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A landscape-ecological appraisal of the diversity and relevance of cultural landscapes

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Abstract

The term 'cultural landscape' is examined from the perspective of its generally accepted use in various parts of the world. Contrasts exist due to the different cultural histories, academic affiliations and to the practitioners of the concept. Presently the term appears to have greater currency and relevance to landscape planning in Europe.

To provide a broad perspective, cultural landscapes are examined, from within the Eastern Deciduous Forest Biome of North America, with particular reference to the province of Ontario, Canada. Here the consequences of a landscape structure onto which human attributes of landscape have been imposed is used as a basis for comparison with the longer, organic evolution of landscape as manifest in Northwestern Europe. More specifically landscape processes are examined with respect to the traditional agricultural practices of the Mennonite community of Southern Ontario where many indicators of landscape sustainability show negative attributes.

The potential for the application of the principles of landscape ecology to the issue of understanding the functional nature of landscapes is stressed, in particular, as a basis for initiating landscape-focussed policies.

Introduction

To review North-American landscapes in the context of the current debate around the value of cultural landscapes in European land management and planning raises and highlights several critical distinctions. The first and perhaps foremost of these is that in Europe, at least within the European Union, there is clearly an ongoing debate about planning in which the idea of 'landscape' plays a major part in a developing, policy-making strategy. By comparison, such a debate within North America, either within Canada or the United States is, at most, of marginal importance. The second distinction relates to the terminology used around this debate; for instance, what is meant by the terms 'cultural landscape' and 'traditional landscape' on different sides of the Atlantic? And thirdly, there is the role the new and emerging landscape sciences are beginning to play in advancing ideas of landscape planning. A transatlantic distinction is perhaps more evident in the field of landscape ecology than it is, for example, in the field of landscape design. Primarily for reasons of disciplinary evolution within landscape ecology, the

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European geo-ecological approach to the subject has, or appears to have, much more direct application to the issue than does the bio-ecological tradition, particularly as it is currently espoused in the United States (see Bastian (2001) and Moss (2000; 2001) for more discussion on this topic).

This paper will attempt to evaluate the nature of, and the reasons for these differing situations. It will initially outline a standardized terminology so that comparisons can be made that may account for the differences in approach to the idea of cultural landscapes. It will then examine landscape in the context of the so-defined cultural landscapes of Northeastern North America, principally Ontario, from a landscape-ecological perspective. In particular, the nature and evolution of form and function and of pattern and process in the landscape will be assessed. Finally, the paper raises the fundamental questions about the importance of cultural landscapes. Are they sustainable and how do we assess a landscape's sustainability? Are cultural and traditional landscapes, as generally understood, more sustainable than modern landscapes? What is the value of landscape ecology to this debate?

Terminology and ideas about cultural landscapes

In a discussion of the value of cultural landscapes to current and future landscape planning one is immediately struck by the lack of any coherent definition or universal acceptance of the term. This problem arises initially from the many and varied interpretations of the term 'landscape'. In this particular case we are dealing with 'ordinary landscape', defined by Meinig (1979, p. 6) as *"...that continuous surface we can see all around us"* as *"...expressions of cultural values, social behaviour and individual actions worked upon particular localities over a span of time"*. Ordinary landscapes, in this sense, are landscapes made by humans. Therefore, we are dealing with those landscapes that are characterized by human-induced attributes rather than those landscapes where natural and biophysical characteristics form the most obvious attributes. The latter are uncommon in Europe, but in much of North America such landscapes are not only more extensive but they are subjected to much greater protection, conservation, and overall management as landscapes than are traditional, humanized landscapes. The best examples of these landscapes are the extensive national, provincial and state parks of both Canada and the United States.

What is a 'cultural landscape'? Here one is immediately confronted with an apparent transatlantic distinction. Essentially in North America a cultural landscape is equated with ordinary, humanized landscapes. Salter (1971) defines such cultural landscapes to be *"...the artificial landscape man creates, remaking nature to better provide himself with his short-term needs of food, shelter, clothing, and entertainment"*. Whereas this broad statement may also encompass European understanding, Europe uses the term 'traditional landscape' as being *"...landscapes which have evolved over the centuries, until the fast and large-scale modern changes in the 'tabula rasa' style started... These changes deform the traditional structures, and thus the functioning, of the existing landscapes... Traditional landscapes can be defined as those landscapes having a distinct and recognizable structure, which reflect clear relations between composing elements and have a significance for natural, cultural or aesthetic value"* (Antrop 2000, p. 21-22).

Antrop (1997) had previously stated that: *"Traditional landscapes are not synonymous with the concept of cultural landscapes"*. A workable definition of cultural landscape, which would seem to encompass ideas of both cultural and traditional landscapes, is one *"which results from many generations of human occupancy. Many*

features of present landscape were fashioned by permanent changes. The cultural landscape is evolved from the natural landscape by a cultural group" (Mayhew 1997, p. 110).

