Managing eastern North American woodlands in a cultural context

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Abstract

The ecological context for the woodlands of much of eastern North America requires that they be understood as part of a cultural landscape. The dominant urban and agricultural matrix of southern Ontario is a novel landscape with remnant woodlands embedded in it. It serves as a model to understand how eastern forests have been regarded as representative of a previous wilderness landscape, but are profoundly affected by historical anthropogenic forces and by external processes in the current cultural landscape. These woodlands change in unpredictable ways, as envisaged in the new ecological paradigm, with no single, predictable ecological pathway, and no final stable state. Research, decision-making, and management requirements for eastern woodlands are identified using this perspective. The paper summarizes specific research needs based on previous publications and recent workshops concerning southern Ontario woodlots.

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1. Introduction

Southern Ontario is one of the most heavily modified landscapes in North America. However, the historical and current processes of agricultural disturbance and reforestation, and of permanent deforestation from urban expansion, are typical of eastern North America as a whole. Thus this region can serve as a model for how to view forested landscapes in the eastern half of the continent (Fig. 1).

Prior to European settlement, the dominant vegetation in southern Ontario was forest (Day, 1990; Moss and Davis, 1992; Keddy and Drummond, 1996; Larson et al., 1999; Puric-Mladenovic and Kenney, 2001). Original forests covered 90% of the region with 70% of these being upland, but by 1978 southern Ontario had less than 20% forest cover (Larson et al., 1999). The contemporary landscape is a typical agriculture–urban mix with scattered remnant and novel woodland patches, and is thus radically different from the original. However, planners and managers of these remnant and new woodlands often assume them to be natural and driven by natural processes (Schmitt, 2004; Schmitt and Suffling, in preparation). Thus, in survey returns (Schmitt, 2004) by approximately 65% of urbanized Ontario municipalities of over 20,000 population, only 18% and 29%, respectively, of the departments responsible for planning and managing woodlands had developed one or more conservation strategies, while 73% and 63%, respectively, stated they had not developed any conservation strategies. Thirteen percent (13%) of the planners stated that they were not sure how many strategies they had. This paper addresses how our approach to remnant woodlots in southern Ontario, should change in light of the above. From this case study we shall draw general inferences about eastern North American woodlots and their management in a landscape context.

2. An Ontario case study

2.1. Biogeographical context of southern Ontario

Southern Ontario can be defined as the lands south and east of the Precambrian shield (Fig. 2). It lies in the Mixedwood Plains Ecozone. The Canadian Ecological Land Classification divides the Mixedwood plains into site regions, 6E and 7E (Lee et al., 1998), corresponding with the Manitoulin-Lake Simcoe and Lake Erie Lowlands ecoregions. Great Lakes Mixed forest vegetation formerly dominated the Manitoulin-Lake Simcoe ecoregion, whereas the Lake Erie Plains ecoregion (also known as the Carolinian Forest) had mostly deciduous forest (Rowe, 1972). Braun (1950) classified these regions as part...
of the larger Northeastern Forest Ecosystem. The considerable diversity of forests within and between these ecoregions is caused by bedrock variations, topography, glacial deposits, soils, climate, and disturbance history (Lee et al., 1998). Presence of forests, prairie and savannah, wetlands, and Great Lake coastal systems further indicates the biodiversity of this region (Riley and Mohr, 1994; Theberge et al., 1989). Indeed Lee et al. (1998) identified over 80 vegetation communities in southern Ontario.

2.2. The agricultural and forestry context of southern Ontario

Southern Ontario was under agricultural influence from Iroquoian natives several centuries before the arrival of the first Europeans, but these people did not exert a major impact outside of well defined regions such as “Huronia” on Georgian Bay (Suffling et al., 2003). European settlement, starting significantly in 1784, was a much greater influence on the forest landscape (Day, 1990; Elliott, 1998). European farmers both enabled and required new types of agriculture, especially large-scale permanent land clearance. By 1920 about 90% of the upland forest in southern Ontario had been cleared (Larson et al., 1999, p. 7) and this is an extreme instance of what happened throughout eastern North America (Matlack, 1997; Barnes et al., 1998, p. 479).

