units estimated to be in the county at time t, based on the "year housing unit built" question in the 1990 census is, H_j^t. Thus, the number of housing units in county j at time t missing from the estimate based on the 1990 Census is equal to:

$$A_j^t = C_j^t - H_j^t \tag{A.1}$$

A_j^t is the number of housing units missing from the estimate of housing units for county j at time t that must be allocated to partial block groups within the county, in order to compensate for the known county-level error. To correct this problem, we used the following three step adjustment process.

Step 1. The first step adjusts the estimated number of housing units in each partial block group according to the growth that occurred in that partial block group during the next decade relative to the growth that occurred in the county. We first assume that the number of housing units allocated in the adjustment procedure at time t to partial block group i of county j cannot exceed the estimated change in the number of housing units occurring between time t and time $t+10$ (Δ_{ij}^{t+10}), with 10 representing the 10-year-period between censuses. The maximum adjustment for partial block group i in county j at time t is given by:

$$\Delta_{ij}^{t+10} = \hat{H}_{ij}^{t+10} - H_{ij}^t, \tag{A.2}$$

where Δ_{ij}^{t+10} is the estimated change in housing units, $\hat{H}_{ij}^{t+10}$ is the adjusted number of housing units one decade after time t, and H_{ij}^t is the estimated number of housing units at time t. Thus, the adjusted number of housing units at time t cannot exceed the adjusted number of housing units at time $t+10$. Partial block groups that did not experience an increase in the number of housing units between time t and time $t+10$ are not adjusted in this step. The estimated change in the number of housing units during the decade from time t to $t+10$ in partial block groups can then be aggregated for the county j to provide the estimated increase in the number of housing units for growing partial block groups:

$$\Delta_j^{t+10} = \sum_{i=1}^{I} \Delta_{ij}^{t+10} 0, \quad \text{for} \quad \Delta_j^{t+10} > 0 \tag{A.3}$$

The first adjustment step with $\hat{H}_{ij}^t$ representing the adjusted number of housing units in partial block group i of county j at time t is given by:if $\Delta_{ij}^{t+10} > 0$, then

$$\hat{H}_{ij}^t = H_{ij}^t + \left(\frac{A_j^{t+10}}{\Delta_j^{t+10}} \Delta_{ij}^{t+10} \right), \tag{A.4}$$

otherwise

$$\hat{H}_{ij}^t = H_{ij}^t \tag{A.5}$$

The adjusted estimate, $\hat{H}_{ij}^t$, is equal to the initial estimate, H_{ij}^t, plus the ratio of the number of missing housing units in the county, A_j^t, to the change in housing units in the county, Δ_j^{t+10}, multiplied by the change in housing units in the partial block group, Δ_{ij}^{t+10}. To ensure that the adjusted number of housing units at time t does not exceed the adjusted number of housing units at time $t+10$ following the first step of the adjustment procedure the following limit is placed on the ratio:

if $A_j^{t+10}/\Delta_j^{t+10} > 1$, then

$$\frac{A_j^{t+10}}{\Delta_j^{t+10}} > 1 \tag{A.6}$$

For counties in which the ratio of the number of missing housing units, A_j^t, to the change in housing units, Δ_j^{t+10}, is greater than one (1), residual missing housing units A_j^{t+10} will remain after the first adjustment procedure. That is, the number of housing units in county j at time t enumerated by the census taken at time t, C_j^t, will exceed the estimated number of housing units after adjustment:

$$\hat{H}_j^t = \sum_{i=1}^{I} \hat{H}_{ij}^t < C_j^t \tag{A.7}$$

This necessitates a second adjustment.

Step 2. The second step in our procedure allocates the remaining missing units, $A_j^{t+10} - \Delta_j^{t+10}$, based on the number of housing units at time t, rather than on the increase in housing units that occurred between time t and $t + 10$, as in the first step.

If $A_j^{t+10} - \Delta_j^{t+10} > 0$, then

$$H'^t_{ij} = H_{ij}^t \left[(A_j^{t+10} - \Delta_j^{t+10}) \frac{\hat{H}_{ij}^t}{\hat{H}_j^t} \right] \tag{A.8}$$

otherwise

$$H'^t_{ij} = \hat{H}_{ij}^t \tag{A.9}$$

The second adjusted estimate, H'^t_{ij}, is equal to the first adjusted estimate, $\hat{H}_{ij}^t$, plus the number of residual missing housing units in the county, $A_j^{t+10} - \Delta_j^{t+10}$, multiplied by the ratio of the adjusted number of housing units in the partial block group, $\hat{H}_{ij}^t$, to the adjusted number of housing units in the county, $\hat{H}_{ij}^t$. This revised estimate is the final estimated number of housing units for each partial block group.

Step 3. A third step in our method removes census *blocks* with zero housing units in 1990 from the respective partial block group. This step assumes that if a block did not contain housing units in 1990 then it did not contain housing units in any of the previous decades. This removes blocks that do not contain housing units from the partial block group that they are located in, thus further improving the geographic scale of the analysis by moving from the partial block group to the block level in certain cases. Other unpopulated areas such as public and industrial lands could also have been removed, if comprehensive, current, accurate data regarding the location of such lands was available.

Appendix B. Cluster analysis

To produce reliable, valid clusters, we used a two-stage procedure that combines hierarchical agglomerative and partitioning methods (Milligan and Sokol, 1980; Cheng and Milligan, 1996; Milligan, 1996). In the first stage we performed an initial hierarchical agglomerative clustering on a simple random sample (with replacement) of 3000 observations to identify seeds (i.e. mean housing density and housing growth rate values for each of the clusters) for the second-stage partitioning clustering, which assigned the full set of partial block group observations from across the region to these cluster seeds. We performed this two-stage clustering procedure separately for housing density (i.e. houses per square kilometer for each census year from 1940 to 1990) and for housing growth (the rate of growth for each decade from the 1940s to the 1980s).

The hierarchical agglomerative method employed in the first stage created clusters using similarity distance measures in which each observation is grouped with the most similar observations and placed furthest from the most dissimilar observations. We used the average-linkage method to avoid both the extreme single-linkage "chaining," which can create clusters that are distinct from one another but not internally consistent, and the extreme complete-linkage "clumping," where clusters are internally consistent but are not isolated from one another (Aldenderfer and Blashfield, 1984; Kaufman and Rousseeuw, 1990; StataCorp, 2001). Due to the skewed distribution of housing density, we used a natural-log transformation with the Euclidean distance measure, which is otherwise allows outlier values to disproportionately affect cluster designation (Aldenderfer and Blashfield, 1984). Housing growth rates were also skewed, but a logarithmic transformation was not practical due to negative values, precluding use of the Euclidean distance measure. As an alternative, we used a Canberra distance measure, which is especially sensitive

to small changes and is not affected by disproportionately large values (Gordon, 1999; StataCorp, 2001).

Hierarchical agglomerative methods create a complete range of clusters, from placing all observations in one cluster to placing each observation in its own cluster, which necessitates the selection of a set of clusters that adequately distinguish similar and dissimilar observations. The number of resulting clusters thus depends on the distance threshold below which neighboring clusters are combined or eliminated. After each of the initial sample-based hierarchical clustering procedures, we examined the resulting 25-cluster dendrogram. To reduce the effects of outliers, we combined relatively similar clusters and dropped dissimilar clusters with limited numbers of observations (5 or fewer in the density clustering and 10 or fewer in the growth clustering). For housing density, 15 clusters remained, while 12 remained for housing growth.

In the second stage of the clustering using the partitioning method, the observations from across the region are assigned to the clusters that were predetermined by the first-stage hierarchical agglomerative sample-based clustering. Partitioning methods are useful for large data sets because they require fewer comparisons than hierarchical methods and thus are less computationally intensive. However, the selection of appropriate seeds is critical to avoid inconsistent and/or poorly differentiated results (Milligan, 1980; Aldenderfer and Blashfield, 1984). K-medians partitioning procedures, which limit the effect of outliers in determining clusters compared to k-means portioning, were applied to both housing density and growth. For both the density and growth cluster analyses, partial block groups without any housing units were excluded from the procedure and were assigned to two additional clusters, water and land.

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Using spatial metrics to predict scenic perception in a changing landscape: Dennis, Massachusetts

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Abstract

This paper investigates residents' perceptions of scenic quality in the Cape Cod community of Dennis, Massachusetts during a period of significant landscape change. In the mid-1970s, Chandler [Natural and Visual Resources, Dennis, Massachusetts. Dennis Conservation Commission and Planning Board, Dennis, MA, 1976] worked with a community group to evaluate the natural resources of their town, an important component of which was scenic value. In the mid-1990s, the original views were re-photographed and another sample of Dennis residents surveyed. Landscape metrics grounded in the landscape ecology literature were used to predict residents' perception of scenic value for each time period. The results indicate that approximately half of the variation in scenic perceptions can be explained by spatial landscape metrics and that this model retains its predictive efficacy after 20 years. These results provide some guidance for landscape planners and designers about the preferred composition and configuration of human landscapes. In particular, they provide additional support for the contribution of natural-appearing landscapes with a complex pattern of edges to a community's scenic quality.
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1. Introduction

The public's sensitivity to scenery—how the landscape looks—was historically one of the first and is perhaps still one of the most important catalysts of environmental awareness and action (Zube, 1980; Nassauer, 1992). In 1969, recognizing the need for defensible assessment techniques and information on which to base scenic quality policies and public land management, Elwood Shafer posed the question that opened the field of landscape perception research:

> In trying to cope with the problem of landscape abuse and destruction, one of the questions that natural resource planners frequently ask is: "Why is one landscape preferred more than another?" (Shafer et al., 1969, p. 1).

He went on to formulate the commonly accepted justification for a science that predicts people's perceptions of the landscape:

> ... to identify what quantitative variables in a natural landscape are significantly related to public preference for that landscape. By knowing what quantitative features in a landscape affect its aesthetic appeal, natural resource planners can make decisions on a factual basis about purchasing, developing, or preserving these features (Shafer et al., 1969, p. 1).

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Shafer proceeded to describe a research design where he measured attributes of photographs taken at eye-level. These attributes included the area and length of edges for water, vegetation, and non-vegetation as seen in the foreground, middle ground and background of the photograph. He then had selected people express their preference for the landscapes represented in the photographs. A regression analysis explained over half of the variation in landscape preference from knowledge of the landscape attributes.

This approach to landscape perception assessments implies a causal link between landscapes changes made on the ground and the perception of scenic value. This link, which includes several assumptions, proceeds in this way. Land planners and managers develop and implement plans or take other actions that change the landscape. These changes are conceived by planners and managers as spreading out over a specified area. They typically develop and represent their intentions using maps or other spatial representations (Marsh, 1997). Normally these changes are visible from many different viewpoints within the landscape. People standing at these viewpoints see the changes in perspective, as landscape views, and make scenic judgments based primarily on what they see. A selected portion of a view is optically similar to a photograph (Gibson, 1979), which is thought to be a fair representation of the landscape's visible condition (Sheppard, 1989). Shafer's approach further assumes that people apprehending a view (or photograph) can effectively express their affective or cognitive reactions using rating scales or other response formats (Nunnally, 1978).

The model implicit in this commonly used approach to landscape perception assessment is specified by a set of variables that describe the relationship between people's response to landscape scenes and changes to that landscape proposed or expressed by planners and managers. Since the justification of landscape perception assessment is to manage the landscape's future condition for people's appreciation, the dependent variables are almost always measures of people's reactions. However, the independent variables used to specify the relationship vary widely in how they have been derived, and include planimetric measures of the land (e.g., Zube et al., 1974), pictorial measures of the perspective view (e.g., Shafer et al., 1969), and psychometric measures of people's perceptions (e.g., Kaplan and Kaplan, 1989). While interesting research may develop from using pictorial and psychometric independent variables, they are not directly transferable to land planners and managers who work primarily with maps and other areal representations of the landscape, not with individual perspective views, or people's thoughts and perceptions.

As part of many current planning processes, planners are expected to project the changes that would result from their plans and evaluate their impacts. The National Environmental Policy Act of 1969 called for the development of new methods to:

> ... insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations (42 USC § 4332, Section 102(B)).

Shafer and others responding to this mandate expected that planners would calculate the appropriate metrics during the environmental impact assessment process in order to predict the public's reactions to the changes. More than 15 years later, Sell and Zube (1986) reviewed the literature on the perception of landscape change and concluded that there was still a significant need for research in this area.

> Perhaps most notable in this review is the absence of research addressing the issue of change at the urban fringe ... there appears to be a paucity of information about perception and response to incremental change on the fringes of cities (Sell and Zube, 1986, p. 48).

While there have been studies during the past 30 years that developed landscape metrics to predict public perceptions, there is still a "paucity of information" about perceptions of landscape change, and there has yet to be a study testing whether predicted perceptions were accurate.

The study reported here begins to address this gap in our understanding of landscape perception assessment. It is particularly important to conduct such studies because perceptions can change both in response to changes in social norms and expectations and as a result of a changing landscape. This research first establishes that over a 20-year period, local residents' norms of scenic value for the Cape Cod, Massachusetts under study are reliable and have not

changed appreciably. Then it proceeds on the belief that landscape perception can best be explained as a reaction to external landscape properties, such as the size of land use patches, the density of edges between land uses, or the relative naturalness of the land uses with a landscape view (Zube et al., 1982; Daniel and Vining, 1983). It looks to the field of landscape ecology to obtain spatial landscape metrics (Forman and Godron, 1986; McGarigal and Marks, 1995).

1.1. Landscape ecological concepts applied to landscape perception assessment

Landscape ecology is the study of spatial and temporal patterns on the land and their consequences to organisms, populations, communities, and the ecosystem (Giles and Trani, 1999). While it may sometimes make sense to investigate only land patterns (e.g., Ritters et al., 1995), it seems generally more reasonable that there should also be a behavioral or perceptual response component. Often land patterns only have consequence in relation to organisms. Since we know that many landscape metrics are sensitive to scale, it is particularly awkward to interpret studies like Ritters et al. (1995) that do not state their ecological context. In order to frame a landscape ecology study, one must consider the ecological appropriateness of the landscape's extent, grain, and elements, all of which gain meaning and consequence from an organism of concern.

Extent is operationally defined as "the area encompassed by an investigation or within the landscape boundary" (McGarigal and Marks, 1995, p. 7). However, a landscape ecology study needs to investigate an ecologically appropriate area. This is identified by With (1994, p. 25) as "the largest scale that an organism perceives." Alternately, Kolasa and Rollo (1991, p. 7) identify extent as "the range at which a relevant object can be distinguished from a fixed vantage point". Both of these definitions make it clear that a study's extent must be based on the organism's perception of the landscape. The methodological decision for the study presented here is: What is the appropriate extent for a landscape perception study of Cape Cod residents? There are two answers, because there are two ways of defining extent. In the first definition, extent is analogous to "home range"—the area around an animal's home that is used during its daily activities (Forman and Godron, 1986, p. 594). For Cape Cod residents, the residential lot or neighborhood seems too small an area to accommodate the pattern of daily activities. On the other hand, the state of Massachusetts or the New England region seems unnecessarily large. A small city or rural township is a sufficiently large extent to accommodate the daily activities of residents and therefore seems appropriate for this study. The second definition of extent focuses on the area that an organism can apprehend from a fixed viewpoint. In landscape perception assessment this is termed the seen area or a viewshed (Smardon et al., 1986).

Grain is operationally defined as "the size of the individual units of observation" (McGarigal and Marks, 1995, p. 7). However, grain also has ecological meaning. With (1994, p. 25) defines grain as "the finest resolution at which an organism perceives spatial heterogeneity." Forman and Godron (1986, p. 182) define grain as "the distance or area to which the species is sensitive in carrying out its functions". In this case, residential lots or similar property divisions seem the appropriate resolution. People can perceive finer detail within these classes. For instance, residential areas are composed of buildings, trees, gardens, lawns, and paved areas. There are even finer resolution clues that can be important—the placement of porches, doors, swing sets, and so forth, or the difference between a driveway and walkway. However, these details are not generally central in determining the broader patterns of daily life within the landscape.

Landscape elements are "the basic, relatively homogenous, ecological units, whether of natural or human origin, on the land at the scale of a landscape" (Forman and Godron, 1986, p. 595). One type of landscape element is the patch—"a nonlinear surface area differing in appearance from its surroundings" (Forman and Godron, 1986, p. 597). An important question when framing a landscape perception assessment is how many meaningful types of landscape patches might people in the landscape distinguish? For instance, Ritters et al. (1995) used 37 land classes from Anderson et al.'s (1976) Level II taxonomy. Might it be more appropriate to use the six or seven Level I classes, or perhaps there should be 100 or more classes? Previous research has found that ordinarily people can distinguish about seven distinct classes at any one time (Miller, 1956; Rosch and Lloyd, 1978). Local residents also seem to come up

with around seven classes when asked to identify meaningful groups of similar landscape views. For instance, in a study of Massachusetts' Connecticut River valley the classes were industry, towns, farms, meadows and woods, forested hills, open water, and wetlands and streams (Palmer, 1976). On Cape Cod, Massachusetts, residents identified commercial/industrial, high-density seasonal housing, low-density housing, open space, beaches and water, woods and wetlands (Palmer, 1983).

Metrics describing the types of land cover or uses that make up the extent refer to the landscape's *composition*. These metrics include the total land area and the percent of the viewshed occupied by individual land use types. While these elements certainly hold particular meaning in and of themselves, one of the more consistent findings in the landscape perception research is that the more natural appearing the elements composing a view, the higher the scenic value (Kaplan and Kaplan, 1989). Zube et al. (1974) developed a naturalism index to measure how 'natural' the visible land uses are.

Metrics that describe the pattern or arrangement of elements within the extent refer to the landscape's *configuration*. For instance, homogeneity in the landscape is indicated by the dominance of the single largest patch. In contrast, increasing patch density means that the landscape's grain is becoming finer, indicating greater heterogeneity and fragmentation. Greater homogeneity increases coherence, while fragmentation decreases it. Coherence is generally thought to have a positive relation to scenic value (Kaplan and Kaplan, 1989). Another configuration metric is edge density, or the length of edge between different patches per unit area. A metric of landscape shape is based on the perimeter-to-area ratio for all the land use patches in a landscape. Both edge density and landscape shape index provide an indication of visible landscape complexity, which is thought to contribute to scenic value (Kaplan and Kaplan, 1989). Landscape diversity is generally considered to have two components, richness and evenness. Patch richness density is a measure of how many different land cover types are present per unit area. Shannon's evenness index is a measure of how evenly the different cover types are represented in the view. It is the opposite of dominance, and measures the distribution of the land use patches.

In summary, a study that proposes to apply spatial data to describe landscape perceptions must use a database with an extent, grain, and classification of elements that are appropriate to the organism being studied. In this study these considerations are investigated in relation to both the composition and configuration of the elements.

1.2. Objectives

This study investigates the power of commonly used landscape spatial metrics to explain the perception of scenic value in a landscape after 20 years of change. There are two objectives:

1. Document changes in a landscape and perceptions of landscape scenic quality over 20 years.
2. Test the efficacy of a scenic perception model to predict the perceptions of the same landscape 20 years later.

2. Methods

This study requires a site that has undergone significant landscape change. In addition, spatial land use and landscape perception data must be available that document the change. Dennis, Massachusetts, a Cape Cod town, was selected for this case study of landscape change and the perception of landscape aesthetics.

This section describes the study area and how it qualifies as a landscape that has undergone recent change. It then describes how scenic perception data were collected in 1976 and 1996, and how landscape data were gathered into a GIS database. Each viewpoint from which a photograph was taken was located in the GIS and used to map the viewshed, or potential area seen, in the photograph. The GIS database was also used to calculate landscape metrics that describe the study area and each viewshed. These metrics were used to predict scenic quality, as well as changes in scenic quality over the 20-year study period.

2.1. Site description

Cape Cod is a large sandy glacial peninsula extending about 100 km into the Atlantic Ocean. The topography has relatively little relief, with the highest point being less than 50 m above sea level. Archeological

Table 1
U.S. Census statistics for Dennis, Massachusetts: 1970 and 1990

	1970	1990	Change (%)
Population	6454	13864	114.8
Median age	44.4	44.3	−0.2
Median per capita income (CPI adjusted to 1989, US$)[a]	12224	15436	26.3
Persons below poverty level (%)	11.4	10.5	−7.9
Housing units	7329	14498	97.8
Occupied housing units	2476	6190	150.0
Median people per unit (owner occupied)	2.2	2.0	−9.1

Source: US Bureau of the Census (1973a,b, 1992a,b).
[a] 1969 per capita income was US$ 3618.

remains indicate at least 9000 years of habitation. English colonists first settled the area that became Dennis in 1639. The town's population ranged between 1400 and 3700 inhabitants during the 19th century and remained around 2000 for the first half of the 20th century (Reid, 1996). After World War II, Dennis experienced a housing boom as a result of the exurban growth that swept across the country (Jackson, 1987; Cohen, 2003). Between 1950 and 1970, the population increased by 158%, and grew another 115% between 1970 and 1990. Median per capita income grew by 26% after accounting for inflation between 1970 and 1990. These trends in the growth of population and wealth are seen in Table 1, which presents the basic social statistics for Dennis from the 1970 and 1990 US Censuses.

These social changes were accompanied by significant changes in Dennis' landscape (see Fig. 1) (MacConnell et al., 1974, 1991). For instance, in 1951 forests covered 58% of the town. By 1971 forest cover had dropped to 47%, and by 1990 it fell to only 29%. In contrast, residential land uses occupied 12% of the town in 1951, 27% in 1971, and 41% in 1990. These changes indicate a shift from a landscape where single-family residential housing is now becoming the landscape's matrix rather than the forest. Table 2 gives the percent change between 1971 and 1990 for 24 land uses grouped into seven classes.

2.2. Landscape representations and perceptions

During the mid-1970s the Town of Dennis organized a series of citizen committees to inventory and assess its natural and cultural resources and to prepare a town plan (Chandler, 1976). One of these committees was charged with assessing the visual resources. They began in 1976 by identifying locations they thought represented the range of visual landscape conditions throughout the town. These locations were photographed between 10 a.m. and 3 p.m. using a 35 mm lens on a 35 mm single lens reflex camera. The committee selected 56 photos they thought best represented the local landscape's diversity (Palmer, 1983). A random sample of citizens was invited to come to

Table 2
Land use change in Dennis, Massachusetts: 1971 and 1990

Land use type	Area (ha)		Change (%)
	1971	1990	
Agricultural and open land	318.1	319.7	0.5
Crop land	38.9	44.1	13.4
Pasture	4.0	5.7	42.5
Open land	259.0	248.1	−4.2
Cranberry bog	14.2	17.0	19.7
Woody perennial, orchard	2.0	4.9	145.0
Forest	2588.0	1610.3	−37.8
Forest	2588.0	1610.3	−37.8
Recreation	119.0	187.0	57.1
Participation recreation	2.4	9.7	304.2
Spectator recreation	40.1	104.0	159.4
Water based recreation	53.0	48.6	−8.3
Golf course	13.0	14.2	9.2
Marina	10.5	10.5	0.0
Lower density residential	924.7	1569.8	69.3
Medium density residential	594.9	870.5	46.3
Low density residential	329.8	699.3	112.0
Other urban	745.9	967.6	29.7
Multi-family residential	0.8	31.2	3800.0
High density residential	547.1	646.3	18.1
Commercial	106.4	157.8	48.3
Industrial	9.7	31.6	225.8
Urban open, public	42.5	52.6	23.8
Transportation	39.3	48.2	22.6
Waste	69.2	103.6	49.7
Mining	29.9	34.0	13.7
Waste disposal	39.3	69.6	77.1
Wetland and open water	766.9	761.6	−0.7
Inland wetland, fresh water	165.9	163.1	−1.7
Salt wetland	397.8	395.4	−0.6
Water	203.2	203.2	0.0
Total area (ha)	5531.8	5519.9	−0.2

Source: Table 8 in MacConnell et al. (1991). Areas are converted from acres.

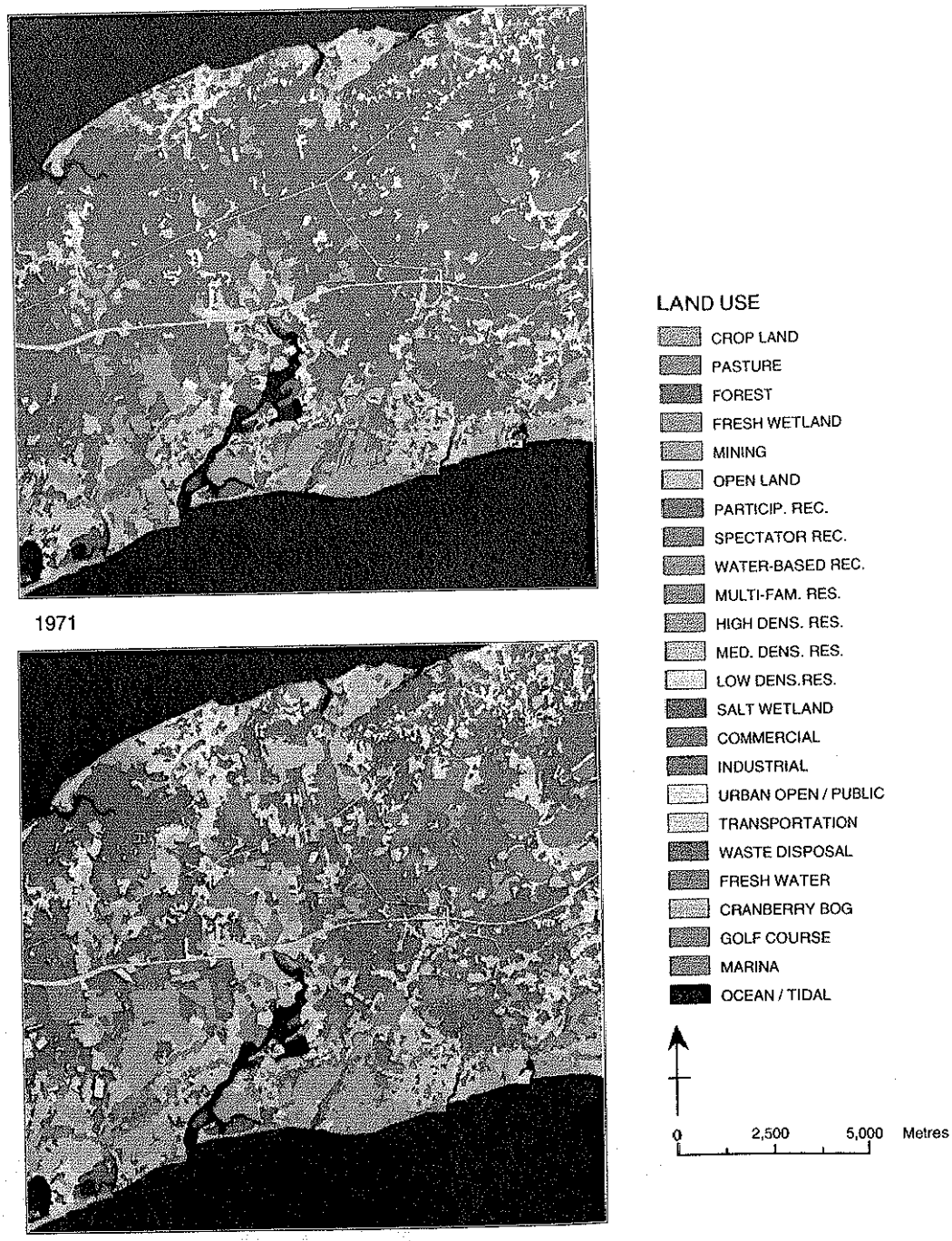

Fig. 1. Maps showing 20 years of land use change for the area surrounding Dennis, Massachusetts.

the town hall and employ one of several methods to evaluate these landscape views. One of these was a Q-sort technique, where the 56 color 13 cm × 18 cm photographs were sorted into seven piles from highest to lowest scenic value according to a fixed, "normal" distribution (Pitt and Zube, 1979). Sixty-eight local citizens made scenic value judgments of these 56 landscape scenes using this Q-sort method (Palmer, 1983).During the summer of 1995, all but one of the original 56 sites were re-photographed by a volunteer from the Dennis Planning Department. The viewpoints were located using a copy of the 1976 study's field map. The single un-photographed site overlooked a wooded wetland that appeared to have been erroneously located on the field map. The photographs were taken using a 35 mm single lens reflex camera and 35 mm lens. Each image was taken from the same general location as the corresponding 1976 photograph. During 1996 a total of 25 Dennis residents visiting the Town Hall evaluated slides of the 1976 and then the 1995[1] views. The same random order was used to arrange the sites for both years. The judgments were recorded using a 10-point rating scale of scenic value.

Photographic media have generally been found to be valid representations of the landscape in scenic quality studies. Palmer and Hoffman's (2001) meta-analysis of 19 studies comparing evaluations of photographic representations to the actual views found a size effect of $r = 0.80$, which supports the use of photographic representations for scenic quality studies. However, they also found evidence that photographic images may not be valid because they are not representative of the conditions seen in the field. The validity of the viewpoints used in this study is affirmed because they were all originally selected by a committee of local residents who identified them as representative. However, there are some compositional differences between the 1976 and 1996 photographs for some locations. In addition, 1976 was drier than 1996, the 1976 photos tend to be lighter (i.e., more exposed), and were taken earlier in the season than they were in 1996.

A second possible concern is that evaluations were made using a Q-sort in 1976 and a rating scale in 1996. Stamps' (2000) meta-analysis of nine studies that compared different scaling methods found a size effect of $r = 0.99$, indicating essential equivalence among the scaling methods. In this study of the Dennis landscape, it was necessary to compare the 1976 and 1996 values, therefore each person's ratings were standardized (i.e., z-scores). RMwin software uses the raw ratings to calculate standardized 'by-slide' scenic beauty estimates (SBE), which have a mean of 0 and a standard deviation of 100 (Brown and Daniel, 1990; Meitner, 1999). All the ratings made by residents in 1996 are used when calculating the SBEs for the 1976 and 1996 scenes. This maintains a uniform scale across these judgments that permits the effects of change to be investigated. The judgments made in 1976 were also transformed to SBEs.

2.3. Viewsheds of the landscape representations

The extent of the study area was a 225 square kilometers area encompassing the Town of Dennis. A grain of 30 m was used, which is slightly smaller than a residential lot at a density of 4 dwelling units per acre (i.e., a lot size of 0.22 acres or 0.09 ha). Thus, the extent corresponded to the area of the community being studied and the grain to an area smaller than the division of land with which they were most familiar (i.e., a residential lot), making them appropriate for the studying Dennis residents' perceptions. These attributes led to the creation of a 500 × 500-cell raster GIS with a 30 m resolution.

The GIS database included topography from the mid-1990s. Raw point-elevation data derived from aerial photos were obtained from the Massachusetts' Office of Geographic and Environmental Information (MassGIS). These data were used to create a TIN (triangulated irregular network) model, which was converted to a 30-m raster grid using ArcInfo™ software.

The viewshed or area seen from each viewpoint was identified using the topographic data without modifications for land use heights (a.k.a. maximum visibility model) (Kirby, 1999). An eye-level of 1.5 m and a 56° cone of vision were used, which corresponded to the camera's placement and angle of view when the photos were taken. A unique viewshed represented the land surface potentially visible in each photograph.

[1] The photographs were taken during the summer of 1995, but residents evaluated them in 1996. The text will reference 1996 for both the photos and rating to reduce confusion.

Table 3
Description of landscape metrics

Landscape metric	Description
Landscape composition	
Agricultural and open land	Percent of total area in crops, pasture, open land, and cranberry bogs
Forest	Percent of total area in forest
Recreation	Percent of total area in participant recreation, spectator recreation and water recreation
Lower density residential	Percent of total area in medium and low density residential
Other urban	Percent of total area in multi-family and high density residential, commerce, industry, urban open land, and transportation
Waste	Percent of total area in mining, and waste disposal
Wetland and open water	Percent of total area in wetlands, salt marsh, and freshwater
Naturalism index	The area-weighted mean "naturalness" rating of land use types (Zube et al., 1974)
Landscape configuration	
Largest patch index	Percent of total area occupied by the largest patch
Patch density	Number of patches per 100 ha
Edge density	Meters of edge, including the background edge, per hectare
Landscape shape index	Total edge in meters, including the background edge, divided by the root of the total area in meters squared, and adjusted for a standard square raster
Patch richness density	Number of different land uses per 100 ha
Shannon's evenness index	Equals 1 if the distribution of area among all land uses is equal, approaches 0 as one land use becomes dominant, and is 0 if there is only 1 land use. It is based on Shannon's diversity index

Notes: See McGarigal and Marks (1995) for details of calculation, unless otherwise noted. Total area refers to the viewshed, excluding the ocean.

2.4. Landscape metrics

The GIS database also included 24 land uses mapped in 1971 and 1990 and obtained from MassGIS as ArcInfo coverages. These data were used to calculate the spatial metrics described in Table 3 for each viewshed. The composition metrics included seven class-level measures describing the relative coverage for each aggregated land use category used to organize the detailed land use types (MacConnell, 1973): agricultural and open land, forest, recreation, lower density residential, other urban, waste, wetland and open water, and naturalism. These seven land use categories more closely correspond to the residents' perceptions of how to classify landscapes than do the 24 land uses (Palmer, 1983, 1997). The final compositional metric, naturalism, is an index based on the average 'naturalness' of all land uses within a viewshed. It was calculated based on ratings of perceived naturalness of each land use by 10 air photo interpretation professionals with natural resource management training (Zube et al., 1974).

Six landscape-level configuration metrics available through FRAGSTATS were also included in the analysis: largest patch index, patch density, edge density, landscape shape index, patch richness index, and Shannon's evenness index (McGarigal and Marks, 1995). These particular metrics were chosen because they characterized different aspects of the landscape, and were appropriate for comparing areas of different size (i.e., the viewsheds).

The landscape metrics were calculated for the complete study area (the first definition of extent) and for the viewshed, or seen area, corresponding to each photograph (the second definition of extent). The viewshed calculation for each photograph was the same in both time periods, because it was based only on topography, which did not appreciably change during the study period. Therefore, the landscape attributes describing each of the 56 views were derived from the same seen areas. Landscape change for each view was calculated as the difference between the 1990 and 1971 metrics.

2.5. Statistical analysis

Correlations and a regression analysis were conducted in JMP™ version 5.0.1a (SAS, 2002). As previously noted, one viewpoint was not re-photographed in 1995 and could not be evaluated. Therefore,

correlation or regression analyses that involved perceptions of the 1995 views used 55 rather than 56 cases.

Several strategies were used to identify the regression solutions reported in the findings. Stepwise regressions using both forward and backward strategies were evaluated. In addition, regressions with high multiple-Rs from among all possible regression solutions with three, four, or five variables entered were considered. Mallow's C_p criterion indicated that solutions with this number of variables were appropriate (Mosteller and Tukey, 1977). The selected model was the one with the highest multiple-R where all the coefficients for the included variables were significant ($P < 0.05$).

3. Results and discussion

The findings begin with a description of the mean landscape metrics for the study area in 1971 and 1990, as well as their change over this period. This is followed by a presentation of the correlation between the scenic value ratings of landscape views with the corresponding landscape metrics describing those views. The third section presents the results of multiple regression analyses using the landscape metrics to predict scenic value. In the fourth section the change in scenic value is correlated with the change in landscape metrics. The final section presents the multiple regression analysis that predicts change in scenic value based on change in landscape metrics.

3.1. Dennis, Massachusetts: a changing landscape

A comparison of the land use patterns in Fig. 1 for 1971 and 1990 makes it quite apparent that the Dennis landscape is undergoing development-associated change. Table 4 summarizes the landscape metrics used in this study for 1971 and 1990, as well as the percent change for each metric over that period. The presentation is organized around the landscape's composition and configuration.

3.1.1. Landscape composition

The landscape compositional changes within the study area mirror the changes within Dennis shown in Table 2. Residential and other urban uses have increased significantly, at the expense of forest cover. This trend is represented in Fig. 2 where the forest on either side of a rural road is converted into single-family residences. Agricultural use is relatively unchanged, but it is a rather small component in the landscape. Waste, which includes gravel mining and land fills, is another small component, but it has increased substantially. The change in wetlands and fresh water is minor, reflecting their special legal status. Fig. 3 illustrates how protection of an ecologically sensitive landscape can also conserve places that may be visually sensitive to change from development.

Table 4
Mean landscape metrics for study area: 1971 and 1990

Landscape metric	1971	1990	Change (%)
Landscape composition			
Agricultural and open land	4.5	4.3	−4.4
Forest	50.8	35.3	−30.5
Recreation	1.9	3.1	63.2
Lower density residential	16.3	25.8	58.3
Other urban	10.5	14.9	41.9
Waste	0.8	1.3	62.5
Wetland and open water	15.3	15.2	−0.7
Naturalism index	6.5	5.7	−12.3
Landscape configuration			
Largest patch index	22.5	16.7	−25.8
Patch density	6.8	8.4	23.5
Edge density	65.9	76.4	15.9
Landscape shape index	25.7	29.7	15.6
Patch richness density	0.1	0.1	0.0
Shannon's evenness index	0.6	0.7	16.7

These values indicate a shift from a landscape that in 1971 was still dominated by land uses generally thought to be "natural" to a nearly 50–50 split between natural and developed areas in 1990. This change in landscape composition is reflected in the naturalism index, which shows an overall 13% decrease over this period.

3.1.2. Landscape configuration

The configuration metrics all exhibit changes, though not as substantial as some of the composition measures. The size of the largest patch relative to the study area has decreased and patch density has increased. This trend is indicative of greater landscape heterogeneity and fragmentation. Edge density and the landscape shape index have both increased, indicating an increase in complexity.

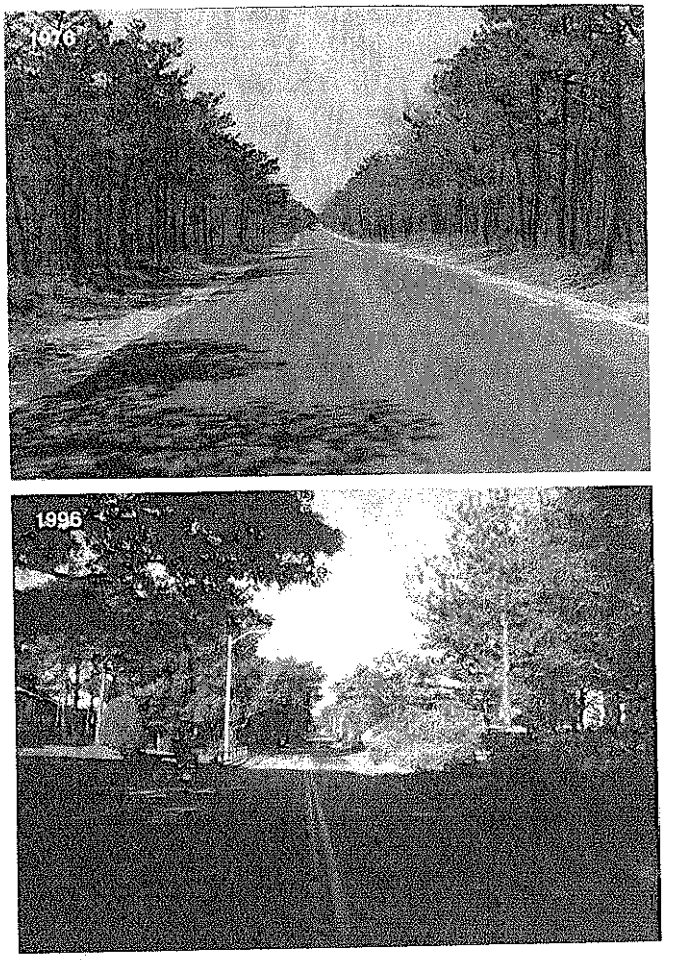

Fig. 2. The forest matrix is being reduced and fragmented primarily by expansion of residential development. Scenic value changed at this location from 57.6 SBE units in 1976 to 40.3 SBE units in 1996.

Patch richness density and Shannon's evenness index both increased. This indicates that the changing land use pattern is leading to greater visual diversity. The average 1976 viewshed included 7.8 out of 24 land uses; in 1996 the average was 8.7 land uses.

3.2. Landscape scenic value

It is important to establish that while beauty may be in the eye of the beholder, there is substantial agreement among the residents of Dennis about scenic value in their landscape (Palmer and Hoffman, 2001). The group intraclass reliability of the 1976 SBEs is $r = 0.99$. The reliability of the SBEs from the ratings made in 1996 is $r = 0.97$ for the 1976 views, and $r = 0.97$ for the 1996 views. Dennis residents from 1996 and 1976 gave very similar ratings to the 1976 scenes ($r = 0.82$). These results are similar to those from an earlier study demonstrating the relative stability between 1976 and 1986 of landscape perceptions among Dennis' residents (Palmer, 1997).

In 1996 Dennis residents evaluated both the 1976 and 1996 views. The SBEs were calculated using all the scenes from both years, making it is possible to determine change in scenic value. The mean SBE for the 1976 views was 7.97, and it had dropped to −8.12 in 1996. This drop of 16 points in 20 years indicates a

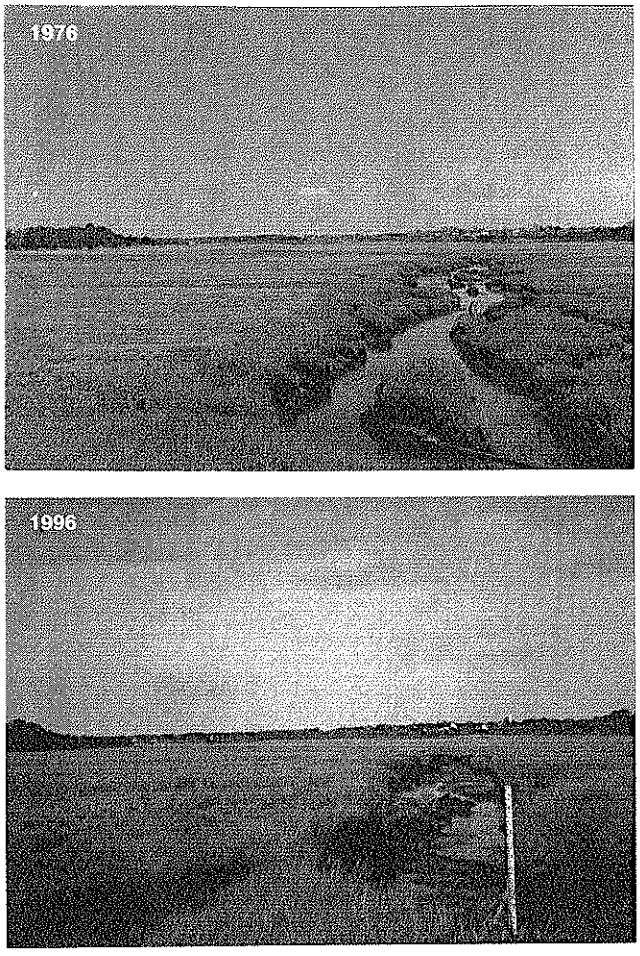

Fig. 3. This salt marsh is protected because of its ecological importance, which has the added benefit of conserving scenic quality. The SBE is 140.8 for the 1976 view and 135.7 for the 1996 view.

significant decrease in scenic value ($t = -2.57$, $P = 0.013$).

The relationship of perceived scenic value to metrics describing the visible landscape is presented in Table 5. The SBE ratings are taken from judgments by Dennis citizens in 1976 and 1996 of the 1976 views, and in 1996 of the 1996 views. In the following discussion of the results, reference is made to the average correlation (i.e., mean r) across the three SBE ratings with a landscape spatial metric.

3.2.1. Landscape composition

The correlations in Table 5 indicate that landscape composition metrics were more closely related to scenic value than were the configuration metrics. Scenic value was most positively related to the relative amount of agricultural and related open lands (correlation of $r = 0.37$ in 1976 and $r = 0.38$ in 1996 for the 1976 views, and $r = 0.31$ in 1996, with a mean of $r = 0.35$). The next most positively related land use was wetlands and open water (mean $r = 0.31$). The naturalism index also had considerable predictive power (mean $r = 0.34$). However, forested area, the most common 'natural' cover in Dennis, did not have a significant statistical correlation with scenic value.

