Suggested Conservation Guidelines for the Identification of Significant Woodlands in Southern Ontario

PREAMBLE

Ontario is a vast province with complex conservation challenges and opportunities. In southern Ontario, most natural habitats have been lost to urban sprawl and agriculture. As a result, natural systems, such as watersheds and ecological communities, are severely degraded, and many plant and animal species have been designated as "at-risk." It is the role of the Province to direct planning authorities in the protection and restoration of this natural heritage. Current provincial policy (*Planning Act*, Provincial Policy Statement), however, is often weak, vague and inconsistent, and therefore cannot provide adequate direction to the planning authorities in carrying out their role as stewards of our environment. Ontario Nature seeks practical solutions designed to protect our remaining natural areas, restore degraded habitats, and help recover those species of plants and animals in need.

Ontario Nature works with governments, non-governmental organizations, private landowners and other partners to develop strategies and programs to promote the protection and restoration of the province's forests and other habitats and natural systems, with particular emphasis on southern Ontario woodlands. Ontario Nature restores and recovers natural systems, habitats, wildlife and species-at-risk. These efforts include work with both the private and public sectors, and include a strong focus on land-use and watershed-based planning.

Ontario Nature promotes a vision for the southern Ontario landscape that consists of a matrix of healthy natural environments and natural systems that support human and economic uses within it. The protection and restoration of woodland ecosystems and other natural areas will enhance the quality of air and water and provide critical habitat for wildlife, including species-at-risk, in southern Ontario. Ontario Nature is committed to protecting southern Ontario's remaining woodlands and promoting restoration projects to reforest the landscape wherever possible and where ecologically appropriate. This involves establishing and maintaining strategic partnerships and developing action plans and policies to identify and protect important forested areas.

INTRODUCTION

As part of the Conserving Southern Woodlands Project, Ontario Nature has engaged a broad coalition of partners in bringing together workable and ecologically defensible guidelines for the identification and protection of significant woodlands. This document should not be considered independently, but rather the centre-piece of a number of supporting documents designed to provide easy-to-use methodologies for the identification and conservation of significant woodlands by planning authorities and the provincial government across southern Ontario. By providing a recommended minimum standard for significant woodland identification that is adaptable and adoptable across a wide array of landscape scenarios, these guidelines can be used by planning authorities with different levels of resources in natural heritage planning.

The guidelines have been reviewed by a multi-stakeholder technical review panel, represented by planners, ecologists, biologists, foresters, Ministry of Natural Resources (OMNR) staff, Conservation Authority staff, and consultants, and are supported by a glossary of terms, and literature review of scientifically-defensible support for the criteria.

Additional documents prepared by Ontario Nature in support of these recommendations include the following:

- Glossary of terms
- Annotated bibliography of scientific support for criteria
- GIS Case Studies / other case studies
- *An Evaluation of Significant Woodlands in Southern Ontario: A Review of the State of the Art*
- Guide to the development of tree conservation by-laws (prepared by the Forest Conservation By-law Committee: a group of municipal and provincial staff and other agencies, including Ontario Nature)
- Southern Ontario Greenway Strategy

The full range of tools and recommendations will be helpful to planning authorities considering the incorporation of a landscape approach to natural heritage system planning within their official plans. The approach outlined within this document is intended to be but one tool that can be used in the development of a southern Ontario wide natural heritage system.

Woodlands and the Provincial Policy Statement

The *Planning Act*, which currently guides municipal planning matters with respect to significant woodlands, states that planning authorities "shall have regard for" policy statements issued under this act. The Provincial Policy Statement (Section 2.3) specifies "development and site alteration may be permitted in significant woodlands south and

east of the Canadian Shield, if it has been demonstrated that there will be no negative impacts on the natural features or the ecological functions for which the area is identified." Without clear guidelines for the identification of significant woodlands, planning authorities cannot be expected to be able to prove whether or not woodlands would suffer negative impacts from proposed development or site alteration.

Unlike the specific technical guidelines provided for the identification of Provincially Significant Wetlands, the MNR has, to date, only provided very general guidance to planning authorities with respect to the identification of significant woodlands through the *Natural Heritage Reference Manual* (for Policy Statement Section 2.3).

The *Natural Heritage Reference Manual* states, "The identification and evaluation of significant woodlands is a planning authority responsibility. Approaches to compiling and assessing woodland information will vary depending on the resources of the planning authority, availability of information, development pressures and the nature and extent of the woodlands present in the planning authority." It provides the definition of 'woodlands' as "treed areas that provide environmental and economic benefits such as erosion prevention, water retention, provision of habitat, recreation and the sustainable harvest of woodland products. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance." Furthermore, it states that *significance* is determined to be "[woodlands] important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system." Criteria for determining significance may be recommended by the Province, but *municipal approaches that achieve the same objective may also be used.*

The *Natural Heritage Reference Manual* provides this general direction in defining significant woodlands:

- Woodland size: bigger is better (within the context of percent forest cover across the landscape or planning area);
- Ecological function: woodland shape, linkages, diversity and proximity are all considerations relative to woodland function;
- Uncommon woodlands: rare tree species or forest community types, old or older growth, woodland size, highly productive tableland woodlands;
- Woodland economic and social values: (active management, historical value);

Need for Consistency across Planning Authorities

With the responsibility of defining and evaluating significant woodlands currently resting with the planning authority, significant woodlands are being evaluated across the province using various methodologies and standards, and in many cases significant woodland evaluation is not being done. Lack of consistency is an impediment to effective bioregional planning and conservation, or planning for a natural heritage system

that is interconnected and functioning on a landscape level. Furthermore, there is no mechanism for standard data collection or evaluation provincially. Also at issue is the variation among planning authorities with respect to their ability to identify significant woodlands, as different levels of resources may be available to them. A planning authority with limited data processing capability (e.g. Geographic Information Systems) or limited human resources (e.g. staff with expertise) or limited financial resources should not be excluded from participating.

There is a need for consistent and defensible "best practices" or "commonly accepted practices" for planning authority approaches. This is particularly important if it becomes necessary for the planning authority or others to defend their position at the Ontario Municipal Board (OMB). A survey of municipalities carried out as part of this project found that at least some planning authorities have not identified significant woodlands because of uncertainty of approaches or concerns about the cost of developing new approaches.

A recent review by Ontario Nature of Ontario Municipal Board hearings involving natural heritage and development disputes revealed that a primary factor in an unfavourable outcome for nature was the fact that proponents of natural heritage had fewer resources to prepare their case, were less well-prepared, and presented information and data without consistent scientific support. A defensible and adaptable approach to identifying significant woodlands across the province will help to alleviate this.

Methods for significant woodland evaluation should not take a "one size fits all" approach. The process should be adoptable and adaptable, at a level appropriate to the planning authority's resources, while remaining consistent with a broader, technically sound approach. Any entry level approach should be consistent with more detailed approaches so that "scaling up" is possible as resources become available.

SIGNIFICANT WOODLANDS IDENTIFICATION GUIDELINES

Overview

Given the variation in resource availability among planning authorities, the significant woodland evaluation could be done at three possible levels. Each level builds on the previous one and requires successively more efforts and resources in data collection and analysis. Ultimately, it is most desirable to practise significant woodland evaluation at the highest level of sophistication.

Level 1

All municipalities should employ Level 1. This includes designating the woodland areas already recognized as ecologically or socially important by the municipality or province, but which may not have protection in the Official Plan (e.g. woodlands within ANSIs, ESAs, etc.). Level 1 evaluation can be described as a consolidation of those data layers that are already available and accessible to all planning authorities. It does not require any fieldwork or GIS analysis (although GIS can be used as a simple map-making tool).

Level 2

The Level 2 approach, which is the focus of this report, is recommended as a reasonable starting point for those municipalities not yet engaged in protection of significant woodlands. The Level 2 approach also incorporates Level 1, and explains how woodland significance can by evaluated using five different criteria.

Level 2 is a practical and recommended approach to the evaluation of significant woodlands. At Level 2, it is intended that any Level 1 significant woodland already identified will be included. Application of Level 2 strictly involves employing GIS to generate significant woodland maps, based on the suggested criteria and thresholds that follow. This level will not require field-collected data, but can be obtained from existing land information databases, aerial photography and other remote sensing. Any woodland satisfying any one criterion is considered significant, and the following criteria are not ranked.

Level 3

Level 3 woodland evaluation is highly desirable, but would require on-the-ground data collection on a site-by-site basis. For those planning authorities initially engaged in Level 2 analysis, some or all components of a Level 3 analysis can and should be incorporated when and where resources and expertise allow, complementing and enhancing a Level 2 analysis. Examples of criteria for significance could be, but are not limited to:

- Floristic quality index
- The presence of rare species
- The presence of uncommon characteristics

- Economic or social values
- The presence of common or representative communities (e.g. for the conservation of examples of characteristic vegetation types)
- The presence of uncommon woodland types
- Woodlands exhibiting older-growth characteristics including old trees, pit and mound topography, significant woody debris, little evidence of human disturbance, significant numbers of snags and den trees, etc.
- Succession (pioneer forests) and buffering capacity.

Criteria & Thresholds for Significance

The criteria and thresholds below represent the recommendations of Ontario Nature for identifying and evaluating significant woodlands south and east of the Canadian Shield, and are based on the Level 2 approach. This approach could be complemented by field analysis suggested in a Level 3 approach. These guidelines include five criteria and a number of thresholds for each criterion. Any woodland satisfying any one criterion is considered significant. The criteria are not in any preferential or weighted order.

I) WOODLAND SIZE

Recommended threshold for significance based on woodland patch size[1] for landscapes with different levels of forest cover.

Forest Cover (by planning area)	Minimum patch size for significance
< 5%, including urban areas[2]	All woodlands
5-10%	2ha
11-15%	4ha
16-20%	10ha
20-30%	15ha
31-50%	25ha
>50%	40ha

Rationale: Woodland size

It is important to conduct this evaluation at a scale that will minimize inaccuracies and account for more localized differences in woodland cover. It is recommended that assessment of percent woodland cover be evaluated at the planning authority level or at a watershed level. This level of resolution will better enable the identification of the smaller woodlands across the landscape.

It is recommended that, within each planning authority, percent woodland cover be assessed within delineated areas of relatively homogeneous woodland cover distribution[3]

[1] The Level 2 analysis approach assumes that in the absence of a digital woodland polygon layer, that a digital OBM vegetation layer can provide a good approximation of woodland polygons. As noted, use of recent air photos (or other remote sensing) for cross-referencing will ensure that spatial and temporal errors are eliminated.
The delineated edge of a woodlot should be defined as the drip-line of the outermost trees within a treed area as defined above (i.e. >35% cover). The delineation of woodland polygons from mapping or remotely sensed data will require consistency in addressing narrow 'gaps' or spaces between polygons as well as gaps within polygons. As a benchmark, the Natural Heritage Reference Manual states, "woodland areas are considered to be generally continuous even if intersected by standard roads (e.g. 21m (69') wide)." I.e. gaps less than this width would not break one polygon into two separate polygons. With respect to 'gaps' wholly within a woodlot, the planning authority may choose to ignore those gaps that represent less than 25% of the treed area for the purposes of evaluating woodland size. They may wish, however, to exclude these areas from forest interior calculations.
[2] Urban areas are as defined by the official plan.
3 Percent woodland cover should be assessed within delineated areas of relatively homogeneous woodland cover distribution (i.e. land cover, not forest type). Ideally, each planning area should achieve a minimum of 30% woodland

(i.e. land cover, not forest type) so as to avoid 'averaging' percent cover values across the planning authority. Specific protocols for assessing differences in distribution are variable. Some of these examples can be found in the Eastern Ontario Model Forest (EOMF) case study[4]. This study analyzed 5 km^2 grids (OBM tiles) and determined percent woodland cover within each tile. Tiles with the same cover values were lumped into homogeneous cover groupings. The Regional Municipality of Halton chose a more simplified approach and analyzed percent woodland cover on and off the Niagara Escarpment, owing to obvious differences in woodland cover between the two landscapes.

The *Natural Heritage Reference Manual* notes the importance of woodland size. It indicates "larger woodlands are more likely to contain a greater diversity of plant and animal species and communities than smaller woodlands and are better buffered against the harmful edge effects of agricultural or urban activities than smaller areas."

Environment Canada recommends a minimum threshold of 30% forest cover in a watershed. Many planning areas do not meet this threshold. It is also important to note that 30% is a minimum recommendation only. Forman (1995) cites an example in a coniferous forest landscape in the U.S. Pacific Northwest and states "… the most critical time for land planning and conservation appears to be when the landscape has 60-90% of its area in natural vegetation."

The thresholds listed have been expanded from those found within the *Natural Heritage Reference Manual* so as to more accurately address variation in percent woodland cover across southern Ontario.

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cover, and strive to maintain woodlands on all representative terrain and soil types. While this document cannot provide exacting guidelines for assessing percent cover, we can provide examples of approaches in other jurisdictions. The Regional Municipality of Halton asked the question, "What constitutes the planning area?" (for the purposes of assessing percent forest cover across the landscape). "Within Halton, three Conservation Authorities have jurisdiction in parts of the Region, representing seven major watershed systems. The Region can be further partitioned politically into nine planning areas that represent the urban cores of the four municipalities and their associated rural areas. When viewed in this holistic manner, it is apparent that even if all of the woodlands in the Region were designated significant, the minimum threshold of 30% is achieved only above the escarpment, where these woodlands compensate for the extremely poor coverage below the escarpment." As such, the Region of Halton chose to assess percent cover from the perspective of on the escarpment and off the escarpment.

[4] EOMF conducted a test run of the guidelines on four regions within eastern Ontario. They tested a number of methods for assessing percent cover based upon the data available. Two of the methodologies are outlined in brief below. Using recently updated Forest Resource Inventory mapping from Ottawa-Carleton, EOMF used watershed boundaries as their planning areas to determine percent forest cover for woodland patch size classification. The watershed boundaries were provided by the MNR through the Watershed Resources Information Project (WRIP). There are four scales of watershed boundary found in this layer (largest area to smallest area): primary, secondary, tertiary, and quaternary. For this study, quaternary was used because there were visible patterns in forest cover that paralleled the watershed boundaries. Ecodistrict boundaries were also tested as a possible boundary theme for woodland patch size. The ecodistrict data was received from the MNR. In this example it was proposed that a generic grid be used to calculate percent forest cover. Equal area grids would be compared and neighbouring grids with similar woodland cover would be grouped together. The percent cover of each of these groupings would then be assessed as discrete planning areas. This method assists in eliminating any source of bias in terms of area or land-use independent of the natural environment. The size of the grid will be very important: too small and the forest cover will appear to be too variable, too large and there will be too much generalization. It was proposed that a generic grid be used to calculate percent forest cover.

No upper limit has been placed upon the use of woodland size as a criterion in order to address the need for larger, contiguous areas of woodland.

The addition of "all woodlands" for areas below 5% cover has been added in order to afford protection to the increasingly fragmented woodlands found across southern Ontario, particularly within urban development boundaries.

The number of percent-cover categories (thresholds) as a whole has been increased from 3 to 7 in order to minimize the loss of woodland in landscapes with higher percentage of cover composed primarily of many, small fragmented woodlands.

II) HYDROLOGICAL LINKAGE

Recommended threshold for significance based on woodland association with hydrological features[5]. A woodland[6] is considered significant if any portion is within 30 metres[7] of any hydrological feature, including:

1. All streams (including intermittent), all wetlands, all lakes
2. All headwater sources, including:
   - Springs
   - Seepage areas
   - Areas of groundwater upwelling
3. The catchment area of all 1st order watercourses

Rationale: Hydrological Linkage

The Natural Heritage Reference Manual suggests the significance of woodlands can, in part, be determined by their overlap with other natural heritage features and areas, have the potential to provide a link with water bodies, are in, close to, or adjacent to, groundwater discharge, recharge or headwater regions. Furthermore, by removing nutrients, sediments and toxins from surface water runoff and sub-surface flows, woodland vegetation contributes to the maintenance of water quality in lakes and streams. The shade provided by woodlands to water bodies also keeps water temperatures cool, helping to maintain high quality habitat for fish species. Woodlands also contribute to the protection of groundwater recharge areas.

This criterion addresses the ecological importance of the linkage between woodlands and water and incorporates the well-understood principles of protecting riparian and shoreline areas.

[5] 'Hydrological' means lakes, ponds, rivers, streams, wetlands, seeps, springs, upwellings and shallow aquifer areas.
[6] The entire woodland is considered significant, not just the portion within the buffer.
[7] The 30 metre buffer would be measured "from the high water mark or the erosion hazard limit, whichever is greater" as described for Hazard Lands (MNR, 2001).

III) FOREST INTERIOR

Threshold for significance based on the presence of forest interior for planning areas with <30% forest cover: Any woodland with a minimum of 4 ha interior forest defined using a 100 metre buffer measured from the interface between woodland and another land use, OR any woodland containing ANY forest interior where *total forest interior* is less than 10% of the *total forest area* within the planning area.

Threshold for significance based on the presence of forest interior for planning areas with > = 30% forest cover: Any woodland with a minimum of 4 ha interior defined using a 200 m buffer measured from the interface of the woodland and another land use

Rationale: Forest interior

The *Natural Heritage Reference Manual* states that "in areas where interior habitat is in limited supply, and/ or where forest interior-dependent species are declining, select woodlands that provide more interior habitat if choosing between similar sized woodland blocks."

The thresholds recommended in this document have sought to highlight the importance of maintaining interior habitat wherever possible, across all landscapes.

IV) LANDSCAPE CONNECTIVITY

Any woodland that falls within, or overlaps with, a core area or corridor, as identified within the *Big Picture 2002* system or any other natural heritage system as developed and designated by the planning authority, would be significant.

Rationale: Landscape Connectivity

The *Natural Heritage Reference Manual* recognizes the importance of connectivity in terms of woodland proximity to other woodlands and other natural heritage features or areas, and as a corridor for movement between habitats.

Though the literature strongly supports the concept that connectivity is species and landscape-specific, it is not practical to determine a threshold for connectivity based upon the selection of a single species or even a group of species for the purposes of broad landscape planning. Consequently, it is recommended that other approaches to landscape connectivity be considered.

Woodlands within, or overlapping with, a natural heritage system identified using *Big Picture 2002* or any other natural heritage system as designated by a planning authority would be identified as significant, as they would function as part of a broader system of connected cores and corridors.

The *Big Picture 2002* approach aims to assist with the design of a long-term natural heritage vision for Canada's southernmost ecological regions (ecoregions 7E, 6E and parts of 5E).

Using multiple data sets in a geographic information systems (GIS) environment, the *Big Picture 2002* identifies existing natural cores, corridors and outlying natural areas, as well as potential connecting links and meta-sites. It provides planning authorities with a means of identifying potential natural heritage systems that could potentially link to those of neighbouring planning authorities.

Any natural heritage system as designated by a planning authority would be appropriate to use in designating significant woodlands.

V) SLOPE

Any woodland on slopes greater than or equal to 10%, or on soils subject to wind and water erosion would be considered significant.

Rationale: Slope

The *Natural Heritage Reference Manual* states that woodlands perform a number of important ecological functions. They affect both water quantity and water quality by reducing the intensity and volume of storm water runoff and decreasing soil erosion and flooding.

Halton Region's *Rationale and Methodology for Determining Significant Woodlands in the Regional Municipality of Halton* (2002) provides rationale for using slope as one criterion for significance. Their recommendation, in brief, is as follows:

- The role that woodlands play in stabilizing the landscape operates throughout the landscape, but becomes more significant as slopes increase;
- The factors necessary to create erosion are complex and can be considerably different for different sets of factors however;
- Site erosion potential is a function of slope gradient, slope length and soil erodibility, and depositional history;
- To be able to simplify this process by relating the susceptibility to erosion of any slope to only two external factors, such as vegetative cover and slope, can be scientifically criticized. However, if a number has to be chosen to alert people that the potential risk of erosion is greater, then a 10% slope would be that number, and this risk will escalate for slopes steeper than 10%.

Citations

Environment Canada, MNR, MOE. 1998. A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern.

Forman, R.T.T. 1995. Land Mosaics: The ecology of landscapes and regions. Pg. 416. Cambridge University Press, Cambridge, pp 632.

Halton Region. 2002. Region of Halton 2002 Official Plan Review, Technical Background Paper #6 "Rationale and Methodology for Determining Significant Woodlands in the Regional Municipality of Halton"

Ministry of Natural Resources. 1999. Natural Heritage Reference Manual. For Policy 2.3 of the Provincial Policy Statement.

Ministry of Natural Resources. 2000. A Silvicultural Guide to Managing Southern Ontario Forests.

Ministry of Natural Resources. 2001. Understanding natural hazards. Queen's Printer for Ontario. 40 p. (also available at http://www.mnr.gov.on.ca/MNR/water/publications.html)

Ministry of Natural Resources. 2000. Significant wildlife habitat technical guide. Queen's Printer for Ontario. 151 p. (also available at http://www.mnr.gov.on.ca/MNR/pubs/pubmenu.html)

Environment Canada, OMNR and MOE. 1998. A Framework for guiding Habitat Rehabilitation in Great Lakes Areas of Concern. (relating to forest-interior birds). Threshold > 10% of watershed forest should be >100m from the edge.

"Methods and Rationale for Assigning Woodland Value at the Patch Scale for Consideration in Planning and Conservation in Eastern Ontario". 2003. Eastern Ontario Model Forest.

APPENDIX A: CATALOGUE OF SCIENTIFIC LITERATURE ON CRITERIA FOR WOODLAND SIGNIFICANCE

(for Conservation Guidelines of the Identification of Significant Woodlands in Southern Ontario)

Prepared for
Ontario Nature

by
Snell and Cecile Environmental Research
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Introduction

Ontario Nature - Federation of Ontario Naturalists has proposed draft criteria for recognizing woodland significance at a GIS-based level of assessment. Literature on these criteria and their thresholds for significance would provide a scientific basis for their support or rejection. This catalogue presents the results of a relatively brief effort at collecting literature applicable to those criteria in the southern Ontario context. Methods included review of a set of literature provided by FON, a search based on keywords of each of the criteria and of Ontario, inclusion of assorted other literature cited in above sources and a few personal interviews. Not all entries are specifically Ontario studies; some are included if of possible application to Ontario's conditions. The entries are in a standard format including citation, threshold, applicable ecological function cited, underlying principles cited, validity for significance cited, location/geographical applicability, scale and other comments. The entries are organized under each of the proposed criteria of significance:

Woodland size, which includes some discussion of percent cover
Woodland Interior size
Hydrological linkages
Connectivity
Slope

In addition, some references to roads were included.

Relatively less effort was expended in the hydrological and slope criteria because of on-going literature reviews on these aspects (contacts: Angus Norman, Ontario Ministry of Natural Resources, London: 519-873-4623; Steve Varga, Ontario Ministry of Natural Resources, Aurora: 905-713-7370). In addition, the reader is referred to a review of recent literature that is currently underway as input to a revision of: Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern (*contact Graham Bryan, Environment Canada, Downsview: 416-739-4286).

The following catalogue was limited by the time available and should not be considered exhaustive.

Woodland Size

Citation: Andren, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. *Oikos* 71:3 pp. 355-366.
Threshold: 10 to 30 % and theoretically 20% of area in habitat above which total area is more important and below which patch size, connectivity and surrounding habitat more important for suitability
Applicable Ecological Function Cited: abundance and distribution of organisms living in suitable habitat
Underlying Principles Cited: when much original habitat in a landscape, patches are close enough that individuals can include them in their range.
- if random patches, distance to the nearest neighbour has a logarithmic jump at 10-30% area of landscape, meaning pattern of patches and use of intervening landscape become important.
Validity for Significance Cited: both theoretical analysis of random units and review of literature.
Location/Geographical Applicability: Literature from around the world.
Scale: wide range of habitat sizes and species
Other Comments

Citation Austen, M.J.W., C.M. Francis, D.M. Burke and M.S.W. Bradstreet. 2001. Landscape Context and Fragmentation Effects on Forest Birds in Southern Ontario. *The Condor*: Vol. 103, No. 4, pp. 701-714
Threshold none suggested. Just that priority for larger tracts especially in highly forested landscapes
Applicable Ecological Function Cited: sustainability of forest bird communities
Underlying Principles Cited
number of bird species/area is independent of size but the composition is dependent
not just regional forest affects size-effects but also regional landscape uses like urban
low regional forest % accentuates the effect of bigger size for forest interior birds
size better indicator than core area
measured breeding presence, not success – latter may also be affected by size

Validity for Significance Cited: data for 14 forest interior species; 15 interior-edge species; 17 edge species
Location/Geographical Applicability: Southern Ontario. Escarpment; Norfolk, Peterborough and Simcoe county areas
Scale: 287 forest patches from < 5 ha to > 20 ha
Other Comments: thresholds may be interpretable from the data

Citation: Billyard, E. Relationships between landscape structure and the distribution patterns of exotic herbs. M.Sc. Theis, York University. . Available from ProQuest 1-800-521-3042: ABB/ISBN0612203514 (this entry from abstract)
Threshold: none given in abstract
Applicable Ecological Function Cited: exotic herbs dispersal

Underlying Principles Cited: dispersal depends on edge aspect, patterns across the forest ecostone, surrounding land use, woodlot area, interior forest as % of total forest, and disturbance
Validity for Significance Cited
Location/Geographical Applicability: King Township, York Region
Scale: site visits to 19 woodlots
Other Comments: abstract gives no results but implies there were trends found by stating their application to identify woodlots at risk

Citation: Burke, D. 1998. The effect of forest fragmentation on food abundance, nest site habitat, and reproductive success of forest-breeding birds: a study in the Peterborough Region of Ontario. Ph.D. thesis Trent University. 183 p. Available from Pro-Quest 1-800-521-3042:ABB/ISBN0612302067 (this entry form abstract)
Threshold: >500 ha
Applicable Ecological Function Cited: composition, demography, density, pairing and reproductive success of forest birds relative to forest cover
Underlying Principles Cited: declines in Ovenbird with smaller core because of lower food abundance and lack of suitable nest sites.
Wood Thrush and Veery were limited by food and interior nest sites in small woodlots
Rose-breasted Grosbeaks and Red-eyed Vireos did not lack food or nest sites
All species more successful in large fragments
Small fragments were habitat sinks for all species.
Validity for Significance Cited: to guard against local population declines
Location/Geographical Applicability: Peterborough region, south-central Ontario. 79 woodlots (0-420 ha core area) polus 2 continuous forests
Scale: county
Other Comments

Citation: Burke, D.M. and E. Nol. 2000. Landscape and Fragment Size Effects on Reproductive Success of Forest-Breeding Birds in Ontario. *Ecological Applications* Vol. 10 No. 6, pp. 1749-1761.
Threshold: >500 ha (>90 ha core) to avoid being habitat sinks. Specifically,
little effect from surrounding landscape
$\geq$23 ha core for Ovenbird for replacement. As ground-nester, most vulnerable of the 5 studied although shrub nesters equally depressed in small fragments
another spot cites >200 ha threshold for habitat source
- 100 m edge zone of nest vulnerability for Veery and Rose-Breasted Grosbeak, esp. pronounced in first 50 m.; also 100 m zone for increased parasitism
Applicable Ecological Function Cited: reproductive success of 5 forest-breeding songbirds (Ovenbird, Wood Thrush, Veery, Rose-breasted Grosbeak and Red-Eyed Vireo
- avoidance of habitat sinks
Underlying Principles Cited: lower breeding success in fragmented forests because of less pairing success, more nest predation, less food and more brood parasitism to the point of productivity being less than mortality (sink). Ground nesters most vulnerable. looked at 10 km radius around woodlots as possible indicator of predator and Brown-Headed Cowbird habitat.

Notes wintering habitat changes may have a bigger effect than fragmentation on some species declines (e.g., Veery, Ovenbird)
Sink habitats have value where source populations remain in range
Validity for Significance Cited checked nests every few days and used Mayfield estimate.
Breeding Bird Surveys do not always correlate with their findings
Location/Geographical Applicability: south-central Ontario
Scale: 40 fragments of 12 –2350 ha size plus 2 continuous forest sites
Other Comments

Citation Burke, D. and E. Nol. 1998. Edge and fragment size effects on the vegetation of deciduous forests in Ontario, Canada. *Natural Areas Journal* Vol. 18 No. 1 pp. 45-53
Threshold: square fragment >.49 ha for forest interior micro-climate and vegetation conditions.
Applicable Ecological Function Cited: Size and edge affects vegetation communities
Underlying Principles Cited: greater edge affects seed dispersal, wind conditions, microclimate, invasive presence – all of which alter the communities from those of the interior
Validity for Significance Cited: measured coefficients of conservatism, floristic quality index, species richness, alien species, temperature, humidity, light, soil moisture, forest structure for 8 points in 100 m transects
This is theoretical threshold based on the edge effects observed. No woodlot approached that threshold – all were > 10 ha.
Location/Geographical Applicability: 22 woodlots with core area (>100 m from edge) from 0.25 ha to 163 ha in Peterborough County
Scale: county
Other Comments: Edge microclimate is affected by aspect, with wider edge effects on warmer slopes, and by age – wider the younger. This study was older forest and just east side, reducing effects.

Citation : Donovan, T. and A. Strong. Linkages between landscape theory and population dynamics: A review of empirical evidence. Chapter 2 in Bissonnette, J and I. Storch (eds.) 2003. *Landscape Ecology and Resource Management: Linking Theory with Practice.* Island Press, Washington and London.
Thresholds: 55-58% cover for "percolation" among patches
patch size and isolation not important when >30% cover, but below 30% cover, patch size, isolation and % loss all become important
amount of habitat more important than configuration and amount more important when sparse no matter what the configuration
50-70% cover threshold for edge effects on nest success
fragmentation only important below some threshold % cover.
Applicable Ecological Function Cited
Underlying Principles Cited
Validity for Significance Cited
Location/Geographical Applicability: variety of locales reviewed.
Scale: depends on organism
Other Comments: connectivity alone not a guarantee of viable populations.

Relatively little work for only a handful of species.

Citation: Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. Canada-Ontario Remedial Action Plan Steering Committee. 76 p. http://www.on.ec.gc.ca/wildlife/docs/frame-toc-e.html
Threshold: 30% of watershed in forest; at least one 200 ha patch that is at least 500 m wide
Applicable Ecological Function Cited: wildlife habitat
Underlying Principles Cited
Validity for Significance Cited: cites some US literature. For Ontario, cites Freemark finding 30% a threshold where several breeding birds disappear near Ottawa, and Tate and Cadman recommendation of 200 ha patch for >80% of expected bird species.
Location/Geographical Applicability: southern Ontario
Scale: some discussion using Tate and Cadman study, suggesting different targets at different scales, generally decreasing in total cover % the larger the scale.
Other Comments

Citation: Fahrig, L. 1997. Relative effects of habitat loss and fragmentation on population extinction. *J. Wildl. Manage.* Vol. 61 No. 3 pp. 603-610
Threshold: $\geq$ 20% of the landscape in habitat
Applicable Ecological Function Cited: effects of habitat loss far outweigh effects of habitat fragmentation
Underlying Principles Cited: "fragmentation" term often combines effects of habitat loss and fragmentation
- Configuration may tend to strongly affect mainly only edge species
Validity for Significance Cited: used assumptions that would maximize fragmentation effect and it still showed little
Location/Geographical Applicability: theoretical model
Scale
Other Comments: 20% compares with literature.
Conservation must focus much more on total area loss in a landscape than on spatial pattern.

Citation: Freemark, K. and M.G. Merriam. 1986. Importance of area and habitat heterogeneity to bird assemblages in temperate forest fragments. 1986. *Biological Conservation* 36 pp. 115-141
Threshold: none mentioned, just maximize especially for: forest-interior species, low abundance species, long-distance migrants and canopy nesters. Although size increases numbers for all assemblages.
Applicable Ecological Function Cited: size and heterogeneity of forest affects numbers and assemblages of breeding bird species.
Underlying Principles Cited: more species in large areas because more habitat types for different preferences and different seasonal requirements or to obtain needs under varying conditions

more species in larger areas just because large and lower extinction possibilities with larger populations.
Large forests have more species than smaller although not necessarily more than an equal area of smaller patches
Validity for Significance Cited: increase in lag area explained 50% of increase in number of species and 60% of # of pairs. Components of heterogeneity explained 17% of species numbers and 10% of pairs numbers.
Location/Geographical Applicability: west of Ottawa
Scale: 21 forests of 3 ha to 7620 ha within 1400 sq. km. study area
Other Comments: conservation should include both large size and habitat heterogeneity - large forests may produce young that disperse to supply smaller patches.

Citation: Friesen, L. 1996. Forest Birds in Fragmented Landscapes: The Pressures from Without. Ph.D thesis, University of Waterloo. 130 p. Available from ProQuest 1-800-521-3042: ABB/ISBN0612093425 (this entry from abstract)
Threshold: No predictable pattern linking size and urbanization. While neotropical migrant abundance and diversity increase with woodlot size, urbanization often trumped it with 4 ha woodlots without nearby (within 100 m) houses on average richer, more abundant community than 25 ha urban woodlots.
Applicable Ecological Function Cited: avian (neotropical migrant) diversity and abundance
Underlying Principles Cited: fragmentation often adversely affects birds but cannot be considered separate from other influences
Validity for Significance Cited
Location/Geographical Applicability: 72 woodlots in Region of Waterloo
Scale: county
Other Comments: Importance of all rural woodlands, of containing sprawl, and within urban areas of non-residential buffers around woodlands.

Citation Friesen, L. 1991. Effects of fragmentation and urbanization on forest bird communities in the Region of Waterloo. M.A. thesis University of Waterloo. 106 p. Available from Pro-Quest 1-800-521-3042: ABB/ISBN0315689730 (this entry from abstract)
Threshold: none given.
Applicable Ecological Function Cited: species and abundance of birds.
Underlying Principles Cited: fragmentation and urbanization affect different bird community classes differently.
Urban forests are particularly stressful to neotropical migrants.
Validity for Significance Cited
Location/Geographical Applicability
Scale
Other Comments Bird species and abundance higher in larger than smaller forests and in rural than urban because of the increased presence of neotropical migrants. Diversity and abundance of short-distance migrants and permanent residents was constant in small and large, rural and urban. Forests. Neotropical migrants account for at least 60% of all breeding birds in extensive rural tracts.

Citation Friesen, L.E., V.E. Wyatt and M.D. Cadman. 1999. Pairing Success of Wood Thrushes in a Fragmented Agricultural Landscape. *Wilson Bulletin*, 111(2), pp. 279-281
Threshold: none given. Study found success in 3-12 ha woodlots
Applicable Ecological Function Cited: pairing success (different from breeding success – many parasitized by Brown-Headed Cowbirds, an edge species favoured in fragmented landscapes)
Underlying Principles Cited: singing birds end of May until June 20 likely paired. Also located nests
Validity for Significance Cited: may differ with different landscapes depending on degree of fragmentation and on the land use/disturbance matrix
Location/Geographical Applicability: Waterloo Region
Scale: transects 100 m apart
Other Comments

Citation: Friesen, L., M. Cadman, and J. MacKay. 1999. Nesting success of neotropical migrant songbirds in a highly fragmented landscape. *Conservation Biology* Vol. 13 No. 2, April 1999. pp. 338-346.
Threshold: none. Size had no effect on nesting success of Wood Thrush or Rose-Breasted Grosbeak within small woodlots (3-140 ha, with only one >50 ha). Wood Thrush reached self-sustaining levels; Rose-Breasted Grosbeak did not.
Incentive to preserve all woodlots in highly fragmented landscapes
Applicable Ecological Function Cited: fragmentation affecting bird abundance and productivity
Underlying Principles Cited: Red-breasted Grosbeaks' low numbers of second broods lowers productivity
Validity for Significance Cited- success if fledge one young. Low range of forest sizes likely affects absence of size effect – studies elsewhere that showed effect had much wider range.
Location/Geographical Applicability: Waterloo Region
Scale
Other Comments: Wood Thrush results differ from many others where they did depend on woodlot size, suggesting predation and parasitism varies regionally (possibly varies over time, fewer predators like snakes, better structure because of syrup and logging, fewer Cowbirds.

Citation: Gartner-Lee Ltd. 2002. Final Report: *Rationale and Methodology For Determining Significant Woodlands in the Regional Municipality of Halton*. Prepared for the Regional Municipality of Halton.
Threshold: *$\geq$ 2 ha in urban areas; $\geq$ 4 ha in rural areas below Escarpment; $\geq$ 10 ha north of the Escarpment*
Applicable Ecological Function Cited: Small urban woodlands for airborne pollution uptake, migratory shelter, potential habitat for rare species, relieve people pressure on large more sensitive woodlands
Rural below Escarpment as habitat for disturbance-sensitive species
Above Escarpment also never cultivated for very high wildlife and botany attributes, dense patches for high resiliency

Underlying Principles Cited:
Need to recognize diversity of Halton's landscape, not one blanket threshold based on whole Region's woodland %
Milton with <5% woodland, qualifies for MNR (1999) 2 ha threshold
Other urban areas >5 % but most in valleys; 2 ha threshold needed to capture tableland landform which <5% woodland
Below Escarpment rural where 12% wooded: 4 ha threshold, fits MNR (1999) – at 4 ha potential for disturbance sensitive species especially if minimum diameter of 100 m.
Above Escarpment, at 41% woodland would get 40 ha threshold by MNR (1999). But fragmented by roads, pipelines, powerlines. Also much never cultivated so very high wildlife and botany attributes. At 40 ha threshold, could lose these "superlative" attributes.
Cites literature showing at least some elevated area-sensitive and disturbance-sensitive wildlife function between 10 and 50 ha
Dense patches above Escarpment "borrow" functions from larger neighbours, e.g., refugia in low productive years, providing resiliency to the larger woodlands – unique to Halton.
Validity for Significance Cited: largely literature interpreted appropriate to Halton's landscapes
Location/Geographical Applicability: Halton, highly relevant although some unique attributes
Scale: regional, no more detailed than 1:10,000
Other Comments: no basic research but interprets literature relative to Halton's landscapes to set landscape specific criteria. Numerous reviewers. Describes GIS method - appears straightforward

Citation : Joos, R. 1996. Biodiversity and urban design in southern Ontario. M.L.A. Thesis University of Guelph. 136 p. Document available from ProQuest 1-800-521-3042: ABB/ISBN0612096920
Threshold: 400 ha
Applicable Ecological Function Cited: maximize biodiversity
Underlying Principles Cited
Validity for Significance Cited: more empirical than specific data
Location/Geographical Applicability: southern Ontario
Scale: assessed 30 m square study plots for plant and soil features
Other Comments: urban design principles recommended include maximize forest interior, shape, connectivity, structural heterogeneity and use of native species

Citation Nudds, T.D. Use of estimated "pristine" species-area relations to generate indices of conservation value for nature reserves. In Poser, S., W. Crins and T. Beechey, eds., 1993. *Size and Integrity Standards for Natural Heritage Areas in Ontario* Proceedings of a Seminar. Provincial Parks and Natural Heritage Policy Branch, Ontario Ministry of Natural Resources, Huntsville. ISBN 0-7778-0970-2 pp. 25-33.
Threshold: 75 ha minimum for numbers of forest passerine species as in pristine conditions; 100,000 ha minimum for vulnerable mammals

Applicable Ecological Function Cited: size with isolation affects immigration
Underlying Principles Cited: fragmentation decreases opportunity for immigrants to replace extinctions
Validity for Significance Cited: threshold at which approaches the species number of historic or pristine landscapes
Location/Geographical Applicability: Great Lakes-St Lawrence forest region, and Alleghanian-Illinoian mammal region, southern Ontario
Scale: regional
Other Comments

Citation: Ontario Ministry of Natural Resources. 1999. Natural Heritage Reference Manual for Policy 2.3 of the Provincial Policy Statement. 127 p.
Threshold: if <5% of land cover, 2 ha; 5-15% of land cover, 4 ah; 15-30% of land cover, 40 ha (preferably >300 m minimum width); >30%, no minimum size – other factors more important.
Applicable Ecological Function Cited. Wildlife use, quoting A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern.
Underlying Principles Cited
Validity for Significance Cited. no new research for this manual.
Location/Geographical Applicability: Ontario
Scale
Other Comments

Citation: Riviere, Lori and Susan McInnes, 1999. Identifying Significant Woodlands: Part of the Process of Bringing Halton's Greenland System into Conformity with the Provincial Policy Statement. *Proceedings of Leading Edge 1999: Making Connections*. Niagara Escarpment Commission, Georgetown, ON.
Threshold: $\geq$ *4 ha where 12% woodland;* $\geq$ *40 ha where 42% woodland*
Applicable Ecological Function Cited
Underlying Principles Cited
Validity for Significance Cited
Location/Geographical Applicability: Halton, very applicable
Scale: regional
Other Comments

Citation: Rowsell, M. 2003. Woodland Valuation System: Methods and Rationale for Assigning Woodland Value at the Patch Scale for Consideration in Planning and Conservation In Eastern Ontario. Version 2.0 Eastern Ontario Model Forest. 80 p.
Threshold: Rural: 3 points $\geq$200 ha, 2 points 20-200 ha, 1 point $\leq$20 ha;
Urban: 3 points $\geq$ 4 ha, 2 points 2-4 ha, 1 point $\leq$2 ha.
Applicable Ecological Function Cited: bigger the better for habitat
Underlying Principles Cited
Validity for Significance Cited: cites other Ontario valuation systems
Location/Geographical Applicability: Eastern Ontario
Scale: regional – several counties
Other Comments

Citation: Schmiegelow, F. 1990. Insular biogeography of breeding passerines in southern Ontario woodlots: a rigorous test for faunal collapse. M. Sc. Thesis. University of Guelph. 76 p. Document available from Pro-Quest 1-800-521-3042: ABB/ISBN0315628626
Threshold: woodlots <30 ha highly unlikely to have bird species diversity = contiguous forest and never the faunal component. Woodlots <75 ha barely up to bird species diversity of contiguous
Applicable Ecological Function Cited: bird species diversity dependent on forest passerine habitat
Underlying Principles Cited
Validity for Significance Cited: measured other habitat structure, configuration and isolation but no other characteristic accounted for additional variation in species richness independedt of area alone. Area is the best indicator of bird species diversity with R^2 = .90 with area alone.
Location/Geographical Applicability: Wellesley Township, Waterloo Region
Scale: 24 woodlots 0.30 to 73.6 ha area
Other Comments: occurrence of rare species dependent on area

Citation: Sinclair, A. and P. Catling. 2000. Ontario Goldenseal, Hydrastis Canadensis, populations in relation to habitat size, paths, and woodland edges. Canadian Field Naturalist: 114(4): 652-655
Threshold: none. Little effect of size. Small areas worthy of protection.
Applicable Ecological Function Cited: natural disturbance benefits Goldenseal
Underlying Principles Cited: threatened species because may have dispersed through natural disturbances no longer prevalent (e.g., fire, passenger pigeons, bears).
Able to be in small areas because of seed bank, inbreeding capability
Validity for Significance Cited: measured location relative to habitat size, edge (defined as 10 m) and paths
Location/Geographical Applicability: southwestern Ontario
Scale: species distribution – several counties
Other Comments continuity allowed small gravel roads but not major roads, highways or streams >10m
Simulation of natural disturbance could help recovery

Citation: Tate. D. 1998. Assessment of the Biological Integrity of Forest Bird Communities – A Draft Methodology and Field Test in the Severn Sound Area of Concern. Prepared for Severn Sound Remedial Action Plan by Canadian Wildlife Service, Environment Canada. 72 p. Highlights in Appendix 7 in Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. Canada-Ontario Remedial Action Plan Steering Committee. 76 p.
Threshold: 35% forest cover to retain forest interior bird species for planning areas in the range of 10,000 ha or less. (A lower threshold for any forest-interior birds is about 47 ha/10,000 ha).
For 40,000 ha blocks, 24%

For larger scales, 20%
For site scale, 200 ha minimum to reach 80% of expected species.
Applicable Ecological Function Cited: more total forest area, bigger patch size and bigger interior, the more breeding bird habitat
Underlying Principles Cited
Validity for Significance Cited: a) Southern Ontario-wide: in comparing bird atlas data and forest cover, forest interior species were the most dependent on forest cover (R^2=0.424). Cover explained less but some of variation in interior/edge species and even less of edge species. Unclassified species shows little relationship (R^2=0.035). Comparing single squares (10,000 ha), forest bird species number increase to 18% cover; forest-associate neotropical species increase up to 15% cover; forest interior species increase to 35% cover. For single squares, forest cover was the best predictor of forest interior birds.
b)Comparing regions (south-west, central and eastern Ontario), all forest birds and forest interior species shoed the steepest increase in southwest. The more heavily forested (>20%) southwest squares tended to more species than similar cover in the other regions. Even by 26% there was no evidence of levelling off in forest interior species. In central and eastern Ontario, forest-interior species increased with forest cover but with a shallower slope up to 34%
c) Within Severn Sound watershed (14 squares with 11 having forest data available), 3 of the 4 most forested squares (35-50%) had the most interior species, supporting the same 35% threshold.
d) in 40,000 ha blocks, significant forest interior increases to 24% cover, forest interior had the strongest relationship, all forest birds also strong, neotropical migrants similar relationship but less strong.
e) 90,000 to 160,000 ha. Increase in interior species up to 20% cover but too few squares above that to test.
f) site scale: surveyed 4 plots from 140 to 201 ha
Location/Geographical Applicability: southern Ontario with local scale focus in Severn Sound area
Scale: southern Ontario to one atlas square (10,000 ha)
Other Comments: Cites Gartner-Lee report findings of 28.9% forest in Hogg Creek watershed (Severn Sound AOC) with 88% of expected bird species.
Southern Ontario-wide has few squares exceeding 50% cover, limiting the data set at that range.
Total forest cover appears to be the most important feature influencing forest interior species richness. Forest in an adjacent square did not make a significant contribution. Within a narrow range of total cover, squares with a higher proportion of interior forest are expected to contain slightly higher number of forest interior species.
Habitat management based on the most sensitive species will benefit the other sets as well.

