Great Lakes Conservation Blueprint for Terrestrial Biodiversity on the Canadian Shield

Bonnie L. Henson[1], Kara E. Brodribb[2] and John L. Riley[3]

[1]Ontario Ministry of Natural Resources

[2,3]The Nature Conservancy of Canada

Abstract

The Nature Conservancy of Canada has partnered with the Ontario Ministry of Natural Resources to conduct a GIS-based analysis to identify areas on the landscape that, if conserved, would ensure the long-term success of the native species, habitats and ecosystems in the Great Lakes ecoregion. This project is the first entire watershed analysis of the landscape, biodiversity values, extent of natural heritage values and conservation priorities, undertaken to assess and to identify the gaps in representation of ecological systems and rare species in Ontario's protected areas. Although the southern Ontario landscape has been dramatically altered, the Canadian Shield portion of Ontario's Great Lakes ecoregion contains some of the largest and most intact natural landscapes. By incorporating our best scientific knowledge, repeatable methods and reasonable consensus, biodiversity targets and their conservation goals were applied to locate the areas that best meet these goals. We used digital Forest Resource Inventory *(FRI) data to create digital spatial mapping of ecological systems for the Canadian Shield portion of the Great Lakes ecoregion. A literature review of natural disturbance regimes and the habitat requirements of wide-ranging mammals informed the design of a spatial model to identify the best representative examples of these ecological systems within each ecodistrict.*

Introduction

The *Great Lakes Conservation Blueprint Project* is a partnership between the Nature Conservancy of Canada (NCC), the Ontario Natural Heritage Information Centre (NHIC) and other contributing partners including Ontario Parks. This project is the first-ever GIS-based landscape-level analysis of aquatic and terrestrial biodiversity in the Great Lakes ecoregion. This paper will focus on the terrestrial analysis, particularly the Canadian Shield portion. The Conservation Blueprint represents a significant conservation planning investment across the ecoregion, regardless of land tenure, that will identify or re-validate best representative areas across the Great Lakes to be shared among partners developing their own conservation priorities.

Some precursors to this project include the development of the U.S. Nature Conservancy (TNC) approach to conservation planning described in *Designing a Geography of Hope* (Groves *et al*., 2000), which resulted in detailed ecoregion planning strategies or conservation blueprints throughout the U.S. ecoregions. The NCC's approach to conservation planning is also based on sound ecological science with scientific consensus and partnerships. This approach is applied across southern Canada with similar conservation blueprint projects. The Ontario Ministry of Natural Resources (OMNR) has developed a gap analysis and representation framework for the selection of Areas of Natural and Scientific Interest (ANSIs) and *Ontario's Living Legacy* sites (Crins and Kor, 2000). The *Great Lakes Conservation Blueprint* has made deliberate efforts to develop a compatible approach within these frameworks, including the representation framework used to assess significant natural areas in Ontario over the past 20 years (Riley and Brodribb, 2003).

The goal of the Conservation Blueprint project is to identify a network of sites on the landscape that, if properly conserved, has the ability to sustain all elements of terrestrial biodiversity in the Great Lakes ecoregion. The project's GIS-based gap representation analysis provides a transparent methodology designed to use the best-available data and scientific consensus from a team of core scientists to provide a basis for selecting conservation priorities within natural, non-jurisdictional, ecoregional boundaries and to efficiently re-analyze, update and measure the conservation achievements over time.

There are fundamental differences in the landscapes and species of the Canadian Shield and the southern Ontario portion of the ecoregion. Therefore, the project methodology and analysis were separated into two distinct study areas (Figure 1).