The most intensive urban land uses, such as higher density housing, commercial and industrial areas, were negatively associated with scenic value

Table 5
Correlation of scenic value with landscape metrics

Landscape metric	1976 views	1996 views		Mean
	1976 SBE	1996 SBE	1996 SBE	
Landscape composition				
Agricultural and open land	0.37***	0.38***	0.31**	0.35
Forest	−0.08	−0.22	−0.04	−0.11
Recreation	0.09	0.31**	0.31**	0.24
Lower density residential	0.20	0.07	−0.01	0.09
Other urban	−0.45***	−0.35**	−0.35***	−0.38
Waste	−0.30**	−0.27**	−0.33**	−0.30
Wetland and open water	0.28**	0.31**	0.33**	0.31
Naturalism index	0.34**	0.23*	0.44***	0.34
Landscape configuration				
Largest patch index	0.04	0.21	0.15	0.13
Patch density	0.12	−0.00	−0.02	0.03
Edge density	0.42***	0.22*	0.19	0.28
Landscape shape index	−0.10	−0.21	−0.16	−0.16
Patch richness density	0.21	0.18	0.13	0.17
Shannon's evenness index	0.20	0.06	0.07	0.11

* $P < 0.10$.
** $P < 0.05$.
*** $P < 0.01$.

(mean $r = -0.38$). Waste areas, including landfills and sand mines, had low scenic value (mean $r = -0.30$). The correlation of lower density residential areas with scenic values was not statistically significant.

The compositional metrics are simple measures of what is present within the view. Their importance is largely the meaning that we associate with them. The strength of these correlations suggests that there is a strong association between this meaning and scenic value.

3.2.2. Landscape configuration

In general, the configuration metrics had weak correlations with scenic value. Edge density had a positive relation to scenic value in the 1976 views (mean $r = 0.32$), but it was not significant in 1996. The other configuration metrics were not significantly correlated to scenic value.

These configuration metrics measure the coherence and complexity of patterns, and the diversity within a scene. While they are conceptually related to scenic value, as measured most did not relate as directly to residents' rating of the scenes as did the compositional metrics.

3.3. Modeling landscape scenic value

The regression model developed from the landscape metrics to explain scenic value perceived by residents in 1976 is shown in Table 6. All five variables in the model made a significant contribution ($P < 0.05$) and taken together they accounted for approximately half the variation in scenic value ($R^2 = 0.521$).

Edge density made the strongest contribution to the model, indicating that this aspect of landscape complexity had an important relation to scenic value. This was moderated by the positive contribution of the largest patch index, which is an indication of visual coherence and the potential unifying influence of a single dominant land use patch.

The second most important contribution to the model came from the naturalism index. The importance of green nature to scenic value is a common research finding (Kaplan and Kaplan, 1989). That wasteland made a significant negative contribution is also congruent with past findings. However, the negative contribution of forest cover is more difficult to explain, since forest cover is the most common 'natural' land use in Dennis. This negative contribution had the effect of moderating the influence of naturalism.

Table 6
Regression model predicting scenic value from landscape metrics

Variable	Unstandardized coefficients		Standardized coefficient	F-ratio	Probability
	B	S.E			
Intercept	−257.08	48.98	0.00		
Forest	−1.12	0.52	−32.64	4.66	0.037
Waste	−4.59	1.88	−25.03	6.13	0.017
Naturalism index	34.41	9.02	52.83	14.55	<0.001
Largest patch index	0.97	0.43	29.74	5.17	0.027
Edge density	1.55	0.35	54.31	20.12	<0.001

Notes: $n = 56$, $R^2 = 0.521$, R^2-adjusted = 0.473, F-ratio = 10.9, $P < 0.0001$.

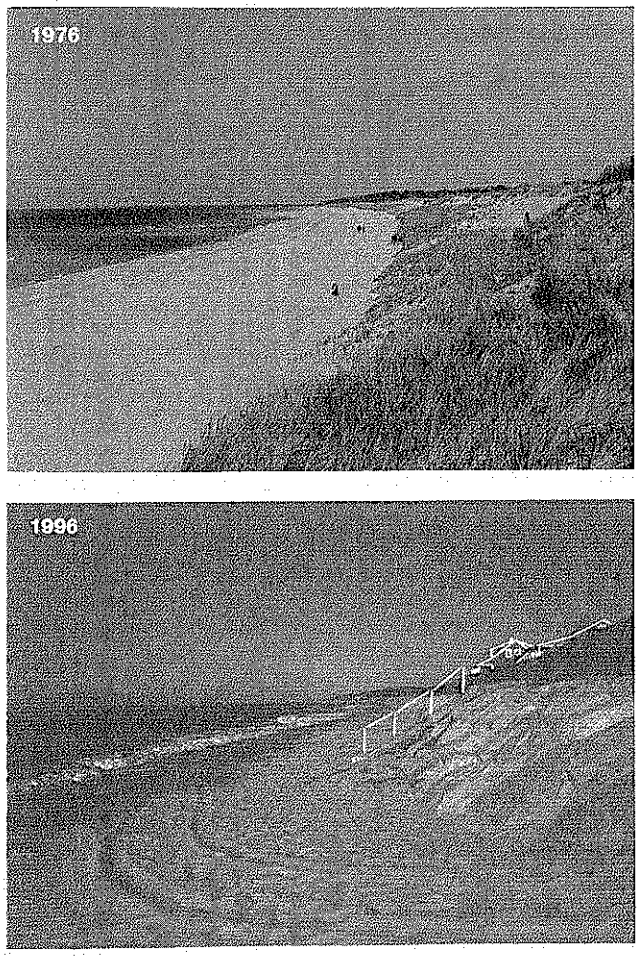

Fig. 4. New houses not only intrude on the scenic quality of what was once a secluded beach, but also bring other intrusive uses as indicated by the vehicle tracks on the upper beach and the need to harden the slope around the stairs. Scenic value fell from 153.1 SBE units in 1976 to 99.2 SBE units in 1996.

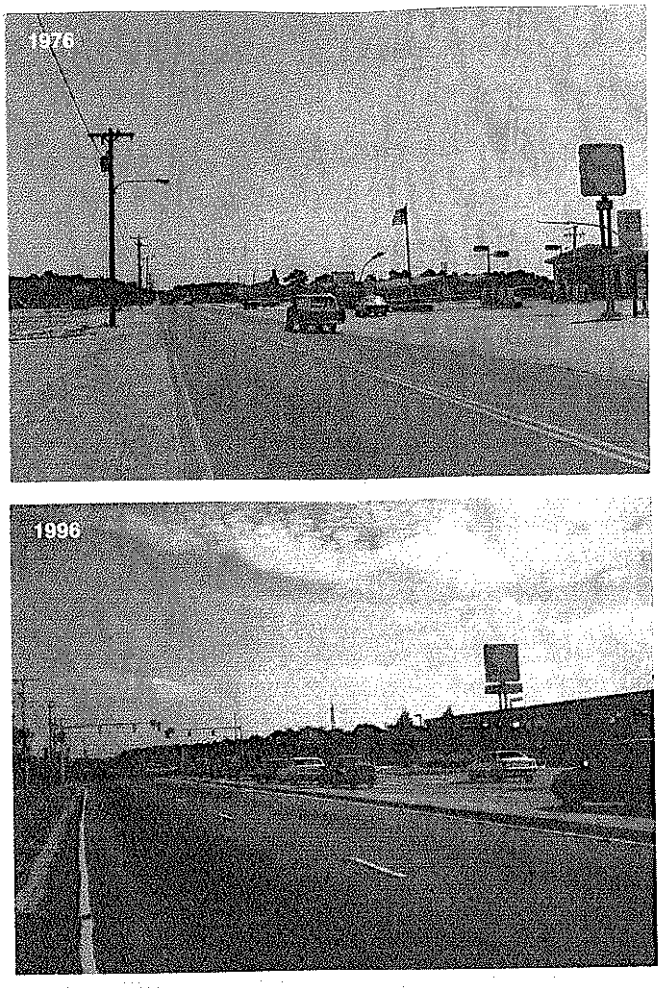

Fig. 5. The widening of this highway, the significant increase in traffic, and other visible changes contribute to a drop in scenic value from −102.9 to −145.8 SBE units.

The coefficients from this model can be used to predict the scenic value ratings made by Dennis residents in 1996 of the 1976 and 1996 views. The Pearson correlation between the predicted and actual 1976 SBEs was $r = 0.622$ ($P < 0.001$) and 1996 SBEs was $r = 0.560$ ($P < 0.001$).

These findings indicate that landscape managers have a dependable way to assess the impacts of proposed landscape changes. While the ability to explain 50% of the variation in perceptions is quite powerful by social science standards, decision makers may hope for something greater. Anecdotal evidence from the residents indicates that they believe intense development has changed Dennis' character and its scenic quality. Sometimes these changes were evident from the GIS database, such as the change in Fig. 4 from water-based recreation (i.e., a secluded beach) to lower density residences. However, other more qualitative changes that may affect scenic value were not readily apparent in the GIS database. For instance, a lower density residential land use classification does not in itself provide information about the use of large rocks to harden the erodable back-beach or the use of the area by off-road vehicles as evidenced by the tracks in the sand. The land use classifications of the 1976 and 1996 views in Fig. 5 remain largely unchanged. However, the widening of the highway from two to four lanes with the introduction of a raised median

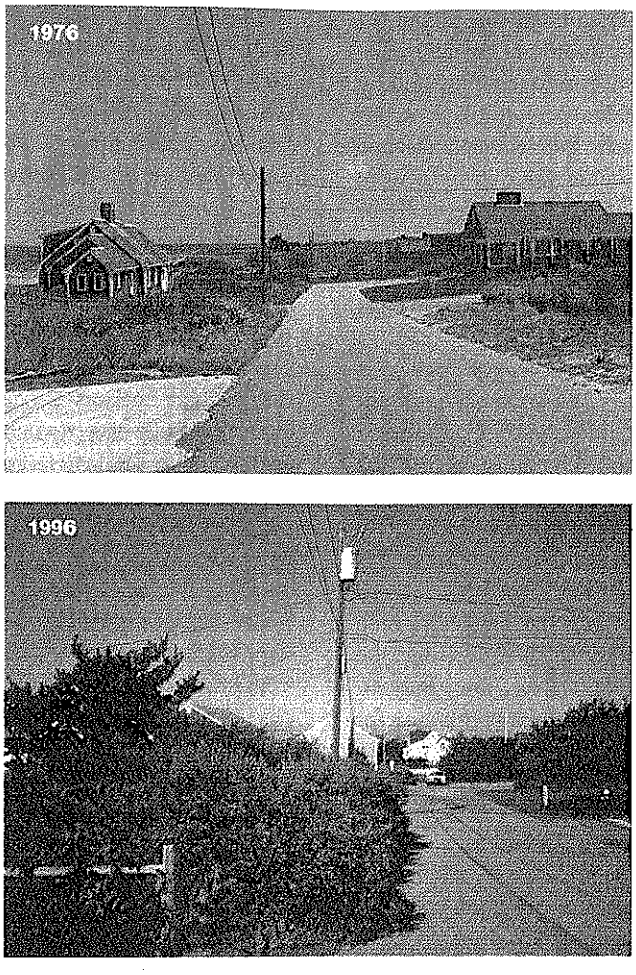

Fig. 6. Several new residences have been built on this modest road above the beach. However, the scenic impact is somewhat screened by planted trees and shrubs. The SBE changed from 20.8 to −8.7.

strip is accompanied by a significant increase in traffic, which brings a need for overhead traffic control lights and other changes that impact the experience of the landscape. In this particular instance, these changes resulted in a drop in scenic value of more than 40 SBE units. Another example is illustrated in Fig. 6 of a low-density residential area above the beach. While the increase in residential land use coverage for this viewshed is only from 43 to 46%, the visual impact of the structures is quite significant. An added complexity is that this impact is somewhat softened by the growth of planted vegetation. In this view, the scenic value changed from 20.8 to −8.7 SBE units.

4. Conclusions and implications

This study attempts to build upon a legacy of landscape perception research by Shafer et al. (1969), Zube et al. (1974), Sell and Zube (1986), and others to develop concepts and models to understand people's perceptions of changes made in the physical landscape. By looking at Dennis, Massachusetts, a landscape that has undergone considerable development-related landscape change within a 20-year period, the study's primary objectives were to document changes in this landscape and residents' scenic quality perceptions of them, and to test the validity of using landscape ecology-based spatial landscape metrics to predict

scenic quality perceptions. Results showed a significant decrease in overall scenic quality in the landscape as the land use matrix shifted from one dominated by forest area to one where residential and related types of development predominated. While the landscape metrics that best explained scenic value in 1976 were equally as effective in explaining the scenic value of the 1996 landscape, those that dealt with the composition of the landscape were on the whole more effective predictors than those measuring landscape configuration.

Establishing the effectiveness of a landscape perception model in the context of a changing landscape is particularly important because it provides a basis for managing landscape character. While the landscape underwent substantial change, the human values that define scenic quality and its relation to landscape composition and configuration have remained relatively stable. In other words, the landscape scenic norms are relatively unchanged, which resonates with previous findings investigating the perceptions of Dennis' residents over time (Palmer, 1997). The results in Dennis indicate a preference for natural appearing landscapes with a mosaic of open and forested land. Preference is for a dominant large patch within a view, rather than a more fragmented pattern. In addition, patch edges should be complex, and simple geometric shapes should be avoided.

The good news is that this research relating GIS-generated landscape metrics to local scenic value explains about half of the variation in landscape perception, which appears very promising. The bad news is that half the variation in landscape perception is unexplained. There are several potential sources for this unexplained variation. There may be errors in the data or analysis. For instance, the viewpoints differ slightly between 1976 and 1996, and the viewsheds do not account for the screening effect of vegetation and structures. Predictive capacity may also improve with an increased understanding of how people think about their landscape and how this might be made more amenable to recording in a GIS database. For instance, experience of the landscape may be affected by traffic volume, or the size, density, and health of vegetation. These observations indicate the need for further investigations that replicate and improve upon this line of research by addressing the following questions.

What are the appropriate extent, grain, and classification of landscape elements? Is the extent of this study sufficiently large and diverse to understand the landscape character of a community? The data used here had a resolution of 30 m. Would a finer resolution better capture the subtleties in landscape configuration? Landscape elements were identified using common land use designations. Perhaps there is a different way to identify landscape elements that incorporates the qualitative aspects of built and natural elements, yet remains amenable to recording in a GIS database.

How accurate is the visibility analysis on which the scenic value analysis is based? The results presented here support the use of visibility analysis as a first step in describing the landscape being viewed. However, the visibility analysis used here only considered topographic variation. Vegetation and structures on the land also obstruct actual visibility. Standard procedures need to be developed and validated that account for the visual screening effect of land cover when determining a viewshed.

How do local citizens think their landscape has changed? It seems appropriate to extend the scope of this type of study by asking a sample of citizens directly about their perceptions of change in their local landscape. For instance, the change from a landscape matrix of forestland to one of residential yards may lead to a significantly different experience of the landscape. There is some anecdotal evidence from the 1996 respondents that Dennis residents feel things have gotten much worse. On the other hand, vegetation growth and landscape management has increased scenic value in some areas. Finally, the way that landscape planners, designers, and managers classify the landscape and its elements may not adequately represent the way residents think about it. After all, the model that maintains the ability to predict half the variation in scenic value after 20 years of change still leaves half of the variation unexplained.

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Urbanization on the US landscape: looking ahead in the 21st century

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Abstract

Conversion of rural lands to urban and other built-up uses affects the mix of commodities and services produced from the global land base. In the United States, there was a 34% increase in the amount of land devoted to urban and built-up uses between 1982 and 1997. This increase came predominantly from the conversion of croplands and forestland, with the largest increases in developed area happening in the southern region of the country. In an analysis of drivers influencing developed land uses in the US, we found results that were consistent with hypothesized relationships, including significant increases in development as a result of increases in population density and personal income. From these results, we projected changes in potential future urbanization and development by 2025 given estimated increases in population and real personal income. The projections suggest continued urban expansion over the next 25 years, with the magnitude of increase varying by region. US developed area is projected to increase by 79%, raising the proportion of the total land base that is developed from 5.2 to 9.2%. Because much of the growth is expected in areas relatively stressed with respect to human–environment interactions, such as some coastal counties, implications for landscape and urban planning include potential impacts on sensitive watersheds, riparian areas, wildlife habitat, and water supplies.
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Keywords: Land use economics; Land allocation; Landscape planning; Urbanization trends and projections

1. Introduction

Conversion of rural lands to urban and other built-up uses affects the mix of commodities and services produced from the world's land base. Further conversions to such developed uses are likely to be substantial, as the world's population is projected to increase by more than one-third over the next 30 years, adding 2 billion people (United Nations, 2002). Almost all expected growth in the world's population is concentrated in urban areas. While providing additional living space and infrastructure, added development may also diminish agricultural output due to farmland loss and change ecological conditions due to conversion and fragmentation of forests and other natural landscapes.

In this paper, we examine urbanization trends and drivers for the United States, a country that has added more than 50 million people between 1980 and 2000, about a 24% increase (USDC Census Bureau, 2001). While this growth in population is substantial, during roughly the same time period the amount of US land devoted to urban and built-up uses grew by more

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than 34% (USDA Natural Resources Conservation Service, 2001). This increase in developed land has come predominantly from the conversion of croplands and forestland. Forests, in particular, have been the largest source of land converted to developed uses in recent decades, with resulting impacts on forest cover and other ecological attributes. From a societal viewpoint, rapid increases in developed area have not gone unnoticed by the US public. Urban sprawl tied with crime as the leading local concern of Americans in a late-1990s poll by the Pew Center (2000). In 1999 approximately 1000 measures were introduced in state legislatures to change planning laws and to make development in the US more orderly and conserving.

With respect to projecting developed area, Alig and Healy (1987) provided projections of changes in US developed area from 1982 to 2000 based on an earlier analysis of developed land area. However, that earlier study was based on only one cross section of nationwide land use data available at the time. Although the associated projections indicated a significant future increase in developed area, external demographic and macroeconomic projections did not anticipate the above-average growth in the 1990s, a growth that was also accompanied by an accelerated rate of development. With the benefit of new data on population and development that are now available, the current study updates those projections by incorporating additional time-series data and updated external macroeconomic and demographic projections.

In this paper, we examine historical trends for developed land area in the US over the past 20 years. Based on historical data on urban area and associated demographic (e.g., population) and socio-economic factors (e.g., personal income), we estimate models of urban land area. We use the models to generate 25-year projections of potential future urbanization and development, based on a projected 35% increase in the US population (NPA Data Services, 2001). We then discuss implications of projected increases in urban area and regional variations in urbanization.

2. Trends in developed areas

Examining historical trends can provide helpful guidance in identifying key factors that are likely to influence urbanization and other changes in developed area in future years. The discussion of historical trends across time and space in this section provides a foundation for subsequent empirical investigation of key determinants of changes in developed area.

When looking at the changes in US developed area over time, two major data sources both show a steady increase in recent decades. Estimates by the US Census Bureau extend farthest back in time, and show a 130% increase in census-defined urban area between 1960 and 2000. Census urban area is comprised of all territory units in urbanized areas and in places of more than 2500 persons outside of urbanized areas. The Census measure of urbanization labels as built-up some land that is still to some extent available for rural productive uses, thereby probably erring on the side of overgenerous inclusion. Although the term "paved over" has frequently been used to describe urban land, only a small fraction of the land so classified is literally paved.

The other data source, which appears more useful in our study than Census urban data, is the National Resource Inventory (NRI) (USDA Natural Resources Conservation Service, 2001). The NRI estimate of developed area increased 34% between 1982 and 1997. Between 1982 and 1997, developed area as a percentage of the total land area in the 48 contiguous states increased from 3.9 to 5.2%. One important feature of the NRI data classification, in contrast to the Census urban data, is the attempt to exclude areas devoted to agricultural crops, forestry, or similar purposes when they are within a parcel or contiguous area that is otherwise built-up. Outside urban areas, the NRI also includes developed land occupied by nonfarm rural built-up uses (e.g., rural transportation land), which are not included in the Census urban category.

The NRI was conducted every 5 years between 1982 and 1997, leading to four estimates across time. NRI data are widely used and sampling details (e.g., measurement error) can be obtained from the USDA Natural Resources Conservation Service's web site: http://www.nrcs.usda.gov/technical/NRI/. For the NRI, the intent is to identify developed land that has been permanently removed from the rural land base. Therefore, the developed land category includes: (1) large tracts of urban and built-up land; (2) small tracts of built-up land (less than four ha in size); and (3) land outside of these built-up areas that is in roads, railroads, and associated rights-of-way (USDA

Natural Resources Conservation Service, 2001). Overall, NRI "urban and built-up areas" are defined as land uses "consisting of residential, industrial, commercial, and institutional land" as well as several public infrastructure land use categories, such as railroads, landfills, and sewerage treatment plants, among others. Within NRI inventories of "urban and built-up areas," highways and other transportation facilities are included if they are surrounded by urban areas. Land use definitions from the four NRI inventories conducted in 1982, 1987, 1992, and 1997 remain consistent from one inventory to the next, and can be used to examine the expansion of developed land uses through time. For the purposes of our analysis, we call urban and built-up land and rural transportation land defined by the NRI simply "developed land".

Most of the US developed area has been added since World War II (USDC Census Bureau, 2001; USDA Natural Resources Conservation Service, 2001). Further, the amount of US development accelerated in the 1990s. During 1982–1997, US developed area increased about 2% per year on average, according to the NRI. The annual rate of conversion during the last 5 years of this period was more than 50% higher than that of the previous 5 years.

Regionally, the largest increases in US developed area between 1982 and 1997 were in the south (Fig. 1), according to the NRI (USDA Natural Resources Conservation Service, 2001). The south contains ten states as listed in Table 1, and had one-third of its developed area added during those 15 years. Between 1982 and 1997, the south had seven of the ten states with the largest average annual additions of developed area according to the NRI. The top three—Texas, Florida, and North Carolina—each added more developed area than the country's most populous state, California.

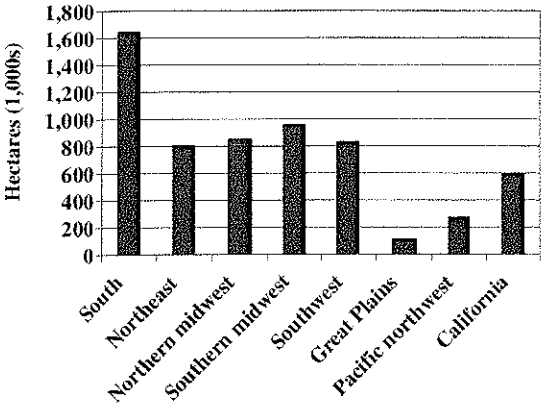

Fig. 1. Change in developed area in the United States, by region, 1982–1997 (million ha) (USDA Natural Resources Conservation Service, 2001).

As a subregion within the south, the southeast (Florida, Georgia, North Carolina, South Carolina, and Virginia) in 1997 had more than 10% of its land

Table 1
Definitions of explanatory variables tested in the urbanization model

Variable	Definition
POPULATION DENSITY	Population (1000s) per square kilometer in county (Bureau of Economic Analysis)
PER CAPITA INCOME	Per capita income (US$ 1000s) in county (Bureau of Economic Analysis)
METROPOLITAN	Variable equals 1 if county is defined as metropolitan by the US Bureau of Census; 0 otherwise
AGRICULTURAL PRODUCTS VALUE	The gross market value before taxes and production expenses of agricultural products sold in the county (US$ 1000s) divided by land in farms (US Bureau of Census)
SPATIAL LAG	Weighted average proportion of land in urban uses in surrounding adjacent counties
HOUSEHOLD SIZE	Average number of persons per household in the county
NORTHEAST	Variable equals 1 if county is located in CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, or VT; 0 otherwise
SOUTH	Variable equals 1 if county is located in AL, FL, GA, KY, MS, NC, SC, TN, VA, WV; 0 otherwise
NORTHERN MIDWEST	Variable equals 1 if county is located in IA, IL, IN, MI, MN, MO, OH, WI; 0 otherwise
SOUTHERN MIDWEST	Variable equals 1 if county is located in AR, KS, LA, OK, TX; 0 otherwise
GREAT PLAINS	Variable equals 1 if county is located in MT, ND, NE, SD, WY; 0 otherwise
SOUTHWEST	Variable equals 1 if county is located in AZ, CO, NM, NV, UT; 0 otherwise
PACIFIC NORTHWEST	Variable equals 1 if county is located in ID, OR, WA; 0 otherwise
CALIFORNIA	Variable equals 1 if county is located in CA; 0 otherwise

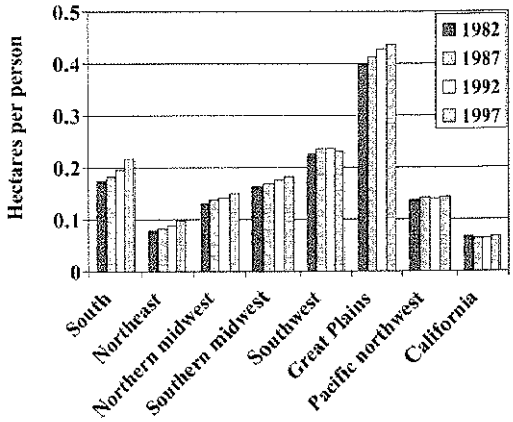

Fig. 2. Total developed area per person, by US region, 1982, 1987, 1992, and 1997 (USDA Natural Resources Conservation Service, 2001).

in developed use. This is similar to the northeast, with both the northeast and the southeast approaching 12% of their total land area as developed. The north (northeast and northern Midwest regions combined) had about one-third of the total addition to developed area. The western regions—Great Plains, Southwest, California, and Pacific Northwest—accounted for less than one-fifth of the total addition.

The Great Plains and the Southwest show relatively high marginal rates of developed area per additional resident. The Great Plains has the most developed area per resident (Fig. 2) across all four NRI surveys. However, it varies from the rest of the country in having lost population between the 1982 and 1987 NRIs, resulting in a loss in developed land area. The Southwest has the second highest level of developed area per person. The south also has a relatively high marginal rate of land consumption, and in addition has had relatively large increases in population compared to the Southwest and Great Plains (Fig. 3). Regional differences for the south were also noted in studies by Alig and Healy (1987) and Reynolds (2001).

Regional differences in urbanization rates are further illustrated by examining trends for three cities within these different regions. In the Pacific Northwest region, for example, while the population of Portland, Oregon (Portland–Vancouver Metro Area) grew by 32% in the 1990s (USDC Census Bureau, 2001), its land area classified as urban increased by only 22%, resulting in a population density increase of 8% in a state with a relatively potent land use law (Kline and Alig, 1999). In contrast, in the south region, Charlotte, North Carolina's population grew by 33%, but its urban area increased by 44%. The more than proportional increase in urban area was due to city population density decreasing by 5%. Finally, in the northeast is the case of Pittsburgh, Pennsylvania, where population declined 5% and urban area increased by 1%, resulting in an overall population density decline of 6%.

As these examples illustrate, significant regional differences can arise not just from total population growth, but also in how that population is distributed across space. While western regions had higher population growth rates, the south has added the most

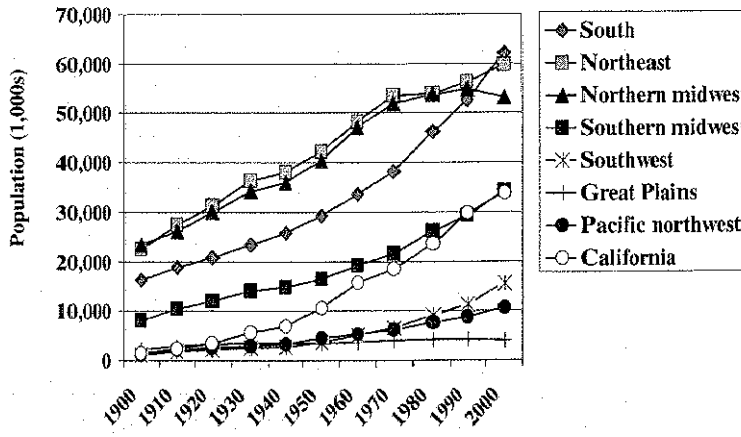

Fig. 3. US population by region, 1900–2000 (USDC Census Bureau, 2001).

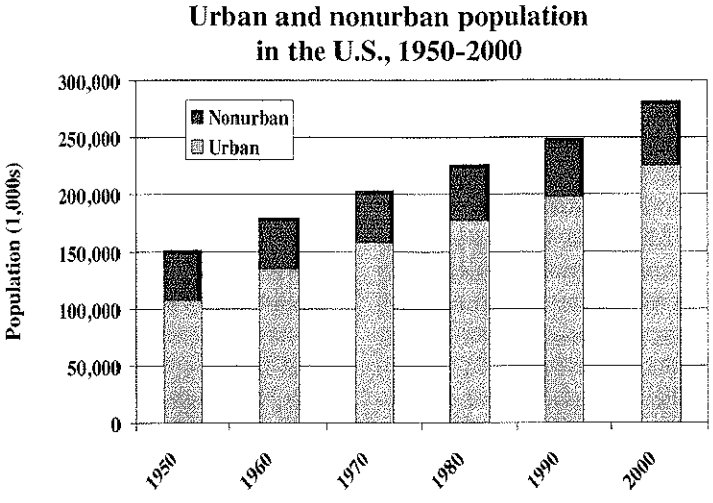

Fig. 4. US population by urban and nonurban components, 1950–1998 (USDC Census Bureau, 2001).

developed area. The south has a larger total population and on average adds more developed area per additional resident.

Key determinants of such changes in developed area have been studied at different scales of inquiry, but with relatively few statistical models at the national scale in the widely available literature. Alig and Healy (1987) estimated regression relationships between urban land area and explanatory variables such as population and personal income for 1970–1980 using Census data, and for 1982 using the first NRI survey of land use. The most important determinants of built-up area were population and personal income variables. The urban proportion of the US population steadily increased from 1950 to 1998, with about 80% of the population now living in urban areas (Fig. 4). In addition to a growing US population, personal income levels on average have also increased substantially since World War II, in constant dollar terms (USDC Census Bureau, 2001). Margo (1992) reported that personal income growth contributed to US suburban growth. In some cases income growth has increased demand for larger houses and lots. Over that same historical period, area of US urban and built-up land has also steadily increased.

Studies at a regional scale include Coughlin et al.'s (1977) examination of urbanized land area for 41 counties in the eastern US in 1970 as related to population density and housing density. Vesterby and Heimlich (1991) also examined a subset of US counties, focusing on those counties that grew by at least 25,000 persons and 25% between 1970 and 1980. Land consumption rates were compared to an earlier study of fast-growth counties, showing that there was little change in marginal rates of urban land consumption between 1960 and the early-1980s. The rate of population growth for larger cities increased on average in the 1990s compared to the 1980s. For cities with 1990 populations above 100,000, the median population growth rate in the 1990s was 9%, more than double the median growth rate of the 1980s (Glaeser and Shapiro, 2001).

Changes in regional urban land areas have also been analyzed when developing regional land use projection models in support of the USDA Forest Service's (2001) Resources Planning Act Assessments. For example, in an early study, Alig (1986) estimated econometric models of six major land uses in the southeast US for 1949–1984, which contained urban population and personal income as key determinants in explaining the proportion of land devoted to urban and related uses. Follow-up studies were conducted for the south central US (Ahn et al., 2002), Pacific Northwest (Kline and Alig, 2001), Lake States (Mauldin et al., 1999) and Maine (Plantinga et al., 1999). Consistent key determinants for the urban area component in these studies are generally population measures and personal income.

Examination of past trends and associated studies point to several core facts to guide our statistical investigation of key determinants of the more than doubling of US developed area since 1950. First, post-World War II increases in developed area were associated with relatively large increases in population and personal income. From 1950 to 2000, the US population increased by 86%, from 151 to 281 million people. Average family income (in constant dollars) increased by more than 150% during this historical period, giving individuals more income to spend. US per capita disposable income in 1998 was US$ 22,353, which represents more than a 10% increase, in real terms, during the 1990s, when we observed acceleration in the rate of expansion of developed area. Regionally, during the past 40 years the largest population growth in the US has been in the south, although western regions have had a higher percentage increase in population. One factor in population growth for both regions has been the climate, as warm, dry places grew since World War II (Glaeser and Shapiro, 2001).

3. Modeling urban land

Land rent maximization is the theoretical basis for several decades of econometric modeling to support development of projection models of land use changes. Barlowe (1978) defines land rent as residual economic surplus, or the total revenue less the total cost. The initial formulation of the concept of land rent is attributable to Ricardo in the 19th century. Ricardo indicated that land rent is a function of soil fertility or climate. Later von Thunen extended Ricardo's theory by adding location and transportation costs components to the model (Barlowe, 1978). Modern land use theory has been built on the earlier contributions of Ricardo and von Thunen, and can be summarized as follows: given a fixed land base, relative land rents are the key determinants of the allocation of land among competing uses. A landowner is assumed to choose to develop land when the present value of the future stream of net returns generated by land in a developed use rises above the present value representing a rural land use or alternative rural land uses, with all other factors or things remaining the same. For example, increased population growth would increase demands for land in residential, commercial, and industrial uses, and thereby increase the value of land in a developed use relative to rural land uses.

In testing the land rent theory in the case of urban and other built-up land, economic and demographic variables are used as proxies for rents from built-up land. Our basic approach in this study is to estimate the relation between the area of land in urban and other built-up uses and the economic and demographic factors influencing such land use decisions. We examined factors related to urbanization and development using regression models describing the proportion of land in urban and built-up uses throughout the US. Given projections of the land use determinants, the fitted models are used in a subsequent section to generate projections of urban and built-up land to 2025.

Developed area data for analysis come from the four NRI data sets from 1982 to 1997 described previously (USDA Natural Resources Conservation Service, 2001). Other data are from the USDC Census Bureau (2001) and US Bureau of Economic Analysis, among other sources. We use county-level developed land areas from the NRI inventories covering the 48 contiguous states to compute the proportion of land in developed uses present within each county at each NRI inventory year. The dependent variable used in our regression analysis is a logit transformation of the county-level proportion of land in developed uses, computed as

$$\text{logit}(\text{Developed}_m) = \ln\left[\frac{P(\text{Developed}_m)}{1 - P(\text{Developed}_m)}\right]$$

where "ln" is the natural logarithm and $P(\text{Developed}_m)$ is the proportion of land in developed uses in each county m computed using NRI data. The logit transformation was used as a dependent variable in the regression equation, where x is a set of independent explanatory variables describing factors in each county m hypothesized to affect the urbanization or development of land, and β is a set of estimated regression coefficients:

$$\text{logit}(\text{Developed}_m) = \beta x_m$$

Actual explanatory variables tested in the regression model included population density to account for the

impact that population growth has on the expansion of urban areas. We included per capita incomes to account for the likelihood that urban land is a superior good, so that per capita land consumption rises with real personal income. Even with constant tastes and preferences, a larger population base with higher income levels will add up to greater consumption and demands for developed space.

Agricultural income is included to test the hypothesis that urban land consumption is inversely related to opportunity costs of foregone agricultural production. Urban fringe residents in areas of high value agricultural production would tend to economize on land by adopting more compact settlement patterns or smaller lots.

A variable describing existing metropolitan areas defined by the US Census Bureau is included to account for the likelihood that existing urban areas likely attract new development. Metropolitan counties satisfy at least one of three criteria: (1) contain a city or town with a population of 50,000 or more; (2) are Census Bureau defined urbanized areas with a county population of 100,000 or more; or (3) are counties with close economic and social ties to other metropolitan counties. For the whole US, more than one-quarter of counties are currently classified as metropolitan. That compares with less than one-tenth 50 years ago (USDC Census Bureau, 2001).

We also tested a spatial lag variable (*SPATIAL LAG*) computed as the weighted average proportion of land in urban uses in surrounding adjacent counties. In particular, the spatial lag accounts for potential spatial autocorrelation that can arise from our use of spatial land use data. Spatial autocorrelation can result from omitted spatial variables that influence county or region-wide land use changes, such as topography, and spatial behavioral relationships, such as county, state, or regional land use policies (Nelson and Hellerstein, 1997). Inclusion of the spatial lag variable in preliminary tests resulted in a statistically significant positive coefficient. However, the spatial lag variable also was found to be highly correlated with the population density, income, and metropolitan area variables included in the model, based on Pearson correlation coefficients. For this reason, the spatial lag variable was omitted from final models so that information could be obtained regarding those other variables. As a result, potential spatial autocorrelation in the estimated models remains untreated, which is consistent with most existing published area-base type land use models (Plantinga et al., 1999).

We also tested household size as an explanatory variable. Household size has been decreasing over time, but it did not appear as a variable in the final model. An aging population has the effect of decreasing family size and increasing the number of homes per person. In the past, each additional household consumed about 0.4 ha of land. The average number of persons per US household has been falling, from 3.14 persons per household in 1970 to 2.63 in 1990 (USDC Census Bureau, 2001). However, cross-sectional variation appears to have overwhelmed changes across time in our data series and the variable was dropped from consideration in the model.

One other research question is whether significant regional variations exist regarding the consumption of land for developed uses. We tested regional dummy variables to account for regional differences in urbanization rates, using the south as the reference region. The regression equation estimated is

$$\begin{aligned}
&\text{Logit(Developed)}\\
&\quad = \beta_0 + \beta_1(\text{POPULATION DENSITY})\\
&\qquad + \beta_2(\text{PER CAPITA INCOME})\\
&\qquad + \beta_3(\text{AGRIC. PRODUCTS VALUE})\\
&\qquad + \beta_4(\text{METROPOLITAN}) + \beta_5(\text{NORTHEAST})\\
&\qquad + \beta_6(\text{NORTHERN MIDWEST})\\
&\qquad + \beta_7(\text{SOUTHERN MIDWEST})\\
&\qquad + \beta_8(\text{GREAT PLAINS}) + \beta_9(\text{SOUTHWEST})\\
&\qquad + \beta_{10}(\text{PACIFIC NORTHWEST})\\
&\qquad + \beta_{11}(\text{CALIFORNIA}).
\end{aligned}$$

Specific explanatory variables are described in Table 1, where β_0 is an intercept term, and the β_1 though β_{11} are regression coefficients to be estimated. Two versions of the regression equation were estimated. The first version is based on ordinary least squares, while the second uses generalized least squares to estimate a random effects model (Greene, 1998) that accounts for potential cross-correlation among multiple time-series observations of developed land within individual counties.

4. Results

4.1. Regression results

The main findings are consistent with hypothesized relationships. Results of the regression models are presented in Table 2. The ordinary least squares regression model is highly significant, with an adjusted $R^2 = 0.60$ ($F = 1.614$, d.f. $= 11$, $P < 0.001$). The generalized least squares model also had an adjusted $R^2 = 0.60$, but is found to be superior based on a Lagrange Multiplier test (LM $= 16.223$, d.f. $= 1$, $P < 0.001$). All estimated coefficients generally are found to be statistically significant at a high level of confidence ($P < 0.0001$) and with the expected signs.

The estimated coefficient for the *POPULATION DENSITY* variable suggests that population density has a positive impact on the proportion of land in urban uses. The variable *PER CAPITA INCOME* is also positive and consistent with increased consumption of land for urban uses as personal incomes rise. The variable *METROPOLITAN* is positive and suggests increased expansion of urban land uses in areas located within metropolitan areas as defined by the US Census Bureau.

The other income-related variable, *AGRICULTURAL PRODUCTS VALUE*, has a negative coefficient in the ordinary least squares model, but is positive in the generalized least squares model. A negative coefficient likely would reflect the equilibrating tendencies in land markets, where higher values for agricultural production would tend to reduce the consumption of land for nonagricultural uses. However, a positive coefficient may reflect the tendency for high value agricultural land in many parts of the US to be located in relatively close proximity to existing urban areas. In fact, we did find that *POPULATION DENSITY* and *AGRICULTURAL PRODUCTS VALUE* were relatively highly correlated, based on a Pearson's correlation coefficient of $r = 0.74$. This is consistent with the hypothesis that high per hectare agricultural values are found in more urban settings.

The statistical significance of the regional dummy variables suggests that regional differences exist in the consumption of land for developed uses. The negative coefficients for all regional dummy variables are consistent with historically higher rates of land consumption per additional person in the south, which is the reference region in the regression models.

4.2. Projections of developed area

We used the estimated regression model coefficients to project developed land area to 2025 for the US. Projected estimates of developed area can then be factored into the many long-range projections of future supply and demand for agricultural crops, animal products, forest products, recreation land, wildlife habitat, water use, and other landscape and environmental measures (see for example, USDA Forest Service, 2001). An

Table 2
Estimated coefficients of the urbanization models

Variable	Ordinary least squares		Generalized least squares	
	Estimated coefficient	t-statistic	Estimated coefficient	t-statistic
Intercept	−3.787	−141.19	−3.621	−160.02
POPULATION DENSITY	0.563	18.94	1.738	79.86
PER CAPITA INCOME	0.055	35.83	0.043	349.75
METROPOLITAN	0.681	45.82	0.538	19.94
AGRICULTURAL PRODUCTS	−0.020	−9.33	0.005	25.63
NORTHEAST	0.004	0.06	−0.198	−4.26
NORTHERN MIDWEST	−0.200	−12.42	0.185	−5.89
SOUTHERN MIDWEST	−0.637	−37.41	−0.606	−18.00
GREAT PLAINS	−1.332	−61.35	−1.285	−30.10
SOUTHWEST	−1.646	−58.74	−1.595	−29.24
PACIFIC NORTHWEST	−1.272	−41.26	−1.268	−20.24
CALIFORNIA	−0.991	−22.91	−1.205	−14.19
Model statistics	Adjusted $R^2 = 0.60$, $F = 1.614$ (d.f. $= 11$, $P < 0.001$), $N = 11967$		Adjusted $R^2 = 0.60$, LM $= 16223$ (d.f. $= 1$, $P < 0.001$), $N = 11967$	

abundance of land is seen by some as one hallmark of the US, and projections of developed area can aid decision-making as a forward-looking process in addressing whether adequate rural land will be available to support valued environmental goods and services in the future.

Our projections of developed area involved computing projected future proportions of developed land within counties, based on projected values of population density and other explanatory variables. The proportions were then multiplied by each county's respective land area to estimate the total area of urban land through 2025.

Population density projections are based on county-level projected population growth through 2025 (NPA Data Services, 2001). Projected increases in population through 2025 are 13% in the northeast, 49% in the south, 20% in the northern Midwest, 45% in the southern Midwest, 25% in the Great Plains, 80% in the southwest, 54% in the northwest, and 44% in California. Projected increases in per capita income (in constant dollars) within individual counties average 72% nationwide.

The NRI-defined area of developed land is projected to increase from 39.5 million ha in 1997 to 70.5 million ha in 2025 (Table 3). Projected developed land areas suggest significant urban expansion over the next quarter century, with the magnitude of increase varying by region. By region, developed land areas are projected to increase by 73% in the northeast, 75% in the south, 80% in the northern Midwest, 81% in the southern Midwest, 71% in the Great Plains, 86% in the southwest, 82% in the northwest, and 98% in California, for a nationwide increase of 79%. The south is projected to continue to have the most developed area, reaching nearly 19 million ha by 2025.

The percentage of the total US surface area in the 48 contiguous states occupied by developed or built-up uses is projected to increase from 5.2% in 1997 to 9.2% by 2025. The projected developed and built-up area of 70.5 million ha in 2025 represents an area equal to 38% of the current US cropland base, or 23% of the current US forestland base (Smith et al., 2001).

We also performed sensitivity analyses by altering projected trends in population density and personal income growth (Table 3). Assumptions about the future are a major influence on projections and we can gain some insights on the relative importance of different assumptions or study limitations by altering key assumptions and assessing the effect on projections. To help guide the sensitivity analyses, we assessed the relative influence of explanatory variables in our model. We computed elasticities that represented the estimated change in the proportion of developed land given a ten percent change in each explanatory variable. Three elasticities for nondummy variables computed at the mean are: population density, 0.0004; per capita income, 0.0036; and agricultural products, 0.0000. For example, at the means, a 10% increase in personal income in the model would increase the

Table 3
Actual and projected hectares[a] (1000s) of developed land in 2025, by region

Region	1997[b]	2025[c]	Low[d] 2025	High[e] 2025
Northeast	5900	10197	7817	13026
South	10696	18688	14248	24049
Northern Midwest	8669	15619	11692	20584
Southern Midwest	6259	11323	8448	14997
Great Plains	1956	3353	2560	4395
Southwest	2161	4019	2942	5598
Pacific Northwest	1636	2976	2207	3998
California	2208	4366	3133	5946
US total	39485	70541	53047	92494
Percentage of continental US area developed	5.2	9.2	6.9	12.1

[a] Projected using coefficients from generalized least squares model (Table 2).
[b] Developed area for continental US (USDA Natural Resources Conservation Service, 2001).
[c] Based on population and per capita income growth projected by NPA Data Services (2001).
[d] Based on 50% less population and per capita income growth projected by NPA Data Services (2001).
[e] Based on 50% more population and per capita income growth projected by NPA Data Services (2001).

predicted proportion of developed land from 0.0456 to 0.0492. The elasticities suggest that population density and per capita income have the larger relative influences, although note that a single point estimate should be viewed cautiously because of the nonlinear nature of the logistic function. That is, the elasticity will vary, depending where on the function the values are computed.

