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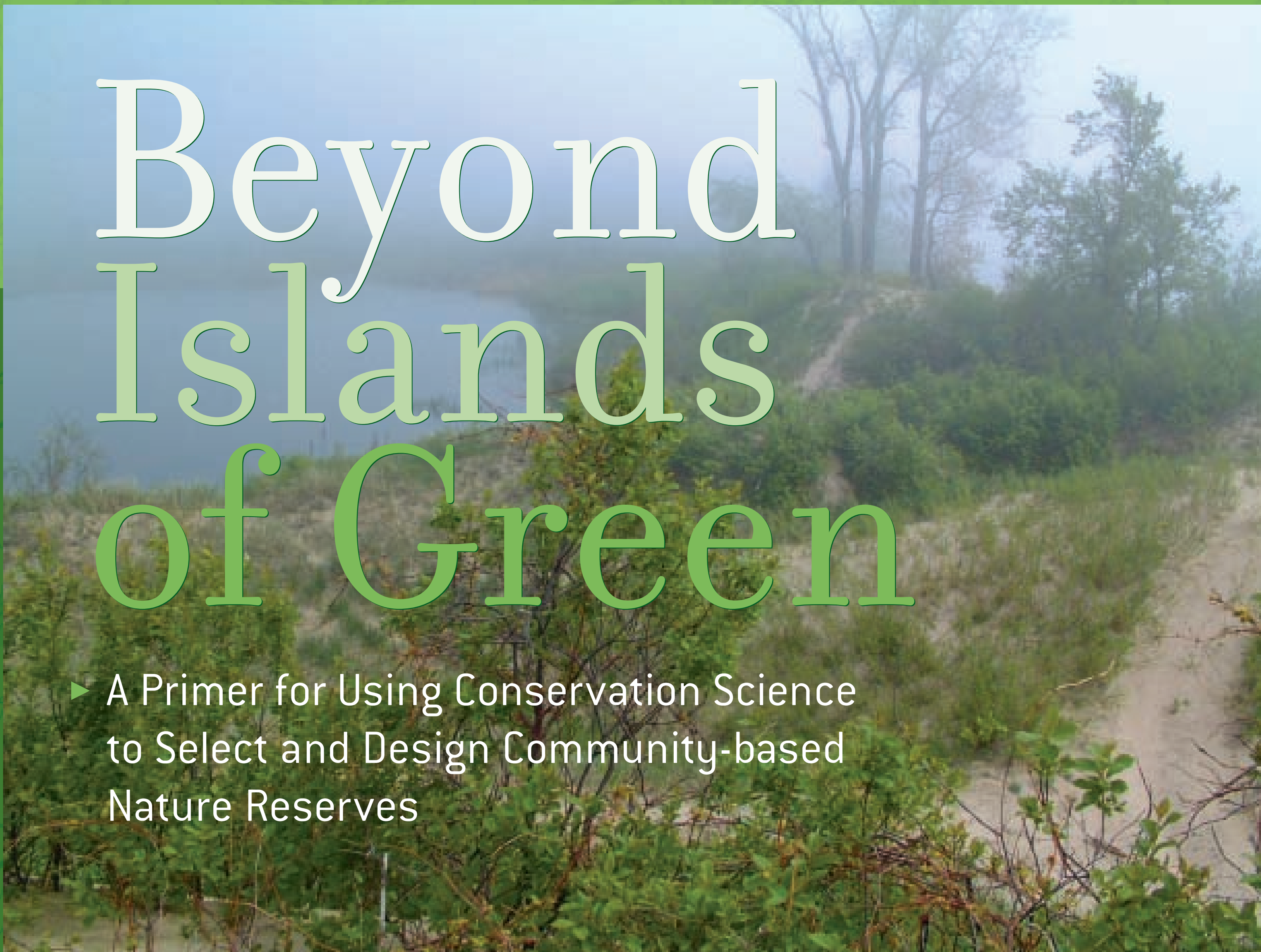

Beyond Islands of Green

A Primer for Using Conservation Science to Select and Design Community-based Nature Reserves

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Canada

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About the Canadian Wildlife Service (CWS)

The Canadian Wildlife Service, part of Environment Canada, manages wildlife matters that are the responsibility of the federal government. These include protection and management of migratory birds, nationally-significant habitat and endangered species, as well as work on other wildlife issues of national and international importance. In addition, the Canadian Wildlife Service does research in many fields of wildlife biology and provides incentive programs for land stewardship and donation.

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Executive Summary

The number and capacity of organizations involved in land conservation in Ontario has been rapidly growing. Their effectiveness can be strengthened over time by moving to a more systematic approach to planning based on conservation science. This report is intended as a "primer" for land trusts and other community organizations involved in nature protection projects, especially the lands to be certified by Environment Canada as ecological gifts. This report provides an introduction to the basic principles of conservation science and how to incorporate this science into the design and selection of nature reserves or other areas set aside for biodiversity conservation purposes.

Nature reserves are usually designed to conserve elements of biodiversity, which include species diversity, genetic diversity, and community and ecosystem diversity. Biodiversity operates at different spatial scales ranging from a few square metres to vast ecosystems, with its distribution driven by variations in climate, soils, topography and geology.

While biodiversity is sometimes threatened by broad-scale processes such as climate change, five threats most commonly impact nature conservation at the regional level:

- Habitat change
- Habitat fragmentation
- Invasive species
- Altered ecological processes
- Over-exploitation and persecution

The process of using conservation science and planning to focus on "what matters most" generally follows a series of steps:

1. Defining and Understanding a Planning Region:

The starting point for conservation planning is selecting a region on the basis of its ecological characteristics (which may not always correspond to a land trust's area of operations). Initial information collection usually highlights sources of information and other planning initiatives that can be useful. For land trusts established according to political or community boundaries, identifying ecologically based planning regions can greatly aid in planning and identifying priorities.

Key Principles:

- Base landscape analysis on an ecologically based planning region to provide a strong framework for conservation planning.
- Incorporate conservation goals and data relevant to the planning region that have been identified in previous conservation planning initiatives.

2. Selecting Potential Conservation Targets:

A key step is to develop a list of priority species, communities and ecological systems within the planning region as potential conservation targets. These targets could include rare or distinctive species and communities, high quality representation, sites of regional interest, or critical ecological functions.

Conservation targets: Species, communities, or other elements selected as a focus for conservation efforts.

Natural heritage sites: Defined areas of conservation interest that form integrated units and that have been mapped and often named (e.g., Greenock Swamp).

Nature reserves: Generally, specific tracts of land or water set aside to conserve natural features and functions through protective ownership and/or regulation. Agencies such as the Ontario Ministry of Natural Resources may have separate definitions and mandates in regard to nature reserves – selecting and designing such reserves are not the focus of this report.

Key Principles:

- Begin at the community and landscape level (coarse-filter targets) in setting conservation targets.
- Give highest priority to communities, species and features that are globally at risk.

- In landscapes with little inventory information, make use of indicators of special biodiversity values, including unique landscape features, an exceptionally high richness of species, and a high diversity of ecological systems including landscape ecotones a (transition zone between two adjacent types of vegetation that are different).
- Include habitats and species with a high frequency of good-quality sites within the planning region, especially for groupings of species of conservation concern.

3. Evaluating the Priority of Potential Conservation Targets:

Not all potential conservation targets are of equal priority or urgency. There are several ways to screen the list of potential targets and identify those of highest priority. Establishing conservation goals for each of those priority targets leads to a framework for a network of nature reserves.

Key Principles:

- Assess the viability of potential conservation target sites based on size, condition, and character of the surrounding landscape to identify the best prospects for conservation action.
- Use a gap analysis to evaluate the degree of protection already in place for conservation targets to focus efforts on species or communities of highest need.
- Consider underlying socio-economic factors impacting the landscape and how those factors will influence the rate and type of landscape changes.
- Consider the effectiveness of nature reserves in countering threats, the urgency for action, and irreplaceability.
- Establish conservation goals to specify the number and type of nature reserves needed to protect the future of selected target communities and species.

4. Building a Network of Nature Reserves – Balancing Science and Opportunity:

While this report focusses on using science to identify optimum target sites, it is also essential to recognize that land trust projects often respond to opportunities. Planning for a network of nature reserves can assist in responding quickly and effectively to those opportunities as they arise, and to developing a more proactive approach in priority areas. A series of principles can help guide the development of this network:

i **Representation** of as many communities and species as possible

ii **Resiliency** to respond to anticipated stresses

iii **Redundancy** of habitat types in case some examples are lost

iv **Restorable** habitats

v **Sufficient habitat** to ensure ecological functions are protected

vi **Flexibility** where appropriate in incorporating common elements

vii **Planning for entire natural heritage sites** rather than individual properties as a minimum scale

viii **Connectivity** between reserves to support gene flow and migration

ix **Thinking beyond reserve boundaries** to recognize the role of surrounding landscapes and potential related advantages from high profile projects

x **Public benefit** from all projects clearly demonstrated

xi **Reality** in determining whether a reserve can successfully be acquired and managed for the long term.