Citation: Villard, M-A., M.K. Trzcinski and G: Villard, M-A., M.K. Trzcinski and G. Merriam. 1999. Fragmentation effects on forest birds: relative influence of woodland cover and configuration on landscape occupancy. *Conservation Biology* Vol. 13, No. 4 pp. 774-783.

Threshold: no sharp thresholds. Forest cover and configuration (# fragments, median fragment area, total edge, mean nearest-neighbour distance) were equally good predictors of forest species presence.
Applicable Ecological Function Cited: forest birds depend on both forest extent and configuration
Underlying Principles Cited: effects of forest configuration depend on the species considered. Factors like natal dispersers, nest predation susceptibility, brood parasite susceptibility, large area needs in a fragmented landscape can affect degree of effect of configuration
Validity for Significance Cited. Studied 33 forest landscapes (2.5 km x 2.5 km) with cover from 3.4% to 66.8%. Looked at 15 forest bird species' presence. Forest cover and configuration each significantly predicted the presences of 6 of the 15 species, even with conservative approach for configuration effects.
Location/Geographical Applicability: agricultural landscapes near Ottawa
Scale: 121 forest fragments in three 10 km x 10 km squares, each divided into 2.5 km x 2.5 km "landscapes"
Other Comments: while configuration is important, agree there is a need for more attention to habitat loss – that emphasis on configuration could just be a short term solution and an easier sell than a focus on minimum thresholds of area. They feel the two aspects should be considered simultaneously, recognizing the specificity of species' responses.

Citation: Weaver, M. 1979. The Effects of Forest Insularization of Woodlot Tree Species Abundance. M.Sc. thesis, York University. Available from Pro-Quest 1-800-521-3042:ABB/ISBN0315968273 (this entry from abstract)
Threshold: none. No effect of size
Applicable Ecological Function Cited: tree species abundance and age trends
Underlying Principles Cited: island biotas lose species at a rate dependent on area.
Validity for Significance Cited
Location/Geographical Applicability: southern Ontario: 10 woodlots
Scale
Other Comments: species extinction in these woodlots is caused by succession, not by habitat insularization

Citation Yahner, R. 1988. Changes in wildlife communities near edges. *Conservation Biology* Vol. 2 No. 4 pp. 333-339.
Threshold: >100 ha (Wilcove, 1985)
Applicable Ecological Function Cited: size to support forest interior to avoid edge effect predation on open forest nests
Underlying Principles Cited
Validity for Significance Cited: cites a study by Wilcove, 1985
Location/Geographical Applicability:
Scale
Other Comments

Interior Size

Citation Andren, H. 1995. Effects of landscape composition on predation rates at habitat edges. In Hansson, L., L. Fahrig and G. Merriam (eds.). 1995. *Mosaic Landscapes and Ecological Processes*. Chapman and Hall, London. Pp. 225-255.
Threshold: 123 m, 80m, >300m, 1000m, >200 m. for studies in north-east/north-central USA where forest in a farmland landscape
Applicable Ecological Function Cited: nest predation in habitat edge higher than in patch interior
Underlying Principles Cited: predation depends on the predator use of habitats. If corresponds to edge as a travel line, then the range of effect is less. But if related to habitat generalists entering from surroundings, then range deeper.
Validity for Significance Cited: of 22 studies in forest within farmland (assumed to apply to most southern Ontario conditions), 18 (82%) found an edge effect
Location/Geographical Applicability: not southern Ontario studies but ones for forests in farmland landscapes. 5 thresholds listed specific to north and east USA.
Scale
Other Comments: edge related increase in predation is most commonly found in forests surrounded by farmland and rarely in forest mosaics

Citation: Burke, D. 1998. The effect of forest fragmentation on food abundance, nest site habitat, and reproductive success of forest-breeding birds: a study in the Peterborough Region of Ontario. Ph.D. thesis Trent University. 183 p. Available from Pro-Quest 1-800-521-3042:ABB/ISBN0612302067 (this entry form abstract)
Threshold: >90 ha core area
Applicable Ecological Function Cited: composition, demography, density, pairing and reproductive success of forest birds relative to forest cover
Underlying Principles Cited: declines in Ovenbird with smaller core because of lower food abundance and lack of suitable nest sites.
Wood Thrush and Veery were limited by food and interior nest sites in small woodlots
Rose-breasted Grosbeaks and Red-eyed Vireos did not lack food or nest sites
All species more successful in large fragments
Small fragments were habitat sinks for all species.
Validity for Significance Cited: to guard against local population declines
Location/Geographical Applicability: Peterborough region, south-central Ontario. 79 woodlots (0-420 ha core area) plus 2 continuous forests
Scale: county
Other Comments

Citation: Burke, D.M. and E. Nol. 2000. Landscape and Fragment Size Effects on Reproductive Success of Forest-Breeding Birds in Ontario. *Ecological Applications* Vol. 10 No. 6, pp. 1749-1761.
Threshold: >90 ha core to avoid being habitat sinks. Specifically,
little effect from surrounding landscape
$\geq$23 ha core for Ovenbird for replacement. As ground-nester, most vulnerable of the 5 studied although shrub nesters equally depressed in small fragments

- 100 m edge zone of nest vulnerability for Veery and Rose-Breasted Grosbeak, esp. pronounced in first 50 m.; also 100 m zone for increased parasitism
Applicable Ecological Function Cited: reproductive success of 5 forest-breeding songbirds (Ovenbird, Wood Thrush, Veery, Rose-breasted Grosbeak and Red-Eyed Vireo - avoidance of habitat sinks
Underlying Principles Cited: lower breeding success in fragmented forests because of less pairing success, more nest predation, less food and more brood parasitism to the point of productivity being less than mortality (sink). Ground nesters most vulnerable. looked at 10 km radius around woodlots as possible indicator of predator and Brown-Headed Cowbird habitat.
Notes wintering habitat changes may have a bigger effect than fragmentation on some species declines (e.g., Veery, Ovenbird)
Sink habitats have value where source populations remain in range
Validity for Significance Cited: checked nests every few days and used Mayfield estimate. Breeding Bird Surveys do not always correlate with their findings
Location/Geographical Applicability: south-central Ontario
Scale: 40 fragments of 12 –2350 ha size plus 2 continuous forest sites
Other Comments

Citation Burke, D. and E. Nol. 1998. Edge and fragment size effects on the vegetation of deciduous forests in Ontario, Canada. *Natural Areas Journal* Vol. 18 No. 1 pp. 45-53
Threshold: 20 m to avoid micro-climate effects and most vegetative changes
Applicable Ecological Function Cited: greater edge affects seed dispersal, wind conditions, microclimate, invasive presence – all of which alter the communities from those of the interior
Underlying Principles Cited
Validity for Significance Cited
Location/Geographical Applicability: 22 woodlots with core area (>100 m from edge) from 0.25 ha to 163 ha in Peterborough County
Scale: county
Other Comments: Edge microclimate is affected by aspect, with wider edge effects on warmer slopes, and by age – wider the younger. This study was older forest and just east side, reducing effects.

Citation: Donovan, T. P. Jones, E. Annand, F. Thompson III. 1997. Variation in local-scale edge effects: mechanisms and landscape context. Ecology Vo. 78 No. 7. pp. 2064-2075
Threshold: none given
Applicable Ecological Function Cited: ecological processes near habitat edges affect forest bird nest predation and cowbird distribution.
Underlying Principles Cited:
Validity for Significance Cited
Location/Geographical Applicability: Ozarks
Scale: 18 locations across 3 states
Other Comments: need to assess habitat characteristics at a landscape scale first, then look for trends in edge effects within homogenous landscapes.

Citation Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. Canada-Ontario Remedial Action Plan Steering Committee. 76 p. http://www.on.ec.gc.ca/wildlife/docs/frame-toc-e.html
Threshold: >10% of watershed forest should be >100 m from edge; >5% should be >200 m from edge.
Applicable Ecological Function Cited: habitat for forest-interior birds
Underlying Principles Cited: different bird species guilds breed different distances from the edge
Validity for Significance Cited: Sandilands and Hounsell study.
Location/Geographical Applicability: Ontario
Scale: may be more important at planning larger units (>1600 sq. km.)
Other Comments:

Citation: Friesen, L., M. Cadman, and J. MacKay. 1999. Nesting success of neotropical migrant songbirds in a highly fragmented landscape. *Conservation Biology* Vol. 13 No. 2, April 1999. pp. 338-346.
Threshold: none. If anything nesting success was best within 5 m of the edge, decreasing inward, for both Wood Thrush and Rose-Breasted Grosbeak within small woodlots (3-140 ha, with only one >50 ha).
Incentive to preserve all woodlots in highly fragmented landscapes
Applicable Ecological Function Cited: predators supposedly higher density at edges
Underlying Principles Cited:
Validity for Significance Cited. Success if fledge one young. Small size range also means very little other than edge.
Location/Geographical Applicability: Waterloo Region
Scale: one county
Other Comments: Edge-related dynamics may depend on landscape context, local types and densities of predators, Cowbirds and vegetative structure.

Citation Gartner-Lee Ltd. 2002. Final Report: *Rationale and Methodology For Determining Significant Woodlands in the Regional Municipality of Halton*. Prepared for the Regional Municipality of Halton.
Threshold: 4 ha interior >200 m from edge
Applicable Ecological Function Cited: area-sensitive and disturbance-sensitive species increase further from the edge
Underlying Principles Cited
Validity for Significance Cited: just states that probability of those species is greater – no references given
Location/Geographical Applicability: Halton
Scale
Other Comments: feels 300 m threshold is not justified. Qualifies the threshold "in this landscape".

Citation: Riviere, Lori and Susan McInnes, 1999. Identifying Significant Woodlands: Part of the Process of Bringing Halton's Greenland System into Conformity with the Provincial Policy Statement. *Proceedings of Leading Edge 1999: Making Connections.* Niagara Escarpment Commission, Georgetown, ON.
Threshold: *> or = 100 m from the edge AND > or = 1 ha*
Applicable Ecological Function Cited
Underlying Principles Cited
Validity for Significance Cited: valuable for wildlife
Location/Geographical Applicability: Halton, very applicable
Scale: regional
Other Comments

Citation: Rowsell, M. 2003. Woodland Valuation System: Methods and Rationale for Assigning Woodland Value at the Patch Scale for Consideration in Planning and Conservation In Eastern Ontario. Version 2.0 Eastern Ontario Model Forest. 80 p.
Threshold: 3 points $\geq$ 4 ha after 200 m edge removed, 2 points $\geq$ 4 ha after 150 m edge removed, 1 point $\geq$ 4 ha after 100 m edge removed.
Applicable Ecological Function Cited: more interior supports more interior-specific species
Underlying Principles Cited: better foraging possibilities
Validity for Significance Cited: cites other Ontario valuation systems
Location/Geographical Applicability: Eastern Ontario
Scale: regional – several counties
Other Comments

Citation: Sinclair, A. and P. Catling. 2000. Ontario Goldenseal, Hydrastis Canadensis, populations in relation to habitat size, paths, and woodland edges. Canadian Field Naturalist: 114(4): 652-655
Threshold: none. Positively associated with edge and paths.
Applicable Ecological Function Cited: natural disturbance benefits Goldenseal
Underlying Principles Cited: threatened species because may have dispersed through natural disturbances no longer prevalent (e.g., fire, passenger pigeons, bears).
Able to be in small areas because of seed bank, inbreeding capability
Edges and paths may replicate some of those disturbance conditions
Validity for Significance Cited measured location relative to habitat size, edge (defined as 10 m) and paths
Location/Geographical Applicability: southwestern Ontario
Scale: species distribution – several counties
Other Comments continuity allowed small gravel roads but not major roads, highways or streams >10m
Simulation of natural disturbance could help recovery

Citation: Tate. D. 1998. Assessment of the Biological Integrity of Forest Bird Communities – A Draft Methodology and Field Test in the Severn Sound Area of Concern. Prepared for Severn Sound Remedial Action Plan by Canadian Wildlife Service, Environment Canada. 72 p. Highlights in Appendix 7 in Environment Canada,

Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. Canada-Ontario Remedial Action Plan Steering Committee. 76 p.
Threshold: At 90,000 to 160,000 ha area, 200 m - suggests 5% but 2% in areas where 5% is not practical. 10% at 100 m.
Applicable Ecological Function Cited: more total forest area, bigger patch size and bigger interior, the more breeding bird habitat
Underlying Principles Cited: 200 m interior is particularly important to forest bird conservation in the context of large planning areas.
Validity for Significance Cited: variation in 200 m interior did not show as strong a relationship as total forest cover with number of interior species in a single square.
In the Severn Sound set of 11 squares, the top forest interior three all had over 10% 100 m interior and 2 of the 3 had over 5% 200 m.
But for 90,000 to 160, 000 ha scale, >200m area had the strongest relationship for interior species richness
Location/Geographical Applicability: southern Ontario with local scale focus in Severn Sound area
Scale: southern Ontario to one atlas square (10,000 ha)
Other Comments: Influence of 100 m interior is increasing species richness at a given level of forest cover. Total forest cover appears to be the most important feature influencing forest interior species richness. Within a narrow range of total cover, squares with a higher proportion of interior forest are expected to contain slightly higher number of forest interior species.

Citation Yahner, R. 1988. Changes in wildlife communities near edges. *Conservation Biology* Vol. 2 No. 4 pp. 333-339.
Threshold: edge effect is 13 m based on vegetative structure but 64 m based on avian nest distribution (Gates and Mosher, 1981)
Applicable Ecological Function Cited: vegetative structure and nest distribution
Underlying Principles Cited
Validity for Significance Cited: cites a study by Gates and Mosher (1981) using forest/field edges in Michigan
Location/Geographical Applicability: Michigan
Scale
Other Comments

Hydrological Linkages

Riparian
Citation: Bowles, J. 2000. Woodlands: Take it to the Limit. . Paper presented at "Best Evidence" Conference, King's College, London ON. May 3, 2000.
Threshold: 15 m for plant species richness, 20 m for air temperature, 40 m for chemical contamination protection, 45 m for shade, 55 m for tree mortality, 60 m for bird density, 150 m for canopy cover, 500 m for seed dispersal and exotics minimization, 600 m to minimize nest predation.
Applicable Ecological Function Cited: variety – see above

Underlying Principles Cited
Validity for Significance Cited: review of other work
Location/Geographical Applicability
Scale
Other Comments: need for bigger riparian buffers. Could set in sub-watersheds to reflect local conditions and functions.
(Entry based on notes taken at the workshop)

Citation: Castelle, A., A. Johnson, and C. Conolly. 1994. Wetland and stream buffer size requirements – a review. *J. Environ. Qual*. 23:878-882.
Threshold: Minimum of 15 to 30 m under most circumstances, lower end to maintain natural physical and chemical characteristics of aquatic resources, upper end for maintenance of biological components of streams and wetlands.
Applicable Ecological Function Cited: buffer effectiveness is determined by size
Underlying Principles Cited: vegetated buffers help protect streams and wetlands from noise, light, temperature, pollutants, runoff, invasive species, human activities.
Validity for Significance Cited: looked at studies based on many buffer functions: sediment removal and erosion control, excess nutrient and metal removal, moderation of stormwater runoff, moderation of water temperature, maintenance of habitat diversity, wildlife species diversity, reduction of human impact
Location/Geographical Applicability: review of many studies throughout USA and a few in Canada
Scale: continent
Other Comments: ideally buffer widths should consider value of the protected resource, intensity of adjacent land use, buffer characteristics, and buffer functions required. But fixed widths are easier to regulate. Site conditions, however, could alter needs from above thresholds.

Citation Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. Canada-Ontario Remedial Action Plan Steering Committee. 76 p. http://www.on.ec.gc.ca/wildlife/docs/frame-toc-e.html
Threshold: 30 m natural vegetation on both sides of stream
Applicable Ecological Function Cited: to protect streams and facilitate wildlife movement
Underlying Principles Cited: smaller buffers adequate where vegetation in good condition and adjacent land use is low-impact. Wider are needed where soils are less permeable or highly erodible, slopes steep, or adjacent land use intense (e.g., agriculture)
Validity for Significance Cited: mostly Castelle (1994)'s review of the literature
Location/Geographical Applicability: Ontario
Scale:
Other Comments:

Citation Gartner-Lee Ltd. 2002. Final Report: *Rationale and Methodology For Determining Significant Woodlands in the Regional Municipality of Halton*. Prepared for the Regional Municipality of Halton.

Threshold: within 30 m of a watercourse
Applicable Ecological Function Cited: temperature regulation, filtering ability, erosion control, wildlife use, maintenance of stream flow, nutrient flow both to and from streams
Underlying Principles Cited
Validity for Significance Cited: cites both scientific literature and other rating systems
Location/Geographical Applicability: Halton
Scale
Other Comments: cites a wide range of widths from scientific literature (4 to 1000 m). 30 m choice appears partly because used elsewhere.

Citation: Johnson, A. and D. Ryba. 1992. A Literature Review of recommended Buffer Widths to Maintain Various Functions of Stream Riparian Areas. Prepared for King County Surface Water Management Division. Washington State.
Threshold: *minimum* of 15 to 30 m. Less than 10 m have little maintenance of functions, 15-30 m provide minimal maintenance for most functions, greater than 30 m provide adequate protection for most functions.
Applicable Ecological Function Cited: buffer effectiveness depends on its width
Underlying Principles Cited: riparian areas stabilize streambanks; prevent erosion; filter sediments, nutrients and other contaminants; moderate stream microclimate; support and protect fish and wildlife; provide migration corridors.
Validity for Significance Cited: review of scientific literature
Location/Geographical Applicability: research in humid, temperate areas of US – Washington, Oregon, eastern coastal states and parts of Mid-West, plus Ontario
Scale
Other Comments: width varies with situation and function. For the 38 studies reviewed thresholds ranged from 3 to 200 m with most from 30 to 122 m.
For sediment removal, 1 study recommends from 3 m for sand to 122 m for clay; 4 suggest 30-38 m; one suggests 88 m.
For stream temperatures, 30 m reaches same as old-growth stand
For wildlife habitat, studies recommend 30 m for salmonid habitat protection, 67-93 m
For small mammals, 75-200 m for breeding birds, 100 m for large mammals
For benthic community protection, 3 authors agreed on 30 m.
For noise abatement, 6 to 32 m width recommended depending on the noise level.
Some local requirements include buffers beyond wetlands as well.
Local regulations across US and Canada generally range from 7 to 30 m width
Adjacent slopes can affect recommended widths.

Citation: Neiman R., H. Decamps and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* Vol. No. 2 pp. 209-212.
Threshold: NA
Applicable Ecological Function Cited: high diversity in non-equilibrium situations
Underlying Principles Cited: biodiversity includes both features and processes and riparian corridors are necessary to maintain both.
Riparian processes are greatly affected by landscape change.
Riparian areas offer far greater biodiversity and ecological services than their proportional extent

Natural disturbance (flooding, micro-topography variation from river-influenced processes, climate variation) and migratory capacity in riparian corridors supports greater biodiversity
Validity for Significance Cited: NA
Location/Geographical Applicability: general. Cite studies from around world
Scale: regional to international. Warn against site-specific decisions missing broader context
Other Comments: Riparian corridors vary in width – tending to be narrow in headwaters, broader downstream
Restoration should consider disturbance regimes and the whole system from headwaters to mouth, coordinating among agencies and nations.

Citation: Niagara Peninsula Conservation Authority. 2000. Twelve Mile Creek Watershed Strategy
Threshold: restore to 10-30 m
Applicable Ecological Function Cited: stabilize stream bank and filter surface water to support stream quality
Underlying Principles Cited
Validity for Significance Cited: none
Location/Geographical Applicability: Niagara peninsula
Scale: watershed
Other Comments: objective to extend riparian widths where less.

Citation: Niagara Peninsula Conservation Authority. 1999. Welland River Watershed Strategy
Threshold: restore ideally to 30 m
Applicable Ecological Function Cited: stabilize stream bank and filter surface water to support stream quality
Underlying Principles Cited
Validity for Significance Cited: none
Location/Geographical Applicability: Niagara peninsula
Scale: watershed
Other Comments: objective to extend riparian widths where less.

Citation: Norman, A. 2000. Vegetative Buffer Strips and Wetlands. Paper presented at "Best Evidence" Conference, King's College, London ON. May 3, 2000.
Threshold: just cites ranges found – see Comments
Applicable Ecological Function Cited: vegetative buffers, properly designed, can protect water quality and habitat.
Underlying Principles Cited
Validity for Significance Cited: review of literature
Location/Geographical Applicability: North America applicable to Ontario
Scale
Other Comments: for protecting water quality, from 6 to 92 m for urban and agriculture

For protecting habitat, varies with species. 40 m for edge species, >100 m for neo-tropical migrants.

Citation: Oelbermann, M and A. Gordon. 2001. Retention of leaf litter in streams from riparian plantings in southern Ontario, Canada. *Agroforestry Systems* 53: 323-331.
Threshold: none. Buffer width less of a role in litter retention than stream morphology.
Applicable Ecological Function Cited: litterfall from riparian forests food source for aquatic biota. Stream morphology also influences its retention.
Underlying Principles Cited: - the wider the buffer, the more litter falls
- different species' leaves have different retention times
Validity for Significance Cited
Location/Geographical Applicability Washington Creek (tributary of the Nith) in Oxford County, southern Ontario.
Scale: site specific.
Other Comments: buffer width does affect total litter entering stream. Greatest debris retained by rocks, streambank and debris dams.

Citation: Rowsell, M. 2003. Woodland Valuation System: Methods and Rationale for Assigning Woodland Value at the Patch Scale for Consideration in Planning and Conservation In Eastern Ontario. Version 2.0 Eastern Ontario Model Forest. 80 p.
Threshold: 3 points if at least one part $\leq$ 30 m from shoreline, 2 points 30-50 m from shoreline, 1 point $\geq$50 m from shoreline.
Applicable Ecological Function Cited: forest protection of water quality
Underlying Principles Cited: provide shade, filter nutrients, reduce erosion
Validity for Significance Cited: cites other Ontario valuation systems
Location/Geographical Applicability: Eastern Ontario
Scale: regional – several counties
Other Comments: note this is proximity to water so can be lake shorelines

Citation: Spackman, S. and J. Hughes. 1995. Assessment of minimum stream corridor width for biological conservation: species richness and distribution along mid-order streams in Vermont, USA. *Biological Conservation* Vol. 71. pp. 325-332.
(for copy see FON CD)
Threshold: for third and fourth order streams:
High water mark for most mammals and for weedy and exotic species (above HWM, these are much less)
30 m above HWM for >90% of plants in a 200 m corridor
75-175 m corridor width for 90-95% breeding birds in a 200 m corridor
Applicable Ecological Function Cited: conserving biological richness
Underlying Principles Cited:
near-stream is disproportionately high in richness and so efficient to conserve
streams bring high level of biological and genetic exchange to help counter fragmentation effects
while natural disturbances (ice scour, flooding, beavers) might shift species occurrence, richness likely conserved as it migrates along the corridor unless land use practices interfere.

Validity for Significance Cited: while significant habitat, validity of threshold is low because species distribution depends on taxon, stream, HWM so standard corridor width is a poor substitute for stream specific assessments. Easy to measure distance but not enough.
Location/Geographical Applicability: Vermont. Riparian within forests
Scale: identified sites at 1:24,000. Field measurements up to 200 m from the streams.
Other Comments: different dynamics for corridors through agriculture and urban areas. Width is an ineffective approach to conserving species. Variables affecting how stream interacts with the landscape (e.g., elevation, above stream, slope) may be better predictors of minimum corridor requirements

Citation: Wilson, M. and J. Imhof. 1998. An Examination of the Functions of Riparian Zones Literature Review: Overview of the State of the Science. Prepared for Riparian Zone Workshop. Cambridge ON. http://www.trentu.ca/wsc/PDFfiles/finallit.pdf
Threshold: summarized only for water quality improvements: picking out the 14 studies with forests that decreased the measured nutrient >50%, width ranges from 4 to 60 m
Applicable Ecological Function Cited: Hydrology, Geomorphology, Water Quality and Nutrient Flux, Ecological Characteristics
Underlying Principles Cited
Validity for Significance Cited: reviewed about 200 papers
Location/Geographical Applicability: around world although interpreted within Ontario context
Scale
Other Comments: concludes re need for more work on landscape setting's variation and effects on riparian function

B) Headwaters
Citation Gartner-Lee Ltd. 2002. Final Report: *Rationale and Methodology For Determining Significant Woodlands in the Regional Municipality of Halton*. Prepared for the Regional Municipality of Halton.
Threshold: in catchment of first order streams
Applicable Ecological Function Cited: protect groundwater
Underlying Principles Cited
Validity for Significance Cited: "theory and practice coincide". Cite an event comparing hydrograph response of a forested wetland watershed and an agricultural one.
Location/Geographical Applicability: Halton
Scale
Other Comments: argue against use of underlying groundwater sensitivity for woodland significance

Slope

Citation: Gartner-Lee Ltd. 2002. Final Report: *Rationale and Methodology For Determining Significant Woodlands in the Regional Municipality of Halton*. Prepared for the Regional Municipality of Halton.
Threshold: ≥10% slope
Applicable Ecological Function Cited: woodlands stabilize landscape
Underlying Principles Cited: foliage intercepts rainfall, roots stabilize soil and increase surface roughness to intercept runoff
Validity for Significance Cited: universally cited as a factor
Location/Geographical Applicability: Halton Region
Scale
Other Comments: discards soil criteria as too complex

Citation: Presant, E and C. Acton. 1984. The Soils of the Regional Municipality of Haldimand-Norfolk. Report No. 57 of the Ontario Institute of Pedology Research Branch, Agriculture Canada. Land Resource Research Institute Contribution No. 84-13. as revised in Brokx, M, F. Burrows and E. Presant. 1989. Revised Site Determination of Soil Capability for General Field Crops in the Regional Municipalities of Haldimand-Norfolk and Niagara. Ontario Institute of Pedology Report No. 89-2.
Threshold: for severe limitations for common field crops (Agriculture Capability Class 4) because of topography including the hazards of water pollution, >9% for most conditions.
Applicable Ecological Function Cited: erosion risk of cropland soils
Underlying Principles Cited
Validity for Significance Cited: extensive studies in Ontario by G. Wall, J. Greuel and I. Shelton (built on principles of the Universal Soil Loss Equation developed by Wischmeier, W and D. Smith 1978. Predicting Rainfall Erosion Losses – A Guide to Conservation Planning. USDA Handbook No. 537) relating erosion to soils and slopes (for precise potential erosion losses see Table 26)
Location/Geographical Applicability: Haldimand-Norfolk and Niagara but can extend to southern Ontario
Scale: field
Other Comments

Citation: Rowsell, M. 2003. Woodland Valuation System: Methods and Rationale for Assigning Woodland Value at the Patch Scale for Consideration in Planning and Conservation In Eastern Ontario. Version 2.0 Eastern Ontario Model Forest. 80 p.
Threshold: 3 points woodlands that have at least part ≥ 30%, 2 points 15-30%, 1 point ≤ 15%
Applicable Ecological Function Cited: erosion control
Underlying Principles Cited:
Validity for Significance Cited: cites other Ontario valuation systems
Location/Geographical Applicability: Eastern Ontario
Scale: regional – several counties
Other Comments

Connectivity

Citation: Anderson, G and B. Danielson. 1997. The effects of landscape composition and physiognomy on meta-population size: the role of corridors. Landscape Ecology Vol. 12 pp. 261-271
Threshold: NA
Applicable Ecological Function Cited: movement in corridors
Underlying Principles Cited: corridor quality and arrangement will influence meta-populations.
Feel arrangements with a greater ration of peripheral to interior patches will support smaller meta-populations and numbers of corridors has no influence unless alters that ratio.
Validity for Significance Cited: models
Location/Geographical Applicability: NA
Scale
Other Comments

Citation: Burke, D.M. and E. Nol. 2000. Landscape and Fragment Size Effects on Reproductive Success of Forest-Breeding Birds in Ontario. *Ecological Applications* Vol. 10 No. 6, pp. 1749-1761.
Threshold: none found; fragmentation not that severe yet. Juvenile songbirds can travel hundreds of kilometres from source areas.
Applicable Ecological Function Cited: immigration
Underlying Principles Cited: isolation will prevent immigration of colonist birds from adjacent sources. Proximity will allow immigration to sustain populations that would otherwise decline
Validity for Significance Cited
Location/Geographical Applicability: south-central Ontario
Scale
Other Comments

Citation Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of the Environment. 1998. *A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*. Canada-Ontario Remedial Action Plan Steering Committee. 76 p. http://www.on.ec.gc.ca/wildlife/docs/frame-toc-e.html
Threshold: forest patches within 2 km. Corridors for species movement >100 m width and those for specialist species >500 m width.
Applicable Ecological Function Cited: wildlife movement
Underlying Principles Cited: width varies with species needs and whether just for movement or also breeding. Vegetation should be similar to the connected nodes.
Validity for Significance Cited: no references for corridor width but worded as if looked at several studies. Austen and Bradstreet 1996 cited for 2 km distance
Location/Geographical Applicability: Ontario. 100 m minimum more appropriate for species movement in southern Ontario
Scale:
Other Comments:

Citation Gartner-Lee Ltd. 2002. Final Report: *Rationale and Methodology For Determining Significant Woodlands in the Regional Municipality of Halton*. Prepared for the Regional Municipality of Halton.
Threshold: linkage of: a) woodlands within 50 m of a major creek or river, cold water creek; or b) within 150 m of the Niagara Escarpment with c) Core Natural Areas - >25 ha with >4 ha >100 m from edge, to draw major and supporting pathways of connectivity
Applicable Ecological Function Cited: potential for connectivity of patches or linear corridor minimum 100-300 m wide
Underlying Principles Cited
Validity for Significance Cited: cites Environment Canada (1998) and Riley and Mohr (1994)
Location/Geographical Applicability: Halton
Scale: regional
Other Comments: landscape connectivity assessment is "an evolving science"

Citation: Groom, M. 1998. Allee Effects Limit Population Viability of an Annual Plant. *The American Naturalist*. Vol. 151. No. 6. pp. 487-496
Threshold: $\leq$ 100 m for small patches but large patches don't need connectivity
Applicable Ecological Function Cited: reproduction and extinction rate of an annual plant, *Clarkia concinna*
Underlying Principles Cited: if too isolated: insufficient pollen transfer, lack of pollinators attracted to patch as a whole, inbreeding
Validity for Significance Cited: experiments included pollen limitation, pollen receipt, seed-set, inbreeding depression, sex-ratio and patch extinctions.
Location/Geographical Applicability: inner coastal range of California
Scale: all patches (211) along public roads in a county
Other Comments: first report of data from natural populations that display occurrence of threshold of isolation for extinction.
- distance thresholds depend on species

Citation: Haddad, N., D. Rosenberg and B. Noon. 2000. On experimentation and the study of corridors: Response to Beier and Noss. *Conservation Biology* Vol. 14 No. 5 pp. 1543-1545
Threshold NA. Feel corridors important for some species but that in some landscapes trade-offs exist with other landscape management techniques.
Applicable Ecological Function Cited: wildlife use of corridors
Underlying Principles Cited: Argue corridor functioning and value similar for small animals as for large, endangered. Also that while agree with Beier and Noss that corridor scale must match animal needs, feel smaller scale experiments valid for defining processes
Validity for Significance Cited: experimentation important, not just observation (favoured by Beier and Noss)
Location/Geographical Applicability: NA
Scale: NA

Other Comments: Corridors may increase movement and population of habitat-restricted species. Movement rates in corridors may increase with decrease of matrix habitat quality. Animals may settle in high quality corridors and reduce movement rates and move more in low quality corridors. Corridor response may depend if its creation preceded fragmentation or not.

Citation: Harrison, S. and L. Fahrig. 1995.Landscape pattern and population conservation. In Hansson, L., L. Fahrig and G. Merriam (eds.) 1995. *Mosaic Landscapes and Ecological Processes*. Chapman and Hall, London. Pp. 293-308.
Threshold: none cited.
Applicable Ecological Function Cited: fragmentation alters population survival
Underlying Principles Cited
as amount of habitat decreases, the probability of regional population survival decreases for the same amount of habitat, increased habitat clumping (increased patch size) increases the probability of population survival, and this positive effect of increasing patch size outweighs the negative effect of increasing inter-patch distance.
Increasing inter-patch variance in patch size increases the probability of regional survival
To maximize species diversity, must also retain range of ecotypes and natural disturbance processes
Validity for Significance Cited: Size, fragmentation, connectivity all inter-connected so difficult to test separately
Location/Geographical Applicability: broad global review
Scale
Other Comments

Citation: Lindenmayer, D., R. Cunningham, C. Donnelly, and R. Lesslie. 2002. On the use of landscape surrogates as ecological indicators in fragmented forests. *Forest Ecology and Management* Vol. 159. pp. 203-216.
Threshold: NA
Applicable Ecological Function Cited: animal numbers (probability of detection) relative to various landscape features
Underlying Principles Cited
Validity for Significance Cited: not very valid. Either no relationship of animals to landscape surrogate features or conflicting ones depending on the animal. Also the landscape surrogates themselves were strongly related and not independent.
Location/Geographical Applicability: Australian examples. Broader applicability
Scale: need to apply the surrogates at the scale appropriate to the animals in question
Other Comments: cites 2 studies in Australia. One with some indicators of exposure to human disturbance showed no relationships with target species numbers. The one with landscape surrogates similar to FON's showed different species numbers related to those parameters but in different directions dependent on species. There is a need for development of a framework (by ecologists and statisticians) to evaluate landscape indicators

Citation: Rowsell, M. 2003. Woodland Valuation System: Methods and Rationale for Assigning Woodland Value at the Patch Scale for Consideration in Planning and Conservation In Eastern Ontario. Version 2.0 Eastern Ontario Model Forest. 80 p.
Threshold: 3 points ≤ 100 m to closest edge, 2 points 100 – 250 m to closest edge, 1 point ≥ 250 m to closest edge.
Applicable Ecological Function Cited: wildlife mobility and survival
Underlying Principles Cited:
Validity for Significance Cited: cites other Ontario valuation systems
Location/Geographical Applicability: Eastern Ontario
Scale: regional – several counties
Other Comments

Citation: Simberloff, D., J. Farr, J. Cox and G. Mehlman. 1992. Movement Corridors: Conservation Bargains or Poor Investments. *Conservation Biology* Vol. 6 No. 4 pp. 483-504.
Threshold: NA
Applicable Ecological Function Cited: questions corridors as necessarily positive
Underlying Principles Cited: some say corridors lower extinction rate, lessen demographic stochasticity, stem inbreeding depression and provide movement needs. They say that isolated patches can avoid these problems if protected from human impact and that corridors can sometimes cause problems.
Validity for Significance Cited: weakness of data supporting corridors
Location/Geographical Applicability
Scale
Other Comments: this is an essay – not results of an experiment. They are concerned the lack of definitive science could lead to high expenditures on corridors that could be more effectively spent for conservation in other ways, e.g., treatment of the whole landscape as a matrix.

Citation: Smith, D. 1998. Habitat fragmentation and The Reproductive Success of *Trillium grandiflorum (liliaceae*) in southern Ontario. M.Sc. thesis Trent University. 134 p. Document available from Pro-Quest 1-800-521-3042: ABB?ISBN0612302326 (this entry from abstract)
Threshold: none found. Knowledge of a plant's reproductive biology is needed to predict effect of habitat fragmentation
Applicable Ecological Function Cited: reproductive success (seed set) of trillium
Underlying Principles Cited:
Validity for Significance Cited
Location/Geographical Applicability: Peterborough region, southern Ontario
Scale
Other Comments: variation in seed set not related to habitat type or any measured environmental factor, possibly because of the generalized pollination system of *T. grandiflorum*

Citation: Tischendorf, L. and L. Fahrig. 2000. On the usage and measurement of landscape connectivity *Oikos* Vol. 90 pp. 7-19

Threshold: NA
Applicable Ecological Function Cited: connectivity is the degree to which the landscape facilitates or impedes movement among resource patches
Underlying Principles Cited: use of corridors not just function of the species' habits but also of the surrounding landscape structure so need to consider both
Validity for Significance Cited: species abundance and distribution or landscape features are not measures of connectivity – only movement is. So many studies not fully valid.
Location/Geographical Applicability: general applicability – review of literature
Scale: combined patch and landscape recommended
Other Comments: Cannot equate connectivity with corridor presence alone. The landscape matrix affects movement too. Few studies consider this.
Recommends combination of empirical studies and models at both patch and landscape scales. Need to examine relationship of connectivity and landscape structure.

Citation: Villard, M-A. 1991. Spatio-temporal dynamics of forest bird patch populations in agricultural landscapes. Ph.D. thesis Carleton University. Available from Pro-Quest 1-800-3042:ABB/ISBN0315708999 (this entry from abstract)
Threshold. None cited. Larger less isolated patches are more likely to have continuous occupancy by Ovenbird and Scarlet Tanager. Connectivity among patch populations critical for recolonization of local extinctions. But habitat structure and tree species composition are the best predictors for Wood Thrush and Black-and-White Warbler.
Applicable Ecological Function Cited: occupancy by Wood Thrush, Black-and-White Warbler, Ovenbird and Scarlet Tanager over 2 breeding seasons (these species are intermediate between those exclusive to extensive forest and ubiquitous species).
Underlying Principles Cited: bird mobility helps their selection of most suitable habitat in breeding range
Validity for Significance Cited
Location/Geographical Applicability: 171 eastern Ontario forest patches (1.2 ha to >3000 ha)
Scale
Other Comments: patch populations went extinct and recolonized while the proportion of occupied patches in the landscape remained constant. Patch shape had minor influence.