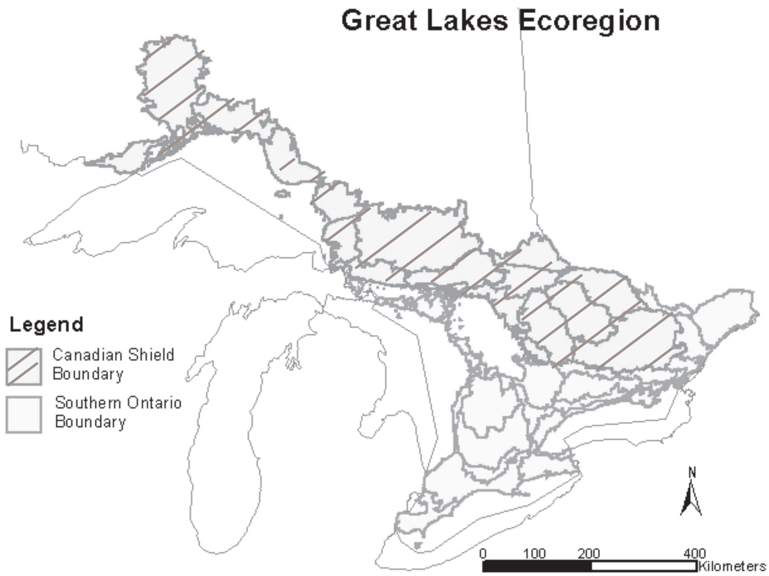

Figure 1. *Great Lakes Conservation Blueprint Project study area.*

Framework of the Conservation Blueprint

Although the Conservation Blueprint is at the scale of the Great Lakes ecoregion, the general methodology for the gap analysis was performed on an eco-district basis. The following section outlines the general framework of the *Great Lakes Conservation Blueprint*, while further details of the technical methodologies are described in Brodribb and Jahncke (2003) and Henson and Brodribb (2004).

There are six key design criteria for the Great Lakes Conservation Blueprint. They are as follows:

- It is important to account for the biodiversity targets that are being sustained by existing protected areas and conservation lands. By performing a gap analysis, a network of sites can be identified that will complement the existing protected areas.

- Sites that are identified as having high 'irreplaceability', such as sites that support extremely globally imperiled species, are given a high priority.

- Only viable occurrences of biodiversity targets were considered in the portfolio in order to select sites that support features with a probable level of sustainability.

- By weighting sites that contain multiple types of conservation targets, we can generate the most efficient portfolio. With the ability to produce multiple data layers in a GIS environment, an assigned weighting system allows outputs to be replicated several times with varying scores, additional datasets and the ability to modify the process over other landscapes.

- The Conservation Blueprint will map biodiversity at several spatial scales to achieve a portfolio consisting of a network of sites that address the conservation of biodiversity targets at coarse, intermediate and fine scales.

- The Conservation Blueprint attributes all remaining natural cover with natural heritage information and the entire land base is evaluated and analyzed, regardless of land ownership.

The standard selection and ranking criteria used in the Conservation Blueprint were representation, diversity, ecological function, site condition and special features. The representation of ecological systems (or landform-vegetation types) occurring in an ecodistrict is the core, coarse filter analysis on which all further analyses are based. Therefore, a classification and associated GIS layer of the ecological systems was created by intersecting the best available biotic and abiotic layers to identify unique combinations of landform and vegetation units. By targeting the representation of these landform-vegetation combinations in an area, we were able to provide the means to preserve the widest variety of species in conditions that support them best.

The primary sources of landform and vegetation data for the Canadian Shield were *Forest Resource Inventory* (FRI) data and quaternary geology. Other sources of vegetation information used to refine these main data sources included provincial landcover mapping (where FRI does not exist), vegetation community element occurrence data, Ontario peatland inventory data, OMNR evaluated wetlands, and Great Lakes shoreline data.

Assessing the relative importance of each representative ecological system is achieved by scoring conservation values for each ecological system polygon. All polygons are scored based on the complementary criteria (diversity, condition, ecological function and special features). On the Canadian Shield, an attempt was made to achieve minimum sizes for representation goals using a score layer based on natural disturbance regimes and information on the habitat requirements for some focal species. The cumulative scores of 24 GIS layers representing surrogates for the selection criteria were used to compare the total contribution of each ecological system polygon with other polygons of the same ecological system type. Table 1 illustrates the gap analysis approach used on the Canadian Shield portion of the Great Lakes ecoregion based on the five selection criteria.