In our sensitivity analysis, if population density and personal incomes grow 50% less than projected, the percentage of the total US surface area in the 48 contiguous states occupied by developed or built-up uses is projected to increase to 6.9% (rather than the base 9.2%) by 2025. If population and personal incomes grow 50% more than projected, the percentage of the total US surface area in the 48 contiguous states occupied by developed or built-up uses is projected to increase to 12.1%.

5. Discussion

Regression results are consistent with hypothesized relationships between developed area and socioeconomic factors driving the development of land. The results also are largely consistent with findings in earlier studies. In particular, positive coefficients for the population density and personal income variables in a national scale study are consistent with findings by Alig and Healy (1987). Based on the regression model developed using 1982–1997 NRI data, the positive coefficients for population density and personal income result in a projected increase of 79% in US developed area by 2025. Projected development rates vary by region, with a range of 71–98% and with the south continuing to have the most developed area.

Land values for developed uses typically exceed those for rural uses by a substantial amount and while agricultural values are usually second to developed uses in potential value, they are often influenced by development potential. Our negative coefficient in the ordinary least squares model for the variable representing agricultural products value is consistent with Brueckner and Fansler's (1983) findings that agricultural rent had a negative impact on urban land consumption in 40 urbanized areas. However, the positive coefficient in the generalized least squares model suggests that the agricultural products values variable could be correlated with other topographic and geographic factors also influencing developed land area. Limitations in data with which to describe agricultural land rents have led some investigators to suggest that, generally speaking, developed uses are so dominant over agricultural uses in land markets that agricultural income has no measurable influence on consumption of land for developed uses. Ideally, the agricultural land rent-related variables should represent net agricultural profits or land rents per hectare, but data with which to construct such variables are not available across all counties in the US.

The role of agricultural income in such a model is complicated as well by the fact that many agricultural producers have benefited financially through land markets from the encroachment of urban growth. The market price of land can be decomposed into different sources of value, such as its current use in agricultural production and its expected use in alternative enterprises. In many areas adjacent to urban centers, the influence from the expectation of urban development on the value of the land is greater than its actual, current use in farm or forestry production. For example, more than 15% of US farmland is considered to have urban development significantly influence its market value. For those urban-influenced hectares, urban development pressures account for two-thirds of their market value (Barnard, 2000). For many landowners, this urbanizing influence can materially increase their net worth, and allow them to borrow more and perhaps expand their agricultural operations, or to sell their land and realize capital gains.

Some producers view urban sprawl as a business opportunity, providing an adjacent market that allows them to stay in farm production. They can shift their commodity mix to satisfy the nearby market demand for perishable fruits and vegetables, as well as other fresh commodities. Other producers have adjusted by catering to the demand by local residents for farm visits. In 2000, 28% of respondents indicated that a motivation for their sightseeing trip was to visit a farm or agricultural setting (calculations based on USDA Forest Service, 2000–2002). These include visits to purchase farm products or visits to learn about farming and enjoy the view on the farm. Pumpkin patches and U-pick operations are common in many urban areas.

In addition, adjacent urban development can mean that farm operator household members have off-farm

job opportunities. The average US farm household earns more income off the farm than on the farm (Ahearn et al., 1993). Off-farm opportunities in nearby urban areas have been a key to the survivability of many US farms.

The statistically significant negative dummy variable coefficients for all regions relative to the south reference case are consistent with the findings by Alig and Healy (1987) regarding the south. The present study examined changes using four NRI data measurement points, while the Alig and Healy (1987) study analyzed data from the 1982 NRI. Since the 1982 NRI, the south has continued the trend of having more built-up land per capita than the US average. The south had the largest percent change in developed area among regions from 1992 to 1997 (USDA Natural Resources Conservation Service, 2001).

The increase in developed area for the south was close to 20%, almost four times as large as for the Great Plains, the region with the smallest percent change. The Great Plains' lower rate of consumption of land for developed uses is related to relative population changes. With respect to landscape planning, falling populations in some Great Plains counties has led to proposals to create in such places a "Buffalo Commons" or large ecological or wildlife refugees (Popper and Popper, 1994).

Several factors contribute to expansion of developed area in the south: (1) above average population growth in part due to climatic factors, including attraction of immigrants (Glaeser and Shapiro, 2001); (2) above average marginal consumption rates of land per additional resident (USDA Natural Resources Conservation Service, 2001); and (3) income growth. Expansion of developed area and urban sprawl in the south has been described as a major issue for future natural resource management, especially for the region's forests (Seelye, 2001; Wear and Greis, 2002).

The south is a region where land is often suitable for multiple land uses, given relatively gentle topography and ease of access. When examining land use dynamics, the many different pathways by which land use can change warrant examining both net and gross area changes for major land uses. For example, the flow between forestland and urban and developed uses is primarily a one-way flow toward urban and developed uses, although some land classified as urban and developed (e.g., corridors for electrical lines) may infrequently shift into forest or agriculture. Movement of land between forestry and agriculture in the last two decades has resulted in net gains to forestry that have offset forest conversion to urban and developed uses in *area* terms. However, forest conditions of hectares entering and exiting the forestland base are likely to have been quite different; entering hectares may be bare ground or have young trees, while exiting hectares often contain large trees before conversion to developed uses.

Concern about the attributes of exiting or entering forested hectares was heightened in the 1990s when the rate of development increased, with 0.4 million ha of forests converted to developed uses per year. Over the entire land base, the total or gross area shifts involving forests are relatively large compared to net estimates. Increased rate of development may mean more indirect pressure for conversion of forests, where forests are converted to replace agricultural land that has been developed. When all conversions of land into and out of forest are included, the net area of nonfederal forests increased by about 1.6 million ha in the contiguous 48 states between 1982 and 1997, according to NRI estimates. However, gross area changes involving forests totaled about 20 million ha between 1982 and 1997, an order of magnitude greater than the amount of net changes.

We performed sensitivity analyses involving major assumptions underlying our projections—future growth in population density and personal income—to address uncertainty because we are dealing with an open system and with the unknowable future. Complexities include using relationships derived from past trends to project future patterns in conjunction with using assumed future values for key explanatory variables. Projections can help to narrow the range of possible futures that decision makers need to focus on, but regardless of the sophistication of the underlying models, the possibility of unpredictable events remains. Efforts to reduce uncertainty can reveal previously undisclosed complexities, and availability of additional data and research may warrant periodic redoing of certain long-term projections. This study updated the Alig and Healy (1987) study, which had access to only one cross section of NRI land use data available in the mid-1980s. The earlier external demographic and macroeconomic projections also underestimated what actually transpired and did not

anticipate above-average US economic growth in the 1990s, accompanied by an accelerated rate of development over a broad geography.

With respect to broad-scale geography, our projections of developed area indicate that most of the US will remain undeveloped. However, undeveloped land may be scarce in certain areas, including where urban sprawl is a concern. Development is often concentrated close to interstate highways and in coastal areas, where more than half of the US population resides (USDC National Oceanic and Atmospheric Administration, 1999). Coastal counties are among the most heavily developed areas in the nation, with the coastal areas of California as examples in that state. The significance of the METROPOLITAN variable in our model suggests that new development is likely to occur close to older development. As population grows, and as coastal areas accommodate ever-increasing residential, commercial, and industrial uses, land and water resources are expected to diminish in both quality and quantity (USDC National Oceanic and Atmospheric Administration, 1999). With respect to temporal changes, our projections are intended as long term, which may mask shorter-term fluctuations in underlying population changes and settlement patterns. A historical example of such shorter-term shifts is that the decadal pattern of nonmetropolitan population rebound in the early-1990s was followed by slower growth in the second half of the decade. The nonmetropolitan US as a whole had net in-movement of people from metropolitan areas and a significant population rebound, in contrast with the 1980s (USDA Economic Research Service, 2002).

The relationship between population and developed area involves components that may be of interest to policy makers. First, developed area per person increased between the 1982 and 1997 NRI surveys. This suggests that the country is not economizing on its use of land for living and playing. This has raised concerns about urban sprawl, further bolstered by the acceleration in development in the 1990s. Second, our use of aggregate numbers masks large variation across space. For example, developed land as a percentage of a state's land base has a wide range, from less than one percent in states such as Wyoming, to more than 25% for New Jersey. Thus, our study was designed to provide broad-scale indicators of developed land, and possible variation across more local areas, such as states or counties, should be borne in mind.

6. Conclusions

Our regression results are consistent with hypothesized relationships, and population density and personal income levels are the primary determinants of developed area in the US. Developed land in 1997 represented about 5.2% of the land base in the contiguous 48 states, and this is projected to almost double by 2025 based on our regression model. Projected development rates vary by region, with the largest projected increase in the south.

Further increases in developed area will have significant implications for landscape and urban planning. Entire conferences or symposia (e.g., American Farmland Trust, 1999; DeCoster and Sampson, 2000) have been devoted to exploring the range of impacts of land development. The land use and environment linkage affects many goods and services and selected aspects are covered in periodic national resource assessments (e.g., USDA Forest Service, 2001), regional resource assessments (e.g., Kline et al., 2001), and other studies (e.g., Kahn, 2000).

Such human–environment impacts will include direct and indirect effects, and can also vary across space and time. Direct impacts include conversion of the rural land base for forestry and agriculture, likely leading to a smaller overall rural land base in the future. For example, US forest area is projected to be about three percent smaller by 2050, primarily due to conversions to urban and developed uses (Alig et al., 2002). This translates into less wildlife habitat and outdoor recreation area.

Indirect effects include forests and agricultural lands that can be physically fragmented. Fragmentation can affect natural resources in a variety of ways, with adverse impacts often cited, such as fragmentation of green space or wildlife habitat for certain species. If fragmentation rates increase faster than population growth, this can have a "bow wave effect" (DeCoster, 2000), which extends far in front of expanding development. It can lead to higher land prices, social and regulatory pressures that affect rural land uses, and changes in incentives to manage rural land.

Fragmentation of ownerships into several smaller ownerships is referred to as parcelization. This phenomenon can also have profound impacts on the economics of farming or forestry, even when land is not physically altered in any major way (Healy and Short, 1981; see also Gobster and Rickenbach, this issue). Trends over time in fragmentation and parcelization warrant further study, along with monitoring of changes in population density for different classes of rural and urban land (Alig, 2000). More people on the landscape include those in rural areas with attractive recreational land and aesthetic amenities, often involving forests. Such demographic changes increase the size of the wildland–urban interface, whose expansion has exacerbated wildfire threats to structures and people. Overall, on average, the US had about 30 people/km^2 of land in 1999 (USDC Census Bureau, 2001). This compares to about 2 people/km^2 in 1790. Although the US has had a large increase in population density, the US had a lower population density than the world average of 40 persons/km^2 in 1999 (United Nations, 2002). However, population density continues to vary notably within the US, warranting monitoring of trends in suburbanization and regional migration (e.g., from the northern "Rust Belt" to the southern "Sun Belt").

Continued spread of built-up uses over the rural landscape has other important indirect impacts. Cumulative effects of expanding developed land may include loss of farmland and forestland to a degree that availability of working farms and forests or green space may become an issue (Kline and Wichelns, 1996). Expectations of neighboring landowners about the future use of their land may also be influenced, generally reflected in higher asking prices. Property taxes may also rise, reflecting the new, higher land values. Composition of land ownership may also change, with an increasing proportion of landowners being primarily nonfarmers, although the land may still be used for farming, often on a rental basis.

Although in the face of encroaching urbanization some individual agricultural producers may be better off when they sell their land to developers, the checkerboard pattern of developed land and farm and forest production can have a variety of negative impacts on producers who choose to stay (Alig and Ahearn, 2003; Alig et al., 2003). Impacts include complaints by new residents about the noise and pollution associated with farm and forestry production, loss of local farm infrastructure such as input suppliers, and the difficulty in expanding for those producers who would like to purchase nearby parcels of land. For those who want to stay in agriculture or forest production, low profit margins do not allow producers to compete with developers for additional land as land prices are bid up by residential and other types of development encroachment. All of these impacts can easily translate into higher production costs.

Social consequences of landscape changes can affect both rural and urban interests. For urban planning, implications of growth in urban populations and developed area can include increased traffic congestion, conversion of open space, increased commuting times, residential energy consumption (e.g., Kahn, 2000), and concerns about changes in quality of life. Changes in quality of life may improve in some cases with increased housing opportunities. Those involved in landscape and urban planning will also recognize that significant expansion of developed land is often an inadvertent byproduct of policies that were designed for other purposes. Related future research could investigate how natural amenities, such as climate (e.g., Kahn, 2000), topography, and presence of bodies of water correlate with changes in settlement patterns and nonmetropolitan population. An increasing population of retirees has augmented out-migration from central cities and suburbs to rural areas that offer aesthetic amenities. In such cases, natural amenities may be more important determinants of development than nearness to metropolitan centers or type of local economy (McGranahan, 1999; see also Hammer et al., this issue).

Future research needs also include further investigation of the potential impacts of greater numbers of people occupying the US landscape and the resulting impacts on quality of life as well as on goods and services from terrestrial and aquatic ecosystems. Population increases can lead to more fragmentation and parcelization of terrestrial ecosystems. An example of related research is examining the relationship between timber management activities of forest owners and density of development (Kline et al., 2004). Integrating urbanization into landscape-level ecological assessments is receiving increased attention (Kline et al., 2001).

Additional data collection and data enhancements permitted us to expand our investigation at a broad scale of developed area trends compared to an earlier study (Alig and Healy, 1987). Since the earlier study, availability of geo-referenced data sets has expanded. Future advances in land use analyses will likely also rest in part on continued improvement of spatial databases, including spatial socio-economic data, as well as improvements in spatial econometric methods to support empirical data analyses. One current shortcoming is the quality and spatial scale of available data. Trade-offs must be considered when assessing the costs and benefits associated with spatial detail in landscape and urban planning. Along with improved data bases, monitoring of developed area trends, associated investment in infrastructure (e.g., transportation networks and nodes), and related socio-economic factors will be important in facilitating updated projections of developed area in the US.

Knowledge of the drivers behind land use change is useful for informing policy discussions concerning society and the environment. One important characteristic of policy formation is that it is concerned with the future. Policy makers must anticipate future conditions and estimate the effects that proposed policies are likely to produce. Value in charting the future includes providing ideas to policy makers of the future allocation of the US land base between urban and rural uses. Given the expected US population increase and changes in economic activity, a key question is how can society make positive progress toward sustainability in the face of needing more developed land to serve more people in the future. Progress toward such goals may rest on progress in a search for a more integrated approach for describing the complex interplay between human activity and the environment. To help evaluate progress, we need a useful definition of sustainability along with measurable indicators that fundamentally reflect the long-term ecological, economic, and social well being as it relates to alternative uses of land.

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Out in the country: sprawl and the quest for nature nearby

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Abstract

Residential development at the rural fringe, although contributing to many environmental problems, is steadily attracting new homeowners. Among the appeals of living "out in the country" are being closer to "nature" and having "space." The purpose of this study is to examine what these concepts mean to individuals who decide to live in new commuter-based subdivisions. Study participants ($N = 231$), drawn from 18 residential communities in the same rural township, responded to a mailed survey that included 24 photographs of natural areas in communities such as theirs. In addition to having the scenes rated in terms of their similarity to the participants' own setting, the survey included other approaches to assessing the perception of the nearby natural setting. Responses to one of these, an open-ended question about describing their neighborhood to a friend, showed a strong preponderance of nature-related descriptions (33% of all items mentioned). Based on the other questions, a typology of seven distinct kinds of natural areas emerged: manicured/landscaped areas, trees, gardens, mowed areas, forest, open fields, and wetlands. Using these seven nature categories to predict participants' ratings of community satisfaction, regression analyses showed the overwhelming role played by the availability of forests. The forested scenes were also by far the most preferred. Yet forests are particularly vulnerable as new developments replace existing woodlands. The study thus points to the importance of finding ways to preserve the forested land, for environmental reasons as well as for the satisfactions derived from them by residents, neighbors, and visitors. Such protection of forests, as well as wetlands and open meadows, is more likely if these areas are seen by residents as being integral, communally owned parts of the overall development.
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1. Introduction

Where once there was forest the land was cleared. Roads were built. Big houses went up. Sod was laid down on bare soil. People moved in. For these new residents this became their dream home "out in the country."

The flight to the country is not a recent phenomenon. In recent decades, however, the dilemmas caused by the massive transformation of the landscape have received increasing recognition internationally. Sprawl has become a problem of national proportion in the United States. Among its characteristics are: low-density developments, reliance on automobiles, lack of centralized planning, and segregated land uses and land covers (Brown, 2001). Despite all the negative ramifications, the leap-frogging continues. More big houses on big lots appear in yet

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another area that had recently been a field, farm, or forest.

People who move to these new locations likely do not cherish the longer commutes and dependence on their cars. Among the tradeoffs that make living "out in the country" an attraction are being closer to "nature" and having "space." The purpose of this study is to examine what these concepts mean to individuals who decide to live in new commuter-based subdivisions at the urban fringe. While these homeowners live in an area that is still relatively rural, their subdivisions are emblematic of suburban sprawl with relatively large lots and substantial lawns.

There is a sizable literature that documents the desire for and benefits of having access to nearby natural areas (e.g., Schroeder, 1988; Kaplan and Kaplan, 1989; Frumkin, 2001). There is also indication that knowledge of the availability of nature plays an important role whether or not residents actively engage with it (Kaplan, 1984a) and that having natural elements in the view from the window is a source of psychological benefits (Kaplan, 2001).

There are many ways to satisfy these desires and benefits from the nearby natural environment. Residential developments at the urban fringe, however, all too often meet these desires at great environmental cost (Benfield et al., 1999). Existing forestland is removed to make room for homes; habitat for wildlife is destroyed; impervious surfaces are increased; and the chemicals used to maintain vast lawns are unhealthy for entire watersheds. It is thus important to examine whether the desire for space and for living close to nature can be satisfied in ways that are more environmentally sustainable. This study explores a variety of natural settings available to the homeowners and their satisfactions with the patterns of nature available to them. Such information can help determine if there are ways of structuring developments in natural areas so that they simultaneously provide satisfaction for homeowners and protection for the environment.

2. Methods

2.1. Study site and participants

The study was conducted in southeastern Michigan in Hamburg Township, an area that was formerly a summer resort community. Its 30 lakes and 10 miles (16 km) of river are still a major attraction, as is its proximity to major transportation routes and reasonable commute to Detroit (Stanford, 1999). Hamburg Township is one of the fastest growing townships in Michigan's fastest growing county, Livingston (Livingston County Data Book, 2000).

In the early 1990s Hamburg Township enacted an incentive-based open space ordinance to preserve natural areas in residential developments. Built along the lines of Arendt's (1996, 1999) open space conservation approach, this ordinance allows developers to site homes on smaller lots than normally required if they preserve specified amounts of the natural, yet buildable, land as open space. (For example, in an area normally zoned for 1 acre (0.40 ha), lots in a conservation subdivision are permitted to be one-third smaller.) These reserved open spaces, including trails and pathways and recreational sites, are owned communally by the residents of the development. (Further details of Hamburg Township's approach are available in Open Space Planning (Livingston County, 1996).)

The study included residents of eleven such open space communities as well as seven traditional communities. (Findings related to comparisons of the two community types are presented in Kaplan et al. (in press)). All housing communities were built since 1990 and were at least 90% completed by the time of the survey (fall 2000). Table 1 shows the distribution of the communities included in the study in terms of median home value and the number of homes in each community.

Surveys were mailed to all residents in the selected communities using contact information provided by the township. We could not ascertain whether the names provided included homes that were not occupied or even lots that were not yet built upon. Furthermore, with bulk mailing, misaddressed material is

Table 1
Median home value and community size of residential communities selected for study

Number of homes	Median home value (US$)	
	≤250000	>250000
16–25	5	1
30–50	2	6
55–70	3	1

not returned to the sender. Calculation of a return rate is, therefore, at the conservative extreme since it is based on number of surveys that were mailed, rather than the number known to have been received. Of the 648 surveys mailed, 231 were returned (36%). The analyses reported here are based on 96 returns from traditional and 135 from open space communities.

2.2. Survey and photo-questionnaire

The cover letter indicated our interest in the township's concern for managing growth and sought the resident's input about this as well as about their feelings related to the natural areas in and around their neighborhoods.

Residents' perceptions of the physical characteristics of their community were assessed using a variety of approaches. An open-ended question asked: "If you would describe your residential neighborhood to a friend, what 4 or 5 things would you want to be sure to mention?" Participants were also asked to indicate how well six natural features (e.g., "trees, but not forest," "woods, forest," "open field/meadow") characterize their residential neighborhood and 10 natural features (e.g., "large mowed area," "garden/flowers," "wetland/marsh") describe the view from their house; these items used a five-point rating scale with 1 for not at all and 5 for very well. (Five additional "view" items focused on aspects of the built environment and are not included in the analyses here.)

Included with the survey was a separate three-page booklet containing eight black and white photographs on each page. The scenes, all taken in residential communities in Hamburg Township, included woods, woods with trails, open fields and meadows, waterways and wetlands, and residential settings. Participants were asked to rate each of these 24 scenes in terms of their similarity to what they see from their home. The five-point rating scale was anchored at 1 for "I never or rarely see this sort of setting" to 5 for "very often—it's like the view from my home." They were also asked to rate the scenes to indicate how much they would like to have such a view (1 for not at all and 5 for very much).

The survey also included 16 items related to neighborhood satisfaction (e.g., sense of community, how your neighborhood looks), which were rated using a five-point scale (1 for not at all and 5 for very much). A question regarding tradeoffs among choices buyers need to make in selecting a home included eight items (e.g., large house, not seeing neighbors' houses) to be allocated so they are equally distributed into four levels of importance (least, somewhat, important, and most).

2.3. Data analysis

For the photograph-based ratings of similarity as well as survey questions consisting of multiple items, we used principal component factor analysis with varimax rotation to generate meaningful themes. In these analyses the criterion of a minimum loading of 0.45 on no more than a single factor was used. Additional criteria were eigenvalues greater than 1.00 and alpha coefficients greater than 0.70.

3. Results

3.1. How would you describe your neighborhood to a friend?

The 949 responses to the open-ended question about describing the neighborhood to a friend represent an average of just over four responses per participant. A coding manual was developed based on these responses with inter-rater reliability between the two researchers of $r = 0.98$. The eight categories are listed in Table 2, both in terms of their occurrence in the participants' responses and their position as first to be mentioned.

Nature/open space was by far the most frequently used category relating to respondents' comments

Table 2
Participant-based description of residential community

Category	Total times mentioned (%)	Mentioned as first item (%)
Nature/open space	33	30
Neighborhood characteristics	18	8
Peace of mind	14	21
Sense of community	12	7
Lot size/space issues	11	17
Neighborhood size/density	5	11
Location/local features	5	5
Rural aspects	2	1

about their neighborhood. These characteristics were also the most likely to be mentioned first in the participants' listing. Included under this heading are mentions of landscape or topographical features (e.g., river or rolling hills), habitat and vegetation (e.g., forest, woodland area, trees, wildflowers), wildlife, views, and more general terms such as "nature," "natural," and "open space."

The neighborhood characteristics category was second highest in overall responses. Included here were mentions of "no thru traffic," cul-de-sacs and curved roads; the newness of the homes, their diversity in styles, and lack of fences. We coded neighborhood size/density comments (e.g., "small, cozy," "small # of houses") as a separate category, although these also characterize the neighborhoods. As shown in Table 2, this category received relatively few mentions.

The peace of mind category, receiving more than one-fifth of "first mentions," included such descriptors as "peaceful," "private," and "secluded." These characteristics reflect the greater sense of "space" residents seek when they move away from the crowded urban setting to a quieter place.

Sense of community was reflected in responses about "friendly, good, nice neighbors," "close neighborhood feel," and "neighborhood pride" as well as in comments about the lack of people at home, problems with dogs, and issues related to homeowner associations. This category ranked fourth in terms of frequency of mentions (12%) yet very few residents mentioned these social aspects of their neighborhood first.

We tracked responses related to the size of the lot as a separate category. We labeled the category lot size/space issues as comments reflected residents' sense of having space by virtue of the size of their own yards and the space immediately around their homes.

While items specific to location/local features of these subdivisions received relatively few mentions (5%), negative characteristics of the location such as high property taxes, too much development in the area, and increased traffic congestion provide evidence that, at least for some, not all is favorable about living in the country. Such negative aspects prompted one individual to state a desire to "move further out" in the country.

Finally, rural aspects (e.g., the presence of a barn in one neighborhood, the fact that the subdivision had been farmland previously, or simply "rural setting") were rarely included in the participants' descriptions of where they live.

3.2. What characterizes nearby nature?

In order to empirically generate a typology of the nearby natural environment based on participants' perceptions, we used a multi-step process based on the three structured questions relating to the physical environment: similarity ratings of the photographs, physical characteristics of the neighborhood, and view from home. The scale for the photographs differed from the other two questions; therefore, two separate factor analyses were conducted. Results of these analyses were then correlated to derive a set of non-overlapping categories (using a criterion of $r < 0.40$).

Factor analysis of the photo-based ratings yielded four factors, which were labeled: wetland, forest, relatively open, and manicured/landscaped. Correlations among the first three factors were between $r = 0.40$ and 0.53, while the last one correlated only with relatively open ($r = 0.47$). Factor analysis of the verbal descriptors of the physical setting yielded three factors: wetland, forest, and trees. These factors were not correlated with each other. However, correlations between the pair of wetland and the pair of forest factors (i.e., derived from the separate factor analyses) were strongly related ($r = 0.53$ and 0.63, respectively). The item about whether an "open field/meadow" is characteristic of the neighborhood correlated highly ($r = 0.60$) with the photo-based relatively open factor, but not with any of the other measures. Two items from the view from home question—"garden/flowers" and "large mowed area"—did not load on any factors or significantly correlate with any of the other measures. Table 3 lists the final set of categories. All but two of the correlations among these seven categories are below $r = 0.20$. The exceptions are correlations of $r = 0.33$ between forest and wetland and $r = 0.29$ between forest and manicured/landscaped. The relative independence among these seven categories thus suggests that they provide a meaningful differentiation of the way the nearby natural environment is perceived.

Manicured or landscaped areas, which received the highest mean rating (3.9) and ratings of "4" or "5" by 55% of the participants, are characteristic of most of these suburban developments. This category consists

Table 3
Nearby nature categories

Category and items[a]	Alpha	Eigenvalue	Mean rating[b]	Percent rating ≥4.0
Manicured/landscaped (five scenes)	0.78	3.29	3.90[c]	55
Trees[d]	0.74	1.62	3.78	62
Garden[e]	[f]		3.46	52
Mowed[g]	[f]		3.33	51
Forest[h]	0.74	1.70	3.23	39
Open[i]	[f]		3.00	39
Wetland[j]	0.75	2.57	2.73	22

[a] N: how well do these describe the natural area in your neighborhood?; V: how well do these describe the view from your home?

[b] Except as noted, rating scale: 1 for not at all and 5 for very well.

[c] Photo-based similarity ratings: 1 for never or rarely and 5 for very often.

[d] N: trees, but not forest; V: trees, but not forest.

[e] V: garden/flowers.

[f] Based on single item.

[g] V: large mowed area.

[h] N: woods, forest; V: forest.

[i] N: open field/meadow.

[j] V: wetland/marsh; N: wetland area; V: lake/pond; N: lake, pond, river; V: river/stream.

of five scenes derived from the factor analysis of the similarity ratings. Fig. 1 shows the two scenes with the highest loadings on this factor. The scene shown in Fig. 2, also loading on the manicured factor, received the highest similarity rating (4.2) of any of the photographs, suggesting that large mowed areas are very common in these neighborhoods. By contrast, responses to the survey item about having a view of a "large mowed area" received a lower mean rating (3.3), although half the sample gave the item a rating of "4" or "5." Large mowed areas are distinct, however, from the large open areas (Fig. 3). Fewer than 40% of the participants gave high ratings to the survey item about whether open fields or meadows characterize their residential neighborhood.

Fig. 2. This scene, showing large mowed area, received the highest similarity rating.

The survey questions related to having "trees, but not forest" received the strongest endorsement (62% rated the items with "4" or "5"), indicating that trees both characterize these neighborhoods and are part of the participants' view from home. Forests, by contrast, were far less likely to be components of the nearby natural environment. Only 39% of the sample rated these items as readily available.

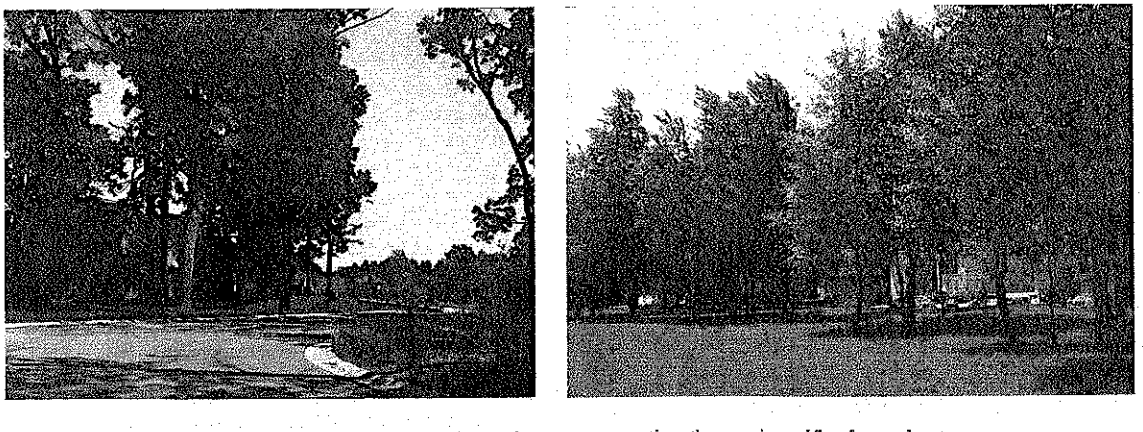

Fig. 1. Two scenes showing the landscaped areas representing the manicured/landscaped category.

Fig. 3. Two scenes from the "Relatively Open" photo-based factor.

3.3. Does what you see matter?

Table 3 shows that the different categories of nearby nature vary considerably in their availability. It does not address, however, whether these domains are related to the participants' satisfaction with their residential community. To answer this question we used the seven nearby nature categories as independent variables and different facets of satisfaction as the dependent variables in a series of multiple regression analyses.

The satisfaction measures were derived from factor analysis of the ratings of 16 items about neighborhood satisfaction (Table 4). In addition to the three satisfaction factors, the single item about satisfaction with "peacefulness" was also included in these analyses as it was related to the open-ended comments. The mean rating for this item was 4.42.

The results of the regression analyses, one for each of the four satisfaction measures (Table 5), show that both the most (i.e., trees) and least (i.e., wetlands) available categories of the nearby natural environment are significant predictors of satisfaction with nature. Two other highly available kinds of nature, mowed areas and manicured or landscaped settings, as well as the less available open fields, were not significant in accounting for any of the satisfaction measures. The availability of gardens positively affected satisfaction with community, and, to a lesser extent, satisfaction with nature. Of the seven categories of nearby nature, however, the one that played by far the most critical role was the availability of forested areas within the residential community. It was a significant predictor of three of the satisfaction measures: nature, community, and peacefulness. It is not surprising that the availability of different kinds of natural features in the environment (i.e., trees, garden, wetland) would be related to residents' satisfaction with their nearby nature. What is surprising, however, is the finding that the forest category is such a pivotal aspect of the satisfaction ($\beta = 0.50$, $P < 0.0001$), strongly contributing to the high R^2 (0.41). It is also surprising that satisfaction with appearance was not significantly related to any of the nature categories.

Table 4
Satisfaction measures (factor loadings, alpha, and means)[a]

	Nature	Community	Appearance
Seeing larger wildlife	0.76		
View of nature from home	0.75		
Seeing birds, squirrels	0.71		
Opportunities to walk	0.66		
Amount of open space	0.63		
Number of large trees	0.55		
Neighborliness		0.87	
Opportunities to interact with neighbors		0.84	
Sense of community		0.77	
Neighborhood landscaping			0.80
Properties looking nice			0.79
How neighborhood looks			0.65
Alpha	0.84	0.89	0.81
Eigenvalue	3.14	2.75	2.41
Mean rating	4.06	3.96	4.15

[a] Items that did not load: peacefulness; privacy; safety and security; and density of homes.

Table 5
Results from regression analyses using nearby nature categories to predict four aspects of satisfaction

Nature category	Satisfaction			
	Nature β	Community β	Peacefulness β	Appearance β
Trees	0.17***	−0.02	0.12	0.09
Manicured/landscaped	0.06	−0.06	−0.08	0.11
Garden	0.12*	0.19**	0.10	0.09
Mowed	−0.04	0.01	0.10	0.01
Forest	0.50****	0.22**	0.19*	0.11
Open	0.01	0.00	0.04	−0.09
Wetland	0.14*	−0.04	0.13	−0.05
R^2	0.41	0.04	0.08	0.02
F	19.73****	2.09*	3.28***	1.61

* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.005$.
**** $P < 0.001$.

The strong role played by forests is further echoed by the participants' preference ratings of the 24 photographs. While most scenes received relatively high preference ratings, only seven scenes had means above 4.00 (on a five-point scale). The forest factor consisted of five scenes each with a mean greater than 4.00 (and a factor mean of 4.4). The two most preferred scenes are shown in Fig. 4. Nearby forests are available to fewer than 40% of the participants (Table 3), but whether or not residents can see them, forest scenes are by far the most preferred.

Further indication of the importance of the nature context comes from responses to the question regarding tradeoffs in choosing where to live. Participants were asked to prioritize the items in Table 6 so there

Table 6
Tradeoffs in choosing where to live[a]

	Least	Some	Important	Most
Nature view from home	1	8	25	66
Large residential lot/yard	8	18	35	39
Nature areas within walking distance	4	21	46	29
Large house	23	37	20	20
Not seeing neighbors' houses	27	33	27	14
Yard that is easy to maintain	22	39	31	8
Recreation areas within walking distance	37	38	15	10
Sidewalks	73	16	7	3

[a] Table indicates percent selecting each importance category.

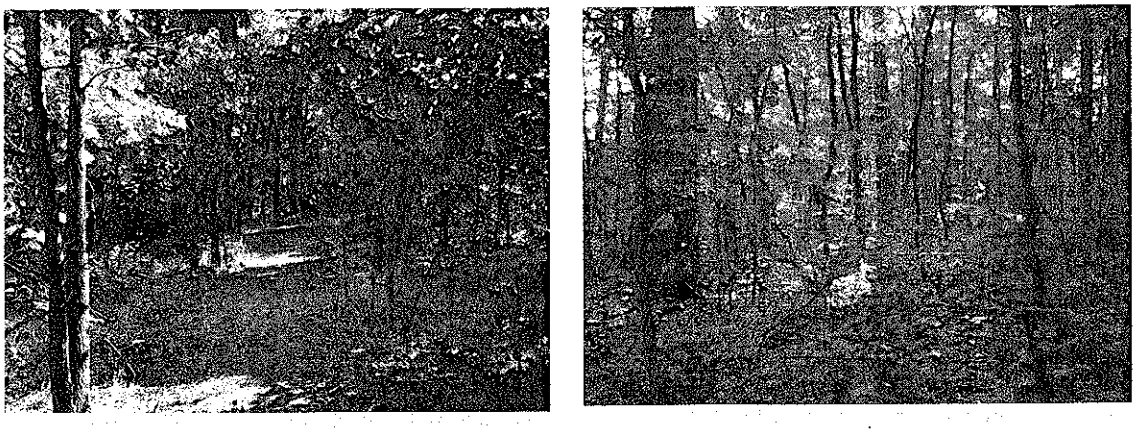

Fig. 4. Two scenes, from the forest factor, which received the highest preference ratings.

would be two checks representing each of the four degrees of importance (least, somewhat, important, and most). The importance of the natural environment is strongly reflected in the top choice, nature view from home. Living out in the country must include opportunities for having nature nearby and, ideally, within walking distance. The second highest priority, large residential lot/yard, reflects the desire for space, for a place that provides a buffer from others. However, the size of the house and the privacy from neighbors, were notably less important.

4. Discussion

Participants in the study are the first owners of homes in a fast growing, relatively rural township. Their residential communities have few if any jobs or services in walking distance and provide no public transportation. These communities are characterized by lots ranging between 0.5 and 2 acres (0.2–0.8 ha) with no fences to mark boundaries. They have large mowed areas, trees, and landscaping around the individual homes and at the entrances to the subdivisions, and individuals may have gardens. Some of the communities also have forested land and a few contain wetlands. These natural features, separately or as a whole, play an important role for the residents. They are the features most likely to be mentioned when residents describe their communities and are rated as the highest priority in selecting a home.

These results suggest that the nearby natural setting for many of these homeowners is not very different from suburban areas that are closer to urban centers. Individual gardens, trees, and lawn are common to many communities, although their expression differs substantially with house values. The desire to live "out in the country," however, entails quests that extend beyond what is available closer to town. Perhaps it is a desire for bigger lawns, larger gardens, and a greater area to landscape around one's home. The findings, however, highlight the overarching significance of forested areas. Such woods are highly prized; they are the strongest of the natural features in accounting for residents' satisfactions not only for their natural surrounds, but also with the community and the sense of peacefulness.

Many residential developments have replaced the forests, and the forests that are still available might soon give way to future developments. This is not the case, however, in the so-called open space communities where the forests, as well as wetlands and open fields, are preserved and owned communally by the homeowners. Such preservation can benefit wildlife, is critical to stormwater management, and may provide other ecological benefits that derive from increased biomass. It also makes the resource everlastingly available to the community's residents, their neighbors, and visitors. As Austin (this volume) shows, however, residents' understanding of the open space concept conveys limited awareness of the unique benefits offered by these communities.

5. Conclusion

The flight to the countryside represents a complex array of human desires. This research provides evidence that the proximity to the natural environment plays a particularly important role for residents living in new subdivisions at the urban fringe. The process of developing new residential communities in these areas, however, often destroys these very qualities (Kaplan, 1984b) and the nearby woodlands that made a residential community attractive may soon become the site of another residential community.

While people appreciate the importance of their nearby natural environment, many of the features they seek and find satisfying could be more readily obtained in other ways than through individual ownership of large parcels of land. Many may not be aware of alternative ways to achieve these goals. The woods they seek and the sense that there are places to explore are more easily achieved by protecting these resources for the common good. A deeper understanding of the quest for nature nearby can be an important step in promoting the preservation of natural features and in designing communities that are more sustainable.

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Resident perspectives of the open space conservation subdivision in Hamburg Township, Michigan

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Abstract

The open space conservation subdivision (R.G. Arendt, 1996) has been presented as an alternative to conventional large lot residential development. A form of clustering, this planning approach emphasizes the quality as well as the quantity of land preserved. The format offers a means for local planning officials to accommodate residential growth while preserving natural areas, rural features, and wildlife habitat that is typically altered as sprawl spreads outward from urban centers. These preserved areas become part of the residential community, accessible via trails and pathways. Residents share in the ownership of the preserved open space and take responsibility for its management. The purpose of this study was to gain an understanding of residents' perspectives of open space conservation subdivisions. What is their understanding of living in an open space community? How this process is implemented and how homebuyers respond to lot size and group management of natural areas is important to further application of this planning technique. Interviews were conducted with homeowners in 13 open space communities in southeast Michigan. Responses to questions about the satisfactions and problems associated with life in these communities, as well as understanding of the open space concept, provide useful feedback from residents to those seeking to implement this planning philosophy. Interviews reveal residents are pleased with the access to nearby nature as well as the social aspects of living in their neighborhoods. However, understanding of the open space conservation concept varies considerably among the residents and carries little recognition of the unique features offered by such subdivisions. Greater emphasis on sharing the principles behind the open space conservation approach with homebuyers may lead to a fuller appreciation of their choice to live there. Furthermore, residents' understanding of this concept may be key to their continued involvement in managing local natural areas and advocating this approach to those who live outside these communities.
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1. Introduction

Across the country our landscape is undergoing considerable change. Urban sprawl was once a concern for high growth regions; today many areas in the United States are experiencing unprecedented residential development (Morris, 1999; Carruthers and Ulfarsson, 2002; Lovaas, 2002). Accompanying new residential subdivisions are changes that further impact the local environment—increased traffic on narrow country roads, new strip malls and commercial facilities, and the loss of rural open space and natural areas. Such developments lead many to question whether it is possible to give new homebuyers the countryside setting they want while preserving the very nature of this setting that led them away from urban areas.

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An innovative land use planning technique proposed by Arendt (1996, 1999a) emphasizes the management of residential growth within a framework of protected communal natural areas and green space. The open space conservation subdivision approach clusters homes on relatively small lots while the remaining land is set aside from development and owned communally by the residents. The protected open space provides residents with access to woods, open meadows, wetlands, and other natural features that are often destroyed by conventional, large lot housing developments.

This paper shares results from a series of interviews with residents of open space conservation subdivisions (called open space communities) in southeast Michigan. The purpose of the interviews was to understand residents' perspectives of living in an open space conservation subdivision and to explore their understanding of this concept. Through these interviews we learn about life in these neighborhoods, in essence, teasing apart the open space conservation subdivision experience in practice. Learning how residents feel about living in these communities, having shared spaces, and being responsible for their management can provide feedback useful in future application of this alternative form of residential development.

2. Open space conservation design

Unlike early cluster developments, which Whyte (1968) feared would focus more on increased density of homes and less on land preservation, the open space conservation subdivision (Arendt, 1996, 1999a) employs a form of clustering that emphasizes the quality as well as the quantity of land preserved from development. Typically, many of the natural areas and spaces that give an area its unique character are altered or destroyed when new residential subdivisions are built in rural areas. With open space conservation subdivisions, primary and secondary conservation areas are designated and set aside from development. Primary conservation areas are unbuildable sections of land (e.g., steep slopes, wetlands), while secondary conservation areas include features such as wooded tracts, meadows, critical wildlife habitat, highly productive farmland, and areas with historic or cultural significance. Homes are then clustered on the remaining land and positioned such that homeowners have views and access to open space and natural areas nearby. The resulting subdivisions will vary in design features, yet all will include trails and pathways within the undeveloped secondary conservation areas, as well as more developed commons areas. Some can also include developed recreational spaces (e.g., ball fields and tennis courts). The preserved lands are protected from future development by a permanent conservation easement. There are several approaches that specify who is then responsible for the management of these preserved areas, including the neighborhood homeowners' association or a local land trust or public entity.

The open space conservation subdivision gives local planners, developers, and community residents an easy-to-follow planning technique for managing growth within a regional landscape framework. By connecting areas of open space it reduces the damaging effects of conventional residential development on local natural resources. A higher proportion of land is spared from development (typically 40–60% of the original parcel), particularly land important to healthy ecosystem function. Open space conservation subdivisions preserve the natural character of the landscape and provide residents with greater access to the open spaces many seek when moving out of urban centers.

The approach has social implications as well. The communal ownership of land can provide a vehicle for more contact among residents and for increased involvement in stewardship of nearby natural areas as they work together to manage these open spaces (Arendt, 1999b). These social dimensions can play an important role in fostering sense of community.

Residential developments that extend out into rural landscapes provide residents with access to natural areas, yet such access can come at a substantial cost. Beatley and Manning (1997) have noted an increasing trend in this country of less citizen contact with one another and more time spent in cars commuting or at home watching television. Suburban residential communities that rely heavily upon automobile use show an accompanying decrease in the amount of neighborhood social ties (Freeman, 2001). Informal social interactions are an important component in the formation of neighborhood social ties, which strengthen sense of community among residents (McMillan and Chavis, 1986). Having a sense of privacy as well as participation in local activities contribute to sense of

community in suburban neighborhoods (Wilson and Baldassare, 1996). As urban sprawl continues to produce subdivisions that result in the loss of precious agricultural land and open space, increased reliance upon the automobile, and longer commute times for residents, opportunities are reduced for citizen contact with both nature and community. Exploring the experience of living in an open space community can further our understanding of the opportunities and challenges afforded by this residential planning approach.