Changing forest values have characterized European use of southern Ontario woodlands. In some areas, Red pine (Pinus resinosa Ait) ship masts were the favored product before and during settlement. Then, with the growth of cattle raising, Hemlock (Tsuga canadensis (L.) Carr.) bark was in demand for...
leather processing, and Tamarack ties (Larix laricina (Du Roi) K. Koch.) were needed by the nascent railway industry. Farmers kept Maples (Acer saccharum L.) for sugar sap extraction while removing other species for potash production, and firewood. Later, sawlogs and firewood were cut and veneer logs selected. Each activity has impacted forest species differentially (Day, 1990; Elliott, 1998; Merriam, 1999; Larson et al., 1999; Suffling et al., 2003). The same pressures can be seen generally in the forests of eastern North America (Whitney and Somerlot, 1985; Whitney, 1990; McDonnell and Pickett, 1993; Peterken, 1996; Foster et al., 1997; McDonnell et al., 1997; Matlack, 1997).

One can also attribute the considerable variation in southern Ontario forest to urban-to-rural and urban-to-wildland gradients. Areas of poor agricultural potential and those furthest from the most intense agricultural and urban systems tend to have the highest contemporary forest cover. Rocky Bruce and Lanark counties, whose agriculture has declined, have 30.5% and 40.1% cover, respectively, whereas intensively cultivated Essex County has only 2.8% (Larson et al., 1999, p. 48). Thus the vast, mostly contiguous forests once covering southern Ontario have been significantly reduced in certain areas, virtually eliminated in some regions, and have rebounded modestly in others. This is reflective of general trends in eastern North America (Flinn and Velland, 2005). Today, fragmented forest remnants are the norm in this relatively new agricultural and urban matrix.

2.3. Urban sprawl impacts

The population of the Greater Toronto area (GTA) has risen from 1.1 million in 1950 to 5.1 million in 2001, and is projected to be 7.1 million by 2028 (Anon, 2003). The economy and population are expanding rapidly along most of the North shore of Lake Ontario, creating a sprawling “Los Angeles-style” megalopolis. Deforestation is occurring at alarming rates in this most rapidly urbanizing region of Ontario, and notably in the GTA (Chant et al., 1999). The forest cover proportion in suburban areas has been reduced dramatically, as in Markham with only 3.2% cover (Tamminga, 1996). In York region, forest cover has declined 30–50% from 1975 to 1988. During this time, the number of forest patches has increased, while patch size and forest interior areas declined (Puric-Mladenovic et al., 2000). There is greater loss of upland communities in contrast to the better protected wetlands, and this has occurred even among the patches designated as ecologically significant (Ouellet and Suffling, 1992). These processes are typical of those in other expanding urban regions in eastern North America (Alig et al., 2003).

The Provincial Policy Statement (Ontario Ministry of Municipal Affairs and Housing, 1997) requires that
municipalities define and protect Significant Woodlands. Our research (in preparation) found that, by 2003, only 56% of the municipalities had identified Significant Woodlands in their municipality, and less than 50% had carried out comprehensive natural heritage planning exercises seven years after they were required to implement these policies. As the Provincial Policy Statement coincided with massive urban expansions many of whose plans had been approved in previous years, municipalities have not been able to comply effectively with the Policy Statement.

Not only is the area of forest plummeting in urbanizing areas, but the ecological structure and function of remaining forest patches is greatly compromised. Researchers observe dramatic differences in urban forest flora and fauna, atmospheric and soil chemistry, and ecosystem processes in comparison with rural systems (e.g. Bradley, 1995, p. 67; Pouyat and Carreira, 2003; Lovett et al., 2000; Steinberg et al., 1997; Gregg et al., 2003; Wear et al., 1998; Pickett et al., 2001; Hutchinson, 1999).

2.4. Woodlots are mostly secondary forest

Peterken (1996), working in a European cultural context, termed woodland that has persisted since before the original forest was fragmented as primary, and patches that regenerated after clearance as secondary. The process of clearance and reforestation continues to this day in eastern North America (Suffling et al., 2003; Zipperer et al., 1990; Matlack, 1997). About 68% of southern Ontario’s current forest cover is secondary (Larson et al., 1999, p. 52) and 25% of woodland area in the St. Jacobs area of the Region of Waterloo is secondary (Martin, 1991). In rapidly urbanizing Markham 13.6% is natural vegetation (not all of which is forest) and 58% of this is secondary (Tamminga, 1996). The process of reforestation has been most marked in marginal farming areas (Suffling et al., 2003) and secondary woodlands are thus an important component of the current forest estate in southern Ontario. The process of clearance and subsequent reforestation is widespread in eastern North America (e.g. Foster et al., 1998) so again, southern Ontario is representative of the larger system.