Further refinement to these ideas, at the international level, is suggested in the terminology found in the UNESCO Convention Concerning the Protection of World Cultural and National Heritage, where three categories of cultural landscape are recognized (UNESCO 1972). Cultural landscapes, identified in this Convention are (i) landscapes designed and created intentionally by man, that is, garden and park landscapes; (ii) organically evolved landscapes; and (iii) associative cultural landscapes, justified on the basis of religious, artistic and cultural associations of the natural environment rather than material cultural evidence. The second category is the most pertinent here. These are landscapes resulting from social, economic and administrative interaction over time in response to the natural environment. Such landscapes fall into two sub-categories: (i) a relict or fossil landscape in which the evolutionary process has come to an end, but which is still visible as a landscape; and (ii) one which retains an active contemporary role reflecting both a traditional way of life in association with evolutionary progress over time. Of these, (i) may be equated with the traditional landscapes outlined by Antrop and (ii) with the situation in much of Europe and North America, prior to the modern industrial, agribusiness or collective phase of landscape evolution.

Another type of cultural-landscape category which has been identified elsewhere, and which has relevance to North America in particular, is the 'indigenous cultural landscape', discussed for example, in the context of Australia, by Bridgewater and Bridgewater (1999).

Figure 1 places the history and evolution of these dominant landscape types, in both Northwestern Europe and Northeastern North America, into a 500-year time span. This has been done to bring out the dominant human influences and themes leading to the present situation and to rationalize the terminology for this discussion as it relates to both sides of the Atlantic. For purposes of this discussion these regions are kept intentionally broad although for Northeastern North America it is taken to be the northern part of the Deciduous Forest Biome. This allows some comparisons to be made with Northwestern Europe. A quite different account of landscape evolution would be required if the arid Southwest of the United States had been used for comparative purposes.

The North-American side of this model is used to set the context for the following discussion on the relevance of landscape ecology to landscape problem-solving in North America and to provide input to the ongoing (more active) debate in Europe. It also provides a framework for the development of some principles for landscape-ecological research that may have application beyond both Europe and North America (see Moss (1999) for a discussion of a research agenda for landscape ecology at the international level).

To add more understanding of this issue, the question of who studies and/or works with the idea of cultural landscapes in North America should be briefly addressed. A review of the literature reveals three fields in which the concept of cultural landscape is to be found. By far the most prominent, and the one which has most relevance to this discussion, is its study by cultural/historical geographers. The principal driver of this theme was Carl Sauer's School of Geography at Berkeley, California. Sauer, and his students, influenced American geography from the 1930's to the 1970's, building upon his seminal work *The Morphology of Landscape* (Sauer 1925). In discussions of the cultural landscape Sauer focuses upon *"...man's record upon the landscape"* as

"...fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium and the cultural landscape the result".

Leighly (1963), in discussing the impact of Sauer's work, expresses its objectives in a way similar to those of the editors of this volume: *"There is such a thing as a humane use of the earth; the simpler cultures are less destructive of the terrestrial basis of man's existence than is our present technology; and the possessors of modern technology may find in the past experiences of man on the earth guidance toward a balance of the capacities of the land with the requirements of life that gives some promise of permanence"* (Leighly 1963, p. 7).

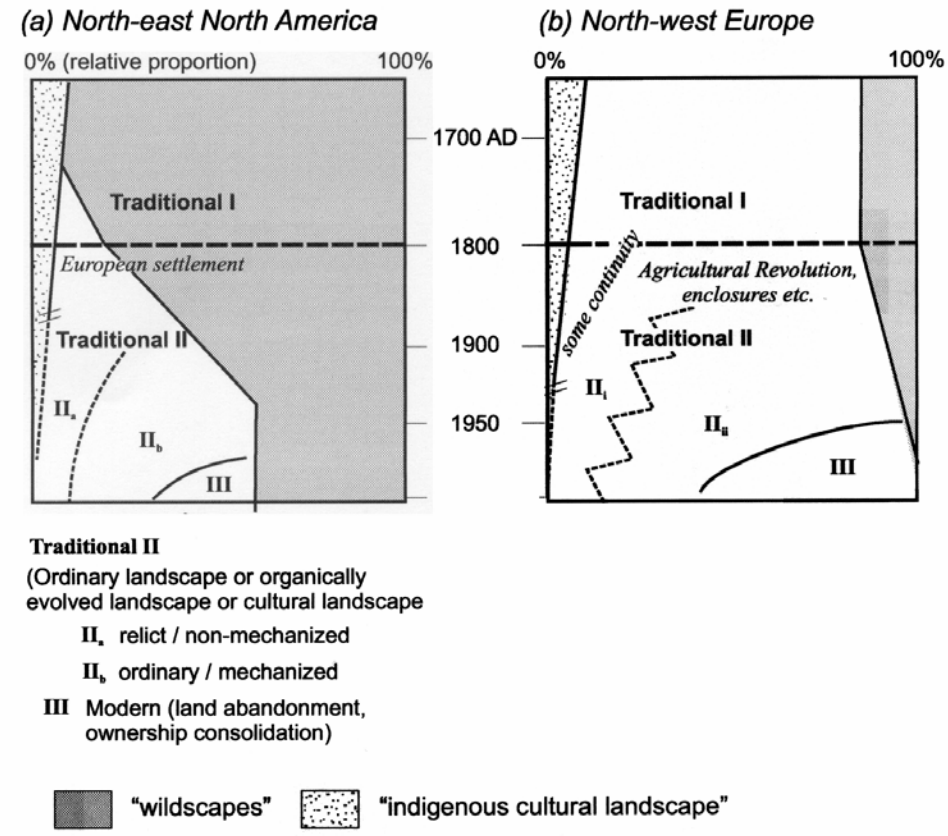

Figure 1. Cultural-landscape evolution

It is unfortunate that the Sauer School neither produced nor developed the methodological or conceptual understandings needed to advance this approach. Although many small regional cultural landscape studies were produced to support the concept, the main impact of Sauer's *Morphology* was to finally lay to rest the doctrine of environmental determinism.