3. Methods

3.1. Study site

Located in southeast Michigan, Hamburg Township is one of the fastest growing townships in the state's fastest growing county (Livingston County Data Book, 2000). County population grew by 31% between 1990 and 1999. The township population increased considerably during that time (43%), and its growth is projected to continue with a 58% population increase through the year 2020.

Two factors contributing to residential growth in the township are its proximity to metropolitan Detroit (less than 50 miles (80 km)) and location near two major transportation routes (Stanford, 1999). Visual evidence of this growth, most strikingly in the form of a 100-unit residential subdivision with 1 acre (0.4 ha) lot minimums, led members of the township planning commission to adopt an open space ordinance in 1992 based upon the concept proposed by Arendt (1999a) (Stanford, 1999). The township open space ordinance is optional; thus developers are encouraged to construct open space residential subdivisions through use of a density bonus. Working with the township planning commission, developers submit new subdivision designs featuring homes clustered on lots smaller than the lot minimum zoned for that particular area (e.g., 0.67 acre (0.27 ha) in a 1 acre (0.4 ha) minimum zone). As a result, the total number of homes built is somewhat higher than would have resulted using a traditional residential design, while the amount of land preserved or set aside from development also increases.

The township is recognized as one of the most forward-thinking townships in the state with respect to use of open space conservation design as a means of land preservation. Township planning staff are often consulted about their open space ordinance by members of other township planning commissions, and open space communities in the township have been featured in land-use planning tours offered by the state extension service (personal communication with Leslie Meyers, June 2001).

Shared natural areas within the township open space subdivisions contain walking paths, recreation areas, provide nature views, and preserve wildlife habitat. Established as site condominiums, open space community residents are required to establish a homeowners' association and guidelines, elect association leaders, and vote on the management of the shared areas within the subdivision. Early in the development process the shared natural areas are the responsibility of the developer. Upon reaching 75% capacity, however, the ownership and responsibility for management of shared areas shifts to the homeowners' association (Stanford, 1999).

3.2. Data collection and analysis

Interviews were conducted with 15 residents living in 13 open space communities in the Township. The communities are diverse in terms of size (overall acreage and number of homes), median home value, open space areas (total acreage preserved and the natural features contained within), walking paths (layout and composition), and the presence of developed recreational features (e.g., tennis court, soccer field). These open space communities are similar, however, in age (each community is less than 10 years old), the presence of communally-owned open space, access by residents to these shared natural areas via walking paths, and shared responsibility for the management of communally-owned areas. In addition, every open space subdivision has a sign at its entrance, which, in addition to providing the name of the neighborhood, includes the phrase "an open space community."

Contacts from each community were obtained from a list provided by the director of the township planning department, who felt that these individuals would be open about sharing both positive and negative opinions. The list contained the names of individuals who served in a leadership capacity within the neighborhood homeowners' association or had, at some point

in the past, served as a liaison between the neighborhood and the township planning department. Two or three individuals were listed for each of 16 open space communities. The leadership status of these individuals meant they were more likely to be available to speak on behalf of their communities and were knowledgeable of activities that occur within the neighborhoods. Such selection criteria can introduce a bias to the data collection process, although, as is clear from the results, it is not the case that they assumed their role was to be uncritical.

Individuals were contacted by telephone, the research project was explained to them, and they were asked if they would be willing to participate in an interview about their neighborhood. Appointments then were made for conducting the interview in person at a location convenient to the resident. A maximum of three attempts to contact each individual were made. A total of 24 individuals were successfully contacted and fifteen agreed to participate in the interviews. The remaining nine declined to participate, most citing they lacked the time to schedule the approximately 1 h interview.

Two people conducted the interviews, the author and a second member of the research team. Both researchers were present during the first four interviews in order to ensure consistency of the interview process. The remaining 11 interviews were conducted individually, eight by the author, and three by the second researcher. A structured interview format with 13 open-ended questions was followed. Residents were asked about their likes and dislikes with respect to living in the neighborhood, their knowledge of the open space community concept, the tradeoffs made by choosing to live in an open space community, specifics of the homeowners' association rules and regulations, and background questions. Questions that are the focus of this article include the following:

- What do you like most about living in (subdivision name)?
- What do you like least about living in (subdivision name)?
- What does the phrase "open space community" mean to you?
- In what ways do you think your residential community is different from other neighborhood developments?
- What do you feel you have gained and lost by having a smaller lot and shared open space?

Notes were taken during the interview and, whenever possible, residents' exact words were transcribed. Analysis of the interview data was performed by the author using cross-case analysis (Patton, 1990). Interview responses were compiled by question and individual responses were grouped into categories, which were subsequently named according to theme. Themes and their associated responses were reviewed and discussed by four researchers on several occasions during the analysis phase. A code book of themes was developed, responses were coded by theme, and responses within each theme were totaled. Quotes are included in the results section, adding imagery helpful in illustrating the construct measured.

4. The open space community experience

In general, residents were eager to talk about their neighborhood and were pleased with their decision to live there. In fact, when asked to describe what they liked best and least about their neighborhood, nearly 70% of the total responses were positive. The positive aspects of life in these open space communities are featured in the next two sections and relate to the physical setting and the neighborhood social scene.

4.1. Physical setting

Eleven of the 15 residents expressed pleasure with respect to the "openness" of their neighborhood. This satisfied, for many, the desire to leave behind the congestion of urban life and move to a more open setting with space around them and where views were unobstructed.

It feels way out, but it's really not.

The amount of space between houses.

I was watching a storm roll in the other day and I remembered that I could never do that where we used to live, because everything was so built up around us.

A second benefit, expressed by eight residents, pertained to viewing natural settings or appreciating the easy access they have to nature from their home.

> Seeing green, seeing woods out my front door.

> When I'm out working in the yard, I see grasshoppers and frogs, and you forget about those things when you live in the city.

A benefit mentioned with less frequency, yet related to the physical setting, was that of the neighborhood being "peaceful" or "quiet." This benefit was experienced from different perspectives including the neighborhood location (being "tucked away" or "out of the way") and noting that the neighborhood had minimal traffic ("not noisy").

Four residents specifically mentioned the enjoyment gained from having shared spaces such as walking trails, recreational features, and community picnic areas. Later in the interview, when asked what they had gained by living in an open space community, both communal natural areas and recreational features were frequently cited in resident responses, mentioned by eight of the 15 residents.

> With the [communal] park areas, there is the opportunity to have large family gatherings if your own place is too small. There is more space that you can say you have if you need it.

> In another community, we wouldn't be able to have our own tennis court or basketball court.

> The communal areas are conducive for families with young children—they are able to enjoy the common space. Kids can look for frogs or sled on the toboggan hill. In other places where you have big lots, children don't feel free to go roaming through the lots.

Three residents mentioned that they enjoyed having a more manageable lot size, something that is "easier to maintain." In addition, three residents were pleased that the communal open space provided a sense of security from future development. In nearly all of the open space subdivisions, the shared natural areas included a buffer of land around the perimeter of the neighborhood.

4.2. Social scene

Social aspects of the neighborhood experience were mentioned in 13 of the 15 interviews. Nine residents included favorable mention of social or community aspects when describing what they liked about their neighborhood. Four additional residents spoke favorably about their neighbors and social aspects of their community when asked in what ways they thought their residential neighborhood was different from other neighborhood developments nearby.

Residents liked having neighbors with whom they shared something in common. For instance, those with small children enjoyed having other families nearby with small children. Others were pleased that the community attracted residents with "similar interests," which they felt gave the neighborhood a certain degree of cohesion.

> People look out for each other's children.

> This type of community draws community-minded folks to it.

> It's like a little village.

> Everyone sticks together.

While the research focused on teasing apart the physical and social dimensions of the open space community experience, for residents the experience of living there provided a mingling of both dimensions. Evidence of this overlap is found in residents' comments about the design of the neighborhood. Three residents felt neighborhood social ties were strengthened by the shared common areas and pathways. These pathways, they believed, provided a space or setting for residents to meet and chat with one another. One resident concluded that the shared ownership of property and, therefore, the responsibility for its management, necessitated that residents "work together."

> I have more interaction with my neighbors because you practically walk in their backyards when using the walking path.

> As a neighborhood we have to make group decisions, which gives me more contact with neighbors.

4.3. Negative aspects of the open space community experience

Despite a majority of positive statements made by these residents, the open space neighborhood picture is not as rosy as it appears. Most of the problems or less than favorable experiences mentioned by residents were social in nature, involving certain individuals or the process of group interaction. Five of the 15 residents expressed frustrations related to the homeowners' association, people not following the association rules, or being a member of a community which requires a degree of commitment that some individuals were not willing to make.

> I don't like having to be the bad guy [homeowners' association president] and having to enforce the rules.

> You have to be willing to keep the communal areas up. Forty percent of the area is communally owned. This can be a problem for other folks who don't like to volunteer.

> Some people want the path removed. Some have torn up the path and put in trip wires. They don't like that people can see into their homes from the path because the foliage around their homes has not grown up yet.

> There are always one or two squeaky wheels that make a lot of noise.

Other complaints included difficulties with individual developers. In some neighborhoods, the transition of open space management duties from the developer to the homeowners' association did not proceed smoothly. In these cases, the developer had not yet relinquished responsibility for these areas or had not performed promised work related to the communal natural areas. While limited to a few subdivisions, it is possible these developer–resident conflicts may have been avoided with more careful oversight on the part of township planning officials.

> It would be nice if the pathway were done because we could walk around the loop. The township signed off on our development before all of the open space areas were completed.

Two residents expressed concern with respect to the future management of the shared natural areas. At the time of the interviews these subdivisions were still relatively new, with some open space communities having formed their homeowners' association within the past year. Even though relatively little natural areas management effort had been required of the residents at the time of the interviews, residents anticipated some problems would arise around future management issues ("we might get into common areas concerns," "there may be problems once we have to discuss things like mowing around the retention pond"). A subsequent series of interviews conducted 1 year later more fully explored natural resource management within these open space communities (Austin and Kaplan, 2003).

Other concerns shared by residents were related to the current rate of growth in the township and having to commute long distances to work or to the grocery store. It would appear that this type of residential development, though commendable in terms of preserving land from development and offering environmental and social benefits to residents, is still not immune from contributing to and suffering from the negative aspects of urban sprawl.

4.4. Resident understanding of the open space community concept

Does living in an open space community within a township that is one of the most advanced in the state with respect to open space conservation design somehow factor into residents' understanding of this concept? Resident response to the question "What does 'open space community' mean to you?" reflected the aspects of the community that are meaningful to these individuals. The impetus behind this query was to determine if residents' understanding of the open space community concept informed their experience of living in one. Do residents speak about the concept in a manner consistent with the way it is described in the literature?

About half of the respondents (seven) indicated that the phrase "open space community" meant a neighborhood that contained communal areas, which could be accessed by all residents. Three individuals said that an open space community meant that residents were given greater access to nature. Two individuals said

the phrase meant that the neighborhood had strong social ties among its residents.

While these comments reflect some of the characteristic features of open space communities—shared open space, greater access to nature, and social interaction (Arendt, 1999b)—residents' comments did not articulate the underlying intention of this concept as an alternative to conventional residential development. Furthermore, two individuals believed the phrase meant giving residents more space between homes (i.e., having "larger lots"). And one individual indicated that he had never heard of the phrase "open space community." When it was explained that his neighborhood was indeed, an "open space community," he commented that he simply called it living "out in the country."

Residents were asked to relate what they thought made their neighborhood different from neighborhoods nearby. It is possible that, without necessarily understanding the principles of the open space conservation subdivision design, residents might recognize certain forces at work to make their neighborhoods unique or special places. Their responses, once again, expressed social and physical dimensions of the neighborhood setting.

Nine of the 15 residents thought their neighborhood was unique because of its residents, indicating it was "the people," "the neighbors," who made their subdivision a special place in which to live. Many viewed their neighborhood as a "smaller-knit community," believing that it was the relative size of the neighborhood that facilitated neighbor-to-neighbor contact. Residents expressing these sentiments reside in neighborhoods that ranged in size from 12 homes to 59 homes per subdivision.

> I think it's a closer knit community because it's smaller.

> It's small enough to get to know people, but big enough for variety.

The physical dimensions that residents felt contributed to neighborhood uniqueness were expressed in four ways. Three residents thought their community was different from others because it offered a greater sense of space. Their responses described their neighborhood as having "more space between homes," being "isolated" or "hidden," or being "more rural" than other nearby subdivisions. For others, the community was unique because it offered a certain "look" or "character" that was different. Its homes were different from those in other subdivisions, or the overall layout of the neighborhood was nicer than most because more trees were left standing in home sites. Two individuals thought the neighborhood provided residents with access to nature, was surrounded by a "woods line" or had "lots of greenery." One individual thought the neighborhood unique because having "open space that would never be sold or developed" meant his neighborhood would be spared from the impacts of future development. The range of these responses suggests relatively little recognition of the unique aspects intended by the open space conservation subdivision.

5. Discussion

These residents enjoyed their neighborhoods and were eager to speak about the experience of living there. Open space communities provide them with natural elements important to their well being, including nature views from home and opportunities to access nature nearby. They enjoyed the peace and tranquility afforded by the amount of nature in their subdivisions that was left undeveloped. Their open space community provided social benefits as well, attracting neighbors with similar interests and encouraging neighborhood interaction along trails and in neighborhood association meetings. Despite struggles with some residents who do not always follow the rules, these residents appeared pleased with living in that setting and conveyed a willingness to be a contributing member of the neighborhood.

This type of residential community provides a unique combination of accommodating residents' desire for new housing in rural areas, promoting neighborhood social interaction, and at the same time preserving natural areas from development. In addition, open space conservation subdivisions offer residents an opportunity to assume an active role in the stewardship of nearby natural areas.

Planning officials see the open space conservation subdivision as a means for managing the growth experienced in this township. Local developers

constructing open space communities work closely with township officials in setting aside open space areas, thus promoting the concept in practice. While it is certainly not necessary for residents to speak about the open space conservation concept in terms similar to land use professionals, the variety of ways residents described it, and the lack of familiarity with the phrase by some, particularly those serving a leadership capacity, is noteworthy. It is evident from this small sample that an understanding of the concept is not being uniformly transferred from planning officials and developers to residents. A larger survey of open space community residents is needed to more fully realize the extent to which the concept has been conveyed to homebuyers.

Given the township's positioning at the forefront of the conservation subdivision movement in the state, it is unfortunate that more has not been done to increase homeowners' understanding of this concept. Since residents seem to recognize a special quality in the way their neighborhoods are organized and composed, this recognition could be used to an advantage with proper planning and guidance. If information about the principles behind the open space conservation subdivision were given to residents early in the home-buying process, it is possible that the neighborhood would have fewer rule breakers. In addition, more information and a clearer understanding of the concept may translate into stronger advocates within these communities for this type of land use planning technique. Land use planners may find residents are more willing stewards of local natural areas with an understanding that the environmental and social benefits of living in an open space community are intended outcomes of this planning process.

There is reason to be both optimistic and timely in attending to this matter, given evidence of a strong social component to life in these communities. Residents may not necessarily see their subdivision as different from conventional large lot subdivisions in the sense that homes are clustered on smaller lots, or that in doing so, land is preserved from development, or that wildlife habitat is saved. However, their belief that their community is unique because of its people and its setting can provide a secure position from which to further their understanding of the contributions this type of residential subdivision can make toward curbing the impacts of sprawl.

6. Conclusion

As rural landscapes continue to undergo the changes brought about by increasing residential development, we are faced with an ever increasing urgency to find alternative ways to approach the residential development process. Such alternatives need to preserve natural areas for healthy human and ecosystem function. The open space conservation subdivision seems to provide the preservation of natural resources in the form of open space, while at the same time offering opportunities for residents to take a more active role in managing these resources. How this approach is applied, and how residents understand this approach, will have important ramifications for its future use, acceptance, and feasibility.

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Natural resources and open space in the residential decision process: a study of recent movers to fringe counties in southeast Michigan

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Abstract

Within many metropolitan areas of the United States, there is great diversity in the type and location of housing available to homebuyers. Of this diversity, new single-family homes built at the urban fringe have become the subject of much criticism in planning circles because of the potential impacts such development can have on agricultural, forest, and other lands valued for their natural resource qualities. To better understand the underlying decisions upon which these prevailing patterns of development are based, we asked new homebuyers about the importance of home, lot, neighborhood, and community features in their recent decision to purchase a home at the urban fringe. Two samples of residents living in fringe areas of the Detroit metropolitan area of southeast Michigan were studied to examine homebuying decision making. A general population mail survey was used to study individuals who purchased a single-family home within the past 7 years, and to contrast them with less recent homebuyers. Focus groups were also used to sample a smaller, more selected group of individuals who purchased homes in open space subdivisions within the same fringe area. Using the general population sample, demographic, geographic, and neighborhood preference variables were analyzed along with homebuying choice factors to identify segments of the population who found natural and openness neighborhood features important in their home purchase decisions. Focus groups were used to further explore how homeowners thought about and valued natural, open characteristics of the landscape. Together, these studies showed that preferences for natural and openness features were not universally important across homeowners in urban fringe areas. While respondents with high household incomes and those living in rural townships tended to rate natural and openness features higher than other income and geographic groups, as a preference factor in homebuying decisions, natural and openness features were generally overshadowed by considerations for neighborhood and housing design, schools, and access. Nor did natural and openness preferences necessarily relate to sprawl-minimizing behaviors, as findings showed that these features tended to be rated as more important by homeowners who also preferred large lot, auto-oriented neighborhoods. While focus group participants living in open space neighborhoods placed great importance on naturalness and openness in their purchase decision, these new homebuyers are a fairly small fraction of all new homebuyers in the metropolitan area. Together, these findings indicate that land use policies in urban fringe areas that attempt to preserve natural and rural features might need further consumer support in order to sustain or expand these housing market segments that aim to preserve the original character of

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the area. Otherwise, traditional development strategies that market homes based solely on home and neighborhood features, schools, and access to transportation may win out.
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1. Introduction

Despite the interest of urban planners in repopulating and revitalizing cities and older suburbs, the population growth of many metropolitan areas around the world is largely occurring in fringe areas beyond the urban core (Daniels, 1999; Duany et al., 2000). In the United States, such growth is precipitated by a combination of factors including relatively low gasoline prices and land costs, improvements in the network of highway and surface streets, attractive income tax deductions on mortgage interest, and the desire of local units of government to expand their tax base (Beatley and Manning, 1997; Chen, 2000). Most land speculators and developers look for opportunities to maximize the return on their investment, and under many land use and zoning regulations this leads to development patterns that push the urban fringe outward. Conversely, innovators who propose alternative smart growth designs are often met with formidable financial and regulatory obstacles (Chen, 2000). Thus, the pervasive trend in new residential development is that of single-family homes in automobile-oriented neighborhoods built on previously farmed or forested land. But while developers may see this as a manifestation of their responsibility to fulfill consumer demand, it is uncertain how prospective homebuyers might weigh a broader spectrum of housing choice alternatives that include natural and open space values.

Although the costs of sprawl have been well documented (Heimlich and Anderson, 2001; Burchell et al., 2002), surprisingly, little attention has been given to research on the impacts of growth on natural resources and agricultural lands (Sorenson et al., 1997). New urbanists have been among the most vocal opponents of the current pattern of growth, contending that sprawl is an unhealthy way for regions to grow and is self-destructive (Duany et al., 2000). Even alternative development patterns that attempt to conserve generous amounts open land have been critiqued by some as nothing more than "well-designed sprawl" that fragments resources and limits their ability to function as natural or agricultural systems (e.g., Atkin, 2003). However, few of these assertions reflect the complexity of issues, nor do they take into account the perspectives of the many actors (i.e., housing consumers, residential builders/developers, government officials) whose decisions impact metropolitan growth.

The purpose of this study was to examine homeowner decision making among residents who have recently moved into rapidly growing urban fringe areas. Specifically, we examined the importance of house, yard, neighborhood, and community factors in homebuying for two groups—a general population of single-family homebuyers and a selected population who have recently bought homes in open space neighborhoods – subdivisions designed to conserve open space and natural features. The study aimed to understand consumer preferences for natural and openness characteristics of new housing development, how these preferences might vary within the general population, and how they compare to consumer preferences among homeowners in open space neighborhoods. Information from this study can help identify consumer home trends that are changing the landscape of urban fringe areas. A general population study can determine market size and market segments most interested in natural and openness preservation within neighborhoods. A specialized market study can assess the character of and value placed on specific design features of residential development that is attempting to be more environmentally sensitive.

2. Nature and open space in the housing choice decision process

Despite an abundance of research dealing with consumer choice in housing, few studies have examined

the role of the natural environment and open space in the decision to move. In early research on mobility and housing, house features (Speare, 1974); proximity to work (Duncan and Newman, 1976); desirable neighbors and neighborhood push factors (Michelson, 1977); and the attractions of small town, non-metropolitan living (Blackwood and Carpenter, 1978) were identified as important in moving decisions.

More recent studies suggest the importance of spacious settings in the decision to move when examining factors influencing population shifts from urban to rural areas (Varady, 1990) and the attraction of exurban and suburban neighborhoods (Nelson, 1992). Only very recently have researchers begun to identify open spaces, parks, or natural areas as factors associated with residential choice (Crump, 2003; see also Kaplan and Austin, this issue; Austin, this issue). Other studies of residential preference note the leisure potential of the natural environment (Feitelson, 1993) or discuss the tranquil lifestyle surrounded by the natural environment that characterize new suburban development (Nelson, 1992). Sullivan (1994) explored preferences for natural settings and housing in fringe areas and found strong preferences for residential developments having mature trees and farm and forested landscapes.

Recent research from the National Association of Realtors (NAR) and National Association of Home Builders (NAHB, 2002) suggests single-family detached homes are the dominant type of housing among recent homebuyers in the US, and price, neighborhood, and proximity to work were cited as the three most important considerations of those recently purchasing a home. A specific set of community amenity considerations revealed that highway access, walking/jogging/biking trails, sidewalks, park areas, and playgrounds were all desired by at least 20% of recent homebuyers. Bigger houses, houses spread out, bigger lots, and less developed areas were all desired by at least 40% of recent homebuyers. When asked about how homebuilding impacts the environment, 18% said they would be willing to pay more for an environmentally friendly home, 35% would not pay more, 33% were concerned about the environment but not in their home purchase, and 14% were not concerned about environmental impacts.

Beatley and Manning (1997) present a model that identifies several "drivers" or forces influencing the pattern of development experienced in US metropolitan areas. These drivers—consumer choice, developer preferences and decisions, and local regulatory guidelines—are often embodied within land use plans and have interacted to produce the dominant pattern of development. It is these same factors that can be used to address the impact that housing development has on the urban fringe landscape. In the 2002 NAR/NAHB study, recent homeowners believed that developers, elected planning officials, and consumers had almost equal responsibility in managing urban sprawl in rural areas. Furthermore, Beatley and Manning suggest that each of these factors represents important points of intervention in moving toward alternative development patterns and lifestyles. As an initial step in moving toward alternative forms of development that address issues of natural resource and open land depletion, an understanding of the decision processes and interactions of the key players is warranted.

This paper examines the decisions of one of those players—single-family homeowners who recently moved into rapidly developing metropolitan areas. Outlying areas of three counties in the Detroit metropolitan region of southeast Michigan were included in the study. A general population sample was examined to understand preferences of recent homebuyers and a more specialized sample allowed a deeper understanding of homebuying in selected open space neighborhoods. Specific questions addressed in the study included:

- *For the general population:* What factors do new homebuyers consider when selecting a place to own a home? What is the relative importance of natural resources and open space in their selecting a place to live? How do homebuying factors differ across different population groups and across different types of places?
- *For new homebuyers in specialized open space neighborhoods:* What factors are considered when selecting a place to live? How do they compare with those of the general population?

3. Methods

Data from two methodological approaches were used to address the research questions. The general

population portion of the study used a probability sample of the adult population living in the outlying areas of the metropolitan area. A mail survey was administered that included a number of quantitative measures related to the quality of community life, including factors influencing home and neighborhood choice (Marans, 2003).[1] The open space neighborhood portion of the study used a purposive sample as no list of homeowners living in specialized neighborhoods for the study area was available or easily assembled. Focus groups using a combination of quantitative and qualitative measures were employed to uncover and understand what lies behind some of the factors other homebuying studies have identified (Strauss and Corbin, 1990).

3.1. Study area and geographic sampling

The Detroit Metropolitan area is located in southeast Michigan in a region rich in natural resources. It borders on two Great Lakes, is host to several rivers, and contains numerous forested areas managed by local, regional, and state park agencies. Like many urban regions of the US, it is also experiencing sprawl. While the population of the seven-county metropolitan region as a whole grew by 5% to 4.83 million people during the period of 1990–2000, the area of developed land increased by 17% to encompass a total of 1.1 million acres (0.45 million ha) or 37% of the metropolitan land base (SEMCOG, 2003).

Rates of land development vary considerably across the region, and for our general population sample we selected three counties that ranged in growth during 1990–2000. These included two outlying counties, Washtenaw and Livingston, which grew by 26 and 50%, respectively, during the period, and the region's core county, Wayne, minus the city of Detroit, which grew by 10% (Fig. 1).

For our sample of open space neighborhoods, we examined the portions of this study area that were growing rapidly but still had a large proportion of the land area in open space (e.g., park and agricultural) land uses. This included all of Livingston and Washtenaw counties and three townships in southern Wayne. Open space neighborhoods or subdivisions were identified using real estate sections of local and metropolitan newspapers and information from local planning officials. Neighborhoods were selected on the basis of several criteria: they were developed after 1990, had a presence of natural areas and open space within the neighborhood, were at least 25 housing units in size, and located in townships where growth was significant. Ultimately, an open space neighborhood became part of the study by finding a cooperative homeowner contact that would assist in providing names or inviting neighbors to a focus group session held in their neighborhood.

Using this procedure, we selected six open space neighborhoods in each county. Together, the 18 neighborhoods varied in size (acres and number of houses); value of homes; and the type, amount, and ownership of internal natural resources (Table 1). Two neighborhoods contained a privately owned golf course, ten neighborhoods were considered heavily forested areas offering significant open space, and the remaining six neighborhoods were considered limited open space areas. The neighborhoods studied ranged from 9 to 700 acres (3.6–280 ha) and contained from 21 to 800 homes. Three neighborhoods included attached condominiums; otherwise homes were single-family homes or detached condominiums. Significant open space was found in developments where developers built to open space guidelines provided by the township. Often the open space was 20–50% of the total buildable area, and residents shared ownership (Arendt, 1996). Limited open space was where a developer added a few acres of shared area at the entrance of a subdivision or around a small retention pond, in islands placed within the road, or for small pocket parks.

3.2. Respondent sampling

For the general population portion of the study, a sample of single-family homeowners living in the study area was drawn from a larger sample of adult residents within the entire metropolitan area, taken as part of the Detroit Area Survey (DAS) (Marans, 2003). Questionnaires were mailed to households following a modified Dillman (1979) mail survey procedure. A split sample technique was used, where half the sample received a small cash incentive and the other received entry passes to a metropark. Among the approximately 4000 people who responded to the

[1] For an overview of the Detroit Area Survey, see http://www.tcaup.umich.edu/workfolio/DAS2001/index.html.

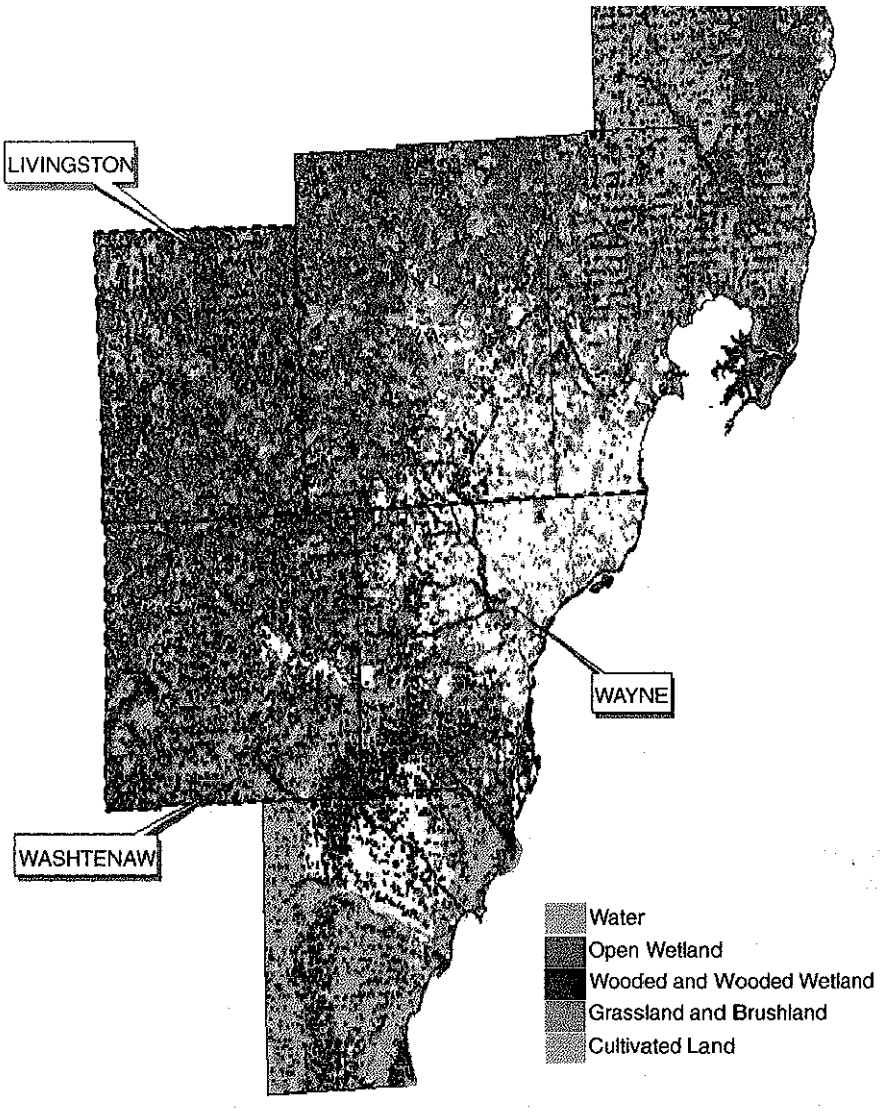

Fig. 1. Land cover map of the seven-county Detroit metropolitan area showing the location of study area counties.

DAS mail questionnaire, 1719 respondents lived in the three-county study area (excluding the City of Detroit). The response rate to the questionnaire in these counties ranged from 56 to 61%. Data were weighted to reflect age, gender, and race population proportions, as well as actual population in these counties. Of these respondents, 470 had purchased their single-family dwelling in the study area within the past 7 years. These respondents were the main focus of our analysis for the general population portion of the study. Another 568 respondents had owned their homes in the study area for more than 7 years, and were included in part of the analysis for this portion of the study for comparison with the more recent homebuyers.

Respondents for the open space neighborhood portion of the study were selected using a purposive sampling method. After identifying, visiting, and selecting a neighborhood, a contact person in the neighborhood was informed of the study and asked to assist. In some cases this person offered to host

Table 1
Characteristics of Livingston, Washtenaw, and Wayne counties

Characteristics	Livingston	Washtenaw	Wayne[a]
Population (2000 estimate)	159326	316040	47620
Size (square miles (km^2))	574 (1486)	710 (1839)	69 (179)
Average housing prices (2000, US$)	214768	228649	94839
Average household income (1990, US$)	45439	36307	45044
Land uses (%)			
Residential	10	10	25
Agricultural	34	45	42
Natural/parks	50	38	25
Commercial/industrial/institutional	1	2	5
Other uses	5	5	3

Sources: Southeast Michigan Council of Governments (SEMCOG); house sales prices from Livingston County Board of Realtors and Ann Arbor Area Board of Realtors.

[a] Grosse Ile, Brownstown, and Huron Township data only. US Census 2000. Housing prices and household income in 1990 dollars.

the focus group and contacted all the residents of the neighborhood; in other cases this person might have suggested to distribute a flyer in everyone's mailbox. Over a 2-year period, 18 focus group sessions were held, in Livingston and Washtenaw counties the first year and in Wayne the following year. Groups ranged in size from 4 to 12 participants per session, with a total of 119 residents participating in total. This number included some who attended along with their invited spouse. These individuals were included in the sessions, as our previous experience has shown that adults in the same household often expressed different house and neighborhood preferences.

3.3. Measurement

The mail survey used in the general population portion of the study asked respondents to indicate the relative importance of a list of factors in their decision to move into their current neighborhood. This list was developed based on four sources—early focus group results and items used in the focus group questionnaire, input from graduate students enrolled in a survey research course, a review of homebuying literature, and items asked in an earlier study by one of the principal investigators. These items included school quality, proximity to work, convenience to shopping and schools, similarity of neighbors, the spaciousness of the area, natural features of the neighborhood, housing costs, housing design, attractiveness of the neighborhood, familiarity with the area, proximity to friends and family, proximity to natural resources, and quantity of recreational opportunities. These 13 homebuying items were measured with a four-point scale ranging from "4" equaling "very important" to "1" equaling "not at all important." Items were factor analyzed using principal components analysis with a varimax rotation and an eigenvalue of greater than 1.0. Internal consistency of the factors was estimated using Cronbach's alpha.

Geographic location of residency was established from respondents' zip codes and interpreted across four variables: population size of the community where respondents lived (using the 2000 US Census), whether or not that community was contiguous to the urban core (Detroit), whether or not the community was incorporated, and for those living in unincorporated areas, whether they lived in a subdivision or in a rural setting. The last variable was interpreted on the basis of a density measure calculated for census blocks of respondents. Large, medium, and small places contiguous to Detroit are generally older suburbs that experienced significant growth in the 1950–1980 period. Large, medium, and small non-contiguous places are typically older cities, villages, and small towns that are part of the metropolitan area but separated from the urban core and its suburbs by undeveloped or sparsely developed land. Unincorporated areas are large and small townships that surround the urban core and its older suburbs, and the non-contiguous cities and small towns. Parts of townships containing subdivisions with lots of two acres and less ($\leq$0.8 ha) were considered

high density. Sparsely developed parts of townships or areas remaining in agricultural use were considered low density (parcels of more that two acres).

Neighborhood design preferences were measured in two questions, each with two choices. Each question stated that the cost of the housing and the mix of people were the same. However, in the first question transportation options were manipulated in a graphic illustration and word description so that respondents selected either a walk and transit design or auto-oriented design. In the second question, the spacing of the houses was manipulated and respondents selected either a large lot or open space design.

Demographics were asked at the end of the questionnaire, and four of the items were used for this study: gender and age of the respondent, household income, and the presence of children 18 years or younger living in the household. Questions regarding the type of home and the length of owning a home were also asked in the questionnaire and used to delimit the sample to single-family homeowners and to partition it according to recent versus less recent homebuyers.

The *t*-tests and analysis of variance tests were used to assess significant differences in homebuying factors by demographic, geographic, and preference variables, with a *P*-level of <0.05 used to determine statistical significance. Levene's test of homogeneity was estimated and statistics for uneven variance were used where
appropriate.

The open space neighborhood portion of the study employed both qualitative and quantitative data collection within the series of focus group sessions. For the qualitative data, the focus group moderator—one of the principal investigators—used a script to direct the discussion with a number of open-ended questions about why participants selected their present neighborhood and their particular house. While the script focused on homebuying considerations, the relevance of nature while living there and the means of taking care of natural areas in the neighborhood were discussed throughout the sessions.

Each focus group session was tape recorded, and additional notes and observations were written down by at least one graduate level research assistant. Transcribed notes were prepared within a few days of each session and reviewed by the moderator. Once the raw data were reviewed, an open coding technique (Strauss and Corbin, 1990) was used to categorize participants' comments into main themes corresponding with the research questions of the study such as decision-making factors, benefits of nature, projected changes in natural resources in the rapidly growing areas, and perceptions of who controls natural resources and open spaces in their community. Next, subthemes were identified and used to categorize the relevant text segments. After all the data were initially categorized, continued examination and comparisons were made to arrive at final categorizations. This effort was carried out by one of the principal investigators and reviewed by the other investigator and the student researcher assistants involved.

Quantitative data were also collected from the focus groups through a self-administered questionnaire that was completed by each participant during the discussion. The questionnaire asked participants to indicate the importance of 16 different neighborhood, dwelling, and lot characteristics in their homebuying decisions using a five-point scale ranging from "5" for "extremely important" to "1" for "not at all important." These items were factor analyzed using a principal components analysis with varimax rotation and an eigenvalue of greater than 1.0. Internal consistency of the factors was estimated using Cronbach's alpha.

While the lists of items used in both this and the general population portions of the study were intended to investigate homebuying decision making, the contexts and samples studied necessarily resulted in slightly different measures. While some qualitative comparisons can be made, these differences prevented us from making direct statistical comparisons between the two data sets.

4. Result for the general population sample

4.1. Descriptive statistics

Respondents in the general population sample who purchased a single-family home in the past 7 years were most likely to be male (55%), between the ages of 30–39 years old (59%) or 40–49 years old (22%), and have children 18 years or younger living at home (71%) (Table 2). Household incomes were most often in the US$ 75,000–124,999 range (49%) or US$

Table 2
Description of general population sample

	Homeowners owning	
	≤7 years (n = 470) (%)	>7 years (n = 568) (%)
Gender		
Male	55	48
Female	45	52
Age (years)		
18–29	8	1
30–39	59	16
40–49	22	22
50–59	7	26
60–69	2	15
≥70	2	20
Children in the household		
Yes	71	40
No	29	60
Household income		
Less than US$ 40,000	7	19
US$ 40,000–74,999	31	37
US$ 75,000–124,999	49	32
US$ 125,000 and above	13	13
Current home location		
Large, contiguous suburb	18	22
Large, non-contiguous suburb	7	6
Midsized, contiguous suburb	18	26
Midsized, non-contiguous suburb	1	1
Small, contiguous suburb	7	7
Small, non-contiguous suburb	5	4
Large rural township, high density housing	23	17
Large rural township, low density housing	4	2
Small rural township, high density housing	7	4
Small rural township, low density housing	10	12
Neighborhood preferences		
Walk and transit design	28	23
Auto-oriented design	73	77
Large lot design	80	80
Open space design	20	20

40,000–74,999 (31%). Compared to households that owned their homes longer than 7 years, these recent homebuyers were younger, more likely to have children in their household, and earned slightly higher incomes.

Respondents lived across a variety of places that differed in size and residential densities. Most common in the sample were individuals living in large rural townships with high density housing (23%) (see footnotes in Table 5 for term descriptions), followed by large contiguous (18%) or midsize contiguous (18%) suburbs. Livingston County respondents were most likely to live in small-population rural townships with low or high density housing. Washtenaw County respondents were most likely to live in large population non-contiguous suburbs or large population rural townships with high density housing. Wayne County respondents were most likely to live in large or mid-sized population contiguous suburbs or large rural townships with high density housing. Compared to households who owned their homes longer than 7 years, these recent homebuyers were more likely

to live in unincorporated rural township areas over contiguous or non-contiguous suburbs.

In response to questions about preferred neighborhood design, seven out of ten recent homebuyers expressed a preference for the auto-oriented neighborhood over the transit-oriented walkable neighborhood, while 8 out of 10 preferred the large lot design to the cluster open space design with smaller lot sizes. However, recent homebuyers preferred a walk and transit neighborhood design slightly more than less recent buyers.

4.2. Factors considered when selecting a home

Based on the principal components analysis, four factors of two or more items were derived from the general population questionnaire data. These factors were titled natural and openness features, social, neighborhood and housing design, and access (Table 3). Three items did not align with factors and were treated as single-item factors; they were titled good schools, community size, and neighborhood of similar type people. The four multi-item factors each held an eigenvalue of greater than 1.0, loading coefficients of the items were greater than 0.60, and 56% of the overall variance was explained by these four factors. The four factors were also tested for internal reliability using Cronbach's alpha. The natural and openness features and social factors showed moderate (0.60 or higher) internal reliability. The other two factors were low (0.49, 0.50), but were used in subsequent analysis based on the factor analysis results. Additional measurement is recommended to improve the internal reliability of the neighborhood and housing design and access factors.

Natural and openness features did not rate highly among the factors considered by recent homebuyers in their choice decisions. Neighborhood and housing design surfaced as the most important set of homebuying considerations, followed by schools and access (Table 3). The natural and openness factor fell below these factors along with social, community size, and similar people in the neighborhood, which were all

Table 3
Principal components analysis of general population homebuyer's preferences ($n = 421$)[a,b]

Home decision factors (italic) and items (indented)	Mean	S.D.	Cronbach's alpha	Eigenvalue
Natural and openness features	2.7[b]	0.7	0.71	3.2
Openness and spaciousness of area	2.8	0.9		
Close to natural areas	2.7	0.9		
Lots of recreation opportunities	2.7	0.8		
Social	2.8	0.8	0.6	1.7
Close to family and friends	2.9	0.9		
Familiarity with area	2.7	0.9		
Neighborhood and housing design	3.5	0.4	0.50	1.4
Housing costs/good value	3.6	0.6		
Attractive neighborhood appearance	3.5	0.6		
Appearance/layout of dwelling	3.4	0.6		
Access	3.0	0.7	0.49	1.1
Convenient to shopping and schools	3.0	0.8		
Close to work	2.9	0.9		
Good schools[c]	3.3	0.9	n/a	n/a
Community size[c]	2.7	0.8	n/a	n/a
People similar to 'you'[c]	2.7	0.8	n/a	n/a

[a] The sample includes single-family homeowners in their current home for 7 years or less who live in Livingston, Washtenaw, and Wayne (excluding Detroit) counties.

[b] Scale where "1" equals "not at all important" to "4" equals "very important."

[c] Separated as individual items after reviewing factor analysis. Items had low loading coefficients and/or loaded almost equally on two factors.

similarly rated just below "somewhat important" on the scale.

4.3. Demographic aspects of homebuying choice decisions

Demographic variables were examined across the seven homebuying factors as some demographic segments may differ on the importance of a factor when purchasing a home (Table 4). Income was the only variable for which natural and openness characteristics appeared as significant, with those reporting high household incomes (US$ 125,000 and greater) placing a greater importance on natural and openness features than respondents in lower income levels ($F = 4.9$, $P < 0.01$). There were a number of other significant relationships between the demographic variables and the homebuying factors. For gender, females were found to place greater importance than men on social factors ($t = -3.3$, $P < 0.001$), neighborhood and housing design ($t = -2.7$, $P < 0.01$), and recreation opportunities ($t = -2.1$, $P < 0.05$). For age, older respondents (60 years or greater) placed greater importance than did younger ones on social factors ($F = 2.5$, $P < 0.05$) and recreation opportunities ($F = 4.7$, $P < 0.001$). Also, those under 50 years old placed greater importance on schools than older respondents ($F = 5.3$, $P < 0.001$). Additionally, those with children in their household placed greater importance on schools than those without children at home ($t = 12.4$, $P < 0.001$). Finally, the importance of access differed across the four income categories, with those in the US$ 40,000–74,999 household income level rating it lower than other income levels ($F = 5.7$, $P < 0.01$).

