# Comparative Evaluation of Ecological Significance of Vegetation Patches by Three Methodologies: Life Science Inventory, GIS, and Remote Sensing

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## Abstract

*Three approaches to evaluating significance of vegetation patches were compared: 1) field investigations by biological inventory, 2) a GIS model of forest patches at the landscape level, and 3) remotely sensed data. In a previous exercise air photo interpretation and landscape data were used to classify 212 vegetation patches at the Ecological Land Classification (ELC) Community Series level and rank them for Conservation Priority. In 2004, field surveys were conducted to obtain ELC classifications at the Vegetation Type level for 61 patches (29%) that had been assigned Low, Medium, and High Priority Conservation rankings from the GIS model. A new GIS model that incorporates additional attributes at the landscape level, plus remotely sensed data, is being developed. Preliminary results generally support the reliability of the landscape-level GIS model of assigning Medium and High Conservation Priority rankings. An important observation is that some vegetation patches that ranked low were in fact wetlands that need further scrutiny to assign a formal wetland evaluation. The results of this exercise will determine whether this is an efficient tool for landscape planning to identify conservation priority ranking for a bioregional woodland strategy in the Carolinian Life Zone.*

***Keywords:*** *vegetation patch significance, evaluation methodology*

## Introduction

The *Planning Act* for the Province of Ontario encourages the protection and conservation of natural heritage and significant woodlands, but the pace of planning for development is outpacing the planning for conservation. The rapid and reliable identification of woodlands that should be protected from incompatible development is an urgent need in municipal planning to secure a viable natural heritage system (DeYoung, 2003). Land-use planning for conservation at bioregional and local scales can be assisted by a composite rendering of multiple data sources. LANDSAT data is a flexible, low cost, and current data set that aids spatial and temporal analyses (Coppolillo, 2004). We report on the comparisons of the GIS and air photo interpretation, LANDSAT classification, and the preliminary analysis of life science inventory from field data.

## Background

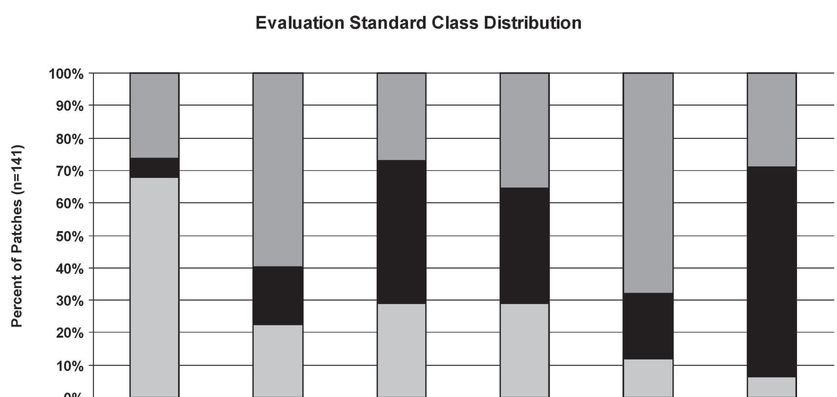
Vegetation patches designated as "Environmental Review" outside the Urban Growth Boundary of London are being evaluated for significance following an Ontario Municipal Board ruling, January 2000. According to the Provincial Policy Statement 2.1, significant means ecologically important in terms of features, functions, representation or amount, and contribution to the quality and diversity of an identifiable geographic area or natural heritage system. The City of London Evaluation for Significant Woodlands Guideline assesses a patch for ecological significance using both quantitative and qualitative data at the landscape, community, and species levels for eight categories of site assessment:

1) site protection (hydrological features, erosion);
2) integrity (richness, connectivity, distribution);
3) age and site quality (successional stage, floristics, disturbance);
4) patch metrics (size, shape, interior);
5) diversity (variation and heterogeneity of topography, specialized habitats, and the ELC Community Series and Vegetation Types);
6) endangered and threatened species;
7) distinctive, unusual, or high quality natural communities (ELC Community SRANK, specialized or rare species, age, size, and distribution of large trees); and,
8) distinctive, unusual, or high quality landforms.

## Study Approach

The GIS exercise of 2002 classified the 212 patches according to the number of Woodland Evaluation Criteria that were satisfied and the results are presented in Figure 1. Two thirds of the patches are associated with a hydrological feature (watercourse, water body, wetland, or sensitive groundwater area). More than one in five patches are associated with an erosion or slope hazard. Fewer than one third of the patches are greater than 8 ha. Forest interior habitat is present in less than one third of patches. Community diversity is low with fewer than one in eight patches with more than three vegetation communities. A small number of patches occur on an uncommon landform.

**Figure 1**. Proportion of patches satisfying Site Protection, Size and Shape, Community Diversity, or Landform evaluation standards of the Woodland Evaluation Criteria.