Key Principles:

- Aim for a network of reserves that will capture the full range of target species and communities and be spread across the region rather than concentrated in one area.
- Use multi-scale approaches, based on an understanding of the geographical scales at which conservation targets function, to ensure that all elements of biodiversity are sustained.
- Use natural heritage sites, such as entire forests or wetlands, rather than individual properties as the minimum scale for nature reserve planning.
- Incorporate ways to interconnect nature reserves, since this is usually preferable to isolated sites, with the type and configuration of these connections based on the needs of target species.
- Recognize the role of good stewardship and strong public and institutional support for nature reserves and surrounding landscapes.
- Match the organizational capacity and resources available to the scope and characteristics of the target nature-reserve system.

5. Designing Nature Reserves That Work:

Based on the distribution of target species and communities and the pattern of property ownership, an approximate boundary can be defined for an "ideal" nature reserve that might not be achieved for many years. Within that boundary, the timing of individual projects will depend on such factors as land availability, urgency and organizational capacity.

Key Principles:

- Base the design of each nature reserve on a clear understanding of its purpose and the critical habitats and other habitat features that contribute to the viability of conservation targets.
- Identify sites that will protect several conservation targets on the same land base as an efficient way to protect biodiversity.
- Plan for nature reserves to be sufficiently large to sustain related conservation targets for the long term; in general, larger sites with minimal edges are more effective for conservation.
- Incorporate buffers of complementary land use between reserves and adjacent lands, when necessary, to protect conservation values.

6. From Planning to Practice: Securement, Stewardship, and Monitoring:

The protection of conservation targets does not end when a nature reserve is acquired. Rather, ongoing adaptive management is required to enhance the viability of the reserve and to abate emerging threats.

When an opportunity arises to secure a natural property, the conservation planning outlined in this report may help an organization to know immediately if the property is a priority. In other cases, especially before the planning process has been completed, the ten questions below may be helpful in deciding how to respond.

Monitoring of success should also be an ongoing activity, both at the project level in terms of securing of conservation targets, and more broadly to evaluate the criteria for success of the program in conserving biodiversity. Generally, successful programs can be measured by the long-term health of conservation values for which an area was protected.

Ten Questions to Ask When Someone Offers Land

1. Does acquisition of this property match well with the mandate of your organization, and serve a clear conservation purpose (e.g., target species or communities)?
2. Have any of the natural values associated with this property been identified by other conservation agencies or studies as priorities?
3. Does this property have unique features or other indicators of special diversity values?
4. Is this property an example of exceptionally high quality for its natural features?
5. What factors threaten the natural values of the property, and is your ownership likely to be effective in countering those threats?
6. Is the property likely to be viable in sustaining its natural features, or does it offer opportunities for future expansion to achieve viability?
7. Is the property connected to other habitats in the vicinity, and does that matter for the species or communities involved?
8. Are surrounding land uses compatible with protecting the site, or likely to cause future conflicts?
9. What are the long-term stewardship costs going to be?
10. What will happen if you choose not to accept the property?

1.0

Introduction

Over the past decade, Ontario and other parts of Canada have experienced an explosion of interest in conserving natural habitats on private lands, especially through community-based organizations known as land trusts. These organizations have become one of the fastest-growing forces in nature conservation, often working in concert with national and provincial agencies and non-government organizations (NGOs) as well as conservation-minded landowners.

CWS

From humble beginnings as local volunteer groups, many of these land trusts are now taking on larger and more complex projects, hiring professional staff, embracing new technologies and becoming more strategic about their role. An early emphasis on reacting to land conservation opportunities is gradually changing to a recognition of a need to focus growing but still limited capacity on projects with the greatest benefit.

One of the great strengths of land trusts is their flexibility. They can respond to local community needs and desires; work with a wide range of partners; and act quickly when necessary. At their best, land trusts can develop an amazing breadth of community support. The challenge is to constantly balance flexibility and ability to seize opportunities with effective long-term strategies to conserve nature.

In short, effective conservation requires good planning. Good planning can and should take into account many factors – financial feasibility, relationship to community priorities, potential partnerships, and so on. But for biodiversity conservation, it needs to be based on a foundation of practical science.

This report provides an introduction to the basic principles of conservation science, and provides help for land trusts on how to incorporate this science into the design of a nature reserve network. Conservation science is a vast topic, with a huge diversity of theory, innovation and different points of view. This report is not intended to be an exhaustive review of the science, but rather to provide enough of an understanding of current scientific thinking to be helpful to local conservation efforts.

This report is intended primarily to help support land trusts and other community-based organizations that focus on nature protection projects, especially those that qualify under the federal Ecological Gifts Program. The tools found within the report will help these groups effectively evaluate the merits of particular projects while employing a systematic approach to their activities. Grounding conservation actions in science is critical for generating public support, raising funds, and successfully participating in provincial and federal assistance programs.

The Ecological Gifts Program

The Ecological Gifts Program provides enhanced income tax benefits to private or corporate donors of ecologically sensitive lands.

www.on.ec.gc.ca/ecogifts

Community lands might be protected for many important reasons, such as aesthetics, recreation, spiritual and cultural values, but the focus of this document is biodiversity and its conservation through land protection. While other steps are also typically needed to sustain the full range of natural diversity, such as reduction of greenhouse gases leading to climate change, control of toxins in the environment or responsible management of working landscapes, this document does not attempt to address those needs.

Conservation science is ultimately a science of hope. While conservation science recognizes the negative consequences that sometimes occur when people interact with nature, it is founded in optimism that positive actions can conserve the integrity and diversity of biological systems.

As an emerging discipline, conservation science integrates life and social sciences to gain a better understanding of nature and find solutions to complex problems. These answers often lie not only in biology or ecology, but also in changing human behaviour, relationships and institutions.

These realities mean that people with a wide range of skills are essential to successful conservation initiatives. It also means that conservation organizations must build on the strategic base that conservation science can provide, and spend much of their time and energy communicating with their constituency, building a strong financial and organizational base, and struggling with the challenges presented by individual projects. Most of those activities are beyond the scope of this document, but an understanding of the fundamentals of conservation science can assist any land trust in creating a strong foundation for all of its work.

The science-based perspective of this report is not meant to infer that human values regarding nature are irrelevant; to the contrary, a conservation organization, especially a charitable one, requires community support. Any conservation organization that ignores community needs and desires does so at its own peril. Good conservation should be founded on credible science, but needs to be integrated with local understanding and values.

1.1 The Need for Good Conservation Planning

Conservation takes a great deal of time and resources. Many conservation groups rely on volunteers and limited budgets that fluctuate from year to year. While planning and background studies can sometimes seem onerous, they are an investment that usually results in more effective projects, successful funding proposals, and better conservation measures. By setting an agenda for conservation, groups can more effectively decide on the priority of potential projects, and be more proactive in protecting key natural areas.

Most people would not buy a car or house without investing time and resources in knowing their options. What seemed like a great deal at first glance could end up costing a lot more than bargained for, or may not be what was needed. A recent report from the United States identified that $17.5 billion USD was spent by local and state agencies towards open-space preservation between 1999 and 2001, but much of that was ineffective in achieving biodiversity conservation goals (Benedict and McMahon 2002). While similar studies have not been conducted in Canada, this study highlights the need to re-examine approaches to conservation.

In the past, much conservation work was not based on need, but on opportunity. While opportunity is a key factor in land conservation, opportunity as the primary decision factor has the potential to exhaust an organization's resources with relatively little conservation return. Without understanding the significance of each project, an organization may be blindly investing in land that does not achieve its conservation goals.

Without understanding the context of the landscape around nature reserves, a portfolio of less valuable lands may be assembled, while irreplaceable properties and conservation values are lost. Effective long-term conservation needs to be proactive and planned, based on a sound understanding of science combined with a local knowledge of ecosystems and socio-economic and political factors.

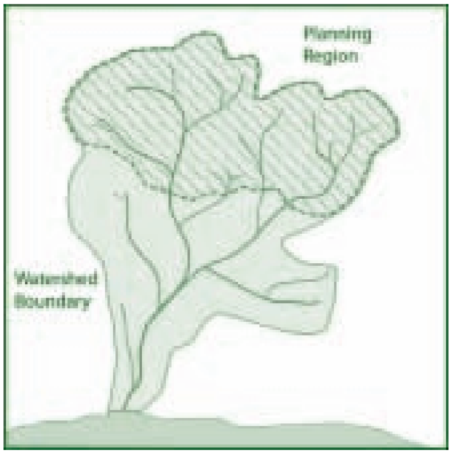
This report deals with the protection of specific tracts of land set aside to conserve nature, known as nature reserves or protected areas. Nature reserves can be established for many different reasons, including: representation of target species and ecosystems; maintaining long-term viability of these targets, supporting landscape biodiversity goals; and maintaining ecological and evolutionary processes (Margules and Pressey 2000).