Table 4
Category means and significance tests for demographic aspects of general population homebuyers' preferences ($n = 421$)[a]

	Natural and openness features	Social	Neighborhood and housing design	Access	Good schools	Community size	Lots of recreation opportunities
Gender							
Male	2.8	2.7	3.5	3.0	3.3	2.7	2.7
Female	2.8	2.9	3.6	3.0	3.4.	2.8	2.8
t-test	0.0	−3.3	−2.7	−0.8	−1.9	−1.1	−2.1
P-level	ns	<0.001	<0.01	ns	ns	ns	<0.05
Age (years)							
18–29	2.6	2.7	3.6	3.0	3.3	2.7	2.2
30–39	2.7	2.9	3.5	3.0	3.5	2.7	2.8
40–49	2.8	2.8	3.4	2.9	3.3	2.7	2.8
50–59	2.8	2.5	3.4	2.9	2.7	2.7	2.6
60–69	2.9	3.2	3.8	2.8	2.6	2.7	3.2
70 or older	2.9	3.1	3.7	2.8	2.9	3.2	3.4
F-test	0.8	2.5	2.1	0.7	5.3	0.6	4.7
P-level	ns	<0.05	ns	ns	<0.001	ns	<0.001
Children in household							
Yes	2.7	2.8	3.5	3.0	3.6	2.7	2.7
No	2.8	2.7	3.5	2.9	2.6	2.8	2.8
t-test	−1.8	1.0	−0.4	1.0	12.4	−1.0	−0.7
P-level	ns	ns	ns	ns	<0.001	ns	ns
Household income							
Less than US$ 40,000	2.7	3.0	3.4	3.3	3.5	2.8	2.6
US$ 40,000–74,999	2.7	2.8	3.5	2.8	3.3	2.6	2.7
US$ 75,000–124,999	2.7	2.8	3.5	3.1	3.4	2.7	2.8
US$ 125,000 and above	3.1	2.6	3.5	3.0	3.3	3.0	2.9
F-test	4.9	1.8	0.8	5.7	0.6	2.2	1.5
P-level	<0.01	ns	ns	<0.01	ns	ns	ns

[a] Preference scale where "1" equals "not at all important" to "4" equals "very important."

4.4. Geographic aspects of homebuying choice decisions

The characterization of geography within the metropolitan area was described with a composite variable created from population size, location relationship with respect to the City of Detroit, and housing density. Ten distinct categories were formed and used in an analysis to identify patterns in the importance of homebuying factors. Five of the seven factors yielded a significant F-test (Table 5). Of these, natural and openness features were of greater importance to respondents living in rural townships (with the exception of large rural townships with high density housing) than to those living in more developed types of areas within the metropolitan area ($F = 10.9$, $P < 0.001$). Neighborhood and housing design, the most important factor, was consistently rated across the geography of the three counties studied. Recreation opportunities were also consistently rated as one of the least considered factors. Community size features were of greater importance to respondents living in small, non-contiguous suburbs and small rural townships than to those living in other geographic locals ($F = 4.1$, $P < 0.001$). Access was slightly more important to respondents living in large suburban areas ($F = 3.9$, $P < 0.001$) than to those living elsewhere. The other two factors, social and good schools, yielded significant F-tests but no consistent patterns were found in the category scores.

4.5. Neighborhood design preferences in homebuying choice decisions

Based on the drawings and text provided in the general population questionnaire, respondents' preferences for neighborhood design were assessed in relation to homebuying factors. Surprisingly, natural and openness features were more important for those selecting the auto-oriented preference ($t = -3.6$, $P < 0.001$) (Table 6). On the design that manipulated transportation features, access as might be expected was more important to those respondents who preferred the walking and transit design than to those who preferred the auto-oriented design ($t = 5.2$, $P < 0.001$). Social factors were slightly more important for those selecting a walking and transit design than the auto-oriented one ($t = 2.2$, $P < 0.05$).

On the second preference question where housing density and amount of open space were manipulated, the only difference in importance ratings was on the natural and openness feature. In line with the transportation findings above, respondents who preferred large lot (or lower density) neighborhood design held

Table 5
Category means and significance tests for geographic aspects of general population homebuyers' preferences ($n = 421$)[a,b]

Geographic categories	Natural and openness features	Social	Neighborhood and housing design	Access	Good schools	Community size	Lots of recreation opportunities
Large, contiguous suburb	2.5[b]	2.9	3.6	3.1	3.3	2.5	2.5
Large, non-contiguous suburb	2.9	2.6	3.4	3.2	3.3	2.8	2.7
Midsized, contiguous suburb	2.5	3.1	3.5	2.9	3.4	2.8	2.8
Midsized, non-contiguous suburb	2.4	2.3	3.7	3.1	2.7	2.4	2.7
Small, contiguous suburb	2.4	2.7	3.5	2.7	3.4	2.5	2.6
Small, non-contiguous suburb	2.7	2.8	3.4	3.0	3.2	3.3	2.8
Large rural township, high density housing	2.7	2.9	3.6	3.1	3.5	2.5	2.9
Large rural township, low density housing	3.2	2.6	3.4	2.8	2.5	2.5	2.4
Small rural township, high density housing	3.0	2.5	3.6	2.8	3.6	3.0	2.8
Small rural township, low density housing	3.3	2.7	3.4	2.7	3.4	3.0	2.8
F-value	10.9	2.6	1.3	3.9	2.5	4.1	1.6
P-level	<0.001	<0.01	ns	<0.001	<0.01	<0.001	ns

[a] *Terms:* Large suburb is defined as 50,000–150,000 inhabitants (2000 US Census); mid-sized suburb 15,000–49,999 population; small suburb: < 15,000; large rural township: 20,000; small rural township: <20,000; contiguous is adjacent to the City of Detroit; non-contiguous are areas that share no borders with Detroit; high density are lots where respondents live on <2 acres (0.8 ha); and low density: 2 acres.

[b] Preference scale where "1" equals "not at all important" to "4" equals "very important."

Table 6
Category means and significance tests for neighborhood preference aspects of general population homebuyers' preferences ($n = 421$)[a]

Scenarios	Natural and openness features	Social	Neighborhood and housing design	Access	Good schools	Community size	Lots of recreation opportunities
Walk and transit design	2.5	2.9	3.5	3.2	3.3	2.7	2.7
Auto-oriented design	2.8	2.8	3.5	2.9	3.3	2.7	2.7
t-test	−3.6	2.2	−1.0	5.2	0.3	−0.5	−0.1
P-level	<0.001	<0.05	ns	<0.001	ns	ns	ns
Large lot design	2.8	2.9	3.5	3.0	3.4	2.8	2.8
Open space design	2.5	2.7	3.5	3.0	3.2	2.6	2.7
t-test	4.6	1.8	1.4	−0.9	1.2	1.8	1.2
P-level	<0.001	ns	ns	ns	ns	ns	ns

[a] Preference scale where "1" equals "not at all important" to "4" equals "very important."

a higher importance rating than respondents preferring the open space design ($t = 4.6$, $P < 0.001$).

5. Results for the open space neighborhoods sample

Using the data from focus groups with recent homeowners in open space neighborhoods, homebuying considerations were further examined. As mentioned previously, while some of the items were similar to the scales used in the general population study, a greater number of items focused on natural features due to the type of neighborhoods being studied. As expected, natural and openness features were some of the top rated items by the importance these homeowners placed in home and neighborhood choices (Table 7). Based on the principal components analysis, we identified a natural factor comprised of seven items receiving a 0.55 or higher loading factor. This

Table 7
Principal components analysis of open space neighborhood homebuyer preferences ($n = 119$)[a]

Home decision factors (italic) and items (indented)	Mean	S.D.	Cronbach's alpha	Eigenvalue
Natural and openness features	4.0	0.6	0.81	4.8
Natural features in neighborhood	4.2	0.8		
Open space and shared recreation areas in neighborhood	3.6	1.2		
Design of neighborhood	4.0	0.9		
Natural features of lot	4.0	1		
Relaxed and comfortable environment	4.3	0.7		
Lot size in neighborhood	3.9	0.9		
Rural atmosphere	3.8	1.1		
Neighborhood location and social character	3.4	0.7	0.70	1.7
Access to highways and interstates	3.6	1.1		
Proximity to retail	2.8	1.1		
Like-minded people in neighborhood	3.4	1.2		
Sense of community	3.8	1.0		
Size of houses in neighborhood	3.5	0.9		
School district[b]	3.5	1.5	n/a	n/a
Proximity to job[b]	3.1	1.4	n/a	n/a
Proximity to state recreation areas, metroparks[b]	2.7	1.1	n/a	n/a
Location of community[b]	4	0.9	n/a	n/a

[a] Preference scale where "1" equals "not at all important" to "5" equals "very important."
[b] Separated as individual items after reviewing factor analysis. Items had low loading coefficients and/or loaded almost equally on two factors.

factor scored a 4.8 eigenvalue and a 0.81 Cronbach's alpha value. The factor is based on natural features in the neighborhood and lot, open space and shared recreation areas in the neighborhood, design of the neighborhood, a relaxed and comfortable environment, lot size, and a rural atmosphere. A second factor included items that describe where the neighborhood is located relative to highways and retail, as well as social items such as like-minded neighborhoods and sense of community. This factor, titled neighborhood location and social character, scored a 1.7 eigenvalue and a 0.70 Cronbach's alpha value. Together, the two factors accounted for 41% of the overall variance in the set of items included. Four additional items did not align with a factor and were placed in the results as other items, including schools, proximity to job and recreation opportunities, and the location of the community.

While a direct statistical comparison between the data presented in Tables 3 and 7 cannot be made, it is worth noting on a qualitative level the much higher relative ratings that the natural factor garnered for open space neighborhood residents than for the general population sample. For those who recently purchased homes in open space neighborhoods, its natural and openness features overshadowed considerations of neighborhood location, schools, and proximity to job, while for the general population survey the findings were roughly reversed.

To further understand how homeowners' thought about natural and openness features, comments made in response to open-ended questions about their recent housing choice decisions were examined. Rolling terrain, trees and forests, wetlands, lakes, wildflowers, parks, golf courses, gardens, scenic drives and trails, wild animals, sounds of nature, open sunlit spaces, and nearby recreational opportunities were mentioned as features that attracted them to their home and neighborhood. For many, the surroundings provided a natural and safe place for children to play.

Participants indicated that being close to natural areas was better than being close to an urban center. Specific comments about nature illustrate these homeowners' preferences for natural and openness features:

- "Would not have bought the house if it did not have the wetland." Livingston County homebuyer.
- "Loved the lot and the forest behind the house, that is what sold me on the subdivision." Livingston County homebuyer.
- "We looked for a golf course and the feeling of spaciousness that we get from that view." Washtenaw County homebuyer.
- "We wanted our kids to be able to walk around the neighborhood and explore, which leads to healthier, more creative and independent children." Washtenaw County homebuyer.
- "We wanted a rural feeling to our neighborhood, where there is space between homes. We wanted to be set back from major roads and nearby highway access. Mature trees was also attractive and streets with a small amount of slow traffic is what we wanted for our kids." Wayne County homebuyer.
- "When we were looking for a house, we recognized that with this subdivision we were close to the city, but really in the country. In our backyard, I can sit back and see horses, ducks, and squirrels." Wayne County homebuyer.

6. Discussion and conclusions

Natural resources and open spaces can be important factors in people's housing choice decisions. In our general population survey of recent homebuyers in three rapidly growing counties in the Detroit metropolitan area, however, neighborhood and housing design, access, and good schools were more important considerations than natural and openness features. Being close to natural areas such as woods, ponds, and streams; having openness and spaciousness to the neighborhood; and being in an area with lots of recreational opportunities constituted the measurement of nature and openness. These results are consistent with results by Varady (1990) and the NAR/NAHB survey (2002), where features of the house, schools, and transportation were found to be very important to homebuying decisions. On neighborhood designs, the majority of the general population sample showed a preference for automobile-oriented, low density neighborhoods. Less than half of those who preferred a walkable neighborhood also preferred the shared open space design (only 13% of total sample). These findings indicate that high density neighborhoods that are planned for walking, public transportation, and proximity to

services, have a minority following among recent homebuyers in the three counties studied. As presented in the results it was also surprising that respondents who preferred large lots and auto-oriented neighborhoods rated natural features as more important in their homebuying decision making than designs intended to be more environmentally sustainable.

A niche market of neighborhoods offering more natural features than a traditionally designed neighborhood is emerging in the diverse offering of housing choices. In some cities or townships, developers are specifically designing open space neighborhoods that meet or exceed required open space allowances or go beyond the standard of saving original natural features such as trees and wetlands that the government policy requires. Several of these neighborhoods were found in the three counties we studied, and we selected a sample of them for further analysis. Our research here shows homebuyers in these neighborhoods find natural resource and open space features to be of great importance, outweighing such usually dominating factors as good schools and access to work and shopping. Our focus group participants viewed these specialized neighborhoods as offering both rural and natural environment values, a finding that concurs with the work of Kaplan and Austin (this issue) and Austin (this issue). The design of neighborhoods that included the preservation of natural resources, one acre or less ($\leq$0.4 ha) lot sizes, and shared recreation areas were all important features that attracted them to the neighborhood.

The growth and expansion of metropolitan areas presents an array of challenges to policy makers, land planners, and residential developers operating at local, regional, and state levels. One challenge is how to minimize or compensate for the loss of natural resources while allowing for growth to occur in an orderly, sustainable manner (SEMCOG, 2003). A related challenge is creating, as part of that growth, new resource opportunities including parks and natural areas that benefit society and the environment. This study suggests that preferences for open space neighborhoods exist. However, for the sample we studied these preferences do not represent the majority of recent single-family homebuyers. Land use policies in communities at the urban fringe that attempt to preserve natural and rural features might need further support from consumers, planners, and legislators in order to sustain or expand these housing market segments. Otherwise, traditional residential developments that feature house design, good schools, and accessibility may win out.

This paper has examined the role of natural areas and open space in the residential decision process. Extensions of this research might include analysis with additional demographic variables including race and ethnicity or additional geographic variables such as distance between home and community or park areas. As future development occurs within the urban core and at the urban fringes, a variety of master plans, zoning ordinances, residential developers, and future homeowners will determine the character of new residential developments. The interplay of these government and market processes over time should continue to be investigated.

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Public policies for managing urban growth and protecting open space: policy instruments and lessons learned in the United States

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Abstract

The public sector in the United States has responded to growing concern about the social and environmental costs of sprawling development patterns by creating a wide range of policy instruments designed to manage urban growth and protect open space. These techniques have been implemented at the local, regional, state and, to a limited extent, national levels. This paper provides a systematic review of the extensive literature that describes these public policies and their implementation. The main public policy instruments for managing urban growth and protecting open space at various governmental levels are identified and briefly described, including public acquisition of land, regulatory approaches, and incentive-based approaches. Key lessons are gleaned from the literature on the implementation of growth management policies. Our assessment of lessons found: (1) a lack of empirical evaluations of growth management policies, (2) administrative efficiency and other details of policy implementation—rather than the general type of policy—are critical in determining their effectiveness, (3) the use of multiple policy instruments that reinforce and complement each other is needed to increase effectiveness and avoid unintended consequences, (4) vertical and horizontal coordination are critical for successful growth management but are often inadequate or lacking, and (5) meaningful stakeholder participation throughout the planning process and implementation is a cornerstone of effective growth management. Faced with a growing population and increasingly land consumptive development patterns, more effective policies and programs will be required to stem the tide of urban sprawl in the United States. We conclude with a discussion of potential federal roles in managing development and coordinating state, regional, and local growth management efforts.
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1. Introduction

Urban sprawl may be characterized as relatively low-density, noncontiguous, automobile dependent, residential and nonresidential development that consumes relatively large amounts of farmland and natural areas (Burchell et al., 1998). Many Americans are ambivalent about sprawl, holding conflicting and changing preferences (Myers and Gearin, 2001). The ideal of a single-family home on a large lot in the suburbs is still preferred by most (Malizia and Exline, 2000). Sprawl provides a variety of private benefits

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to new residents, developers, and other stakeholders, as well as potential social benefits such as more affordable housing costs from building farther out (e.g. Kahn, 2001).

But sprawl is increasingly viewed as a significant and growing problem that entails a wide range of social and environmental costs. Although the process of suburbanization in the United States dates from the early years of the 19th century, widespread apprehension about the impacts of sprawling development patterns did not emerge until the boom in suburban growth following World War II (Jackson, 1985). Concern about the environmental and social costs of urban growth grew in the 1960s and 1970s with the rise of the modern environmental movement and in recent decades has increased dramatically. A variety of social indicators point to this increase. For example, the remarkable growth in the number of state and local referenda on smart growth and open space preservation in the late 1990s indicates a surge in anxiety about the impacts of sprawl and interest in managing growth (Myers, 1999; Myers and Puentes, 2001). A recent study by the Surface Transportation Policy Project and Center for Neighborhood Technology (2000) found that in many sprawling US cities such as Houston and Atlanta, residents paid more for transportation than shelter. Attitude surveys provide another indicator of the public's increasing concern (e.g. Pew Center for Civic Journalism, 2000). Even traditional development interests have begun to voice alarm that the costs of sprawling development patterns have begun to outweigh the benefits, such as a Bank of America report claiming that "unchecked sprawl has shifted from an engine of California's growth to a force that threatens to *inhibit* growth and degrade the quality of life" (Bank of America, 1995, p. 1, emphasis in original).

The public sector response to growing concern about the undesirable impacts of sprawl has been the creation of a wide range of policy instruments designed to manage urban growth and to protect open space from development.[1] These policies have been implemented at the local, regional, state and, to a limited extent, national levels. Local governments have traditionally managed development through the basic planning and regulatory tools of comprehensive plans, zoning ordinances, subdivision regulations, and capital improvement programs (Porter, 1997). But the increasing social and environmental costs of sprawl have prompted local governments to adopt an array of additional tools.

Interest in the role of regional entities in growth management has increased in recent decades (Weitz and Seltzer, 1998). Regional agencies have been created to manage growth and protect open space on a larger scale and coordinate the fragmented efforts of individual municipalities and counties. For example, one of the early regional planning agencies in the US was the Minneapolis–St. Paul Metropolitan Council, created by the state legislature in 1967 in response to problems associated with rapid urban growth (Johnson, 1998). A number of substate and bistate regional growth management agencies have been created across the US. These regional entities have experimented with a wide range of innovative policy instruments.

State growth management efforts have developed in about a dozen states over the past 40 years, typically in areas that have experienced rapid urban development and its associated problems (Weitz, 1999). State growth management has evolved from an early emphasis on environmental concerns during the "quiet revolution" in state land-use management in the 1960s and 1970s (Bosselman and Callies, 1971) to a much broader set of social goals and related policy tools in the current era of smart growth (Gillham, 2002).

Even as state involvement in growth management has expanded, the federal government continues to play a minor role due to the lack of a national land-use policy and a long tradition in the United States of local authority in managing land use and development. But many national policies have significant *indirect* impacts on urban growth and sprawl (Marsh et al., 1996b; US GAO, 1999). The main finding of a survey of urban experts asked to rank the top 10 influences on the American metropolis over the last 50 years was the overwhelming impact of federal policies that intentionally or unintentionally promoted suburbanization and sprawl (Fishman, 2000).

[1] The term "open space" is used broadly in this paper to refer to natural resource lands such as farmland and timberland, environmental resources such as wildlife habitat and wetlands, and a variety of other socially valued landscapes such as scenic sites, wilderness areas, historic and cultural resources, and recreation areas.

Regardless of the governmental level at which they are applied, public policies for managing growth and protecting open space are at the center of the issue of sustainable development, i.e. making growth and development economically, environmentally, and socially sustainable. Growth management has been defined in many ways, but essentially it consists of government actions "... to guide the location, quality, and timing of development" (Porter, 1997, p. vii). A wide range of important issues are closely tied to growth management policies, including environmental conservation, quality of life, taxpayer protection, efficient urban form, transportation planning, urban revitalization, environmental justice, affordable housing, and others. A better understanding of the range of policy instruments available and the lessons that have been learned about designing effective growth management programs is therefore vital for planners and policy makers.

The objectives of this paper are two-fold. The first objective is to describe the main policy instruments that have been proposed and utilized for managing urban growth and protecting open space at various governmental levels. Given the number of policy instruments, the individual growth management techniques are not described in detail. Instead, this review briefly summarizes the main techniques and points to the extensive literature that describes them in much greater detail. We include both policies for managing urban growth and protecting open space because they are two sides of the same coin. It has long been realized that urban planning and open space preservation are part of the same process (Hollis and Fulton, 2002), and that the most effective way to protect open space is by effectively containing and managing urban growth (Alterman, 1997).

A second objective is to glean the key lessons learned from the literature on the implementation of growth management techniques, i.e. what has been learned about the effectiveness of growth management policies and programs? How can policy makers and planners design growth management programs that are effective in accomplishing their goals?

The methodological approach of this study is a multidisciplinary literature review and assessment of the diverse literature on public policies for managing urban growth and protecting open space. Many academic fields are relevant for such a multidisciplinary review, including economics, environmental law, evaluation studies, geography, landscape architecture, landscape ecology, planning, policy analysis, political science, sociology, urban studies, and others. We systematically reviewed recent books, journals, and "gray literature" (e.g. government technical reports, conference proceedings), in addition to the websites and online reports of policy and conservation organizations that focus on issues related to growth management and open space protection.[2]

In order to keep our review manageable given the magnitude of the literature, we limited our search in several ways. First, we focused on public sector policies for managing urban growth and protecting open space. Private and nonprofit organizations have also developed innovative programs and initiatives, but they are beyond the scope of this review. Second, only policy instruments applied in the United States were examined, to the exclusion of many novel and useful policies developed for the institutional contexts of other countries. Finally, this review focused primarily on relatively recent policies—typically proposed or implemented since the early 1980s—rather than dwelling on earlier policies that often had a much more limited set of objectives.

Before proceeding, we first provide a broad categorization of public policy instruments relevant for growth management and protecting open space. Such a framework for understanding policy instruments is needed to structure our review and to make sense of the large and diverse literature.

2. A classification of public policy instruments

Public policy instruments may be defined as "the set of techniques by which governmental authorities wield their power in attempting to ensure support and effect or prevent social change" (Vedung, 1998, p. 21). Policy analysts have proposed many classifications of policy instruments, ranging from minimalist two-part classifications to long, unstructured lists of specific instruments. This paper employs a three-part classification that has the virtues of simplicity,

[2] Contact the authors for a list of journals and websites reviewed.

mutually exclusive categories, and is exhaustive of the domain of public policy instruments for managing urban growth and protecting open space. The broad categories are (1) public ownership and management, (2) regulation, and (3) incentives.[3]

The first category, public ownership and management of some asset or activity, is often justified on the basis of the public goods characteristics of the asset and the failure of markets to adequately respond to the demand for such public goods. Non-exclusive property rights and indivisibility of consumption (i.e. use of the good by one person does not reduce the amount available for others) characterize public goods. Examples include national defense, interstate highways, public education, and many types of open space. Public provision of goods such as these reflects a social decision that they should be managed for the benefit of the general public.

A second broad type of public policy instrument is regulation. The defining characteristic of regulation is its obligatory nature—regulation involves an authoritative relationship between the individuals or groups being regulated and the government (Stone, 1982). Regulation is often backed by negative sanctions or the threat of sanctions. Incentive-based approaches are a third broad category of policy instruments, which involve either the handing out (incentives) or taking away (disincentives) of monetary or non-monetary material resources in order to change behavior. The distinguishing characteristic of incentive-based approaches is that no one is obligated to take a particular course of action. For example, a government subsidy for compact development does not require developers to build more compactly; the incentive simply makes it less expensive to do so.

[3] A fourth type of policy instrument is informational or educational campaigns: "Information as a public policy instrument covers government-directed attempts at influencing people through transfer of knowledge, communication of reasoned argument, and moral suasion in order to achieve a policy result" (Vedung and van der Doelen, 1998, p. 103). Information campaigns have been widely used as a public policy instrument with mixed success (Weiss and Tschirhart, 1994; Rice and Atkin, 2001). While transfer of information is certainly a part of growth management efforts, coordinated information campaigns carried out by the public sector have been lacking in the United States, and we therefore do not include this policy instrument in our review.

3. Public policy instruments for managing urban growth and protecting open space

As shown in Table 1, the commonly used public policy instruments for managing urban growth and protecting open space can be categorized by the three broad types of policy instruments and by the level of government (indicated in parentheses) at which they are typically applied. This list is not comprehensive; the toolkit of public policy instruments is large and growing, and innovative tools are being added on a regular basis, especially at the local level (e.g. National Association of Counties, 2001; Smart Growth Network, 2002; US EPA, 2002b). The policy instruments listed in Table 1 and described in the following sections are simply the most commonly discussed techniques.

3.1. Public acquisition of land for managing urban growth

Public acquisition of land is most often carried out for the primary purpose of protecting open space. But in and around urban areas, land acquisition almost always serves multiple goals and plays a significant and often overlooked role in shaping metropolitan form and managing urban growth (Hollis and Fulton, 2002; Ruliffson et al., 2002). Nineteenth century urban planners advocated systems of regional urban parks, parkways, and nature preserves. Today's urban and landscape planners advocate public investment in green infrastructure that shapes metropolitan form as surely as investment in gray infrastructure such as roads, sewers, and water lines (Benedict and McMahon, 2002). The popularity of this approach in the United States is indicated by the fact that 30 of the largest 50 metropolitan areas—and hundreds of smaller communities—have regional green space plans or are developing them (McMahon, 1999). Public land acquisition helps provide a framework for urban growth and can define where not to grow.

3.2. Regulatory approaches for managing urban growth

Regulatory approaches for managing urban growth include diverse strategies that have been used mainly at the local level (Table 1). A development morato-

Table 1
Public policies for managing urban growth and protecting open space

Policies for managing urban growth
Public acquisition
Fee simple public ownership of parks, recreation areas, forests, wildlife refuges, wilderness areas, environmentally sensitive areas, greenways, etc. (local, regional, state, national)
Regulation
Development moratoria, interim development regulations (local)
Rate of growth controls, growth-phasing regulations (local)
Adequate public facility ordinances (local, state)
Upzoning or small-lot zoning, minimum density zoning (local)
Greenbelts (local, regional)
Urban growth boundaries (local, regional, state)
Urban service boundaries (local, regional)
Planning mandates (regional, state)
Incentives
Development impact fees (local)
Development impact taxes, real estate transfer taxes (local)
Infill and redevelopment incentives (local, state)
Split-rate property tax (local)
Brownfields redevelopment (local, state, national)
Location efficient mortgages (local)
Historic rehabilitation tax credits (state, national)
Policies for protecting open space
Public acquisition
Fee simple public ownership of parks, recreation areas, forests, wildlife refuges, wilderness areas, environmentally sensitive areas, greenways, etc. (local, regional, state, national)
Regulation
Subdivision exactions (local)
Cluster zoning (local, regional)—incentives also sometimes used
Downzoning or large-lot zoning (local)
Exclusive agricultural or forestry zoning (local, state)
Mitigation ordinances and banking (local, state)
Nontransitional zoning (local)
Concentrating rural development (local)
Incentives
Right-to-farm laws (local, state)
Agricultural districts (local, regional, state)
Transfer of development rights (local, regional)
Purchase of development rights, conservation easements (local, state, federal)
Use-value tax assessment (state, national)
Circuit breaker tax relief credits (state)
Capital gains tax on land sales (state)

rium is a drastic growth management policy—usually implemented through a prohibition on the issuance of building permits—that is sometimes used in rapidly growing communities to buy time needed for planning long-term solutions to growth-related problems (Owens, 1990). Short of a moratorium, communities may adopt interim development regulations, or stop-gap ordinances, as another temporary solution to severe problems associated with rapid growth. This allows some forms of development to continue but postpones development that is causing problems until solutions have been studied and long-term regulations enacted (Zovanyi, 1998).

Other regulatory approaches sometimes used in communities experiencing very rapid development are rate of growth controls and growth-phasing regulations (Kelly, 1993; Nelson and Duncan, 1995). Rate of growth controls are typically ordinances that put an upper limit on the number of building permits issued annually. Growth-phasing regulations also impose development caps, but the timing of development is linked to the scheduled timing of public improvements needed for development (e.g. sewers, drainage, major roads, parks, and fire protection). In essence, growth-phasing programs translate the availability of public facilities into a maximum number of building permits in a given year.

Adequate public facility ordinances (APFOs) also require the availability of urban services and facilities needed for development, but they do not impose development caps. Instead, APFOs require that developments not be approved unless it is demonstrated—on a case-by-case basis—that adequate public facilities are available or will be available when the impacts of new development occur (Weitz, 1997). Local governments implement APFOs, but several states have included adequate public facilities requirements in their growth management programs. Florida was the first state to require all local governments to adopt APFOs for selected local services and facilities. This policy is referred to as "concurrency" in Florida because it requires public facilities to be available concurrently with the impacts of development.

Zoning is a core technique in urban growth management. In many cases, urban land may be zoned such that more dense development is prohibited. Small-lot zoning or upzoning allows small lots in urbanizing areas in order to encourage more intense development

(Nelson and Duncan, 1995). Upzoning is generally locally implemented but can be state initiated. Extensive upzoning occurred in urban areas throughout Oregon in the 1970s and 1980s as part of its statewide growth management program (Knaap and Nelson, 1992).

Three types of urban containment policies are identified in Table 1. Greenbelts, urban growth boundaries, and urban service boundaries (Pendall et al., 2002). A greenbelt refers to a physical area of open space—farmland or other green space—that surrounds a city or metropolitan area and is intended to be a permanent barrier to urban expansion. Greenbelts are typically created through public or nonprofit acquisition of open space or development rights, although they may be enforced by strict regulation of private property. The city of Boulder, CO has the longest running and most widely discussed greenbelt in the United States (Pollock, 1998; Lorentz and Shaw, 2000). Greenbelts have rarely been used in the United States but are common in some other countries (e.g. Hall, 1973; Bae, 1998).

In contrast to greenbelts, an urban growth boundary (UGB) is not a physical space but a dividing line drawn around an urban area to separate it from surrounding rural areas. Zoning and other regulatory tools are used to implement an UGB. Areas outside the boundary are zoned for rural uses, and inside for urban use. Unlike greenbelts, an UGB is typically drawn to accommodate expected growth for some period of time, and is periodically reassessed and expanded as needed. Oregon's Land Conservation and Development Act of 1973 required, among other things, the delineation of urban growth boundaries around all of the state's cities and around the Portland metropolitan area (Pendall et al., 2002).

Urban service boundaries also consist of a line drawn around a city or metropolitan area, but they are even more flexible than UGBs. An urban service boundary delineates the area beyond which certain urban services such as sewer and water will not be provided. They are often linked with adequate public facilities ordinances that, as described above, prohibit development in areas not served by specific public services and facilities. Some metropolitan areas using urban service boundaries use tiering systems that attempt to direct public infrastructure into new areas in a particular sequence.

Finally, at the regional and state levels, planning mandates have been used to require local governments to prepare and adopt comprehensive plans to guide land-use decisions. Hawaii was the first state to require land-use planning by local governments in 1961 (Callies, 1992). Land-use planning is now required in about half of all states, although the state role varies widely (Nelson and Duncan, 1995). Some states have a strong, interventionist state role in local planning that requires locally prepared plans be consistent with state land-use policies and goals, while others have a weak, noninterventionist state role. Metropolitan or regional planning mandates are also used in many areas. For example, all local governments in Minneapolis–St. Paul, MN are required to prepare comprehensive plans consistent with the Twin Cities Metropolitan Council's plans for highways, sewers, transit, airports, and regional parks (Johnson, 1998).

3.3. Incentive-based approaches for managing urban growth

Development impact fees are one of several types of development exactions—assessments levied on developers requiring them to contribute land, facilities, or funding to help pay for off-site capital improvements that benefit the contributing development (Peddle and Lewis, 1996). The main purpose of impact fees is to help finance off-site impacts and infrastructure costs of development, but they can be used to encourage more efficient development patterns. Jurisdictions can discourage development through higher impact fees in areas without infrastructure, and encourage development through lower fees in areas already served by public facilities (Nelson and Duncan, 1995). Development impact fees are sometimes classified as a regulatory tool because, unlike taxes, they derive from the police power of the state. In practice, however, they function as an incentive-based approach.

Tax policy has a powerful influence on land use and therefore may be an important tool for growth management. Development impact taxes, or improvement taxes, and real estate transfer taxes are used in some jurisdictions to help make development pay its own way. Like impact fees, revenues collected with these taxes are typically earmarked to provide public facilities and services made necessary by new development (Nelson and Duncan, 1995).

Incentives to encourage infill and redevelopment are needed to make urban containment policies effective. A variety of infill and redevelopment incentives have been used by cities in an effort to direct development into areas that are already urbanized. For example, the Smart Growth Initiative of Austin, Texas includes a waiver of development fees in a desired development zone to promote infill development (Lorentz and Shaw, 2000). Incentives used in other communities include subsidized land costs, tax exemptions or reductions, improvements to infrastructure, reduction of development fees, low-interest loans, assistance in securing zoning changes, and others (Nelson and Duncan, 1995; Porter, 1997). Some states have also included infill and redevelopment incentives in their growth management programs. For example, a central element of Maryland's Smart Growth Program is a policy to direct development into priority funding areas by offering state funding, including development loans and grants, for projects in these areas before development in other areas in the state (Gillham, 2002).

A split-rate or two-rate property tax is another approach that has been proposed to promote infill and redevelopment in urban areas (Gihring, 1999). Under such a system, a higher tax rate is applied to land values and a lower rate for improvement values such as buildings. This reduces the tax burden on land-intensive uses (e.g. apartments) and increases the tax burden on land-extensive uses (e.g. parking lots). A split-rate property tax would have the goals of (1) providing the incentive of lower taxes for capital investment in building improvements, and (2) taxing away the speculative value of holding undeveloped property within the urban growth area, thus promoting infill and redevelopment. Experience in several communities in Pennsylvania indicates that a split-rate property tax can be an effective tool to stimulate central city revitalization (Hartzok, 1997), but effective regulatory mechanisms are needed to prevent unintended consequences such as premature land conversion in outlying areas (Gihring, 1999).[4]

[4] Additional incentive-based approaches for encouraging infill and redevelopment include brownfields redevelopment (Simons, 1998; Miller et al., 2001), location efficient mortgages (Blackman and Krupnick, 2001), and state and federal historic rehabilitation tax credits (Beaumont, 1999).

3.4. Public acquisition of land to protect open space

Public acquisition and management is the policy instrument with the longest history of use for protecting open space in the United States. Public acquisition of open space occurs at local, regional, state, and federal levels, and is used for the creation or expansion of such diverse landscapes as parks, recreation areas, forests, wildlife refuges, wilderness areas, environmentally sensitive areas, greenways, and others. Public acquisition continues to be an important policy instrument for protecting open space, as demonstrated by the recent growth in state and local referenda on open space preservation (Myers and Puentes, 2001). Acquisition is the most certain public policy instrument for protecting open space, but it is also the most expensive (Kelly, 1993). Many techniques have been used to finance open space acquisition, ranging from various types of long-term bonds to lottery proceeds (Myers, 1993). Partnerships between nonprofit organizations and government agencies at all levels have become an increasingly important part of public acquisition of open space (Endicott, 1993).

Some authors categorize "partial rights" approaches such as purchase of development rights (PDR) as a land acquisition strategy (e.g. Kelly, 1993; Porter, 1997). But from the landowner's perspective, a PDR program provides an incentive to maintain open space. Hence, we include the acquisition of partial rights as an incentive-based approach to protect open space (discussed below).

3.5. Regulatory approaches to open space protection

A range of regulatory approaches has also been used for protecting open space. At the local level, subdivision exactions require developers to set aside environmentally sensitive areas (such as steep slopes, floodplains, and buffers around wetlands and streambeds) and areas for parks and playfields. Subdivision exactions are perhaps the most widely used regulatory approach to protecting open space (Porter, 1997). The land that has been set aside may be managed by a community association or by the local jurisdiction implementing the regulations. State and federal regulations that prohibit building in wetlands

and require development setbacks from wetlands, protect endangered species, and protect areas of critical environmental concern preserve open space as well as achieve other environmental goals (Gillham, 2002).

Cluster zoning or clustered development is another regulatory technique that has been used for decades at the local level for protecting open space, reducing the cost of development, and in some cases keeping land such as farmland and forest in existing use. Cluster zoning ordinances allow or require houses to be concentrated together on small lots on a particular part of a parcel of land, leaving the remainder in open space (American Farmland Trust, 1997). The undeveloped land may be owned by the developer, a homeowner's association, the local government, or a private nonprofit organization, and may be protected under a restrictive covenant. In some cases, incentives—such as permitting the construction of more houses than would otherwise be allowed—have been offered to developers to encourage clustered development (Porter, 1997).

Downzoning or large-lot zoning is an approach to protecting open space that stands in sharp contrast to cluster zoning. Rather than concentrating development on small lots, downzoning in rural areas requires minimum lot sizes large enough to discourage residential development (Nelson and Duncan, 1995). A key to effective use of this approach is to set lot sizes sufficiently large. Lot sizes have ranged from 20 acres (8 ha) per house in the eastern US to 640 acres (259 ha) per house in the West (American Farmland Trust, 1997). If minimum lot sizes are set too small to discourage residential development, the result will be fragmented parcels too small for commercial agriculture or forestry. Downzoning has often been used in efforts to preserve community character rather than protecting open space, and it may be purposefully exclusionary by increasing the cost of purchasing land or a home in a community (Gillham, 2002).

Exclusive agricultural or forestry zoning, or agricultural protection zoning, has been used widely at the local and state levels across the US to protect resource lands. Land is zoned only for agricultural or forestry use—usually on the basis of soil quality or locational factors—and other types of land uses are restricted or not allowed (American Farmland Trust, 1997). Large-lot zoning is typically a part of agricultural protection zoning. A problem with this policy instrument is that it generally creates a reduction in property values for which property owners have not been compensated. It is therefore sometimes combined with various types of compensation for landowners (Gillham, 2002).[5]

3.6. Incentive-based approaches to open space protection

Aldo Leopold recognized the importance of conservation incentives and the need for innovative incentive-based policy instruments in a 1934 essay (Leopold, 1991, p. 202). A large number of incentive-based policies for protecting open space have been developed and implemented in recent decades. Right-to-farm laws, for example, provide an incentive to farmers and ranchers to keep land in agriculture by protecting them from nuisance lawsuits that may arise as residential development encroaches into rural areas and suburban homeowners are exposed to odors, noises, and other impacts from farm operations (Bradbury, 1986). Without this protection from liability, farmer's operating costs would increase and agricultural practices would be restricted or prohibited. All 50 states have at least one right-to-farm law, and some local governments around the nation have enacted their own, stronger laws (American Farmland Trust, 1997). Although right-to-farm statutes help support the economic viability of agriculture, it is unclear whether they have been effective at maintaining the land base.

Agricultural districts—also known as agricultural preserves, agricultural incentive areas, and other names—are legally recognized geographic areas designed to keep land in agricultural use. They differ from exclusive agricultural zoning areas because enrollment in them is voluntary (Heimlich, 2001). Farmers who join an agricultural district may receive a variety of benefits, such as differential tax assessment, limits on eminent domain and annexation, protection against nuisance lawsuits, and eligibility for conservation easement programs (American Farmland

[5] Additional, less commonly discussed regulatory techniques for protecting open space include mitigation banking and ordinances (Marsh et al., 1996a), the use of nontransitional zoning (Nelson and Duncan, 1995), and concentrating rural development (Porter, 1997).

Trust, 1997). Agricultural districts have been created at the local, regional, and state levels.

Several approaches have been developed to protect open space through acquisition of development rights to land that is near urban areas and threatened by development, including transfer of development rights (TDR) and purchase of development rights or conservation easements. These approaches are based on the idea that ownership of land involves a bundle of rights—such as mineral rights, surface rights, air rights, development rights, etc.—that can be separated (Wiebe et al., 1997). Transfer of development rights allows the sale and transfer of development rights from a particular parcel of land to other properties. Future use of the original parcel is then protected from development by means of a permanent conservation easement or deed restriction prohibiting development. TDR programs may be mandatory but more often are voluntary in nature. They provide a means of compensating landowners for regulatory restrictions that reduce property values (Porter, 1997). There are, however, challenges with TDR programs, including administrative complexity and resistance from residents in areas designated to receive the transferred development rights and hence denser development. Economists have proposed market-driven TDR programs as a more efficient alternative (Thorsnes and Simons, 1999).

Purchase of development rights has become a popular approach for protecting open space by federal, state and local governments, and by a large number of private land trusts (Gustanski and Squires, 2000). The landowner voluntarily sells the development rights but retains title to the land, and a permanent conservation easement then prohibits future subdivision and development. Landowners may also donate development rights in exchange for tax benefits. Buckland (1987) and Daniels (1991) discuss the pros and cons of PDR programs for the purpose of preserving open space. The main disadvantage can be their relatively high cost in areas where land values and development pressures are high, although PDR can be a much cheaper option than outright purchase where costs and development pressures are low. Heimlich and Anderson (2001) estimate the cost for voluntary easements on all US cropland influenced by urban development at US$ 130 billion. Federal support of PDRs and conservation easements has increased in recent years. For example, the US Department of Agriculture (USDA) Forest Service's Forest Legacy Program is a partnership with states that encourages and supports acquisition of conservation easements on private forestland (USDA Forest Service, 2002).

Like PDR programs, the idea behind use-value tax assessment (also called preferential or differential tax assessment) is to provide landowners with an incentive to maintain their land in its current use rather than sell it for development. Land is taxed at a lower agricultural or forestry value rather than the higher values associated with developed uses (American Farmland Trust, 1997; Williams et al., 2004). Use-value assessment laws are enacted by states and implemented at the local level. Every state except Michigan has an agricultural use-value tax program. These programs typically include requirements that the owner be actively engaged in farming and have rollback provisions to recover lost tax revenues if the land is developed (Heimlich, 2001).[6]

4. Lessons learned

This section attempts to draw some key lessons from the literature with regard to questions about public policies for managing urban growth and protecting open space: What has been learned from formal and informal evaluations of the array of policy instruments? How can growth management and open space protection policies and practices be made more effective? What works and what does not work? While the following lessons are at a high level of generality due to the quantity and breadth of the literature, they offer insights for future policy directions.

4.1. Lesson 1: a lack of evaluations

Few empirical evaluations of policy effectiveness and impacts have been conducted (Howe, 1994; Nelson and Moore, 1996; Weitz, 1999). As a recent Brookings Institution report stated, the growth management literature tends to focus on describing policy

[6] Other incentive-based techniques for protecting open space include circuit breaker tax relief credits (American Farmland Trust, 1997) and capital gains tax on land sales (Daniels et al., 1986; Nelson and Duncan, 1995).

instruments and programs rather than evaluating their impacts (Hollis and Fulton, 2002). There have been a few ambitious evaluations, such as various assessments of Oregon's growth management programs (e.g. Abbott et al., 1994) and Burby and May's (1997) evaluation of the effect of state comprehensive planning mandates on local government land-use policy and management. But such evaluations have been rare and are typically narrow in their focus, such as Burby and May's topical focus on natural hazards planning.

The lack of impact evaluations is surprising at first glance because growth management techniques have been employed for many decades and the stakes are high, judging by the apparent costs of sprawl (Burchell et al., 1998) and the high level of public concern about its impacts (Pew Center for Civic Journalism, 2000). But there are several reasons for the shortage of evaluations related to inherent challenges in evaluating government programs and policies. First is the lack of knowledge of the counterfactual, i.e. something must be known about what would have happened in the absence of a policy or program in order to evaluate its effectiveness or impacts. Growth management policies are but one of many factors that influence land use and development patterns (e.g. the rate of economic growth, changes in preferences for housing, government policies intended to achieve other goals, and so on). Distinguishing between the effects of these and other factors from the effects of a growth management policy is a thorny task for evaluators.[7] An analyst may attempt to econometrically control for all the factors influencing land use change over time, but inability to identify all relevant factors and lack of high-quality data—or even reasonable proxy variables—will likely confound the policy evaluation (Heimlich, 2001).

Second, policies for managing urban growth often take years to implement and have impacts over long periods of time, and therefore short-term evaluations may be unable to detect the effects. Howe (1994, p. 284) observes that even for the Oregon land-use planning program, one of the longest-running state-level efforts, "... the true impact of the program in containing growth and protecting resource lands may not be apparent for several generations."

Third, the issue of scale is a factor. Policies for managing growth and protecting open space have been implemented at a variety of often overlapping spatial scales and jurisdictions. The policies in one area affect other areas, making it difficult to sort out the effects of a particular policy from that of policies at other spatial scales or in neighboring areas.

Finally, many growth management programs do not include explicit goals or targets, which makes evaluation difficult if not impossible. Determining whether or not a program has been effective in accomplishing its goals requires clarity regarding the goals and objectives. In addition, the goals and mix of policy instruments used in growth management programs typically evolve over time, further complicating policy evaluation (Innes, 1993). Despite the challenges, there is a need for careful *ex post* evaluation of the effectiveness and impacts of growth management efforts.

