Conserving Biodiversity in an Urbanizing Landscape

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Abstract

Rapid urbanization in the Greater Toronto Area is resulting in incremental loss of biodiversity in an already fragmented landscape. The traditional approach of identifying and protecting only the most significant features does not adequately address the loss of ecosystem function that results from such consistent and rapid habitat loss. In response to this situation the Toronto and Region Conservation Authority has developed an innovative approach to terrestrial natural heritage that applies consistent criteria in the evaluation of biodiversity at the landscape, vegetation community and species levels. The approach combines field data with GIS analysis to evaluate existing conditions and uses modelling scenarios to identify restoration needs and opportunities. The result is a target regional natural heritage system that can be used in municipal planning and by the general public to direct protection of existing features and restoration options at a variety of scales.

Introduction

The Greater Toronto Area (GTA) is one of the most rapidly urbanizing landscapes in Canada. Although much of the historical forest and wetland cover was removed for agriculture in the 19th century, remaining natural areas - particularly those on table lands - continue to shrink or be lost incrementally with the expansion of residential and industrial subdivisions. Those that remain are often degraded by intense recreational pressure, or by negative external influences that result from intensification of land use in the surrounding matrix. Currently approximately 17 percent of the GTA is in forest cover (TRCA, 2001), while over 80 percent of wetland are thought to have been lost (Snell, 1989).

This continuous loss of biodiversity suggests that existing approaches to natural heritage protection are inadequate. Parks and designated special features such as Areas of Natural and Scientific Interest protect only sites with the most significant or most representative features, and many of these are becoming degraded through overuse. Recognizing this, the Toronto and Region Conservation Authority (TRCA) has developed a Natural Heritage Approach that is designed to be pro-active in the protection of terrestrial biodiversity. This peer-reviewed approach recognizes that all natural areas contribute to landscape function, and therefore should be considered as part of the natural heritage system. Furthermore, given the small amount of remaining habitat in the TRCA jurisdiction, restoring healthy ecological function to the landscape undoubtedly means increasing habitat cover. Thus a natural heritage system should be defined not merely by existing conditions. Targets should be

based on potential conditions, including those that may not be immediately apparent.

The TRCA Approach to Terrestrial Natural Heritage

The TRCA approach addresses three major levels of biodiversity: species, vegetation communities, and landscape The fourth level, genetic diversity, is expected to be covered as a result of actions taken at the landscape level. A scoring and ranking system was developed for each of these levels, and a number of indicators were identified for target setting and monitoring. Criteria used for scoring and ranking and indicator development were designed to allow for comparison of conditions between levels. For example, patch size and shape at the landscape level relate to area sensitivity at the species level.

Species of concern are identified using the scoring and ranking system. Criteria used for fauna include current abundance, population trends, habitat dependence, area sensitivity, mobility restrictions, and sensitivity to development. For flora the criteria include abundance, population trend, ecosite dependence, microhabitat dependence, and cultural vulnerability. Fauna and flora species of concern are mapped as point data during field surveys, and can be highlighted on maps to inform the target setting, strategy development, and monitoring.

The vegetation community level makes use of the Ecological Land Classification System for Southern Ontario (Lee *et al.* 1998), focussing on Acommunity type, which is the highest level of detail in the system. All community types found within the Toronto region are scored and ranked by the TRCA according to two criteria: local distribution and geophysical requirements. Vegetation communities of concern as defined by this method can then be highlighted when communities are mapped, and their protection prioritized. The goal is to eventually have complete mapping of vegetation communities for all natural habitat patches in the TRCA jurisdiction. As with species, all vegetation community information is used to inform target setting, strategy development and monitoring.

Both community and species criteria are designed to emphasize the sensitivities which are thought to explain their incremental disappearance from the urbanizing landscape. Identifying these communities and species as being of a local concern before they become rare demonstrates the proactive perspective behind this approach to conservation, and reflects the assumption that a healthy natural heritage system is one which contains all of its component parts.

At the landscape level the TRCA has developed a GIS polygon-based analysis of habitat patch characteristics. This analysis has been particularly useful in part because it can provide a value for habitat patches based on remote information, and because it presents the opportunity to undertake modelling exercises for increasing habitat, the results of which can be measured numerically and used to set targets.

Species and habitat condition data will be used to check the accuracy of the patch evaluation through the landscape analysis, and revisions made as required.

The landscape analysis requires that natural areas are divided into four major habitat types: forest, meadow, wetland, and beach/bluff. All habitat patches within the jurisdictional area are then digitized based on interpretation of up-to-date orthographic aerial photos. All non-natural land uses are then divided into two major categories: urban and agriculture, and digitized.