By the 1970's this type of cultural/historical geography had lost its currency and effectively disappeared, not only from U.S. geography, but it paralleled the demise of regional synthesis and study – again bases that could have provided a direction and major input to landscape ecology from the discipline of geography in North America (Moss 2001). Only in the past couple of years have we begun to see something of a modernized and updated revival of these ideas of cultural landscapes in geography (see for example Head 2000).

Not unrelated to Sauer's approach is another, practised particularly in the United States, which centres around the identification of unique landscape types as defined by

local and regional artefacts such as barn types, house styles and fence rows. This is a field now primarily the concern of local heritage conservationists.

The third dimension to this history is the growing recognition of the need to understand the role of culture in landscape analysis and planning. This is a fertile ground for development between the fields of landscape architecture and landscape ecology. Joan Nassauer, for example, has stressed the importance of examining culture in landscape ecology on the premise that "culture structures landscape" and "landscapes inculcate culture". But she points out that neither has been examined sufficiently to produce cultural-landscape principles (Nassauer 1995; see also Nassauer 1997 for a broader discussion of this topic).

Cultural-landscape evolution in North America and Europe

In Figure 1, a schematic representation of cultural landscape evolution in both Northeastern North America and Northeastern Europe, the total landscape has been divided into the humanized landscape and the wildscape, the latter being that portion of the total landscape which retains, as dominant characteristics, its natural features. Clearly the distinction between North America and Europe around 1500 AD is that the wildscape covers essentially the majority of the total landscape in North America, whereas in Europe this percentage is extremely small, the extent of the humanized landscape reflecting a significant spatial impact extending from the Bronze Age and Neolithic. Traditional landscapes evolved over this time period in Europe.

Embedded within this pre-1700 AD matrix are 'indigenous cultural landscapes'. Spatially their extent was much greater in North America than in Europe, where they would be represented, for example, by land occupied by peoples of the Arctic regions. Although these cultures remain in place today in North America, over virtually all of the deciduous and mixed forest biomes the landscape significance of indigenous cultures effectively ceased as waves of European immigrants began to enter North America, particularly from 1750 AD onwards. The remnants of these earlier traditional landscapes today are spatially insignificant and the incorporation of any cultural characteristics into subsequent landscapes is almost non-existent.

Prior to about 1700, in the case of Ontario, the Iroquois people practised a system of slash-and-burn agriculture, growing maize, beans and squash in forest clearances surrounding villages with populations of up to 1000 people. These villages moved after periods of 8 to 20 years once the land had lost its initial fertility. It would appear that site selection favoured mesic sites with maple, oak, basswood, beech and hemlock (MacDonald 1987). The fossil pollen record indicates this phase by a significant rise in pine and oak pollen after around 1360 AD at the expense of the beech–maple forests. This phase also coincides with the appearance of grass pollen as well as maize and purslane pollen (MacDonald 1987, Fig. 5.1). The disappearance of this type of landscape coincides with a period of intertribal warfare and the introduction of European diseases by the first traders and settlers. This phase of First Nations/traditional landscape (indigenous cultural landscape) contrasts markedly in both its restricted temporal range and spatial impact to that described by Bridgewater and Bridgewater (1999) for Australia.

One of the most extensive areas inhabited by First Nations was that part of South-central Ontario, now known as Huronia, and occupied by the Hurons or Wendat peoples. European reports from the early decades of the 17th century report the Huron population in this region to be about 30,000 people, living in 18 to 25 villages (Heidenreich 1967;

1971). However, by 1649 the population had been reduced to 6,000, and by 1650 to just 300, as a result of wars with the Iroquois and exposure to European diseases. Consequently, at the time of the first main phases of European settlement (in Southern Ontario), beginning100 years later, there existed virtually no landscape history of First Nations; land abandonment and forest regeneration had masked any remnants or artefacts of this tradition. For quite extensive areas of Southern Ontario, for example in the Niagara Peninsula, there is little or no evidence of Indian occupation (Burghardt 1969; Turner 1994). Consequently the overall impact by First Nations on the landscape was spatially quite restricted. In the scenario outlined in Figure 1 this phase is referred to as Traditional I and clearly differs markedly in characteristics from Traditional I as outlined for Northwestern Europe.

Beginning in the early 1700s, on both sides of the Atlantic very significant landscape changes took place. In Europe the drivers of this change were the Agricultural Revolution and the population shifts associated with the Industrial Revolution. The timing and spread of these events in Europe are summarized by Antrop (1997), with major landscape changes initiated by such landscape processes as the enclosure movement in England in the early decades of the 18th century. These processes give rise to Traditional II landscapes for Europe (Figure 1). This period represents one of evolution from the former (Traditional I) landscape to a greatly modified landscape where new patterns were created and the many earlier relationships between humans and their environment radically altered. Over the ensuing 200 years the 'typical' cultural landscapes of Europe emerged in their many and varied forms. These varied local and regional forms are assumed to reflect both a local and regional balance and a landscape representing evolved, sustainable attributes. Using the terminology of the UNESCO Convention these would be the 'organically evolved landscapes'. Throughout this period the balance between landscapes inherited from Traditional I (that is IIi in Traditional II) reached something of a spatial equilibrium with newly evolving, post-c1750 landscapes reflecting the new socio-economic forces. This is expressed in new landscape forms; that is IIii in Figure 1. Given the length of time for the evolution of these landscapes the assumption is that they not only represent an optimal balance between humans and their local environmental capabilities but that they are inherently sustainable.