Citation: Villard, M-A., M.K. Trzcinski and G: Villard, M-A., M.K. Trzcinski and G. Merriam. 1999. Fragmentation effects on forest birds: relative influence of woodland cover and configuration on landscape occupancy. *Conservation Biology* Vol. 13, No. 4 pp. 774-783.
Threshold: no sharp thresholds. Forest cover and configuration (# fragments, median fragment area, total edge, mean nearest-neighbour distance) were equally good predictors of forest species presence.
Applicable Ecological Function Cited: forest birds depend on both forest extent and configuration
Underlying Principles Cited: effects of forest configuration depend on the species considered. Factors like natal dispersers, nest predation susceptibility, brood parasite susceptibility, large area needs in a fragmented landscape can affect degree of effect of configuration

Validity for Significance Cited. Studied 33 forest landscapes (2.5 km x 2.5 km) with cover from 3.4% to 66.8%. Looked at 15 forest bird species' presence. Forest cover and configuration each significantly predicted the presences of 6 of the 15 species, even with conservative approach for configuration effects.
Location/Geographical Applicability: agricultural landscapes near Ottawa
Scale: 121 forest fragments in three 10 km x 10 km squares, each divided into 2.5 km x 2.5 km "landscapes"
Other Comments: while configuration is important, agree there is a need for more attention to habitat loss – that emphasis on configuration could just be a short term solution and an easier sell than a focus on minimum thresholds of area. They feel the two aspects should be considered simultaneously, recognizing the specificity of species' responses.

Citation: Wigley, T. and T. Roberts. 1997. Landscape level effects of forest management on faunal diversity in bottomland hardwoods. *Forest Ecology and Management*. Vol. 90 pp. 141-154
Threshold: none
Applicable Ecological Function Cited: effects of many landscape variables on fauna
Underlying Principles Cited
Validity for Significance Cited: reviews literature
Location/Geographical Applicability: variety
Scale
Other Comments: concerned that many of conclusions on landscape level on patch size, edge, and especially corridors and connectivity are based on very little research although what does exist is in agricultural landscapes.

Citation: Young, A. 1995. Landscape structure and genetic variation in plants: empirical evidence. In Hansson, L., L. Fahrig and G. Merriam (eds.). 1995. *Mosaic Landscapes and Ecological Processes*. Chapman and Hall, London. Pp. 153-177.
Threshold: none cited
Applicable Ecological Function Cited: fragmentation affects plant genetic variation
Underlying Principles Cited
Validity for Significance Cited: some evidence of linkages between landscape structure (type, size, connectivity) and plant genetic variation but the relative magnitudes are poorly understood.
Location/Geographical Applicability: broad review but includes studies of Sugar Maple in Ontario by Young, Merriam and Warwick. 1993. *Can. J. For. Res*.., 23, 2568-2578.
Scale
Other Comments

Roads
Citation: Adams, L. and A. Geis. 1983. Effects of Roads on Small Mammals J. of Applied Ecology. Vol. 20. No. 2 pp. 403-415.
Threshold: none

Applicable Ecological Function Cited: effects of roads on diversity, distribution and density of small mammals
Underlying Principles Cited
Validity for Significance Cited
Location/Geographical Applicability: locations in several states throughout USA
Scale: transects 400 m from road
Other Comments: not all through forest and often data of ROW is compared only to adjacent habitat without saying what that habitat was. There were more species and numbers in ROW than adjacent habitat for large roads, less for small. Mortality on interstates was highest for highest density species and did not affect viability

Citation: Burke, D.M. and E. Nol. 2000. Landscape and Fragment Size Effects on Reproductive Success of Forest-Breeding Birds in Ontario. *Ecological Applications* Vol. 10 No. 6, pp. 1749-1761.
Threshold:
- 100 m edge zone of nest vulnerability for Veery and Rose-Breasted Grosbeak, esp. pronounced in first 50 m.; also 100 m zone for increased parasitism
Applicable Ecological Function Cited: rates of nest predation
Underlying Principles Cited:
Validity for Significance Cited: checked nests every few days and used Mayfield estimate. Edge included hard edges and internal edges (smaller gravel roads, powerline corridors or gaps >3 x height of canopy)
Location/Geographical Applicability: south-central Ontario
Scale: 40 fragments of 12 –2350 ha size plus 2 continuous forest sites
Other Comments
Citation: Forman, R. 2000. Estimate of the Area Affected Ecologically by the Road System in the United States. *Conservation Biology* Vol. 14 No. 1 pp. 31-35
Threshold: >100 m for wetland drainage, stream channelization, road salt into water bodies, planted roadside exotics, moose, deer, forest birds, vernal pool amphibians. Uses 305 m for 10,000 vehicles/day through woodland; 810 m for 50,000 vehicles/day in natural ecosystems in urban areas
Applicable Ecological Function Cited: flows of materials, blockage of corridors, noise effects, fragmentation of populations
Underlying Principles Cited: distance of effects depends on topography, traffic volume
Validity for Significance Cited: depends on several variables
Location/Geographical Applicability: USA with a major cited study in Massachusetts but others from Europe
Scale: uses local studies to make a country-wide estimate of effect. Rough estimate for highly variable zone.
Other Comments: policy options include animal crossing structures, closing of remote roads, techniques to decrease noise, concentrate traffic on primary to keep light usage roads light, reduce noise through road and vehicle design

Citation: Ontario Ministry of Natural Resources. 1999. Natural Heritage Reference Manual for Policy 2.3 of the Provincial Policy Statement. 127 p.

Threshold: area continuous even if intersected by standard roads (e.g., 21 m wide)
Applicable Ecological Function Cited. Wildlife use, quoting A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern.
Underlying Principles Cited
Validity for Significance Cited. no new research for this manual.
Location/Geographical Applicability: Ontario
Scale
Other Comments
Citation: World Wildlife Fund. Importance of Roadless Areas in Biodiversity Conservation: A Scientific Perspective: Executive Summary. 5 p.
Threshold: >5000 acres ideally but >1000 acres (400 ha) where many roads. Large carnivores disappear at about 0.5 miles of road per sq mile.
Applicable Ecological Function Cited: roads reduce biodiversity
Underlying Principles Cited: roads can stop dispersal of some sensitive species and encourage dispersal of invasives, alter hydrology, degrade fish habitat, cause erosion, encourage over-hunting, wildlife collisions, alter fire patterns, increase soil water and air pollution, edge effects.
Validity for Significance Cited: reviewed science (none specifically cited in Exec. Summ.)
Location/Geographical Applicability: USA
Scale
Other Comments

Citation : Zipperer, W., S. Sisinni, and R. Pouyat. 1997. Urban tree cover: an ecological perspective. Urban Ecosystems. Vol. 1 pp. 229-246.
Threshold: 30 m
Applicable Ecological Function Cited: lateral extent of deposition of pollutants in patches with understory (road-side environment)
Underlying Principles Cited
Validity for Significance Cited: cites study by Pouyat et al, 1995
Location/Geographical Applicability: New York state city
Scale
Other Comments

General

Citation: Merriam, G. 1994. Managing the Land: A Medium –Term Strategy for Integrating Landscape Ecology into Environmental Research and Management. Forest landscape Ecology Program Forest Fragmentation and Biodiversity Project. Report No. 13. Ontario Ministry of Natural Resources. Sault Ste. Marie. 53 p.
Threshold: NA
Applicable Ecological Function Cited
Underlying Principles Cited
Validity for Significance Cited
Location/Geographical Applicability

Scale
Other Comments: Discussion can be interpreted to suggest thresholds be based on relatively homogenous landscape units (e.g., site regions and districts, physiography, urban/rural). Thresholds should be based at least partially on the history of the landscape and so should be open to adjustment as this information is gathered. Thresholds should aim high (use Precautionary Principle). Successful site management will need larger-scale landscape management.

Citation: Noss, R. N. Slosser, J. Strittholt and C. Carroll. 2000? Some Thoughts on Ecological Integrity for Terrestrial Ecosystems and Entire Landscapes.
Threshold: cites Steedman, 1988,'s threshold of stream degradation in Ontario ranging from at 75% removal of riparian in rural areas to 0% removal in areas 55% urban. Also EPA studies in Georgia that show IBI scores are similar for similar % woodland in basin whether in riparian 50 m or elsewhere.
Applicable Ecological Function Cited
Underlying Principles Cited: correlates of ecological integrity are: biodiversity, stability or resilience, sustainability, naturalness, wildness, beauty
Validity for Significance Cited
Location/Geographical Applicability
Scale
Other Comments: one composite index is not appropriate. Uses Karr and Dudley's definition of ecological integrity including composition and organization comparable to natural ecosystems and the ability to recover from most natural perturbations and some of man's.
Roth et al (1994) found stream integrity more dependent on overall landscape than on that adjacent.
Cites studies showing bird community shifts along gradient of disturbance but bird diversity peaking at mid-range of disturbance. High integrity have more forest interior, upper canopy foragers, ground gleaners, bark-probers, canopy-nested and single-brooded; but fewer omnivores, nest predators, brood parasites, residents and exotics.
Discusses criteria for metrics of a terrestrial index of biotic integrity.
Landscape metrics have a danger that different species are affected differently.
Need to pick focal species: e.g., representatives of area-limited; dispersal-limited, resources-limited, process-limited, keystone, narrow endemics, special cases. Suggests meeting of experts to pick best representatives of each.
Cites main landscape components as amount, mean patch size, patch size variation, mean inter-patch distance, variance in inter-patch distances and landscape connectivity.
Andren hypothesized that habitat loss most important at high levels of remaining habitat; patch size and isolation becoming important only at low levels. But Trzcinski et al (1999) found total forest cover more important that patch size and number for breeding birds in southern Ontario.
Indices of fragmentation might be useful beyond some threshold of forest loss but species –specific
Landscape indicators can explain more than macro- or micro-habitat parameters. Especially whether agricultural or natural matrix.
Theoretically derived thresholds not useful when such variation in species

If combine metrics, make sure they do not combine stressor and response in one because linked.
Ten metrics used in one study: largest late-successional patches, concentration of late-successional patches, road density, location of imperilled species, forest neighbourhood age, forest fragmentation, potential connectivity to existing protected areas, road-stream intersections, forested riparian zones, management and restoration potential - rating each 1 to 5 relatively.
Recommends any system consider goals and values, ecoregional characteristics, community type, disturbance history, impacts of exotics, spatial and temporal scale, combination of metrics.

Abstracts for Some Additional Literature on Woodland Significance Criteria

TI: Title
A Survey and Overview of Habitat Fragmentation Experiments
AU: Author
Debinski, MD; Holt, DR
AF: Affiliation
Department of Animal Ecology, 124 Science II, Iowa State University, Ames, IA 50011, U.S.A., [mailto:debinski@iastate.edu]
SO: Source
Conservation Biology [Conserv. Biol.]. no. 2, pp. 342-355. Apr 2000.
IS: ISSN
0888-8892
PB: Publisher
Blackwell Science Ltd
AB: Abstract
Habitat destruction and fragmentation are the root causes of many conservation problems. We conducted a literature survey and canvassed the ecological community to identify experimental studies of terrestrial habitat fragmentation and to determine whether consistent themes were emerging from these studies. Our survey revealed 20 fragmentation experiments worldwide. Most studies focused on effects of fragmentation on species richness or on the abundance(s) of particular species. Other important themes were the effect of fragmentation in interspecific interactions, the role of corridors and landscape connectivity in individual movements and species richness, and the influences of edge effects on ecosystem services. Our comparisons showed a remarkable lack of consistency in results across studies, especially with regard to species richness and abundance relative to fragment size. Experiments with arthropods showed the best fit with theoretical expectations of greater species richness on larger fragments. Highly mobile taxa such as birds and mammals, early-successional plant species, long-lived species, and generalist predators did not respond in the "expected" manner. Reasons for these discrepancies included edge effects, competitive release in the habitat fragments, and the spatial scale of the experiments. One of the more consistently supported hypotheses was that movement and species richness are positively affected by corridors and connectivity, respectively. Transient effects dominated many systems; for example, crowding of individuals on fragments commonly was observed after fragmentation, followed by a relaxation toward lower abundance in subsequent years. The three long-term studies (greater than or equal to 14 years) revealed strong patterns that would have been missed in short-term investigations. Our results emphasize the wide range of species-

specific responses to fragmentation, the need for elucidation of behavioral mechanisms affecting these responses, and the potential for changing responses to fragmentation over time.

TI: Title
Species diversity and the scale of the landscape mosaic: do scales of movement and patch size affect diversity?
AU: Author
Debinski, DM; Ray, C; Saveraid, EH
AF: Affiliation
Iowa State University, Department of Animal Ecology, 124 Science II, Ames, IA 50011, USA, [mailto:debinski@iastate.edu]
SO: Source
Biological Conservation [Biol. Conserv.]. Vol. 98, no. 2, pp. 179-190. Apr 2001.
IS: ISSN
0006-3207
AB: Abstract
We use a combination of a model and empirical data to examine the relationship between the scale of the landscape mosaic and individual movement patterns on the measurement of local butterfly species diversity. In landscapes where patch sizes are smaller, the type of patch adjacent to the patch surveyed can influence both local species richness and incidence. In landscapes composed of larger patches, adjacency has no effect on species richness or incidence. We hypothesize that the mechanism for species enrichment is the potential for movement of individuals between habitats, resulting in either (a) spillover of species from the higher-diversity patches into other habitats, or (b) habitat sampling by species that benefit from the resources in adjacent patches. In order to determine whether landscape configuration alone can account for the observed patterns of diversity, we employ a simulation model. Simulation results suggest that both specialist and generalist butterflies can sample a much more diverse array of habitat types in a more fine-grained landscape.

TI: Title
A meta-analysis of forest cover, edge effects, and artificial nest predation rates
AU: Author
Hartley, MJ; Hunter, ML Jr
AF: Affiliation
Dep. Wildl. Ecol., 5755 Nutting Hall, Univ. Maine, Orono, ME 04469, USA
SO: Source
Conservation Biology [CONSERV. BIOL.]. Vol. 12, no. 2, pp. 465-469. Apr 1998.
IS: ISSN
0888-8892
AB: Abstract
Landscape fragmentation has been among the most intensely studied topics in conservation biology for decades. The influence of habitat edge has often been investigated as an important feature in fragmented areas, especially with respect to bird nesting success, as evidenced by three recent reviews. Paton (1994) concluded that "current evidence, although equivocal, suggests that predation and parasitism rates are often significantly greater within 50 m of an edge." Andren (1995) examined edge (or patch size) effects in a review of 40 papers and concluded that "edge-related increase in predation seems to be most commonly found inside forests surrounded by farmland and was rarely found in forest mosaics." Major and Kendal (1996) showed that a

preponderance of studies "demonstrated a positive correlation between predation rate and the degree of habitat fragmentation," but found "more variable results" regarding edge effects. We believe that none of these papers adequately addressed the issue of whether or not predation rates and edge effects differ between deforested versus forested landscapes. Thus, we decided to evaluate relationships between degree of forest cover in a landscape and (1) avian nest success rates and (2) the existence of elevated predation rates near habitat edges. We combined data from 13 previous studies in 33 U.S. landscapes to explore pattern of nest predation and landscape composition.

TI: Title
Effects of Forest Fragmentation on Breeding Tanagers: A Continental Perspective
AU: Author
Rosenberg, KV; Lowe, JD; Dhondt, AA
AF: Affiliation
Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, NY 14850, USA, [mailto:kvr2@cornell.edu]
SO: Source
Conservation Biology [Conserv. Biol.]. no. 3, pp. 568-583. Jun 1999.
IS: ISSN
0888-8892
AB: Abstract
We studied the effects of habitat fragmentation on four species of North American tanagers (Piranga spp.) at 1107 study sites in 1995. Volunteer researchers used the standardized protocol of Project Tanager to select sites, census for breeding tanagers, and measure habitat and landscape features on a continental scale. In a principal components analysis, we used measures of forest patch size, distance to nearest other forest patches (isolation), percent forest cover and length of linear edge in a 1000-ha landscape, and elevation. Our results showed that three independent habitat gradients affected tanager occurrence: (1) overall amount of fragmentation; (2) forest configuration (the amount of edge in a landscape); and (3) elevation. Multiple logistic regression indicated significant variation among the tanager species in how habitat gradients affected tanager occurrence, presence of parasitic Brown-headed Cowbirds (Molothrus ater), and various nest predators. Scarlet, Western, and Summer Tanagers (P. olivacea, P. ludoviciana, and P. rubra, respectively) responded similarly to the fragmentation gradient, with the probability of finding breeding tanagers dropping below 0.50 in highly fragmented sites. Response to the other habitat gradients was more variable, and effects on cowbirds and predators were usually opposite those of breeding tanagers (i.e., they were more common at highly fragmented sites). Response to habitat gradients also varied significantly among four regions within the range of Scarlet Tanagers. The strongest response to fragmentation, by breeding tanagers as well as by cowbirds and nest predators, was in the largely deforested Midwest and Atlantic Coast regions. In the heavily forested Northeast region, fragmentation had a significant but less severe effect on breeding tanagers. Effects were not significant in the Northern Forest region, where tanager abundance was low. Results of our continent-wide study suggest that (1) forest fragmentation can be described similarly across most regions of North America; (2) three widespread tanager species exhibit clear and similar negative responses to habitat fragmentation; (3) local sensitivity to fragmentation varies geographically and may be lower in regions with greater overall forest cover; and (4) results from single-species or local studies cannot be extrapolated to other species or regions. Conservation strategies to reverse the declines of forest bird populations will require knowledge of habitat requirements across the entire ranges of widespread species, as well as how demographic and landscape factors interact to create population sources and sinks.

TI: Title
Toward Ecologically Scaled Landscape Indices
AU: Author
Vos, CC; Verboom, J; Opdam, PFM; Ter Braak, CJF
AF: Affiliation
Alterra Green World Research, P.O. Box 23, NL 6700 AA Wageningen, The Netherlands, [mailto:c.c.vos@alterra.wag-ur.nl]
SO: Source
American Naturalist [Am. Nat.]. Vol. 157, no. 1, pp. 24-41. Jan 2001.
IS: ISSN
0003-0147
PB: Publisher
University of Chicago Press
AB: Abstract
Nature conservation is increasingly based on a landscape approach rather than a species approach. Landscape planning that includes nature conservation goals requires integrated ecological tools. However, species differ widely in their response to landscape change. We propose a framework of ecologically scaled landscape indices that takes into account this variation. Our approach is based on a combination of field studies of spatially structured populations (metapopulations) and model simulations in artificial landscapes. From these, we seek generalities in the relationship among species features, landscape indices, and metapopulation viability. The concept of ecological species profiles is used to group species according to characteristics that are important in metapopulations' response to landscape change: individual area requirements as the dominant characteristic of extinction risk in landscape patches and dispersal distance as the main determinant of the ability to colonize patches. The ecological profiles and landscape indices are then integrated into two ecologically scaled landscape indices (ESLI): average patch carrying capacity and average patch connectivity. The field data show that the fraction of occupied habitat patches is correlated with the two ESLI. To put the ESLI into a perspective of metapopulation persistence, we determine the viability for six ecological profiles at different degrees of habitat fragmentation using a metapopulation model and computer-generated landscapes. The model results show that the fraction of occupied patches is a good indicator for metapopulation viability. We discuss how ecological profiles, ESLI, and the viability threshold can be applied for landscape planning and design in nature conservation.

TI: Title
Extinction Thresholds for Species in Fractal Landscapes
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Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA, [mailto:kwith@bgnet.bgsu.edu]
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Conservation Biology [Conserv. Biol.]. Vol. 13, no. 2, pp. 314-326. Apr 1999.
IS: ISSN
0888-8892
AB: Abstract

Predicting species' responses to habitat loss and fragmentation is one of the greatest challenges facing conservation biologists, particularly if extinction is a threshold phenomenon. Extinction thresholds are abrupt declines in the patch occupancy of a metapopulation across a narrow range of habitat loss. Metapopulation-type models have been used to predict extinction thresholds for endangered populations. These models often make simplifying assumptions about the distribution of habitat (random) and the search for suitable habitat sites (random dispersal). We relaxed these two assumptions in a modeling approach that combines a metapopulation model with neutral landscape models of fractal habitat distributions. Dispersal success for suitable, unoccupied sites was higher on fractal landscapes for nearest-neighbour dispersers (moving through adjacent cells of the landscape) than for dispersers searching at random (random distance and direction between steps) on random landscapes. Consequently, species either did not suffer extinction thresholds or extinction thresholds occurred later, at lower levels of habitat abundance, than predicted previously. The exception is for species with limited demographic potential, owing to low reproductive output (R' sub(o) = 1.01), in which extinction thresholds occurred sooner than on random landscapes in all but the most clumped fractal landscapes (H = 1.0). Furthermore, the threshold was more precipitous for these species. Many species of conservation concern have limited demographic potential, and these species may be at greater risk from habitat loss and fragmentation than previously suspected.
Authors: Villard, Marc-Andre, Martin, Paul R and Drummond, Christopher G
Volume: 110
Issue: 4
UMI Publication No.: 01954011
Start Page: 759
Source Type: PERIODICAL
ISSN: 00048038
Subject Terms: Ornithology, Birds, Animal reproduction, Animal populations
UMI Journal Code: IAUK
Abstract:
A study of ovenbirds (Seiurus aurocapillus) in Canada was undertaken to determine whether pairing success increases with population density and decreases with fragmentation of the habitat. Both hypotheses were confirmed. Habitat fragmentation reduced pairing success by altering dispersal dynamics or habitat selection by females.

TI: Title
A framework for the design of wildlife conservation corridors with specific application to southwestern Ontario
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Fleury, AM; Brown, RD
AF: Affiliation
Sch. Landscape Architecture, Univ. Guelph, Guelph, Ontario, Canada N1G 2W1
SO: Source
Landscape and Urban Planning [LANDSCAPE URBAN PLANN.]. Vol. 37, no. 3-4, pp. 163-186. Jul 1997.
IS: ISSN
0169-2046
DO: DOI
10.1016/S0169-2046(97)00001-7
AB: Abstract

Natural disturbances and human development can cause habitat fragmentation. Plant and animal populations can become isolated, but wildlife corridors can potentially alleviate the problem by providing linkages between isolated patches of natural areas. These connecting corridors need to be designed to create habitat appropriate for target species. This study developed a framework for design of wildlife corridors which considered both critical corridor attributes and target species. It provided a methodology for use in designing corridors to ensure appropriate species composition. Objectives included identifying and analyzing attributes which constitute a corridor. An 'ecosystem approach' for selecting guilds of target species was used. The framework was applied to a fragmented landscape case study in southwestern Ontario, Canada. Results indicated that, by applying this framework to a fragmented landscape, ecologically appropriate corridors could be designed when corridor attributes and target species were carefully analyzed. In addition, it was shown that optimal corridor designs could be altered to fit a landscape's opportunities and constraints.

TI: Title
The behaviour of landscape metrics commonly used in the study of habitat fragmentation
AU: Author
Hargis, CD; Bissonette, JA; David, JL
AF: Affiliation
Rocky Mountain Forest and Range Experiment Station, Southwest Forest Science Complex, 2500 S. Pine Knoll, Flagstaff, AZ 86001-6381, USA
SO: Source
Landscape Ecology [Landscape Ecol.]. Vol. 13, no. 3, pp. 167-186. Jun 1998.
IS: ISSN
0921-2973
DO: DOI
10.1023/A:1007965018633
AB: Abstract
A meaningful interpretation of landscape metrics is possible only when the limitations of each measure are fully understood, the range of attainable values is known, and the user is aware of potential shifts in the range of values due to characteristics of landscape patches. To examine the behaviour of landscape metrics, we generated artificial landscapes that mimicked fragmentation processes while controlling the size and shape of patches in the landscape and the mode of disturbance growth. We developed nine series of increasingly fragmented landscapes and used these to investigate the behaviour of edge density, contagion, mean nearest neighbour distance, mean proximity index, perimeter-area fractal dimension, and mass fractal dimension. We found that most of the measures were highly correlated, especially contagion and edge density, which had a near-perfect inverse correspondence. Many of the measures were linearly-associated with increasing disturbance until the proportion of disturbance on the landscape was approximately 0.40, with non-linear associations at higher proportions. None of the measures was able to differentiate between landscape patterns characterized by dispersed versus aggregated patches. The highest attainable value of each measure was altered by either patch size or shape, and in some cases, by both attributes. We summarize our findings by discussing the utility of each metric.

TI: Title
Importance of Farmland Habitats for Conservation of Plant Species

AU: Author
Freemark, KE; Boutin, C; Keddy, CJ
AF: Affiliation
National Wildlife Research Centre , Environment Canada, 100 Gamelin Boulevard, Hull, Quebec, K1A 0H3 Canada
SO: Source
Conservation Biology [Conserv. Biol.]. Vol. 16, no. 2, pp. 399-412. Apr 2002.
IS: ISSN
0888-8892
PB: Publisher
Blackwell Science Ltd
DO: DOI
10.1046/j.1523-1739.2002.00387.x
AB: Abstract
Little attention has been paid, particularly in North America, to the importance of the mosaic of farmland habitats for the conservation of native plant species. We examined patterns in plant species richness, composition, and abundance at the scale of site, habitat (sites of a given habitat type pooled), and landscape for 10 farmland habitats (crop, hay field, pasture, old field, herbaceous fencerow, woody fencerow, roadside, ditch, plantation, woodlot) at 121 sites in eastern Ontario, Canada. At the site level, woodlots (3-79 ha) had the highest richness of overall (average 57.6 species), woody (23.4), and herbaceous species (25.0). Crop, herbaceous fencerow, and plantation habitats had few native species per site. Introduced species comprised >50% of herbs per site in seven habitats. Across habitats, 305 species were observed; 227 species were herbaceous, 70% of which were native and 31% of which were weeds. Wooded fencerows had the highest species richness in total (153) and for herbs (107). Woodlots had the most woody species (56). Percent native species was generally lower and percent weeds higher at the site level than at the habitat level. All habitats had unique species; woodlots had the highest number of unique species (74). Results of the multivariate analysis for abundant herbs revealed that woodlots and plantations were different, as were crop and ditch habitats. The results of our landscape-level study show that plant species richness and composition varied substantially among the five landscapes studied, ranging from a row-crop monoculture landscape to a diverse mosaic of crop and noncrop habitat landscape. The row-crop monoculture landscape had 11% of total, 4% of native, 27% of introduced, and 27% of the weed species found in the landscape with a greater diversity of crop and noncrop habitats. The richness of introduced and weed species was asymptotic with the addition of ditch, hayfield, and pasture in the landscape, and native species richness increased steeply, particularly with the addition of marsh, wooded fencerow, and woodlot. Our results emphasize the importance of maintaining a diverse mosaic of habitats and of noncrop habitats in farmland for conserving herbaceous and woody native plants.

TI: Title
Independent effects of forest cover and fragmentation on the distribution of forest breeding birds
AU: Author
Trzcinski, MK; Fahrig, L; Merriam, G
AF: Affiliation
Department of Biology, Dalhousie University, Halifax, Nova Scotia B3H 4J1, Canada
SO: Source
Ecological Applications [Ecol. Appl.]. Vol. 9, no. 2, pp. 586-593. May 1999.
IS: ISSN

1051-0761
AB: Abstract
The aims of this study were (1) to determine the relative importance of the independent effects of forest cover and fragmentation on the distribution of forest breeding birds, and (2) to test the hypothesis that the negative effect of forest fragmentation on species distribution increases with decreasing forest cover, i.e., the negative interaction effect of forest cover and fragmentation on distribution. The independent effects of forest cover and forest fragmentation on the distribution of forest breeding birds were studied in 94 landscapes, 10 x 10 km each, ranging in forest cover from 2.5% to 55.8%. For each landscape, percent forest cover was measured, and a fragmentation index (independent of forest cover) was generated using PCA from the measures of mean forest patch size, number of forest patches, and total forest edge. Presence of 31 forest breeding bird species in each landscape was determined using Breeding Bird Atlas data. The effects of forest cover and forest fragmentation on species presence were analyzed using multiple logistic regression. All responses of individual species to forest cover were positive. Responses to forest fragmentation were weak and variable. There were only two species for which the interaction between cover and fragmentation was significant (one positive, one negative). We found no evidence for the hypothesized negative interaction effect between forest cover and forest fragmentation on species distribution. We conclude that (1) forest cover at the 10 x 10 km (Universal Transverse Mercator [UTM]) scale has a positive effect on the distribution of forest breeding birds, (2) forest fragmentation does not have a consistent negative effect on the distribution of forest breeding birds, (3) the effect of forest cover is greater than that of forest fragmentation, (4) responses to forest fragmentation are generally weak and highly variable among species, and (5) the effect of forest fragmentation on species distribution does not increase with decreasing forest cover. These results suggest that conservationists' primary focus should be on preventing a decrease in forest cover. They should not be misled by recent discussions of "fragmentation effects" to think that the negative effects of forest loss can somehow be countered by careful consideration of the spatial pattern of remaining forest. Our results indicate that they cannot.

TI: Title
Importance of spatial scale to habitat use by breeding birds in riparian forests: A hierarchical analysis
AU: Author
Saab, V
AF: Affiliation
USDA Forest Service, Rocky Mountain Research Station, 316 E. Myrtle Street, Boise, ID 83702, USA
SO: Source
Ecological Applications [Ecol. Appl.]. Vol. 9, no. 1, pp. 135-151. Feb 1999.
IS: ISSN
1051-0761
AB: Abstract
Patterns of habitat use by breeding birds were studied in cottonwood riparian forests along 100 km of the South Fork of the Snake River in southeastern Idaho, United States, from 1991 to 1994. A hierarchical approach was used to examine habitat use at three spatial scales: microhabitat (local vegetation characteristics), macrohabitat (cottonwood forest patch characteristics), and landscape (composition and patterning of surrounding [matrix] vegetation types and land uses). This paper addresses a series of predictions about species' distributions that incorporate the different spatial scales. Bird distribution and abundance and vegetation data were collected on 57

cottonwood forest patches ranging in size from 0.40 ha to 205 ha. The surrounding landscape changed from a valley surrounded by mountains, on the upstream end of the study area, to a narrow canyon adjacent to natural upland vegetation in the middle section, and to a wide, open floodplain dominated by agriculture on the downstream end. The best predictors of high species richness (r super(2) = 0.71) were natural and heterogeneous landscapes, large cottonwood patches, close proximity to other cottonwood patches, and microhabitats with relatively open canopies. Distribution and frequency of occurrence were evaluated for 32 species of small land birds. The most frequent significant predictor of species occurrence was the landscape component: increases in upland natural vegetation with decreases in agriculture. Both interior and edge specialists were found in arid land, cottonwood riparian forests that are linear in nature, with large amounts of edge. Nest predators, brood parasites, and exotic species responded positively to human-altered landscapes. Landscape patterns were the primary influence on distribution and occurrence of most bird species, whereas macrohabitat and microhabitat were of secondary importance. Thus, surrounding landscape (matrix) features should be a primary consideration for selecting riparian reserve areas.

TI: Title
Modification and assessment of an index of biotic integrity to quantify stream quality in southern Ontario.
AU: Author
Steedman, RJ
AF: Author Affilition
Dep. Zool., Univ. Toronto, Ont. M5S 1A1, Canada
SO: Source
Canadian Journal of Fisheries and Aquatic Sciences [CAN. J. FISH. AQUAT. SCI.], vol. 45, no. 3, pp. 492-501, 1988
IS: ISSN
0706-652X
AB: Abstract
A multivariate measure of stream quality, the Index of Biotic Integrity(IBI), was adapted to southern Ontario and calibrated to watershed land use on a variety of spatial scales. The fish fauna at 209 stream locations on 10 watersheds near Toronto, Ontario, was sampled with a backpack electrofisher in the summers of 1984 and 1985 to provide biological information for the IBI. Watershed urbanization, forest cover, and riparian forest were measured from 1:50,000 scale topographic maps and related to IBI estimates by linear regression. Land use immediately upstream of sample stations was most strongly associated with stream quality as measured by the IBI.

TI: Title
Landscape ecology of birds breeding in temperate forest fragments.
AU: Author
Freemark, K; Collins, B
AF: Author Affilition
Environ. Canada, Canadian Wildl. Serv., Ottawa, Ont. K1A 0H3, Canada
CF: Conference
Symp. on Ecology and Conservation of Neotropical Migrant Landbirds, Manomet, MA (USA), 1992
ED: Editor

Hagan, JM III; Johnston, DW (eds)
SO: Source
ECOLOGY AND CONSERVATION OF NEOTROPICAL MIGRANT LANDBIRDS., 1992, pp. 443-454
IB: ISBN
0-56098-140-7
AB: Abstract
We compared bird species numbers in a range of forest sizes (1.8-65 ha) replicated among two study areas in Ontario, and one each in Missouri and Illinois, to examine the importance of differences in landscape context of their forests. Regression parameters for numbers of edge species against forest size were not significantly different among study areas. Regression slopes were not significantly different for numbers of interior-edge species against forest size, but the 3-ha regression estimate was significantly lower for the study area with the most forest cover. Few forest-interior species, many of which overwinter in the Neotropics, were found in small-sized forests (particularly those < 10 ha) in any study area. At least one-half of the regional pool of area-sensitive species was observed in 54-65-ha forests annually. The study area with the most forest cover had the highest number of area-sensitive species per forest, and the greatest increase in numbers of forest-interior species as forest size increased.

APPENDIX B: GLOSSARY OF TERMS

These terms refer to the *Suggested Conservation Guidelines for the Identification of Significant Woodlands in Southern Ontario.*

CATEGORY	TERMS	DEFINITIONS	SOURCE
POLICY			
	Planning Authority	Municipality or Conservation Authority	
	Negative Impacts	In regard to natural heritage features and areas (other than fish habitat), the loss of the natural features or ecological functions for which an area is identified	Natural Heritage Reference Manual (O.M.N.R., 1999)
	Development	The creation of a new lot, a change in land use, or the construction of buildings and structures, requiring approval under the Planning Act; but does not include activities that create or maintain infrastructure authorized under an environmental assessment process; or works subject to the Drainage Act	Natural Heritage Reference Manual (O.M.N.R., 1999)
	Site Alteration	Activities, such as fill, grading and excavation, that would change the landform and natural vegetative characteristics of a site	Natural Heritage Reference Manual (O.M.N.R., 1999)
Ecological Features	Tree	"A woody plant usually with a single main stem and capable, under the right conditions, of reaching heights of several metres or more" "A woody perennial plant that grows to a height of at least 4.5 metres"	ELC (Ecological Land Classification for southern Ontario, O.M.N.R., 1998) Trees in Canada (Farrar, 1995)
	Woodland (including "forest")	A treed community with at least 34% tree cover	ELC (Ecological Land Classification for southern Ontario, O.M.N.R., 1998)
	Forest Interior Habitat	Those portions of a habitat patch which are relatively stable and uninfluenced by the changing	Dictionary of Natural Resource Management (Dunster and Dunster

		climatic conditions and other variables (noise, wind, sunlight, temperature, moisture) associated with edge conditions. All woodland habitat at least 100 metres from the edge.	1996)
	Spring	The point where an aquifer intersects with the ground surface and discharges water	Dictionary of Natural Resource Management (Dunster and Dunster 1996)
	Seepage Areas	The point where an aquifer or area of minor groundwater flows out onto the land surface or into a stream channel. Seeps are too small to be a spring and do not produce runoff at a visible rate	Dictionary of Natural Resource Management (Dunster and Dunster 1996)
	Watershed	An area of land, which may or may not be under forest cover, draining water, organic matter, dissolved nutrients, and sediments into a lake or stream. The topographic boundary, usually a height of land, that marks the dividing line from which surface streams flow in two different directions.	Dictionary of Natural Resource Management (Dunster and Dunster 1996)
	Catchment area	The entire area from which drainage is received by a river or lake; most generally used in reference to surface runoff.	Water and Water Use Terminology (Veatch and Humphrys, 1966)
	First Order Stream	The smallest, unbranched, perennial tributaries, terminating at an outer point, are first-order streams in a system as described below. Stream Order: A system of stream classification based on a number from one to six or higher, ranked from headwaters to river terminus, that designates the relative position of a stream or stream segment in a drainage basin.	Water and Water Use Terminology (Veatch and Humphrys, 1966)
Landscape Features	Adjacent lands	Means those lands, contiguous to a specific natural heritage feature or area, where it is likely that development or site alteration would have a negative impact on	Natural Heritage Reference Manual (O.M.N.R., 1999)

		the feature or area. The extent of the adjacent lands may be recommended by the Province or based on municipal approaches which achieve the same objectives	
Ecological Concepts	Core Area	An area of land that has vital attributes necessary for the survival of one or more species, or ecosystem functions, and that is considered an essential component of a broader management plan.	Dictionary of Natural Resource Management (Dunster and Dunster 1996)
	Corridor [Linkage]	A physical linkage, connecting two areas of habitat and differing from the habitat on either side. A physical or biological link	Dictionary of Natural Resource Management (Dunster and Dunster 1996)
	Ecological Functions	Means the natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes. These may include biological, physical and socio-economic interactions	Natural Heritage Reference Manual (O.M.N.R., 1999)
	Forest Fragmentation	The change in the forest landscape from extensive and continuous forest cover to a mosaic of smaller patches separated by open areas or very young stands of forest. The process of reducing the size and degree of connectivity of the stands that make up the forest, leading to varying degrees of isolation of the remaining patches. Can also refer to the elimination of continuous forest cover by changes in adjacent land uses.	Dictionary of Natural Resources Management (Dunster and Dunster 1996)

APPENDIX C: GIS CASE STUDIES SUMMARY

Introduction

The Significant Woodlands Guidelines is being developed for use by a range of upper and lower tier municipalities and planning authorities with a range implementation capability. During the early stages of refinement of the criteria and thresholds, the process was tendered to four municipal jurisdictions for "testing". The aim was to determine if the guidelines could be applied by the GIS and planning staff, the results analyzed and interpreted, and to identify any technical barriers to their application and make recommendations for overcoming those barriers.

The information outlined below is a summary of the findings of four test user groups across the province. Portions of the data are as yet unreported, but this summary will be updated over time.