Eric Dresser

Definitions: *(see the Glossary for other definitions)*

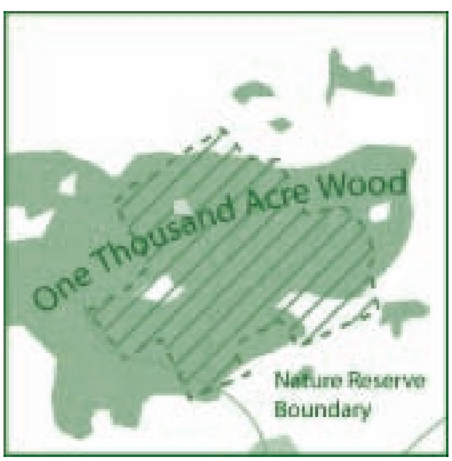
- **Planning region** is the geographic area defined by a land trust or other organization as a basis for analysis of conservation needs and priorities; it may be based on landforms, watersheds, municipal boundaries, or other landscape features (See Figure 1).

Figure 1: A watershed-based planning region



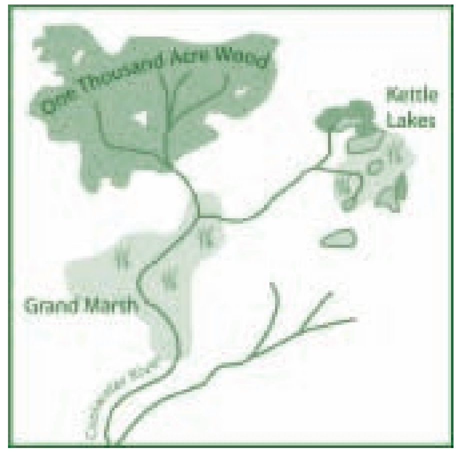
- **Nature Reserve selection** involves planning within a defined boundary (political or ecological) to systematically identify key natural areas for conservation action.
- **Nature Reserve design** determines the optimal actions to achieve conservation success within a particular nature reserve area. Conservation success is identified as maintaining the long-term health of the conservation values for which the area was protected (See Figure 2).

Figure 2: Nature Reserve



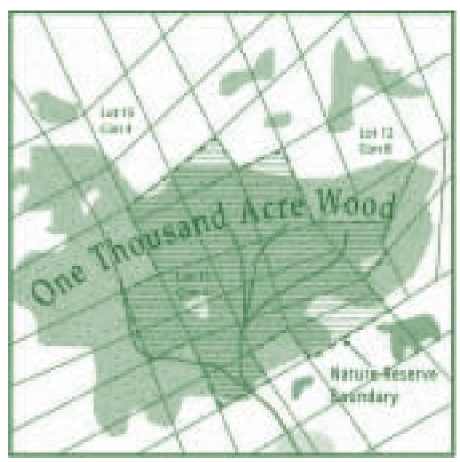
- **Natural heritage sites** or **natural areas** are defined areas of conservation interest that are more-or-less continuous, and form integrated units within the landscape. While sites may contain several types of habitats (e.g., wetland, forest), they have usually been mapped and named, and are surrounded by farm fields or development (See Figure 3).

Figure 3: Natural Areas



- **Properties** or **land parcels** are areas of individual ownership within a site, and are often the level where individual conservation projects are carried out. A site or natural area is often comprised of several properties (See Figure 4).

Figure 4: Properties



- **Conservation targets** are the species, vegetation communities, ecosystems or other elements of biodiversity that have been selected as a focus for conservation efforts.

2.0

The Foundations of Protected Areas Planning

Eric Dresser

Conservation science is an applied science and does not have absolute rules. The path for the successful conservation of one species, community or landscape may not be effective in every situation. The following section highlights some of the key general principles of conservation science that relate to decision making for the selection and design of nature reserves.

While it is important to understand these general principles, it is equally important to have the ability and judgement to adapt these concepts to local projects. For example, while habitat interconnections are generally desirable in principle, an isolated pocket of specialized habitat may be better off without connections that could introduce invasive species.

This section also provides a brief description of conservation approaches taken in Ontario, introduces how biological diversity is organized, defines the different scales at which nature operates, and discusses how biodiversity is distributed within the landscape. These topics are important for building a foundation to address the three key "conservation questions" (from Johnson 1995):

- What needs to be protected?
- Where should it be protected?
- How should it be protected?

2.1 A Brief History of Conservation Approaches

Humans have been setting aside lands to protect nature for millennia. Historically most of these lands were associated with sacred places, hunting areas and timber reserves. In North America in the late 1800s, as human impacts on the landscape became increasingly prevalent and limits to wilderness more apparent, protected areas were established for scenic and recreational values. Yellowstone National Park, Banff National Park and Niagara Falls, some of the first parks in Canada and the United States, were set aside as tourist destinations.

In Ontario, Algonquin Provincial Park was originally established in 1893 as a wildlife sanctuary and to protect the headwaters of five rivers and commercial forest resources from rapid agricultural expansion in the region. This was one of the first protected areas to be established primarily to conserve what would now be considered ecological values. However, during the late 1800s and most of the twentieth century in Ontario, protected areas were created and managed largely for recreational uses. Many older Ontario parks such as Point Pelee National Park and Rondeau Provincial Park experienced very heavy recreational uses and camping from the post-war period to the 1970s.

Canadian Pacific Railway Archives A.6510

With only a few exceptions such as wildlife sanctuaries, it was not until the environmental movement of the late 1960s and early 1970s that lands started to be identified and protected primarily to conserve nature. International Biological Program (IBP) field inventory surveys occurred throughout Ontario at this time. These surveys were the first efforts to identify representative habitats and employ a systematic approach to preserving nature in the province. It was during this time that the first concepts of protecting areas for intrinsic values became formalized in the provincial parks system with the introduction of the "nature reserve" park class in 1967.

The identification of Nature Reserves was supported by the surveys for the province's Area of Natural and Scientific Interest (ANSI) program in the 1970s and 1980s. This program resulted in the identification and evaluation of sites within different ecologically derived planning units (ecodistricts) based on: representation, condition, diversity, ecological functions and special features. This program continues with ongoing reassessments and detailed studies, maintained in digital spatial databases or Geographic Information Systems (GIS). Today, these ANSIs include many areas of ecologically significant lands (Table 1).

Beginning in the 1980s, the Ontario Ministry of Natural Resources (OMNR) also applied a standardized scoring system to evaluate wetlands in southern and northern Ontario. Areas designated as Provincially Significant Wetlands (PSWs) receive some protection under Ontario's *Planning Act.*

Conservation Authorities (CAs) were established in many parts of southern Ontario following the floods of Hurricane Hazel in 1954. The Authorities manage and protect water resources on a watershed basis and have acquired large areas of land for water management, nature conservation, and recreation (Table 1). In southern Ontario, CAs are the largest holders and managers of public lands. The Ontario Heritage Foundation has also acquired key natural and cultural properties, mostly in southern Ontario.

Today, both the national and provincial parks systems include nature conservation as a key component of their mandates, and include some of the most ecologically significant lands in Ontario. Over 90 provincial parks have been established south of the Canadian Shield. Five national parks have been established in Ontario along the Great Lakes and St. Lawrence, and one national marine park. As well, some regions such as the Niagara Escarpment, Long Point on Lake Erie, the Frontenac Arch in eastern Ontario, and the Georgian Bay coast have been internationally designated as World Biosphere Reserves.

Private land trusts and conservation groups have also played an increasingly important role in protecting nature in Ontario. Groups such as Ontario Nature (formerly Federation of Ontario Naturalists) and the Nature Conservancy of Canada (NCC) began purchasing lands in the 1960s. World Wildlife Fund Canada has taken the lead in developing parameters and standards for representative networks of nature reserves and promoting their establishment on public lands (Noss 1995). Today there are over 35 members of the Ontario Land Trust Alliance, with most members operating at the regional level. This membership and the significance of land trusts in protecting nature are rapidly growing. Land trusts are particularly important in southern Ontario, where most of the land is in private ownership.