Illustrations of the present-day importance of cultural landscapes to sustainability and ecological integrity in Europe is to found in a series of papers in a special issue of the journal *Landscape and Urban Planning* (vol. 50, 2000). The papers by Baudry et al. (2000), Ihse and Lindahl (2000) and Pinto-Correia (2000) demonstrate this perspective very clearly. The longer-term evolution of related landscape-ecological values, over a 3000 year time span, has been analysed for the Noord-Brabant province of The Netherlands by Pedroli and Bolger (1990).

Traditional II landscapes in North America differ markedly from these examples. There is no carry-over or evolution from Traditional I; that is the 'indigenous cultural landscape'. In Europe the landscape *pattern* and hence landscape *processes*, which evolved in this phase, are assumed to reflect a balance between human activities and the resource base. Given the tremendous cultural and physical environmental variation across Europe it is not surprising that many distinctive landscape patterns evolved, far more in than North America, thus giving Europe a much greater degree of landscape diversity.

In North America the situation was completely different; the humanized landscape pattern – that is the system of land holdings, their size, shape and spatial organization – was *imposed* on the physical environment with an overarching regularity and without reference to any of the cultural attributes of the new settlers, most of whom were from

Northwestern Europe. The human dimensions of the landscape were forced to fit into a pre-ordained pattern that was established without reference to the land characteristics or capability upon which it was imposed. The land was surveyed and a pattern or framework established generally before settlement took place. Some 600 townships were established across most of Southern Ontario, a land area of over 49,000 square miles (Gentilcore 1969; Gentilcore and Donkin 1973), beginning in 1783 when the first township was laid out. With very few exceptions these township plans conformed to one of five survey types (Figure 2). Although some consideration was given to major geographical features – shorelines, major landforms, limits of remaining Indian lands etc. – one of these five patterns or landscape frameworks was imposed, no matter what the natural resource base.

A rectilinear, structural pattern was therefore imposed on the landscape, and with the exception of a few previously established urban centres and trading posts, settlements were initially dispersed, generally at equally spaced intervals across each surveyed unit of land in the form of isolated farmsteads. The survey system imposed was one of townships of 6 miles square, seven concessions in depth and 25 lots in width, with an allowance for a road, 40 feet wide, in front of each concession and between every five lots. Each concession was divided into 120-acre lots, resulting in long, narrow lots, 19 chains wide and 63 chains deep. By 1815, standard lot size was increased to 200 acres (30 by 66.7 chains). Each incoming settler family acquired one lot, which apart from the initial survey points, had to be cleared of forest and the land drained before production agriculture could begin.

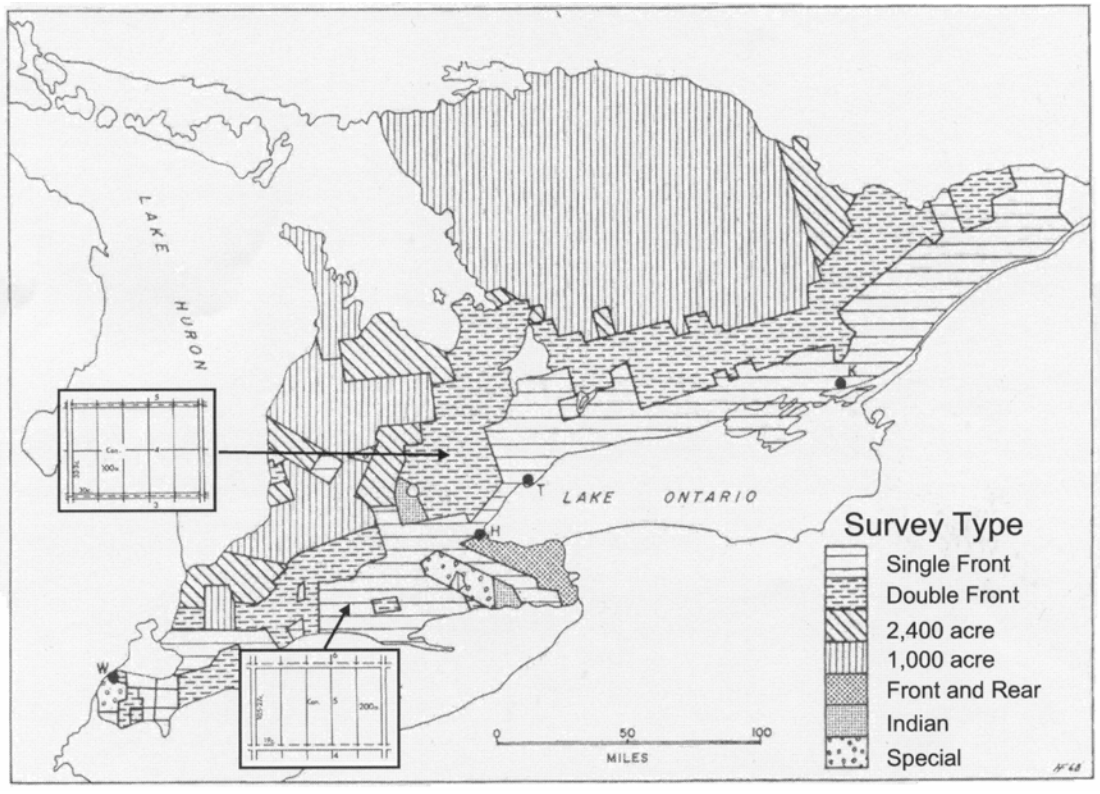

Figure 2. Survey systems in Southern Ontario (after Gentilcore 1969)