Criteria tested:

1. woodland patch size
2. hydrological connections or linkages
3. interior forest habitat
4. landscape connectivity
5. slope

Objectives:

- To assemble suitable data sources to be used in analyzing the five criteria as outlined
- To identify the number of forest polygons assessed within each case study area and which keyed out as significant based on the thresholds in each criterion
- To prepare mapping which identify forest polygons satisfying at least one criterion
- To identify technical barriers to the application of the guidelines criteria
- To make recommendations for overcoming any technical barriers

Case Study areas:

1. Municipalities of Vaughan and Georgina (Regional Municipality of York)
2. Regional Municipality of Waterloo
3. City of Ottawa, Lanark Highlands, Leeds and the Thousand Islands Township, Dundas County (in Eastern Ontario Model Forest)
4. Essex Region

Data Sources Used	
York Region	Forest Cover Mapping (The R. M. of York 2001a)
Region of Waterloo	1:250 000 NTS, 1:50 000 NTS, 1:10 000 OBM
EOMF	NRVIS / FRI, EOMF data, NESS
Essex Region	NTS data sheets 1:50 000

Percent Forest Cover Across Case Study Regions		
Site	Sub-sets	% cover
Essex Region		< 5%
Region of Waterloo		Approx. 15% forest cover
York Region	Vaughan	11%
	Georgina	37%
Eastern Ontario Model Forest (EOMF)	Dundas	23.93%
	Lanark	88.16%
	Leeds	55.50%
	Ottawa	27.93%

Percent of All Woodlands Identified as Significant Using All Criteria		
Site	Total # of Woodlands Assessed	Percent of total # Identified as Significant
Essex Region	823	100%
Region of Waterloo	10,227	N / A
York Region	Vaughan: 525	79.4%
	Georgina: 529	47.6%
Eastern Ontario Model Forest (EOMF)	Dundas: 1,932	91.8%
	Lanark: 863	92.5%
	Leeds: 777	83.7%
	Ottawa: 1,180	94.6%

Percent of All Woodlands Identified As Significant on the Basis of Size Only		
Site	# of Patches Assessed	# of Patches identified as significant based upon size criteria
York Region	Vaughan: 525	158
	Georgina: 529	NA (cover over 30%)
Region of Waterloo	10,227	At 4 ha - 3,315
	"	At 10ha - 208
	"	At 20 ha - 156
	"	At 40 ha - 73
EOMF	Dundas: 1,932 By Watershed	8.02%
	By Ecodistrict	12.22%
	By 25km2 Grid	29.97%
	Lanark: 863 By Watershed	N/A
	By Ecodistrict	0.5%
	By 25km2 Grid	5%
	Leeds: 777	

	By Watershed	10.7%
	By Ecodistrict	10.7%
	By 25km2 Grid	15.8%
	Ottawa: 1,180 By Watershed	13.2%
	By Ecodistrict	15.5%
	By 25km2 Grid	27.5%
Essex Region	1,675	842

Percent of All Woodlands Identified as Significant on the Basis of Hydrological Connections Only		
Site	# of Patches Assessed	# of Patches identified as significant based upon hydrological connections criteria
York Region	Vaughan 525	318
	Georgina 529	204
Region of Waterloo		N/a
EOMF (touching vs. inside)	Dundas	1072 / 1715
	Lanark	641 / 2260
	Leeds	574 / 2635
	Ottawa	643 / 1061
Essex Region	417	297

Percent of All Woodlands Analysed and Identified as Significant on the Basis of Interior Forest Habitat Only		
Site	# of Patches Assessed	# of Patches identified as significant based upon forest interior habitat > 4ha
York Region	Vaughan 525	at 100 m buffer: 16
		at 200 m buffer: 2
		at 300 m buffer: 0
	Georgina 529	at 100 m buffer: 51
		at 200 m buffer: 0
		at 300 m buffer: 0
Region of Waterloo	N/a	at 100 m buffer: N/a
EOMF	Dundas: 1,932	166
	Lanark: 863	187
	Leeds: 777	86
	Ottawa: 1,180	127
Essex Region	1675	Interior present: 48 Interior highly probable: 269 Interior Probable: 343

Percent of All Woodlands Analysed and Identified as Significant on the Basis of Landscape Connectivity Only		
Site	# of Patches Assessed	# of patches identified as significant based upon landscape connectivity
York Region (nearest neighbour analysis)	Vaughan 525	332 (at 50m between patches)
		403 (at 100 m between patches)
		492 (at 250 m between patches)
		513 (at 500 m between patches)
	Georgina 529	399 at 50 m
		442 at 100 m
		484 at 250 m
		510 at 500 m
Region of Waterloo		N/a
EOMF	Dundas: 1,932	1,291
	Lanark: 863	841
	Leeds: 777	629
	Ottawa: 1,180	964
Essex Region		N/A

Percent of All Woodlands Analysed and Identified as Significant on the Basis of Slope Only		
Site	# of Patches Assessed	# of patches identified as significant based upon slope (%)
York Region	Vaughan 525	290 at 10% slope
		224 at 15% slope
	Georgina 529	79 at 10% slope
		45 at 15% slope
Region of Waterloo		N/A
EOMF	Dundas: 1,932	Slope inside: 0
		Slope touching: 0
	Lanark: 863	Slope inside: 3,042
		Slope touching: 150
	Leeds: 777	Slope inside: 2,625
		Slope touching: 116
	Ottawa: 1,180	Slope inside: 279
		Slope touching: 63
Essex Region		N/a

Detailed Breakdown of Combined Criteria			
Site	# of Patches Assessed		# of patches identified as significant based upon combination of criteria
York Region	Vaughan: 10% slope, 100m buffer: 525		108 with 0 criteria
			184 with 1 criterion
			127 with 2 criteria
			96 with 3 criteria
			14 with 4 criteria
			0 with 5 criteria
	Georgina: 10% slope, 100m buffer: 529		277 with 0 criteria
			181 with 1 criterion
			48 with 2 criteria
			19 with 3 criteria
			0 with 4 criteria
Region of Waterloo			N/a
EOMF	Aggregation of Significance Criteria		Dundas: 91.8% Lanark: 92.5% Leeds: 83.7% Ottawa: 94.6%
Essex	# of Patches assessed	Size	# Considered significant
	164	<0.5 ha	0 criteria = 85 1 criterion = 64 2 criteria = 14 3 criteria = 1 4 criteria = 0 5 criteria = 79
	1,465	>0.5 ha	0 criteria = 346 1 criterion = 484 2 criteria = 421 3 criteria = 161 4 criteria = 48 5 criteria = 5
	823	>2.1ha	0 criteria = 0 1 criterion = 237 2 criteria = 375 3 criteria 158 4 criteria = 48 5 criteria = 823

Methodologies used to satisfy analysis of woodland significance based on criteria as outlined (i.e. assembly of suitable data sources used in the identification of the five criteria)

Regional Municipality of York

- 3 GIS forest cover mappings available for the region of York
    - Forest Cover Mapping (R.M. of York 2001a); FRI Mapping (O.M.N.R. 1992); the Ontario Land Cover Database (O.M.N.R., 199a).
- These maps were compared and validated to see what differences exist between them and to determine which one to use for modeling the existing forest cover.
    - The Regional Forest Cover Mapping is the most updated forest cover map and provides an accurate spatial extent of forest polygons in the Region of York (Region of York 2001). This was the most accurate mapping to use in determining the spatial extent of forest patches.
    - Forest cover includes early succession patches
    - The boundaries are updated with a minimum patch size of 0.5 acres
    - The minimum patch size was established based on the regional tree by-law, where forest cover is defined as "an area equal to or greater than 0.5 acres or 0.2 hectares in size that contains 400 trees of any size per acre"
- The York Regional Forest Cover Mapping was produced by updating the boundaries of forest polygons from the Forest Resources Inventory using the digital orthophotography from September 1995 and April 1999. Forest polygons were checked in the field to determine if the forest still existed and to confirm that the digitized polygon was properly defined as forest. Based upon field observation, some attribute information on stand characteristics were added to the database.
- In the York Region analysis, only the municipalities of Vaughan and Georgina were examined.

Regional Municipality of Waterloo

- Four test sites were defined, beginning with 5 x 5 kilometre squares, but expanded as necessary to capture woodlands that straddle the boundaries of these test sites
- Candidate data sets were assembled, compared, and applied to the relevant criteria proposed in the draft guidelines for significant woodlands identification
- The intention was to test four "woodland" data sets
    - Ontario Hydro's LANDSAT-based layer [unable to procure]
    - 1:250 000 NTS
    - 1:50 000 NTS
    - 1:10 000 OBM
    - The Region's own 1:5 000 woodland layer served as a reference (based on 2000 aerial photography)

- Each site was then analysed using the 1:250 000 NTS; the 1:50 000 NTS; and the 1:10 000 OBM layers

Eastern Ontario Model Forest

- Due to the variability of the landscape it was decided to test the criteria in four different study areas representing several landscapes across the Eastern Ontario Model Forest area.
- There was no contiguous GIS layer that depicted current forest cover condition with forest attributes suitable for detailed analysis in southern Ontario
- This study examined woodlands from a geometric and association point of view.
- This report focused on methods as it related to the best available data, which happened to be vector based.
- In all, a mosaic of different woodland and forest cover datasets were used: NRVIS, FRI, EOMF, NESS

Essex Region

- The study area included Essex County, excluding Pelee Island and the Erie Archipelago
- The data set used in this evaluation included only vegetation polygons of Type 3 on NTS Sheets at the scale of 1: 50 000
- For the purposes of this study, woodland patches are the NTS Type 3 vegetation polygons

Technical barriers to the application of the guideline criteria and recommendations for overcoming these.

Variables	Data Sourcing: Suitability / Technical Barriers	Application of Criteria: Suitability / Technical Barriers
Forest Cover	Different results are obtained in the identification of % forest cover depending upon the data source(s) utilized: Temporal Variation Spatial Variation Quality of Detail Different results are obtained depending upon the selection of the landscape unit used to determine percent forest cover: % Cover Total # of Woodland Patches	Differences attributed different data sources and selection of landscape units can mean: Differences in % forest cover estimates Differences in total numbers of patches identified and assessed Problems in data interpretation related to gaps in forest patches (i.e. distinguishing between polygons) Other issues include: Use of % forest cover vs. % natural cover Differentiating between shrub and forest layers Differences in the definition of "forest" and "woodland" in the ELC guide "all woodlands" may be too inclusive of a definition
Patch Size	Different data sources can result in differences in distinguishing between polygons: e.g. high resolution mapping shows small openings and intrusions that will reduce the overall area attributed to each patch and especially the interior area of each patch	Landscape units with % forest cover estimates which straddle the line between minimum patch size categories may face a loss of a greater number of small woodland patches especially if % cover is estimated at too coarse of a scale (e.g. Ecodistrict) Landscape units with higher overall cover composed primarily of many small patches may end up with less protection than warranted
Hydrological Connections	Spatial / Temporal data sourcing issues	For the purposes of GIS applications it may be necessary to better define what "falls within" means in terms of overlapping with a hydrological feature. I.e. overlap means the feature is "entirely" within "within 30 metres of streams" may be more appropriately worded as "within 30 metres of hydrological feature" then define hydrological feature itself
Interior Forest	Differences in data sources will have an impact upon determination of forest interior	A gap in a forest polygon indicated in one data source but not in another may mean the difference between a patch meeting a minimum size criteria

	size: Spatial / Temporal Differences Resolution Differences	for forest interior habitat or not Use of the word "buffer" may lead to definitional problems. An alternate may be reliance upon "100 metres from the edge" as the measure of forest interior conditions Suggestion put forward to use perimeter to area ratio as a suitable proxy for interior habitat that has ecological function and a mathematical calculation can do a better job of accounting for the variations in patch shape
Landscape Connectivity	Use of Big Picture cores and corridors as locators for significant woodland connectivity is well received but also recommended is the option of using planning authority designated cores and corridors as well	Clarification for GIS applications required for definition of "falls within". Definition needs to be explicit that any overlap means the entire patch is "in" (i.e. significant)
Slope		Again, need to specify for the purposes of GIS that if it touches the slope, the entire feature is inside (i.e. significant) Suggestion of adding unusual landform to the calculation Slope was seen to be an important criterion however it favours forests on certain land physiographic units Suggestion that we need to heed usability of methods per GIS

Conclusions

York Region	• Patch size is among the most important criteria and thresholds should be determined based upon average patch size (concern regarding landscape units with higher percent forest cover composed largely of many small, fragmented woodland patches) • Forest interior thresholds should be related to average interior area o It might be suggested that core area size be related to the average core area. For example, if average core area is 3.7ha then minimum core area could be 1.75ha • Nearest neighbour distance was used as a measure of connectivity
Region of Waterloo	• Data sources must be addressed as the impacts of data selection is prevalent throughout the analysis • Criteria should be specified in relation to the spatial resolution of the mapping employed (for example, a 4 ha interior criterion will not mean much if it is unclear as to whether openings of less than, say, 0.5 or 0.2 ha should be ignored or not; roads, houses, ponds and creeks that may or may not break the canopy)
Essex	• Report suggests that a preliminary representation of significant woodland can be

	readily accomplished at a landscape level
Eastern Ontario Model Forest	• There is no contiguous GIS layer that depicts current forest cover conditions with forest attributes suitable for detailed analysis (e.g. age class distribution by forest type) in southern Ontario • A technical barrier to this study in terms of input data would be the lack of good current forest cover with large coverage • Different data sets had to be used for different jurisdictions within the EOMF • NRVIS data layer: this layer is almost 12 years old and does not differentiate between woodland and shrub, so it overestimates the woodland cover • FRI mapping was also almost 12 years old • Should look at testing the feasibility of incorporating stream order and variable buffer widths with respect to hydrologic feature type (wetland vs. creek) • Should look at testing a series of larger equal areas grids for determining percent forest cover for woodland patch size threshold classification • This study successfully developed methodologies for testing the five criteria for determining priority woodland AND all the criteria tested in this study are very feasible given good data and a simple GIS platform • However: A coordinated effort among interested parties is necessary to ensure the entire landscape is assessed with similar parameters. A provincial agency like the MNR would be the ideal coordinator of this effort (e.g. using SOLRIS). Ensuring consistency across the study area in terms of accuracy and time is very important for a study like this

APPENDIX D: MUNICIPAL CASE STUDIES

City of London, Ontario
County of Middlesex, Ontario

Prepared for
Ontario Nature

By
Bonnie Bergsma, M.Sc. Ecologist Planner (City of London)
Tara Tchir, M.Sc. Ecologist (County of Middlesex)

CASE STUDY: City of London

City of London Process to Implement Policies and Develop Guidelines to Identify Ecologically Significant Woodlands.

Prepared by Bonnie Bergsma, M.Sc. Ecologist Planner, City of London, Ontario

Abstract

The City of London developed a strategy and process for implementation of a significant woodlands policy in the Official plan. This case study describes the development of the strategy and process that included stakeholder involvement, challenges and endorsement at the Ontario Municipal Board (OMB), Council enactment and ongoing refinement. The major points to develop an assessment strategy are:

1. Begin at the broader landscape scale and to develop a strategy, establish targets and provide the context and recommendations for further studies at the local, and finally the site-scale.
2. Ideally the municipality or other conservation agency or neutral group should conduct the evaluations. This will help to ensure integrity of the process and work toward securing a healthy natural heritage system because "whoever controls the scale will win".
3. Involve representatives of the development community and the environmental community (preferably represented by a municipal Ecological Advisory Committee (EAC)) in the development of the evaluation criteria and guidelines. This approach can help to resolve issues.
4. Develop an information base or data set that characterizes woodland patches at a consistent level of detail within the study area so that relative comparisons can be made. For some sites, the coarsest filter could justify the designation of significance, particularly in the southern Ontario and the Carolinian Canada life zone.
5. Use evaluation tools that will be technically supported and that help to advance the screening or filtering process which is a necessary component of evaluation and assessment.
6. Collect and use more detailed inventory to increase the level of confidence about the relative significance of areas.
7. A statistical sample set of inventory data on woodland patches in an area should be used to establish thresholds for significance based on the distribution and frequency of occurrence of measured parameters.
8. Patches must be assessed by a relative ranking with respect to each other and the landscape in which they reside, as opposed to solely on their own merits.
9. The ranking of woodlands should be used to assist private woodlot owners in their self-assessment of ownership objectives, perhaps also in applications under Managed Forest Incentive Program (MFTIP) or for tree cutting permits and public decisions relating to direct conservation action on specific woodlands.
10. The evaluation process is used to identify significant woodlands and the policy designates Significant Woodlands.

Introduction

The process and implementation of a policy to recognize significant woodlands requires a coordinated effort, flexible process and cooperative approach involving all stakeholders. The City of London has been through this process, and while not yet finalized, it has been generally accepted and acknowledged that vegetation patches outside of Environmentally Significant Areas (ESAs) and Provincially Significant Wetlands (PSWs) may also meet criteria for significance and be identified as Significant Woodland in the official plan. The following case study documents the process taken by the City of London to elaborate the intent of the woodland policies in the Provincial Policy Statement (PPS) and the Official plan (OP), by providing a scientific and technical basis for determining significance and identifying woodlands that form important components of the City's natural heritage system. John Riley, Director of Conservation Science and Stewardship, Nature Conservancy Canada, wrote that "your evaluation of woodlands is particularly important because woodlands will almost invariably comprise the largest proportion of your overall natural heritage system, so that systematic data collection and evaluation will also provide you with better context, over time, for assessing your achievement of overall official plan conservation goals". (letter, October 25, 2000, to Planning Committee) The case study will highlight both important fundamental requirements and areas of difficulty that hopefully others will not have to repeat.

Strategy

In 1992, the City of London annexed an area of land tripling the size of the City, and was required to complete an official plan Amendment for these lands by January, 1996. A comprehensive community-based program called "Vision 96" was launched and subwatershed studies were completed to develop the framework for a natural heritage system. This system was delineated on the Floodplain and Environmental Features Schedule B of the official plan. City Council adopted the Vision London Official Plan Amendment July 2, 1996. Appeals to the new policies included, among other matters, environmental policies and the designation of components of the natural heritage system outside of Environmentally Significant Areas. In the ensuing Ontario Municipal Board (OMB) hearing these policies were upheld noting that "the environmental policies resulting from the underlying subwatershed studies present a balanced approach to ecosystem planning, the natural heritage system and environment, and has received the endorsement of the majority of the community-at-large." The Official Plan Office Consolidation became effective January 1, 2000.

Woodlands are one of the components of the City's natural heritage system. They are generally identified as vegetation patches outside of Environmentally Significant Areas (ESAs) and Provincially Significant Wetlands (PSWs) on Schedule 'B' of the plan. During the 4-year period of OMB hearings, city staff and members of the Environmental and Ecological Planning Advisory Committee (EEPAC) began to develop a framework and guidelines for evaluating and ranking vegetation patches for their conservation value and priority for protection. The development industry (London Development Institute (LDI) and planning or environmental consultants active in London) was invited to participate, but did not because LDI was appealing its very basis in policy. The first patch

evaluation guideline, developed on March 19, 1998, presented multiple criteria and measurable factors representing various features and functions to see if the woodland meets a standard in a category. Each was ranked on a 5-point scale, where the highest category of significance was equivalent to meeting an ESA criterion (see Appendix 1). Overall scores could rank and compare patches. The thresholds for each rank were supported by existing data collected from more detailed field inventory work on a representative subset of unstudied patches (85 of 600) within 13 subwatersheds, and new data being collected through testing in several planning areas. The data on over 715 vegetation communities within these patches were used to generate cumulative frequency curves and species area curves to establish thresholds for significance (Figure 1). Revisions were made and new factors added based on new data and other models and approaches, however, the 5-point scale format was deemed to be overly complicated and appeared to duplicate the council approved ESA Guideline Document.

The format of the guideline document was thus changed to reflect the five considerations or criteria for evaluation of woodlands outlined in the official plan (Appendix 2). The details of the application guidelines would encompass a number of criteria and evaluation factors that can measure the variability of woodlands. The context for evaluation of woodland patches would be made with a multi-scale perspective and include both landscape and site level variables that represent different spatial and temporal scales. Ecological systems are scale-dependent and understanding their spatial configurations is central to understanding the ecology of landscapes (Forman 1995). Each criterion is evaluated on its merit for retention in a system of natural areas. Reasons to identify a patch as significant could be because it serves a linkage between areas that would otherwise be beyond the migration distance of a particular species, or because it offers the potential for a nucleus for restoration, or because it adds to the representation of landforms and communities that naturally occurred in an area and maximizes biodiversity (City of London 1995).

On July 12, 1999 the first draft of the woodlands guideline was presented and circulated for review to provincial agencies (MNR, MOE), non-government organizations (NGO), consulting firms, clubs and community associations and the general public, as requested. This was an ideal time for agencies like the MNR to assist in the development of policy implementation guidelines. It is worth noting some of the more salient points made:

- *It would appear that most upland woodlands could meet the priority acquisition ranking*;
- *How do we ensure consistency of application by different users?;*
- *Social values and acquisition issues be separated from ecological values and significance;*
- *There must be clear terminology, definitions, data collection standards, references and technical justification.*

A second draft was circulated on November 15, 1999. This version was used to identify significant woodland and was appealed to the OMB. The decision was favourable noting that "although Council has not yet adopted a specific policy to guide the assessment of

woodland areas based on criteria in the official plan, city staff's evaluation in the context of draft guidelines represents current thinking on these issues, and although not fully in agreement in some technical areas, it was acknowledged by the landowners' ecologist to contain relevant information (February 2000)". This time the comments praised the logical, scientific approach and methodology. The comments raised other non-ecological issues and policy and planning considerations including interpretation and subjectivity, provincial versus local significance, determination of boundaries, cultural values, fair market compensation, acquisition criteria, long-term management and sustainability, associated costs to maintain, level of protection afforded, permitted uses if not acquired, and the effects on infrastructure and servicing costs related to urban sprawl for the municipality.

To ensure that the revised guidelines were able to discriminate significant and non-significant woodlands, staff re-evaluated 24 patches to ensure consistent results could be achieved at the site-specific patch level. The evaluation methodology focused on 4 of the 5 criteria describing ecological features, processes and functions that generate and maintain biodiversity and ecological integrity. The evaluation of patches for the social and recreational value criterion would be addressed in a separate process. The results of the re-evaluation identified 14 significant and 10 not significant, with 4 woodlands changed from significant to not significant.

On October 16, 2001 Municipal Council adopted the Guideline Document for the Evaluation of Ecologically Significant Woodlands (dated October 4, 2000) on the recommendation that it be reviewed within one year to incorporate any required modifications (e.g. changes to thresholds for significance, or evaluation factors) or clarifications (e.g. of interpretation or definitions) concerning the application of these criteria to various woodlands. As there were only 5 new evaluations completed in the year and few formal changes, amendments were not pursued. Instead, municipal staff embarked upon a broader approach to characterize, evaluate and prioritize woodlands within the natural heritage system. This approach was developed over a 2-year period with input and advice proffered from more informal discussions and workshops with consultants, other municipalities developing similar criteria, and our own GIS analyses. No changes were recommended to the criteria in the official plan. However, based on a synthesis of all elements, the City will be recommending some changes to the thresholds and application of some of the landscape level factors.

Process

The following steps describe the rapid assessment evaluation for ecological importance at the landscape level. An optimum landscape has large patches of natural vegetation, supplemented with small patches scattered throughout the matrix and connected through small corridors (Forman 1995).

STEP 1 - *Define and map the natural heritage system.*
The subwatershed studies identified the natural heritage system of the study area based on general landscape criteria, such as the percent vegetation cover in the planning area,

size of vegetation patches, and existing information on rare species populations and critical habitat. Within the landscape context of London and Middlesex County where woodlands cover 5% to 15% of the land, an initial cut-off size of 4 ha was determined to be a minimal size for functional woodland (Riley & Mohr 1994; OMNR 1999). While 4 ha was the nominal cut-off size for patches, smaller patches < 4 ha were mapped if they were within 100 m of another patch, not separated by permanent cultural barriers, and the total size of the two patches was > 4 ha. All patches were assigned a number: the first two digits corresponding to the numerical code assigned each of the 13 subwatersheds.

STEP 2 - *Refine boundaries and characterize the natural heritage system to a consistent level*.
In the summer of 2000, a digital polygon layer was created that identified all patches to the Community Series level of the Ecological Land Classification System using ArcView Geographic Information Systems (GIS). A consistent data set is important in order to provide an objective evaluation of common units of measurement. This was accomplished using the original vegetation patch outline boundaries from the 1996 subwatershed studies, 1999 aerial photos, and various inventory and audit reports including the terrestrial life science inventory completed for the Subwatershed Studies. Minor adjustments to the outer boundaries to correct for scale and shift of data were made, removing 15 hectares that no longer existed on the 1999 aerial photo and adding patches located in two areas of the City that had not been part of the Subwatershed Studies. This included patches located in the core of the city in the Central Subwatershed (coded 00) that been identified in the Remnant Woodlot Inventory for the City of London (1991) and, or that are already designated Open Space as natural parks or within flood plain regulated lands, as well as three patches in the northwest corner of the City, in the Oxbow Creek Subwatershed (coded 15). The total area of these additional patches amounted to 236.43 hectares. The mapping layer was linked to the Terrestrial Subwatershed Database (Bowles *et. al*. 1994) and another database of audit and inventory information on patch characteristics.

In London, over half of the total area of vegetation patches is terrestrial forest (53.4%). Wetland swamp forest and thicket swamp represent 17.9% and cultural woodland, thicket and meadow represent 21.4%. Wetland marshes, meadow marshes and aquatic open water wetlands collectively represent only 6.1% of the total area of all vegetation patches. Natural areas identified as bog, fen, prairie and bluff each represent less than 1% of the total natural land area. These latter four vegetation community types are regarded as rare in the province and their presence in a natural area within the City of London would be considered highly significant. In fact, where these types of communities have been identified, they are generally located within larger patches and patch complexes that form the core Environmentally Significant Areas (ESAs) of the natural heritage system in association with the major river and valley systems of the Thames River, Medway River, Stoney Creek and Dingman Creek.

STEP 3 - *Apply methodology to evaluate woodland significance at the landscape level using ArcView (v.3.2) geographic information system (GIS)*

A landscape level assessment was accomplished using remote sensing (air photos) and GIS to map measure and evaluate characteristics of habitat patches and their landscape context. The digital polygon layer of vegetation patches was used to query all vegetation patches for the presence of a woodland community as defined in the approved guideline document. A total of 212 patches were identified that met the definition of woodland, were designated Environmental Review (ER) on land use Schedule "A" and, or were identified in a report dated November 29, 1999, entitled "Setting Priorities for Public Acquisition of Significant Woodlands." Core areas already designated Open Space were not included in this evaluation. The assessment was completed on patch boundaries determined from 1996 subwatershed studies.

The criteria and factors for evaluation as set out in the Woodland Patch Assessment Score Sheet (Appendix 3) were differentiated based on the level of analysis that could be applied to patches (Table 1). This differentiation was based upon the ability to utilize ArcView GIS and linked databases to analyze the 212 patches for any of these criteria and factors. It was possible to apply the GIS analysis to 10 factors representing five of the seven evaluation criteria for significance. In accordance with the methodology, each factor was ranked as high, medium or low with the rank of each criterion (high, medium or low) based on the highest standard achieved. For criterion 2.2, only two of the three factors could be evaluated and for criterion 2.3, only two of the four factors could be evaluated based on best available information. Rankings were assigned according to the rated factors, noting however, that these rankings could change as more study and, or information is made available on the patches at a site-specific level. Shape files were created for each of the 10 factors evaluated. Once the assessment was complete, a map was produced for each factor assessed and tables exported to MicroSoft Access. Summary tables were developed for each factor showing the patch number and area, calculated values, the rank based on the thresholds and any explanatory notes. Each of the maps shows the distribution of high, medium and low rankings for all 212 patches.

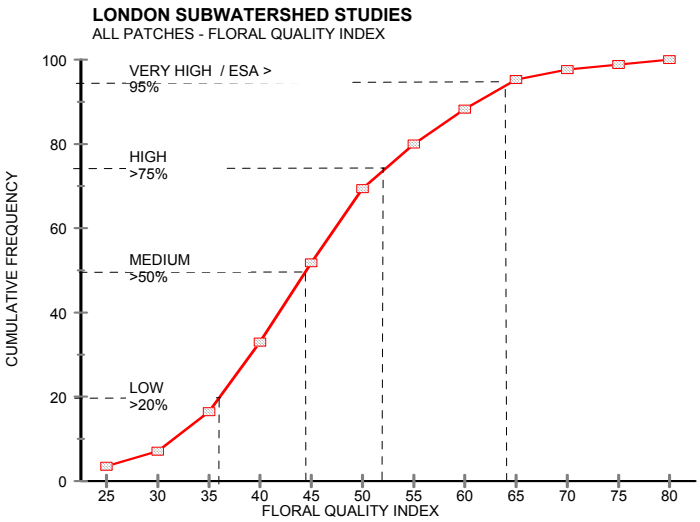
Table 1: The criteria and factors for evaluation as set out in the Woodland Patch Assessment Score Sheet differentiated by level analysis.

Criterion	Factors for Evaluation	Patch Assessment		
		Landscape Level	Community Level	Species Level
1.1 Site Protection	a) Proximity to hydrological features	✖		
	b) Erosion and slope protection	✖		
1.2 Landscape Integrity	a) Local Woodland Cover	✖		
	b) Linkages Between Patches	✖		
	c) Distance Between Patches	✖		
2.1 Age and Site Quality	a) Woodland Community Age		✖	
	b) Mean Coefficient of Conservatism of Woodland Communities		✖	
	c) Disturbance related to Human Activity		✖	
2.2 Size and Shape	a) Woodland Size	✖		
	b) Patch Shape/Interior	✖		
	c) Conservative Bird Species			✖
2.3 Diversity of Natural Communities and Associated Species	a) ELC Community Diversity	✖	✖	
	b) ELC Vegetation Type and Topographic Diversity (variation and heterogeneity)		✖	
	c) Diversity (species and individuals) & Critical Habitat Components for Amphibians			✖
	d) Presence of Conifer Cover	✖		✖
3 Endangered and Threatened Species presence				✖
4.1 Distinctive, Unusual or High Quality Natural Communities	a) ELC Community SRANK		✖	
	b) Specialized or rare species presence/absence			✖
	c) Age, size and distribution of large trees		✖	
4.2 Distinctive, Unusual, or High Quality Landforms	a) Distinctive Landforms	✖		

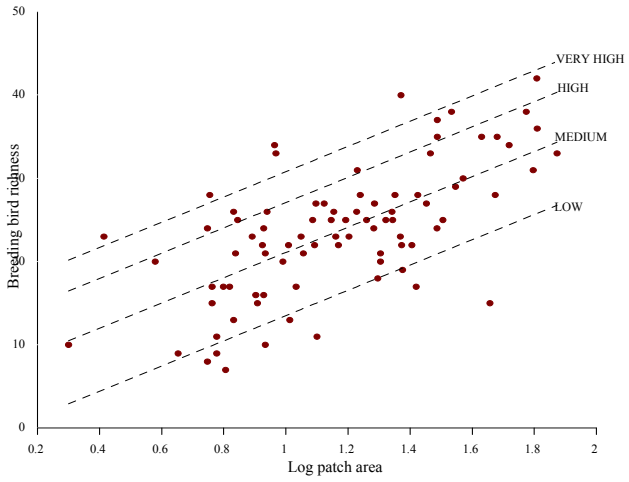
FIGURE 1 : Cumulative Frequency Curve Examples

The following figures are based on data collected in 715 vegetation communities in 85 patches during the London SWS. Cumulative frequency curves indicate the percent of communities or patches which are above a certain standard for measures such as mean conservatism (MCC), Floristic Quality Index (FQI) and species richness. The following cut-off values are used Very High / ESA - top 5%; High - top 25%; Medium -top 50%; Low - bottom 50%; Very Low - bottom 20%.

a) Floristic Quality Index



b) Species - Area curve for Breeding Birds



STEP 4 – *Analyze the results and make adjustments where statistical tests indicate.*
The landscape level assessment provided opportunity to identify woodlands that may meet the criteria for significance based on principles of landscape ecology. Of the total 212 patches, there were 61 where three or more of the criteria met the standard for High. According to the evaluation guidelines these patches are identified as significant woodlands. However, one of the objectives of this study or exercise was to test the application of the criteria based on the definitions, guidelines and thresholds and evaluate these results to support any recommended modifications to the guidelines. Site-specific inventory will be conducted in 2003 to collect information required to evaluate the woodland quality criteria. The additional level of detail provided by field assessments can be used to confirm the GIS predictions and increase the level of confidence of the evaluations.

Landscape level factors were modified as follows:

- Better define various terms and recognize currently mapped resources or features;
- Adjust the thresholds for significance where supported by cumulative frequency distribution of all patches within London to the upper quartile of patches so that the top 25% are assigned a ranking of High;
- Eliminate potential for double-counting;
- Eliminate factors or criteria that were difficult to measure;
- Minimum size of mapped communities was set at 0.5 ha.

Modifications to the community and species level factors were proposed based on the experience and approach of other evaluation systems; however, the site-specific inventory of 2003 will be used as a further test to refine and define significance.

The woodland data set was expanded to include all patches with a designated land use "Environmental Review", including potential ESAs and patches designated Open Space. The GIS analysis was applied to 406 vegetation patches. There were 4 measurable criteria used in the evaluation:

Criterion 1 - Site Protection was defined by two factors: hydrology and slope.
Criterion 2 - Ecological Integrity was defined by two factors: patch isolation & arrangement and patch linkage and connectivity.
Criterion 3 - Size and Shape was defined by two factors: patch size and patch shape & presence of interior habitat.
Criterion 4 - Diversity was defined by two factors: ELC community class and presence of coniferous trees.

The distinctive landform criterion was not included in the second assessment as it was difficult to interpret at a local scale and had the potential to be a double count of other criteria. Again, the highest level achieved for any one factor for each criterion would be the rank. As a test, the criteria were applied to all patches, including ESAs. All of the ESA patches met four of the four criteria, as expected. However, as many of the ESAs and PSWs are already protected through open space land use designation and, or public

or conservation ownership, the data set for these areas was compiled and displayed as existing protected areas. The other patches were displayed on a single map based on the number of high criteria or scores met. The data set was also queried to find any patches where 4 Medium scores had been met. The distribution of patches was relatively even, indicating that the approach is consistent and reliable. A high level of confidence can be placed on the identification of significant woodland patches using this evaluation methodology.

STEP 5 – *Overlay and compare the evaluation with broader area studies where available*
The final step in the process is to evaluate and compare the results with other broader studies where there is overlap of values. While this study was being completed for the City of London, the Upper Thames River Conservation Area (UTRCA) began a natural heritage study for Middlesex County. As much of London falls within the county, it was logical to begin developing an assessment method that could be linked with the City's method at the broader landscape scale. The data set was incorporated with Middlesex data. Criteria were developed with a committee of experts to ensure scientific rigour and discriminating criteria. Patches that were significant at the county level should also be significant at the local city level. This will be tested when the Middlesex analysis is completed in 2003.

At an even larger scale, "The Big Picture" Project of Carolinian Canada provides a coarse scale spatial image that highlights existing natural cores and connections, and preferred areas for restoration and rehabilitation of the Carolinian Zone. Applied as an overlay on the subwatershed patch mapping, it represents another consideration for identification and prioritization of critical areas to achieve long-term conservation goals of the City, the adjacent planning areas and southernmost ecological region of Canada.

Implementation

STEP 6 **-** *Develop policy to define significance based on number of criteria met*
The number of criteria that must be met for a patch to be deemed significant is a policy and planning decision that is applied outside of the realm of the ecological science. In the settled landscape of southern Ontario, all woodlands would be significant if the target were to achieve 30% vegetation cover. The woodland guideline document and patch assessment that was approved by council based significance on the fulfillment of 3 High criteria, or a combination of high and medium ranks. The following are recommended:

1. All patches that meet at least one criterion are identified as components of the natural heritage system.
2. The fulfillment of 3 High or 4 Medium criteria be accepted as a minimum for designating the patch as a Significant Woodland,
3. ER lands that are identified as potential ESAs be included in an expanded boundary of the ESA where 4 High rank criteria have been met.
4. No development will be permitted within Significant Woodland, ESA or PSW.

References / Glossary / Acronyms

Bowles, Jane, William Draper, Audrey Heagy, Michelle Kanter, Brendon Larson, October 1994. City of London Subwatershed Studies Life Science Inventories

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Riley, J.L. and P. Mohr 1994. The Natural Heritage of Southern Ontario's Settled Landscapes. A review of conservation and restoration ecology for land-use and landscape planning. Ontario Ministry of Natural Resources, Southern Region. Aurora.

Terra Geographical Studies Inc. July 27, 1994. Draft Terrestrial Resource Strategy 2nd (Draft).

Woodlands are a general term which collectively refers to areas occupied by trees, treed areas, woodlots and forested areas". The definition of an "urban forest" in the *Forestry Act* is tree-dominated vegetation and related features found within an urban area and include woodlots, plantations, shade trees, and fields in various stages of succession, wetland and riparian areas".

EAC	Ecological Advisory Committee
EEPAC	Environmental & Ecological Planning Advisory Committee
ELC	Ecological Land Classification
ER	Environmental Review
ESA	Environmentally Significant Area
GIS	Geographic Information System
LDI	London Development Institute
MFTIP	Managed Forest Tax Incentive Program
NGO	Non Government Organization
NHIC	Natural Heritage Information Centre
OBM	Ontario Base Map
OMB	Ontario Municipal Board
PPS	Provincial Policy Statement
PSW	Provincially Significant Wetland
SRANK	Provincial Rank of species as listed by the NHIC

APPENDIX A (City of London Case Study)

Evaluation of Environmentally Significant Areas

Candidate areas that clearly satisfy two or more of the following criteria will be considered for recognition:

i. The area contains unusual landforms and, or rare to uncommon natural communities within the country, province or London subwatershed region.

ii. The area contains high quality natural landform-vegetation communities that are representative of typical presettlement conditions of the dominant physiographic units within the London subwatershed region, and, or that have been classified as distinctive in the Province of Ontario.

iii. The area, due to its large size, provides habitat for species intolerant of disturbance or for species that require extensive blocks of suitable habitat.

iv. The area, due to its hydrologic characteristics, contributes significantly to the healthy maintenance (quality or quantity) of a natural system beyond its boundaries.

v. The area has a high biodiversity of biological communities and, or associated plant and animal species within the context of the London subwatershed region.

vi. The area serves an important wildlife habitat or linkage function.

vii. The area provides significant habitat for rare, threatened or endangered indigenous species of plants or animals that are rare within the country, province or county.

APPENDIX B (City of London Case Study)

Woodlands

The significance of Woodlands will be based on an evaluation of the following considerations:

i. The Woodland contains natural features and ecological functions that are important to the environmental quality and integrity of the Natural Heritage System.

ii. The Woodland provides important ecological functions and has an age, size, site quality, diversity of biological communities and associated species that is uncommon for the planning area.

iii. The Woodland is important for the balanced distribution of open space amenities and passive recreational activities across the urban area.

iv. The Woodland provides significant habitat for endangered or threatened species.

v. The Woodland contains distinctive, unusual or high quality natural communities or landforms.

APPENDIX C (City of London Case Study)

EVALUATION OF SIGNIFICANT WOODLANDS

The conservation and protection of woodlands has been identified a priority for some time and has more recently been an issue of increasing public attention and concern (Larson et. al. 1999; OMNR 1993a;Hilts 1977; Upper Thames Valley Conservation Report 1952). Particular focus has been directed on the state of southern Ontario's landscape, woodlands being one component of the natural heritage of southern Ontario that is recognized in Natural Heritage section 2.3 of the Provincial Policy Statement (1997). The criteria in the City of London Official Plan Section 15.4.5 recognize that significant Woodlands may be selected for ecological or socioeconomic benefits. This evaluation methodology focuses on ecological values that discriminate high quality woodlands. Ecological values include features and conditions that are associated with mature woodlands, processes and functions that generate and maintain biodiversity and ecological integrity.

ASSESSMENT FOR WOODLAND SIGNIFICANCE

A Woodland will be considered as a significant component of the Natural Heritage System based on the following categories:

- If three or more criteria meet the standard for High;
- If two criteria meet the standard for High and four or more criteria meet the standard for Medium;
- If one criterion meets the standard for High and six or more criteria meet the standard for Medium;
- If all seven criteria meet the standard for Medium.