Archives of Toronto and Region Conservation Authority

Hurricane Hazel – flood damage and rescue

Table 1: Land Conservation in the Great Lakes Region of Ontario *(from Henson and Brodribb 2004)*

	Federally Protected	Provincially Protected	Provincially Significant Life Science ANSI	Conservation Authority Lands
Southern Ontario (ha)	**22,540**	**42,006**	**215,759**	**103,047**
% of entire landbase	0.27	0.49	2.54	1.21
Canadian Shield (ha)	**185,339**	**2,287,318**	**58,062**	**8,096**
% of entire landbase	1.36	16.75	0.43	0.06
Great Lakes Ecoregion (ha)	**208,918**	**2,332,541**	**278,840**	**116,750**
% of entire landbase	0.94	10.51	1.24	0.50

With advances in digital technologies such as GIS and Geographic Positioning Systems (GPS), spatial data collection, storage, analysis and retrieval has become more efficient and precise. Most government agencies active in environmental data collection and reporting now have significant GIS capacity to support their management goals and mandates. These agencies will continue to support digital growth and updates to relational spatial and non-spatial data banks to maintain currency and accuracy as well as standardization of data resources.

The increasing number of groups involved in conservation will result in a greater need for coordination to ensure common goals are being efficiently achieved. In Ontario, there are now more than 40 conservation land designations amongst federal, provincial, municipal and private management. Paleczny *et al.* (2000) categorized Ontario's protected areas and conservation lands according to the International Union for the Conservation of Nature (IUCN) classification (IUCN 1994). The IUCN system provides a global standard and categories to identify the types of protected areas, based on management objectives (Table 2). This system can enhance understanding, coordination, and regional reporting on nature conservation.

C. Bryan

Dorcas Bay Nature Reserve, 1962

Table 2: IUCN Protected Area Classification *(IUCN 1994)*

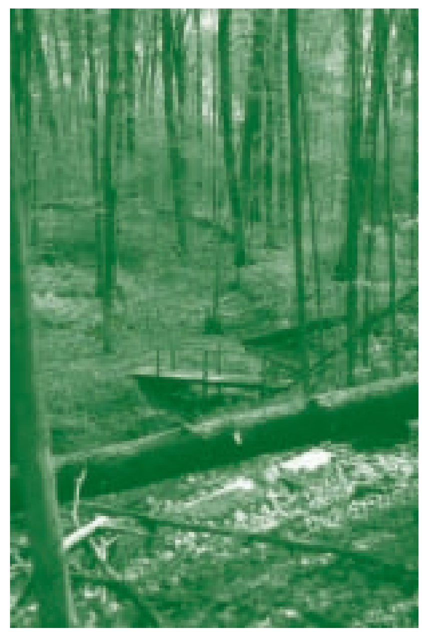
CATEGORY Ia

Strict Nature Reserve: protected area managed mainly for science

Definition:

Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

Ontario example: Peter's Woods Provincial Nature Reserve ▸



C. Bryan

CATEGORY Ib

Wilderness Area: protected area managed mainly for wilderness protection

Definition:

Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Ontario example: Kesagami River Provincial Wilderness Park

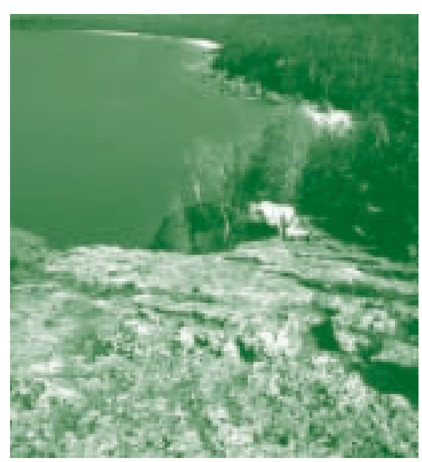
CATEGORY II

National Park: protected area managed mainly for ecosystem protection and recreation

Definition:

Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Ontario example: Bruce Peninsula National Park ▸



C. Bryan

CATEGORY III

Natural Monument: protected area managed mainly for conservation of specific natural features

Definition:

Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

Ontario example: Winsk River Provincial Waterway Park ►

Alain Goulet

CATEGORY IV

Habitat/Species Management Area: protected area managed mainly for conservation through management intervention

Definition:

Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Ontario example: St. Clair National Wildlife Area ►

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CATEGORY V

Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation

Definition:

Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Ontario example: Great Lakes Heritage Coast ►

James Sidney

CATEGORY VI

Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

Definition:

Area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Ontario example: Niagara Escarpment Plan, Escarpment Rural Area ►

G. Bryan

The trend towards more systematic use of protected areas to conserve nature in Ontario is mirrored by what is occurring globally. Today, most countries have mechanisms to conserve nature through protected area programs. This reflects the increasing recognition of the importance of conserving nature for both intrinsic values and to sustain human health and prosperity.

2.2 An Introduction to Biodiversity

Nature reserves are usually selected and designed to conserve elements of biological diversity, or biodiversity. Biodiversity is defined by the Convention on Biological Diversity (Secretariat on the Convention of Biological Diversity, 1992), and subsequent Canadian Biodiversity Strategy (Biodiversity Working Group, 1995) as: *the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.*

This definition recognizes that biological diversity occurs in all habitat types and includes three primary levels of organization:

- diversity of different species
- diversity within species (genetic variation)
- diversity of communities and ecological systems.

Species Diversity

Species diversity or richness is the number of species found within a given area. This is often the simplest level of biodiversity to measure and understand, and is commonly used in reporting on natural areas. For example, the number of plant species or breeding birds can be recorded within a nature reserve. The measure of the number of species can be useful for understanding habitat quality, identifying special elements and tracking ecological change. Globally, biodiversity "hotspots" based on endemic species (those that only occur within a restricted geographical area) and richness have been used to set conservation priorities (Mittermeier *et al.* 1998; Olsen and Dinerstein 1998; Myers *et al.* 2000). Even at a regional scale, species richness may be one of the most effective decision rules for prioritizing land protection (Meir *et al.* 2004).

A species can be defined as a group of taxonomically distinct individuals that can potentially reproduce themselves. The simple concept of a species is complicated by a number of factors. Distinguishing between species can be very difficult within some groups. Individuals can look very different, yet still be the same species. These differences could be attributed to genetic variation (e.g., a different colour) or environmental conditions (e.g., different growing conditions). Alternatively, individuals that look similar may not interbreed and be biologically separate due to different uses of habitats.

The development of new species is an ongoing, natural process. Individuals of two different, but very closely related, species may interbreed. Sometimes these offspring have characteristics that allow them to better survive in different habitats, and, in time, a new species can be formed. Populations can also become isolated and begin to develop unique adaptations to their particular environment that eventually result in new species. This phenomenon is well documented for islands, where it often occurs very rapidly. However, it also occurs on the mainland (see next section, Genetic Diversity). Planning for speciation and evolutionary processes requires conservation planning that considers long time periods and broad spatial scales.

The current status of many species in Ontario, particularly vertebrates and vascular plants with declining or vulnerable populations, is well documented. Nationally, species at risk are identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Within Ontario, provincially endangered and threatened species and species of special concern are identified by the Committee on the Status of Species at Risk in Ontario (COSSARO). The Ontario Natural Heritage Information Centre (NHIC) also identifies species and community conservation ranks in Ontario based on abundance,


Eric Dresser

Blackburnian Warbler


Eric Dresser

Black-throated Green Warbler


Eric Dresser

Common Yellowthroat Warbler

range, protected status, threats and population trends. This methodology is applied consistently across the hemisphere-wide network of conservation data centres (CDCs) called NatureServe. The NHIC is one of the CDCs that plays an important role in itemizing and tracking the status of species and communities over their entire range, allowing the identification of globally important elements.

Genetic Diversity

Individuals within a species are genetically different from one another to varying degrees. Groups of individuals, or sub-populations, may vary from one another in response to local conditions. These conditions include physical attributes such as climate and disturbance regimes, and ecological factors such as competition and resource availability.

Populations adapt to survive and reproduce within the environmental conditions where they originate. Over time, a population may become specially adapted to the local climate, resource availability and disturbances. For example, it has been demonstrated that a Red Oak population from the Algonquin Park area is genetically "programmed" to grow differently than Red Oaks that have evolved in the Toronto area. When an individual Red Oak is moved to a different set of climate conditions, even within the overall range of the species, it may suffer due to spring or fall frosts, moisture or heat stress, or damage from snow and cold temperatures. These stresses can kill the tree or result in reduced growth and vigour, which then makes the tree more susceptible to insect or disease damage (Forest Gene Conservation Association 2005). Considering these genetic differences is important for re-introduction and restoration projects.