Wonders (1982) describes the significance of this pattern imposition and its lack of relationship to the underlying physical characteristics in an example from the Peterborough area of Ontario. The area was settled in the early 19th century by

immigrants directly from the British Isles. The major water body, Rice Lake, which trends northeast to southwest, formed the basis for the orientation of the rectangular survey system. In this case the system imposed was the "double front" type adopted in 1815 (Figure 2). However, the natural grain of the land was formed by parallel drumlin features up to 45 metres in height, which have a northeast to southwest orientation. Consequently, depending upon location of the township settlers holdings would have varying amounts of low-lying cedar-swamp land, difficult to drain and unhealthy, separated by ridges of relatively well-drained slopes, suitable for clearing and farming.

Many local land-use problems can be directly attributed to the lack of harmony between survey (i.e. the imposed pattern) and the terrain (i.e. the natural resource base). In particular, soil erosion from uplands and deposition and drainage alteration of low-lying areas, caused significant landscape change in a few short years. European settlers encountered a markedly different set of environmental conditions to those in existence today.

The success of settlement in early modern Ontario was tied to land clearance. The essential strategy of agricultural development in the extreme southern and southwestern townships before the mid-nineteenth century was to seek a larger income by increasing the amount of cleared land, thereby making farming practices extensive rather than intensive on smaller fields. Clearance was often a means of generating a cash income from the sale of timber. This was very important for making improvements requiring capital. A system of wheat-fallow-wheat farming was the most common and was related to the difficulty of keeping recolonizing forest plants out of fields (Kelly 1971; 1973).

The best lands were soon exhausted with overcropping, and regular inputs of manure on both fallow and cropped fields had become an increasingly necessary practice. Buckwheat was occasionally ploughed under as green manure. Later, some farmers applied mineral fertilizers such as lime and gypsum. They also established a rotation system of grass preceded in various years by spring wheat, barley or oats (Kelly 1973; 1975).

Swamp and marsh reclamation was one way of increasing the number of promising sites for agricultural development. Artificial drainage was employed by the mid-1880's in almost all counties of Southwestern Ontario (Alexander 1974), but it was not as universal a modifier as the removal of the forests, though it too brought unwanted environmental change and damage in its wake (Kelly 1975). Towards the end of the wheat boom (in 1890), the farming community was aware of the detrimental effects that the loss of woodland had caused in terms of fluctuations in local water budgets, leading eventually to soil erosion (Kelly 1974b; 1974a; Jones 1946). Despite recognition of the need to reforest large blocks of land and the passage of the *Tree Planting Act* (1871) and the *Ontario Tree Planting Act* (1883), both of which promoted the planting of shelter-belt trees through financial incentives, little effort was really made until the turn of the century. The original uncleared, but not necessarily unused forest remnants remained as functioning farm woodlots, often in a regular pattern across the landscape.

Land devoted to agriculture in Southern Ontario, as in much of the Deciduous Forest Biome, was most extensive in the 1920's. Since that time, for a variety of reasons, a good deal of this land has gone out of production. This land has either become urbanized or is greatly influenced by secondary succession of forests. In some areas, particularly on the Canadian Shield areas of Eastern Ontario, land has reverted almost exclusively to a 100% forest cover. Elsewhere, even in the most fertile agricultural regions such as Niagara, as much as 30% of the rural landscape may be undergoing secondary succession.

This illustration of landscape change in Northeastern North America (i.e. Traditional

II) over the past 200 years is a marked contrast to the changes in landscape processes and evolution taking place in Europe over the same period. From a landscape-ecological perspective the situation in Ontario, for example, is one where a relatively unaltered natural environment prior to the 1800's, had imposed upon it an administrative framework (i.e. the survey pattern) within which the rapid humanizing of the landscape took place. In other words, the cultural landscape did not evolve over a long period of time where acquired local knowledge would normally have worked against degradation, as was generally the case in Europe. Because of the restricted time frame and the imposed disharmony between the humanizing factors and the natural resource base, environmental destruction through severe soil erosion in particular, often had devastating effects, not only on the quality of the land resource base but also on all components of the hydrological cycle as it operated in that environment. Very significant landscape changes, particularly in environmentally sensitive units such as floodplains, occurred over very short periods of time, subsequently generating new structures and related landscape processes reflecting something of a new, quasi-environmental stability in the newly humanized landscape.