WOODLAND DEFINITION

The Provincial Policy Statement and the Official Plan policy definitions consider woodlands as areas containing trees. Thus, *all vegetation patches containing treed areas may be defined as Woodlands.* Treed areas may include all communities with a tree cover of >10%. (ELC definition, Lee et. al. 1998)

Ecological Land Classification (ELC) Definitions

The Ontario Ministry of Natural Resources has developed a standardized classification system for vegetation communities across southern Ontario, entitled *Ecological Land Classification for Southern Ontario - First Approximation and Its Application* (Lee, et. al. 1998). In this classification system, the term woodland has a specific definition based on percentage of treed cover and is thus not the only classification that meets the policy definition of a woodland. In the ELC system, a treed area is any community with a tree cover >10%. Application of the ELC keys identifies the following ELC Community Classes and Series as Woodland:

FOREST - deciduous forest (FOD), mixed forest (FOM) or coniferous forest (FOC);
SWAMP - deciduous swamp (SWD), mixed swamp (SWM) or coniferous swamp (SWC);
BLUFF - treed bluffs (BLT);
TALLGRASS SAVANNA and WOODLAND - (TPS, TPW)
CULTURAL - cultural woodland (CUW), cultural savanna (CUS) or cultural plantation (CUP)

Woodland Patch Assessment Score Sheet			
Ecological Values	**Priority Ranking**		
	High	**Med**	**Low**
1. Criterion 15.4.5 (i)The Woodland contains natural features and ecological functions that are important to the environmental quality and integrity of the Natural Heritage System.			
1.1 Site Protection			
a Proximity to hydrological features. Includes groundwater recharge areas, headwater/first-order watercourses, river or stream corridors, wetlands (OMNR 1993b), shallow aquifers or discharge/seepage areas. As identified by the subwatershed studies and/or mapped on Schedule B and/or verified through technical studies.			
one or more hydrological features/functions located within the woodland patch			
one or more hydrological features located within 50 m of the woodland patch (PPS and OPA trigger distance for an EIS)			
one or more hydrological features located > 50 m from the woodland patch			
b Erosion and slope protection. Protection of runoff processes and ground stability (erosion potential) for slopes > 10%. As mapped in the Slope Stability Mapping Project (UTRCA 1996) and digital topographic layers (City of London GIS) for slopes, and based on soil textures and type as described in ELC manual based on OIP (1985) and Canadian Soil Classification System (1978).			
woodland present on steep slopes >15% on any soil type			
woodland present on moderate slopes >10 - 15% with erodible soils (Silty Loam, Sandy Loam and Loam, Fine to Coarse Sands)			
woodland present on moderate slopes >10 - 15% with less erodible soils (Heavy Clay and Clay, Silty Clay) or gentle slopes <10% with any *soil* type			
Score for Criterion 1.1 (based on the highest standard achieved for any one of the two categories)			
1.2 Landscape Integrity			
a Local Woodland Cover. Percentage cover of woodlands within 2 km radius circle from patch centroid. Native plant richness and flora quality are significantly related to local forest cover (UTRCA 1997; Bowles and Bergsma 1999)			
>25% woodland cover			
10-25 % woodland cover			
< 10% woodland cover			
b Linkages Between Patches . Woodlands are considered to be continuous even if intersected by standard roads, 21 m wide (OMNR 1999) = secondary collector or local roads in the City of London.			
patches directly connected by natural corridors			
patches indirectly connected by cultural corridors; or have the potential to be connected by potential naturalization areas and upland corridors (as identified on Schedule B) unless separated by permanent cultural barrier (see glossary)			
patches separated by active agricultural lands or urban development with permanent cultural barriers			
c Distance Between Patches (nearest neighbour) not separated by urban development or permanent cultural barriers (Larson et.al. 1999).			
< 100 m to next patch > 4ha			
100 -250 m to next patch > 4h			
> 250 m to next patch > 4 ha			
Score for Criterion 1.2 (based on the highest standard achieved for any one of the three categories)			

Woodland Patch Assessment Score Sheet

Ecological Values	Priority Ranking		
	High	Med	Low
Criterion 15.4.5.(ii) The Woodland provides important ecological functions and has an age, size, site quality, diversity of biological communities and associated species that is uncommon for the planning area.			
2.1 Age and Site Quality			
a Woodland community age. Based on definitions in the Canadian (Strong et. al. 1990) and provincial (Lee et. al. 1998) classification systems			
patch contains one or more mature or old growth woodland community types			
patch contains one or more mid-aged woodland community types			
patch contains only pioneer to young woodland community types			
b Mean Coefficient of Conservatism (MCC) of Woodland Communities or Patch. Based on Floristic Quality Assessment System for Southern Ontario (Oldham et. al. 1995) and analysis of distribution in the London Subwatershed area (Bowles & Bergsma 1999)			
one or more woodland communities with a MCC > 4.6; or MCC of patch > 4.5			
one or more woodland communities with a MCC 4.2 - 4.5; or MCC of patch >_4.0-4.5			
all woodland communities with a MCC < 4.2; or MCC of patch < 4.0			
c Disturbance related to Human Activity. Based on ELC disturbance rating data sheet (Lee et.al. 1998)			
few disturbances mostly light and local			
disturbances mostly moderate to light and local			
disturbances mostly moderate to heavy and widespread throughout the patch			
Score for Criterion 2.1 (based on the highest standard achieved for any one of the three categories)			
2.2 Size and Shape			
a Woodland size. Based MNR Natural Heritage Reference Manual for Policy 2.3 of the PPS (OMNR 1999)			
patch contains > 4 ha of upland woodland (Natural Heritage Reference Manual MNR 1999)			
patch contains 2- 4 ha of upland woodland			
patch contains < 2 ha of upland woodland			
b Patch Shape/Interior. The proportion of interior to total area based on a 100 m interior edge zone. Based on analysis of subwatershed study patches (Bowles and Bergsma 1999)			
> 4 % of the total patch area is more than 100 m from the edge			
2-4 % of the total patch area is more than 100 m from the edge			
< 2 % of the total patch area is more than 100 m from the edge			
c Conservative Bird Species - species with high Jurisdictional Responsibility, Preservation Responsibility and/or Area Sensitivity Scores for Middlesex County. Based on Southern Ontario Conservation Priorities (Couturier 1999)			
Possible breeding of one or more species at Level 1 or two or more at Level 2 or > five at Levels 2 - 4 in the patch			
Possible breeding of one species at Level 2 or two or more at Level 3 or four to five at Levels 3 - 4 in the patch			
Possible breeding of one to three species in Level 3 - 4 in the patch			
Score for Criterion 2.2 (based on the highest standard achieved for any one of the three categories)			

Woodland Patch Assessment Score Sheet			
Ecological Values	**Priority Ranking**		
	High	**Med**	**Low**
2.3 Diversity of Natural Communities and Associated Species			
a ELC Community Diversity. Applied at the patch level; excluding cultural communities. Based on ELC Community Tables (Lee et.al. 1998)			
patch containing 3 or more Ecosites in 1 Community Series; or 4 or more Community Series			
patch containing 2 or more Ecosites in 1 Community Series; or 2-3 Community Series			
patch relatively homogeneous; 1 Ecosite in 1 Community Series			
b ELC Vegetation Type and Topographic diversity (variation and heterogeneity). Applied to woodland communities; excluding cultural communities. Based on ELC Community Table (Lee et.al. 1998)			
woodland represented by four or more Vegetation Types, or by two or more Vegetation Types on two or more different topographic features (e.g. tableland, rolling upland, valley slope, terrace)			
woodland represented by three Vegetation Types on one topographic feature, or by one Vegetation Type with inclusions or complexes			
woodland represented by one to two Vegetation Type on one topographic feature			
c Diversity (species and individuals) and Critical Habitat Components for Amphibians; including 1) unpolluted shallow water that remains wet for the breeding season; 2) emergent and submergent aquatic vegetation; 3) logs and shoreline shrubs; 4) closed canopy offering a shaded moist understorey environment; 5) abundance of downed woody debris. Amphibians are indicators of healthy woodlands with well functioning processes (OMNR, 1999, 2000)			
4 or more species of amphibians present in the woodland patch; or 1 species of amphibian that is abundant in one or more communities; or 3 or more critical habitat components present in the woodland patch			
2-3 species of amphibians present in the woodland patch; or 1 species of amphibian that is occasional in one or more communities; or 2 critical habitat components present in the woodland patch			
1 species of amphibian present in the woodland patch; or 1 critical habitat component present in the woodland patch			
d Presence of Conifer Cover. Important for providing winter food and shelter for a variety of wildlife species (OMNR 1999, 2000)			
Patch contains naturalized vegetation communities with > 25% indigenous conifer canopy cover			
Patch contains plantations of indigenous conifer species			
Patch contains no coniferous communities; or plantations of non-native conifer species			
Score for Criterion 2.3 (based on the highest standard achieved for any two of the four categories)			
Criterion 15.4.5.(iv) The Woodland provides significant habitat for endangered or threatened species.			
3 Note: refer to Policy 15.4.4. re: Endangered and Threatened Species (TE Habitat)			
Identification, evaluation and listing of provincially endangered or threatened species is the responsibility of the MNR. (OMNR 1999).			
	Priority Ranking		
	High	Med	Low
The presence of TE habitat will add one HIGH score to this assessment			

Woodland Patch Assessment Score Sheet			
Ecological Values	**Priority Ranking**		
	High	**Med**	**Low**
Criterion 15:4.5.(v) The Woodland contains distinctive, unusual or high quality natural communities or landforms.			
4.1 Distinctive, Unusual or High Quality Natural Communities. Applied at the patch level.			
a ELC Community SRANK. Based on Bakowsky (1996) and current status from NHIC web page (http://www.mnr.gov.on.ca/MNR/nhic/veg/lists/commlist.html)			
one or more communities with an SRANK of S3/S4 or higher			
no communities with an SRANK higher than S4			
no communities with an SRANK higher than SS			
b Specialized or rare species presence/absence. See glossary for definitions and lists of species.			
patch contains one or more rare tree/shrub species; or one or more rare herbaceous species; or >2 northern and specialized habitat tree/shrub species; or >5 Carolinian tree/shrub species; or >3 species that are regionally rare			
patch contains 2 northern and specialized habitat tree/shrub species; or 3-5 Carolinian tree/shrub species; or 1-3 species which are regionally rare			
patch contains 1 northern and specialized habitat tree/shrub species; or 1-2 Carolinian tree/shrub species; or common tree and tree/shrub/herbaceous species			
c Age, Size and Distribution of Large Trees			
trees > 50 cm dbh occasional to abundant in more than one community			
trees > 50 cm dbh occasional in one community			
trees > 50 cm dbh present, but rare in patch (one to few widely scattered)			
Score for Criterion 4.1 (based on the highest standard achieved for any one of the three categories)			
4. 2 Distinctive, Unusual or High Quality Landforms			
a Distinctive landforms. As identified by the Slope Stability Mapping Project (UTRCA 1996) and City of London Glacial Geomorphology mapping (City of London GIS layer).			
woodland patch located on remnant valley slopes associated with the Arva, Ingersoll and Westminster Moraines or glacial melt water channels or lakes or on Beach Ridge or Sand Plain physiographic landform unit			
woodland patch located on other slopes associated with glacial deposits or lake shorelines or the Till Moraine physiographic landform unit			
woodland patch not located on significant slopes and or is located on Till Plain or Spillway landform unit			
Score for Criterion 4.2 (based on the highest standard achieved)			

Criterion 15.4.5(iii) The Woodland is important for the balanced distribution of open space amenities and passive recreational activities across the urban area.

Note: refer to Guidelines for Priority Ranking of Woodlands for Public Acquisition for Application of this Criterion

Assessment for Woodland Significance:

A woodland will be considered as a significant component of the Natural Heritage System and designated as open space based on the following categories:

If three or more criteria meet the standard for High;
If two criteria meet the standard for High and four or more criteria meet the standard for Medium;
If one criterion meets the standard for High and six or more criteria meet the standard for Medium;
If seven criteria meet the standard for Medium.

CRITERION	**SCORE**
CRITERION l. l Site Protection	
CRITERION 1.2 Landscape Integrity	
CRITERION 2.1 Age and Site Quality	
CRITERION 2.2 Size and Shape	
CRITERION 2.3 Diversity of Natural Communities and Associated Species	
CRITERION 3 Endangered and Threatened Species (TE Habitat)	
CRITERION 4.1 Distinctive, Unusual or High Quality Natural Communities	
CRITERION 4.2 Distinctive, Unusual or High Quality Landforms	

SUMMARY OF SIGNIFICANCE OF EIGHT ECOLOGICAL **CRITERIA** (Including TE habitat if present)	Number of High			
	Number of Medium			
	Number of Low			

Patch Number:	Subwatershed:
Woodland is a Significant Component of the Natural Heritage System	YES / NO
Completed By:	Date:

CASE STUDY 2

Middlesex County Natural Heritage Study.

Prepared by Tara Tchir, M.Sc. Ecologist, Upper Thames River Conservation Authority

Background

The County of Middlesex is located in the agricultural heartland of southwestern Ontario between Oxford County to the east, Lambton County to the west, Perth and Huron Counties to the north and Elgin County to the south. Middlesex County spans the watersheds of five Conservation Authorities (Upper Thames River, St. Clair, Ausable-Bayfield, Kettle Creek and the Lower Thames Valley) and is a federation of 8 municipalities covering an area of approximately 2844.64 square kilometers (1098.32 square miles). The largest municipality in the county is the City of London with a population of approximately 331,000. At 422.98 square kilometers (163.31 square miles), the City of London is the largest city in southwestern Ontario.

As a result of economic activity that the City of London generates, development pressures in those municipalities surrounding the City are great. The population projection, shown in 5 year increments in Appendix B of the 1999 County Official Plan, are 75,562 (in 2006), 79,844 (in 2011) and 84,144 (in 2016). Based on these projections, approximately 7,531 additional residential units will be required by 2016 throughout the County to house the increased population. Urban development, rather than rural, is the focus for future population growth.

With these pressures have come the challenges of protecting and retaining the natural environment, the agricultural community, countryside aesthetics and the county's community spirit. Recognizing that agriculture is the predominant land use and economic mainstay in the County (80 % of the landscape), the protection of the farming community and of agricultural land represent major thrusts in the policies of the County Official Plan. Integral to the preservation of agricultural land is the protection of the natural environment (*i.e.* wetlands, Areas of Natural and Scientific Interest, woodlands and stream corridors). Wetlands and woodlands are important to the agricultural community for flood attenuation and water quality enhancement, as well as providing economically valuable products and recreational opportunities. Other land uses in Middlesex County (according to the Ontario Ministry of Agriculture, Food and Rural Affairs 1983) include urban development (7 %), aggregate extraction (0.5 %), water (0.5 %) and woodlands (12 %).

Middlesex County lies in the transition zone between the Great Lakes - St. Lawrence forest region to the north and the Carolinian zone or Southern Mixed Deciduous forest region to the south. The Carolinian Forest Zone makes up less than 1 % of Canada's land area, yet boasts more species of plants and animals than anywhere else in Canada, mostly due to its warm climate. Many years of agricultural settlement, aggregate resource

extraction, clearing of forests, recreational development and urban development have introduced significant changes to the ecological systems of the County. For example, increased settlement and the push for economic development between 1825 and 1875 led to the very rapid depletion of the original forest for agriculture, timber, fuel wood and railway construction. The reduction was so rapid that by 1860 the forests of Middlesex County were depleted by more than 60% and by 1910 by more than 90%. In 1940, the census of Canada showed woodland coverage for Middlesex County (not including London) to be 7.8 %. Although the retirement of marginal lands and the introduction of tree planting programs have increased the amount of woodland cover on the landscape to 12%, these woodlands are not the same as original growth forests in terms of ecological form and function. More recently, urban expansion has had a greater impact on the environment in southern Ontario. The creation of impermeable landscapes associated with the urban environment has altered the natural hydrology, fragmented forests and wetlands into isolated components, degraded aquatic communities and has reduced the habitat of floral and faunal populations.

The current official plan for the County of Middlesex is an improvement over the previous 1984 official plan, which was a roads and utility corridor policy document that did not recognize natural heritage features or deal with county-wide land use planning issues. The current official plan addresses natural resource issues by establishing consistent, county-wide standards within and between municipalities. Natural Heritage Features are recognized on Schedules A and C of the official plan. These Schedules have different policies associated with them. Areas designated as Natural Environment Areas on Schedule A are related to statements of Provincial Interest and consist of Provincially Significant Wetlands (Class 1-3) and flood regulated watercourses and flood plains. These features preclude development and have restrictive official plan policies associated with them. On the other hand, the natural features identified on Schedule C do not preclude development and represent a range of ecosystem elements, which have been consolidated from a number of existing sources. The features recognized on Schedule C include locally significant wetlands (Class 4-6), Areas of Natural and Scientific Interest (ANSIs) and Significant Natural Areas (SNAs). Although official plan policies associated with Schedule C features are not restrictive, there is an interest in protecting these areas from incompatible development.

Despite the fact that the current official plan for the County of Middlesex is an improvement over the previous 1984 County of Middlesex Official Plan since it recognizes natural heritage features, there are still some limitations to the plan:

- ANSI boundaries on Schedule C are open to interpretation since they are represented by a symbol and not delineated.
- Ecological function and significance of natural heritage features shown on Schedule C are open to interpretation.
- Other components of natural heritage features, such as river, stream, ravine and

upland corridors as well as areas of endangered and threatened species habitat, are not shown on either Schedule A or C.

- The County Plan meets only the minimum standards as defined by the province. However, it can be more proactive in protecting natural heritage features by going beyond the minimum to include restrictive policy for regionally or locally significant areas as well as those areas of provincial interest.

The County of Middlesex has recognized the need to develop a more proactive approach in identifying and protecting woodland and wetland features in order to fulfil the County's obligations under the Provincial Policy Statement for the protection, enhancement and rehabilitation of natural heritage features and functions (Section 2.3). The Provincial Policy protects natural heritage features and areas that are not currently identified in upper or lower tier plans. Therefore, the goals of the Middlesex Natural Heritage Study (MNHS) are to:

1. Increase the understanding of the health of the County's forest-dominated ecosystems *(e.g.* woodlands, wetlands), which would act as background information for a natural heritage framework.

2. Develop land use planning information and policy that identifies, protects and enhances the County's forest-dominated natural heritage features and systems.

3. Encourage and facilitate private stewardship and public education.

4. Protect the relationships between plant and animal communities.

The Middlesex Natural Heritage Study (MNHS) is based on the premise that biological diversity and ecosystem health depend on maintaining landscape ecological functions over time. Environmental areas that are already recognized, such as ANSIs (Areas of Natural and Scientific Interest), ESAs (Ecologically Significant Areas) and PSWs (Provincially Significant Wetlands), do not function in isolation, but instead rely on the remaining woodland patches and natural features for their continued support. At the landscape scale, the size and shape of woodlands and their linkage to other woodlands are important factors in maintaining ecological integrity. Larger woodlands are more likely to contain a greater diversity of plant and animal species and are better buffered against harmful edge effects. Woodland shape affects the relative amounts of edge and interior habitat, thereby affecting wildlife. Woodland patches that are relatively close together are more valuable to migration of plants and animals than woodland patches of the same size that are located farther apart. Based on these landscape functions, Riley and Mohr (1994) identify three key concepts to ecosystem planning which the Middlesex County Natural Heritage Study incorporated when developing criteria for woodland significance: the protection of relatively large core areas, the restoration of corridors associated with watercourses and the replacement of connecting linkages on the landscape.

Partnerships

The Middlesex Natural Heritage Study (MNHS) was coordinated by the Upper Thames River Conservation Authority (UTRCA) in partnership with the County of Middlesex, Middlesex Stewardship Committee, Elgin Stewardship Committee, Middlesex County Conservation Authorities (Ausable Bayfield, St. Clair Region, Lower Thames Valley, Kettle Creek and Upper Thames River), City of London, Carolinian Canada, Nature Conservancy of Canada, Ministry of Natural Resources, Ministry of Municipal Affairs and Housing and the Thames-Talbot Land Trust. Representatives from each of these organizations were members of the steering committee and provided input to the design and development of woodland and wetland criteria. Both a technical (scientific) subcommittee and a policy (planning) subcommittee were formed and reported directly to the steering committee.

METHODOLOGY

Field Work

Biological information from both the Middlesex County Natural Heritage Study and the City of London Subwatershed Study (Bowles *et al.* 1994) was used to identify trends in Middlesex County. The landscape was stratified according to physiography to represent the landscape conditions. A range of woodland patch sizes was selected in each of the physiographic units and landowner permission was sought to survey the selected patches. Woodland patches were defined as irregularly shaped areas on Ontario Base Maps (OBM) and air photos that contain at least 60 % tree cover and differ from the adjacent land. Wetland patches were defined as irregularly shaped areas on OBM maps and air photos that are saturated with water long enough to contain hydrophytic vegetation. The boundaries of the patch were determined using a *whole patch concept,* where all naturalized vegetation within the patch is identified for inclusion in the boundaries of the patch.

Field assessments for the Middlesex Natural Heritage Study (MNHS) were carried out in 68 woodland patches (151 communities) by two surveyors between June 14 and August 22, 2001. Field assessments for the City of London Subwatershed Studies (COLSWS) were carried out in 85 woodland patches (715 communities) by 5 surveyors between March 21 and June 27, 1994. Patches were surveyed at approximately the same level of effort, based on time per unit area. Each patch was visited once and described by a collection of intrinsic field variables including soil texture and moisture, basal area by tree type and size and amount of anthropogenic and natural disturbance. Vascular plants were chosen as the primary indicator of woodland quality because of the relative ease with which they can be sampled and because much is known about their distribution in southern Ontario. From the list of vascular plants for each patch, indicators of species richness, mean conservatism, weediness and wetness coefficients were selected as the best approach to assessing the health of the natural environment in Middlesex County.

Geographical Information Systems (GIS)

Geographical Information Systems (GIS) was used to synthesize multiple layers of information across the County and was an invaluable tool in completing the Middlesex Natural Heritage Study (MNHS). For example, historic forestry information from the Conservation Reports and point attribute data of threatened and endangered species from the Natural Heritage Information Centre (NHIC) was linked to the woodland patches defined by GIS. To define the state of the Middlesex County landscape and to select locations for field sampling, GIS was used to overlay various abiotic (*i.e.* soil type, physiography), biotic (*i.e.* Ontario Base Maps, locations of threatened and endangered species) and cultural (*i.e.* historic forest cover) mapping layers. GIS was also used to manually correct (re-digitize) discrepancies between the OBM layer, 2000 air photography and Middlesex County vegetation layers.

Biological information that was collected from field surveys was linked to the mapping layers produced by GIS using the patch centroid. Analytical queries were performed by GIS which further assessed the landscape attributes of the woodland patch variables (*i.e.* patch size, patch interior, patch shape, distance between patches, distance to nearest road and railroad). The woodland patch variables are defined as:

- Patch size: woodland patch area
- Patch interior: amount of woodland area remaining after a 100 m buffer was removed from around the patch perimeter
- Patch shape: woodland patch edge to total area ratio
- Patch distance: distance to nearest neighboring woodland patch greater than four hectares in size and distance to nearest ANSI , ESA or wetland
- Road / Rail distance: distance to nearest road / railroad

Statistical Analysis

Multiple regression analysis for each of the forest health indicators (*i.e.* species richness, mean conservatism, weediness and wetness coefficients, disturbance index) against the woodland patch variables (*i.e.* patch size, patch interior, patch shape, distance between patches, distance to nearest road and railroad) was used to identify relationships between the various indicators and the size, shape and spatial distribution of the remaining forest-dominated ecosystems in Middlesex County. To examine the importance of patch size and patch interior, forest health indicators were plotted individually against the log of patch size and patch interior for all patches surveyed. An Analysis of Variance of each forest health indicator among patch size and interior was used to show if the indicator differed significantly among the size classes.

Resources

The main resource constraint in completing the project was the amount of time for collection of field data. Two vegetation ecologists had only one summer in which to

collect the biological information that would be used to develop criteria. With the exception of Bowles, *et al*. (1994), all other sources of life science information (*e.g.* Environmental Impact Assessments, Master Plan updates, *etc*.) in Middlesex County had many inherent problems associated with the data collection (*i.e.* varying methodologies, a focus on local rather than county context, outdated information, *etc.*). Since the information from City of London Subwatershed Studies (Bowles, *et al*. 1994) was collected in a comparable method and is up to date, it could be used to identify trends in Middlesex County.

Other data sources that were used in the study include:

Soil: Ontario Ministry of Agriculture, Food and Rural Affairs. 1985. Soils of Middlesex County. Resources and Regulations Branch. Geographical Information Systems Unit. Scale:1:63,360.

Forest Patch Size: Ontario Ministry of Natural Resources. 2000. Ontario Base Mapping (OBM) produced by UTRCA under licence. Queens Printer. Scale: 1:10,000.

Physiography: Chapman, L.J. and D.F. Putnam. 1972. Physiography of the Southwestern Portion of Southern Ontario. Map 2225. Scale 1:253,440. Ontario Department of Mines and Northern Affairs, Ontario Research Foundation.

Historical Forestry Information: Ontario Ministry of Natural Resources. Conservation Reports. Department of Planning and Development.

Threatened and Endangered Species Locations: Ministry of Natural Resources. Natural Heritage Information Centre (NHIC). Peterborough Ontario.

CRITERIA

A set of six landscape criteria were developed for Middlesex County that incorporate key ecological principles from conservation biology and landscape ecology. The approach used in developing criteria for Middlesex County recognizes that all woodland patches have some value and contribute towards ecological health. Where possible, information from the statistical analysis between independent woodland patch variables (*i.e.* patch size, patch interior, patch shape, distance between patches, distance to nearest road and railroad) and dependent woodland quality indicators collected in the field (*i.e.* species richness, mean conservatism, weediness and wetness coefficients, disturbance index) was used in developing the criteria.

The criteria are based on landscape (extrinsic) characteristics rather than field (intrinsic) characteristics for two main reasons. First, we were constrained in the number of woodland patches we could sample. Recognizing that there are approximately 8000 woodland patches in Middlesex County (not including City of London), it would take several seasons to collect a statistically significant sample that would allow for the development of defensible intrinsic criteria and appropriate thresholds. Therefore, we felt the best approach would be to use the trends we found in our field data to support established models of landscape ecology. Second, the documentation of intrinsic characteristics is more subjective, and therefore more open to interpretation, than that for extrinsic characteristics. For example, a 10 ha patch size criteria is easier to define and less open to interpretation than a 50 native species per patch criteria, since the number and type of species found depends on many factors including the season, amount of time spent in the patch, type of patch habitat, etc. Instead, we used the trends we found in our field data to develop appropriate thresholds specific to Middlesex County.

*** Natural Heritage Features recognized in the County Official Plan or City of London Official Plan** **All patches are pre-screened using any or all of these landscape criteria** **These are all scored at the PATCH level which means that the whole patch is identified if one or more of the criterion are met.**	1. Any woodland / wetland where 50% of the area is within 750m of a recognized Natural Heritage Feature*	**LANDSCAPE CONNECTIVITY**
	2a. Any woodland / wetland greater than 10 ha in area.	
	2b. Any woodland / wetland less than 10 ha that contains forest interior (defined as treed habitat more than 100 m from the patch edge).	
	3. Any woodland / wetland where 50% of the area is within 100m of a woodland / wetland greater than or equal to 10 ha.	
	4. Any woodland / wetland in a Carolinian Canada Big Picture corridor.	
	5a. Any woodland / wetland containing a watercourse.	
	5b. Any woodland / wetland within 50m on either side of a watercourse but not containing a watercourse.	**HYDROLOGY**

	6. Any woodland / wetland on porous soils that may have sensitive groundwater recharge / discharge resources.	

ANALYSIS

The following is a brief description and rationale behind each of the criteria:

<u>Criterion 1:</u> *Any woodland where 50 % of the area is within 750 m of a recognized Natural Heritage Feature ("core area").*

The objective of Criteria 1 is to ensure connectivity between the protected core areas in Middlesex County and their supporting natural heritage framework. A variety of ecological models (metapopulation, percolation, island biogeography) demonstrate that an absence of surrounding vegetation for core areas can jeopardize the long-term stability of these areas.

Seven hundred and fifty metres was selected as the maximum distance between core areas and woodland features for two reasons. First, most remnant core areas contain wetland components. The Southern Ontario Wetland Manual (OMNR 1994) states that wetlands can be hydrologically connected up to 750 m. Second, when the core areas are buffered by 750 m, linkages between these features and other woodland patches start to appear on the Middlesex landscape. 50 m was selected as the minimum amount of woodland patch that must be influenced by the buffer distance to ensure that the majority of the patch will be influenced by the distance.

The number of native plant species per patch and the sum of weediness scores per patch was tested against landscape and patch characteristics in a multiple regression. The number of native plant species was significantly negatively related to distance from a recognized natural heritage feature (ANSI and Wetland) while the sum of weediness scores per patch was significantly positively related to distance from wetland but significantly negatively related to distance to ANSI. The regressions were significant. Therefore, the closer the distance between the woodland feature and the recognized natural heritage feature, the greater the number of native plant species in the woodland. However, woodland patches closer to wetlands but farther from ANSIs have more highly aggressive species than woodland patches farther from wetlands or closer to ANSIs.

<u>Criterion 2:</u> *Any woodland greater than 10 ha in area or any woodland less than 10 ha that contains forest interior.*

The objective of Criteria 2 is to establish at what size of woodland patches consistently begin to serve a variety of ecological functions. Riley and Mohr (1994) recommend that woodlands dominated by mesic beech-maple forests, which are the dominant forest type in Middlesex County, should be protected if they are at least 4 ha in size. Riley and Mohr (1994) also recommend that in areas where overall woodland cover is between 5-15 %

(Middlesex County is approximately 12%), all woodland patches 4 hectares or greater in size should be protected. We further refined this size threshold based on trends found in Middlesex County. For example, models of island biogeography, which have been applied to studies of fragmented forest patches, predict that species richness will increase with patch size up to the regional species diversity. In Middlesex County, there is a significant positive relationship between native species and area, but no relationship between non-native species and area of woodland patch. As well, native species richness was much higher than expected for patches 10 ha or greater in size.

Patch size difference also accounts for much of the variation observed in mean conservatism. In general, mean conservatism scores of patches 4 ha or less are much more variable than mean conservatism scores for larger sites. Some of the smallest patches (< 4ha) have mean conservatism scores close or equal to that for many larger patches, while other small patches have much lower mean conservatism scores. As well, mean conservatism was higher in patches of size class 4-10 ha than in any other size class except patches > 40 ha. Bowles (1997) has suggested that past management history could account for the high mean conservatism values in these smaller patches. The fact that more conservative species were found in patches between 4 and 10 ha suggests that the patches have been preserved and managed as farm woodlands. These woodlands are the products of good stewardship, they may have been selectively logged for many years, but are generally more pristine and the community age is often older than the larger patches which have been commercially logged or are regrown from abandoned agricultural land.

Finally, 10 hectares is the size at which most woodland patches had interior habitat. Recognizing the numerous functions attributed to woodlands with forest interior, all woodland patches that do not meet the 10-hectare woodland size but that do have forest interior should be recognized. Wilcove (1987) and Harris (1984) have shown that physical edge effects (microclimate, sun scald, noise, wind, desiccation, invasive species, etc.) extend into a forest to a depth of three times the height of the trees in the forest. For a mature forest in Middlesex County, this would be 100 m. Therefore, forest interior is defined as treed habitat in the woodland patch that is more than 100 m from the patch edge.

Criterion 3: *Any woodland where 50 % of the area is within 100 m of a woodland greater than or equal to 10 hectares.*

The objective of Criteria 3 is to ensure connectivity between higher quality woodlands in order to protect their supporting natural heritage framework. In Middlesex County, species richness was higher for small patches closely linked to larger patches than similarly sized patches not linked to larger patches. 100 m was selected as the maximum distance between these woodland features since this is the distance at which linkages between these features and other woodland patches start to appear. 50 m was selected as the minimum amount of woodland patch that must be influenced to ensure that the majority of the patch will be affected by the distance.

Criterion 4: *Any woodland within a Carolinian Canada Big Picture corridor that does not contain a watercourse or is not within 50 m of a watercourse.*

Carolinian Canada Big Picture corridors have been identified in Middlesex County. The woodlands identified in these corridors have an added value associated with them in that they provide broader linkage opportunities between regions. Therefore, woodland patches located within these corridors should be recognized for their connectivity potential at the landscape scale.

Criterion 5: *Any woodland containing or within 50 m of a watercourse.*

The objective of Criteria 5 is to protect the feature (*e.g.* water quality and quantity) and function (*e.g.* life cycle requirements of a variety of terrestrial and aquatic organisms, wildlife habitat corridors) of watercourses. Buffers placed along large rivers provide habitat, bank stability and flood control functions, while buffers along smaller streams have more impact on water quality (Lowrance, *et al.* 2002). Large blocky buffers provide optimal wildlife habitat and groundwater cleanup while dense, narrow buffers may be effective at reducing sediment delivery at critical points (Lowrance, *et al.* 2002). Fifty m was chosen as a reasonable minimal buffer width to provide good buffering functions (*i.e.* moderate temperature and buffer erosion, sedimentation and runoff) and wildlife habitat or corridor functions for edge species (Castelle, *et al.* 1994, Lowrance, *et al.* 2002).

Criteria 6: *Any woodland on porous soils that may have sensitive groundwater recharge or discharge resources.*

The objective of Criterion 6 is to insure the integrity of the groundwater system. Until detailed groundwater studies and comprehensive hydro-geological mapping is completed (currently underway), all woodlands on porous soils will be recognized as potential zones of groundwater recharge / discharge. This criterion will be modified when the groundwater studies have been completed.

RECOMMENDATIONS

Based on the analysis of trends in Middlesex County, the steering committee supported the following recommendations by the scientific subcommittee:

1. All woodlands are important to Middlesex County and their protection should be advocated.

2. The six criteria for recognizing significant woodlands in Middlesex County are scientifically defensible.

3. Woodlands that do not meet the six criteria should still have some sort of assessment of intrinsic features to determine significance.

Under direction of the steering committee, the planning subcommittee drafted policy to support the recommendations. The draft policy and recommendations were presented to County council for approval. The final report will be completed at the end of December at which time it will be presented to the general public for review.

IMPLEMENTATION

The Middlesex Natural Heritage Study is a pilot project for the Carolinian Canada Big Picture Project and the Ministry of Natural Resources Ecological Land Classification System for Southern Ontario (Lee, *et al.* 1998), as well as landowner outreach and stewardship approaches. The study's specific products that will be implemented in the official plan update include:

- Background information for official plan policy (county and local plans) including planning and management scales for the implementation of MNHS
- Baseline data for natural heritage features
- Natural heritage systems mapping
- Criteria for, and local definition of, woodland significance to assist in evaluating Environmental Impact Studies (EIS) or Development Assessment Reports (DAR)
- Landowner conservation / stewardship / education tools
- Sites for future restoration and rehabilitation projects

The natural heritage framework defined by this study will be incorporated into county planning policy documents. It is anticipated that with the next iteration of the official plan review process, areas currently identified for future restoration and rehabilitation, as well as natural features that did not meet any of the six criteria, will be protected in official plan policy. Finally, the study provides a cost saving and increased efficiency to the County. It will be incorporated into the natural heritage component for local official plans, it will provide natural heritage information up front, thereby streamlining the approval process by removing some of the ambiguity in evaluating natural heritage features and it will provide the County with background information on such features as the health of the County's woodlands that can be applied to other policy tools such as the Tree Cutting Bylaw.

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APPENDIX E: *EVALUATION OF SIGNIFICANT WOODLANDS IN SOUTHERN ONTARIO: A REVIEW OF THE STATE OF THE ART*

Prepared for
Ontario Nature

by Ron Reid, Bobolink Enterprises
May 2002

1.0 Introduction

Within the Ontario Provincial Policy Statement last revised February 1, 1997, Section 2.3 Natural Heritage includes part 2.3.1 b), which states in part that "*development and site alteration may be permitted in significant woodlands south and east of the Canadian Shield if it has been demonstrated that there will be no negative impacts on the natural features or the ecological functions for which the area is identified*." Within the context of this policy, "significant" is defined to mean "*ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system. Criteria for determining significance may be recommended by the Province, but municipal approaches that achieve the same objective may also be used*."

In practice, the Province has not yet produced criteria for determining the significance of woodlands, except in a general way through the Natural Heritage Reference Manual. A number of municipalities have developed their own approaches to evaluating significant woodlands, and several others are in the early stages of doing so.

Over the past three years, the Federation of Ontario Naturalists has identified southern Ontario woodlands as a major priority for conservation progress, and has produced several conferences and publications to advance work in this area. This study, which is part of the broader Southern Ontario Woodlands Campaign, examines the state of the art in current approaches to identifying significant woodlands as a basis for further progress. In doing so, we hope to:

- Encourage municipalities to undertake woodland evaluation studies and incorporating the results into their Official Plans, by providing information on reliable, easy-to-use methodologies;

- Reduce duplication of effort and inefficiency by documenting previous approaches and encouraging information exchange;

- Develop a greater degree of consistency and standardization where appropriate among evaluation approaches, so that results are more comparable across jurisdictions and more defensible from attack before the OMB; and

- Identify areas requiring further research and consensus-building to establish generally consistent approaches.

This draft study provides a quick summary of work to date in various municipal jurisdictions across southern Ontario, a comparison of the evaluation criteria being used, and some initial thoughts on how evaluation approaches might be implemented in future. This draft will be circulated for comment and reaction, and subjected to review at a workshop of municipal planners, foresters, and ecologists. As well, the consultant will seek to work with several municipalities or other agencies in developing and testing refined approaches. At the end of this project, results will be compiled in a manual of recommended woodland evaluation approaches if possible.

2.0 Status of Woodland Evaluation: Southern Ontario Municipalities

The following information was gathered through a review of published reports and through personal contacts with staff of municipalities, conservation authorities, and other agencies. Blank columns indicate that no known work is underway, or that no information has yet been received. Corrections or additions to this table would be welcomed.

Municipality	Evaluation Status	Official Plan Policies	ELC Mapping	Contact
Southwestern Ontario				
Essex				
Chatam-Kent	Terms of Reference out for development of a natural heritage strategy, including woodlands.			
Lambton				
Elgin				
Middlesex	Natural Heritage Study under-way, focused largely on woodlands. Field work done on 68 patches in 2001. Draft criteria for landscape and woodland quality variables currently under discussion.		Completed for field study sites.	Tara Tchir 519-451-2800 x261 TchirT@thamesriver.on.ca
London	Comprehensive inventory of woodlots completed, evaluated as part of Natural Heritage System based on 7 criteria.	Incorporated into OP by amendment in 1996; upheld by OMB in 2000.	Completed for all sites.	Bonnie Bergsma bbergsma@city.london.on.ca
Norfolk				
Haldimand				
Oxford	Some work done as part of a terrestrial ecosystems study in 1997, but not for use in OP. New OP calls for a Natural Heritage System, including woodlands.	Target to increase forest cover from 12% to 15%. Where the Province identifies significant woodlands, require EIS. Encourages retention and enhancement of locally-sign. woodlands.	No	Marg Evans 519-539-0015 x347 mevans@county.oxford.on.ca

Brant	Size only.	2000 OP maps woodlands >4 ha; developers do study to determine if each is significant.		
Huron				
Perth				
Bruce	Size only.	1997 defines woodlands >40 ha as significant in townships with <30% forest cover; requires EIS.		
Grey				
Simcoe	Natural Heritage System mapped in 1996, based on landscape units; included woodlands >40 ha but modified to reflect local landscapes, shape and proximity, age and health, species composition.	Included as part of Greenlands system in 2000 OP; development generally directed away from significant woodlands, etc.	No	Ian Bender 705-726-9300 x255 ibender@county.simcoe.on.ca
Tay Township	Natural Heritage Study done about 1995, included size, age, presence of hemlock, proximity and linkage.	Included within OP and also zoned as Environmental Protection. Has caused controversy, field ground truthing underway.	No	Wes Crown 705-534-7248 x225 wcrown@tay.township.on.ca
Oro Moraine	Draft natural heritage criteria proposed for planning study in its early stages; also draft woodlands criteria for Couchiching Conservancy field study.	To be incorporated under Oro-Medonte OP.	Underway	Mike Jones, Azimuth Environ-mental Consulting mike@azimuthenvironmental.com
Dufferin				
Wellington	Any woodland >10 ha.	Incorporated into 1999 OP as part of Greenland designation; requires EIS.	Part of Erin Twp.done by CVC.	Mark Van Patter 519-837-2600 x208 markv@county.wellington.on.ca

Waterloo	Recently initiating a study of significant woodlands; developing workplan.	Woodlands which fulfill criteria will be designated ESPAs by Region; others Locally Significant Natural Areas by local municipalities.	No	Chris Gosselin 519-575-4501 gchris@region.waterloo.on.ca
Niagara	Mapping sign. woodlands as part of Natural Heritage System this spring. LandCare Niagara applied Ontario Hydro Spatial Habitat Model to identify woodland patches, linkages, restoration areas.	New environmental policies being developed currently for OP.	No	Ken Forgeron 905-984-3630 ken.forgeron@regional.niagara.on.ca
Niagara Falls	Urban wooded area assessment (1993) considered stand quality, landforms, other designations, diversity, sign. species, size, disturbance, expansion potential, recreation activities, and linkage.			Report by Trees Unlimited.
Hamilton	Sign. woodlands defined on basis of size (modified for landscape context), other designations, age, rare species, interior habitat.	Part of Regional Greenlands System.	Gradually being implemented in ESA surveys and EIS reports.	Catherine Plosz 905-643-1262 x231 cplosz@city.hamilton.on.ca
Halton	Draft criteria currently under discussion.	1995 OP includes a Greenlands System; current review would more specifically incorporate significant woodlands and other natural heritage features.	Yes, through CVC	Carolyn Hart 905-825-6000 x7214 Dale Leadbeater dleadbeater@gartnerlee.com
Oakville	Five criteria used to evaluate 25 tableland forest blocks. Earlier pilot study by OMNR (1995), similar to Mississauga-Brampton.	Part of 1999 Natural Heritage System development.	Yes, through CVC	
Peel	Primarily size, as part of a broader Greenlands System.	In 2001 OP, Greenlands System includes woodlands >30 ha in core areas; woodlands >3-30 ha in Natural Areas and Corridors; woodlands <3 ha in Potential Natural Areas and Corridors.	Yes, through CVC and TRCA	Andrea Warren 905-791-7800 x4355 andrea.warren@region.peel.on.ca

Caledon	2000 Woodlands Policy Review, includes criteria based on size, interior forest, age, VTE species, community rarity and diversity, adjacent wetland, connectivity.	To be incorporated into OP policies in near future.	Yes, through CVC	Todd Salter tsalter@Town.Caledon.on.ca
Mississauga	Part of Natural Areas Survey of 144 sites. 1995 pilot study by MNR, similar to Brampton.	Requirement for EIS prior to development.	Yes, through CVC	Lesley Paven
Brampton	1995 MNR pilot study used four criteria: size, uncommon woodlands, occurrence of other natural heritage features within or adjacent to site, and ecological functions such as primary succession or buffering.			Adrian Smith adrian.smith@city.brampton.on.ca
Toronto	Developed a numerical scoring system for a terrestrial natural heritage approach, based on size, shape, matrix influence, habitat types, forest interior, geographic distribution.	Contributes to Ops within watershed.	Yes	Lionel Normand lnormand@TRCA.on.ca
York	Greenlands System generally includes forest areas >15 ha plus major blocks of contiguous successional communities.	York OP includes a Regional Greenlands System. 1994 forest resource mapping being updated to include woodlands >0.5 ha.	For some watersheds in LSRCA and TRCA	Barb Jeffrey 905-830-4444 x1526 barb.jeffrey@region.york.on.ca
Newmarket	Undertaking a natural heritage study.			
Oak Ridges Moraine	Primarily size - >1ha within core areas; >4 ha in countryside	Part of Oak Ridges Moraine Plan	Parts	Fred Johnson 905-713-7379 fred.johnson@mnr.gov.on.ca
Durham	Currently working on methodology as part of Natural Heritage System.	Durham OP undergoing review.	Yes, through CAs.	Chris Darling chris.darling@region.durham.on.ca
Pickering	1996 MNR study identified criteria for size, other natural heritage features, uncommon forest features, and ecological functions.		Yes, through CAs.	

Clarington	1998 study (Geomatics) using FRAGSTATS to identify woodlands with forest interior.	Draft OPA defines significant woodland as old growth or >30 ha on Oak Ridges Moraine, or >4 ha in other rural areas, or >1 ha in urban areas. All significant woodlands included in core areas; special protection for two major cores on ORM and corridor linking them.	Yes	Janice Auger Szwarz 905-623-3379 jswarz@municipality.clarington.on.ca
Peterborough Co.	Preliminary work done by MNR for two townships, using a point score system; never completed.	County OP current undergoing review.	No	Sandy Welsh 705-743-0380 x330 swelsh@county.peterborough.on.ca

Kawartha Lakes	May be undertaken as part of new OP.	New OP development in early stages.	Underway through KCA.	Richard Danziger 705-324-9411 x239 rdanziger@city.kawarthalakes.on.ca
Northumberland	Natural heritage system for Lower Trent watershed identifies significant woodlands based on size, interior habitat, hydrology, diversity, and age.			Glenda Rodgers 613-394-3915 x19 rodgers@blvl.igs.net
Hastings	Part of Hastings included in Lower Trent study.			
Prince Edward				
Lennox/Addingt.	Cataraqui Region CA tested a methodology (1994), based on biodiversity, location, size, shape, diversity, fragmentation, riparian links and disturbance.			
Leeds/Grenville	2000 pilot project with MNR and EOMF; mapped woodland polygons but no evaluation.	None yet.	No	Karen Fraser 613-342-3840 x 328 kpfraser@ripnet.com
United Co. of D/S/G				
Prescott/Russell	No evaluation.	1999 OP requires an EIS for development inside or within 50 m or significant woodlands.		Pierre Mercier pmercier@hawk.igs.net
Ottawa	1997 Natural Area evaluation across Ottawa-Carlton region but no woodland-specific criteria; Natural and Open Spaces Study within City, using environmental and social criteria.	Part of Natural Environment Systems Strategy within OP.	No	Deborah Irwin 613-580-2424 x13000 deborah.irwin@city.ottawa.on.ca

3.0 Evaluating Significant Woodlands: A Comparison of Municipal Approaches

Over the past eight years as noted in the table above, various municipalities and other jurisdictions have undertaken studies to identify significant woodlands. While these studies have varied greatly in their degree of detail, their reliance on existing data or collection of new field data, and their comprehensiveness, they are all based to some degree on Policy 2.3 of the Provincial Policy Statement, and on the guidance provided by the 1997 Natural Heritage Reference Manual.

This section will look at the degree to which various criteria have been used or are proposed for use in these studies (since in many jurisdictions the criteria are still in draft form). In the following, references to Ottawa-Carlton relate to the 1997 natural areas study carried out for the Region, while Ottawa refers to the Natural and Open Space Study done for the former City of Ottawa.