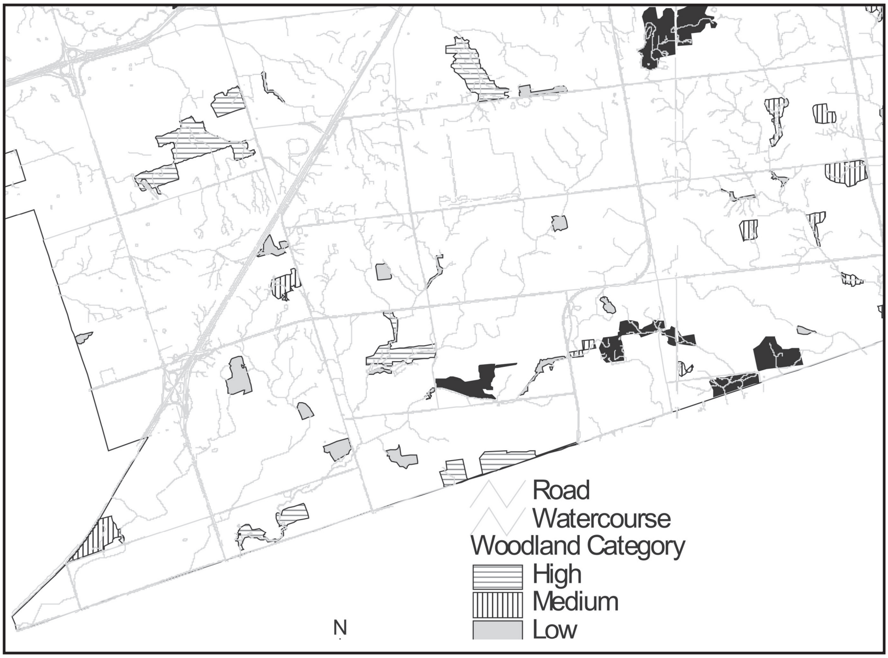



| | Presence of hydrological features | Erosion and slope protection | Woodland Size | Patch Shape/Interior | ELC Community Diversity | Distinctive Landforms |
|---|---|---|---|---|---|---|
| Lo | 26.2 | 59.6 | 27.0 | 35.5 | 68.1 | 29.1 |
| Md | 5.7 | 17.7 | 44.0 | 35.5 | 19.9 | 64.5 |
| Hi | 68.1 | 22.7 | 29.1 | 29.1 | 12.1 | 6.4 |

## Sample of Classified Patches

Patches in the City of London were classed as Environmentally Significant Areas (ESA), ESA Candidate or Environmental Review (ER) (Figure 2). Each was assigned a Conservation Priority Ranking (High, Medium, Low) by six of 20 standards available as analog or digital data. A sample of 35 patches representative of the three classes was selected for intensive field investigation by Team 2 and another sample of 26 was selected for a field investigation by Team 1 (this study). Field investigation was used to gather data on 11 standards. Landscape metrics will be determined for three more standards of landscape integrity (size, shape, connectivity).

**Figure 2**. Example of vegetation patches in Kettle and Dodd Creek sub-watersheds classed for significance or conservation priority rank.