4.2. Lesson 2: implementation is critical

As with any public policy instrument, the specific details of how growth management is implemented—rather than the general type of policy—are critical in determining effectiveness and impacts. For example, Pendall et al. (2002, p. 31) conclude, "... the impact of urban containment policies depends largely on their implementation." An urban growth boundary that is tightly and rigidly drawn around existing development will differ in its effectiveness at containing growth and its impact on land prices, housing affordability, an other factors, than one that encompasses more than enough land to accommodate future growth or is frequently expanded. Similarly, an adequate public facilities ordinance that is carefully and continuously monitored by a local jurisdiction will likely be more effective at increasing the density of development than an identical APFO in a community that lacks the capacity to monitor. This obvious point is likely to hold for every type of growth management policy due to the large number of variables related to implementation that can determine effectiveness. Porter (1997) points out that even growth management techniques that appear conceptually simple may be difficult to successfully execute in practice.

[7] The changing social context also complicates evaluation in another way if, as often happens, the original goals of the growth management program become irrelevant: "An evaluation could reveal that the program was an adequate response to the original needs, but, contextual changes might make the program irrelevant in meeting current and/or future needs," (Howe, 1994, p. 283).

A critical aspect of implementation is administrative efficiency. Nelson and Duncan (1995) identified the administration of growth management programs as the key to effectiveness. Poorly administered growth management efforts often frustrate desirable development and make a community unattractive for developers. The result may be development leapfrogging to distant communities at higher environmental and social costs, exactly the opposite of what growth management seeks to achieve. Nelson and Duncan suggest that basic principles of administrative efficiency for growth management programs include streamlined permitting for development, nondiscretionary standards for approving development permits, and rational review of urban expansion.

4.3. Lesson 3: packages of complementary policy instruments

One of the clear lessons from the growth management literature is that the use of multiple, reinforcing policy instruments is far more effective than relying on a single technique. As Porter states, "The hallmark of *effective* growth management... is that these individual techniques are interlinked and coordinated in a synergistic manner rather than applied incrementally and individually" (1997, p. 13, emphasis in original). In fact, relying on a single technique may produce perverse results. For example, in the absence of zoning and other techniques to protect open space, purchase of development rights or conservation easements will likely result in a patchwork of protected lands that will be a magnet for development on unprotected adjacent lands (American Farmland Trust, 1997; Bowers, 2001).

Oregon's program to preserve farmland from urbanization is a good example of the use of reinforcing policy instruments. The program includes exclusive farm zones, farm tax deferral, right-to-farm laws, and urban growth boundaries. An evaluation of Oregon's program—comparing farmland protection in Oregon to Washington State and to the rest of the nation—concluded that Oregon's policies have been effective in protecting farmland from urban encroachment due to the way in which the policies reinforce and complement each other (Nelson, 1992). The evolution of smart growth strategies in recent years—based on a set of diverse and reinforcing principles—is an implicit recognition of this lesson. Smart growth efforts typically integrate planning, incentives, regulations, public acquisition of open space, and educational programs (Ducker and Owens, 2000). Maryland's Smart Growth Program, for example, utilizes an array of policy approaches including programs to encourage growth in existing developed districts (e.g. priority funding areas, brownfields redevelopment, live near your work, job creation tax credit, and expanded-transit programs) and programs to protect open land (e.g. the Rural Legacy and GreenPrint Programs) (Gillham, 2002).

4.4. Lesson 4: vertical and horizontal coordination

The first law of ecology, according to Commoner (1971), is that you cannot change just one thing because everything is connected to everything else. Extending Commoner's law from ecosystems to urban systems, the policies of one community affect and are affected by the policies of other communities, regions, states, and the nation. Therefore, successful growth management efforts must take into account and coordinate with the policy actions of others. The task of coordinating the actions of many levels of government, agencies, and non-governmental actors is at the heart of growth management (Innes, 1993).

Two dimensions of coordinating growth management and open space protection may be distinguished: vertical coordination between policies at different governmental levels, and horizontal coordination among neighboring communities, regions, or states.[8] With regard to vertical coordination, Nelson and Duncan (1995) state that growth management is most effective within a statewide context, so that each level of government coordinates their plans with other governmental levels. Horizontal coordination is needed to help avoid situations in which growth management policies in one jurisdiction undermine policies or create burdens in neighboring communities. For example, the unilateral actions of Boulder, CO in creating its urban greenbelt have led to development leapfrogging over the greenbelt and creating sprawl in nearby areas (Pendall et al., 2002).

[8] Innes (1993) adds time as a third dimension, i.e. coordinating development with infrastructure availability.

Both vertical and horizontal coordination of growth management efforts are often inadequate or lacking. Depending on how state growth management is defined, only about a dozen states have such programs and not all of these have effective coordination mechanisms (Weitz, 1999). Some states, including Oregon and Florida, require consistency between state land development plans and local plans. In other states, the state role in the review of local comprehensive plans is weak or nonexistent and consistency between state and local plans is not enforced. States also differ widely in the degree of coordination across state agencies with land use related responsibilities and in requiring their actions to be consistent with state growth management goals and programs (Innes, 1993; Weitz, 1999).

Many authors have suggested that the involvement of regional entities is a key to vertical coordination and the effectiveness of growth management (e.g. Ndubisi and Dyer, 1992; Nelson and Duncan, 1995; Porter, 1997; Gillham, 2002). But the role of regional bodies in coordinating growth management remains modest at best (Innes, 1993). Some form of regional governance and coordination is needed to transcend local boundaries and serve as a bridge between local communities and state government. A number of different types of regional organizations participate in growth management, including regional planning councils or districts, metropolitan transportation planning organizations, regional public service authorities, consolidated city/county governments, county planning organizations, and others (Porter, 1997).

4.5. Lesson 5: stakeholder participation

Finally, participation by citizens and other stakeholders has often been identified as a vital element for success of growth management and open space protection efforts: "The cornerstone of any effective growth management policymaking process is citizen involvement" (Nelson and Duncan, 1995, pp. 144–145). Meaningful, grassroots participation from the outset of the planning process and throughout implementation of plans is needed if community goals and concerns are to be incorporated and local land-use plans are to have legitimacy with those affected by the plans. Innes (1992) analyzed participatory group processes in three growth management states and found that they have been useful for a variety of important tasks, including framing the problem of growth management, placing the issues on the public agenda, writing growth management legislation, turning general policies into specific strategies, providing oversight and review of growth management laws as they are applied, and negotiating differences among conflicting stakeholders.

An effective approach to support and facilitate public involvement is to build it into each level in state growth management programs. In Oregon, for example, citizen advisory committees exist at the state, regional, county, and city level (Nelson and Duncan, 1995). Long-term stakeholder collaboration is also important. Public participation in growth management should be a continuing role that extends throughout the entire implementation process. Citizens and groups should be able to challenge land-use decisions and plan amendments. Watchdog groups, such as the many "1000 Friends" organizations, have often been effective at ensuring that policies are properly implemented and changes to plans are consistent with state growth management goals (e.g. Oliver, 1992; Liberty, 1996).

5. Concluding comments

The challenges planners and policy makers face in managing urban growth and protecting open space in the 21st century are daunting. A recent US General Accounting Office report on growth issues stated, "Faced with a projected 50-percent increase in the US population in the next 50 years, communities across the nation must address the challenges of planning for and managing growth" (US GAO, 2000, p. 5). Other projections of US population growth suggest a 50% increase by the year 2030 (US Census Bureau, 2000). In addition to the prospect of a burgeoning population, metropolitan areas are using significantly more land per person as they expand than was the case a few decades ago (Fulton et al., 2001). Innovative and effective policies and programs will be required to stem the tide of increasingly land-consumptive development. Public sector responses to sprawl—mainly at the local and state levels in the past—will have to be reconsidered.

A recurring suggestion to improve the effectiveness of growth management in the US is to advance a federal role in coordinating state, regional, and lo-

cal efforts. Land-use planning and policy have long been the domains of local governments in the US, but the time may be right for change. Local communities have been found to support changes in the federal role regarding coordination of growth management (US GAO, 2000). Some have suggested a federal role modeled after the federal Coastal Zone Management Program (e.g. Nelson, 1999; Rylander, 2000). Management of coastal areas under this program appears to be an effective approach (Hershman et al., 1999) and a model that could be used to improve the management of urban growth and protection of open space. Distinguishing features of the coastal program include: (1) a national level role of administration and oversight, and (2) a voluntary approach in which incentives in the form of grants are used to generate federal/state/local cooperation and coordination.

Potential federal roles in managing development include helping to increase planning capacity; coordinating local, regional, and state efforts; coordinating federal development activities and growth management goals; and providing greater funding of incentives for open space protection and infill development (Heimlich and Anderson, 2001). The US Environmental Protection Agency has also suggested a federal role that would include providing information, developing model programs and analytical tools for communities, removing federal barriers to smart growth, and creating new incentives to encourage smart growth (US EPA, 2002a). The beginnings of a new federal role can be seen in a variety of smart growth initiatives from the US Environmental Protection Agency, the President's Council on Sustainable Development, the Livability Agenda (Rylander, 2000), and similar efforts.

This paper has described the US public policy response to growing concern about the social and environmental impacts of sprawling development patterns. A panoply of policy instruments has been developed and experimented with in communities across the nation. The importance of holistic approaches and the reality that managing urban growth and protecting open space are two sides of the same coin are increasingly recognized. Whether or not these efforts—even with an enhanced federal coordination role—will be sufficient to make development environmentally and socially sustainable remains to be seen.

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An integrated analysis of the effectiveness of Tennessee's Forest Greenbelt Program☆

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Abstract

Concerns about the preservation of farm and forest land in the United States in the face of development pressures have led to many land preservation policies, including preferential, or use-value (UV), taxation of property. Use-value taxation permits landowners to continue deriving income from their land without having to pay the higher taxes occasioned by rising property values, which otherwise might force them to convert their land to other uses. Tennessee's Forest Greenbelt Program differs from many in that enrollment is voluntary and that it is targeted specifically to forest land owners. We developed a theoretical framework to examine the effectiveness of the program in protecting forested land as a function of several criteria: (1) owners knowing about the program, (2) owners deciding to enroll once they learn about the program, and (3) owners deciding not to convert after enrolling in the program. In addition, the Greenbelt Program was considered cost-effective only if it primarily targeted those parcels facing conversion pressure. In an application of this framework using a probit analysis of landowner survey and tax data, we found that that the Greenbelt Program failed in protecting forested lands. Few knew about the program, and not all those who knew enrolled. Finally, the large majority of enrollees reported that the Greenbelt Program failed to affect their decisions to convert land in the future, and we found no evidence that those who reported some influence of the Greenbelt Program were influenced by the program's economic incentives.
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1. Introduction

Planners and policymakers in many urbanizing countries are concerned over the conversion of farm and forest lands to uses that diminish their long-held commodity and non-commodity values. In the United States, a number of states have adopted preferential taxation policies that encourage the preservation of these lands. Under a preferential or use-value taxation policy, landowners who keep their land in either an agricultural or forestry use are taxed on the basis of the land's value in that use rather than at its market value, which may reflect the land's development value. The

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hope of policymakers is that this tax subsidization of farm and forest lands will provide sufficient incentives to prevent the conversion of farm and forest land to commercial and residential use. In this paper, we examine how effective Tennessee's preferential taxation program for forested lands, known as the Forest Greenbelt Program, has been in preserving the state's forests.

Tennessee's legislature established the Greenbelt Program with passage of the Agricultural, Forest, and Open Space Land Act of 1976. Although many states automatically apply preferential taxation to all farm and forested lands, Tennessee's voluntary Greenbelt Program requires that forest and farm landowners file first with the county tax assessor to establish eligibility. For owners of forest land to qualify, their parcel must be a "forest unit engaged in the growing of trees under a sound program of sustained yield management, or any tract of fifteen or more acres ($\geq$6 ha) having tree growth in such quantity and quality and so managed as to constitute a forest" (State of Tennessee, 1976). The law allows an individual owner to enroll up to 1500 acres (600 ha) of land per county. By enrolling, the owners agree not to change the use of the land and, in return, their land is assessed at its use value instead of market value. If owners withdraw from the program, change the land's use, or sell their Greenbelt parcels to someone who converts the land to another use, owners must pay a penalty equal to the tax savings for the past 3 years.

This paper is organized as follows. First, we review the literature on use-value taxation and evaluate the evidence to date of the effectiveness of use-value taxation programs. Second, we outline a theoretical framework to understand both the enrollment decision and the circumstances under which the Greenbelt Program will alter behavior. Third, we present the survey and tax data that are used to evaluate the program's effectiveness. Fourth, we estimate the probit models of enrollment. Fifth, we present a series of empirical tests to determine the effectiveness of the program based on the tax data and subjective responses from the survey. The paper concludes with a summary of key findings and a discussion of possible reforms that might help focus the program so as to enhance its performance.

2. Literature review

An important conclusion of the theoretical literature is that use-value taxation delays conversion of land to more developed uses but does not prevent it. Anderson (1993) concludes that use-value taxation will delay conversion longer the greater the difference is between the use value and the developed value of the land, and the higher the tax rate. Using search theory, Tavernier and Li (1995) show that use-value taxation preserves agricultural land only over a certain range. Tavernier et al. (1996) also use search theory to examine the role risk preference plays in farmland preservation. In their theoretical model, farmland preservation policies that increased the value of land in farm use have a greater effect if agents are not risk averse, and protect the interests of land speculators more effectively than of farmland and open-space held by farmers.

Less theoretically formal assessments tend to agree. Nelson (1992) concludes that, because owners never have to repay 100% of their tax savings should they convert their land or sell to someone who does, they use tax relief programs to speculate. For similar reasons, Stokes et al. (1997) state that preferential assessment is an expensive and inefficient way to preserve open space. Hickman's (1982) analysis of the fiscal effects of the Tennessee Greenbelt Program's property tax finds that many properties in the program lie outside of areas experiencing development pressure, and that the program is unnecessary in those cases. Moreover, in areas with high enrollments the program tends to be costly in terms of lost tax revenue and the shifting of the tax burden to non-enrolled parcels.

Few empirical studies of use-value taxation exist, and almost all of the research has focused on farm use-value taxation policies. Parks and Quimio's (1996) econometric study of farmland preservation in New Jersey (using state level data) showed that preferential taxation of farmland may have a small impact on conversion in an environment of increasing values for alternative uses. By examining changes in trends for the proportion of a county devoted to farming, Ferguson's (1988) study of four Virginia counties from 1920 to 1980 concluded that use-value taxation only appeared to have had an impact in one, Virginia Beach. Morris' (1998) econometric analysis of about 3000 counties from 1959 to 1987 concluded that preferential

assessment delays conversion of farmland. The effects increase the longer a program is in existence, so that after 20 years approximately 10% more land is in farming than would be otherwise. To the authors' knowledge there are only two empirical studies that have explored preferential assessment for forestland. Brockett et al. (2003) examined Forest Greenbelt owners' attitudes and behaviors, as well as the economic effectiveness of preferential assessment in one Tennessee county for 1 year and concluded that the program largely has provided a windfall to landowners without bringing a substantial change in their decision to convert or preserve land. In addition, Gottfried and Haddican (1999) simulated the Greenbelt Program under various assumptions and showed that it provided very limited protection to forest lands. They also showed that in the face of land appreciation the program only delays conversion for a limited period.

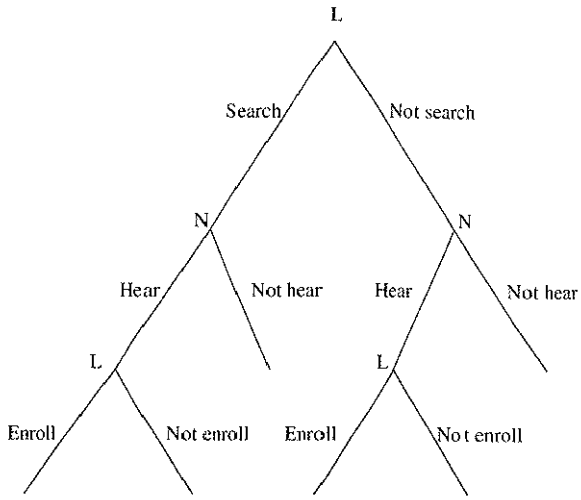

Fig. 1. Sequence of events that determine the likelihood of a landowner joining the Forest Greenbelt Program.

3. Theoretical framework

In this section, we develop the theoretical framework for the empirical analysis of program effectiveness that follows. The effectiveness of the program in preventing conversion will depend on several factors: (1) knowledge of the program; (2) enrollment into the program given knowledge about it; and (3) a change in land use decisions given enrollment.

To join the Greenbelt Program, a landowner must develop a written management plan that requires out-of-pocket costs of about US$ 200. Our survey of landowners provides strong evidence that tax assessors do not strictly enforce the requirement for a management plan, so the out-of-pocket cost for many landowners is nil. Because the cost of joining the Forest Greenbelt Program is small and the tax subsidy amounts to an interest-free loan, everyone who qualifies for the program should join. But, in fact, only a small proportion of eligible landowners actually decide to join the program. The primary reason, as we show below with evidence from our survey of landowners, is that landowners are unaware the program exists. This finding suggests that the likelihood of joining the program depends on a sequence of three events that are shown in Fig. 1. First, a landowner ('L' in the figure) decides whether or not to search for information about land management, including government subsidy programs like the Forest Greenbelt Program. Second, 'nature' ('N' in the figure) chooses whether or not information about the Forest Greenbelt Program is revealed. The likelihood that landowners find out about the program should depend on the resources invested in search and the search strategy. And, third, once landowners hear about the program, whether through a search process or sheer luck, they make a decision whether or not to enroll in the Greenbelt Program.

The first decision is whether or not to actively seek out information about managing one's land. Applying a cost–benefit framework to the search decision suggests that landowners will be more likely to search the greater the value of their land, since the benefits from a search are likely to be proportional to land value. We might also expect that landowners who actively manage their land (e.g. tree farming) and who directly seek information to help in their management might anticipate higher expected benefits from the information discovered in a search compared to landowners (e.g. speculators) who do not actively manage. Although both active and inactive landowners have reason to search for information on tax subsidies, only active landowners expect the additional benefit of discovering information beneficial to their management of the land. In addition, we might expect more educated landowners to be likely to search because they

may be more familiar with or have better access to knowledge sources such as the Internet. Finally, absentee landowners are less likely to search because the costs of searching from a remote location will be higher compared to landowners who live on or near their land. The variables likely to affect the probability of search and their predicted signs are shown in Eq. (1), where P (search) represents the probability of search:

$$P(\text{search}) = f(\underset{(+)}{\text{land_value}}, \underset{(+)}{\text{education}}, \underset{(-)}{\text{absentee}}, \underset{(+)}{\text{active}}) \quad (1)$$

'Land_value' and 'education' are both continuous variables, while 'absentee' and 'active' are dichotomous variables for whether the owner resides in the area and whether the owner is actively managing the land, respectively.

The final decision, if 'nature' chooses to reveal information about the Forest Greenbelt Program, is whether to join the Greenbelt Program. Given that they have heard about the program, it is more likely that landowners who experience the greatest tax subsidy (those with higher valued land) will join the program. Landowners with smaller costs of joining should also be more likely to enroll. For those landowners unaware that the management plan requirement is not enforced, costs will be lower for those who actively manage their land and perhaps already have a management plan.[1] Absentee owners, who must make costly arrangements either to be on site to enroll or to hire an agent, will be less likely to enroll. The variables likely to affect the probability of enrollment, given that one knows about the program, and their predicted signs are shown in Eq. (2), where P(enrollment|knowledge) represents the probability of enrollment, given that a landowner has knowledge about the program:

$$P(\text{enrollment}|\text{knowledge}) = f(\underset{(+)}{\text{tax_subsidy}}, \underset{(-)}{\text{absentee}}, \underset{(+)}{\text{active}}) \quad (2)$$

[1] The state mandated fee is US$ 200 for all Greenbelt participants. Still, the indirect costs are likely to be lower for those landowners who actively manage their land because an existing management plan and existing contacts with professional foresters will facilitate completing the Greenbelt management plan for the state.

'Tax_subsidy' is a continuous variable, while again 'absentee' and 'active' are dichotomous variables for whether or not the owner resides in the area and whether or not the owner is actively managing the land, respectively.

Because any qualifying individual can join the Greenbelt Program, the conversion behavior of some (if not most) participants in the program is unaffected by enrollment. This group of unaffected landowners would not have converted their land even without the incentives provided by the program. The landowners that should be targeted by a cost-effective forest protection program are those who would have converted in the absence of the program (referred to as targeted landowners, henceforth). For these targeted landowners, the gain in converting their land prior to participation exceeds the 'use-value reservation premium,' a condition expressed in inequality (3):

$$\text{MV}_i - \text{UV}_i > r_i \quad (3)$$

where "MV" is the market value of developed land, "UV" the present value of future income available from forested land, and r_i is the use-value reservation premium, defined as the monetarized value of the intangible benefits (e.g., conservation) from keeping the land forested. Note that r_i is assumed to be independent of use-value. After targeted landowners enroll, the Forest Greenbelt Program affects incentives to convert land to a non-forested use. To understand how the program alters incentives, we need to model the targeted landowner's conversion decision after enrollment.

The net monetary benefit from converting forested land (NMBC) for Greenbelt participant i can be expressed as

$$\text{NMBC}_i = \text{MV}_i - \text{UV}_i - \text{PV}_{i(\text{tax subsidy})} - \text{PV}_{i(\text{tax penalty})}, \quad (4)$$

where '$\text{PV}_{i(\text{tax subsidy})}$' is the present value of tax savings from participation and '$\text{PV}_{i(\text{tax penalty})}$' is the penalty that must be paid by a participant that converts. A participant will not convert if condition (5) holds:

$$\text{NMBC}_i < r_i. \quad (5)$$

Participation in the Forest Greenbelt Program only prevents conversions for those Greenbelt participants

where both conditions (3) and (5) hold. Condition (3) may not hold for many Greenbelt participants either because the program offers insufficient tax incentives (i.e. those owners who satisfy condition (3) have already converted and, therefore, cannot participate) or because very few landowners have incentives to convert in the absence of the program. For participants that do not satisfy condition (3), the program has no effect on conversion behavior. Therefore, any assessment of program effectiveness has to determine how many Greenbelt participants satisfy both conditions (3) and (5) and are changing their conversion behavior in response to Greenbelt incentives.

4. The survey data

The survey data used for the analysis in this paper covers Franklin, Marion, and Grundy counties in Southeastern Tennessee, which have significant acreage on the heavily forested Cumberland Plateau. All three counties are predominantly rural and at least two are experiencing rapid economic growth. This growth has been accompanied by land use conversion and a loss of forested land on and off of the Plateau.

In the spring of 1999, all private landowners in the three-county area were sent a questionnaire. Of the 754 surveys sent, 168 were returned—a 22% response rate. A comparison of the survey data from the three-county area with enumerated state tax data on all the parcels in the three county area suggests that on several key variables the survey data is representative. For example, 33% of the landowners in our sample have parcels more than 100 acres compared to 35% for the total population.

Table 1 provides a summary of the data broken down by Greenbelt participation. We report P-values for t-statistics and Pearson's Chi-square statistics to test for differences between the two groups. In the discussion of statistical tests in the remainder of the paper, we use a 10% threshold to determine significance. The survey's respondents hold some 168,000 acres or 18% of the total land area in the study area. Of the surveyed parcels, approximately 24% are enrolled in the Greenbelt Program. While the income distribution for the two groups are similar, there is a significant difference in the educational distribution. Greenbelt landowners are more likely to have some post-graduate education and are less likely to have dropped out of high school. There are also some significant differences in ownership objectives between the two groups. Greenbelt landowners more likely own land for conservation and recreation purposes while non-Greenbelt landowners more likely own land for investment and 'other' purposes. In addition, non-Greenbelt owners are significantly more likely at a 10% level to be absentee owners, who live outside the three-county area.

Table 1
Summary statistics for Greenbelt and non-Greenbelt parcels

Summary statistics	Greenbelt	Non-Greenbelt	P-value
Total acres	40873	127582	
Average acres	294	514	0.395
Value/acre (US$)	1179	1426	0.204
Income (%)			0.467
Under US$ 40K	27	30	
US$ 40–80K	37	30	
Over US$ 80K	36	40	
Education (%)			0.034**
H.S. dropout	2	7	
H.S. grad. only	17	14	
College	35	42	
Post-graduate	46	37	
Absentee	38	45	0.067*
Objective (%)			0.03**
Timber	12	10	
Investment	21	33	
Recreation	26	18	
Conservation	26	18	
Other	15	21	
Freedom over land use (%)	26	20	0.115

Greenbelt: $N = 156$, non-Greenbelt: $N = 255$.
* Significant at a 10% level.
** Significant at a 5% level.

Why are less than a quarter of qualified participants enrolled in the program? This seems surprising given the low cost of enrollment compared to the benefits accrued. Once enrolled, owners receive tax savings for as long as they do not convert their land to a non-forested use. In addition, if they convert, landowners simply pay back the tax savings for the last 3 years with no interest. So at worst the tax savings for the previous 3 years are a no-interest loan. The only reason not to participate is the small upfront cost for the required management plan. In practice, many Greenbelt Program participants never file a management plan. Therefore,

everyone should participate, assuming that it is widely known that the management plan provision is not enforced.

5. Explaining enrollment decisions

Table 2 provides the results of a probit model that attempts to explain what determinants affect the probability of enrollment without controlling for the likelihood of searching or hearing about the program. The dependent variable is a dichotomous variable that takes the value 1 if enrolled and 0 if not enrolled. Each estimate reported in Table 2 gives the change in the probability of enrollment for a one unit change in the associated exogenous variable. Variables relating to ownership objective and freedom over land use were the only ones that were significant in helping to explain enrollment decisions. Owners who have investment as an objective are significantly less likely to enroll compared to those with timber as an objective.[2] As discussed in the theoretical section, landowners who hold their land for investment purposes are less likely to actively manage their land and therefore less likely to come into contact with information about the Greenbelt Program. Additionally, libertarian owners, who believe they should be free from government interference in using their land, are more likely to enroll in the program. This result appears paradoxical at first since we might expect libertarians to be less likely to enroll in a government program. However, the Greenbelt Program reduces taxes so many libertarians might view the program as a means of getting back what is rightfully theirs. Of the remaining variables, neither income, education, nor absentee status had any effect in explaining the probability of enrollment.

Table 3 provides some insights as to why more landowners do not enroll in the Greenbelt Program. Nearly 80% responded either that they had never heard of the program or that they did not have sufficient information about the program. Only 4% cited a reason ('benefits insufficient' or 'too much trouble') indicating that non-participation reflected a cost–benefit calculus. These responses suggest the importance of the decision framework we discussed above in Fig. 1 and that a fruitful approach might be to estimate probit models for each step in the decision process, which we do below.

The first step in the decision process is acquiring information about the program. Table 4 shows the results of a probit model that attempts to explain the probability of receiving information from public or private institutional sources on land management. The dependent variable ('advice') takes on a value of 1 if the landowner has received information from a private or public institution and a value 0 if the landowners has

Table 2
Estimates for probit model where enrollment status is the dependent variable

	Coefficient	S.E.	*P*-value
Land value	6.39E−09	2.11E−07	0.98
Income			
<US$ 40K	–	–	–
US$ 40–80K	0.207	0.238	0.38
Over US$ 80K	−0.052	0.258	0.84
Education			
H.S. or less	–	–	–
College graduate	0.284	0.239	0.24
Post-graduate	0.139	0.253	0.58
Absentee	−0.233	0.201	0.25
Objective			
Timber	–	–	–
Investment	−0.886	0.339	0.01**
Recreation or conservation	0.005	0.295	0.99
Other	−0.630	0.363	0.08*
Freedom over land use	0.467	0.227	0.04**

$N = 242$.
* Significant at a 10% level.
** Significant at a 5% level.

Table 3
Reasons landowners gave for why they are not enrolled in the Greenbelt Program

Reason for not enrolling	Responding (%)
Have not heard of program	72
Benefits insufficient	2
Too much trouble	2
Not enough information	7
Do not want government interference	3
Other	7
No answer	7

$N = 237$.

[2] The 'timber' objective is the left-out dummy variable in the probit model.

Table 4
Estimates for probit model where seeking advice is the dependent variable

	Coefficient	S.E.	*P*-value
Land value	5.26E−07	3.17E−07	0.10*
Education			
H.S. or less	–	–	–
College	0.536	0.202	0.01**
Post-graduate	0.492	0.209	0.02**
Absentee	−0.284	0.168	0.09*
Objective			
Timber	–	–	–
Investment	−0.815	0.287	0.00**
Recreation or conservation	−0.567	0.339	0.04**
Other	−0.938	0.329	0.00**

$N = 295$.
* Significant at a 10% level.
** Significant at a 5% level.

received advice from friends or has not received any advice at all. Since information from private or public institutional sources is sought out, this model can conceptually be thought of as explaining the probability of seeking advice and an empirical test of the hypotheses implicit in Eq. (1) presented earlier. Table 4 provides support for all of the variables included in the model. As hypothesized above, landowners are significantly more likely to seek advice if their land is highly valued, presumably, because the expected benefit of searching increases with the value of the land. In addition, landowners with a college degree are more likely to seek advice compared to persons without a college degree. As hypothesized above, this might be expected because education encourages one to be more resourceful. Interestingly, there appears to be no significant difference between the coefficient for college graduates and that for post-graduates. Also, landowners who primarily manage their land for objectives that require less active management are less likely to seek information than landowners who manage their land for timber. This result is significant and is consistent with the hypothesis that the expected benefits for persons who actively manage their land are higher compared to those landowners who are not actively managing their land.

According to the enrollment decision tree in Fig. 1, 'nature' determines whether or not landowners hear about the program after they search for information. Once landowners hear about the program, they then must decide whether to enroll or not. Recall that Eq. (2) shows that enrollment is considered a function of tax subsidy, absentee, and active land management variables. Table 5 shows the results from three probit models that test the hypothesized relationship of these variables with enrollment. Model A includes only those respondents who knew about the program, regardless of whether or not they searched for

Table 5
Probit model coefficient and standard error (in parentheses) estimates for enrollment status where only landowners with program knowledge are included

	A	B	C
Land value	−1.96E−07 (2.44E−07)	−1.79E−08 (2.85E−07)	−5.30E−07 (9.24E−07)
Education			
H.S. or less	–	–	–
College	−0.036 (0.324)	0.035 (0.494)	0.123 (0.521)
Post-graduate	−0.201 (0.328)	0.156 (0.556)	−0.143 (0.502)
Absentee	0.147 (0.270)	−0.151 (0.408)	0.302 (0.406)
Objective			
Timber	–	–	–
Investment	−0.228 (0.409)	0.389 (0.648)	−0.372 (0.714)
Recreation or conservation	0.539 (0.370)	0.931 (0.619)	0.576 (0.596)
Other	0.115 (0.468)	0.985 (0.853)	0.432 (0.731)
Freedom over land use	0.371 (0.293)	0.010 (0.513)	0.609 (0.473)
N	117	52	53

A: model including only respondents who new about the Greenbelt Program, regardless of whether or not they searched for information. B: model including respondents who searched for information. C: model including respondents who did not search.

information. In models B and C, we partition those who have program knowledge into those who searched for information (B) and those who did not search (C) because of the possibility that these two groups may have different enrollment behavior. We did not have the data to compute the tax subsidy available to each landowner, so we used land value as a proxy. What is most striking about these results is that many of the coefficients have the wrong sign and none is significant at a 10% level. The weak results in these models may be due to the small number of observations, or they may reflect that once a landowner hears about the program, whether or not they join is a random event.

6. Understanding program effectiveness

The survey of Cumberland Plateau landowners included a number of questions to determine the effect of the Forest Greenbelt Program on conversion. One question asked landowners to self-report the influence of the Forest Greenbelt Program on their behavior. Only about 15% of the 152 responding to this question stated that the Greenbelt Program was the major influence, suggesting that the Greenbelt Program has little effect on conversion behavior. About 48% responded that the major influence was a "desire to conserve land," suggesting that the non-tangible benefits (r) of keeping land forested are high. Of the remaining responses, 9% stated they saw other types of uses as unprofitable, 2% mentioned other incentive programs as influencing their decisions, and 26% listed various other reasons.

Another question asked respondents about the degree of influence the Greenbelt Program had on their conversion decision. Only about 19% responded that the impact was strong, while another 15% responded that the Greenbelt Program had some impact. About 66% responded that the program had little or no impact. Although the responses to both of these questions indicate that the majority of Greenbelt participants would not have converted in the absence of the Greenbelt Program, 15–20% of owners self report that the Greenbelt Program is a major factor in keeping their land forested.

Social scientists are generally skeptical of survey responses that do not represent actual behavior. To gauge the likelihood that the survey responses reflect actual behavior, we conduct a series of tests below to determine if owner's responses are consistent with the economic incentives provided by the Greenbelt Program. The subjective responses to these two questions along with conditions (3) and (5) from above provide for an empirical test of Greenbelt effectiveness in altering incentives. To formulate this test, we can rewrite condition (3) as Eq. (6):

$$I^* = \mathrm{MV}_i - \mathrm{UV}_i - r_i > 0 \tag{6}$$

If inequality (6) holds so that $I^* > 0$ for Greenbelt participant i, then the participant would have converted forested land to a non-forested use in the absence of the program. If $I^* < 0$, then the program is unnecessary for the participant. All Greenbelt participants will satisfy condition (5), which we can rewrite as Eq. (7):

$$J^* = \mathrm{NMBC}_i - r_i < 0 \tag{7}$$

It will be the case that $J^* < 0$ for all Greenbelt participants. Otherwise, landowners would have converted and would no longer be participating in the Greenbelt Program.

Eqs. (6) and (7) form the basis for empirical tests of whether the Greenbelt Program is influencing landowner behavior as predicted by theory. If the program is having an impact on conversion, there should be a positive relationship between I^* and MV − UV and a negative relationship between I^* and r for program participants. We have a dichotomous variable in our data for whether $I^* > 0$ or not, which takes the form of the self-reported influence of the Greenbelt Program on behavior. We also have data on MV − UV, but r is not observable. Eq. (6) implies the following hypotheses regarding self-reported responses to program effectiveness.

- Owners are more likely to report that the Forest Greenbelt Program is the major influence in keeping their land forested (i.e., $I^* > 0$) the higher the difference between market value and use value (MV − UV).
- Owners are more likely to report that the Forest Greenbelt Program had a strong or somewhat strong impact on keeping their land forested (i.e., $I^* > 0$) the higher the difference between market value and use value (MV − UV).

Eq. (7) provides the basis of an empirical test for whether the Greenbelt Program affects the willingness

Table 6
Probit model coefficient and standard error (in parentheses) estimates of Greenbelt effectiveness as a function of the strength of the incentive to convert

Dependent variable	Coefficient on MV − UV	Coefficient on NMBC	*P*-value
Greenbelt major influence in keeping lands forested	0.0002 (0.0002)		0.13
Impact of Greenbelt in preventing conversion	−0.0002 (0.0002)		0.21
Plans to convert in 5 years		0.0002 (0.0002)	0.23

of a participant to convert. According to Eq. (7), Greenbelt participants who plan to convert are those landowners for whom $J^* > 0$ in the future. We have data on Greenbelt participants who plan to convert in the next 5 years. If we interpret a stated intention to convert in the next 5 years as $J^* > 0$, then there should be a positive relationship between that stated intention and the net money benefits of conversion (NMBC). In the context of our data, we can state this hypothesis as follows.

- Owners are more likely to report that they have plans to convert in the future ($J^* > 0$) the higher their NMBC.

Eqs. (6) and (7) can be estimated for Greenbelt participants using probit analysis. Because of the way that landowners select into the Greenbelt Program, MV − UV and NMBC are not independent of r for Greenbelt participants. In particular, landowners in the Greenbelt Program with a higher value of MV − UV have a greater incentive to convert their land and, therefore, must have a higher value of r to have incentives to join the program, compared to those landowners with a lower value of MV − UV. Given that we do not model this selection process directly, our estimates can be viewed as a conservative test of Greenbelt effectiveness.[3]

We test these hypotheses and present the results in Table 6. Two of the three models have the theoretically predicted sign but none of the models has a significant coefficient. None of these reported models includes controls (i.e., other variables that might also explain responses), and the relationships become weaker when controls are included. As mentioned above, however, the coefficients likely suffer from bias so that no strong conclusions can be drawn from these tests.

[3] We believe the selection process will bias our coefficients downward because cov(MV−UV, r) > 0 and cov(NMBC, r) > 0.

A second approach to testing the effectiveness of the Greenbelt Program is to take advantage of a natural experiment due to widespread ignorance about the program. Let group A be those landowners who do not know about the program, are not enrolled in the program, and claim they would have enrolled if they had known. Let group B be those landowners who know about the program and have joined the program. Now, assume that the members of groups A and B have been randomly selected into their groups. If the Greenbelt Program is effective, it should follow that those who belong to the program (group B) will be less likely to have plans to convert compared to those who do not belong (group A). Our survey data allow us to conduct this natural experiment because we have data on group A (owners who responded they had no knowledge of the Greenbelt Program but expressed strong interest in joining such a program) and group B (Greenbelt participants). Table 7 shows the results of this natural experiment. The dependent variable in these models indicates plans to convert in 5 or 10 years and the independent variable indicates membership in the Greenbelt Program. All of

Table 7
Influence of Greenbelt membership on conversion plans comparing those enrolled with a quasi-control group who would have enrolled had they known about the program

Dependent variable	Coefficient on dummy variable for Greenbelt status	S.E.	*P*-value
Plans to convert in 5 years	0.0455	0.2704	0.87
Plans to convert in 5 years	0.0156[a]	0.3261	0.96
Plans to convert in 10 years	0.3533	0.2442	0.148
Plans to convert in 10 years	0.4203[a]	0.2839	0.139

[a] Controls included.

the coefficients on Greenbelt membership have the wrong sign and none is significant. The results are not sensitive to the inclusion of controls.

Neither of these approaches allows us to conclude that the Greenbelt Program is effective in preventing the conversion of forested land to a non-forested use by altering economic incentives.

7. Conclusions

With what appears to be growing public concern about preserving the nation's forests and the preservation of biodiversity, an important research goal is to assess the effectiveness of current government programs in achieving these goals. In this paper, we show that perhaps the biggest failure of the Tennessee's Forest Greenbelt Program is that many people who are eligible to participate do not know about it. Regardless of how effective the program is in changing behavior, it will obviously not be effective if few people participate in it.

Greenbelt Program participants vary from nonparticipant landowners in some significant ways. In terms of the knowledge component of our theoretical framework, our probit analysis shows that those most likely to seek advice on how to manage their land tend to have more highly valued land, have more education, live in the region, and manage primarily for timber. Landowners who actively seek such advice are more likely to encounter someone, such as an extension agent or forester, who will tell them about the program. Consequently, knowledge about the program tends to reside in more educated, local landowners who actively manage their land.

Once landowners know about the program, however, we can find no explanatory variables that are statistically significant in explaining enrollment. If enrollment indeed is random, then the Greenbelt Program must appeal to all landowners—as indeed it should. It is a money-saving proposition for all, with few strings attached.

Finally, we find little evidence that the Greenbelt Program convinces landowners not to convert who otherwise would plan to convert their land to some non-forest use. Although some landowners report that the program has a major influence on their conversion decision, there appears to be no relationship between reporting a major impact and the strength of the economic incentives to convert in the absence of the program. Moreover, there appears to be no difference in conversion plans between program members and those nonmembers who claimed they would have joined if they had known about the program. This lack of evidence could be because of biased coefficients, because the number of landowners on the margin whose behavior could be affected by the program is small or, because the subsidy is too small to matter.

The above analysis leads to the conclusion that the Greenbelt Program is ineffective on several grounds. First, most landowners do not know about the program. Second, the difficulty of finding out about the program results in only a relatively small subgroup of owners benefiting from it—the more highly educated, local landowners who own and manage high-valued land. Third, participation in the program does not affect whether owners will convert their land within 5–10 years. Finally, the program fails a basic test of cost-effectiveness. By failing to target only those landowners who most likely will convert, the program forces counties to forgo property tax revenue in return for a negligible impact on land use.

Targeting only landowners in geographical zones that are in danger of conversion and that provide substantial biodiversity benefits would allow much larger landowner subsidies with greater potential for changing behavior and for preserving ecological values. Also, a revised program could tie the size of tax break to the expected ecological benefit—e.g., landowners who coordinate with their neighbors by jointly enrolling in the Greenbelt Program and thereby protecting large tracts of contiguous forest could receive greater benefits than isolated landowners. Program participants also might be expected to promise not to convert for a minimum period of time and/or face a much greater penalty for conversion. Targeting also could minimize the problem of educating landowners about the program's existence. State and county officials can contact targeted landowners more easily than all landowners in a county. Thus, a more focused program has the potential both for preventing conversion and for providing ecological benefits to society.

Why non-targeted, tax preference programs remain the preferred policy of policymakers to influence land use even in the face of considerable evidence and logic

that these programs make for bad public policy is puzzling. Are landowners powerful enough politically to protect what amounts to welfare for the middle and upper classes? Do rural legislators benefit sufficiently that they have no incentive to reform these programs? Or has the research showing the ineffectiveness of non-targeted, tax preference programs simply failed to penetrate the walls of the legislature? We believe that the answer to this puzzle is the first important step in implementing any reform.

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Agricultural buffers at the rural–urban fringe: an examination of approval by farmers, residents, and academics in the Midwestern United States

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Abstract

In the Midwestern United States, urban areas most often expand by converting farmland into residential sites. This process puts households and working farms in close contact, often resulting in conflicts. Can agricultural buffers, which provide a variety of environmental and aesthetic benefits, help mediate this conflict? This study examined the approval of different buffer types by three stakeholder groups: farmers, residents, and academics. Participants rated three buffer conditions (no buffer, basic buffer, and extensive buffer) for each of six buffer types. Findings reveal support for buffers, with approval of basic buffers over three times that of the no buffer conditions and even greater approval for extensive buffers. Farmers, academics, and residents agreed on their approval for the basic buffers over no buffers, but differed with respect to the extensive buffers. Responses to buffers were nearly equivalent on privately and publicly owned land. The approval for buffers suggests they may provide more than their documented environmental benefits in the agricultural landscape.
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1. Introduction

In recent years, the rural–urban fringe has become the setting of the most intense growth and change in the United States (Friedberger, 2000). One consequence of this new development is that non-farm residents increasingly come to live in close contact with working farms. Such close association often results in conflicts that reduce the likelihood of a satisfying co-existence between farmers and non-farm residents (Daniels, 1999; Hammond, 2002).

To farmers, land is the foundation for the business of agriculture, supporting crops and livestock. Farmers depend on the land for their livelihood. But for urbanites that settle outside of central cities because they enjoy the open space and bucolic environment of the agricultural landscape, many practices associated with modern farms can be a source of tension. These new residents often find themselves annoyed by dust, noise, slow traffic, and odors that accompany farming operations (Kendall, 1993; Hammond, 2002).

One possible, albeit partial, solution to this tension is to introduce agricultural buffers into the fringe landscape. Agricultural buffers are strips or corridors of vegetation designed to ameliorate environmental impacts from agricultural operations. But will residents who sought out an agricultural setting object to changes that might block their view of farmsteads nestled in the open landscape? And what about farmers—will they object to the introduction

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of buffers that might shade their fields, harbor weeds, and attract animals?

Such questions underlie the extent to which stakeholders might approve[1] of agricultural buffers on a working farm. In this paper we examine factors related to the approval of buffers by those who hold a stake in the rural landscape. We begin by exploring the conflict between farming and new housing developments and review evidence suggesting the opportunities to experience this conflict are growing. Next, we examine the costs and benefits of agricultural buffers. Finally, we test the extent to which three stakeholder groups approve of a variety of buffers on a large, publicly held working farm and discuss the implications of the results.

2. Background

The movement of urbanites from metropolitan areas to the rural fringe has led to the coexistence of two groups of residents: those who have lived in rural settings for most of their lives and who depend on farming for all or part of their income (farmers), and those who recently moved to the rural–urban fringe in an effort to enjoy the rural landscape and lower land costs (residents). The close proximity of these two groups, each with their own set of ideals for rural living, has led to conflict in many cases. In order to develop a better understanding of the situation, we review trends in population growth at the rural–urban fringe, sources of conflict for both farm and non-farm residents, and possible land use alternatives to reduce the conflict.