The four different land-survey systems used in Ontario produced four patterns of forest remnants across the landscape. Moss and Davis (1994) analysed spatial change in and between these forest remnants in four Ontario townships from the time of the original surveys (early 1800's) and from four time periods from the 1930's to the present. This study essentially looked at changing spatial relationships with respect to agricultural land-use history and species change. The need still exists, however, for a study of the significance of the underlying relationships between the major land-survey patterns and landscape evolution, particularly in the forest component. Species change, habitat change, landform and edaphic changes are all dynamics which are likely to show markedly different changes within the framework of these survey systems.

Traditional landscapes and processes

Consequently, what may be called cultural landscapes (Traditional II in Figure 1) differs significantly between Northwestern Europe and Northeastern North America due to a whole series of quite distinct humanizing factors. It would be irresponsible to try to derive any general principles from these comparisons as they relate to the understanding of the significance of cultural landscapes to future landscape planning. The landscape histories are too distinct. However, in rural North America there are areas and communities that practice none, or minimally-mechanized agriculture, that are regarded as 'traditional', and therefore by implication reflect 'good' agricultural practices supporting sustainable agriculture. Their landscapes are assumed to reflect these positive attributes. However, these populations often moved into the area as a later phase of settlement, after the first phases of settlement and forest clearance. Hence 'traditional landscape' in this context is relatively new, even with respect to the short time scale of landscape evolution in North America. A good illustration of this type of landscape is that found in the Mennonite farming areas of Waterloo County in Ontario. This 'relict or non-mechanized landscape' system is identified as IIa in Figure 1.

The farming system and related landscape of the Old Order Mennonites of Southern Ontario, have been described by Mage (1994), who outlined how culture and cultural practices form an integral component of landscape analysis and how "traditional farming practices manifest themselves in identifiable agricultural landscapes" which, in this case, he assumes, have resulted "in the long-term stability of such areas as Waterloo County".

He identifies how their system maintains a mosaic of ecosystems (water bodies, woodlots, shelter belts, small fields etc.) considered essential to landscape stability. The generally accepted belief is that the Mennonites, as traditional farmers, are good environmentalists.

However, Okey (1998) evaluated the impact of these traditional (i.e. less-mechanized) agricultural practices and compared them with the impacts of conventional (mechanized) farmers in adjacent watersheds in this same area. His findings throw a good deal of light on the impact of both of these systems on landscape processes by the use of a number of indicators of agro-ecosystem health (e.g., avian and fish biodiversity). Throughout both conventional and traditional landscapes there exists a positive correlation between native bird H' (i.e. Shannon-Weaver Index (Shannon and Weaver 1964)) and number of habitats. However, there is a greater proportion of forest-interior-using birds in the conventional landscape, corresponding with greater mean woodlot size in this farming area. There is a significant positive correlation between exotic bird species and actual farmstead habitats, the latter having a higher relative abundance in the Mennonite areas. There are significant positive correlations between ground insectivores and woody-verge and bean-field habitats, both of which are more abundant in the conventional farming area.

Using fish-community composition as an indicator of water quality it was found that significant negative correlations exist between total phosphorus and fish diversity, general insectivores and one species of brood-hiding speleophil (Creek Chub: *Semotilus atromaculatus*). Each of the fish indicators shows significantly lower values in the Mennonite sub-watersheds where total phosphorus levels are significantly higher. Likewise, significant negative correlations exist between stream concentrations of ammonia and fish H', general insectivores and brood-hiding speleophils; again each of these exhibited lower values in the Mennonite areas where ammonia levels were found to be higher.

These indicators of system health can be examined also in a scalar framework to relate to other landscape characteristics in these two contrasted farming systems at (a) the local level (farm and habitat) and (b) the landscape level (i.e. habitat configuration).

(a) *The local (farm and habitat) scale*. Conventional farms in the area are primarily specialized dairy or beef operations with cash grains (e.g. corn, soybeans). Mennonite farming systems are mixed operations producing more than one type of livestock and a variety of crops. These Mennonite farms also differ substantially in other respects. Greater proportions of mixed grains and other small grain crops (‘other grains’) are grown instead of high-value bean crops. Lower levels of commercial fertilizer are applied to the mixed grain crops on these operations compared to conventional farms. This reduced dependence on inputs produced off-farm is offset by the higher cattle densities insuring a greater supply of manure fertilizer. Mennonite farmers commonly employ work horses for field labour, reducing the need for tractors. Mean farm size and field area are smaller, scaled to the slow but highly manoeuvrable horse-drawn ploughs. Related to total farm area was the greater average proportion of farm land comprising ‘farmstead’ (i.e. farm buildings and surrounding yards and gardens). This is a function of smaller farm size, as the actual area of farmsteads was relatively consistent throughout both study areas. The above characteristics accord with two basic tenets of traditional Anabaptist life: self-sufficiency and a limited adoption of machines and other technology. A more diverse cropping system observed on these farms also illustrates this belief system.

Both the conventional and Mennonite farms are crop–livestock systems which produce multiple stresses on habitat. The farm-scale results indicate, however, that the

types of stresses originating from intensive cropping are more characteristic of the conventional study area, while stress associated with intensive livestock practises are more typical of the Mennonite farms. Fields are the most common habitat in each area and farms throughout are generally managed under some variant of a three-year crop rotation (hay, corn, small grains). Bean crops are absent from the farms in the Mennonite study area, while 'other grain' and 'farmstead' habitats there are relatively more abundant.