Table 1. *Gap analysis approach in the Canadian Shield portion of the ecoregion.*

Criteria	Gap Analysis Approach and Some GIS Surrogates
Representation	Capture the best examples of each unique landform-vegetation (l-v) type. These l-v types will be the basis for the coarse filter gap analysis. Where several options for filling the gaps exist, then other criteria were applied.
Condition	Amount of natural area in adjacent landscapes
	Distance from roads, urban areas, croplands, mines, pits and quarries
	Distance from railways and transmission lines
Diversity	Wherever possible, when filling gaps we selected sites that contain many types of l-v combinations
Ecological function	Size
	Amount of core area
	Hydrologic functions (riparian areas, wetlands and Great Lakes shorelines)
	Coincidence with existing conservation lands
	Proximity to existing protected areas
Special features	NHIC Element Occurrence data for species and vegetation community targets
	Presence of other rare species and vegetation community types

Consistent stratification of representation goals was conducted to identify the suite of the most significant natural areas in an ecodistrict by searching for the highest-scoring polygons representing each ecological-system type. For example, on the Canadian Shield the *three* highest scoring sites representing each target ecological system were chosen for inclusion in the Conservation

Blueprint portfolio. These sites could be considered to be the most significant, or provincially significant. Because the Conservation Blueprint is GIS-based and automated, the stratification rule can be tested in relation to different stratification rules so that other high ranking sites (fourth and fifth highest) could be identified as the secondary, or regionally significant, sites.

The coarse filter approach does not necessarily address rare species representation. To ensure that all elements of biodiversity are included in the Conservation Blueprint, a fine filter biodiversity analysis was included to target known occurrences of species of conservation concern, including globally imperiled species, species at risk, endemic species and rare vegetation communities. This was achieved by using an efficiency model (C-Plan) to incorporate yet unrepresented 'irreplaceable' elements of biodiversity.

To be inclusive of past work and achievements on provincially significant conservation lands, the Conservation Blueprint also included all existing protected areas including conservation authority lands, all provincially significant life science ANSIs and all provincially significant wetlands. This approach attempts to conserve the continuity of Ontario's overall representation framework while incorporating new rule-based, GIS approaches that make it possible to handle the volume of natural area and species data available. The resulting outputs can be used by a variety of conservation partners in different ways and at different scales, to ask fundamental questions about the geography of Ontario's biodiversity.

Although the creation of a GIS-based analysis model will reduce uncertainty and human judgement biases it is still not a substitute for expert knowledge and in-field verification. These results are based on a GIS analysis of modelled data and therefore should be validated through detailed field survey prior to any conservation action. However, this GIS analysis will ultimately enhance the expert discussions surrounding natural heritage information and the conservation of species and communities.

Results of the Conservation Blueprint

There are 437 species targets and 172 vegetation community targets within the terrestrial Great Lakes Conservation Blueprint, of which there are 157 species targets and 63 vegetation community targets with occurrences known to be in the Canadian Shield portion. Over two-thirds of all extant biodiversity target occurrences in the Canadian Shield portion of the Great Lakes ecoregion occur within the Conservation Blueprint portfolio, of which two-thirds are within existing protected areas and conservation lands. A large portion of these biodiversity targets occurs within provincial parks and other protected area boundaries.

There are a total of 250 ecological systems on the Canadian Shield, of which 182 were targeted for representation in the analysis. These targets consist of 174 forested ecological systems and eight wetland systems. Those not targeted include water, anthropogenic systems and natural systems that were missing key descriptive information to attribute them to an appropriate system type. Approximately 70% of the total area of all targeted top-scoring ecological systems in the Canadian Shield portion of the Conservation Blueprint occur outside existing conservation lands. The top-scoring systems that are within conservation lands are generally found inside provincial parks and conservation reserves.

Overall, the Canadian Shield portion of the final Conservation Blueprint portfolio represents over 3 000 000 ha, or approximately 23% of the land base (Figure 2). Twenty-one percent of the total targeted forest systems and 22% of the wetland systems occurring on the Canadian Shield occur in the final Conservation Blueprint portfolio.