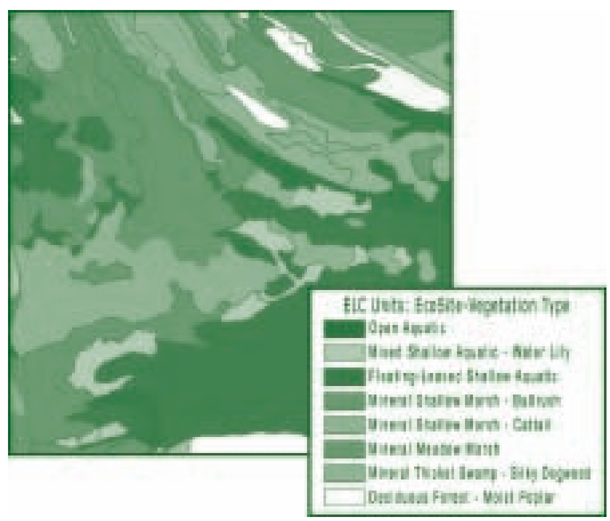
The amount of genetic variation between populations depends on several factors. Generally, the more isolated the population, the greater the probability it will have a higher degree of genetic deviation from the primary population centre, and, in time, may be more likely to develop into a new species. Endemics often develop in specialized and isolated habitats. Populations of a species with slow dispersal rates that occur in locations isolated from its core range are more likely to have unique genetic characteristics. For this reason, geographically isolated, or disjunct, occurrences of even common species are often considered a conservation priority. Examples of disjunct species in Ontario include coastal plants such as American Beachgrass and Bushy Cinquefoil that occur along the Great Lakes and are separated by hundreds of kilometres from larger populations on the Atlantic coast. Appendix A provides a list of disjunct and endemic species from the Great Lakes basin in Ontario.

Community and Ecosystem Diversity

Communities are groups of species that interact on the same site, and often occur as repeatable assemblages on the landscape. Communities develop based on physical factors such as soils, topography and climate, and biological factors such as seed availability of different species. Examples of common vegetation communities in southern Ontario are Dry-Fresh Sugar Maple-Beech Deciduous Forest, White Cedar Organic Coniferous Swamp and Sumac Cultural Thicket (Lee *et al*. 1998).

There are many systems to define and describe communities. One of the greatest challenges for ecologists and land managers has been the development of frameworks to classify and organize community information. In Ontario, vegetation communities have been organized within the framework of the Ecological Land Classification System (ELC). An ELC has been developed for most of the province including: southern (Lee *et al*. 1998), northeast forest ecosystems (Jones *et al*. 1983; McCarthy *et al*. 1994), northwest (Sims *et al*. 1989; Racey *et al.* 1996) and central (Chambers *et al*. 1997). While ELC communities are generally based on dominant vascular plants, soil type and moisture, these units can also be useful in identifying suitable habitat for other plant and animal species, because many plants and animals are closely associated with particular habitat conditions.

Figure 5: Ecological Land Classification



Communities are often dynamic and change over time, resulting in changes to species composition, structure and ecological functions. Some community types are relatively stable and less likely to change from year to year, such as a mature Maple-Beech forest. Younger community types, such as an old field or Poplar forest, are more likely to transition into a new stage over time in a process called succession. Maintaining different community stages within an area can be important to ensure species are available as younger communities mature, and to re-colonize disturbed sites.

Many community types depend on disturbances to maintain composition and function. These natural disturbances can include flooding along rivers, fire in prairies or the opening of canopy gaps in mature forest. Maintaining key natural processes is important for conserving the natural range of variation in communities.

Vegetation communities can be organized into ecological systems. Ecological systems generally occur in an area with similar physical conditions, although the specific compositional and structural expression of vegetation may differ. Ecological systems from Ontario are shown in Table 3. The Great Lakes region in Ontario has one of the highest diversities of ecological systems in North America, including many systems that are globally rare and irreplaceable (Comer *et al.* 2003). This diversity is largely driven by the coastal features and processes of the Great Lakes.

Table 3: Ecological Systems from Central Ontario

FOREST
Boreal Aspen-Birch Forest
Boreal Jack Pine-Black Spruce Forest
Boreal White Spruce Forest and Woodland
Boreal White Spruce-Fir-Hardwood Forest
Laurentian Acid Rocky Outcrop
Laurentian-Acadian Northern Hardwoods Forest
Laurentian-Acadian Northern Pine-(Oak) Forest
North-Central Interior Beech-Maple Forest ►
SAVANNA
Laurentian Pine-Oak Barrens
North-Central Oak Barrens
HERBACEOUS
North-Central Interior Sand and Gravel Tallgrass Prairie
WOODY WETLAND
Boreal-Laurentian Bog ►
Boreal-Laurentian Conifer Acid Swamp
Laurentian-Acadian Conifer-Hardwood Acid Swamp
North-Central Interior Shrub-Graminoid Alkaline Fen
North-Central Interior Wet Flatwoods
North-Central Interior Wet Meadow-Shrub Swamp
North-Central Interior and Appalachian Acid Peatland
North-Central Interior and Appalachian Rich Swamp


CWS

Beech-Maple Forest


CWS

Boreal-Laurentian Bog

HERBACEOUS WETLAND
Great Lakes Freshwater Estuary and Delta
Laurentian-Acadian Freshwater Marsh ▸
Laurentian-Acadian Wet Meadow-Shrub Swamp
North-Central Interior Freshwater Marsh
Northern Great Lakes Coastal Marsh
Northern Great Lakes Interdunal Wetland
MIXED UPLAND AND WETLAND
Eastern Boreal Floodplain
Great Lakes Dune and Swale
Great Lakes Wet-Mesic Lakeplain Prairie
BARREN
Great Lakes Acidic Rocky Shore and Cliff
Great Lakes Alkaline Rocky Shore and Cliff
Great Lakes Alvar
Great Lakes Dune ▾

CWS

Freshwater Marsh

CWS

Great Lakes Dune

As with species, significance rankings have been identified for many community types, providing a tool to identify those elements that are rare at the provincial and global level. ELC provides an excellent framework for organizing vegetation community information and identifying "coarse-filter" targets for conservation (Noss 1987; Noss 1996). Coarse-filter targets are communities and ecosystems that, if conserved, will also protect multiple species targets. Table 4 provides a list of some "coarse-filter" community targets in Ontario and associated species targets.

Table 4: Examples of Coarse-filter Communities and Fine-filter Targets

COARSE FILTER	FINE FILTER
Fresh Sugar Maple-Beech Forest Type	Interior-forest birds, Broad Beech Fern
Great Lakes Dunes	Great Lakes Wheat-grass, Sand Cherry
Great Lakes Coastal Wetland	Black Tern, Swamp Rose Mallow
Granite Rock Barrens	Five-lined Skink, Eastern Hog-nosed Snake

Walter B. Fechner

Scarlet Tanager

2.3 Geographic Scales of Biodiversity

Just as nature operates at different levels of biological organization (genetic, species, community and ecosystem), nature also operates at different spatial scales ranging from a few square metres to vast areas of the Earth. A Spotted Turtle in a coastal marsh may spend its entire life in a home range of less than one hectare (Graham 1995), while colonial waterbirds that inhabit the same marsh forage tens of kilometres away from nesting sites and migrate over vast distances between summer and winter.

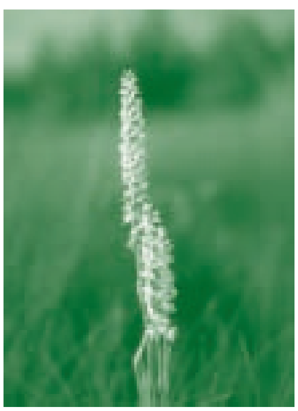
Vegetation communities also occur at different scales. Some vegetation communities cover (or formerly covered) vast areas based on widespread soil types and other physical conditions, and form the dominant or matrix habitat type. Other systems are restricted to very specific physical conditions such as slopes or seepage areas, and naturally occur as small patch systems. Large patch systems may occur within a matrix system on a particular soil type or aspect.

Understanding these relationships is important for identifying key conservation strategies. Poiani *et al.* (2000) identified four geographical scales – local, intermediate, coarse and regional – in which populations and communities/ecological systems occur (Table 5).