Birds species diversity at the site level does not appear to vary as a result of contrasting farm management systems and few differences were evident among the other bird-community indicators. Ground insectivores were significantly correlated with bean field and 'other' habitats. Thus, the lower relative abundance of this functional bird grouping among sites in the Mennonite study area is likely related to lower proportions of these two habitats among these sites. The most noteworthy difference in terms of farming systems is the greater relative abundance of exotic bird species and granivores among the Mennonite area sites. A strong positive correlation is found between 'farmstead' habitat and exotic bird and granivore species. Furthermore, a significantly greater average proportion of this habitat was present on Mennonite area farms. The presence of exotic bird species in this study area would appear, then, to be at least partly a function of the existence of this habitat.

Corn and woodlot habitats, in addition to farmsteads, appear to exert the greatest influence over bird-community composition. However, neither of these two habitats exhibited significant differences between the conventional and Mennonite farming areas, and, unlike bean fields and farmsteads, neither can be linked to significant site-level differences in bird communities.

Riparian and stream-channel characteristics, at the site level, are similar in the two study areas. However, mean total phosphorus, ammonia and potassium concentrations – all higher among the Mennonite sites – are water-quality indicators that differed significantly. Because these water parameters can be elevated in association with livestock and pastured areas, it is likely that these water-quality differences are linked to the significantly greater cattle-density average for Mennonite farm areas.

Mean fish H' diversity was greater among the conventional farming sites. Functional fish-community groups associated with Creek Chub (i.e. general insectivores, brood-hiding speleophils) were relatively more abundant in these areas. Each of these three indicators is significantly and negatively correlated with higher phosphorus and ammonia concentrations observed in the Mennonite area sites. Benthic insectivores exhibited a greater mean proportion among these sites due to the dominating influence of Brook Sticklebacks (*Culaea inconstans*). This species possesses traits that may improve its competitive ability in more heavily degraded sub-watersheds. Benthic insectivores are significantly and positively correlated with ammonia concentrations. However, this is entirely due to the influence of Brook Sticklebacks and is contrary to the tendency of benthic insectivores to be sensitive to degradation. It appears therefore that total phosphorus and particularly ammonia are important determinants in the fish-community variation between the conventional and Mennonite farming areas.

(b) *The landscape scale.* These local scale findings accumulate spatially and contribute to variations in pattern and process at the landscape level. In some cases, these are emerged differences (e.g. the forest patch and landscape 'grain' pattern) not evident at finer scales.

Collectively, cumulative habitat differences produce two distinct landscape patterns. Differences in habitat revealed in farm-level comparisons are reflected in the habitat

proportions calculated for all farmland in the two study areas. Although the difference in proportions of pastured area at the farm level is not significant, this contrast is among the strongest at the landscape level: 11% of surveyed farm area in the Mennonite study area was pastured compared to 6% in the conventional area. This difference is even greater in riparian zones, defined for analytical purposes as areas within 100m of streams; the percentages of pastured riparian zones ranged from 8% to 10% in the conventional sub-watersheds and from 14% to 26% in Mennonite sub-watersheds. From the perspective of stream habitat, this contrast is extremely important due to the implications for water quality and channel stability.

Total area of wooded habitat in both areas was similar (about 7.5%). However, the mean forest patch size in the conventional area was more than twice that found in the Mennonite (9.1 ha vs. 4.4 ha). Also, large (> 25 ha) patches were more common in the conventional study area (5.0 vs. 1.0 ha). These patch indicators point to a lower capability within the Mennonite landscape to provide interior forest habitat.

The pattern of smaller fields and more diverse land uses at the farm level in the Mennonite study area contributes to a more fragmented, 'fine-grained' landscape. At the landscape level, habitat H' diversity in the conventional study area was, in fact, marginally higher due to a wider variety of crops grown among the different farm types. Consequently, although the individual farms were more specialized, the variety of farm types in this area enhanced habitat diversity at the landscape, as opposed to the farm level. More importantly, and not reflected in the H' value, larger grain size (i.e. farm, field and forest units) in the conventional landscape resulted in a greater potential to accommodate interior habitat needs of some species.

Compared to less transitory land-use components (i.e. farmsteads, pasture, woodlots), shifting (i.e. crop) habitats did not appear to exert much influence over species or communities at the landscape level. This suggests that forests and riparian pastures are the two most important components affecting landscape biodiversity through which farming-system control was exercised at the landscape level. A configuration of fewer, larger farms in the conventional study area contributed to a landscape with fewer, larger woodlots, where the proportions of forest-interior and tree-using bird species were observed to be greater. The greater number and proportion of farmstead habitats in the Mennonite landscape coincided with a higher relative abundance of exotic species which thrive in areas of human habitation. The physical similarity (e.g. channel sizes, adjacent land uses) among stream reaches in the two study areas, coupled with the differences in average nutrient concentrations, suggests that the apportionment of pasture and other land uses, up to and including the sub-watershed level, had a strong influence over water quality at the site level. This, in turn, is linked to less species-rich, less functionally-balanced fish communities in the Mennonite area.

Greater landscape biodiversity, as measured by avian and fish populations, is to be found in the conventional farming area, where bird communities feature greater numbers of native species and are less dominated by tolerant species. Moreover, there are identifiable farming stresses that can be used as indicators to contrast biodiversity at the landscape level. These are: smaller farm size, greater farm heterogeneity (e.g. smaller field and woodlot habitats) and more abundant riparian pastures.