The secondary woodlands vary from monotypic pine and spruce plantations to semi-natural regeneration after the land was idled. As secondary woodlands vary widely in structure (May, 1995; Elliott, 1998) one may expect differences in ecosystem function, and this is a neglected topic that needs to be addressed systematically. While the temperate forest of North America is well recognized for its resilience to natural disturbances such as tornadoes, it has not fared as well in the face of anthropogenic perturbations (Foster et al., 1997). Moss and Davis (1992) noted changes in species occurrence, dominance, and habitat structure for surviving southern Ontario woodlands, and Suffling et al. (2003) documented the virtual disappearance of whole forest types. Similarly, Foster (1993), working in New England, found general changes in forest structure due to human impact and identified new successional trajectories that result. McLachlan et al. (2000) have even questioned if the old-growth attributes of certain New England forests are natural or if they really result from human activities.

2.5. Exotic species compromise woodlot ecology

Introduced diseases such as Chestnut blight (Cryphonectria parasitica (Murrill) Barr) and Dutch elm disease (Ophiostoma ulmi (Buismann Nannf.) have exerted major and continuing impacts on southern Ontario forests, but their full effects are unknown (Castello et al., 1995). Further alien pathogens and insect pests arrive with increasing frequency as international trade burgeons and these are, or will be ecologically disruptive. Currently, they include emerald ash borer (Agrilus planipennis Fairmaire), Asian longhorn beetle (Anoplophora glabripennis Motschuski), butternut canker (Sirococcus clavigimenti-juglandacearum V.M.G. Nair, Kostichka and Kuntz) and beech bark disease (an interaction between the native fungus Nectria galligena Bres. in Strass. and several introduced scale insects).

Ontario woodlands are also changing at the understorey and soil level. Garlic mustard (Alliari petiolata [Bieb] Cavara and Grande), periwinkle (Vinca minor L.) and European buckthorn (Rhamnus cathartica L.) are all common invaders of deciduous woodland. The widespread introduction of non-native earthworms is changing the soil of woodlots, as has been documented in neighboring US states (Hale et al., 2005; Gundale et al., 2005). It appears that the woodlots most affected by exotic species are more urban and more impacted by recreational activities and trails, but this phenomenon has not been addressed systematically in the research literature.

Thus there is solid evidence that historical and ongoing human activity is changing the ecological structure and functions of these remnant natural areas. However, accepting this truth is difficult because many of the influences are subtle and the lag times for their full effect can be considerable.

3. General inferences

3.1. Incorporating cultural woodland as a North American concept

How can one generalize from this Ontario case? Southern Ontario woodlots, and woodlands in eastern North America generally, are strongly influenced by human activities and face new and profound stresses, many of which are poorly understood. Nowak (1994) and Nowak et al. (1996) emphasized that urban woodlots, in particular, are complex systems that evolved through interaction of natural and human processes, while Merriam (1999) has made similar arguments for southern Ontario forests in general. Such forests are therefore mostly heavily altered woodland patches in an artificial matrix of agriculture and urban development. They are not really “islands of green” as originally characterized by Francis (1977) but are just less altered patches in a thoroughly cultural landscape.

Researchers and land managers in Europe have long used the concept of cultural landscapes (McCollin et al., 2000; Thomas et al., 1997). Peterken (1996, p. 4) defined them as “dominated by the effects of past and present management” where humans have cleared most of the original forest. Watkins (1998) has described the long history of European forests in providing
domestic, agricultural, industrial and military services so that such landscapes result from past management policies and are closely linked to important events and cultural developments in human history. While the length of intense human occupation has been strikingly shorter in North America than in Europe, the landscape has been transformed almost as profoundly to meet the aspirations of its human inhabitants.