3.1 Defining Woodland Patches

Before evaluation criteria can be applied, it is necessary to define which landscape features are included within the definition of "woodland", and how individual patches are identified for evaluation. For example, at what point does a regenerating old field become part of a "woodland"? If a road crosses through a forested landscape, does it create two separate patches for evaluation purposes? Such definitions can profoundly affect the application of some criteria (e.g. interior forest), but in most studies, they are assumed rather than specifically spelled out.

The definition of woodland within the PPS is of little assistance:

> *"treed areas that provide environmental and economic benefits such as erosion prevention, water retention, provision of habitat, recreation, and the sustainable harvest of woodland products. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance."*

Often municipal tree by-laws, which are based on the *Forestry Act*, provide a more precise definition, such as the Waterloo Regional Tree By-law:

> *"Woodland means any area of land, 0.8 ha in size or larger, having a density not less than:*

- *1000 trees per hectare of any size;*
- *750 trees per hectare measuring more than 5 centimeters dbh;*
- *500 trees per hectare measuring more than 12 centimeters dbh; or*
- 250 trees per hectare measuring more than 20 centimeters dbh; and shall include the area up to the drip line of the Woodland and any corridors measuring up to and including 30 metres in width."

A few municipalities, such as London, have referred to the ELC manual definition (Lee et al., 1998) of woodlands as *"all vegetation patches containing treed areas; treed areas may include all communities with a tree cover of >10%"*. The ELC classification system differentiates

between "woodland", with 35 to 60% tree cover, and "forest" with at least 60% tree cover. However, the use of the term "woodland" in the PPS and related documents (including this one) is generally interpreted to include both of these definitions.

Comment:
In most cases, the definition of "woodland" has been left somewhat vague. Where woodlands are evaluated as part of broader natural heritage systems, this may be less of a problem, but more specificity would seem to be generally desirable. In particular, a standard approach on when restored "woodland" is first considered to be present, whether created through natural regeneration or planting, would be helpful. For example, a minimum height of 2 metres might be used. MNR has recently addressed this problem for studies using satellite imagery through a report Steps and Procedures for Editing an OBM Vegetation Layer to Produce a Woodlands Layer Using Satellite Imagery (Pilot Project for the United Counties of Leeds & Grenville (Scherzer, 2000).

A related issue, which some municipalities have addressed, is whether or not to include plantation forests. In Simcoe County, conifer plantations are included only if they form an integral part of larger core areas or corridors. A similar definition was used in Tay Township, with the added provision that plantations could be defined as significant woodlands if they are on steep slopes or areas of high infiltration. In Peel Region, plantations are normally included unless an EIS determines that they should not qualify as a significant woodland. Clarington includes "significant plantations" under their policies, which are defined as plantations larger than 30 ha located on the Oak Ridges Moraine or greater than 4 ha located elsewhere, which are structurally diverse and in good health, and which provide important ecological functions. Other studies appear to be silent on this issue.

Comment:
Given the potential of most conifer plantations to return to naturally-occurring woodland communities over time, if managed to that end, their inclusion as part of larger woodland areas would normally appear to be appropriate. Their inclusion might also be linked to their location in the landscape - those with the potential to expand a core area or provide linkages could be included, but not isolated patches.

Similarly, most studies do not specify how much distance or what kind of barriers would determine the edge of a woodland patch. Those that do include:

- OMNR's Significant Wildlife Habitat Technical Guidelines (2000) suggests that gaps, including roads and rights-of-way, should be <20 metres within contiguous closed-canopy forests.
- The Natural Heritage Reference Manual states that woodlands areas are considered to be generally continuous even if intersected by standard roads (e.g. 20 metres wide).
- The City of London uses a similar value, considering woodlands to be continuous even if bisected by a standard 21 metre road, including local roads and secondary collectors.
- In Caledon, woodlands are considered as one patch if separated by 26 metres or less, unless there is a major road or barrier between.

- The Ontario Hydro Spatial Habitat Model includes woodlands within 50 metres of each other in a single patch.
- On the Oro Moraine, where forest cover is much higher (60% of the landscape unit), woodland patches have been separated by even gravel-surfaced rural roads, where the canopy break is sometimes minimal.
- In Clarington, all railways and major provincial roads are consider to bisect forest blocks, but secondary county roads, unpaved roads and trails do not. Two and four tower Hydro right-of-ways break a forest block, but single line right-of-ways do not.
- MNR's pilot studies in Mississauga/Brampton/Oakville considered woodlands separated by a small road, a single house, or a railroad to be one site, but split those separated by a major highway or >50 m distance.
- The Lower Trent study uses 21 metres as a guideline, but normally splits polygons for County roads and Highways, but not for Township roads, with some exceptions where the clearing is obviously more than 21 metres, or where extensive overhanging woodland cover is present.

Comment:
Clearly, the impacts of woodland gaps on wildlife movement and interchange are closely related not only to distance, but also the nature of the barrier created (blowdown, field, rural road, busy road, urban development, etc.) and the species involved (e.g. birds may be relatively mobile compared to amphibians, and plants vary according to their methods of seed dispersal). To some extent, the assessment of woodland patch boundaries has to be based on site-specific characteristics. But some greater standardization of approaches would appear to be useful, particularly with respect to determining the extent of interior forest conditions.

Another concept which has been mentioned but not extensively tested is the idea of "woodland complexes", that would consider a number of small patches in close proximity as a single unit. Such an approach could be useful if there is good potential for regeneration of larger woodland blocks over time, but could not be used to measure forest interior habitats without severe bias.

3.2 Commonly-Used Evaluation Criteria

The following seven criteria are used by most of the jurisdictions surveyed.

1. Woodland Patch Size:
The Natural Heritage Reference Manual (in Attachment A.4) suggests standards for considering woodlands significant relative to the amount of cover in the landscape:

- Where woodlands cover less than 5%, woodlands 2 ha or larger;
- Where woodlands cover 5 to15%, woodlands 4 ha or larger;
- Where woodlands cover 15 to 30%, woodlands 40 ha or larger, preferably 300 metres in minimum width;
- Where woodlands cover >30%, no minimum size; consider other factors.

Virtually all of the municipalities responding have used patch size criteria that are identical to or similar to these standards. In a few cases, size is the only criterion used e.g. Wellington County, with 17% forest cover, identifies all woodlands >10 ha as potentially significant. Several municipalities (Peel, Caledon, Pickering, Simcoe, Hamilton, Clarington) have applied different standards to different landscapes within their jurisdictions, recognizing local differences in forest cover.

Some municipalities have used tighter standards, such as Hamilton, where landscapes with 17-19% cover define woodlands >20 ha as significant, and landscapes with 6-8% cover define woodlands >2 ha as significant. Some have linked size ranges to designations within a Greenlands or natural heritage system, such as Peel Region which includes woodlands >30 ha in its core areas, and woodlands >3 ha in a natural areas/corridor designation. The Ontario Hydro SHA Model assigns a range of numerical values to a series of patch sizes ranging from 2-5 ha up to >2560 ha. These values are correlated to ratings of habitat diversity within each size class.

Comment:
This criterion appears to have been applied relatively uniformly, with the exceptions to the suggested provincial standards appearing appropriate to local landscape conditions. The differentiation of standards where differing landscape conditions apply within regions is especially appropriate. However, it could be helpful to provide more direction on how to determine which landscape units to use to measure the percentage of forest cover, since the results could differ substantially between upper-tier and lower-tier municipalities, watersheds, or landform units.

2. Forest Interior Habitats:
The Natural Heritage Reference Manual recommends that woodlands with more interior habitat be selected in areas where interior habitat is in limited supply and/or where forest interior dependent species are declining. The Significant Wildlife Habitat Technical Guide suggests that the most significant forest stands should contain at least 10 ha of forest interior excluding at least a 200 metre buffer around the forest interior. Ontario Hydro's SHA Model assigns numerical values to a range of forest interior core sizes, based on buffers of 100, 200, and 300 metres.

Although relatively few southern Ontario woodlands could meet those standards, most of the jurisdictions surveyed considered the presence of at least some interior habitat, usually based on a 100 meter edge buffer, as a significant criterion. Gaps in the canopy created by rural roads or single-row utility corridors are not usually considered to fragment forest interior habitats.

In some studies, the importance of woodland shape and interior habitat is mentioned, but without specific standards (e.g. Simcoe, Tay, Oakville). In some areas, the occurrence of any size of interior habitat is considered significant (Middlesex, Hamilton, Caledon on Peel Plain section, Pickering). In others, a minimum size of 4 ha of interior habitat is used as a standard (London, Caledon north of Peel Plain). In the Oro Moraine draft criteria, an interior habitat size of >40 ha is proposed for the highest score, with >6 ha for a moderate score. In the Lower Trent criteria, interior habitats with a 100 m edge buffer and a minimum patch width of 300 m are considered significant..

Several other measures have been proposed to evaluate the effect of the shape of the woodland patch, including the interior:edge ratio (Middlesex, Oro Moraine) and the edge:total area ratio (Middlesex). In London, the presence of conservative forest bird species, based on County-level priority birds identified by Bird Studies Canada, was used as an indicator of functional forest interior habitats. The Clarington study also lists forest interior bird species, but does not specify these as a criterion for significance.

Comment:
The linking of the amount of forest interior considered significant to local landscape/forest cover conditions would appear to have merit. It may even be possible to propose some standards linked to the same woodland cover classes used for the patch size criterion e.g. where woodland cover is <15% of the landscape, any forest interior is significant; where woodland cover is 15-30%, forest interior >4 ha is significant, etc. Another area needing greater consistency is the merging or splitting of woodland polygons, as discussed previously, since this factor greatly influences the amount of interior habitat measured within a landscape.

3. Proximity and Connectivity:
The proximity of other woodlands or natural heritage features, and the degree of connectivity with these other natural areas, have been identified in most studies as significant factors. However, a range of differing standards have been used to evaluate these factors. For example:

- The FON Woodland Heritage Study (Larson et al. 1999) measured the percentage of natural area within 1 kilometre of each study site;
- Toronto Region Conservation is looking at the amount of natural cover and other land use within a 2 kilometre radius;
- London measured percent woodland cover within 2 kilometres, as well as the nearest patch >4 ha not separated by urban development or a permanent cultural barrier;
- Regional Municipality of Ottawa-Carlton measured the percentage of forest/wetland cover in the landscape within 3 kilometres;
- The Oro Moraine study proposes to consider the distance to the next forest patch in each direction, starting with contiguous, and then <50 metres, as well as the number of forested linkages to other units and the width of those linkages >100 metres;
- Middlesex is considering a distance of <750 metres to an ANSI or a natural area >10-15 ha as a standard for significance;
- The MNR pilots in Mississaga/Brampton/Oakville used a measure of within 250 metres of another significant natural heritage feature.
- Niagara Falls used the presence of a wooded ravine, hedgerow or prominent fencerow to measure connectivity.
- Pickering notes other nearby natural heritage areas with the opportunity to restore adjacent areas;
- Hamilton uses a standard of being within 50 metres of a core natural area.
- Ontario Hydro SHA Model used a proximity standard of within 100 metres of another woodland, as well as patches with forest interior within 2 km of each other.

The other common measure of connectivity is the location of a woodland within a natural corridor of some type, which is employed as a criterion by London, Middlesex (Big Picture corridors), Simcoe, Hamilton, Caledon (including woodlands that could act as a locus for restoration), Ottawa, and Pickering.

Comment:
While occurrence within corridors appears to be a standard for connectivity with common acceptance, the standards for proximity to other woodlands or natural heritage features clearly need further examination. Current approaches on measuring proximity are "all over the map", and seemingly not based on an extensive body of science. This area should be a high priority for further work.

4. Hydrological Linkages:
A number of linkages to natural water systems have been recognized in the evaluation criteria of most of the municipalities surveyed:

- The presence of rivers or streams within a woodland (London, Pickering, Brampton, Ottawa-Carlton, Ottawa) or in close proximity (Middlesex - within 50 metres, Lower Trent - within 10 metres);
- The presence of wetlands within or adjacent to a woodland (London, Pickering, Lower Trent, Caledon - within a wetland complex or combined with contiguous wetland for patch size calculations);
- Within headwater areas or catchment area of first-order streams (London, Pickering, Brampton, Lower Trent, Ottawa-Carlton, Oro Moraine);
- Within groundwater recharge or discharge areas, shallow aquifers (London, Pickering, Brampton, Ottawa-Carlton, Ottawa, Oro Moraine).

Comment:
This criterion is relatively easy to apply at a landscape level. While there may be some overlap with the provincial wetlands policy or Policy 2.4 on water quality and quantity, its use normally appears justified (some additional jurisdictions may have included wetland within or adjacent to a woodland under the streams category). Some aspects of hydrology might be combined with measures of proximity/connectivity - e.g. woodlands within 50 metres of a watercourse.

5. Diversity:
The Natural Heritage Reference Manual proposes woodland diversity as an evaluation factor, suggesting that several vegetation community types, age compositions, etc. are more valuable as wildlife habitat than less diverse woodland. Similarly, the Significant Wildlife Habitat Technical Guidelines identify a series of evaluation criteria relating to "forest stands providing a diversity of habitats", including:

- stands providing several kinds of significant wildlife habitats (e.g. forest interior, raptor nesting, rare community);

- larger sites;
- sites with a wide variety of age classes of trees, especially those with a high proportion of old or diseased/damaged trees and uneven-aged stands;
- sites with a diversity of tree and shrub species in a diverse understory, mast trees, conifers within stands, and a variety of tree species;
- sites containing a diversity of wildlife cavities;
- sites near water.

Some of these factors have been incorporated into other criteria by municipalities. In general, most municipal evaluation approaches have assessed diversity at a broader habitat level, by documenting the number of vegetation communities occurring within a site. In earlier studies, such as Ottawa-Carlton, this was done on the basis of vegetation/landform types. In the City of Ottawa study, a high ranking was given to sites with >5 vegetation communities. In Brampton, a criterion of 4 or more different forest cover types was used.

Since 1998, most studies have relied upon the Ecological Land Classification protocol produced for southern Ontario (Lee et al. 1998) as a basis for evaluating habitat diversity. Diversity is usually measured at the community series level, but the number of ELC communities present within a patch to qualify as high diversity varies within several applied or proposed approaches: London - 4 or more communities; Middlesex - 2 or more; Caledon - 2 or more; Oro Moraine - 5 or more.

Several studies have used other measures of diversity as well. London included diversity criteria for 4 or more ELC vegetation types, or 2 or more vegetation types on 2 or more different topographic features. London also identified the presence of >25% indigenous conifer cover, and the diversity of amphibian species and critical habitat components for amphibians as measures of diversity.

Niagara Falls measured the diversity of tree and shrub species present within each patch. The proposed Peterborough County prototype assigned low diversity ranks to plantations, and higher scores to hardwoods with >4 tree species and mixed woods with >30% conifers. Ottawa defined a criterion based on the relative number of plant species present with high floristic indices. The Oro Moraine study proposes to measure species diversity in three structural layers - the canopy, intermediate shrubs, and herbaceous ground cover. The Lower Trent criteria relate diversity to the presence of PSWs, ANSIs, or ESAs.

Comment:
The emergence of ELC mapping as a standardized approach to community classification has greatly facilitated the application of this criterion. The number of communities used as a cut-off for significance will vary regionally. The use of more fine-scale measures of diversity, such as species diversity, is highly dependent on the degree of field effort possible. One caution about the use of this criterion is the relationship of the number of communities or species to patch size - larger patches could be expected to encompass a larger number of communities/species, but this relationship does not appear to be incorporated in the studies examined to date.

6. Age

Older woodlands were identified as particularly valuable within the Uncommon Characteristics factor of the Natural Heritage Reference Manual, with specific mention of woodlands >100 years in age. The criteria used to identify the heritage woodlands of southern Ontario (Larson et al. 1999) have a particular focus on the identification of old-growth woodlands, including a series of criteria intended to assess the ecological integrity of older stands, such as:

- Tree size (mean diameter, size of largest tree sampled, % of sampled trees >49 cm dbh, % of sampled trees >69 cm dbh);
- Total basal area of trees >10 cm dbh (with reference to a proposal by Keddy and Drummond (1996) that a basal area >29 sq m/ha is indicative of older-growth stands);
- Size-class distribution, with an idealized reverse-J distribution providing evidence of old-growth;
- Number and degree of decomposition of coarse woody debris;
- The number of conservative woodland bird and plant species;
- A mean conservatism index and floristic quality index calculated for each site;
- Herb richness;
- Prevalence of non-native species, with fewer species indicating higher quality;
- The number of stumps within 10 m of sampling plots as evidence of logging.

Most municipal approaches have simply considered the age of the woodland as a criterion, with >100 years or >99 years being the universal standard (e.g. Simcoe, Tay, Hamilton, Clarington, Mississauga, Brampton, Lower Trent, Ottawa). A few others have been somewhat more specific, such as Pickering, which used >100 years in age OR >6 late successional tree species, and Caledon, which specified at least 8 tree/acre >100 years in age, OR a climax community >50 cm dbh. London identified "mature or old growth community types" as significant without identifying a particular age, along with a criterion based on the mean coefficient of conservatism as an index.

A proposed approach for Middlesex also makes use of the mean coefficient of conservatism, based on the Floristic Quality Assessment System for Southern Ontario (Oldham et al. 1995), along with a measure of the percentage of non-native plants as an indicator of age and integrity. The proposed Middlesex evaluation system also uses the identification of late seral stages and the proportion of shade tolerant trees in the canopy as important indicators of age.

Comment:

While there appears to be broad agreement about woodlands >100 years in age as an important criterion, the way in which this criterion is applied could use some standardization. It is often not clear how this age is identified in the field (for stands, as opposed to individual trees), and currently available FRI mapping is usually too out-of-date to allow extrapolation. A standard way of identifying woodlands >100 years would be useful, without requiring the kind of intensive field work that are needed for the criteria used by Larson et al. (1999). As well, the value of late seral stages, and especially mature or old-growth examples of late seral stages, needs further examination. This might be measured by documenting the proportion in the canopy of shade

tolerant species such as American beech, sugar maple, basswood, and eastern hemlock, as proposed by Keddy and Drummond (1996).

7. Rare Species

Rare species are not mentioned as a factor for evaluation significant woodlands within the Natural Heritage Reference Manual, and some studies have argued that rare species are adequately covered through other natural heritage policies. Nonetheless, rare woodland bird and plant species were included as a criterion in the FON heritage woodlands study (Larson et al. 1999), and rare species are commonly included within municipal studies as well.

Most studies include habitat for any designated VTE (vulnerable, threatened, endangered) species (Middlesex, London, Caledon, Mississauga, Brampton, Oakville, Ottawa-Carlton, Ottawa), and Middlesex also includes species ranked as G1-G3 and S1-S3/4 by the Natural Heritage Information Centre. Several jurisdictions also include regionally rare species (London, Niagara Falls, Ottawa-Carlton, Ottawa), with Middlesex specifying that to mean 1-5 records within the County. Several other studies (Pickering, Oro Moraine) mention rare species but are less specific on how these are defined. Hamilton has restricted their application of this criterion to rare tree species, based on rarity at the national, provincial, or regional level.

Comment:

Some concern has been expressed that including rare species as a criterion could result in double-counting this factor, since it is specifically considered under another natural heritage policy. While this could be true in part, it is important to note that only threatened and endangered species are covered elsewhere, and similar double-counting could arise for identified treed wetlands, ANSIs, etc. For jurisdictions with multi-faceted Natural Heritage Systems, this duplication may be of less concern. A more significant concern relates to the adequacy of data sets relating to rare species. Particularly in regional studies with limited field work, the inclusion of a rare species record from known data may reflect more the amount of expert field time in a site than the actual distribution of the species. Where field visits to all or most of the woodlands being studied has been done by qualified people, this is less of a concern.

3.3 Criteria Used by Some Studies

The following nine criteria have been used by fewer than half of the jurisdictions surveyed.

8. Landscape Matrix

As noted above, many evaluation studies consider the proximity of other natural areas. Some also look at the context of human uses in the surrounding landscape, which may negatively affect the quality or functioning of a woodland, or isolate it from natural landscape connections. In the FON Heritage Woodlands study, this factor was considered by measuring the length of roads/ha in the area adjacent to woodland sites, as well as the number of buildings/ha.

A few municipal approaches have also considered this criterion. Toronto Region Conservation identifies "matrix influence" as the relative amounts of urban, agricultural, and natural cover within a 2 km radius of a site. The Oro Moraine study proposes to document the adjacent land use category for each compass point around each woodland site. London and Middlesex

consider the nature of urban development or permanent cultural barriers separating its woodlands from other natural areas.

Comment:
In some ways, this criterion is a converse of the proximity criterion, and the two factors can be measured jointly. However, there is evidence that the health of woodlands can be affected by adjacent urban development (particularly residential development which may bring tree-cutting, dumping, and free-roaming pets), with impacts that go beyond isolation effects.

9. Landforms
A few studies have identified woodlands on uncommon landforms as significant. London identified 5 distinctive, unusual, or high quality landforms, and considered woodland patches on these landforms to be significant. Middlesex proposes a similar approach for 4 kinds of physiographic types. The Oro Moraine study proposes to use topographic complexity as a criterion, based on this landform effect on microhabitats. The Natural Heritage Reference Manual also notes "highly productive tableland woodlands" as uncommon and significant. The Mississauga/Brampton/Oakville studies carried out by MNR included forests on the highest quality sites as a criterion. The MNR pilot study in Peterborough County referred to productivity as a criterion, with deep, fresh, fertile sites scoring highest.

Comment:
This criterion appears to be largely oriented to ensuring that samples of uncommon landform types are represented within a system of protected woodlands. Since ELC classes consider both landforms and vegetation, it could possibly be combined with Uncommon Woodland Types criterion (see below). It also includes some elements of representation (see below), by trying to ensure that the most productive sites are also captured.

10. Representation
A few studies identified woodlands that provide excellent representation of common or representative community and landform types. Ottawa-Carlton provides the best example of this approach, where the largest forest polygons of common types were identified as significant. The Tay Township study also mentions species composition and representativeness as an important evaluation factor, but is lacking in detail on how this factor was applied.

Comment:
This approach parallels the provincial methodology for identification of ANSIs, but at a more local level. The artificial nature of municipal boundaries relative to natural landscapes could present difficulties in applying it effectively in some areas.

11. Uncommon Woodland Types
The Natural Heritage Reference Manual lists woodlands composed of rare tree species and/or are a rare forest community type as uncommon and significant. Some municipalities have identified the presence of uncommon woodland types as an important criterion. In a few cases, the criterion is left generally stated (Pickering - uncommon forest type or rare trees; Ottawa-Carlton

- provincially rare communities) but most jurisdictions using this criterion base it on the NHIC community rankings.

Caledon identifies S1-S3 communities, and London and Middlesex identify S1-S3/4. Ottawa-Carlton also includes >5 regionally rare communities (defined as occupying <0.1% of the region) within a single site as significant, and Ottawa includes >2 locally rare communities in a site as well. The proposed Oro Moraine criteria include a provision for vegetation community rarity, based on an occurrence in the landscape of less than 10%. The MNR pilot for Mississauga and Brampton included forest types representing <5% of the forest group to which it belongs (e.g. hardwoods, mixed), as well as natural forests with occurrences of uncommon species in their tree composition.

The other uncommon element of woodland cover is the presence of naturally-occurring conifer patches. The draft Middlesex criteria identify conifer canopy cover as significant, along with coniferous forest, coniferous swamp, fen or bog. London also identifies conifer canopy cover as a criterion, and Tay Township lists the presence of Eastern Hemlock as an important criterion for significant woodlands.

Comment:
Broader use of ELC mapping should help greatly with the consistent application of this criterion. There appears to be a need for discussion on a reasonable standard for "uncommon", to narrow the current range from 0.1% to 10% of the landscape. The Natural Heritage Reference Manual suggests <5% of the woodland area in a planning area as a standard for uncommon characteristics, which may provide a useful guide. The importance of conifer cover is likely to vary considerably by region, since this type of cover is more abundant northwards.

12. Individual Large Trees
The presence of individual large trees, which are usually of great age and increase structural diversity of the woodland, has been identified as a criterion by a few municipalities. London lists the presence of trees >50 cm in dbh as a criterion. Caledon lists the presence of significant individual heritage trees within a woodland as a criterion for inclusion in a natural corridor.

Comment:
This criterion may be of some assistance at a local level, but requires relatively detailed field knowledge to apply.

13. Erosion and Slopes
Several studies have included the role of woodlands in curtailing erosion on steep slopes as a criterion for significance. Ottawa refers to stabilizing slopes >15%. London lists woodlands on steep slopes (15%), or on moderate slopes (>10-15%) with erodible soils. The Peterborough prototype study used a criterion called Environmental Protection, based on erodibility and location next to a watercourse.

Comment:
This criterion appears to have a similar rationale as protection or buffering of watercourses, and it is a little surprising to see it used so seldom. A standard approach to defining slopes to be included would be appropriate.

14. Lack of Disturbance
Although lack of disturbance is not specifically included within the approach identified in the Natural Heritage Reference Manual, it is applied to woodland areas supporting area-sensitive species as part of the Significant Wildlife Habitat Technical Guide, with guidelines relating to:

- The amount of contiguous canopy cover with few man-made gaps;
- Preference for roadless sites with no history of grazing or forestry operations for at least 20 years;
- Stands with a history of little or no forest management are considered most significant, and uneven-aged stands are generally more significant than even-aged forests.

The FON Heritage Woodlands study used the proportion of non-native plants and evidence of logging or trails as indicators of disturbance. London used a disturbance rating based on the ELC system. Ottawa-Carlton looked at the degree of human disturbance from trails, dumping, etc., as well as the proportion of plants with a coefficient of conservatism >7. Ottawa also looked at the presence and extent of human disturbances, as well as the degree of regeneration of canopy tree species. Niagara Falls ranked disturbance based on 11 factors, including both human and natural disturbances.

Comment:
The ELC Management/Disturbance sheet provides a standard and relatively comprehensive approach to rating disturbance, including both man-made (logging, sugar bush, grazing, planting, etc.) and natural (wind throw, deer browsing, beaver flooding, etc.) disturbances, with a numerical scoring system for each. Its broader use could provide a more standardized approach.

15. Other Planning Designations
A few jurisdictions have identified overlap with other planning designations as a criterion for woodland significance. Hamilton lists Environmentally Sensitive Areas, ANSIs, Provincially Significant Wetlands, and Significant Fish Habitats within their approach; Pickering used ESAs, ANSIs, Oak Ridges Moraine core areas and corridors, Lower Trent suggests PSWs, ANSIs, and ESAs, and Town of Seaton high-ranked woodland designations. The Oro Moraine approach suggests including ANSIs, EP zoned areas, PSWs and other classified wetlands, deer yards, and documented fish habitats. The MNR pilot projects in Mississauga/Brampton/Oakville included significant wildlife habitats, evaluated wetlands, VTE species, and earth and life science ANSIs. Niagara Falls used a similar approach.

Comment:
Most jurisdictions have not identified this overlap as a criterion of significance, but rather evaluated woodlands on their merits independent of any other planning designation they might have. In some studies, this approach was considered and rejected because of concerns of

double-counting. If woodlands and other natural heritage designations are brought together into a natural heritage system, sites with significance for multiple designations should be identified as high priorities.

16. Succession and Buffering

A few studies included younger forests as a criterion of significance. For example, the MNR pilots in Mississauga and Brampton included successional and degraded forests as sources for gradual restoration, as well as pioneer forests that buffer and protect the edges of forest patches. The Niagara Falls study included a criterion for expansion potential, which included old fields and young forests adjacent to forest patches.

Comment:

Some of these areas might be included within forest patches, depending on the definitions used to define "woodlands". They might also logically become part of connecting links in a natural heritage or greenlands system, but it seems inappropriate to use them to identify significant woodlands on their own.

17. Economic and Social Values

The Natural Heritage Reference Manual includes a section relating to economic and social values, which suggests as a criterion woodlands that are subject to long term forest management agreements. This management is thought to stimulate canopy gap replacement dynamics, encourage succession to native hardwood forests from conifer plantations, encourage regeneration of more shade tolerant tree species, and discourage invasion by exotic species. However, none of the municipal approaches surveyed to date have included this criterion.

Three urban municipalities have included social factors. London has developed a criterion to recognize woodlands that are important for a balanced distribution of open space amenities and passive recreation opportunities. Niagara Falls identified a series of formal and informal recreational activities present as a criterion of significance. In a very comprehensive study with public input, the City of Ottawa applied a long list of social criteria to their urban woodlands, including:

- Size;
- Paucity of other natural/open space areas in neighbourhood;
- Presence of recreation facilities;
- Scenic views;
- Heritage/landmark elements;
- Presence of or potential for interpretive aids;
- Contribution to local quality of life;
- Frequency of human usage;
- Capture area from which site attracts users;
- Cleanliness and safety of area;
- Recreational linkage values.

The MNR Peterborough approach also included criteria for recreational use (based on ownership) and aesthetics, based on proximity to a hamlet or village.

Comment:
Municipalities wishing to identify woodlands under long-term forest management agreements could do so readily, both through their own records of MFTIP properties, and through requesting information from the relatively few public agencies such as conservation authorities and some Counties/Regions which have such lands. It is interesting they have chosen not to do so. Social criteria may be very important within an urban context, and the Ottawa Natural and Open Spaces study (1998) provides a good model for others to follow.

4.0 Initial Thoughts on Possible Future Approaches

At this point, there are several potential approaches that could be considered for future recommendations.

a) A multi-level approach to evaluation:
It is clear that municipalities vary significantly in their planning capability, their availability of financial resources, and the degree of threat to their woodland resources. It is also clear that some of the evaluation criteria now used can be applied readily at the landscape level, while others require much more detailed site-level data. It may be possible to develop multiple layers of acceptable woodland evaluation approaches, such as:

- A base-level evaluation, suitable for jurisdictions with relatively low levels of capacity and threat, that includes only a few easily-measured criteria such as patch size and shape to provide a first approximation of their roster of significant woodlands. This kind of analysis could be implemented with or without GIS capability.

- A landscape-level evaluation, suitable for most regions/counties and rural municipalities, that uses a GIS-based analysis to overlay a series of criteria based on available data sets. This level would be similar to many of the regional approaches now used, and could recognize the need to incorporate regional landscape differences and priorities.

- An enhanced evaluation, suitable for urban areas or jurisdictions where most forests are publicly-owned, in which detailed, site-specific data is generated and compared through an extended set of criteria.

b) Filling the knowledge gaps:
From the review of the criteria and their application in section 3 of this study, it appears that some criteria are relatively "solid", while a few others are quite varied in their application and probably less well-based in field science. A program of literature review, expert review and discussion, or even new field research projects might need to be developed to provide greater consistency in approaches in these areas.

c) Linking evaluation to policy:
While this project is not oriented to examining the effectiveness of municipal planning policies with respect to significant woodlands, there does appear to be a good deal of interest in the kinds of policy approaches being taken, which ones are most workable and publicly accepted, and how implementation problems have been overcome. As well, the evaluation approaches and criteria used to define significant woodlands are closely linked to the municipal policies that subsequently are established to provide some degree of protection. Forums or discussions on municipal policy options might be an important activity for the future.

APPENDIX F: A REVIEW OF ONTARIO MUNICIPAL BOARD NATURAL HERITAGE DECISIONS (1996-2003) (SUMMARY)

Prepared for
Ontario Nature

by Sternsman International Inc.
Research by David Berney
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Introduction

The Ontario Municipal Board

One of the best tools for good, green land-use planning in Ontario is a strong municipal Official Plan. That is where environmental conservation and community organizations often try to focus their energy, to get into the planning process "on the ground floor." However, many land-use planning decisions, actions or inactions by municipal governments pursuant to the *Planning Act* can and are being appealed to the Ontario Municipal Board (OMB). In public discourse about the OMB over the past several years, there has been considerable dissatisfaction expressed about the OMB process and many of the Board's decisions.

How Does the OMB Work?

The OMB mandate includes authority to decide appeals concerning municipal zoning, and other constraints on development that protect natural heritage. Changes in the *Planning Act* that took effect in 1996 gave developers the right to by-pass municipalities after ninety days and take their appeals directly to the OMB. This often resulted in appeals ending up at the OMB that could have been avoided if the municipality had had more time to review the application.

Ontario Nature's Review of Natural Heritage Case Decisions

What we did

While developers were rushing to the OMB, the staff and resources of the government agencies responsible for protecting water and natural heritage (e.g. Ministry of Natural Resources, Conservation Authorities, Ministry of the Environment and Energy) were drastically reduced. Also, the development boom of the '90s increased the value of lands zoned for development, and generated great financial rewards for developers who could secure OMB approval. The OMB gained new prominence, sometimes seen as the defender of nature heritage, but often as the facilitator of development and urban sprawl.

In an effort to better understand how the OMB has or has not worked successfully in cases dealing with natural heritage, whether woodlands, wetlands or wildlife in southern Ontario, we have reviewed a number of its natural heritage decisions. The goal was to identify patterns and opportunities to improve future decisions, and to provide answers to these questions:

- How could decisions under the existing tribunal process, rules and guiding policies be improved?
- How would changes in legislation, policies and Board process reduce the impact on natural heritage of future development decisions that come before the Board?

The purpose of this report is to review OMB decisions that had a significant natural heritage component, and to identify patterns and opportunities to improve future decisions.

How we did it

Appendix I summarizes 71 cases with significant natural heritage issues that were decided by the OMB between May 1996 and July 2003. Since this report focused on OMB decisions, the many cases or parts of cases that were resolved by others through mediation or agreement among the parties were not included.

Organization of the Database

The database is organized to help citizens who are contemplating participation in the OMB hearing process. Examination of relevant decisions can provide insight into the Board process, the kind of tests and questions that must be addressed, and the best road to success. As a minimum, the information contained will guide citizens to decisions that will be useful during the preparation process.

The case summaries are organized in two sections:

- Natural Heritage Appeals -- appeals made in defence of natural heritage
- Development Appeals -- appeals initiated to facilitate or expand development, and have a significant natural heritage issue or impact

Within each section, the appeals are sorted by OMB decision:

- ALL -- allowed
- ALL1 -- allowed with conditions
- DEN -- denied

Within each subsection, the appeals are sorted by natural heritage issue (NA for natural area, WET for wetland, etc). For example, you will find first the Natural Heritage Appeals that were "allowed", and the issue was NA (natural area protection).

An explanation of the codes used can be viewed at the beginning of Appendix I.

Methodology

To obtain a list of cases for this study, several *Quicklaw* (QL) searches were done. Cases resulting from the different searches were combined and duplicates were eliminated. The cases were then read for relevance and screened to eliminate those without significant natural heritage discussion.
The initial list of 578 cases was determined by using the following search terms:

wood lot, woodland, wetland, endangered species, natural heritage, aggregate, naturalist, environmentalist, ecologist, botanist, ANSI, Federation of Ontario Naturalists, Sierra, Greenpeace, Nature Conservancy, World Wildlife, STORM

Of the 578 cases reviewed, 71 were included for this study.

Not included were:

1. Cases that did not have a significant discussion of natural heritage, for example, when the natural heritage feature, etc. was only mentioned in passing, or was not a major focus or point of contention between the parties. Several cases had search terms come up in attachments to the case (for example, parts of an Official Plan) and may have been included as a reference for the case. For example, search terms may have only appeared within the wording of the Official Plan, not in the "case proper".

2. Preliminary rulings were excluded. Preliminary rulings can include an outline of, or decision on, the parties, issues, expected time needed for the hearing, etc. In the cases identified, rulings that deal with these matters did not address natural heritage issues.

3. Mediated decisions were excluded. Typically, they only provide a brief statement of what was decided or agreed upon and do not go into any significant detail.

4. "Settlement Decisions" were excluded. The OMB reports settlements between parties. These are not "decisions" of the Board and therefore were not considered useful for this study.

To view the full report including the detailed case summaries on the Ontario Nature website at http://www.ontarionature.org/enviroandcons/issues/local_issues.html .

Results

Quantitative Analysis: The Numbers Crunched

The researcher coded all 71 natural heritage decisions of the OMB to facilitate quantitative analysis. The following comments and charts provide a basic analysis to address common questions. It is important to note that many other analyses are possible using the same data.

NOTE: Please see KEY TO CODES at the end of this section for an explanation of abbreviations in the charts.

Who appeals at the OMB?

Developers, or those with development as an objective, initiated more than two-thirds of appeals that affect natural heritage. Defenders of natural heritage launched the remaining one-third of the appeals. It should be noted that some of the natural heritage appeals were to protect natural heritage for its own sake, but others appeared to be initiated by individuals and groups using "environment" or "nature" as an argument to stave off development.

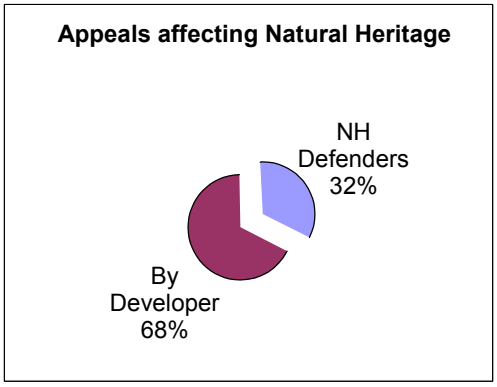

Figure 1

What are the development issues?

Development proposals triggered by far the most appeals (59 percent) followed by severances (25 percent). This pattern was similar for both appeals by natural heritage defenders, and appeals by those interested in development.

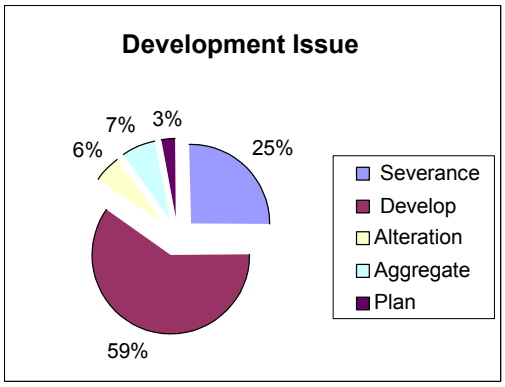

Figure 2

What are the natural heritage issues?

Wetland protection was the leading natural heritage issue. It represented nearly half of all natural heritage appeals, and was the key issue in one quarter of the development appeals.

Refer to the key at the start of Appendix I.

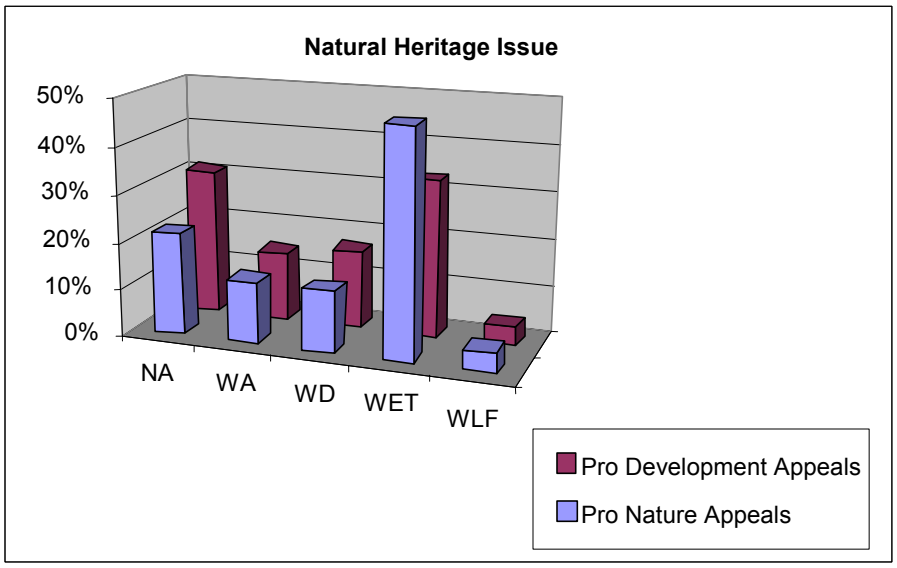

Figure 3

Who succeeds in winning the appeal?

It is not surprising that there is widespread dissatisfaction with OMB decisions in the naturalist community. Defenders of natural heritage had a 30 percent success rate while development interests had a 70 percent success rate in winning the appeal. The result was approximately the same whether the defenders of natural heritage were appealing a damaging decision or opposing development appeals.

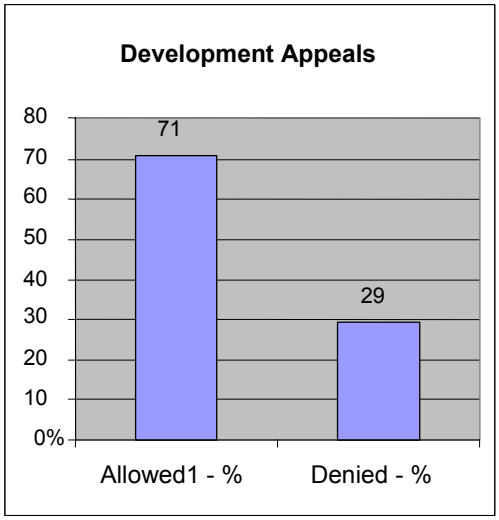

Figure 4

While the success percentage was unsatisfactory, there were some very important "wins" for natural heritage as a result of appeals and efforts to oppose development appeals. In addition, there was value in defeat, as development proposals were not left unchallenged.

Nevertheless, a 70 percent failure rate suggests there was something radically wrong. Review of the data and discussion with professionals in the field suggest a number of factors, including:

- OMB weakness in outreach in terms of support or guidance available for potential appellants
- Weakness in the cases presented by natural heritage proponents
- Imbalance in resources between defenders of natural heritage and development interests
- Lack of clarity in the Provincial Policy Statement with respect to natural heritage, and whether or not decisions must be consistent with provincial policy
- Inability of some Official Plans to adequately protect natural heritage
- Variation in understanding and attitude toward natural heritage among OMB hearing officers
- Too many cases proceed to the OMB before proper municipal review. As a result the resources of natural heritage defenders (like conservation authorities) are spread too thin. The large number of appeals arising from the 90-day time limit is a case in point.