Table 5: Geographic Scales of Vegetation Communities

GEOGRAPHIC SCALE	COMMUNITIES	SPECIES
1. LOCAL < 2,000 acres (800 ha)	**Small patch** systems occurring under very specific physical conditions. *Examples:* cliff associations, fens, seeps	Limited dispersal ability and generally restricted to a specific community type. *Examples include many rare species:* e.g., Pitcher's Thistle is restricted to dune systems (small patch community)
2. INTERMEDIATE 1,000-50,000 acres (400-20,200 ha)	**Large patch** systems defined by distinct physical factors and environmental regimes. *Examples:* Black Oak savanna, alvars	Species that depend on large patch systems or several different types of small patch systems. *Example:* Wood Frog
3. COARSE 50,000-1 million acres (20,200-405,000 ha)	**Matrix** communities that are, or historically were, the dominant habitat between patches. Matrix systems are defined by a broader range of physical conditions such as moisture and topography. *Example:* upland deciduous forest	Species that require large areas to access the habitat required. *Examples:* Pine Marten, Barred Owl
4. REGIONAL > 1 million acres (> 405,000 ha)	Applies to species only.	Population where individuals have very large home ranges or species that migrate over large areas. *Examples:* migratory birds; Lake Sturgeon; Monarch Butterfly

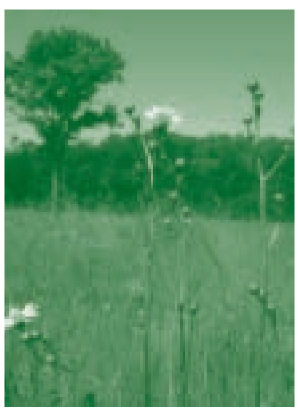
1. LOCAL



G. Bryan

White Bog Orchid in fen

2. INTERMEDIATE



G. Bryan

Savanna and Prairie Dock

3. COARSE

G. Bryan

Upland Deciduous Forest

4. REGIONAL

John Mitchell

Monarch

These scales are useful for understanding conservation needs and driving effective nature reserve design. For species or vegetation communities that occur as small patch systems, small isolated nature reserves may provide effective protection. But species or communities which require a larger geographic scale will require different protection strategies – perhaps a series of reserves protecting key habitat areas, plus effective linkages or compatible land-use management on the rest of the landscape. A clear understanding of the needs of the species or communities being targeted for protection or restoration is essential to ensure that the related elements of scale are considered. Good conservation considers and plans at appropriate biological and spatial scales (Poiani *et al.* 2000; Noss *et al*. 1997).

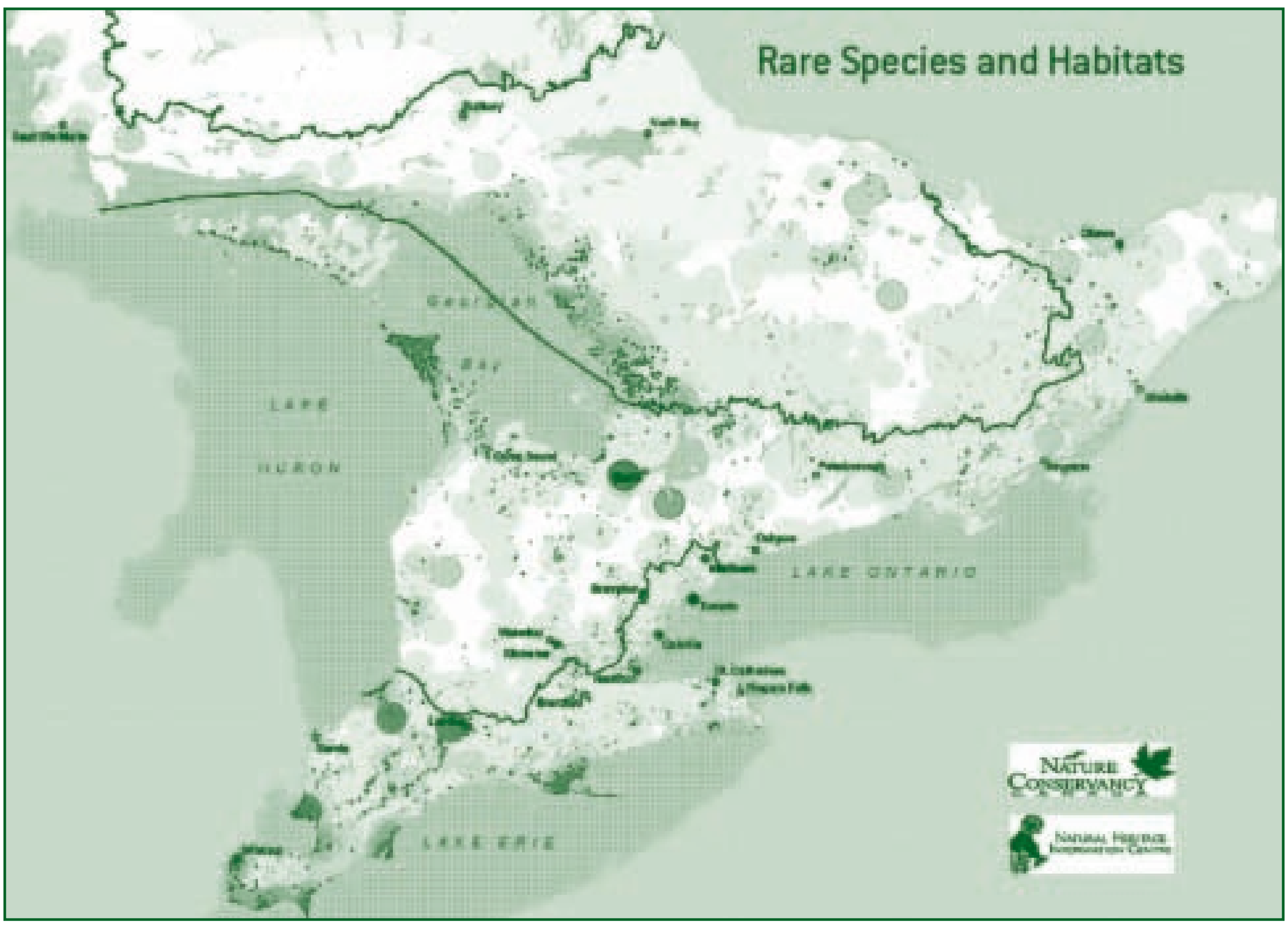
2.4 Distribution of Biodiversity

Biological diversity is not evenly distributed. Globally, the most species-rich environments appear to be tropical forests, coral reefs, deep seas and large tropical lakes (Groombridge and Jenkins *et al*. 2002). This diversity can be attributed to several driving factors including ecosystem age, size, isolation and productivity. Biodiversity also shows a trend of increasing from the poles to tropical regions in terrestrial, aquatic and marine systems.

Locally, biodiversity is driven by variation in climate, soils, topography and geology (Gaston 2000). The number of species and communities tends to be greatest where there is the greatest complexity of physical factors. Often soil and geology, especially in combination with coarse vegetation measures, can be used as surrogates or indicators to identify where unique and diverse biological systems may occur (Wessels *et al.* 1999; MacNally and Fleisman 2002; Oliver 2004). Areas with a diversity of ecological systems often have high species diversity.

Within Ontario, species richness is greater south of the Canadian Shield, with the highest number of rare species associated with specialized habitats such as prairies, alvars, older growth forests and shorelines. The Great Lakes also play a key role in species diversity by creating unique habitat types and moderating coastal habitats. Ontario landscapes with the highest diversity of rare species include the Bruce Peninsula, Long Point, lake-plain prairies along the Detroit River and Lake St. Clair, and the Rondeau peninsula. Habitat types that support rare species and communities are often associated with unique and localized physical features such as shallow bedrock, cliffs, shorelines and groundwater seepage. Figure 6 illustrates the diversity of rare elements from Ontario (Natural Heritage Information Centre and Nature Conservancy of Canada, 2002).

Figure 6: Rare species and habitats. Darker green indicates increasing number of records.



NCC and OMNR

2.5 Threats to Biodiversity

Nature reserves are needed because biodiversity is threatened by incompatible human activities. Assessing and understanding threats is critical for setting conservation priorities. This section provides an overview of the threats that are most likely to be impacting biodiversity in Ontario at a local scale, where protected areas may be effective in countering those threats.

Threats can occur at many different scales, and must be managed at the appropriate spatial and temporal scale if they are to be effectively abated. Threats that operate on very broad scales, such as climate change and cross-border pollution, while absolutely critical for conservation, are not addressed in this section. Five threats that commonly impact nature conservation at the regional scale include: habitat change, habitat fragmentation, invasive species, altered ecological processes, and over-exploitation or persecution.

Habitat change

Habitat change includes the conversion and degradation of ecosystems, and is the primary cause of the loss of biodiversity in terrestrial and freshwater ecosystems – a factor that will likely continue for the next 100 years (Sala *et al*. 2000). Habitat change directly displaces species and can radically change ecological functions. Habitat alteration often favours common, widespread species that can occupy a wide array of habitat types, while displacing more sensitive species with narrower habitat requirements. Common forms of habitat change in Ontario include conversion of lands for agriculture and urban uses, forestry practices (i.e., altering the structure and composition of woodlands) and changes of water quality and quantity in streams. Habitat change is closely related to habitat fragmentation and invasive species (discussed in next sections).