The cultural landscapes construct has also been taken up in North America. At the Lockwood conference on suburban forests (Waggoner and Ovington, 1962), Pierre Dansereau suggested that most of the state of Connecticut was a “suburban forest”, a semi-domesticated area between garden and forest. Stephen Spurr, likewise suggested that “the suburban forest is all of Connecticut except a strip along Long Island . . . It is really one great ecosystem”. Pollan (1991) has echoed this argument. Similarly, Burgess and Sharpe (1981) referred to Wisconsin’s landscape as human dominated and controlled, arguing that “some or all of the biota are in disequilibrium with the current landscape patterns”, and southern Ontario has been termed a settled or cultural landscape (Riley and Mohr, 1994; Moss and Davis, 1992; Pearce, 1992; Perera et al., 2000, p. 81). Foster and Motzkin (2003) noted the importance of treating certain New England ecosystems as cultural systems, but observed that this would probably be met with resistance from within the conservation community. The issue of North American conservationists finding difficulty in recognizing the value of highly human modified systems has also been raised by Norment (2002) who attributes this to an exclusive focus on native species and to human modified systems has also been raised by Norment (2002) who attributes this to an exclusive focus on native species and to conservation community. The issue of North American conservationists finding difficulty in recognizing the value of highly human modified systems has also been raised by Norment (2002) who attributes this to an exclusive focus on native species and to a philosophy of restoring conditions of a particular era. In addition, most thinking on how to manage woodlots in eastern North America originates in ideas of North American landscape ecology founded in studies of large wilderness tracts (e.g. Burgess and Sharpe, 1981; Pickett and White, 1985; Turner et al., 2001; Urban et al., 1987; Forman, 1995). Thus we believe that the wilderness orientation of much of North American ecology continues to colour the attitudes of conservationists towards remnant woodlots that are now cultural entities.

3.2. The “New Ecology” and cultural woodland

Much research and woodland management fails to reflect the recent paradigm shift in ecology (McDonnell, 1997; Pickett et al., 1992; Botkin, 1990). The New Ecology recognizes that ecosystems are: (1) open, (2) controlled by both internal and external processes, (3) exhibit multiple equilibria, (4) have multiple, probabilistic successions, (5) are subject to natural disturbances, and (6) include humans and their influences. In contrast, the older “Equilibrium paradigm” envisions a stable end point or climax community and self-regulated ecosystems less affected by outside processes. The role of humans was also treated as insignificant (often by omission), and there was a strong focus on the “balance of nature”. The new ecological paradigm factors in global and local anthropogenic influences, as well as acknowledging limited understanding of these systems. We neither know the original state of southern Ontario woodlands (Suffling et al., 2003), nor do we fully understand their future trajectory under a cascade of human influences.

3.3. The current research context

The knowledge gaps regarding woodland patches in agricultural and urban landscapes exist, in part, because ecologists lacked interest in such areas (McDonnell et al., 1997), but there is now a growing literature, such as material in the new journal, Urban Ecology. Strobi (1998) called for more research on remnant woodlands, as did Larson et al. (1999), and The Natural Heritage of Ontario’s Settled Landscapes (Riley and Mohr, 1994) has been the framework for several of these initiatives. Friesen (1998) identified research needs regarding the optimal size and function of buffer zones, along with how these vary with different types and intensities of neighboring land uses. He envisaged human impacts on the suburban forest as edge effects analogous to microclimate and vegetation edge effects but exceeding these in both severity and spatial extent. Larson et al. (1999) identified key topics for further research including: (1) a need for greater understanding of pre-settlement conditions, (2) mapping of old-growth and similar (>100 years old) forest stands in forest inventories, (3) improved incentives for landowners to conserve woodlands, (4) standard practices for setbacks and buffer zones around woodlands, (5) management practices that promote old-growth conditions, (6) connections and linkages, (7) educational material, and (8) ongoing monitoring of southern Ontario woodlands.

In Ontario, interest in urban woodlots has been fuelled by the Ontario Provincial Planning Policies (Ontario Ministry of Municipal Affairs and Housing, 1997) that acknowledged a need to protect significant woodlands as natural heritage. This policy initiative has influenced the Ontario Ministry of Natural Resources to issue conservation guidelines, including those from Lee et al. (1998), Ontario Ministry of Natural Resources (1999), and Anon (2000), and these complements other work such as Oldham et al. (1995) and Ontario Nature (2004). However, it is unclear whether these conservation guidelines are appropriate or whether they will work. Riley and Mohr (1994) have referred to the current natural heritage planning exercises in Ontario as “the most significant ecological experiment being carried out in southern Ontario”. Flores et al. (1998) stated that, while there is a “modern ecological framework”, inappropriate and outdated ecological concepts continue to be used in land-use planning. Though the Ontario Provincial Government has introduced these natural heritage policies, it provides little financial support for research or monitoring to determine what is working. Therefore ideas such as adaptive management, which is part of the new ecological paradigm, are not being supported with these policies.