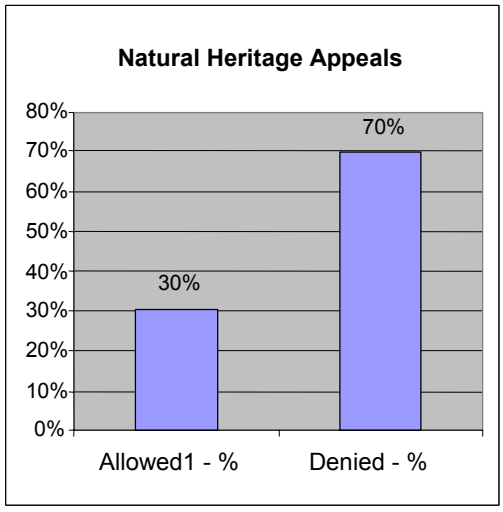

Figure 5

Time Limit Appeals

Since 1996, developers have been able to appeal directly to the OMB after 90 days of failure to make a decision by the municipality. In complex cases or jurisdictions where growth has been rapid, a 90-day response was not always practical. The "time limit" OMB hearing became a common alternative to review by municipal planners and elected officials. 75 percent of the development appeals with significant natural heritage impact were so-called "time limit appeals." Given the costly nature of OMB hearings, and the fact that the hearing officers are neither elected nor accountable to the affected community, this new provision should be reviewed.

Costs

When hearing costs were awarded against naturalists who objected to a development at "Cedar Point" in Tiny Township (OMB case 1134), a "chill" spread among naturalist groups around Ontario. Added to the common advantage of superior financial resources on the part of the developer, the possibility of a cost award against natural heritage advocates could contribute to a reluctance to pursue the protection of natural heritage at the OMB. This analysis looked at the frequency of a cost award against those defending natural heritage. Refer to the key at the beginning of Appendix I.

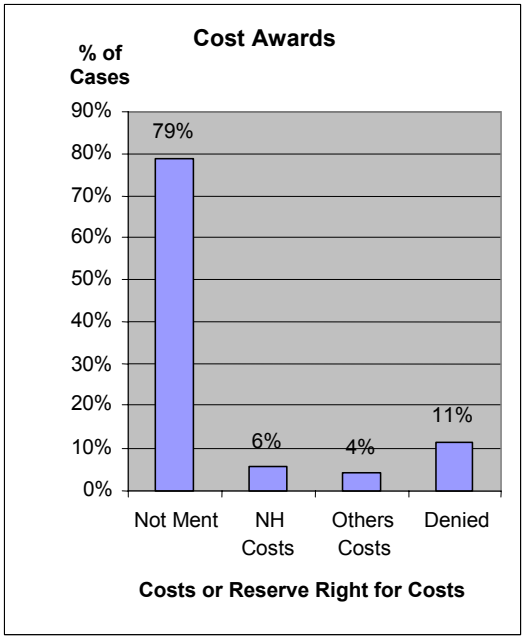

Figure 6

It is important to note that the figures shown combine "AWD" where a decision was made to award costs and "RR", cases where costs could be awarded at a future point in time (but may or may not be awarded in the end). So these figures represent the worst case, and may overstate the impact somewhat.

In summary:

- Costs were not mentioned 79 percent of the time;
- The majority of cost requests were denied;
- In four cases, or 6 percent of the cases, an award was made or reserved against the natural heritage defender.

To reduce the risk of a cost award, both the OMB and others must provide better guides that will assist would-be proponents in preparing and presenting their case.

Participation by Agency

There have been concerns that the "one window" approach would greatly reduce participation by the Ministry of the Environment or Natural Resources in OMB hearings. Indeed, MOEE appeared in only 8 percent of cases, but MNR did participate in 35 percent of cases. Clearly the role of agency defender of natural heritage rests with the Conservation Authorities as they appeared in 40 cases or 56 percent of all appeals. However, in 28 percent of the cases, no agency participated or presented evidence to assist the OMB. Refer to the key in Appendix I.

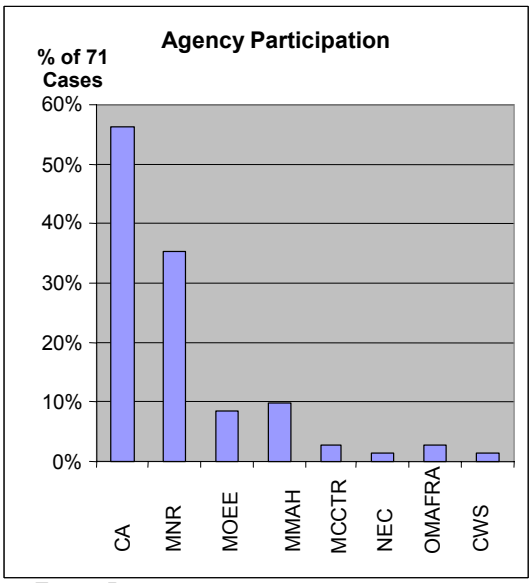

Figure 7

Municipal Participation

Two-thirds of all the cases had involvement from the municipal level (city, town, region, county). Sometimes the appearance was in defence of natural heritage, sometimes neutral (or to address other matters in a "time limit" case), and sometimes negative (as in the case of Marshfield Woods). With this complexity, it is hard to measure the impact of the municipal engagement, and therefore it must be judged on a case-by-case basis. In general, it was advantageous to have the support of the municipality.

For additional information, see:

Appendix II - Quantitative Tables
Appendix III - Agency Participation

Found in the full report online at
http://www.ontarionature.org/enviroandcons/issues/local_issues.html

Qualitative Analysis: Success and failure factors in a positive outcome for natural heritage

A review of numerous OMB decisions revealed that certain factors played a significant role in attaining a positive or negative outcome. To achieve the best possible outcome at the OMB the following should be considered when preparing to present at OMB: the evidence presented, policy considerations, OMB process, and opportunities for prior settlement of disputes.

About Evidence

The evidence presented at a hearing must be *strong*, *relevant* to the dispute at hand, and tightly *focussed*.

Consider and then locate and obtain the best and *strongest* evidence. For the most part, evidence is conveyed to the Board via witnesses. The credentials and experience of the witness or witnesses can be critical. To illustrate this, a witness that has the appropriate credentials and relevant field experience will be better placed to advocate a position and will be more convincing to the Board than a witness with the appropriate credentials but without the relevant field experience, or vice versa. Gaining the support of government agencies (MNR, Conservation Authority, etc.) and having their employees appear as witnesses can add significant credibility. Other evidence (academic or other studies, etc.) should be beyond reproach. An obscure piece of research, or research conducted by a novice or amateur, will not carry the same weight with the Board as the research of a noted expert in the field. All evidence presented should be detailed, analytical, comprehensive and balanced.

Evidence must be *relevant*. The degree of relevance is significant. For example, an ecologist should not be called if a biologist would be more suitable to speak to the issue, or would be in a superior position to counter an opposing argument or claim. If relevant evidence is not presented it is akin to presenting little or no evidence – the Board makes decisions based on the evidence it has before it. In presenting a case the opposition's evidence must be addressed or refuted. It is not sufficient to only present evidence in support of one's position.

Evidence should be *focused* on the pertinent issue. There are specific policies that the Board must apply. Advancing a general or broad environmental ethic will not be effective or relevant from the Board's standpoint. The most useful evidence to the Board is evidence that is strong, relevant and sharply focused on the issue or issues under consideration.

The following cases are examples that illustrate this. They can be found in the Detailed Case Summaries in Appendix I.

Mississippi Valley Field Naturalists Club v. Mississippi Mills (Town) Committee of Adjustment
Sixteenth Warden Ltd. v. Markham (Town)
Tiny (Township) Official Plan Amendment No. 18 (Re)
561650 Ontario Inc. v. Ottawa
Greenock (Township) Zoning By-law No. 9617 (Re)
Material Handling Problem Solvers Inc. v. Essex (Town)
Erin (Township) v. Erin (Township)
Clarington (Municipality) Official Plan Amendment Special Policies Designations (Re)

About Policy

Policies relevant to the issue at hand are carefully considered. It is important to have *knowledge* of what these policies are, how they are *interpreted*, and that they can be strictly adhered to or simply viewed as a guide.

One of the primary functions of the OMB is the enforcement of policy. Pertinent policy can include Township Official Plans, Regional Official Plans, agency policy, etc. Policy must be comprehended not too narrowly and not too liberally. Once policy is comprehended it will

inform the appropriate arguments to be put to the OMB. (Note: the appropriate policy to address is the policy that was in effect at the time the subject of the appeal arose or took place.)

For the most part, the OMB is reluctant to stray from established policy. However, policy can be viewed as a guide and may not be strictly adhered to. If a policy conflicts with the protection of a natural heritage element, the policy may be preferred. If it would be unjust to enforce policy the OMB may look to the intent of the applicable policy in order to find a way to bring about a just resolution. If the natural heritage area is of very high quality the OMB may give protective policy its most liberal interpretation. If the OMB views a policy as outdated a new course of action may be approved.

The following cases are examples that illustrate this. They can be referred to in the Detailed Case Summaries in Appendix I.

London (City) Official Plan Designate Primary Collector Amendment (Re)
DiCecco v. Amherstburt (Town) Committee of Adjustment
Prince Edward (County) Official Plan Wetlands Amendment (Re)
Scroggie v. Seguin (Township)
Harnell v. Wellington (County) Land Division Committee
King (Township) Zoning By-law No. 74-53 (Re)
St. Catharines (City) Zoning By-law No. 84-419 (Re)
Halton Hills (Town) Official Plan Amendment No. 67
Little v. Grey (County) Planning Approval Committee
Toronto (City) Zoning By-law No. 10217 (Re)
Woudstra v. Halton (Regional Municipality) Land Division Committee

About Board Process

The Board tries to achieve *balance* between private and public interests; however, it cannot act outside its quasi-judicial functions. Procedures of the Board and the responsibilities of those taking part in the OMB process are published by the OMB. It is expected that everyone taking part will consult and adhere to them. *Expectations* of the Board cannot be the same as of courts of law.

If an appeal is being brought, it is not enough to raise issues or to speculate on possible impacts. Cogent, credible evidence in opposition to the application, etc. must be presented.

The OMB works on the premise of balance. It is evident from several decisions that the Board is attempting to achieve a balance between the public good and the private good. It is advisable that the position of the other party be given due consideration and addressed when presenting a case before the Board.

It is the Board's role to protect the public interest under the *Planning Act*. Section 2 of the *Planning Act* and the Provincial Policy Statement refer to provincial interests for which the OMB must have regard. Both should be consulted when preparing a case. Caution and tact should be employed in suggesting to the Board what is in the public interest. Advocates should avoid broad environmental causes that the Board cannot address.

The OMB is not a precedent-setting body, but advocates sometimes provide information, including prior relevant decisions "for the assistance of the Board".

The Board views third party appeals with scepticism. If this route is chosen, enlisting and gaining the support of provincial agencies (MNR, Conservation Authorities, etc.) will add credibility to the position in the eyes of the Board.

Desired outcome should be considered. It must be remembered that the OMB cannot act independently of its general administrative and quasi-judicial functions. The Board does not have the power to grant the types of equitable remedies that have been given to the courts of law by the Judicature Act.

The following cases are examples that illustrate this. They can be found in the Detailed Case Summaries in Appendix I.

Lau v. Richmond Hill (Town) Committee of Adjustment
Mississippi Valley Field Naturalists Club v. Mississippi Mills (Town) Committee of Adjustment
Material Handling Problem Solvers Inc. v. Essex (Town)
Greenock (Township) Zoning By-law No. 96-17 (Re)
Clarington (Municipality) Official Plan Amendment Special Policies Designations (Re)
Tiny (Township) Official Plan Amendment No. 18 (Re)
Aurora (Town) Official Plan Amendment No. 30 (Re)
Aurora (Town) Zoning By-law No. 2213-78 (Re)
London (City) Official Plan Multi-Family Residential Amendment (Re)

About Prior Resolution

The OMB encourages the *settlement* of disputes between parties. Mediation may be requested by the parties or may be suggested by the Board. The OMB may suggest Liaison Committees in the hope of precluding future disputes.

Settlement through negotiation should be considered. Settlements between parties have resulted in the protection of natural heritage elements beyond what the OMB may have decided or required, and even beyond what is required from a planning and environmental standpoint.

The following cases are examples that illustrate this. They can be found in the Detailed Case Summaries in Appendix I. [bookmark to Appendix I]

Ingersoll (Town) Zoning By-law No. 00-3940 (Re)
840180 Ontario Ltd. v. Georgina (Town)
Toronto (City) Official Plan Amendment No. 974 (Re)

KEY TO CODES

AGR	agrologist
AGY	agency
ALL	allowed
ALL1	allowed in part
AP	appealing party (When AP or OP are not present in front of a code then a position was not taken, mentioned or clear from the case - *Witnesses and Other Input column)
ARB	arborist
ARC	architect
AWD	awarded
BIO	biologist, fish wildlife technician
BOT	botanist
CA	conservation authority
CG	community group
CI	commercial interest
CI	commercial interest
COU	county (upper tier)
CTY	city (lower tier)
CWS	Canadian Wildlife Service
DEN	denied
DEV	developer
DP	development proposal
ECE	environmental committee
ECO	ecologist
EDU	institution, school board, teacher
EM	environmental manager
ENG	engineer, engineering technician
EP	environmental physiologist
ES	earth scientist
EW	environmental witness
EXS	environmental expert, environmental researcher, environmental officer, qualified wetland expert, environmental consultant, author of EIS
EXT	extraction (aggregate)
F	final
FFA	flood fringe analysis
FOR	forester
GCE	golf course expert, golf course technician
GEO	geologist
GMO	geomorphologist
HYD	hydrogeologist

INT	interim
LA	landscape alteration
LD	landscape designation
LIM	limnologist
LP	landscape protection
LR	leave refused
LSA	landscape architect
LSV	land surveyor
LUP	land use planner, land use specialist, planning consultant, environmental planner, manager of planning
M	mentioned
MMAH	Ministry of Municipal Affairs and Housing
MNR	Ministry of Natural Resources
MOE/MOEE	Ministry of Environment
MOT	motion
MTO	Ministry of Transportation
MUN	municipality
N/A	not available/mentioned
NA	natural areas, etc.
NAT	naturalist, environmentalist
NEC	Niagara Escarpment Commission
NF1	not final till conditions met - by-law, OP, possibility of hearing reopened
NHG	natural heritage group
NHG	natural heritage group
NM	not mentioned
NVE	noise and vibration expert
OMAFRA	Ministry of Agriculture, Food and Rural Affairs
OMBWI	witness called by OMB Board
OP	Opposition (When AP or OP are not present in front of a code then a position was not taken, mentioned or clear from the case - *Witnesses and Other Input column)
ORN	ornithologist
OTH	other (police, by-law officer, local amateur historian, adult lifestyle expert, regional health department, building officer)
PAR	partial
PH	phased
PI	private individual
REG	regional, county government (upper tier)
RES	residents, landowners, members of the public
RR	reserved right to bring motion for costs at later date
SEV	severance
SOI	soil scientist
TWN	town (lower tier)

UNC	uncertain
WA	water quality
WD	woodlots, forests, trees
WET	wetlands
WHD	withheld
WLF	wildlife
ZOO	zoologist

Note: The full report is available for download from the Ontario Nature website at http://www.ontarionature.org/enviroandcons/issues/omb.html

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APPENDIX G: SOUTHERN ONTARIO GREENWAY STRATEGY: A COOPERATIVE APPROACH TO PROTECT NATURAL CORES AND CORRIDORS

An opportunity to:

- Connect communities and nature
- Protect water at its source
- Conserve wildlife and species-at-risk habitat
- Engage communities to ensure healthy landscapes

MARCH 31, 2004

Southern Ontario Greenway Strategy
A cooperative approach to protect natural cores and corridors

EXECUTIVE SUMMARY

The time is right to develop a Southern Ontario Greenway Strategy, to create a robust network of natural core areas and linkages that:

- Protects and restores core natural features and functions;
- Protects water resources;
- Protects and restores habitat for wildlife and species-at-risk;
- Connects communities; and,
- Provides recreational opportunities for present and future generations.

This strategy should apply to southern Ontario, principally those lands south and east of the Canadian Shield, with linkages to green spaces farther north. Southern Ontario is subject to the most development pressure and most in need of special measures to establish core and corridor protection.

In a sea of development, we still have islands of green and limited linkages. Imagine our "green islands" laced together by ribbons of green that connect parks, scenic landscapes, natural areas and communities. Include green space and trails through our urban settlements and cities, providing opportunities to enjoy nature close to home. Include wetlands and woodlands that absorb and protect clean water, and provide habitat for nature in all its forms. Many of the elements are already in place in the form of parks, protected areas, and lands carefully stewarded by individuals and conservation organizations. Missing are the overall picture and goal, and a practical program to engage communities and create a coherent system of core natural areas and linkages.

It is time to make the connection:

- Between the existing greenways like the Niagara Escarpment, Oak Ridges Moraine, Lake Ontario waterfront and others, to enhance their value;
- Between the existing greenways and the new corridors and connections envisioned in the provincial government's plans for the "Golden Horseshoe Greenbelt" and the 600,000 acres of protected land;
- Between the need for groundwater protection at source and the greenlands that can provide that protection;
- Between greenlands in each municipal official plan and those in neighbouring municipalities;
- Between the need for transportation and economic infrastructure that supports our economy, and the need for "green infrastructure" that protects and supports our

quality of life and the natural systems that feed us, clean our air and provide safe drinking water;
- Between the health of our environment and human health and well-being; and,
- Between the dream of a healthy connected system of natural areas and the practical program needed to make it happen.

The Oak Ridges Moraine Conservation Act received all-party support in the Ontario Legislature, and is widely admired. It is proposed that this Strategy draw heavily on the standards, terminology and general approach of the Oak Ridges Moraine Conservation Plan, and that implementation should be delivered municipally through official plans and zoning. As with the Oak Ridges Moraine, there should be a trust fund to support voluntary protection and restoration programs.

The Oak Ridges initiative emerged under great pressure, and too late to save some important and sensitive lands in the Yonge Street corridor in Richmond Hill. Now is the time to "get ahead of the wave" in the rest of Ontario where the population is expected to grow by 3.1 million people, or 43 %, by 2031. In the same period, it is projected that 1,070 square kilometres of land will be urbanized, an area almost double the size of the amalgamated City of Toronto. We have already lost 75 % of the pre-settlement wetlands and virtually all of our old growth forests. At the same time, we have lost much of our natural capacity to mitigate impacts of urban development on air, water and health. A Greenway Strategy is an essential element in "smart growth," to manage growth and restore the green infrastructure that sustains us.

In implementing a Greenway Strategy, we can build our greenways around and linking to parks and corridors already in place. There is an opportunity to learn from the past and engage the creativity and support of private landowners who are the stewards of most of the greenlands in Southern Ontario, include them early in the process and consider their interests at all stages. It is important to secure the support of regional and county governments, municipalities and agencies, such as conservation authorities and stewardship councils, which have experience, local knowledge and established relationships with private landowners.

A natural cores and corridors strategy is already part of the Ministry of Natural Resources' South Region Plan, and has received favourable comment from the Environmental Commissioner of Ontario, conservation scientists and environmental groups for years. The Oak Ridges Moraine experience demonstrated the contribution of regional and county governments and conservation authorities, providing there is a sound, collaborative process and adequate resources. The government has every reason to expect strong support for this approach. The Southern Ontario Greenway Strategy is practical, scientifically sound, and the most efficient way to establish new greenways in southern Ontario, and would complement the government's proposed legislation for the "Golden Horseshoe Greenbelt" (i.e. Greenbelt Protection Act 2003, Bill 27). What is needed now is government leadership and support.

Southern Ontario Greenway Strategy

A cooperative approach to protect natural cores and corridors

Vision for Southern Ontario Greenways

A satellite view of southern Ontario reveals a fertile slice of land between Lake Huron and Georgian Bay on the west, and Lakes Erie and Ontario and the St. Lawrence River to the south and east. Much of southern Ontario, especially south and east of the Canadian Shield, has been cleared for agriculture or urban development, but some dark green forested portions remain. A narrow band along the Niagara Escarpment extends from Niagara Falls to Tobermory, and scattered patches cling to the Oak Ridges Moraine, and parts of eastern Ontario.

One hundred thousand more people crowd into the Greater Toronto Area each year, creating extraordinary demands for homes, transportation and places to shop and work. Similar pressures are building around Ottawa, Barrie and along the industrial corridor from Windsor to Kingston. The resulting development and pavement are carving up our remaining natural areas north and south, east and west. Forests become woodlots that become patches that become lonely specimen trees. Many natural areas are fragmented and no longer support the species that once were safe and numerous. But all is not lost. Through the stewardship efforts of organizations and individuals, some of these lands remain intact and some are prime examples of restored woodlands (often as a result of government-led reforestation efforts). In a sea of development, we do have some islands of green and limited linkages. We also have innumerable opportunities to restore and re-connect natural areas through restoration and stewardship activities.

Now, imagine our "green islands" laced together by ribbons of green that connect parks, scenic landscapes, natural areas and communities. Include green space and trails through our urban settlements and cities providing opportunities to enjoy nature close to home. Include wetlands and woodlands that absorb and protect clean water, and provide habitat for nature in all its forms. Add paths and bikeways that provide connections within communities and longer trails that join one community to another, and forests and natural cover that afford the same benefits for wildlife. Imagine communities, governments, foundations, colleges, universities, citizens, landowners, and individuals working cooperatively to protect and connect their greenlands to those in the next community and create healthy landscapes. Together, they contribute to a network that is stronger and more beautiful than the sum of its parts.

We must imagine all this because it does not exist today. However, many of the elements are already in place in the form of parks and protected areas, and lands carefully stewarded by individuals and conservation organizations. We have policies and programs for selected lands like the Niagara Escarpment and the Oak Ridges Moraine,

and there are some similar efforts by particular municipalities. Missing are the overall picture and goals, and a practical program to engage communities and create the system of core natural areas and linkages. This is the promise and the challenge of a Southern Ontario Greenway Strategy.

Our Changing Landscape

Since World War II, southern Ontario has seen dramatic increase in population change and urbanization of the landscape:

- At the time of European settlement in about 1800, over 90 percent of southern Ontario was covered by forest. Eighty percent of the upland woodlands south and east of the Canadian Shield have been lost since the 19th century;

- Almost no old growth forest is remaining. Less than 0.07 percent of the land base is left in these vital old growth habitats;

- Over 75 percent of the pre-settlement wetlands have been lost due to draining, filling or other habitat alteration for a number of human uses. Eighty to 90 percent of Canada's urban wetlands have been destroyed;

- For the "Greater Golden Horseshoe" area (the area from Midland in the north, to Fort Erie in the south, Waterloo in the west and Peterborough in the east), the population will grow from 7.4 million in 2000 to 10.5 million in 2031, an increase of 43 percent;[8]

- In the same region over the same 30-year time period, 1,070 square kilometres of land will be urbanized [1]. This is almost double the area of the amalgamated City of Toronto and represents a 45 percent increase in urbanized land in the Greater Golden Horseshoe;

- Each year, 1,900 premature deaths can be attributed to poor air quality in the province[9]. This deterioration in air quality can be largely attributed to motor vehicle use necessitated by our sprawling urban land use patterns. At the same time, we are destroying the very features of our landscape that can help mitigate this pollution as we sprawl out into the countryside – our forests, wetlands and other natural areas.

[8] Neptis
Foundation, 2000
[9] Ontario Medical Association, 2000

The Role of Greenways

The benefits of a system of natural cores and corridors have been known for some time. Conservation science, including the work of Reed Noss, has established the critical role of connections and adequate habitat size for species survival and healthy ecosystems. In the past decade, as the pressure of population growth and urban sprawl increased, there has been a growing appreciation of the other potential benefits from natural areas, including:

- Groundwater source protection;
- Recreational, economic and healthy community benefits through trail access;
- Wildlife and species-at-risk habitat protection;
- Human health benefits; and,
- Coordination and rationalization of municipal "greenlands" policies.

There have been separate initiatives to provide continuity for cores and corridors along linear landscape features including:

- Niagara Escarpment Planning and Development Act and Niagara Escarpment Plan;
- Oak Ridges Moraine Conservation Act and Plan; and,
- Lake Ontario waterfront strategy.

Recently, the provincial government tabled the Greenbelt Protection Act 2003 (Bill 27) and created an advisory Greenbelt Task Force. All of these initiatives have merit, but could be more effective and deliver more benefit for the time and money invested if they contributed to the larger vision, produced plans that properly connect, and enjoyed some common planning support tools, terminology, and funding. It is time to create the coherent plan to knit them all together – a Southern Ontario Greenway Strategy.

Southern Ontario Greenway Concept

The time is right to develop a Southern Ontario Greenway, a robust network of natural core areas and linkages that:

- Protects and restores core natural features and functions;
- Protects water resources;
- Protects and restores habitat for wildlife and species-at-risk;
- Connect communities; and,
- Provides amenities and recreational opportunities for present and future generations.

This Greenway Strategy should create the network over time and through a cooperative approach. This strategy should apply to southern Ontario, principally those lands south and east of the Canadian Shield, with linkages to green spaces farther north. Southern Ontario is subject to the most development pressure and most in need of special measures to establish core and corridor protection. [Map to be inserted.]

Typical Greenway

The typical greenway would consist of mostly rural private lands that include exceptionally important natural features and groundwater recharge and discharge zones. Land use regulation (zoning) would exclude incompatible new uses (such as certain industrial activity, intensive recreation, and urban development outside settlement areas), but farming and existing land uses would continue in all such lands outside settlement areas. Special provisions would protect natural features and functions within settlement areas, and across the landscape.

Within the natural cores and corridors, protection and restoration within greenways could be accomplished over time through incentives and encouragement of private landowners. All landowners in core and corridor areas would qualify for stewardship support and special incentives for voluntary measures that support greenway protection, such as excluding cattle from streams, buffering streams and waterbodies, protecting or creating interior forest, protecting wetlands, etc.

While private landowners will continue to hold and steward most of the greenway lands, some greenway lands are held by conservation organizations, and some are already in public ownership in the form of parks, regional and county forests, conservation areas, rail trails, hazard lands or other publicly owned land. In exceptional cases, additional lands may be purchased on a willing buyer/willing seller basis, to make connections, buffer or join existing parklands or to provide for low-intensity public access.

It is envisioned that the Strategy would be implemented through a range of tools including:

- Public education and land stewardship information;
- Landowner-focused incentives and special programs;
- Incentives for planning including support for consultation and identification of the greenlands within each region and county;
- Land use policies and zoning; and,
- In critical circumstances, land securement on a “willing buyer/willing seller” basis. Most greenlands will continue in private ownership.

All greenways should be:

- Based on sound conservation science;
- Respectful of landowner rights and interests;
- Subject to restrictive official plan policy and zoning;
- Eligible for special incentives for restoration and protection; and,
- Largely on privately owned lands in cooperation with landowners.

There is an opportunity to learn from the past and build support for greenways by:

- Engaging the creativity and support of private landowners who are the stewards of most of the greenlands in Southern Ontario, by including them early in the process and considering their interests at all stages;
- Securing the support of regional and county governments, municipalities and agencies, such as the conservation authorities, who have experience, local knowledge and relationships with landowners;
- Building on the lands and connections already in place; and,
- Working cooperatively with all stakeholders for greater community benefit.

The strategy will likely require enabling provincial legislation to establish the program, its objective, authority, incentives and structure. It is intended that determination of goals and standards for the system of natural cores and corridors should involve extensive consultation with regional, county and local governments, and be provincially supported both technically and financially. Implementation of the strategy would be achieved through regional, county and local governments, with the support of conservation authorities, and possibly stewardship councils. All regions and counties should have greenways, but their location and extent should be determined in a coordinated fashion by upper-tier municipalities, the Ontario Ministry of Natural Resources, lower-tier municipalities, conservation authorities and other ministries and stakeholders working together to ensure meaningful ecological connectivity.

Learn from the Oak Ridges Moraine Experience

A great deal of thought and consultation was required to develop the Oak Ridges Moraine Conservation Act and Plan, the Province's most recent natural core and linkage landscape plan. The Oak Ridges Moraine Conservation Act received all-party support in the Legislature, and is widely admired. It is proposed that the strategy will draw heavily on the standards, terminology and general approach of the Oak Ridges Moraine Conservation Plan, and implementation should be delivered by the upper- and lower-tier municipalities through official plans and zoning. As with the Oak Ridges Moraine, there should be a trust fund to support voluntary protection and restoration programs.

The Southern Ontario Greenway Strategy should establish broad basic standards for stewardship of cores and corridors across southern Ontario. Within this broad area, certain areas of extreme sensitivity, areas of provincial, regional or local significance may

require special policies or legislation as determined by regional, county, local or provincial governments. In this case, the more restrictive policy shall apply.

In summary, the Strategy would be implemented through cooperation with the regional, county and local municipal governments, with the following basic elements:

- A Greenway Act – setting the geographic scope, enabling creation and implementation of the Plan, ensuring municipal consultation and conformity, providing direction to the Ontario Municipal Board, etc.;
- A Greenway Plan – setting out the criteria, targets, standards etc.;
- A Greenway Trust Fund – providing support for special planning, and incentives for land owners; and,
- A Greenway Council – providing oversight for implementation of the plan, recommendations for adjustments, and reports on progress.

Trails and Greenways

The primary objective of a greenway should be the protection and stewardship of sensitive natural areas and groundwater. Most of these lands will be privately owned and stewarded, and consequently the existence of a greenway will not include any inherent right of public access. However, portions of a greenway will be located on public lands and in some cases footpaths can be located without interference with sensitive features. These paths may also be connected through trail easements, converted railway trails or voluntary agreements with landowners to provide a network of paths across the southern portion of the province. Footpaths will connect communities, and will help more people to enjoy the natural beauty of Ontario. The Bruce Trail on the Niagara Escarpment, the Oak Ridges Trail, the Bay Area Trail in San Francisco and many others have demonstrated that public foot trails build appreciation and support for natural area protection. They will be very popular and contribute to community health and healthy landscapes, and will benefit local economies.

Many of these trails exist today. Like the natural areas in every municipality, they just need some links to make them stronger and more valuable. Trails should be part of Greenway planning where natural features and functions are adequately protected and connections can be created on public land or in cooperation with private landowners.

Farmland Preservation and Greenways

Any greenway plan should be "farm friendly," and greenways will provide protection for some farmland. While farmland is under threat in much of southern Ontario, farmland preservation has different criteria and extends far beyond the lands that may be included in greenways. Lumping farmland preserves with greenlands would greatly increase the amount of land involved, the size of the task and the complexity of the issues. Therefore,

it is recommended that farmland protection and agricultural preserves should be addressed by other means and processes, and separate from the Greenway Strategy.

Why a Southern Ontario Greenway Now?

It is time to make the connection:

- Between the existing greenways like the Niagara Escarpment, Oak Ridges Moraine, Lake Ontario waterfront and others, to enhance their value;
- Between the existing greenways and the new corridors and connections envisioned in the government's plans for the "Golden Horseshoe Greenbelt" and the 600,000 acres of protected land;
- Between the need for groundwater protection at source and the greenlands that can provide that protection;
- Between greenlands in each municipal official plan, those in neighbouring municipalities, and linkages among protected green spaces across southern and central Ontario;
- Between the need for transportation and economic infrastructure that supports our economy, and the need for "green infrastructure" that protects and supports our quality of life and the natural systems that feed us, clean our air and provide our safe drinking water;
- Between the health of our environment and human health and well-being; and,
- Between the dream of a healthy connected system of natural areas and the practical program needed to make it happen.

It is evident that the rapid growth in many parts of southern Ontario is increasing fragmentation and driving up the price of land and natural area protection. The cost of delay will be considerable. There is much to do to achieve water source protection, nature protection, species-at-risk protection, and recreation and public access. Addressing each issue and community separately will consume more resources than a coordinated greenway approach. Today there are organizations, municipal governments, agencies, and non-governmental organizations that see these needs, and are willing to work together. Many existing or fledgling initiatives will help support these goals, including increased public awareness about smart growth, public transit and transportation issues, urban design and intensification, and various landscape-level ecological visions for southern Ontario, including the Big Picture 2002.

What is needed now is provincial leadership and support to start the consultation and move the processes ahead. Ontario needs a Southern Ontario Greenway Strategy to bring these people and resources to the table.

Who Cares

The government can expect support for a southern Ontario system of natural cores and corridors from both government and non-government sectors, including (for example):

- Ontario Ministry of Natural Resources;
- Environmental Commissioner of Ontario;
- Environmental Non-Governmental Organizations (ENGOs) like Ontario Nature - Federation of Ontario Naturalists, Nature Conservancy of Canada, World Wildlife Fund Canada, Carolinian Canada Coalition and many others;
- Upper-tier municipalities;
- Lower-tier municipalities;
- Conservation authorities;
- Hiking and Recreational Trail Organizations.
- *Note: list of endorsing organizations to be appended*

The *Ontario Ministry of Natural Resources* has a new "Natural Heritage Strategy for the South Central Region" covering the area south of the French River. A key element in that strategy is a "natural heritage system" which will consist of "core conservation lands and waters linked by natural corridors and restored connections," and this in turn is the central definition for the Southern Ontario Greenway.

The *Environmental Commissioner of Ontario* commented on MNR's new strategy in his report released on November 27, 2003. While the Commissioner was quite supportive of the natural heritage system, he observed: "None of the policies or programs referred to in the Strategy specifically address how the ministry would create a system of natural cores and corridors…." Clearly, the Commissioner would welcome an approach that would deliver the system, such as the Southern Ontario Greenway Strategy.

ENGOs have been working closely with government agencies to develop a biological map ('bio-map') of Southern Ontario over the past five years. MNR's Natural Heritage Information Centre and Nature Conservancy of Canada, in partnership with Ontario Nature – Federation of Ontario Naturalists, Carolinian Canada and others, have worked diligently to create the "Big Picture 2002" map, which profiles a conceptual system of cores and corridors. Similarly, Carolinian Canada and partners have developed a "Big Picture" map of cores and corridors for the highly imperilled Carolinian forest region of south-western Ontario. These 'bio-maps' are based on conservation science principles, and contain essential information that could form the basis for the development of the Greenway Strategy and Map.

Many upper-tier municipalities (regions, counties and cities) have policies to protect natural heritage and groundwater within the region. While the terminology may vary, they are commonly referred to as "greenlands." Coordinating these areas across municipal boundaries, relations with landowners and finding the right package of

policies, incentives and measures to actually make those greenlands effective have presented some challenges. In some cases, lack of funds to gather the necessary data, develop criteria and implement the system, has slowed progress greatly.

At *the local municipality* level, there are difficulties finding the funds and staff resources to consult with the community and implement a program. Local governments are also concerned with a consistent and defensible approach that will stand up at the Ontario Municipal Board (OMB). Consequently there is considerable potential for upper-tier and lower-tier municipal support, *providing* the approach includes effective collaboration and participation for municipal government, municipal flexibility in location and implementation and some supporting funds and incentives for land stewardship.

Conservation authorities are leaders in proposing means of protecting water at source. Their expertise and local knowledge with both natural heritage and groundwater are key elements in greenway development. It is expected that conservation authorities will support the Greenway Strategy, *providing* there is a collaborative approach, additional resources and provincial support.

The Bruce Trail has been a leader in the protection and securement of a natural heritage corridor along the Niagara Escarpment. The Appalachian Trail Association has been a leader in the development and implementation of the extensive *Commonwealth Connections Greenway System* in Massachusetts. There is good reason to expect that other hiking and non-motorized trail users will be highly supportive of the proposed greenway system.

There are many other potential supporters for a system of greenways, including the general public. According to a 2001 Environics poll of urban Ontario residents, 84 percent think the presence or existence of woodlots and forests found generally throughout southern Ontario is very important. A further 13 percent think that these forests and woodlots are somewhat important, for a total of 97 percent who think that forests are important. Ontarians have made it clear that they want and need natural areas to be protected for the future and interconnected across the landscape and throughout our communities.

Creating the Greenway Strategy

Collaboration in the creation of the strategy is critical to success. While the Province must provide leadership, financial and technical support, those who will deliver the program on the ground, the conservation authorities and municipalities, must be engaged from the outset. Those who own most of the land, private landowners, particularly farmers, must be engaged as well to ensure that the strategy is "farm friendly" and "land owner friendly." In addition, the landscape conservation oriented provincial ENGOs will provide essential information, leadership, and a non-government perspective.

Having generally described "who" should be involved, a drafting team is needed. In this respect, it is recommended that the province draw heavily on the largely successful experience in developing a cores and corridors program for the Oak Ridges Moraine (ORM). The resulting Oak Ridges Moraine Conservation Act received all party support in the Legislature.

In the ORM process, several ministries played important roles including: Municipal Affairs (MMA), Natural Resources (MNR), Environment (MOE), Agriculture and Food (OMAF), and Finance (MOF). A council of senior ministry officials (Assistant Deputy Ministers) watched over the process, provided advice, and kept their Ministries engaged and informed. This idea should be retained. It is likely that additional steps, following the ORM process model, would include:

- Release of a "Green Paper" or announcement of general intent and objectives, process and timetable;
- Setting the Table – the critical task of which groups should be represented on the advisory panel, and which individuals should be recruited;
- Establishing the multi-stakeholder advisory panel including representatives of conservation and naturalist organization, farmers, municipalities, conservation authorities, aggregate producers and other landowners. The advisory panel should have a mandate to develop a vision, principles and process to draft a Strategy proposal. The advisory panel should be supported by MNR, MOE, MMA, and OMAF staff, a facilitator acceptable to the group, and have a council of ADMs for further support and liaison. The panel should have a timetable to produce a consensus;
- Creating an initial draft, the Panel should conduct public consultation, and then produce a recommendation document;
- Identifying the Minister responsible for posting the recommendations on the Environmental Bill of Rights Registry, and conducting other consultation as considered practical, and then proceeding to prepare enabling legislation, a "Southern Ontario Greenway Act;"
- Legislature debating the proposed Act and amending or approving the Act as appropriate
- Following the passage of the Act, defining the process to develop and implement the Greenway system, including steps in implementation, priorities, responsibilities, funding, and how the incentives will be administered.

<u>Implementing the Strategy and the "Golden Horseshoe Greenbelt"</u>

Before creating more greenways, it is important to set up the Southern Ontario Greenway Strategy first to achieve a coherent and efficient approach to new regional greenways, such as the proposed "Golden Horseshoe Greenbelt."

While the principles and broad aspects of the Strategy must be developed first, some regions of the province will have the necessary data and consultation complete before others. Also, the pressures of development or other issues may suggest priorities for implementation. It is likely that the greenway development will proceed at different speeds in different regions.

In view of the government's interest and commitments, priority should be given to implementation in the "Golden Horseshoe" segment, including how and where this greenway or other protection should be put in place.

Conclusion and Call to Action

Now is the right time to develop and implement a Southern Ontario Greenway Strategy to bring consistency and coherence to the creation of greenways and greenlands across the southern portions of the province.

Following the success of the Oak Ridges Moraine process, initiatives have emerged in many areas, responding to the same issues and pressures. These pressures are particularly acute in the "Golden Horseshoe Greenbelt," a region of particular interest to the government. Rather than allowing additional initiatives to evolve separately and in a piecemeal fashion, it is more efficient and effective to develop the most urgent prospects under the "umbrella" of a single piece of enabling legislation, and consistent scientific and data standards.

There are strong interests involved, but Ontario has shown that it has the maturity and the skills to develop a strong consensus, and to move to practical implementation. There is strong support for a collaborative approach to this opportunity, but provincial leadership is needed to support and initiate the process.

APPENDIX H: GUIDE TO DEVELOPING FOREST CONSERVATION BY-LAWS

Updated Feb 13, 2003

This document has been prepared by the Forest Conservation By-law Committee: a group of municipal and provincial staff and other interested agencies that meet informally to:

- ***provide support to municipal staff by providing a forum for discussion, information exchange, and input into Forest Conservation By-law related initiatives.***
- ***encourage training opportunities, and improve competency in Forest Conservation By-law officers.***
- ***encourage more effective and consistent application of Forest Conservation By-laws across Ontario.***

This document is intended to assist in the development and upgrading of Forest Conservation By-laws. It is not legally verified information. This document is for discussion purposes only. Neither the Committee, its members, the Ministry of Natural Resources, nor the municipalities participating on the Committee provide any representation, warranty or guarantee of any kind as to the suitability, accuracy or validity, legal or otherwise, of the document, the information contained therein or the use of either. Any by-laws or action based on the use of this document should be undertaken only after consultation with municipal legal council.

This document will be updated, as better information becomes available.

INTRODUCTION

In Ontario both upper tier and lower tier municipalities can prohibit or regulate tree cutting on private land through powers granted under the Municipal Act. Municipalities can enact forest conservation by-laws that set a minimum standard for forest harvesting practices. These minimum standards are usually based on restricting cutting below certain circumference limits. Although this approach is widely considered to be bad forestry practices, it does prevent the total removal or destruction of forests and is relatively easy to enforce. The option to carry out good forestry practices is also found in most by-laws and is encouraged as much as possible. Good forestry practices should also be promoted and supported through other initiatives such as education and awareness opportunities and good stewardship programs.

When developing a forest conservation by-law, municipalities must consider what type of by-law would be most appropriate for the circumstances within their municipality. Consideration must be given to the sensitivity of landowners to a new by-law and to new requirements such as filing a Notice of Intent or applying for a Permit. Appropriate staff resources need to be allocated to enforcement and administration. Political will and atmosphere will have a significant influence over the perception and acceptance of a new by-law or a by-law amendment.