The original ecosystems of southern Ontario underwent very rapid change during European settlement. Old growth forests were changed into agricultural lands in less than 100 years. While many native species have benefitted from this change, such as White-tailed Deer, Raccoons, Red-tailed Hawks and Common Milkweed, many forest species have become restricted to isolated blocks of woodland, or have been extirpated from local areas. Where forests do remain, they are often managed for timber products, and maintained at younger ages than original forests.

CWS

Habitat Change: Wetland and forest to urban and agriculture

Habitats can also be changed by degradation. This process can include inputs of chemicals or energy that disrupt ecological processes. While the original habitat has not been directly altered physically, changes in chemistry and energy flow can cause significant changes in the composition and structure of ecosystems. Wetland areas adjacent to agricultural lands may have reduced amphibian breeding capacity due to pesticide drift (Davidson 2004).

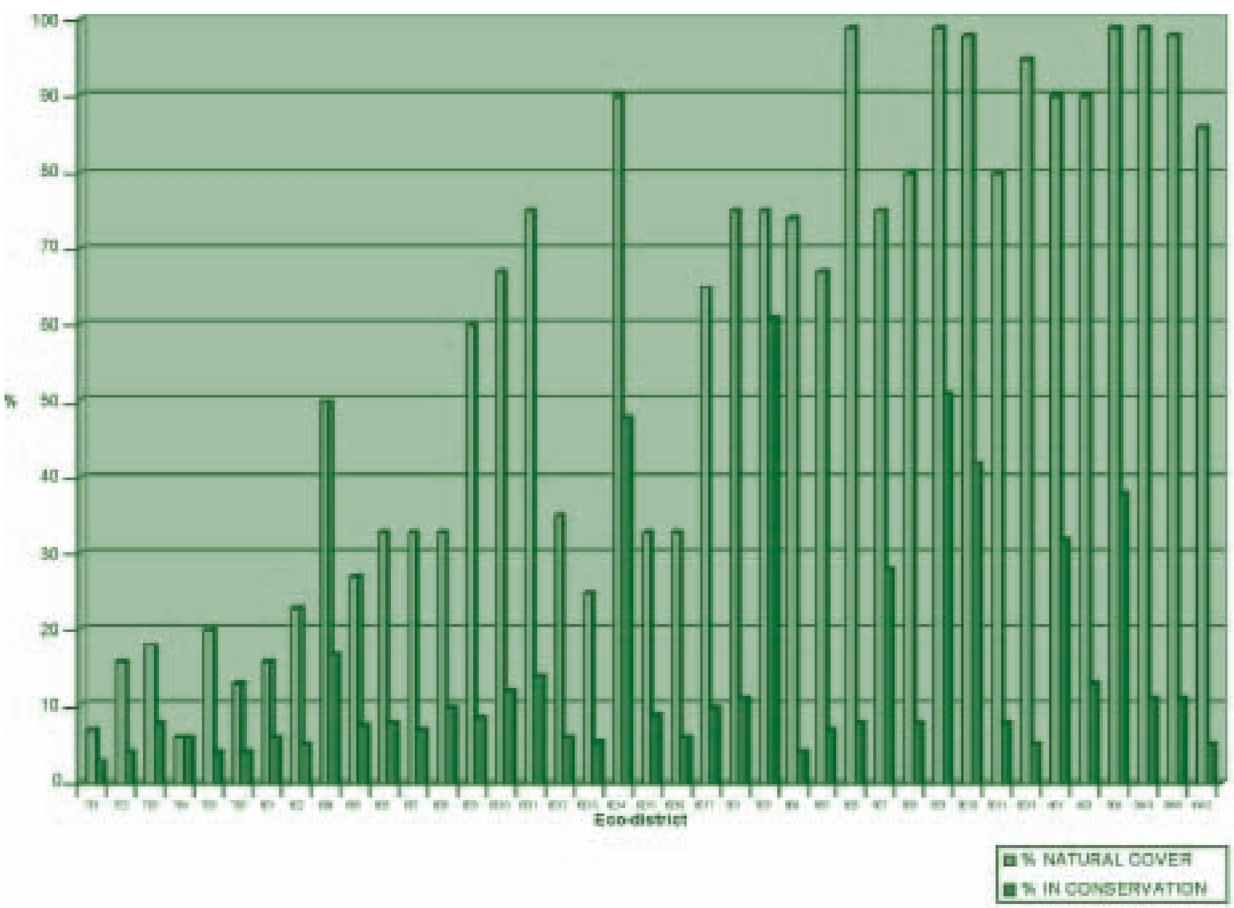
Habitat Fragmentation

Most of the natural areas remaining in southern Ontario are fragmented. Habitat fragmentation is the conversion of formerly continuous habitat into small, isolated patches (Meefe and Carroll 1994). Ecosystems that once occurred as large-scale units are now interrupted by human-dominated landscapes including roads, urban areas, and agricultural lands. Research has suggested that after extensive habitat loss and fragmentation one-third to one-fifth of the fauna may decline to thresholds vulnerable to extinction (Driscoll and Weir 2005).

Habitat fragmentation has a significant impact on biological diversity (Vitousek *et al*. 1997), primarily through two results: isolation and edge effects.

Isolation occurs when a large community type or population becomes divided up or past connections to other habitat types are broken. Most of the forests in southern Ontario, once part of large continuous woodlands, are now isolated patches. Isolation effects some species more than others. For species that can fly or have no difficulties moving through agricultural landscapes, such as Raccoons or American Toads, isolation of woodland habitats has less effect. For species that are less mobile in agricultural or urban landscapes, isolation may mean that that they are virtually cut off forever from other individuals of their species. This is especially true for plants and invertebrates. If the patch is large enough and the quality remains suitable, these species might be able to persist, but they are more vulnerable to local extinctions due to disturbances or disease.

Figure 7: Habitat percent cover and conservation lands in ecodistricts for southern and central Ontario.



CWS

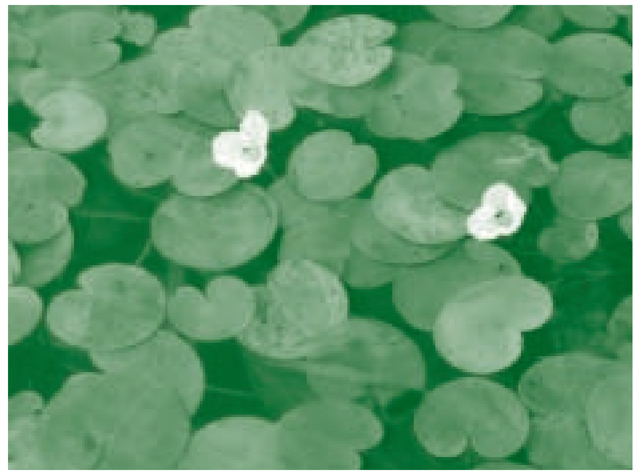
Fragmented forest

Habitat edges may change the distribution and abundance of species and types of communities (Murica 1995; Harrison and Bruna 1999), a phenomenon that has been well documented for birds in eastern North America. Nesting success of many interior-forest birds is lower along forest edges than within the core of the forest due to high levels of predation and Cowbird parasitism (e.g., Robinson *et al.* 1995; Hartley and Hunter 1998). Edges can also change forest habitats due to increased light and wind, typically resulting in a drying effect. This can result, for example, in changes to salamander populations (Marsh and Beckman 2004).

Invasive Species

Invasive species are a significant threat to biological diversity (Mack *et al.* 2000), particularly to those species that are already at risk. Within the United States, almost half of all endangered species are threatened by invasives (Wilcove *et al.* 1998). Many rare habitats in Ontario, including prairies, alvars and beaches, are also threatened by invasives such as Garlic Mustard, Viper's Bugloss, and Glossy Buckthorn (White *et al.* 1993). Aquatic ecosystems are also greatly effected by invasives such as Zebra Mussel, Spiny Water Flea, and Common Carp. Invasive species expand their distribution and abundance by significantly displacing native species. Some invasives are able to expand their range because they have no natural predators or diseases that control their population growth. Others may be facilitated by human-caused habitat changes or disturbances that create new resources.

Invasive species can include native species that are now functioning outside their normal range of distribution or abundance. These are usually common native species that can occupy a wide range of habitats (e.g., Manitoba Maple). When their abundance exceeds historical numbers for long periods of time, it can have a negative impact on more sensitive native species. This increase is usually associated with human-initiated changes such as removing predators or disturbing soil. In some parts of Ontario, White-tailed Deer exist at such a high density that they have a significant impact on natural vegetation.