2.1. Urbanites move to rural areas

In the Midwestern US, there has been considerable movement in population away from the center of metropolitan areas to more rural settings, often at the fringe of farmland. A number of factors are driving this trend (see, for example, Alig et al., this issue). For one, the US population is growing: by the year 2050, there are expected to be 403 million Americans, an increase of 122 million, or 43%, over the 2000 Census figure of 281 million (Bureau of the Census, 2002). Continued advances in telecommunications and transportation networks are also making it easier to live and work further from central cities (Edwards and Edwards, 1999). And many Americans prefer living in semi-rural areas, where a rising level of affluence coupled with lower property values and taxes makes this option attractive to an increasing number of households (Daniels, 1999).

Thus in coming years, these and other factors are expected to increase the population of non-farm residents living at the rural–urban fringe. A substantial portion of new housing developments will be built abutting, or at least close to, working farms. As a consequence, conflicts between land uses are likely to grow considerably in the near future.

2.2. Conflict at the rural–urban fringe

Although many urbanites move to rural agricultural settings to seek the privacy and peacefulness of nature, after moving there they are often annoyed with various functions that accompany active farming operations. Frequent complaints focus on pesticide use, noise and dust from large machinery, and odors from livestock (Hammond, 2002).

Farmers, long accustomed to familiar neighbors, have their own set of complaints about these new residents. Farmers express concern about litter, trespassing, pets in their fields, restrictions regarding their activities, and the loss of rural character (Lapping et al., 1989; Hammond, 2002). Instead of receiving compensation for the positive benefits the farmland provides to the nearby public, farmers are often required to defend the very practices that allow farming in the area. In the conflict between residents and farmers, the farmer typically loses (Nelson, 1999).

With the likely increase in conflict at the rural–urban fringe, there is an urgency to find acceptable solutions for farmers and their neighbors. Some have argued that local governments and the courts must provide the solution. Lapping and his colleagues state that the friction between farmers and non-farmers involves a clash of property rights that cannot be resolved in the marketplace. Instead, they assert that legislative

[1] In the survey, participants were asked to rate their response to the following question: "To what extent *do you approve* of the use of (grass buffers, windbreaks, etc.) at the South Farms?" Therefore, the responses indicate the level of approval for each buffer type. The use of the term "approval" refers directly to the responses to this question.

bodies and the courts must act as referees (Lapping et al., 1989, p. 178). But there are hints that a design solution—one that involves the use of agricultural buffers—might provide both farmers and non-farm residents some relief.

2.3. The benefits of agricultural buffers

Buffers are often used in agricultural areas as part of conservation programs that improve environmental quality. Buffers typically contain grassy or treed areas, providing a more natural environment than much of the intensively farmed land surrounding them (Buck, 2001; Lowrance et al., 2002). For both farmers and residents, buffers provide a number of environmental benefits (Henry et al., 1999; Mitsch and Gosselink, 2000). For example, properly placed grass and riparian buffers help prevent movement of sediment into surface waters, and windbreaks help mitigate wind erosion (Pimentel et al., 1995; Chow et al., 1999). Carefully placed grass, riparian, and wetland buffers also improve water quality by capturing residues from pesticides and fertilizers in the rainfall run-off (Cooper and Gillespie, 2001). For instance, herbicide concentrations can be reduced by 29–45% in vegetative buffers (Misra et al., 1996). Phosphorus runoff can be reduced by as much as 95% in a 10-m-wide grass buffer (Vought et al., 1995). Nitrogen, which is a harmful pollutant in many water sources, can be reduced from between 40 and 94% in a buffer or wetland before entering a stream (Groffman et al., 1991; Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Kovacic et al., 2000; Lowrance et al., 2002).

In addition to removing chemicals, riparian buffers also create animal habitat by cooling stream water to temperatures that support a diversity of aquatic life, providing food sources, and offering spawning, den, and nesting areas that are otherwise absent in intensively farmed areas (Naiman et al., 1993). Buffers may also increase the biodiversity of an area and promote the stability of native flora and fauna (Vought et al., 1995; Henry et al., 1999; Lowrance et al., 2002; Paine and Ribic, 2002; Boutin et al., 2003). On a broader scale, buffers can even contribute to a small decrease in the greenhouse effect by sequestering carbon in the soil (Uri, 2000).

For residents of the rural–urban fringe, buffers may provide a number of important social benefits. First, buffers can improve the aesthetic quality of Midwestern landscapes by creating spatial definition, much like an artist paints a picture. Vertical elements in buffers can frame views of an otherwise expansive horizon, while on the ground, colorful and textured plants in buffers can provide interest and variety in the foreground and middle-ground (Nassauer, 1979). Second, buffers can provide opportunities for recreation. With buffers in place, more pleasurable experiences can be had while canoeing streams, traveling along shaded trails, and encountering wildlife. Simply being in or having a view to nature can provide a restorative effect that improves human functioning (Kaplan and Kaplan, 1989; Kuo and Sullivan, 2001).

2.4. Research questions

Although research has examined the attitudes of various groups regarding conservation practices and natural areas (Kline and Wichelns, 1996; Ryan, 1998), little attention has focused on the use of agricultural buffers and their capacity to alleviate some of the conflict at the rural–urban fringe. Several questions arise as agricultural buffers are considered as part of the landscape at the rural–urban fringe. To what extent do stakeholders at the rural–urban fringe approve of agricultural buffers? Are the patterns of approval similar for different types of buffers? Do stakeholder groups differ in their approval for buffers? Does approval for buffers vary on privately versus publicly owned land?

3. Methods

In order to appraise stakeholders' attitudes regarding the use of buffers on public farmland, a photo-questionnaire was developed and distributed to a sample of individuals in Champaign County, Illinois.

3.1. Study area

Champaign County is located on a flat plain in east-central Illinois, where prairie ecosystems produced extremely fertile soil. Most of the land is used for row crops such as corn and soybeans, and many of the features that are considered to give rural areas character (hedgerows, timberland, and natural areas) have either been removed to allow for more row

cropping, or never existed. The county's urban core is in Champaign-Urbana, home of the University of Illinois, a large land grant institution. The University is currently expanding its agricultural research area, the South Farms, which lies at the fringe of the metropolitan area. But between 1960 and 1990, urbanization of the area surrounding Champaign-Urbana increased by more than 150%, the largest percent increase of any metropolitan region in the state, and the South Farms complex is now bordered by residential communities on three sides (American Planning Association, 1999). Local residents have expressed concern about the University's farm expansion plans, particularly over the impacts of odors from relocated livestock operations (Wirth, 1999).

3.2. Photo-questionnaire

The photo-questionnaire included descriptions and diagrams that explained the advantages and costs of buffers, simulated color photographs of buffer scenarios and corresponding questions, and space for participants to share their views about buffers on the South Farms.

Table 1
Content provided in the survey prior to requested ratings

Buffer type	Description	Diagrams
Grass waterways	Grass waterways carry storm water to a stream while helping to prevent soil erosion. The roots hold the soil in place when the waterway becomes a fast-moving stream. Wider grass waterways collect more sediment and help to reduce flooding by slowing water down, but take more cropland out of production. Maintenance includes annual mowing.	Basic grass waterway Extensive grass waterway
Riparian grass buffers	Grass buffers are planted on sloped areas to slow rainwater runoff. Soil, fertilizer, and herbicides are collected in the grass buffer, reducing the amount that reaches the stream. Wider buffers capture more sediment but take more cropland out of production. Maintenance costs include annual mowing.	Basic grass buffer at streams Extensive grass buffer at streams
Wetlands	There are three main purposes of wetlands on farms. First, they help to prevent downstream flooding by holding surges of water from fields and drain tiles. Second, they reduce the amount of fertilizer that flows into streams and some drinking water supplies. Third, they support large amounts of wildlife, especially migratory birds. Wetlands take some low-lying cropland out of production and are formed with the addition of dikes. They are not ponds, and can become dry. There is little maintenance.	Basic wetland Extensive wetland
Odor buffers	To reduce odor, trees may be planted next to livestock buildings. The trees help to slow the wind, which allows odor-carrying dust to drop to the ground. A second windbreak, at some distance from the first, will help to further reduce odors. Odor buffers do not eliminate the animal odor. Crop reductions due to shadows might be offset by higher yields downwind. Maintenance includes occasional tree replacement and forest management.	Basic odor buffer Extensive odor buffer
Windbreaks	Windbreaks are lines of trees located at the edge of fields. Windbreaks slow winds, and reduce the amount of soil lost to the air. They provide nesting habitat for birds and change views of farm fields. Windbreaks reduce the crops near their shadows, but they also improve the crop yield at some distance from the trees. Maintenance includes occasional tree replacement and forest management.	Basic windbreak Extensive windbreak
Riparian tree buffers	Stream-side tree buffers consist of one or two zones of trees, followed by a zone of grass next to the cropland. Trees capture underground flows of fertilizer that would otherwise seep into the stream. Trees along the stream also provide wildlife habitat. The stream may function less like a drainage ditch. Some cropland would be taken out of production. Maintenance includes forestry and periodic mowing.	Basic tree buffer at streams Extensive tree buffer at streams

Information in the questionnaire communicated the size, layout, function, and appearance of buffers based on the Natural Resources Conservation Service (NRCS) farm program buffer guidelines. Six types of buffers were described: grass buffers at streams, odor buffers, grass waterways, wetlands, windbreaks, and tree buffers. For each buffer, there was a brief written explanation and a description of several advantages and disadvantages to the farmer and community (Table 1). The full description of the buffer areas is provided by Anderson (2001). On the same page, two diagrams compared a "basic" and an "extensive" buffer, illustrating composition, approximate dimensions, and environmental functions of each (Fig. 1).

Accompanying the text and diagrams for each buffer type were pairs of color photo simulations showing the three buffer conditions: no buffer, basic buffer, and extensive buffer. For each condition, one of the photos in the pair showed the view from ground level and the other showed an aerial view (Fig. 2). The three pairs of images included some of the surrounding landscape with the buffer design identical in type, but changing in size. The buffers were proposed in conjunction with a recreational trail that was illustrated along buffers that

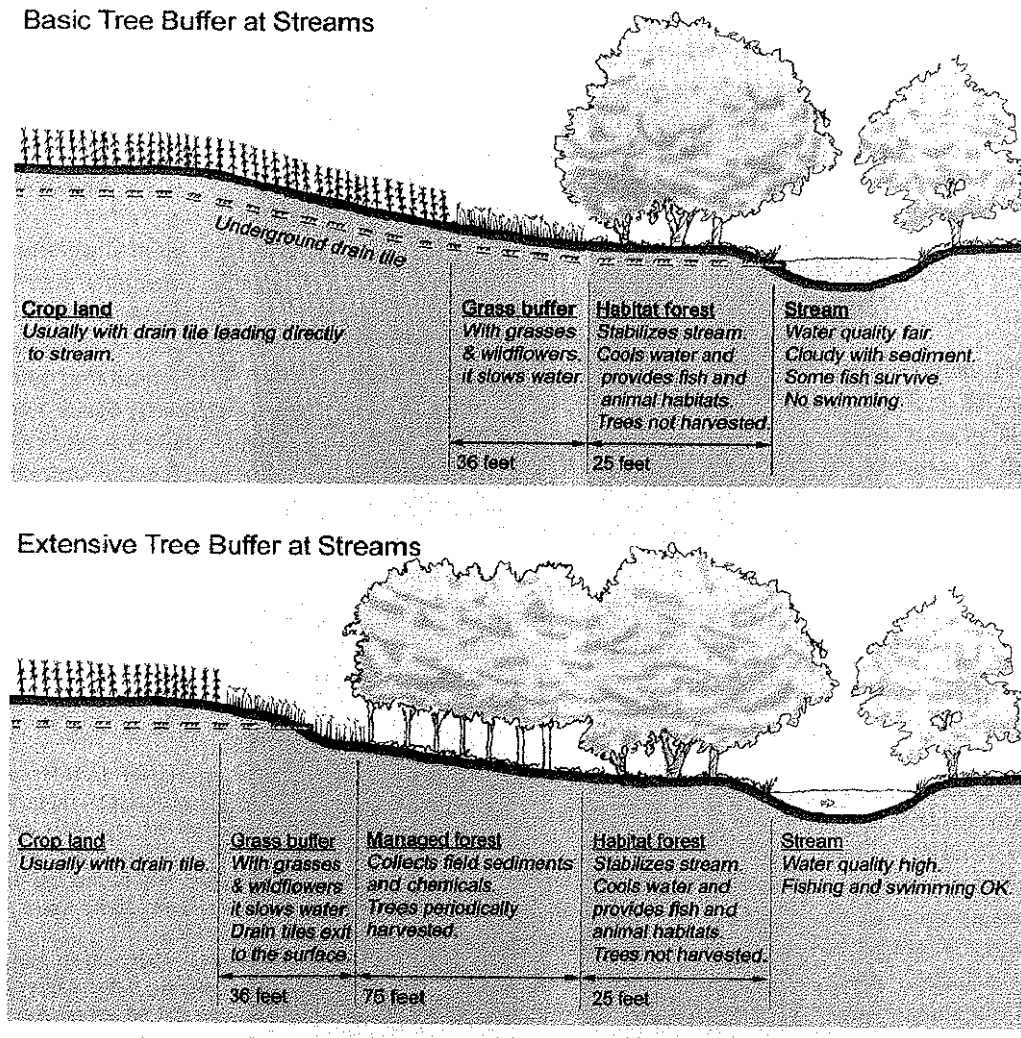

Fig. 1. Typical diagram of basic and extensive buffers provided in the survey, in this case showing a riparian tree buffer.

Fig. 2. A typical photo simulation from the survey, in this case showing a riparian tree buffer.

would typically be found at the edge of a farm (e.g. windbreak), but not along grass waterways that more typically are found within a farm field. Ground-level photographs were taken with a digital camera shot from a 10-foot folding ladder,[2] while aerial photos were shot from a small airplane using a 35 mm camera with a telephoto lens. All photographic editing was accomplished using Adobe® PhotoShop®.

Participants were asked two questions regarding each type of buffer. First, "To what extent do you approve of this buffer at the South Farms?" They responded for each of the three buffer conditions (no buffer, basic buffer, and extensive buffer) using a 5-point scale ranging from 0 = "not at all" to 4 = "very much".[3] Second, "If government shared the cost, which would be the best option for *private farmers* in Illinois?" Participants answered by choosing between no buffer, basic buffer, and extensive buffer.

3.3. Participants

The participants in the study included local Champaign farmers (farmers), professors and researchers in the College of Agriculture, Consumer, and Environmental Sciences (academics), and individuals who live in close proximity to the South Farms, along the rural–urban fringe (residents). Each of these groups has a stake in the use of agricultural buffers. The farmers in this rural–urban fringe area must deal with the conflicts arising from the close proximity of farms to residential areas. The academics conduct their field trials on the South Farms, and as a result they must deal with complaints from nearby residents regarding their farming activities. The residents live in the rural–urban fringe area where farms (both public and private) and housing coexist.

A sample of farmers was obtained through the Champaign County Farm Bureau annual meeting. The survey was described during the meeting, and farmers were provided with survey packets including the survey, cover letter, and return envelope. Of 287 copies distributed at the 2001 Champaign County Farm Bureau annual meeting, 94 were returned, providing a response rate of 33%. It was not possible to initiate follow-up contact with farmers to increase the response rates.

The other stakeholders (academics and residents) were surveyed using methods patterned on Dillman (2000). A sample of academics was obtained by distributing 387 surveys to the University of Illinois members of the College of Agriculture, Consumer, and Environmental Sciences. Surveys were received from 194 academics via campus mail, for a response rate of 50%. A sample of residents was obtained by randomly extracting a deliverable list of 359 addresses from subdivisions near the South Farms. Surveys were received from 182 residents, providing a response rate of 51%.

4. Results

Results are presented in four sections. First we examine support for agricultural buffers. Second, we examine how support for buffers varies by stakeholder group. Next, we investigate reactions to the various buffer conditions on private farmland. The final section explores the comments from participants of the survey.

4.1. Buffer approval

To what extent do stakeholders approve of agricultural buffers? To answer this question, we compared the mean approval ratings across the six types of buffers for the no buffer, basic buffer, and extensive buffer conditions. A repeated measures analysis of variance (ANOVA) found striking differences; $F(2, 412) = 415.5$, $P < 0.0001$. On a 5-point scale (0 = not at all to 4 = very much), the no buffer condition earned the lowest approval rating (mean = 0.8). Approval of the basic buffer (mean = 2.6) was over three times that of the no buffer condition, while approval of extensive buffers was higher still (mean = 2.9). These means are each significantly different from each other ($F(2, 412) = 415$, $P < 0.001$). This

[2] The "ground-level" photographs were taken from a small ladder in order to provide participants slightly elevated views of the ground plane. Although this was only important for the buffers without trees—where much of the detail regarding the buffer was close to the ground—for consistency, all the "ground-level" simulations were made from base photos taken from the ladder.

[3] Participants of the study responded to the questions about approval of various buffer types by making a check in one in five boxes. The box on the far left was labeled "not at all" and the box on the far right was labeled "very much." The middle three boxes were not labeled.

result was reinforced by responses to the statement "Overall, I think it is important that the University should have buffers at the South Farms" (mean = 3.4 on a 0–4 scale, S.D. = 1.1).

Did the pattern of approval for the most extensive buffer condition hold for each of the six buffer types? To answer this question, we conducted repeated measures ANOVA's comparing the mean approval ratings for the three buffer conditions (no buffer, basic, and extensive) for each of the six buffer types. On the whole, as can be seen in Fig. 3, the pattern did hold. For each of the six buffer types, the no buffer condition earned the lowest approval rating and the basic and extensive conditions earned considerably higher ratings. Note that for the three buffer types without trees (grass waterway, riparian grass buffer, and wetland), ratings of the basic and extensive conditions were not significantly different from each other. Conversely, for the three buffer types with trees (odor buffer, windbreak, and riparian tree buffer), the extensive condition was rated slightly, but significantly, higher than the basic condition.

4.2. Approval by stakeholder group

Do the stakeholders (farmers, academics, and residents) differ in their approval for the three buffer conditions (no buffer, basic, and extensive)? The means and standard deviations from a repeated measures ANOVA (3 × 3) comparing approval ratings for each of the three buffer conditions by each of the three stakeholder groups are presented in Table 2. The ANOVA revealed a significant interaction between the buffer conditions and the stakeholder groups; $F(2, 4) = 12.7$, $P < 0.0001$. Notice in Fig. 4 that for the no buffer condition, approval by farmers was greater than by residents, but the opposite occurred for the extensive buffer. The response pattern for academics was similar to that of the residents. Farmers approval of extensive buffers less than the basic buffer, while the opposite was true for residents and academics. These ratings were reinforced by written comments on the questionnaire. One farmer wrote: "While I strongly support buffer zones, I feel we should not go overboard with them." A resident

Table 2
Buffer approval means and standard deviations by stakeholder group comparing three buffer conditions on a scale of 0 = "not at all" to 4 = "very much"

Stakeholder group	Approval of buffer condition					
	No buffer		Basic buffer		Extensive buffer	
	Mean[a]	S.D.	Mean	S.D.	Mean	S.D.
Farmers	1.2 c	1.2	2.7 a	1.0	2.3 b	1.4
Academics	0.8 b	1.0	2.6 a	0.9	2.9 a	1.2
Residents	0.5 a	0.8	2.6 a	0.8	3.1 a	0.9

[a] Means in the same column followed by the same letter are not significantly different at $P < 0.05$ (d.f. range from 2, 423 to 2, 441).

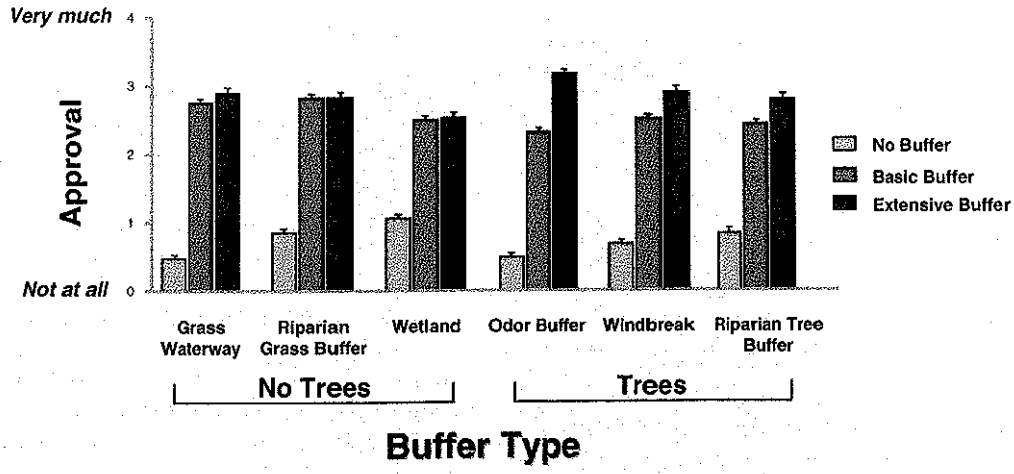

Fig. 3. Mean approval comparing six buffer types under three buffer conditions.

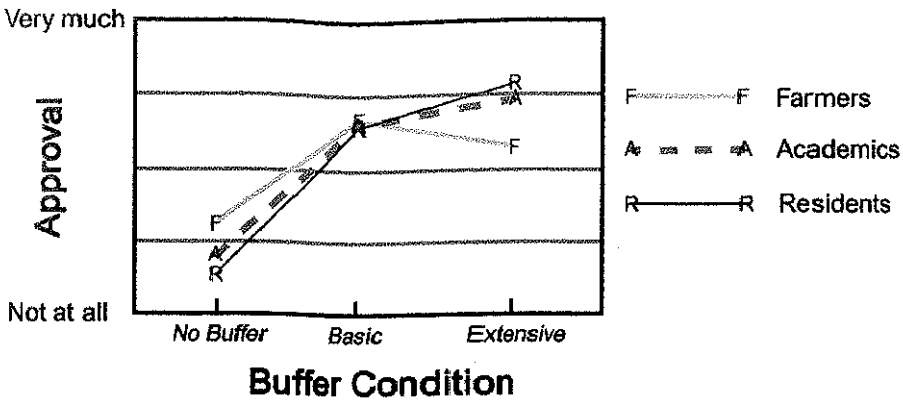

Fig. 4. Mean approval ratings of buffer conditions by three stakeholder groups.

added that environmental benefits of buffers make the extensive buffer the "... best option for everyone."

To what extent does the pattern of results described in Fig. 4 hold for stakeholders' responses to each of the six buffer types? The individual means and patterns of interactions can be observed in Table 3 and Fig. 5, respectively. Notice how the general pattern seen in Fig. 4 is repeated for each of the six buffer types: for the no buffer condition, farmers generally have the highest approval, while residents report the lowest approval. For extensive buffers, the opposite pattern occurs.

Table 3
Buffer approval means and standard deviations by buffer type comparing three buffer conditions with three stakeholder groups on a scale of 0 = "not at all" to 4 = "very much"

Buffer type	Buffer condition	Mean approval ratings			F-statistic	P-value
		Farmers	Academics	Residents		
Grass waterway	None	0.6 a	0.6 a	0.4 a	1.6	N.S.
	Basic	2.9 a	2.7 a	2.7 a	1.1	N.S.
	Extensive	2.6 a	3.0 a	3.0 a	2.4	0.09
Riparian grass buffer	None	1.2 a	0.9 ab	0.7 b	3.7	<0.05
	Basic	3.0 a	2.8 a	2.8 a	1.4	N.S.
	Extensive	2.3 a	2.9 b	3.0 b	4.7	<0.05
Wetland	None	1.5 a	1.1 ab	0.8 b	5.2	<0.01
	Basic	2.4 a	2.5 a	2.6 a	0.9	N.S.
	Extensive	1.9 a	2.5 b	2.8 b	8.0	<0.0005
Odor buffer	None	0.8 a	0.7 a	0.2 b	10.0	<0.0001
	Basic	2.5 a	2.4 b	2.2 b	4.1	<0.05
	Extensive	2.6 a	3.0 b	3.6 c	15.0	<0.0001
Windbreak	None	1.1 a	0.8 b	0.4 c	8.9	<0.0005
	Basic	2.6 a	2.6 a	2.4 a	1.5	N.S.
	Extensive	2.2 a	2.9 b	3.3 c	12.2	<0.0001
Riparian tree buffer	None	1.5 a	0.9 b	0.5 c	15.9	<0.0001
	Basic	2.3 a	2.4 a	2.5 a	0.6	N.S.
	Extensive	1.9 a	2.9 b	3.1 b	15.3	<0.0001

Means in the same row followed by the same letter are not significantly different at $P < 0.05$.

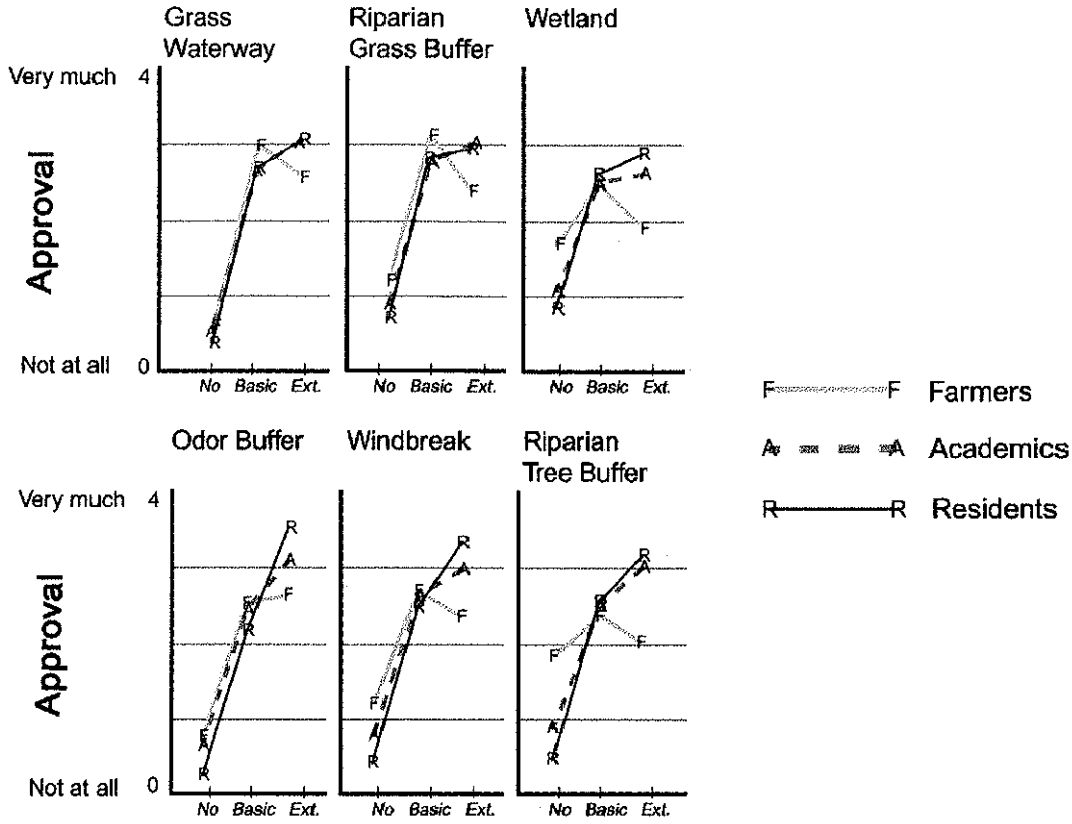

Fig. 5. Mean approval ratings for no buffer (No), basic buffer (Basic), and extensive buffer (Ext.) for each of six buffer types by three stakeholder groups: farmers (F), academics (A), and residents (R).

4.3. Buffers on public and private land

The approval ratings assessed thus far concern buffers on public farmland—the University's South Farms. To what extent do stakeholders have similar attitudes about buffers on private land? To answer this question, we evaluated responses to the survey item asking participants to select the best buffer condition (no buffer, basic buffer, or extensive buffer) for private farmers. The percentages of individuals selecting each buffer condition for all buffer types are shown in Fig. 6. Results indicate that most individuals felt a basic or extensive buffer would be a better option for private farmers than no buffer. In fact, depending on buffer type, only 3–15% of the participants indicated the no buffer condition would be best. Comparing the responses from different stakeholder groups, the pattern of results was nearly identical to the approval ratings for buffers on public land (as seen in Fig. 4). For private land, farmers indicated the basic buffer would be the best option while academics and residents indicated the extensive buffer was the best option.

4.4. Selected comments from participants

Survey participants were encouraged to include comments regarding the survey itself and any additional thoughts about the use of buffers. Most of the comments from residents were positive, reinforcing their approval for buffers and supporting the use of buffers on the university's South Farms. Some comments from farmers, however, revealed concerns about economics, unwanted pests, and maintenance issues associated with buffers. One farmer commented, "... there needs to be an economic benefit for constructing buffers, as profit margins are too small to tie up

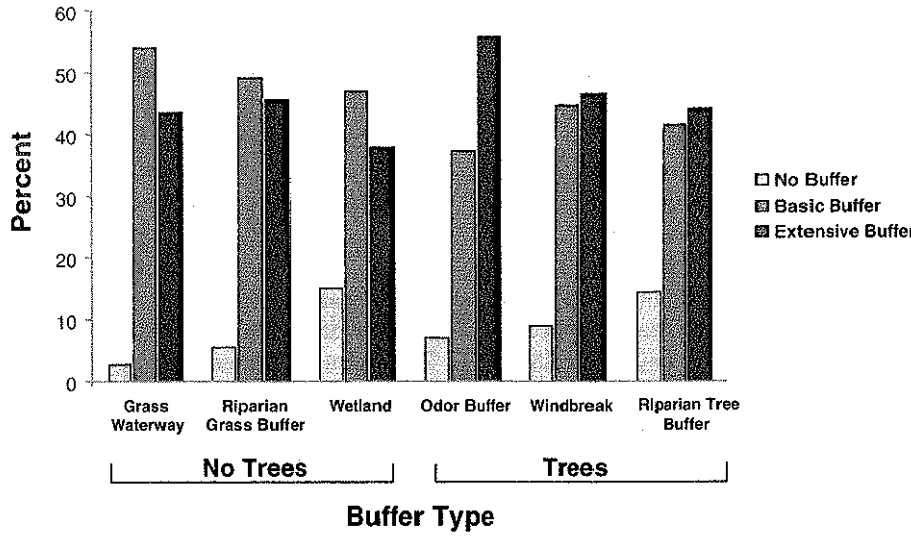

Fig. 6. Percentage of participants selecting the no buffer, basic buffer, or extensive buffer condition as the best option for private farmers for each of six buffer types.

productive land." Several other farmers commented on problems with beavers in riparian tree buffers. One farmer summed up the situation, "I am in favor of wildlife and conservation practices, but we who farm are having a tough time making ends meet. I could not afford to plant and manage trees around my farms ... I like the look and the wildlife habitats, but it is too idealistic." Many of the comments from academics referred to the fact that the University should practice good environmental stewardship. As one academic noted: "The University should be a leader in using and demonstrating conservation practices in agricultural landscapes."

5. Discussion

This study examined the extent to which three stakeholder groups approved of various agricultural buffers at the rural–urban fringe. The findings reveal considerable support for the use of buffers. Approval for the basic buffers was over three times that of the no buffer conditions, and the extensive buffers were rated higher still. This pattern of approval held over a range of buffer types, with particularly high ratings for extensive buffers with trees. Farmers, academics, and residents agreed on their approval for basic buffers over no buffers, though farmers showed less approval than other stakeholders for the extensive buffer.

These findings provide new information about approval for agricultural buffers at rural–urban fringe, suggest design alternatives for land use at the fringe, and raise new questions regarding the role of buffers and natural areas in urban sprawl and land planning.

5.1. Contributions

The findings contribute to our understanding of the role of agricultural buffers at the rural–urban fringe. First, the work provides evidence of the widespread approval for agricultural buffers in the landscape. The aesthetic and functional qualities of buffers are likely to contribute to this approval. The findings here are consistent with a good deal of previous research on aesthetic preferences for natural or open spaces (Kaplan and Kaplan, 1989; Kent and Elliot, 1995; Geoghegan, 2002) and rural landscapes (Nassauer, 1989; Arendt, 1992; Kline and Wichelns, 1996; Brush et al., 2000; Ryan, 2002). The results suggest Midwestern US rural landscapes including buffers would not only be acceptable, but actually strongly approved over those without buffers.

A second and more specific contribution of this work is to identify the extent to which the width of buffers impacts approval ratings. We found that the standard or basic grass and wetland buffers were approved of as much as a more extensive grass and wetland buffer. This pattern, however, did not hold for buffers that contained trees. Greater approval for more extensive areas with trees may result from the increased diversity and visual interest in treed buffers (Fry and Sarlöv-Herlin, 1997; McCollin et al., 2000; Darke, 2002). The higher approval ratings might also be attributed to the improved functional benefits of more extensive areas with trees. It is possible, for example, that participants realized that an extensive buffer with trees would reduce soil erosion and protect the water supply better than a basic buffer.

The findings also demonstrate interesting stakeholder differences and, more importantly, similarities, in approval for buffers. That residents and academics approved of settings with buffers was not surprising since they have the opportunity to share the ecological and aesthetic benefits without contributing to the costs of establishing or maintaining the buffers. The farmers' reactions were less predictable. Their approval for a basic buffer over none at all suggests that they are looking beyond the cost of conservation practices, to see some value in these buffer areas. Several researchers have demonstrated that visual factors can be important for farmers' adoption of conservation practices (Erickson and De Young, 1992–93; Ryan et al., 2003), and it is likely that such factors were a part of farmers' reactions to the buffers in this study. It is also likely that farmers' reactions were influenced by the functional qualities of buffers. Thus, it is our best guess that, in responding to the buffers, individuals were considering a variety of visual and functional characteristics. Although each of the stakeholders may be influenced by some of the functional outcomes of buffers (improved water quality and reduced odors and chemical drift), the aesthetic qualities of buffers may be more important to the residents than to the farmers. This is question for future research.

Finally, the work contributes to our understanding of stakeholder attitudes toward conservation practices, specifically on publicly owned land. Previous studies have investigated preference for, acceptance of, and economic valuation of buffers and other conservation practices on private farmland. To our knowledge, no previous studies have dealt with stakeholder approval for buffers on publicly held farmland. There is no clear pattern regarding how citizens' expectations for private industry apply to public institutions. On one hand, the expectation is the same for both public and private entities. Such is the case with the US Postal Service: the public expects services equivalent in efficiency and effectiveness to private carriers such as FedEx or UPS (Truitt, 1995). On the other hand, television viewers hold public television to a higher standard than commercial television (Epstein and Neubauer, 1999). The findings reported here suggest that where agricultural buffers are concerned, stakeholders have similar standards for publicly and privately owned farmland. Stakeholder approval for buffers appears to be related more to the type and extent of the buffer area than to the ownership of the property on which they occur.

5.2. Implications

The findings suggest that an increase in use of buffers on farms would be a favorable alternative for both farmers and residents at the rural–urban fringe. Buffers can reduce a number of environmental problems including pesticide movement, noise pollution, livestock odors, and soil erosion. Buffers can also improve the visual appearance of the landscape without reducing the rural character of the area. Public farmland in the rural–urban fringe would provide a good place to implement real-life prototypes of the kinds of buffers simulated for this research so that further tests could be made of their benefits and costs. The use of buffers in public areas could serve as a demonstration of conservation practices at work, providing an educational opportunity for farmers and other citizens.

The results presented here have implications beyond the use of buffers on public property. Buffers could be incorporated into the design of residential developments at the rural–urban fringe. As opposed to relying on the farmer to dedicate land for buffers, a portion of the land in a newly developed area could be allotted for buffer zones abutting farmland, as with conservation design housing (Arendt, 1992; see also Austin, this issue). Ultimately, the findings suggest an increased use of buffers within the rural–urban fringe might require countywide or regional planning to organize the input from different stakeholder groups.

Collaboration with residents regarding land use might lead to creative solutions that would improve the visual quality and ecological health of the area.

5.3. Generalizations and future research

This study was conducted in an area that consists of flat farmland running continuously across the horizon. The environmental benefits and aesthetic value of buffers could be significantly greater in this area that is devoid of natural variation. Future studies should examine the appropriateness of buffers beyond the Midwestern US. Do trees matter as much in other areas? To what extent does buffer width influence approval ratings in different parts of the world?

Considerable efforts were made in this study to obtain representative samples and maximize the return rates for each stakeholder group. It should be noted, however, that participants in the farmer group were selected from members of the Champaign County Farm Bureau, an organization that might not appeal to more liberal-minded farmers. The lower net return rate for farmers (33% versus 50 and 51% for academics and residents, respectively) indicates the results may not adequately represent farmers in the area. Additional research on farmers' approval of buffer areas and motivations for adoption of conservation practices should include more extensive efforts to represent all farmers in the area.

Future research might also focus more directly on the conflict between farmers and residents, attempting to understand if the stakeholders feel buffers would provide a sufficient solution to the problem. Questions probing the conflict itself, the use of buffers at the rural–urban fringe, and the willingness of the stakeholders to financially support such a solution would be appropriate.

Finally, there is concern regarding the extent to which the positive changes in the rural landscape, through the use of buffers, would actually promote more urban sprawl into existing farmland. Buffers that improve the visual quality and add to character of the rural–urban fringe might draw an increasing number of urban residents to the edge. Efforts to reduce conflicts at the fringe should not compromise initiatives intended to limit growth and development.

As we look to the future, more sustainable approaches must be considered for areas where the agricultural landscape is threatened by urban sprawl and development. In his assessment of growth at the rural–urban fringe, Daniels (1999, p. 99) suggests the negative impact of urban sprawl could be minimized by designs that protect of water quality, maintain open space, and create true edges between the rural and developed environments. Agricultural buffers offer design solutions that could address these issues. The findings from this study suggest that a variety of stakeholders at the rural–urban fringe would approve of a great many more buffers at the rural–urban fringe.

Acknowledgements

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Community identities as visions for landscape change

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Abstract

Residents' felt senses of their community can play substantial roles in determining visions for landscape change. Community identities are often anchored in tangible environments and events of a community, and have the potential to serve as visions for landscape planning processes. Photo-elicitation is applied in this study to connect community-based meanings to environments and events. Twenty participants took photographs of landscapes just outside the southwest fringe of the Chicago metropolitan area and were interviewed while viewing their photographs. Analysis of interview texts focused on meanings of environments that connected participants to their community, and were organized into three overlapping themes: (1) places to learn about community landscapes, (2) places to enact community, and (3) places to improve community landscapes. These meanings are explicitly connected to landscape features through participants' photographs and could form the basis of visions for landscape change within strategic planning processes.
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Keywords: Empowerment; Stakeholder perceptions; Human dimensions of holistic landscape ecology; Photo-elicitation; Midewin National Tallgrass Prairie

1. Introduction: protecting community while changing landscape

The growth of towns and cities, and their encroachment upon agricultural and forest lands, is conventionally viewed as both inevitable and largely uncontrollable. In United States and many other countries, the boundaries of urban areas are moving outward due to growth of residential developments, retail districts, and other related land uses. Communities that were once rural are now experiencing significant economic expansion, changing traffic patterns, infrastructure development, increasing demands on schools, and other issues connected to urban growth (e.g., Wilkinson, 1991). In this paper, the inevitability of growth is not an issue; the primary concerns are the ability of communities to influence the nature of their growth and their relationship to changes in land use.

Depicting rural or suburban communities as victims of urban sprawl, with their decision-making controlled by powerful local or extra-local groups, is a common and sometimes justifiable portrayal of growth. Several studies have supported notions of pro-growth policies imposed on hapless communities whose residents either fail to recognize the cumulative effects of incremental development, feel powerless to affect constructive change, or lack alternate visions of their

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collective future (Logan and Molotch, 1987; Orum, 1991). In contrast to this popular depiction, another line of research, which has local autonomy as its focus, argues that social processes and the mix of public values within decision-making forums are the strongest factors in determining the nature of community growth (Moxley, 1985). Lending support to this approach, other researchers have provided arguments and evidence that the development of extra-local community relationships does not necessarily disempower a community (cf., Warren, 1963; Richards, 1978; Wilkinson, 1991; Donner, 1998). Many communities have relationships with urban centers that are mutually beneficial (Richards, 1978; O'Brien, 1999). As Cronon (1991) concludes, just as urban centers are important factors in the development of rural areas, so, too, do rural areas influence patterns of development in urban centers. His explanation for development of the 19th century American West has application to contemporary land-use planning and is succinctly stated as the "frontier and metropolis turn out to be two sides of the same coin" (p. 51).

A growing area of study involves the understanding of local forces that influence the way people think about their community (Chavis et al., 1986). As argued by Wilkinson (1972, 1986) and extended by Bridger (1996), the sharing of local living spaces and history of cooperation among local groups provide socially created senses of purpose. To the extent that such felt senses of purpose are shared, they ultimately can improve a community's ability to affect change in land-use development (Bridger, 1996; see also Stokowski, 1996, where a shared but latently expressed sense of purpose failed to affect locally desirable change). Richards (1984), for example, discussed various strategies that communities have employed to maintain control over land uses in the face of external forces. The strategies were related to shared community values and public decision-making processes. It is clear from his discussion that a community's ability to control the nature of growth is intimately tied to citizens' sense of their community within a larger geographic locale (see also Hummon, 1992; Cuba and Hummon, 1993).

A number of studies have indicated that citizens' felt sense of their community, referred to as "community identity," is reflected in the way individual residents think about themselves and interact with their community (Lofland, 1991; Cuba and Hummon, 1993; McCool and Martin, 1994; Huang and Stewart, 1996; Wiesenfeld, 1996). As used in this paper, community identity is centered on individual residents' felt senses of "we" that connect them with one another by means of visions for a collective future (McMillan and Chavis, 1986; Summers, 1986). Although created through informal socialization processes (Greider et al., 1991), community identities are connected to tangible environments, events, and/or material history. For residents, certain environments and events function to link the past with the present (Cuba and Hummon, 1993) resulting in a felt sense of coherence (Linde, 1993). As residents make such connections, these environments and events become emblematic of stories residents tell about themselves to explain their values and life contexts. To varying degrees, the environments and events of community life have the potential to create and reaffirm community identities.

Bridger (1996) refers to "heritage narratives" as representing community identity and suggests they influence the direction of localized land-use change. From a different approach, Stokowski (1996) suggests that community identity is a reflection of heritage. She argues that the public rhetoric about heritage provides contexts to frame development decisions (pp. 61–88). Research that explores the development of such narratives, and their links to certain environments and events, is still emerging.

This study allows for plurality regarding community identity. The intentions of this research do not require, nor are they aligned with, notions of a monolithic community identity as an ideal. Within any locale, there are expected to be several community identities felt by a collection of residents. Bridger (1996) (see also Canan and Hennessy, 1989) argues that conflicts concerning landscape change are often embedded within inconsistent visions of community identity (Robbins, 1999), and that such inconsistencies affect land-use decision-making. However, planning processes are not always sensitive to articulating environmental meanings nor representing a plurality of visions for a community (Brandenburg and Carroll, 1995; however, see Gobster and Westphal, 1998 and Gobster, 2001 for exceptions to this point). Indeed, several scholars have argued that a major problem of

land-use decision-making is its lack of opportunities for citizens to articulate their perspectives and learn from one another (Reich, 1988; Yankelovich, 1991; Lee, 1993; Yaffee, 1994).

Without a vision that connects people with each other and to the places of their local landscape, the desirable end-state of planning is left incomplete and opportunities for community-building through civic debate are lost. Resulting plans will be disproportionately devoted to infrastructure development details, without due attention given to community identities that would distinguish one locale from another. Sometimes referred to as "strategic planning," Carmona and Burgess (2001) provided examples of 15 cities in which such visioning re-created the nature of urban spaces. Haines and McCoy (1995) provided an explicit process for visioning the "essence of your ideal future" (p. 54), and specifically argued that the technical details of "how to" are not part of the visioning process. In addition, although "holistic landscape ecology" has been connected with the physical landscape, its integration of human dimensions addresses problems with fragmentation through designs that connect people with their community and local environments (Li, 2000). The emergence of the holistic approach is a reaction to reductionism in planning and the need to make coherent the landscapes in which we live and work (Antrop and Van Eetvelde, 2000). A premise of this paper is that opportunities for citizen discussion about community identities are part of the visioning process to frame elements of subsequent plans.

As an ultimate goal, this study is directed toward developing strategies that integrate community-based values into planning processes. The specific objective is to explore ways in which local environments and events reflect community-based meanings. In this sense, the purpose is not focused on community identity, but on assessing a way in which community identities can be articulated and implemented as visions into a planning process. Grounding visions for land-use planning within the social contexts of a community is a step toward protecting a community's identities within processes of landscape change. The development of grounded visions can be facilitated by understanding connections between local environments and the meanings they evoke from community members.