HOW TO USE THE TEMPLATES

Various by-law templates using the four approaches discussed below have been prepared to assist municipalities considering a forest conservation by-law. These templates are provided as SAMPLES only and should not to be used "as is". Each municipality MUST review the various sections and options in detail and tailor the clauses to suit their local situations.

Schedules to facilitate the administration of the by-law must developed, and recommendations of key areas to include have been provided. Municipalities may want to standardize where possible schedules and forms with surrounding municipalities to assist the forest industry working across municipal boundaries.

COMPONENTS OF A BY-LAW

The main components of such a by-law are listed here and briefly explained to help municipalities gain a general understanding of how forest conservation by-laws work.

Each by-law begins with a statement of the locally determined purpose of the by-law. The main functional components consist of the following:

General Prohibition: sets out generally the requirements under which tree cutting can take place.

Exemptions: provides a list of situations not affected by the by-law. Some exemptions are mandatory as stated in the enabling legislation and others can be added by the municipality. A process is also prescribed to assist Councils to deal with applications for exemptions under special circumstances.

Notification and Applications: provides opportunity for the municipality to require notification in advance of tree cutting. The municipality can also chose a permit system where application must be made to obtain a permit to cut. An appeal process is also provided for the permit system.

Penalties and Enforcement: The ability of the municipality to appoint a by-law officer and the legislated fines are described here. The municipality may impose stop work orders and has the option of setting ticketable fines through the short forming process (contact the Provincial Attorney General's office for more information).

DIFFERENT APPROACHES TO BY-LAWS.

There are different approaches to forest conservation by-laws. Each municipality must carefully consider the pro's and con's of each approach and decide which might suit their local situation best.

- A Basic By-law
- By-laws Requiring Notification in Advance of Cutting
- By-laws Using a Permit System
- By-laws Using a Combination of Notification and Permit System Depending on the Forest Management Approach Being Used.

The Basic Approach

A basic by-law sets the requirements to cut trees, but would not impose any requirements on the owner to provide the municipality with advanced notice of tree cutting or an application to obtain a permit to cut. Enforcement would be carried out through random inspection or in response to complaints or concerns.

Advantages: Administrative costs are greatly reduced. Citizens feel they are contributing and have a role in their community's environmental protection by reporting alleged infractions. This approach is clearly less onerous on the landowner and may also be perceived as less restrictive.

Disadvantages: Citizens may not wish to report on their neighbors. By-law Officer may not become aware of poor cutting practices occurring until damage is done. A municipality must provide sufficient education and awareness so that there is widespread knowledge that there is a Forest Conservation By-law and that citizens have a role in enforcing it.

By-laws Requiring Notification in Advance of Cutting

Many by-laws in the past have required the landowner to provide the municipality with advanced written notice of their intention to cut. This allows the municipality to make inspections to ensure cutting is consistent with the By-law.

Advantages: This approach gives the municipality the advantage of advanced notice of tree cutting but it is not as onerous as a permitting process.

Disadvantages: The Notice does not give the municipality the opportunity to deny cutting. The cutting must first take place before a stop work order, or a ticket is issued, or a charge can be laid.

By-laws using a Permit System

An application for a Permit is required before cutting can begin.

Advantages: The permit application process puts more accountability on the owner to show that thoughtful forest management is being conducted. A permit system makes enforcement easier because a review of the application may provide a good indication of the type of cutting that may take place. The municipality may set special conditions or deny cutting entirely where poor practices are proposed. The visible permit makes it easier for the public to be assured that the minimum standards of the by-law are being adhered to.

Disadvantages: Adequate administrative support is required to process, review and issue permits. In some municipalities, forest owners will feel that a permit requirement is too onerous.

By-laws Using a Combination of Notification and Permit Systems

A combination of approaches may be preferred. For instance, advanced notice of cutting is required when good forest practices are being planned, but an application for a permit is required when circumference limit cutting is being proposed.

Advantages: The notice is less onerous for those using good forestry practices and still gives notification to municipalities. The permit provides the municipality with the option to accept, deny, or place conditions on all other types of cutting.

Disadvantages: This combination may not be as transparent to the public. The notice does not give the municipality the opportunity to deny cutting when "good forestry practices" are not to be employed. The cutting must first take place before a stop work order or a ticket is issued, or a charge can be laid.

OTHER RESOURCES

The Ontario Woodlot Association has developed the ***Forest Service Directory for Landowners*** Web site that contains numerous items of interest when considering Forest Conservation Bylaws, such as the template referred to above, the information for

Successful Forest Conservation Bylaws, and contact information for other jurisdictions with tree cutting bylaws. The Web is located at www.ontariowoodlot.com

The Landowner Resource Centre provides an extensive selection of publications including the Ministry of Natural Resources Extension Note Series. They can be reached at 613- 692-2390 or 1-800-387-5304 or on the Internet: at www.lrconline.com

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A Template for Forests Conservation By-laws

For upper tier municipalities to protect forests 1 ha in size and over.

Uses a combination of the Permit and Notice Systems as described in the "Guide to Developing Forest Conservation By-laws"

(Other templates are available for the other by-law options such as using either a notice or permit system.)

Updated Feb 19, 2003

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NOTE: THIS IS A TEMPLATE TO GUIDE DISCUSSIONS AROUND DEVELOPING A FOREST CONSERVATION BY-LAW – TEMPLATE IS NOT INTENDED TO BE USED AS IS.

FORESTS CONSERVATION BY-LAW NO. [ ]

To prohibit or regulate the destruction or injuring of trees in woodlands in the [Name of Municipality]

WHEREAS s.135(2) of the *Municipal Act*, R.S.O. 2001, S.O. 2001, c.25, as amended, permits the enactment of a By-law by the Council of [Name of Municipality] to prohibit or regulate the destruction or injuring of trees in woodlands;

The power to "*prohibit* or *regulate"* means that an upper tier municipality has the ability to promote sustainable forest mangement activities (traditionally referred to in tree cutting By-laws as Good Forestry Practices) and prohibit activities known to be detrimental to woodlands. Note that the municipalities must adopt the harsh wording of "*destruction or injuring*" because the Municipal Act uses these terms, but we recognize that it generally refers to harvesting, cutting and logging.

AND WHEREAS Council may require that a Permit be obtained to injure or destroy trees in woodlands specified in the By-law and impose conditions on a Permit, including conditions relating to the manner in which destruction occurs and the qualification of persons authorized to injure or destroy trees. [see s.135(7)]

AND WHEREAS Council has determined that it is desirable to enact such a By-law for the purpose(s) of:

This section is optional and provides the Council an opportunity to state its purpose and intent of the By-law which may help to increase the public's understanding of the purpose of the By-law and may inscrease the public's support for the By-law. The following are examples which may be included. Be thoughtful as you want to ensure that the By-law is within the jurisdiction of Council and consistent with proper municpal purposes.

- preserve and improve the woodlands in [Name of Municipality] through Good Forestry Practices;
- promote Good Forestry Practices that sustain healthy woodlands;
- minimize the destruction or injuring of trees;
- regulate and control the removal, maintenance and protection of trees;

- minimize and guard against dangerous conditions which may result in injury;
- protect, promote and enhance the aesthetic values of woodlands;
- contributing to human health and quality of life through the maintenance of woodland cover;
- provisions for habitat

Now, therefore, the Council of [Municipality] HEREBY ENACTS as follows:

1. DEFINITIONS

Where definitions appear in the *Municipal Act*, they do not need to be repeated in the By-law. However, they can be included for clarity.

The By-law must define the terms that will be used in the By-law, its forms and schedules. This section should be carefully drafted to ensure that the By-law can be enforced. Use plain language whenever possible.

Technical terms that are defined should be capitalized throughout the By-law.

All measurements within the By-law should be in metric. A separate sheet of conversions could be prepared and provided for information purposes. However this information should not be incorporated as part of the By-law.

In this By-law:

(a) "Basal area" means the area of the cross-section of the stem of a tree taken at a point of measurement 1.37 metres above the highest point on the tree where the ground meets the stump.

The phrase previously used in By-laws "above the highest point of ground in an undisturbed state at the base of the tree" has been replaced with plain language.

Metric has been used throughout this template, but some municipalities may prefer to include the imperial measurements in brackets.

(b) "Building Permit" means a Building Permit issued under the *Building Code Act,* 1992, S.O. 1992, c23, as amended.

(c) "Business day" means any day falling on or between Monday and Friday of each week but does not include [list selected holidays].

(d) "Circumference" means the measurement of the perimeter or outer boundary of a stem or trunk of a tree with such measurement including the bark of the stem.

(e) "Coppice growth" means where more than one tree stem grows from a single tree stump.

(f) "Council" means the Council of [Name of Municipality].

"Destroy" and "injure" has been previously defined in some By-laws. However, defining these terms may limit enforcability of parts of the By-law. It is possible that other actions may destroy or injure trees that do not fall within the definition and it is possible for an enforcement proceeding to fail. It is recommended not to define these terms and instead leave the definition to the discretion of the By-law enforcement Officer.

Should a municipality chose to use these terms, definitions used in the past include;

"Destroy" means any action which causes or results in the irreversible injury or death of a tree.

"Injury" means any action which causes physical, biological, or chemical damage to a tree.

"Harvest" means the removal of a tree or trees by cutting which results in destruction of a tree by design for the purposes of extraction of some type of product.
.

(g) "Diameter" means the diameter of the stem of a tree measured outside the bark at a specified point of measurement.

(h) "DBH" means the diameter of the stem of a tree measured at a point that is 1.37 metres above the ground.

(i) "Good Forestry Practices" means the proper implementation of harvest, renewal and maintenance activities known to be appropriate for the forest and environmental conditions under which they are being applied and that minimize detriments to forest values including significant ecosystems, important fish and wildlife habitat, soil and water quality and quantity, forest productivity and health and the aesthetics and recreational opportunities of the landscape;

Always use the plural of the term Good Forestry Practices, to be consistent with the *Forestry Act*. The *Municipal Act* refers to Good Forestry Practices as defined in the *Forestry Act*.

Legislative Council has advised that the definition of Good Forestry Practices may be expanded as long as the list expands upon the definition and does not include substantive provision that should stand alone. We have therefore chosen and hereby recommend to further explain the definition as follows:

And Good Forestry Practices permits the destruction or injuring of trees that:

- have been damaged by disease, insects, wind, ice, fire, lightning, or other natural causes to an extent that the health of such trees is likely to further deteriorate;

- should be cut or removed to prevent disease or insects from spreading to other trees;
- are cut in accordance with the Provincial Silvicultural Guidelines as referred to in the Forest Operations and Silviculture Manual and its revisions prepared under the authority of the *Crown Forest Sustainability Act,* S.O. 1994, c. 25. These Provincial Silvicultural Guidelines include, but are not limited, to: A Silvicultural Guide to Managing Southern Ontario Forests, Silvicultural Guide for the Tolerant Hardwood Forest in Ontario, A Tree Marking Guide for the Tolerant Hardwood Working Group in Ontario, A Silvicultural Guide for the Great Lakes – St. Lawrence Conifer Forest in Ontario;
- are marked and cut as part of a woodlands management plan approved by a Registered Professional Forester.

Note that by including the Silvicultural Guide for the Great Lakes – St. Lawrence Conifer Forest, we are including Good Forestry Practices for conifer plantations.

(j) "Officer" means an individual appointed by Council for the administration and enforcement of this By-law.

(k) “Owner” means a person having any right, title, interest or equity in land.

(l) “Own Use” means use that does not include a sale, exchange or other disposition of trees destroyed or injured.

(m) “Permit” means the written authorization from the Officer as provided in Schedule “F”.

(n) "Point of Measurement" means that point on the tree trunk measured above the highest point on the tree where the ground meets the stump. For coppice growth the point of measurement shall be at the point on the tree trunk where the tree stems separate provided that such point of separation is less than 1.27 metres from where the ground meets the stump.

(o) “Registered Professional Forester” as defined in the *Professional Foresters Act,2000,* S.O. 2000, c.18.

(p) "Sensitive Natural Areas" means the:

You may wish to identify areas that are of municipal importance such as areas designated within your Official Plan. You may also wish to consider showing these areas on a map in an additional Schedule. The following are examples.

- Greenland's Systems
- Natural Heritage Systems
- Oak Ridges Moraine
- Special Recharge Areas
- Significant Forest Cover
- Significant Policy Areas
- Provincially or regionally identified Significant Wetlands
- Areas under the jurisdiction of the Niagara Escarpment Commission.

- any portion of woodlands located within 30 metres of the water's edge of a locally, regionally, or provincially significant wetland, lake, river, stream or intermittent stream. Intermittent stream means a stream which flows for fewer than 9 consecutive months per year under average annual precipitation conditions and which has defined banks.
- Provincial or Regional Life Science Areas of Natural and Scientific Interest identified by the Ministry of Natural Resources, 1982, as amended.
- Environmentally Sensitive Areas identified by [list Conservation Authorities or other appropriate authorities in your area]
- habitat of Vulnerable, Threatened or Endangered Species, as identified by [authority as appropriate].
- Lands receiving property tax reduction under the Conservation Land Tax Incentive Program.

Another approach is to create a section in the By-law that prohibits any person from destroying or injuring trees in a list of areas within the municipality. This may be easier to enforce. E.g. "The destruction or injuring of trees in the following areas is prohibited:" and list the areas within the municipality.

(q) "Silviculture" means the theory and practice of controlling forest establishment, composition, growth and quality of forests to achieve the objectives of management.

This is the definition found in MNR's "A Silvicultural Guide to Managing Southern Ontario Forests".

(r) "Tree" means any species of woody perennial plant, including its root system, which has reached or can reach a height of at least 4.5 meters at physiological maturity.

(s) "Woodlands" means land at least one hectare and more in area with at least:

(i) 1000 trees, of any size, per hectare;

(ii) 750 trees, measuring over five (5) centimetres in diameter at DBH, per hectare;

(iii) 500 trees, measuring over twelve (12) centimetres, in diameter at DBH, per hectare; or

(iv) 250 trees, measuring over twenty (20) centimetres, in diameter at DBH, per hectare;

but does not include a cultivated fruit or nut orchard or a plantation established for the purpose of producing Christmas trees.

It would be preferable if the definition of Woodlands was not limited by property boundaries. Although this concept is important from a landscape protection perspective, Legislative Council has advised that the definiton from the *Forestry Act* cannot be expanded to go beyond property boundaries. Note that the Town of Oakville's by-law does not limit woodlands by property boundaries.

2. GENERAL PROHIBITION

(a) Except as provided in section 3, no person through their own actions or through any other person shall destroy or injury any living tree unless;

Section 2 provides for two main provisions to allow tree cutting: through good forestry practices; or through circumference limits. Additional exceptions for specific situations are listed in Seciton 3.

- Provision for tree cutting through good forestry practices appears first in Section 2 (a)(i). The intent is to promote this option first and foremost in the bylaw. Tree conservation bylaws and information developed to support the bylaw should always promote the use of good forestry practices as the preferred method of ensuring the sustainability of a woodland's economic and environmental values.

- Provision for tree cutting through circumference limits has appears second in Section 2 (a) (ii). Circumference or diamter limits have been the traditional approach to regulating tree cutting in

municipal bylaws. Including provsions for circumference limit cutting recognizes this past approach as well as the rights of private landoweners to make choices as to how their woodlots are managed. However, circumference or diameter limit cutting is generally detrimental to the economic and ecological values of the forest and is generally not consistent with good forestry practices. Circumference or

diameter limit cutting is also not recommended by the Ontario Ministry of Natural Resources Silvicultural Guide to Managing Southern Ontario Forests.

(i) the person who is destroying or injuring trees does so in accordance with good forestry practice as prescribed by:

(a) a Registered Professional Forester or;

(b) a member in good standing of the Ontario Professional Foresters Association; and

(c) the person who is destroying or injuring trees has abided by the requirements of section 5 ; or

The *Professional Foresters Act*, provides that these are the only people qualified to practice professional forestry, including writing silvicultural prescriptions. Local municipalities should be encouraging local industry to apply for associate membership in the Ontario Professional Foresters Association to ensure private landowners have access to qualified individuals.

Note: There has been a trend to provide an exemption where woodlands are marked by Certified Tree Markers, with the assumption that this would ensure Good Forestry Practices. Although Certified Tree Markers are trained to mark according to a prescription, prescriptions are often not prepared and Certified Tree Markers are not necessarily trained in the preparation of prescriptions. For these reasons, we do not recommend providing an exemption for the use of Certified Tree Markers.

Note: There has also been a trend to allow exemptions where Woodlands are receiving a tax reduction under the Managed Forest Tax Incentive Program. Although this program requries a management plan, it does not ensure that good forest management practices are carried out at the time of cutting. We do not recommend providng an exemption for Woodlands under the Managed Forest Tax Incentive Program.

ii) the person who is destroying or injuring trees, has only destroyed or injured those trees which have attained, at the specified point of measurement, the Circumference measurement which equals or is greater than the minimum Circumference prescribed for the species in Schedule “A”;and

a) the person who is destroying or injuring trees has abided by the requirements of Section 5; and

b) the destruction or injuring of trees will not reduce the number of trees per hectare below the minimum number of trees per hectare required to be considered Woodlands;

Diameter limits have been replaced by Circumference limits because Circumferences are easier to measure and the measurement procedure is easier to describe to lay people.

OPTIONAL SECTION as follows:

c) the injuring or destruction of trees has not reduced the Basal area in that part of the Woodlands, where trees have been destroyed or injured below____ m^2/ha; and

Square meters/ha can be adjusted appropriately for the municipality and currently ranges between 15 and 20 m^2/ha. This refers to trees 10 cm diameter and larger.

b) No person through their own actions or through any other person shall;

(i) fail to comply with an Order issued under this By-law;

(ii) remove or deface any Order that has been posted pursuant to this By-law;

(iii) contravene the terms or conditions of a Permit issued under this By-law.

c) No person through their own actions or through any other perosn shall destroy or injure a tree located in an identified Sensitive Natural Area;

This clause could be adapted to suit local needs. The by-law could require a permit for cutting in a sensitive natural area, or could require good forestry practices, or it may depend on the type of sensitive natural area. For instance, cutting might need to be done in a Red oak ANSI.

OTHER OPTIONAL SECTIONS as follows:

d) A person shall not:

(i) destroy or injure any tree that is to remain standing after the destruction or injuring of trees is completed;

Although this is enforceable it is not really practical because realistically residual trees are always damaged to some degree during harvesting. (The municipality may wish to have a policy or guideline about good forest practices or a Code of Practice instead of these provisions.)

(ii) operate a vehicle, machinery or equipment or conduct their operations in such a manner or at such a time that results in excessive damage to the soil, wetlands or other portions of the woodlands;

Excessive damage to soil is difficult to assess without criteria that can be measured in some objective manner. This should perhaps be looked at during the development of a site alteration By-law.

(iii) operate a vehicle, machinery or equipment or conduct operations in a manner or at a time, that results in the leaving of any part of a tree in a watercourse including any trees that have not been cut, but have been pushed, knocked over or otherwise ended up in a watercourse;

This can also be enforced through the *Lakes and Rivers Improvement Act.*

3. EXEMPTIONS

This section includes two types of exemptions: mandatory exemptions found in the *Municipal Act* and exemptions granted by the municipality.

The following are the legislated exemptions that are set out in the *Municipal Act* and cannot be changed by By-law. Although these don't have to be re-written into the By-law, it is preferable to have them re-stated to eliminate confusion.

This By-law does not apply to;

(a) activities or matters undertaken by a municipality or a local board of a municipality; or

(b) activities or matters undertaken under a licence issued under the *Crown Forestry Sustainability Act,* 1994; or

This would include trees on private land that the Province has retained timber rights to.

(c) the injuring or destruction of trees by a person licensed under the *Surveyors Act* to engage in the practice of cadastral surveying or his or her agent, while making a survey;or

(d) the injuring or destruction of trees imposed as a condition to the approval of a site plan, a plan of subdivision or a consent under section 41, 51, or 53, respectively, of the *Planning Act* or as a requirement of a site plan agreement or subdivison agreement entered into under those secitons; or

(e) the injuring or destruction of trees imposed as a condition to a development Permit authorized by regulation made under section 70.2 of the *Planning Act* or as a requirement of an agreement entered into under the regulation; or

(f) the injuring or destruction of trees by a *transmitter or distributor, as those terms are defined in Section 2 of the Electricity* Act, 1998, for the purpose of construction and maintaining a transmission system or a distribution system, as those terms as defined in that Section; or

(g) the injuring or destruction of trees undertaken on land described in a licence for a pit or quarry or a Permit for a wayside pit or wayside quarry issued under the *Aggregate Resources Act*; or

(h) the injuring or destruction of trees undertaken on land in order to lawfully establish and operate or enlarge any pit or quarry on land,

i. that has not been designated under the *Aggregate Resources Act* or a predecessor of that Act; and

ii. on which a pit or quarry is a Permitted land use under a By-law passed under section 34 of the *Planning Act*.

The following are examples of <u>OPTIONAL EXEMPTIONS</u> that can be included at the descretion of the Municipality.

(i) the injuring or destruction of trees where the owner of the Woodlands has been granted an exemption by Council pursuant to section 4; or

(j) the injuring or destruction of trees that is required in order to erect any building, structure or thing in respect of which a Building Permit has been issued and has taken into consideration the protection of trees surrounding the structure or work within the building envelope, provided that no tree is destroyed or injured that is located more than 15 metres from the outer edge of the building, structure or thing; or

"Thing" could be a septic bed. 15 meters is suggested. Consult with your local building department.

(k) the injuring or destruction of trees that is required in order to install and provide utilities to the construction or use of the building, structure or thing in respect of which a Building Permit has been issued; or

(l) the injuring or destruction of trees that is required in order to install and provide utilities to a single lane driveway for vehicular access to the building, structure or thing in respect of which a Building Permit has been issued; or

(m) the owner of the Woodlands that has destroyed or injured trees for his or her own use where the owner has been the registered owner of the Woodlands for at least two years prior to the date of the commencement of the destruction or injury of the trees; or

The requirement of ownership for 2 years does not restrict an owner from commercial harvesting. This clause is optional as it maybe too restrictive for owners who wants to apply good silvicultural operations on their own.

A variation to this clause is to require an owner to own the woodland for at least 2 years before commercial harvesting is to occur, except in instances where good forestry practices are to be applied. Such restriction would be inserted under Section 2 (a) (ii) indicating that they would have to own the woodland for at least 2 years. This prevents individuals from stripping the forest resources from a property and re-selling the land.

Other Variations: Some municipalities have limited the personal use to a certain number of trees per year/hectare to be sold commercially. Some municipalities have limited the personal use to a certain number of trees per year/hectare, to be sold commercially.

(n) the destruction or injury of trees where the trees are destroyed or injured pursuant to a legally binding contract if:

(i) the owner of the Woodlands has given notice under section 5; and

(ii) the contract was signed within one year immediately preceding the date on which this By-law was passed and;

(iii) proof of the signed contract and payment in full has been submitted to the Officer and;

(iv) the trees are injured or destroyed in a manner consistent with By-law No ____ and;

4. COUNCIL EXEMPTION

This section allows the owner to apply for an exemption other than those listed in the previous section. The same Permit would be used, but the exemption would have to be granted through this process. This also describes the process for objecting to decisions regarding an application for a Permit or exemption.

In order to be considered for an exemption to Section 2 the owner of the Woodlands must apply to the Clerk for an exemption at least ___ months prior to the anticipated commencement of injury or destruction of trees by submitting;

i) a completed application form as described in Schedule "B"; and

ii) the applicable fee as set out in Schedule "C".

(b) At least ____Business days prior to consideration of the application for an exemption the Clerk shall send, by regular mail, written notice in the form of Schedule "D" to the applicant and all assessed owners of each parcel of land that abuts the applicant's Woodlands for which an exemption is being sought and to such other persons as prescribed by Council.

(c) The applicant shall erect and display a public notice regarding the exemption application at the entrance to the Woodlands in a position that ensures that it is clear and visible to all persons, and the notice shall be in the form of Schedule "E".

(d) The notice shall be posted at least _____ Business days prior to consideration of the application.

(e) Provided that there have been no objections filed with the Clerk and the Officer agrees that the general purpose and intent of this By-law is maintained, the Clerk may grant the Permit for the exemption in the form of Schedule "F".

The Officers' agreement has been added because otherwise there is a concern whether the Clerk has the expertise to determine whether the activities proposed are consistent with the purpose of the By-law. The fact that no objections have been made does not ensure this. Ensure that the Officer has had sufficient training to make this judgment.

(f) When granting a Permit for an exemption, the Clerk may include terms or conditions.

(g) When denying an exemption, the Clerk must notify the applicant.

(h) The applicant may object to the terms and conditions on the Permit for the exemption.

(i) Where there have been objections filed with the Clerk or where the applicant objects to the terms and conditions on the Permit for the exemption, Council will consider the application for exemption, any conditions to the Permit and make a decision whether to grant the exemption and therefore a Permit.

(j) The Council shall hear any person who wishes to speak to the exemption for which objections have been filed.

(k) When granting an exemption Council may include terms or conditions on the Permit.

5. NOTIFICATION/APPLICATION

Requiring submission of a Notice of Intent when Good Forestry Practices are to be carried out;

(a) Every owner of Woodlands who intends to destroy or injure trees personally or through another person, under Section _2_(a) (i) of this By-law shall complete and submit a notice to the Officer or their designate no less than ____ Business days prior to the start of destruction or injury, all the information as prescribed in Schedule "G".

Requiring application for a Permit when a Circumference harvest is planned;

(b) Every owner of Woodlands who intends to destroy or injure trees personally or through another person, under Section 2 (a) (ii) of this By-law shall make application for a Permit to the Officer or their designate by submiting all of the information as prescribed in Schedule "H" and the appropriate fee as outlined in Schedule "C".

NOTE: This clause is optional.

(c) Any person who is required to file a Notice under subsection (a) or has obtained a Permit under subsection (b) shall also erect and display a sign at the entrance at the adjoining roadway to the land where the destruction or injury of the trees is to occur, in a position that is clear and visible to all persons, and such sign shall in the format as outlined in Schedule "OPTIONAL –Notice of Timber Harvesting".

6. PERMIT APPLICATIONS

1. Applications for Permits will not be processed if;

i) applications have not been completed in full; and

ii) the substantive requirments that must be submitted with an application have not been included; and

iii) applications are not in keeping with the general purpose and intent of this By-law; and

iv) the prescribed application fee, as set forth in Schedule "C" has not been paid in full, and

v) will be returned to the applicant with the prescribed fee within 30 days.

The *Municipal Act* permits fees to be charged on a full cost recovery basis so that the costs of the application are entirely borne by the applicant. CAUTION: A new fee may discourage compliance.

i) A Permit in the form of Schedule "F" may be;

i) issued to the applicant for a term of up to ___ years.

ii) renewed by an Officer for one term of ___ year(s).

iii) renewed by Council for an exemption Permit for one term of ___year(s).

In *The Municipal Act*, the municipality may delegate the power to issue Permits to Officers, but it is silent on whether Officers can renew Permits. It may be that the municipality has to renew Permits rather than Officers. Something that needs to be checked out with a muncipal lawyer.

ii) An Officer may impose conditions to a Permit that relate to;

i) the manner in which destruction or injury is to occur; and

ii) the qualifications of persons authorized to destroy or injure trees.

Municipalities should promote the involvement of a member of the Ontario Professional Foresters Association (OPFA) in managing Woodlands to ensure that the objectives of the By-law are met. For instance, a review of the prescription should be done by a member of the Ontario Professional Foresters Association.

Ideally, qualified Officers should be grandfathered as Associate Members of the OPFA to review applications and set conditions which are in keeping with good forestry practices. However concerns with the application of good forestry practices within a prescription could be deferred to the OPFA, MNR or another qualified body should the municipality not have a qualified RPF on staff.

4. When denying a Permit, the Clerk must notify the applicant.

7. APPEALS TO THE MUNICIPAL BOARD

An applicant for a Permit under Section 6 may appeal to the Municipal Board if;

(a) the municipality refuses to issue a Permit, within 30 days after the refusal; or

(b) the municipality fails to make a decision on the application, within 45 days after the application is received by the Clerk; or

(c) If the applicant objects to a condition of the Permit, within 30 days after the issuance of the Permit.

8. ORDERS TO DISCONTINUE ACTIVITY

(a) Where an Officer is satisfied that a contravention of this By-law has occurred, the Officer may make an Order requiring the person who contravened the By-law or who caused or Permitted the injuring or destruction of trees in contravention of the By-law to stop the injuring or destruction of trees. The order shall set out the information contained in Schedule "I".

Note that Schedule I must contain the three items in s.137 (3) of the Municipal Act in addition to other items as indicated in the template.

(b) An Order issued under this section may be served personally or served by sending it by mail to the last known address of;

i) the owner of the Woodlands; and

ii) the person identified as injuring, destroying or harvesting a tree or trees.

(c) Where service of an Order is made by mail, service shall be deemed to have been served on the fifth day after the order is mailed.

(d) Where service cannot be carried under section 8, subsection (b), it is deemed sufficient if the Officer places a placard containing the terms of

the Order in a conspicuous place on the affected lands and the placing of the placard shall be deemed to be sufficient service of the Order on the person to whom the Order is directed.

(e) If the person to whom the Order is directed is not satisfied with the terms of the Order, the person may appeal to Council by filing a Notice of appeal by personal service or certified mail to the Clerk within 30 days of the date of the Order.

(f) Where an appeal has been filed, Council shall hear the appeal and have all the powers and the functions of the Officer.

(g) Before conducting a hearing under this section, the Clerk shall give notice to such persons or direct that notice be given to such persons as the Clerk considers should receive notice and in the manner directed by the Clerk.

(h) After hearing an appeal, Council may confirm or revoke any Order issued under this By-law or may issue a Permit with conditions, provided that in the opinion of the Council, the general intent and purpose of this By-law has been maintained.

(i) The proceedings at the hearing held by the Council shall be in accordance with the provisions of the *Statutory Powers Procedures Act,* R.S.O. 1990, c.22. The decision of the Council under this section is final.

There is no authority in the *Municipal Act* for an appeal of a stop work order.

A copy of the By-law should be provided to the recipients of the Order. The Order should be served on all people who have been observed on site: the contractor, the site supervisor, the owner and any other adult individual who appears to have control over the activities on site. In addition, a copy of the Order should be posted prominently on the site.

9. PENALTY

(a) Any person who contravenes any provision of this By-law, or an Order issued under section 8 is is guilty of an offence and is liable:

(i) on first conviction, to a fine of not more than $10,000 or $1,000 per tree, whichever is greater; and

(ii) on any subsequent conviction, to a fine of not more than $25,000 or $2,500 per tree, whichever is greater.

(b) If a person is convicted of an offence for contravening this By-law or an Order issued under section 8, the court in which the conviction has been entered, and any court of competent jurisdiction thereafter, may order the person to rehabilitate the land or to plant or replant trees in such a manner and within such period as the court considers appropriate, including any silvicultural treatment necessary to re-establish the trees.

10. ENFORCEMENT

(a) This By-law shall be enforced by an Officer appointed by the municipality and listed in Schedule "J".

Persons do not need to be appointed by a separate By-law. They can be listed within a separate schedule to this By-law. Individuals enforcing a by-law under the Municipal Act MUST be appointed as Provincial Offences Officers to legally enforce the enacted by-law.

A municipality is required to issue a Certificate of Designation to every Officer (sample attached).

There is nothing in the legislation that prohibits a municipality from retaining a private firm to enforce the By-law provided the names of the relevant employees are contained in the appointment schedule in the By-law. However, the municipality is required to ensure that each Officer is properly trained to perform her or his duties, and if the Officer is not an employee of the municipality, is supervised by an employee of the municipality.

(b) An Officer may at any reasonable time enter and inspect any land to determine whether this By-law, an Order or a condition of a Permit is being complied with.

The power to inspect any land does not extend to entry into any building and does not extend th epower of entry to a person acting under the Officer's instructions. See section 137 (2) of the *Municipal Act*.

(c) Any person who obstructs or interferes with an Officer in the discharge of his or her duties under this By-law, shall be considered in violation of this By-law.

11. ADMINISTRATION

(a) Schedules "A – J" shall form part of this By-law.

(b) If any section or sections of this By-law or parts thereof are found by any Court to be illegal or beyond the power of the Council to enact, such Section or Sections or parts thereof shall be deemed to be severable and all other Sections or parts of this By-law shall be deemed to be separate and independent there from and continue in full force and effect unless and until similarly found illegal.

(c) The short title of this By-law is the "Forest Conservation By-law".

(d) By-law {insert previous By-law no.} of the Municipality of {insert Municipality} shall be repealed effective on the coming into force and effect of this By-law.

(e) Despite subsection (d) of this section, By-law {insert previous By-law no.} of the Municipality of {insert Municipality} shall continue to apply to proceedings in respect of offences that occurred before its repeal.

PASSED this day of , A.D. 20 .

_____ _____

Chair Clerk

SCHEDULE A

CIRCUMFERENCE LIMITS BY CATEGORY OF TREE SPECIES

Species and circumferences must be verified and adjusted for the local forest conditions within the municipality being considered.

As a starting point to help develop this list, consult with the local forest industry, forest consultants, landowners and land managers as to what they consider appropriate circumference limits. Look at circumference limits in by-laws used by surrounding municipalities. Make sure you list every tree species you want to protect.

Increased circumference limits will promote the use of good forest practices, but may present a concern to the forest industry and landowners because it may place additional restrictions on them.

Note that circumference limit cutting is not considered good forestry practice but has been the most effective way to enforce minimum cutting standards to date.

The following table is an EXAMPLE for the Greater Toronto Area

These circumference limits and species may be quite inappropriate for other areas of Ontario.

In this table for example, a Sugar Maple found in Category 1 with a circumference of 280 cm or less at the point of measurement 2.5 cm from the ground cannot be cut.

Category 1: Large Circumference Tree Species	**Category 2: Medium Circumference Tree Species**	**Category 3: Small Circumference Tree Species**
Acer saccharum (Sugar Maple) Acer nigrum (Black Maple) Acer rubrum (Red Maple) Acer saccharinum (Silver Maple) Quercus spp (Oak species) Juglans nigra (Black Walnut) Juglans cinerea (Butternut) Carya spp (Hickory species) Prunus serotina (Black	Pinus resinosa (Red Pine) Larix spp (Larch) Picea spp (Spruce) Fraxinus nigra (Black Ash) Fraxinus pennsylvanica (Red & Green Ash) Salix spp (Willow species)	Pinus banksiana (Jack Pine) Pinus sylvestris (Scot's Pine) Abies balsamea (Balsam Fir) Thuja occidentalis (White Cedar) Betula papyrifera (White Birch) Populus spp (Native Poplar species) Ostrya virginiana (Ironwood) Picea mariana (Black Spruce) Carpinus caroliniana (Blue Beech) Prunus pensylvanica (Pin

Cherry) Fraxinus americana (White Ash) Tilia americana (Basswood) Fagus grandifolia (Beech) Pinus strobus (White Pine) Tsuga canadensis (E. Hemlock) Ulmus spp (Native Elm species) Betula alleghaniensis (Yellow Birch)		Cherry) Amelanchier spp., (Service Berry) Red Cedar

Height above ground	**Group 1 Species**	**Group 2 Species**	**Group 3 Species**
2.54 cm	280 cm	239 cm	183cm
10 cm	254 cm	208 cm	160cm
20 cm	230 cm	175 cm	127 cm
30 cm	208 cm	160 cm	112 cm
46 cm	198 cm	142 cm	96 cm
137 cm Breast Hght	175 cm	127 cm	79 cm

SCHEDULE B

APPLICATION FOR COUNCIL EXEMPTION TO FOREST CONSERVATION BY-LAW

Minimum Application Requirements

- Landowner and/or Agent Information
- Property Information
- Property and Forest Description including application area
- Purpose of Exemption Request
- Map of application area
- Details of the council request for exemption process

Optional Application Questions

- Restoration Plans
- Fees
- Other requirements e.g. Environmental Impact Study, or farm land quality assessment.

SCHEDULE D

WRITTEN NOTICE OF APPLICATION MADE FOR EXEMPTION TO FOREST CONSERVATION BY-LAW

The Clerk is to send a written notice to the applicant and all assessed owners of each parcel of land that abuts the applicant's woodlands for which an exemption is being sought and to such other persons as prescribed by Council.

Such written notice should include:

- the name and address of the owner who has made the application for an exemption;
- a description of the woodlands in respect of which the application has been made;
- a description of the nature and extent of the trees in the woodland;
- a description of the purpose, nature and extent of the exemption for which application has been made;
- a description of the process by which objections can be filed in regards to the exemption application; and
- the date, time and location of the {Insert title of Decision Making Body} meeting where objections to the application will be heard.

SCHEDULE E

PUBLIC NOTICE

APPLICATION FOR COUNCIL EXEMPTION UNDER THE FOREST CONSERVATION BY-LAW

This Public Notice should include:

- Description of application area
- Landowner Name
- Why the Public Notice is there
- Who to contact for further information
- Deadline for comments
- Reference to by-law

NOTE: THIS IS A TEMPLATE TO GUIDE DISCUSSIONS AROUND DEVELOPING A FOREST CONSERVATION BY-LAW – TEMPLATE IS NOT INTENDED TO BE USED AS IS.

SCHEDULE F

PERMIT TO DESTROY OR INJURE TREES

This Permit should include:

- Applicants name
- Descriptions of application area
- Conditions
- Date of Expiry
- Notarized by municipal official
- Reference to by-law

SCHEDULE G

NOTICE OF INTENT - GOOD FORESTRY PRACTICES TO BE USED

The Notice Form should require:

(Make sure it is consistent with the by-law and consistent with the terms in the by-law.)

- Filing date
- Landowner information
- Forest Operations Prescription writer information and copy of prescription
- Tree marker information
- Cutting Contractor Information
- Property Description and locator map
- Sketch of area to be cut
- Signature of landowner and contractor cutting
- Reference to the by-law
- Estimated start date and completion date

Optional questions may include:

- Purchaser Information
- Tree harvest summary
- Notification by phone or fax 24 hours prior to cutting
- Basal area and basal area distribution by diameter
- Signature of prescription writer, tree marker.
- Estimated volume
- Colour of paint used on trees
- A statement noting that if cutting is taking place using circumference limits know that this method is generally not considered good forestry practices and may affect the health and economic return of the forest in the future.

SCHEDULE H

APPLICATION FOR PERMIT - CIRCUMFERENCE LIMIT CUTTING

Minimum Application Requirements:

(Make sure this is consistent with the by-law and consistent with the terms in the by-law.)

- Filing date
- Landowner and/or Agent Information
- Cutting Contractor Information
- Property Description and locator map
- Sketch of area to be cut
- Signature of landowner and contractor cutting
- Reference to the by-law
- Estimated start date and completion date

Optional Application Questions:

- Purchaser Information
- Tree harvest summary
- Residual Basal area
- Estimated volume
- Marker information
- Notification by phone or fax 24 hours prior to cutting
- Colour of paint used on trees

- A statement near the owners signature reminding the owner that circumference limit cutting is generally not considered good forestry practices and may affect the health and economic return of the forest in the future.

SCHEDULE I

STOP WORK ORDER

YOU ARE HEREBY DIRECTED AND ORDERED TO forthwith stop, halt, cease, and desist from any and all works associated with the destruction of trees or removal thereof from those lands comprising;

MUNICIPAL ADDRESS / LEGAL DESCRIPTION OF THE PROPERTY:

_____

LOT: CONCESSION: MUNICIPALITY:

OWNER / INDIVIDUAL RESPONSIBLE FOR DESTRUCTION OR INJURY OF TREES:

_____

DESCRIPTION OF INFRACTION:

_____

_____

Date of Inspection: _____

Effective Order Date: _____ TO _____

Signature of Officer: _____ Date:

Pursuant to By-law {insert No.} Section 8, subsection (e) Where the person to whom the Order is directed has been served in accordance with this By-law is not satisfied with the terms of the Order, the person may appeal to Council by filing Notice of Appeal by personal service or certified mail to the Clerk within 30 days after the date of the Order.

NOTE: THIS IS A TEMPLATE TO GUIDE DISCUSSIONS AROUND DEVELOPING A FOREST CONSERVATION BY-LAW – TEMPLATE IS NOT INTENDED TO BE USED AS IS.

{Insert Contact Information, Phone Number}

OPTIONAL SCHEDULE

NOTICE OF

TIMBER HARVESTING
SHOULD INCLUDE:

- Reference to By-law
- Property Location Description
- Municipal Contact name and number

OPTIONAL:

- Contractor name, phone number
- Owner
- Name of marker and phone number
- Do not enter during operations for your safety

OPTIONAL SCHEDULE

LOGGING DAMAGE ASSESSMENT

Municipality may wish to consider establishing a methodology to assess damage and acceptable standards to include either within the by-law or to be utilized outside of the by-law.

Benefit of being in the by-law is that it gives it legal credibility during a prosecution. Such standards have been used in several areas within the province already. Disadvantage is that it will require some consensus. It could cause too much restriction for some areas of the province especially in areas where tree by-laws are new. Education of these practices could be supplemental to the by-law in such areas.

Refer to A Silvicultural Guide to Managing Southern Ontario Forests and Forest Research Information Paper No. 117 – Logging Damage: The Problems and Practical Solutions – J.A. Rice ISSN 0319-9118;117.

Discuss what is locally acceptable and practical with your local industry, forest consultants, land owners and land managers.

OPTIONAL SCHEDULE

SHORT FORMED FINE SCHEDULE

FOR TICKETABLE OFFENCES

The Ministry of the Attorney General document ***SET FINE "HOW TO" MANUAL*** can be obtained from:

Devyani Anandjit
Ministry of the Attorney General
Crown Law Office – Criminal
720 Bay Steet, 10th Floor
Toronto, ON M5G 2K1
416-326-2491
416-326-1746 (fax)
devyani.anandjit@jus.gov.on.ca