4. Conclusion

As we are neither in a position to fully understand the original woodland system nor to re-establish the ancient forest landscape, we are obliged to devise a more benign cultural system. If we recognize that we should be both creating a new ecological landscape and preserving altered fragments of an old one, then we shall have more success than is possible merely by scrambling to preserve fragments of the old system. Research,
planning, and management should facilitate both rehabilitation and restoration in this milieu, and should explicitly acknowledge management uncertainties using the new ecological paradigm. Adaptive management (Walters and Hilborn, 1978) also has a role here.

This relatively small body of research on eastern North American urban woodlands, and specifically in southern Ontario, reflects the scant regard of society for such systems. Further, lack of tangible support for related policies suggests that politicians, planners, managers and the public still believe that, once protected, natural areas take care of themselves. Ideas about woodland recreation, restoration, and management are low on the political agenda (Schmitt, 2004), and we still debate whether all or only a part of the surviving 19% forest cover of southern Ontario is of high value (Puric-Mladenovic and Kenney, 2001). If the focus is really on protecting significant woodlands, have we really made any progress from the planning of nearly 30 years ago that saved “Pieces of Green” (Francis, 1977)? The current approach in a milieu of rampant urbanization is to define which woodlands are significant and therefore worthy of saving, with the implication that the rest must be sacrificed on the altar of “highest and best use”. Such discussions, driven by government policy under the agenda of natural heritage planning, are not based on current thinking in ecology, but rather on expediency, land economics and legal precedent. To be fair, Ontario society has begun to recognize functional and heritage reasons for preserving larger habitat fragments, as on the Oak Ridges Moraine and in the Rouge River Valley. However, as we preserve these remnants and the matrix between them, we should ask if we have yet learned to manage them wisely. As humans are the dominant drivers in these preserved systems, and as many natural processes have been dimmed or altered there, we face the unwelcome truth that southern Ontario’s woodlands are cultural features, not wilderness, and society should undertake the fiscal, research and planning responsibility to manage them accordingly. To the extent that we continue to believe that eastern North American woodlands are pure remnants of an original forest, we shall both fail to fully conserve them and jeopardize their successful management.

Therefore, explicitly acknowledging the following during land-use decision-making, and during regular management should help to foster appropriate management for North American cultural woodlands:

1. The eastern North American woodland and its matrix constitute a landscape that exhibits intertwined natural and cultural legacies. Both the natural features and cultural practices can be evaluated for ecological quality.

2. Every landscape and every woodlot has an existing management regime. The regime can be benign or otherwise, and can be characterized by intervention or passivity (whether by neglect or judicious inaction).

3. Every landscape is in the process of re-invention, and the desired ecological quality of the result can be defined and evaluated. Ecological processes often take effect over long time spans, with distinct lag or latent periods. Management and evaluation must recognize this explicitly.

4. As relatively natural systems are very rare in this context (Larson et al., 1999), they should be managed with a view to minimal intrusion by recreational and other functions.

5. Heavily modified systems should be actively managed to retain ecological function and services while maintaining and building capacity to resist or reverse negative ecological change. Neglect should not stand as a metaphor for wilderness preservation.

6. Where traditional or historical management systems have functioned well in (4) and (5), above, they may best be maintained.

7. The cultural matrix and the woodlot should be considered as a single system. The management of the matrix between woodlots should consider effects on the woodland fragments. Such effects include, but are not limited to, connectivity for desirable species as well as for invasive exotics, pests, predators and parasites, and the interior/edge effect.

8. In woodlots, every management action is effectively an experiment. Whenever possible, research questions should be formulated and tested both to monitor actions and policies, as well as to enhance management skills.

9. Policy makers, planners and managers must shift from classical ecology to the new ecological paradigm, because adaptive, experimental management will only succeed if applied within the new paradigm.

10. Woodland conservation in a cultural landscape must consider the social component and involve the community. Management that ignores social concerns will often encounter resistance that jeopardizes the original goals.

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