The landscape analysis criteria for determining patch values are based on principles of conservation biology. They include size, shape, and matrix influence. Size is based on the principle that larger habitat patches provide a higher function than smaller ones because they can support more species, have a greater capacity to support interactions between species, and are more likely to be resilient against external perturbations (Diamond, 1975; Noss and Cooperrider, 1994). The shape value is based on the edge to perimeter ratio as a measure of the degree to which a patch is exposed to negative edge effects. Because two patches with an identical edge to perimeter ratio may be found in entirely different landscape contexts, the third criterion, matrix influence, attempts to evaluate the kinds of negative external influences that may be impacting a particular habitat patch based on surrounding land use. To do this the calculation considers the relative coverage of natural, agricultural, and urban land use within a two kilometre radius of the outside edge of the habitat patch. Numerical values for each land use type reflect the premise that natural cover is considered to have a benign influence; agriculture a slightly negative influence, and urban a considerable negative influence. Thus a habitat patch within a matrix dominated by other natural areas and agricultural lands will score higher than a similar patch where the surrounding matrix is dominated by urbanization.

Connectivity is being considered as a fourth criterion for the TRCA's landscape analysis, however a useful measure for this criterion has been elusive. For example, connecting two patches of forest creates a single patch that, as a GIS polygon may have lower shape values, and which is then disconnected from other patches when looked at from a larger scale. Furthermore, the idea of defining cores with connecting corridors can be problematic in an urbanizing landscape. This is because valley and stream corridors tend to have more protection than table land habitats, thus even the largest remaining habitat patches simultaneously exhibit both core and corridor functions. For these reasons, and because distance between patches, the presence of insurmountable barriers, or risks in transit may be more relevant for some species than contiguous habitat, a proximity measure may turn out to be more useful than a measure of contagion.

The landscape analysis accomplishes more than the evaluation of existing conditions; it provides a baseline for predicting and measuring change. As a result it acts as a predictive tool that can be applied at any scale ranging from site, to watershed,

to region. Potential conditions, whether as a result of restoration or development, can be measured numerically and depicted on maps by colour coding ranges in values. These maps are effective education and planning tools, and have been extremely useful in inspiring action by municipalities and the public.

The TRCA approach assumes that the health of a fragmented landscape that was historically dominated by forest cover will be improved if forest cover is increased. Modelled scenarios are therefore based on conversion of available meadow (most of which is old field), agricultural, and in some cases urban lands to forest. Thus a targeted regional terrestrial natural heritage system for the TRCA jurisdiction will be defined based on lands that have been identified as being needed for protection for their existing or potential condition. Privately owned lands that rank high in the landscape analysis based on existing or potential conditions can be considered for acquisition if private landowner stewardship is not an option.

Measures or indicators used to determine baseline conditions and assess progress at the landscape level will include total area of habitat, distribution of habitat, amount of forest interior, and the size, shape, matrix influence, and connectivity values that result from applying the landscape analysis to the modelled system. The scoring and ranking system for species forms the basis for using these as indicators of change in habitat quality as increments towards the completion of the natural heritage system are achieved.

Application

In order to ensure wide acceptance, the process of defining a regional natural heritage system and developing an accompanying strategy is undertaken in close consultation with municipalities and community groups. Target natural heritage systems can be identified at the watershed, municipality, or site level as nested subsets of the regional system. For example, the TRCA works closely with watershed stewardship councils composed of representatives from municipalities, local business, and the public to identify priorities for action in relation to watershed health, and to develop regular report cards summarizing progress. Terrestrial habitat targets for each watershed are based on the contribution of the watershed to the regional natural heritage system. These are then incorporated into watershed-based natural heritage strategies as a minimum. The indicators used to measure and report on progress are those used to evaluate the natural heritage system at the landscape, community, and species levels.

For municipal governments, the ideal is to have their portion of the regional natural heritage system considered in the development of official plans, and use the strategy to inform policy. As with watersheds, targets for habitat cover, vegetation communities, and species can be set at the municipal level, and progress monitored and measured through the evaluation criteria. It is important to recognize, however, that in the multiple use context characteristic of municipalities and the TRCA terrestrial biodiversity is one component of regional health to which the terrestrial natural

system contributes. Aquatic ecosystems, water quality and quantity, recreational use, and public safety will also be identified as components of a comprehensive natural heritage strategy.

Conclusions

The TRCA approach to terrestrial natural heritage shifts the emphasis for protecting biodiversity from identification and protection of only the highest quality features to recognizing that in a fragmented landscape all natural features make an significant contribution to ecological function. Furthermore, in the Greater Toronto Area so much habitat has been lost, that identification of a desired system must include future habitat, thus increasing cover is as important as protecting what remains.

Among the advantages of the TRCA approach is that it provides an evaluation and target setting tool that is science based and peer reviewed. The regional natural heritage system is thus defined based on a method that is consistent, conscientious, and defensible. Because developers would be aware of the defined system and related policies before applications are made, the process should also reduce the need for Ontario Municipal Board hearings about the fate of individual properties. The emphasis on education within the approach - in particular through the criteria used for evaluation, target setting, and monitoring - will help municipal planners, developers, and private land owners to better understand the issues related to biodiversity conservation, and the consequences of their individual actions within the regional context. Education of the public will also provide the basis of support for changes in policies and funding for environmental action.

Finally, the TRCA approach is being designed as a tool that can be replicated by other organizations in fragmented landscapes in Ontario and beyond. Peer review and outreach will continue to ensure that the approach is consistent and compatible with regional natural heritage initiatives that also take a landscape approach to the definition of natural heritage systems.

References

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