Concluding comments

What does the preceding discussion then say about the need to understand cultural landscapes in both North America and Europe? Initially there is the question of

terminology which when examined illustrates the need to understand a region's cultural history as it expresses itself in the landscape. The European concept is one of a landscape that has evolved over many hundreds of years and that reflects that evolution in its current pattern. However, much of the European cultural-landscape pattern, as it is currently seen, is a reflection of major changes to those traditional landscapes, and in particular to the pattern on the landscape, that has evolved from the late 18th century. By contrast, the last 200 years in Northeastern North America is essentially a time when a cultural landscape was introduced and its framework imposed upon the land surface. What evolved from that was a landscape system that was only sustainable in particular areas. In other locations sustainability of the landscape and its associated cultural functions failed because the imposed pattern, particularly with respect to local site characteristics, was not synchronized with the humanizing processes. These humanizing processes were themselves imported from other environments. Consequently, in order to compare the meaning of the term across a range of environments requires an understanding of each region's cultural history.

Can we assume that cultural landscapes, particularly those reflecting more relict/non-mechanized land use practices, are the most environmentally balanced and sustainable? A generally held assumption is that this must be the case. However, in the agro-ecosystematic analysis of the Mennonite landscapes of Ontario it was found that, by comparison to the more widespread 'ordinary' landscapes, the Mennonite system points to many negative indicators. To fully embrace such traditional systems, without carefully examining the cross-currents among all agro-ecosystem components and dimensions, would be naive (Okey 1998, p. 153). Whether such statements could be made of other traditional/non-mechanized agricultural systems in North America remains to be seen. There exist to date few studies of the integrative nature and significance of landscape processes, as opposed to studies of the historical evolution of landscape pattern, in North America. This situation is quite different to that in Europe, where the academic foundations of the landscape sciences differ.

What can these landscape sciences, particularly landscape ecology, contribute to the debate about landscape planning and management? What has emerged from the foregoing discussion is that those critical tenets of landscape ecology – pattern and process, form and function – need to be more thoroughly understood across a range of different landscapes. Only by increasing the number of case studies of individual situations within the framework of the stated goals of landscape ecology any clear objectives, models, methods and techniques for landscape planning will emerge. Landscape ecology desperately needs to state and to develop what these goals are. In particular, the gap and the link between pattern and process *in landscapes at the landscape scale* have to receive much greater attention. The distinction often made amongst landscape ecologists themselves, between biotic processes and abiotic processes (particularly water and nutrient processes in the landscape) has to be bridged (Opdam, Foppen and Vos 2001). And to return to an earlier theme (Moss 2001), not only does this particular bridge have to be crossed but its understanding must be extended to *all* landscapes. The current tendency in landscape ecology is for the two landscape-ecological "solitudes" – the geo-ecological and the bio-ecological – to exist side-by-side (Moss 2001).

The principles of landscape ecology have been shown to be very effective in their application to such diverse fields as landscape and ecological restoration, wildlife management, conservation and to landscape planning and design. Increased acceptance of these principles will, however, depend upon the recognition of a more complex

landscape ecology, one which addresses the critical issue of landscapes as spatially variable, integrated biotic and abiotic entities. Regrettably, within North America, the realization of these principles appears to lag behind the situation in Europe where, at least, the question is being raised. Nevertheless, there are a few indications of change taking place. For example, Leitão and Ahern (2002) have recently reviewed critical stages in the evolution of ecologically-based physical planning methodologies. The majority of these have been termed 'ecological' methods because they are based on overlays of landscape information. These methods have inherent limitations which landscape ecology is capable of overcoming. Steinitz (1990; 2001) has addressed this issue and raised some critical questions and directions that landscape ecology is uniquely placed to address. These are:

(1) How does the landscape operate? What are the functional and structural relationships among its elements?
(2) Is the current landscape functioning well?

Answers to these questions then lead to two further questions:

(1) How might the landscape be altered?
(2) What differences might changes cause?

Each one of these questions – and the answers they generate – has much relevance to the question of understanding the value and role of cultural landscapes in landscape planning.

Finally, all of this discussion becomes irrelevant if there are no policy or management demands or requirements for landscape planning. Again Europe appears to be well ahead of most of North America in this regard. The policies for the province of Ontario illustrate only too well the situation. In 1995 the word 'landscape' was used for the first time in planning legislation. The 1995 *Planning Act* defined landscape as a significant resource (Pollock-Ellwand in press). This significance extended to both the visual and cultural value found in landscape in addition to the conservation of significant cultural- and built-heritage landscapes. This represented an opportunity to transform the landscape idea from an academic and aesthetic construct to a protected planning element (Pollock-Ellwand in press).

This policy remained in place for just nine months. Then a newly elected provincial government introduced new legislation (the 1996 *Planning Act*) which gave much less protection to environmental issues, including landscapes, in an effort to remove "red tape and the legislation and policies tilted in favour of environmental concerns to the detriment of Ontario's economic health" (Wright 1995 quoted in Pollock-Ellwand in press).

Ultimately, until we have effective policy and legislation, any knowledge about the value and significance of landscape – cultural or otherwise – will remain the realm of the theorist and the scientist. The real challenge is to develop our ideas about landscape and to be able to translate these into applications in a language that policymakers can understand. So far, in North America, we have failed to make these inroads.

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