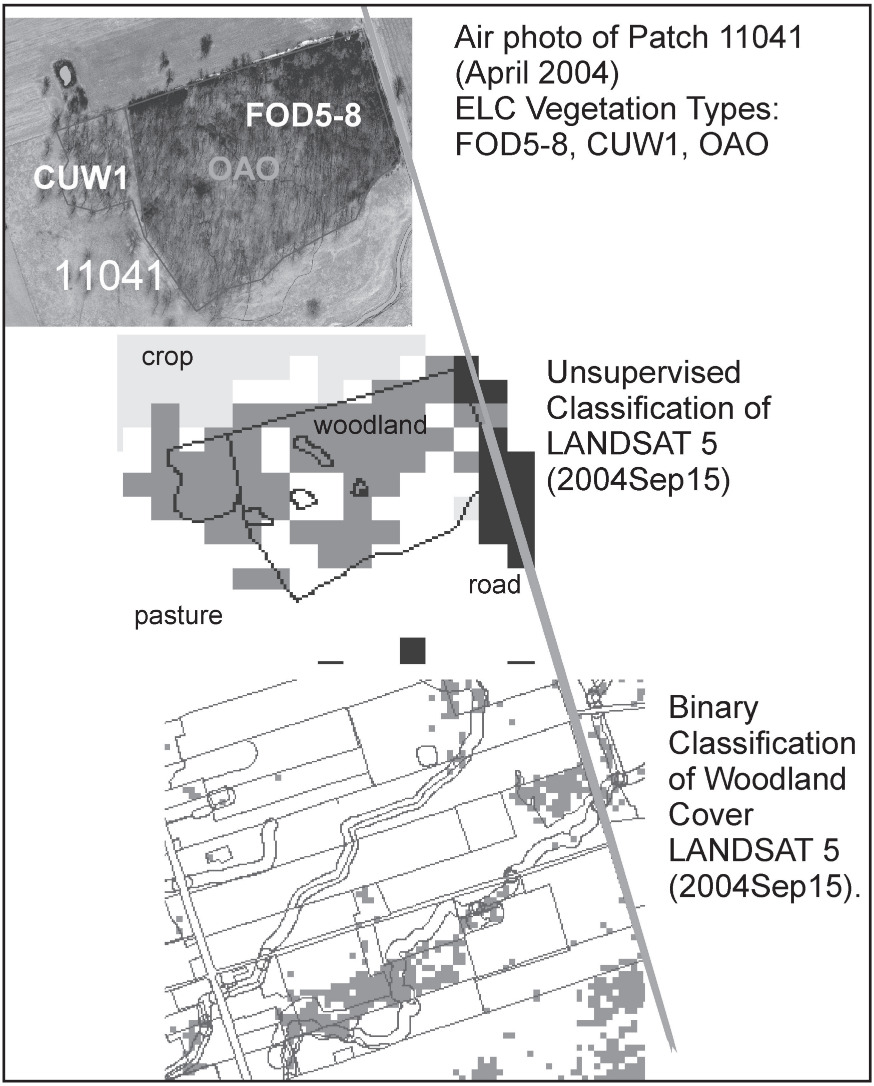

## Examples Demonstrating Need for Field Investigation

Preliminary analysis reveals that more than 10% of the vegetation patches were incorrectly assigned a Low Conservation Priority Ranking. This finding is consistent with Carter (2000) who reported that extrinsic data cannot be relied upon to predict intrinsic conservation value.

Several patches that were ranked Low were in fact wetlands incorrectly classified in the first GIS model as deciduous forest or cultural meadow. Field investigation reveals them to be swamp thickets on organic soils or palustrine-type wetlands with diffuse sheet flow. These important observations indicate that these sites require further scrutiny to assign a formal wetland evaluation.

One example is presented in Figure 3 for Patch 11041 in the Dodd Creek sub-watershed in the extreme southwest corner of the City of London close to the Elgin County-City of London boundary. The air photo shown in Figure 3A is from April 2004. Field investigation in June 2004 classified the vegetation communities as ELC Vegetation Types (FOD5-8, CUW1, OAO). Figure 3B shows the results of the unsupervised classification of the LANDSAT 5 image of 2005 Sep 15. The classification yielded a very good approximation of the land-use types present as compared with the air photo interpretation and site reconnaissance data. However, neither the air photo GIS nor the LANDSAT classification could identify the presence of two provincially rare species observed by field investigation and hence the incorrect assignment of Low Priority rather than High Priority.

**Figure 3**. A 6.2 ha woodland patch with a high Mean Coefficient of Conservatism (4.75) and the presence of two provincially rare species (S2 and S3). A) air photo, April 2004; B) unsupervised classification of land use [land-use types: woodland, crop, pasture, road]; C) binary classification of woodland cover with topographic vector overlay of fence lines, roads, and watercourses [30 m buffer width].



## Remote Sensing Data in GIS Model

The binary classification of the LANDSAT 5 image as woodland cover (Figure 3C) yielded a value of 12.5% woodland cover in the 25 km by 25 km field of view centred on London. Natural cover in Middlesex County is estimated at between 10.5 and 12.5% (Jalava and Sorrill, 2000) and within the City of London at 10.8% by GIS polygon area determination (Bergsma and Boitson, 2000). These data suggest that the use of remotely sensed data is reliable for some measurements.

A GIS model that incorporates additional thematic attributes from several sources and LANDSAT 5 spectral data is being developed to show the potential for interior habitat, connectivity, hydrology, the human built environment, and vegetation types.

The advantages of LANDSAT data are that it is a flexible, low cost, current dataset that permits spatial or temporal analyses. It is scalable for bioregional planning and is suitable to classify woodlands, wetlands, and landscape and patch diversity (Honnay, 2003). The joint problems of a 25 m pixel size and "mixels" with different land-use classes are illustrated in Figure 3B where a single tree on the east side of the road coupled with the woodland on the west is assigned woodland cover. These early findings support the belief that the opportunities and advantages weighed against its limitations and disadvantages indicate that a GIS-LANDSAT model will be an efficient tool to support conservation priority ranking.

## Summary

The findings of the previous GIS exercises and the analysis of the field data will be used to calibrate, *a priori*, the interpretation of the LANDSAT image data. Temporal analyses of natural areas (Hilts, 1977) will also be undertaken to assess trends in the natural heritage system. The new GIS model is expected to provide a higher level of accuracy by virtue of this calibration and by the inclusion of other thematic attributes. The model can be used for Conservation Priority ranking for a bioregional woodlands strategy in the Carolinian Life Zone. Although a GIS model contributes to screening for conservation priority ranking it is clear that field investigation is the definitive standard.

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