2. Methods

2.1. Landscapes around Midewin

The study area lies just outside the southwestern fringe of the Chicago metropolitan area, and encompasses the communities and landscapes around the Midewin National Tallgrass Prairie, referred to as Midewin. Prior to the 1800s this area was a diverse complex of ecosystems consisting of a tallgrass prairie matrix interspersed with wetlands, savannas, and woodlands, inhabited and managed by various Native American cultures. Although Illinois officially refers to itself as the "Prairie State" because 60% of the state at one time was covered by prairie, less than 0.01% of this native prairie exists today (Pielou, 1991). The establishment of Midewin is a reflection of the growing public interest in native ecosystems, and in this particular case, in restoring prairie to the Illinois landscape.

Anglo pioneers began settling the area in the early 1800s, and by the mid-1800s it became home to scores of families who drained and farmed what became some of the most productive agricultural landscapes in the country (Bogue, 1994). During the early 1940s, the Department of Defense identified the site for an army munitions plant and purchased approximately 23,000 acres (9300 ha) for use in the manufacture and storage of dynamite and other explosive materials. It was still employed as a munitions facility, known as the Joliet Arsenal, during both the Korean and Vietnam conflicts. Various citizen groups in the area (e.g., Midewin Tallgrass Prairie Alliance, Chicago Wilderness), the Illinois Department of Natural Resources, private/public partnerships (e.g., Prairie Parklands Partnership), and elected officials have been instrumental in shaping the idea of a tallgrass prairie reserve and in passing the Illinois Land Conservation Act of 1995 (PL 104–106). The act resulted in a transfer of land to the United States Forest Service in March 1997 for purposes of ecological restoration, education and research, recreation opportunities, and agricultural uses. Part of this act allowed for a national veterans cemetery, a county-wide landfill, and two industrial parks within the site.

In close proximity to Midewin is a diverse mix of land uses, including several state conservation sites, petrochemical processing plants, and a large power

utility. Communities to the east, south, and west of Midewin are largely rural but comprise some of the fastest growing places in Illinois. To the north is the City of Joliet, long a distinct entity from Chicago but now considered a southwestern anchor for metropolitan development with the impending potential to surround Midewin. Joliet has a complexity of images linked to its location as a federal prison site, its "blue collar" industrial heritage, the recent development of gambling casinos, its prospects to add a commuter train link to downtown Chicago, and now, Midewin. In short, the communities and landscapes around Midewin comprise a diverse collection of land uses mixed with various land-use histories. Many of the rural communities near Midewin are in the process of exploring and/or re-defining their visions for growth as the boundaries of the metropolitan region draw nearer. Midewin thus provides a context to explore a plurality of community identities in which meanings of the landscape connect people to each other and provide a sense of community.

During the time period of this study, the Midewin National Tallgrass Prairie was undergoing a comprehensive planning process for land and resource management. Workshops and public hearings were directed at understanding stakeholder viewpoints about prairie restoration, wildlife habitat, endangered species protection, appropriate recreational opportunities, hunting, cultural heritage sites, agricultural practices, and contexts for regional land-use changes. While the majority of Midewin's public involvement opportunities were part of a formal Environmental Impact Statement process, there were a few opportunities related to drafting guidelines for architectural design and planning for interpretive programs. Midewin has been closed to the public due to residual contamination and toxicity of previous munitions manufacturing processes. Although there are plans to de-contaminate the soil and wetlands of various places in Midewin, like prairie restoration, the cleanup is projected as a long-term process.

2.2. Procedures

Resident-employed photography coupled with long interviews, referred to as photo-elicitation, is the primary method of study. There are several planning processes that potentially allow for community-based meanings to surface (Lee, 1993; Cortner and Moote, 1999; Marcucci, 2000), yet tools to identify them and understand their connections to local environments and events are not well developed (Reich, 1988; Yankelovich, 1991; Kruger and Shannon, 2000). Photo-elicitation provides a straightforward way for residents to discuss their perceptions and interpreted meanings of specific land uses (Harper, 1986; Sell and Zube, 1986; Phillip, 1993), and thus holds promise as a technique to connect meaning to environments and events.

Photo-elicitation has been employed in various contexts (Chenoweth, 1984; Botterill and Crompton, 1987; Taylor et al., 1995; Markwell, 1997). In the outdoor recreation and leisure field, for example, Cherem and Driver (1983) asked park visitors to take pictures of places in the park and then write descriptions of the places they photographed. From their analysis, the authors were able to identify places meaningful to visitors. Similarly, in a travel and tourism research context, Haywood (1990) issued cameras to a sample of visitors to Toronto and held interviews with them about the pictures they took. He found photo-elicitation to be a useful way for "recording experiences while on a holiday," and argued that the richness of details about visiting places in Toronto would not have been developed without the use of photography. And in the context of visual sociology, Banks (2001) (see also Collier and Collier, 1986) suggests that photo-elicitation can help to understand the meanings assigned to places and events. With land-use planning in dire need of techniques that allow people to articulate their perceptions, meanings, and values for landscapes, photo-elicitation was selected as the appropriate method for this study.

Twenty-five participants were recruited at various workshops related to Midewin planning processes during fall 2000 and spring 2001. The sample was not intended to represent residents of the communities near Midewin. However, the sample is characterized by residents who have thought about regional land-use changes and who think of themselves as stakeholders in the Midewin planning process. Because participants self-selected to be part of Midewin land-use planning, they would be expected to have thought about local environmental issues in a more deliberate fashion and feel more responsible to influence agency deci-

sions compared to the general public (Burch, 1976; Wellstead et al., 2003). In this sense, participants may be similar to stakeholders in other park and land-use planning processes—even though they are not representative of the full spectrum of local citizenry.

Representativeness is a complex issue (Denzin, 1994). In this study it was addressed by enhancing stakeholders' ability to represent their perceived connections between themselves, their community, and their landscape. A goal of this research was to enhance the "civic culture" of planning processes in ways that facilitate debate (Nacht and Goodwin, 1995) and further transform planning into a collaborative activity between citizen-stakeholders and experts (Forester, 1998). Photo-elicitation shows promise to foster public dialogue about meanings of places, and in doing so, to enhance stakeholders' ability to learn from each other.

Each participant was provided with a disposable camera and asked to take pictures of places, people, and environments that were important to them. Since Midewin was officially off-limits to visitors, participants were specifically directed to take photographs from locales outside its boundaries and within the nearby vicinity. A follow-up letter was sent to recruits reiterating instructions on their role as a study participant:

> With your camera, take pictures of places that are important to your living and working within the Midewin vicinity (say, 20 to 30 mile proximity of Midewin). It is not expected that your important places will be the same as another person's places. The places you choose to take pictures could be as "simple" as your backyard, the neighborhood park, the diner in town, your church, or whatever place has been meaningful for you. The places you take pictures of could be related to positive feelings (of areas you like) and negative feelings (of areas that you don't like or are source of bother and trouble) ... If you have just a handful of places important to you, then just take enough pictures to cover your sense of meaningful locales. After you are finished taking pictures, send the camera back to us. We will develop the film and schedule a time to talk about your special places. During our follow-up discussion, we will ask about the places in your pictures and their importance to you.

After returning their cameras, film was developed and interviews were scheduled and conducted with each participant to discuss their pictures.

2.3. Analysis

The study approach was interpretive, and relied on understanding the meanings that participants linked to environments and events (Puddifoot, 1996). Data generated was the consequence of interactions between researcher and participant (McCracken, 1988; Daitch et al., 1996; Schwandt, 1997). The interviewing approach sought meanings in which participants explicitly connected themselves to their community or connected their community to local environments during a conversation while viewing photographs (Harper, 1986; Phillip, 1993).

Two sets of photographs were used during the interviews. The participants held one, and the interviewer held the other. The photographs were numbered consecutively on the back so we could track the text of the interview with corresponding photographs. An "interview guide" approach was used to allow participants to have expectations of the format of the semi-structured interviews (Patton, 1990). Participants were told at the onset of the interview that we would like to know why they took pictures of the places that they did, and to explain the importance of each place that was photographed. The interviews generally followed the sequence of photographs, discussing each one in turn. However, there were many occasions in which conversations strayed from the pictured places. In general, straying from the visual images of the photographs was not considered a problem, and actively encouraged if it elaborated on connections between participants, their community, and the local landscape. In this sense, the photographs were used to elicit meanings and to facilitate dialogue about environments that provided a sense of community. In the final segment of the interview, participants' viewpoints were summarized by the interviewer and checked to ensure that the meanings were accurate. As part of the final segment, participants were asked to identify three photographs that best represented their special places and to explain their choices in more detail. This final exercise provided further elaboration of, and the ability to verify, their perspectives. With the permission of each participant, conversations were tape-recorded.

Photographs were examined in conjunction with text from the transcribed interviews. The first author was the primary analyst of the data and adapted a three-phase approach (listening carefully, digesting thoroughly, and forming knowledge) developed by Witz et al. (2001) in conjunction with guidelines on data analysis and verifying conclusions developed by Huberman and Miles (1994) (see also Strauss and Corbin, 1998, for a similar technique). During the first phase of "listening carefully," the data were reviewed several times and general themes were identified in an iterative process of grouping and partitioning. During this phase, marginal notation on the transcripts and bracketing was done to highlight text. Themes were developed through a comparison of meanings related to the highlighted interview text.

During the second phase of "digesting thoroughly," themes specifically related to community identity were further developed. This phase was directed at moving between first-level data and more general categories (Huberman and Miles, 1994), and by finding relations between themes or sub-themes (sometimes referred to axial coding, Strauss and Corbin, 1998).

The purpose of the study provided a strong framing for the data analysis. There were several meanings identified related to environments and events. Some meanings were linked to personal or individual meanings of environments, such as spiritual aspects of natural scenes, tranquility and relaxation of particular places, scenic beauty of natural environments, personal history of childhood places, or personal preferences for environments (e.g., "I like rural areas and farms"). There has been substantial progress already made in the development of personal or individual meanings of environments and natural landscapes (for reviews see Knopf, 1987; Kaplan and Kaplan, 1989; Ulrich, 1993). However, investigations related to meanings of environments that link people with other people, or that link people to their community, are still in a developmental stage (for a comprehensive example see Stokowski, 1996; also Williams and Carr, 1993).

This paper is directed at themes reflective of a felt sense of community identity, themes that in some way characterize community life, local heritage, or bonds between residents. Thus individual-based meanings of landscapes or text that were not related to some collective sense of "we," were not the focus of the themes presented herein; individual-based meanings will be part of a forthcoming and separate analysis. Examples of text that was relevant covered topics that included descriptions of feelings about local culture and heritage, emotions evoked by a photograph of a community festival, statements about the local significance of pictured places or peoples, representations of participants' sense of belonging to a group of people or community, or comments that championed aspects of their community or the lifestyle of local people. Meanings that were not relevant to characterizing community identities included elaborations on physical features just outside the border of the photograph (beyond the range of the camera), discussion on the physical features depicted in the photograph that further described the content of the photograph (e.g., "... this is up by the lodge, up by the restaurant, where they got a big open café with a deck."), or other text that did not provide insight into informants' significance of community-based meanings of the landscape. Participants were not explicitly asked to discuss their "community identity"; this is an academic concept that would have stifled the flow of discussion. By asking them to discuss the significance of their special places, contexts for identifying their notions of community identity emerged in the conversations and were further developed through the analysis.

In the final phase of "forming knowledge," a coherent understanding of the data set was developed, which included developing constructs to characterize the range of variability of participants' community identities. The primary themes were elaborated within a "cross-case analysis," in which participants' texts and photographs were compared with each other. There was one participant whose text did not connect with meanings that would link her to other people or a community (and her perspective is not represented within this paper). However, analyses of texts from other participants provided ample evidence connecting participants to other people, and their aggregation converged on the identified themes without force, or without a need to reconcile any particular participants' meanings with the general themes presented (Huberman and Miles, 1994). As part of this final phase, a presentation was made to most of the participants (as a group) after the analysis. The study was explained using a format and content similar to

that presented in this paper. Copies of the presentation were distributed, as were drafts of this paper, and in doing so, participants were asked to comment and, if necessary, revise their perspectives either at the presentation or on individual follow-up. Along with comments suggesting that the presentation reaffirmed participants' perspectives, there were requests for additional copies of the paper.

An important part of photo-elicitation is the pairing of text with photographs. The following results discuss meanings of places emerging from interviews with corresponding photographs being referenced during the discussions. The photographic images are printed in color to provide a close representation of the images that elicited participants' discussion. Some ideas would probably not have been discussed had the photographs been black-and-white.

3. Results and discussion

Of the 25 recruits, 20 completed their roles as participants of taking pictures, returning the cameras, and being interviewed. Although we attempted to follow-up on the five recruits who dropped-out, we were unable to contact four of them through telephone, email, or regular mail. The one recruit who was contacted would not indicate his reasons for dropping-out except to say that he was unable to complete the study and that his inability was not related to difficulties in using a camera. Participants ranged in age from approximately 30 to 70 years old; eight were female. Collectively they took 429 photographs of which most were taken within a 30 mile (50 km) radius of Midewin; the minimum number of photographs taken was eight and the maximum was 27. Each interview lasted between 20 and 120 min and collectively resulted in 304 single-spaced pages of interview text.

The meanings of landscapes relating to a sense of community identity are represented by the following three inter-related themes: places to learn about community landscapes, places to enact community, and places to improve community landscapes. These themes have overlapping content, and are useful to organize the community-based meanings that emerged from the analysis. Each theme is further developed and discussed in turn.

3.1. Places to learn about community landscapes

Several participants appreciated landscapes from which they could learn about their community and its environment. Sometimes the learning was focused on functions of a natural ecosystem, and other times on connections between human society and the landscape. A recurrent sub-theme centered on the need to teach the history of local community landscapes, in this case, as instrumental in transporting natural resources and raw materials from the Lake States to the Pioneer West. The important point about the teaching and learning was not so much that participants appreciated their awareness of community landscapes, but felt others needed to learn about ways in which the local landscape functions and/or has functioned. In other words, several participants were able to deconstruct aspects of local landscapes, and felt others needed to have similar understandings and abilities.

Several participants felt that their community needed places where others could visit natural environments in order to "connect with nature." David, a retired chemist, appreciated public opportunities to learn about the natural history of prairie plants and animals. He felt that the beauty of Midewin was its proximity to the Chicago metropolitan area and the potential to encourage people to learn about a prairie landscape. David felt that many people go to parks to enjoy spring blooms or fall colors, and that these were the "little hooks" that start the "never-ending education process." In his discussion of a photograph with some naturalized daffodils blooming (Fig. 1), David stated:

> ... [People] come out to see the really spectacular stuff, then you start parking your car and walking back and seeing other stuff and becoming interested in the prairie and learning more about it. And that's sort of the thread that draws you in ... There's something about beginning to attach names that make it nicer to people. You go out and see things like the pretty flowers. Well, once you put a name on those pretty flowers, you start to learn how they grow, what sort of areas they grow in, why do they grow here rather than over there.

Carol, a state employee in her 40s, took several pictures during a local festival called "prairie days,"

Figs. 1–6. Several participants indicated that important landscapes were those from which they could learn about their community and its environment. Sometimes learning was focused on functions of a natural ecosystem, and other times on connections between human society and the landscape. Landscapes that provided learning opportunities included a field of wildflowers (Fig. 1), a special event at a local park (Fig. 2), a trailside interpretive sign explaining the flow of water at a sewage treatment plant (Fig. 3), a local community dulcimer festival (Fig. 4), a backyard vegetable garden (Fig. 5), and a community "children's garden" (Fig. 6).

which celebrated the cultural and natural heritage of the local landscape. She was involved with programs catering to school children that came to learn about the prairie (Fig. 2):

> Here's part of the 5th graders that came ... they had different checkpoints ... and it worked out really good. They had some out at the cabin, and some on the trails to take them

to different checkpoints to show them the prairie.

Thomas, a librarian and avid bicyclist in his 30s, was one of several participants who took pictures of signs or markers meant to represent community values and, in some sense, educate those who pass. Thomas took a handful of pictures near sewage treatment plants. He felt that locating bike paths and trails next to water treatment facilities provided critical opportunities to educate the community about the water they use, and thought that signs were an appropriate educational tool. In his characterization of an interpretive sign at one such plant, Thomas stated (Fig. 3):

> ... this is nice because number one, they educate you on what the sewage treatment facility is and how it works ... Secondly, you know that they're not doing anything too bad because now they're constantly being watched ... And it's just a reminder that every time I flush my toilet, you know. It's a very educational thing.

Rather than a sign or marker, some participants felt that the education of others is best done through social interaction, such as that found at local festivals. Meg, a retired doctor and hospital administrator, was particularly concerned about local knowledge being passed from one generation to the next. She appreciated places that encouraged people of all ages to learn from each other. In response to a photograph taken at a community dulcimer festival (Fig. 4), Meg explained:

> ... it's important to involve children in things that adults do. Getting them involved in prairie restoration, for example. Getting them involved in volunteer activities ... If you don't teach the next generation to value the same things that we currently value, where are they going to learn it? Who's going to teach them? And if you don't take value on events like this, it's all that they see on television and in videos. We're going to lose a lot of what we have, and if we cherish it I think we want it to be *not* lost ... to be saved so it can be carried on by the next generation and generations down the line.

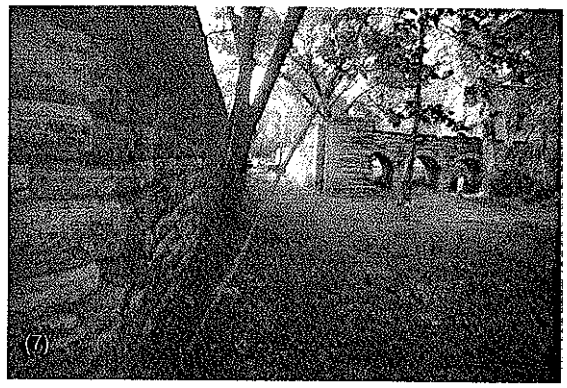
Several participants felt that community members and the public at-large needed to understand connections between food found in the grocery store and farm communities such as those of Midewin. Jerry, an employee of the federal government in his 30s, appreciated farm and garden landscapes because it was important for people to know linkages between grocery stores, farmers, and growing crops. In his response to a photograph of a vegetable garden (Fig. 5), he stated:

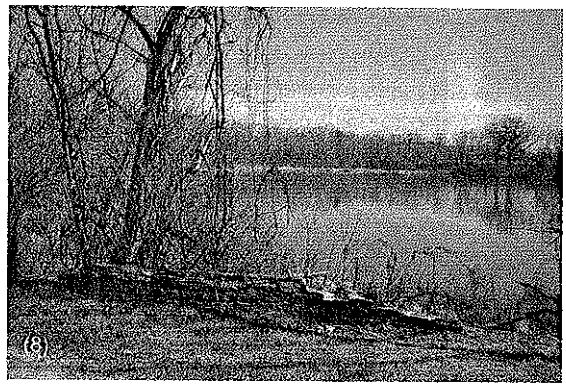
> My dad had a wonderful garden. We would eat a lot of the stuff that we grew right in our backyard. Fresh vegetables ... as a kid you would find a slug or something on it because you can't get them as clean as in a grocery store (laughter). In retrospective [sic] I realize now that it kind of connects you with the earth and you realize where your food comes from. It doesn't come from a grocery store.

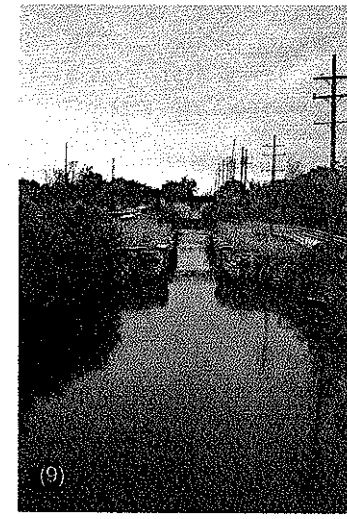
Other participants also lamented that society has become so removed from earthly connections that "some people don't even know that milk comes from a cow!" (Alice, who is a fourth generation farmer of the area in her 70s). Such statements suggest not only an appreciation for farming landscapes, but a feeling that communities need places that allow others to witness or experience gardening, farming, and the production of food. Will, an engineer in his 40s, was proud of his community's "children's garden" which provides hands-on gardening experience (Fig. 6):

> The children's garden is a big project for the community to come in and build this area for children. It's in walking distance from the grade school. They have just about every conceivable kind of flower and shrub you can imagine in there. They have a garden in there with sunflowers and corn and tomatoes for the kids to go in and pick ... It's a community thing so volunteers go out there and help with watering and weeding.

The features of the community landscape that garnered the most pride and whose importance as a focal point for learning was shared by the most participants involved places with historic ties to transportation of goods from the east to the west, and the north to the south. In particular, many participants felt that stories related to the Illinois & Michigan (I&M) Canal, an historic network of waterways of the mid-1800s whose purpose was to haul goods from the east (mostly the Great Lakes area) to the waterways of America's Pioneer West, needed public representation. For example, Henry, a retired real estate agent and volunteer at a local historical society, told a story about the significance







Figs. 7–9. Features of the community landscape that served as a focal point for learning were places tied to historic transportation of goods and raw materials. Stories related to the Illinois & Michigan (I&M) Canal and its "opening of the West" permeated a significant portion of community history as re-told during the interviews. Landscape scenes related to such heritage narratives included remnants of structures used for the canal (Fig. 7), parks that line the waterways of the canal (Fig. 8), and views from bridges that cross the canal (Fig. 9).

of towpaths along canal routes (Fig. 7) and afterwards encouraged the interviewer to "see for yourself" by providing detailed directions to these places:

> On the I&M Canal, they pull barges down there. They were pulled by mules upon the towpath ... The locks should be preserved ... it's just a feeling of history. That's too much history to plow back into the ground ... and destroy it.

Maggie, a nurse in her 50s, also appreciated opportunities to "re-live history" through first-hand knowledge of landscapes around the I&M Canal (Fig. 8):

> It was really a big deal with this I&M Canal and how they brought commerce from the East down to the Mississippi River... immigrants came over to find work, they settled there and became part of the community ... there's a group called the Canalers trying to get on one of those canal boats and take people on rides ... at least history will live on.

Bob, a housing contractor in his 40s, would like to enhance the public opportunities to learn about Midewin area as a national transportation hub (Fig. 9). Along with his discussion of the need for people to know about railroads as a strategic development for growth of Chicago and the Anglo expansion westward, he also envisioned ways to tell about commercial transportation on the area's waterways:

> This is a shot ... showing that the canal, even though it hasn't had any boats in it for 130 years it's still a viable waterway. With just a little amount of care, it could be restored to a replica of the original waterway. My plan would be to put in a towpath along the side and to allow people to walk along the

canal if possible. Have a replica of a barge boat and have it pulled by a mule ... The canal represents that pipeline that gave people work and provided for the continued growth of the western United States ... This is the lock that I would like to see rebuilt and reused to provide a canal heritage park. The type of experience where people could actually get into barge boats and go up and down ... have a bunch of mules pulling along the lower canal.

It was clear from participants that their senses of community identity needed to be reflected in the public places of their community. Such places would allow others to learn, and community members to reaffirm, past and present relationships with the land. Landscapes that allowed people to learn about their inter-connections with each other and with their environment included places for first-hand experience of locally-based nature, places that tell landscape functions through signage or markers, and places (like festivals or parks) with opportunities to bear witness to connections between community members and landscape. This theme aligns with Proshansky et al's (1983) discussion of "environmental competence," in which individuals need to understand their landscapes in order to behave appropriately, and ultimately, to be able to function well in them. Manzo (2003) also suggested that individuals need competency in reading environments by arguing that "relationships to places are a dynamic phenomenon" (p. 51) in that we are constantly reacting to places, even those familiar to us, due to insights from the array of other places in our lives.

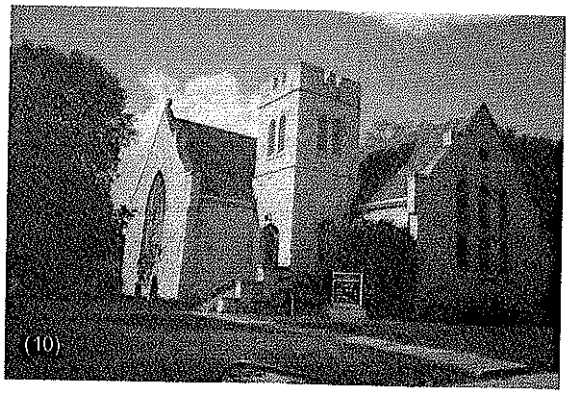
3.2. Places to enact community

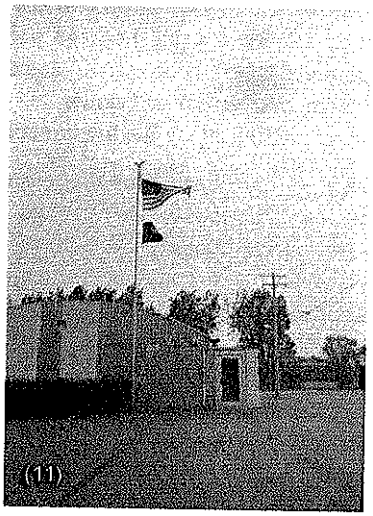
Several participants appreciated gathering places, public or semi-public indoor and outdoor sites, where people would meet and work toward shared goals or demonstrate shared beliefs. Such gathering places gave participants a sense of community they might otherwise not have. Wilkinson (1986) (see also Tilly, 1973) suggests that community enactment is an essential element to indicate a community's identity. Without places or events in which people act in consort, or without some degree of unified action and resultant feelings of solidarity, one would not have a community (Wilkinson, 1986, pp. 5–6). Although Wilkinson framed community enactment within contexts of action against outside threats or resistance to external forces, several participants in our study were able to connect a variety of collective behavior to enhancement of their sense of community. Enacting community was related to places where people would gather to negotiate shared goals and reaffirm their relationships. This does not mean that all goals were shared; it means that there were enough shared to motivate people to gather, and as a result, foster a sense of community.

Photographs of churches elicited comments related to collective behavior and shared values. Several participants took pictures of churches, and not necessarily the churches of which they were members. Teri, a former rodeo circuit rider and current horse-breeder in her 50s, appreciated churches within a small town setting because they reminded her of a community church "that wasn't strictly Baptist or Methodist or anything like that, it was just a community church ... and the community supported it ... and that people in the community would go to it." On a similar sub-theme, Henry took pictures of churches that elicited a discussion of various baptisms and weddings of family members, past Christmases, rituals or procedural details of various church services, and other memories related to the churches as well as linking his stories to other church congregations around Midewin that he did not photograph. Churches, as places to hold events for his family and others in the community, were a significant part of Henry's important places of Midewin (Fig. 10). For Henry, churches function as a "kind of community center."

Besides churches, places for fraternal organizations or restaurants also elicited discussion related to enactment of community. Jill, a clock and watch vendor in her 50s, took a picture of the local Veterans of Foreign Wars (VFW) club house. She and her husband were active with this organization and felt the VFW influences community togetherness through weekly dinners for community charity, assisting local funerals, and sponsoring various youth activity programs. In her response to the VFW club photograph (Fig. 11), Jill stated:

Tonight they're having food. A ham and bean supper for the Boy Scouts. And they do a lot of things. Members handle the funerals at the Abraham





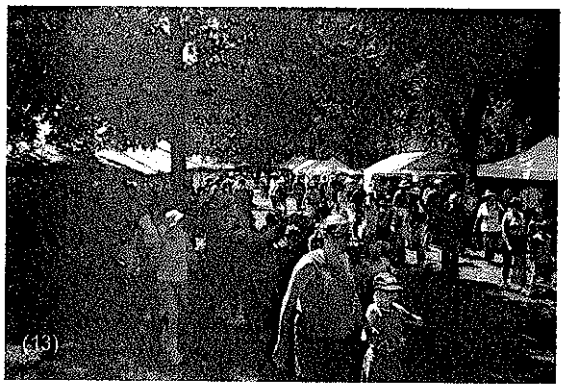
Figs. 10–12. Several built environments represented gathering places where people would meet and work toward shared goals or demonstrate shared beliefs. Such places provided participants with opportunities to reaffirm their commitment to one another and provided a sense of belonging. Places where segments of the community would gather included a church (Fig. 10), a local VFW Club (Fig. 11), and a diner (Fig. 12).

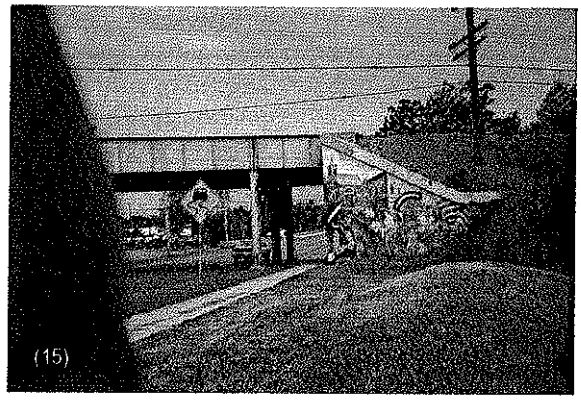
> Lincoln National Cemetery ... Our guys on Monday handle the funeral services for all the soldiers that come. They'll be doing something for the veterans over in Mattoon [another town] ... There are a lot of special programs for the kids that start early and run late... it combines the community together and gives them a sense of cohesiveness.

Cristina, a school teacher in her 40s, feels a part of the community because of the many places in town where she meets people she knows, coupled with her development of caring relationships. The public demonstration of "helping each other out" leads Cristina to feel she is part of a community. In comments about her photograph of a local restaurant (Fig. 12), she stated:

> Basically it's the only restaurant that's really close to us so we go there a lot. And there's nice people. My husband's a carpenter and contractor. One other carpenter's girlfriend bartends there. And we just kind of know everybody ... If something bad happens, our local people come out. I know a woman who found out she has cancer. On the way to cancer treatment, she was in a really bad car accident ... and so all of the people had a huge benefit, and everybody gave things. And they had raffles and auctions. And you see that all of the time. We come together and do benefits when somebody dies, somebody's kid is sick. You see, we feel a lot more a part of the community in Manhattan than we did in Bloomington [a larger city to the south].

Public places for family activities were appreciated by several participants. Meg indicated that community festivals reflect "wholesome" values of a community in that they allow people of all generations to celebrate





Figs. 13–15. Participants appreciated public places for family activities, particularly when the activities were opportunities to connect with the cultural heritage of the community. Such places included a local festival (Fig. 13), a living history "farm theme park" (Fig. 14), and public murals painted by local artists (Fig. 15).

together (Fig. 13). Local festivals are often linked to historic themes that could define a community's sense of itself. Meg said that in contrast to the "non-reality of Disney World," community festivals are:

> so much more creative and so much giving of one's self, even for the audience that claps and sings along when the artists want you to sing along. Real people having a good time with their families. It's sort of like one big party. Not a wild party, just a quiet party ... it is the whole community together.

Thomas appreciated "Perry Farm," a farm that was donated to the local park district and now serves as a living history farm, complete with a diversity of stock animals, gardens and orchards, wildlife sanctuary, children's museum, and restored farmhouse. Thomas took several photographs of sites in Perry Farm and for each often discussed the things that families could do together. In discussion of his photograph of the barn (Fig. 14), He stated:

> This is not really preservation of farming history. I took the picture to show the farm animals and barn, and the fact that you can take your kids there and do something.

Sometimes community places do not function as a current gathering place, yet are capable of representing enactments of community. Bob took photographs of murals painted on a wall of a railway underpass. The murals were painted by local Latino artists and youth volunteers, and depict stories of the past 150 years of human settlement within the area. Although Bob mentioned the *content* of the murals, most of his discussion focused on the *production* of the murals by community artists and volunteers. His interview suggests that it was the social context related to

community groups acting in consort that gave the murals significance (Fig. 15). The murals not only depict local heritage, but more importantly they:

> portray local pride and craftsmanship ... where local art and civic groups can take pride in restoring part of the city's history ... helps to promote the spirit of the city.

For several participants, their senses of community identities were enhanced by places that represented people working together toward shared goals. These places allowed community members to reaffirm their social relationships in ways that demonstrated they cared for one another. In all cases, the places were not gathering spots for the entire community, but were gathering spots for a segment of the community that shared similar goals. In addition, the places depicted by participants were rarely used as gathering spots. Rather, they represented an ability (or perhaps potentiality) for the "whole community to come together." The potentiality for like-minded people to gather, even if just for a one-time gathering such as Joliet's Latino murals, helped frame several public places as reflective of the community spirit.

As a curious observation, not one picture was taken of a local high school or football field. For many towns both big and small, pride in the local high school football team is a powerful force that shapes the public culture and leads to Friday night gatherings during the fall at the school stadium to demonstrate community support (Bissinger, 1990). A few participants discussed the changing of school boundaries due to expanding population as well as the construction of a new school, yet the lack of attention to local high school sports was noticeable. Most likely this was due to participants who did not represent the range of variability within the communities near Midewin.

3.3. Places to improve community landscapes

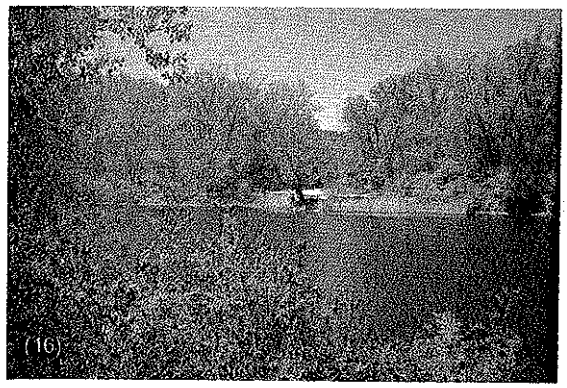
Several participants told progressive stories about their community, in which landscapes got better due to people working together to improve, restore, and/or beautify them. Although this theme could be considered a sub-theme of "enacting community," it often emerged outside of the contexts of collective action, and instead was embedded in stories about landscape change. With a few exceptions, participants were generally positive about past land-use changes and optimistic about future change (see Zube et al., 1989, for a similar finding). Improving local landscapes often was done through collective action and appeared as sources of community pride, even though neither of these attributes were necessarily noticeable within the discussions of participants. However, it was clear that several participants were aware of landscape change and favorably impressed with their community's ability to affect positive change, and in some sense, embrace the improvement of various local landscapes as a point of hometown pride.

Several participants' visions for landscape change were mindful of local history and noticeably not affected by traditional environmental discourse. Environmentalism has a longstanding affinity for concepts such as "wilderness" or "pristine land" (Cronon, 1995), or within the short life of restoration ecology concepts such as "pre-settlement conditions" or "historic range of variation" (Egan and Howell, 2001). These concepts suggest visions for landscape change with intentions to erase the human imprint. In contrast, participants were creative in their appreciation of worked landscapes (White, 1995; Goin and Raymond, 2001) and centered their visions for landscape change on human industry and intentions. For example, Luke, a special education instructor in his 40s, was so proud of the restoration of an abandoned coal mine into an outdoor sporting club that he felt "kind of spoiled by the high quality lakes" of the sporting club (Fig. 16).

> Previously it was used to mine coal. Coal companies came in and strip mined the coal, and made these features which have pretty much by themselves re-vegetated a lot of cottonwood ... in general, this shows the kind of restoration of an area that could have been pretty bleak.

Walt, a retiree in his 70s, is a member of a citizen-based environmental monitoring group. He was concerned about a farmer grazing cattle in a particular creek and the implications it had for environmental degradation (Fig. 17), but nonetheless was hopeful that someday the site would improve.

> There's no law that says he can't graze cattle on the creek and this is the land he couldn't put into



Figs. 16–18. Most participants were comfortable with the accumulated human impact on the landscape and their visions to improve the landscape did not include restoring it to some "pre-settlement" condition. For examples, sporting clubs use abandoned mine pits as lakes to fish (Fig. 16). Or, improvement of water quality while accommodating pasture for cattle is an ideal vision for landscape change for one participant (the scene in Fig. 17 is downstream from the scene in Fig. 18).

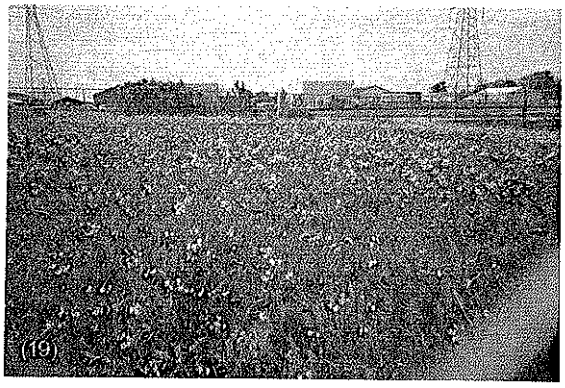
> production obviously so he uses it for cattle. To me it's not a good idea but what are you gonna do? . . . Especially as you start getting more development upstream, you're going to have more runoff into the stream and it's going to cause more erosion, it's going to cause more meandering as the stream picks up speed it has a tendency to meander, cut in to the banks, there's no stopping that . . . If Prairie Creek Preservation got to the point where we had finances, we would do something, we would buy that from that guy. Get his cows out of the there. I hope to see that someday.

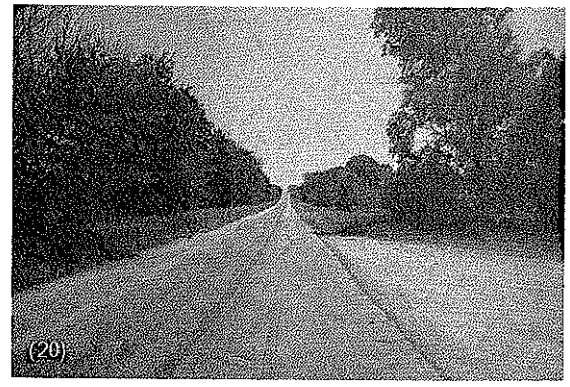
Walt was hopeful for Prairie Creek restoration because he was involved with a riparian restoration project upstream from the site of Fig. 17. Fig. 18 shows the site of Walt's restoration project upstream from the site where cattle are grazed in the stream.

> That's showing a stream bank restoration project that I was doing this past November and is completed now. It should be growing in pretty good. We'll see how that works out, stop some of the erosion from filtering into the creek.

For several participants, the target of improving local landscapes was the restoration of prairie ecosystems with success being indicated by the flourishing of native plants and wildlife, even on the smallest of land parcels. David characterized his vision for landscape change at Midewin by championing the virtues of a nearby prairie even though it was surrounded by development (Fig. 19):

> This is what a prairie should look like but it's not likely they're ever going to get much bigger than this because you can see there are industrial buildings and the railroad runs along this side. There are





Figs. 19–20. Midewin is effectively a long-term restoration project encompassing the conversion of more than 15,000 acres into a restored prairie. These photographs are especially salient to the purposes of prairie restoration efforts in that participants' visions were linked to a *contemporary* prairie compatible with mixed uses and human development, rather than an *historical* prairie that would erase the past 150 years of human settlement. As examples, one participant indicated a nearby restored prairie surrounded by development was an excellent model for Midewin to follow (Fig. 19). Another participant was keenly aware of the human effort necessary to restore prairie, the need for public participation in restoration efforts, and public access through trailhead development (Fig. 20); his visions for Midewin were represented by a road leading to a Midewin trailhead.

> houses starting to be built around the other side. So this is sort of one little acre that's isolated, but this is what Midewin could be in 200 years if we do it right. This is what the goal is.

Joseph, a US veteran with a disability, was intimately familiar with the process of restoring the Midewin site into a tallgrass prairie, and enjoyed discussing markers of a healthy prairie ecosystem. Yet many of his photographs elicited comments about the human effort needed to improve such sites, such as the work needed to develop a prairie trailhead (Fig. 20):

> We had a volunteer workday the day we opened the trails up. We had several truckloads of volunteers. And what they did was with the trucks on the road the volunteers would go up on both sides and pick up any trash that was laying around. When I say trash, I'm including downed tree limbs, stuff like that. Just a cleanup.

Two exceptions to optimism about improving community landscapes were related to casino development and the recently built tracks for NASCAR races. The race tracks were viewed by several participants as inconsistent with other local values. Jill indicated that the race tracks "just mess things up. It's not made for us. It's made for Chicago." Luke indicated that the race tracks were built "with very little prior public discussion" resulting in a "done deal ... that just in terms of physical appearance, it's really out of place for this part of Illinois" (Fig. 21).

Casino development did not surface as much as the race tracks within participant interviews. However, the few interviews that mentioned casino development

Fig. 21. Meanings elicited from participants' photographs were often connected to progressive narratives in which landscapes improved due to people working together. Two exceptions to this optimism were related to the development of gambling casinos and race tracks built for stock cars. Both of these developments were viewed as being imposed by outside forces without sensitivity for local communities and their public histories. Fig. 21 shows one of the local racetracks taken through a car windshield.

cast them as detracting from the downtown life of the City of Joliet and bringing in strangers from outside the community. As succinctly stated by Maggie, "the [casino] hotels on the river make the place ugly, and I feel alienated from those that think it's exciting." Both casinos and race tracks cater to outsiders, or tourists, and were developed largely for their perceived economic impact on Joliet's tax base. The literature on tourism impacts has documented scores of places in which local residents effectively lose their community due to tourism development gone awry (e.g., Stokowski, 1996).

The improvement of community landscapes was an important part of some participants' community identities. "Improving" current conditions is different than erasing or eliminating current conditions. In general, participants' envisioned landscapes were ones that showed signs of past human use. Of those who discussed improvement of community landscapes, they were aware of incremental landscape change and could attribute the change to various actors in the community. In this sense, there were not any landscapes considered "sacred" or "untouched by humans" at Midewin, nor was there any felt need to mask the human imprint on the land in an attempt to revise its history. The perceptions of participants generally aligned with humans as caretakers or stewards to protect vestiges of a long line of humanity that has affected landscape change. This was a surprise finding for several of the Midewin staff; they anticipated that the desirable vision for landscape change (and in particular for the lands they administer) to be an historic prairie restored to pre-settlement conditions—appearing vast, pristine, and nostalgic. Instead, the findings herein claim that a contemporary prairie, complete with visible reminders of human development, should be the target.

The architecture, design, and/or physical appearance of these "improved" places were less important than the social contexts by which they are known. As indicated by Stokowski (1996) in her study of gambling development in two small towns, landscape features may improve in terms of newer buildings and infrastructure, but if the context for change is not connected to community values, such "improvements" run the risk of destroying a felt sense of community. No doubt community identities adjust through time in some cumulative sense of development, yet the changes with the least social upheaval are typically incremental and grounded rather than punctuated or viewed as being from the outside (van den Berghe, 1993; Freudenburg and Gramling, 1994). At Midewin, the race tracks, and to a lesser extent the casinos, were not viewed as improvements by participants nor were they viewed as large enough threats to warrant a local resistance movement (Wilkinson, 1986).

4. Conclusion

Landscape change was embraced by most participants. The positive allure of change was due to prospects of enhancing community-based meanings of local places and events. These meanings served as both visions for change and as collective motivation to contribute to change. To look toward community members as a source of planning visions is not a new thought, although its implementation has had difficulties (Freudenburg and Gramling, 1994; Fischer, 2000). The contribution of this study is the relative ease in eliciting community-based meanings that could represent visions for landscape change. The overlapping themes are each directed at aspects that further empower community members within landscape planning processes. Participants felt that people needed to know for themselves how a landscape functions; they needed public places to gather to negotiate (and reaffirm) community identities; and they needed to change landscapes in ways that align with their senses of themselves.

Although the findings generally support landscape change, participants only supported landscape change when it enhanced a sense of locality in which landscapes revealed connections between people and their environments (Sell and Zube, 1986; see also the special issue of *Landscape Journal*, 1998, entitled "Eco-revelatory design: Nature constructed/nature revealed"). Several of the themes could be elicited by landscapes and features that do not necessarily involve large capital outlays. However, implementation will require the voices and collective action of citizen-stakeholders to articulate visions different than the creep of ex-urban sprawl. Most communities already have citizen-stakeholder committees formed in some capacity of planning, but they may not feel empowered to affect change nor have an understanding of alternative visions for landscape change. The

findings illustrate the ability of stakeholders to know, and be able to express, important meanings of their community. When these meanings are legitimized through planning processes and represented in local landscapes, they will further enhance a sense of community.

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