The digital layer in the Canadian Shield analysis that was largely influential for the assessment of ecological function was the fire disturbance layer. Approximately 94% of the amalgamated contiguous portfolio sites on the shield can be considered large enough to withstand an average fire disturbance.

On the Canadian Shield, over 80% of the Conservation Blueprint is identified as conservation lands (2 540 253 ha). Together, conservation lands represent approximately 19% of entire land base for the Canadian Shield portion of the ecoregion.

The Blueprint results for Southern Ontario were analysed using a similar methodology and results have been compiled for this area as well. Further information, results and mapping will be available in Henson and Brodribb (in prep).

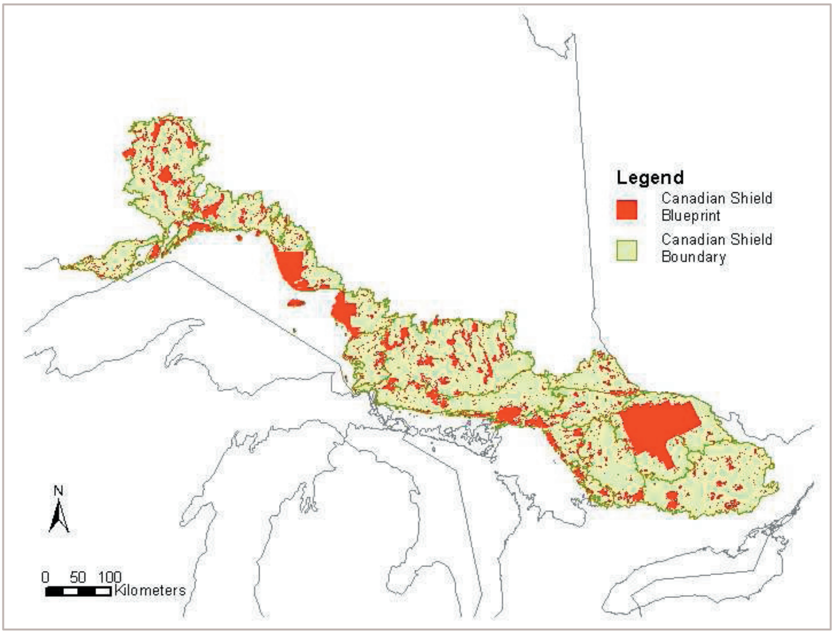

Figure 2. *Conservation Blueprint Results for the Canadian Shield.*

Summary and Future Direction

The *Great Lakes Conservation Blueprint* targets, goals and outputs are capable of assisting NCC, NHIC, Ontario Parks and their partners with the development and implementation of conservation initiatives and priorities. This can be achieved at a variety of scales such as the Great Lakes ecoregion (landscape scale), the ecodistrict scale, or for particular sites on the landscape. Opportunities can also be created to share the Conservation Blueprint's methodology and results with a diverse array of conservation practitioners in the Great Lakes, Ontario and beyond who are interested in similar conservation planning initiatives. As stated previously, the Conservation Blueprint results are based on a GIS analysis of modelled data and therefore must be validated through detailed field surveys prior to any conservation action.

The Conservation Blueprint consists of the most recent GIS coverages of protected areas and other conservation lands, and digital data compiled for the array of biodiversity features in the ecoregion including ecological systems, rare species and rare vegetation communities. The distribution of these biodiversity features has been mapped and the degree to which they are represented by existing conservation lands in the Great Lakes have been assessed. The Nature Conservancy of Canada intends to summarize this data for conservation planners to provide a gap analysis of existing conservation lands for various jurisdictions and planning authorities.

The Conservation Blueprint also underscores and validates the biological significance of key core areas on the landscape in southern Ontario and the Canadian Shield. The final Conservation Blueprint provides an updated, transparent and well-documented set of core areas in which conservation planners can consider existing natural corridors and potential connecting linkages. This analysis will also be valuable for informing the stewardship and securement of these core areas.

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