Shawn Meyer

Frog's bit – a wetland invasive species

Altered Ecological Processes

Many types of habitat require some kind of periodic disturbance to be maintained. These types of disturbance are usually natural and occur beyond the regular (and predictable) changes of season and normal climate. Examples of these disturbances could include flooding, fires, drought, rock slides, storm surges and down-bursts of wind. Traditionally many of these events have been seen as negative, as they often radically change the appearance of habitats and may make them less suitable for human uses in the short term. But they are often necessary to maintain and refresh those habitat types. These disturbances are as much of a part of the habitat as the plant communities and wildlife. Understanding these processes can be critical for managing nature reserves.

The timing, frequency and severity of these events will vary. While some are regular, such as annual spring flooding, some may only be experienced every few decades such as wind down-bursts, rock slides and severe drought. Many of these events are beyond human control. Humans have been very effective at stopping others, particularly changing historic fire regimes and the flow of watercourses.

Many natural resource policies have encouraged the suppression of all wildfires. This has had a significant impact on the functions of the many habitat types that have developed under a regular fire regime, and has resulted in changes to community structure and functions. Communities such as prairies and savannas which depend on fire can only be preserved if fires are an integral part of nature reserve management.

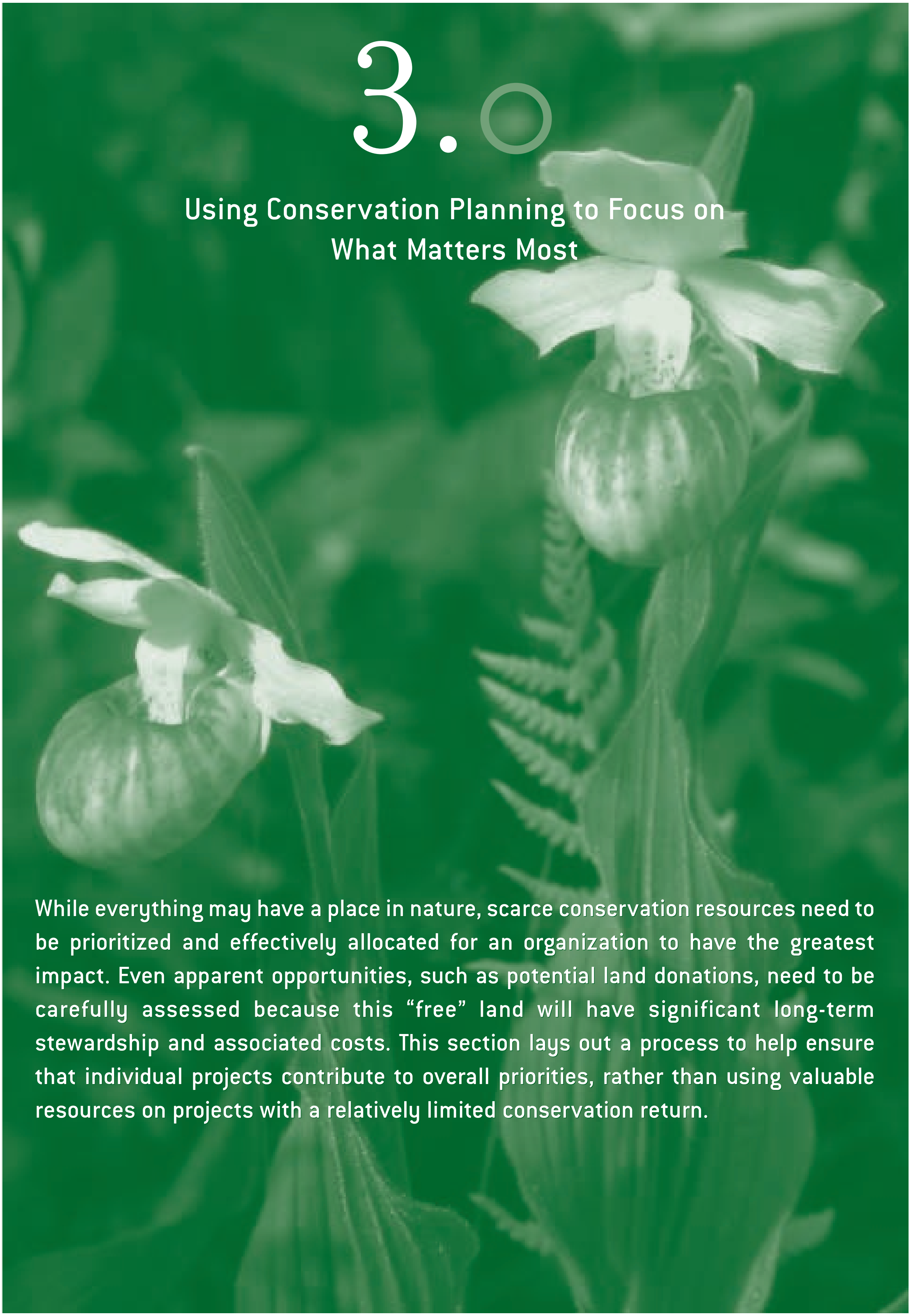
Over-exploitation and Persecution

While the days of market hunting of birds for their plumage are long gone, various forms of exploitation are still a significant threat to some species. American Ginseng, for example, is now seriously threatened in the wild because of zealous collecting of its roots for herbal medicine. Ram's-head Orchid is another rare plant threatened by collecting for attempted transplants into gardens. Some aquatic species appear to be especially vulnerable to over-harvesting. Populations such as Lake Simcoe Whitefish, and Lake Trout throughout the Great Lakes, are drastically reduced from their former abundance.

Persecution by humans is a factor for "charisma-challenged" species such as reptiles, bats and spiders. While attitudes are slowly changing, the impulse to kill such species on sight is a major threat to Eastern Massasauga, Eastern Hognose and many other snakes.

OMNR

Fire disturbance



Eric Dresser

3.0

Using Conservation Planning to Focus on What Matters Most

While everything may have a place in nature, scarce conservation resources need to be prioritized and effectively allocated for an organization to have the greatest impact. Even apparent opportunities, such as potential land donations, need to be carefully assessed because this “free” land will have significant long-term stewardship and associated costs. This section lays out a process to help ensure that individual projects contribute to overall priorities, rather than using valuable resources on projects with a relatively limited conservation return.

3.1 Defining and Understanding a Planning Region

To develop a systematic approach to nature reserve design, it is useful to begin by considering the distribution of biodiversity at the regional level. While the region of operations for conservation organizations may be defined on the basis of municipal or watershed boundaries, or simply by proximity to some central town, the distribution of landforms and associated natural features provide a more useful ecological context for this analysis.

Wherever possible, it is preferable to use natural landscape boundaries for a planning region. At a minimum, a land trust should recognize that its operating area may form only a part of a broader ecological region, or contain several distinct regions, and that conservation planning needs to incorporate relevant information from those entire regions. Even if conservation action will only occur within specific political boundaries, the context and priority of these actions should be derived from an understanding of the broader ecosystem.

Differing landforms or geology greatly influence the natural communities and land uses that occur on those landscape units. In Halton Region, for example, the clay plains below the Niagara Escarpment are intensively farmed and urbanized with only a few remnant wood lands and wetlands and only about 12 percent natural cover; the areas above the Escarpment face have over 40 percent forest cover and include an abundance of wetlands (Riviere and McInnes 1999). To adequately analyze the ecological priorities in this planning region, it would be necessary to look at each of these landscapes individually.

The Ontario Ministry of Natural Resources has subdivided all of Ontario into "ecoregions" and "ecodistricts" (previously known as site regions and site districts) based on variation in landforms and climate (Hills 1959; Crins and Uhlig 2002). These can often form a natural basis for planning regions. Detailed site district reports are available for most of southern Ontario from the NHIC and from many OMNR District Offices. Concise summaries of the features of individual ecodistricts have been prepared by the NHIC and NCC for the Great Lakes region of Ontario (Henson *et al*. 2005, Henson and Brodribb 2005). These summaries provide information on ecological systems, communities, species and existing conservation lands.

Another helpful resource for defining a landscape-based planning region is mapping associated with The Physiography of Southern Ontario (Chapman and Putnam 1984), which identifies broad landscape units as well as individual landforms. In some regions, provincial programs may also have also mapped boundaries based on special landform features (e.g., the Niagara Escarpment, Oak Ridges Moraine, Great Lakes Heritage Coast).

Key Principle:

Base landscape analysis on an ecologically based planning region to provide a strong framework for conservation planning.

▸ CASE STUDY

Georgian Bay Coast

That the Georgian Bay coast is a special place is obvious to anyone who has visited there – a labyrinth of coastal islands, narrow bays and inlets, and a mosaic of colourful rock and windswept pine. Those special qualities had already been recognized through its designation as a World Biosphere Reserve. But when the Nature Conservancy of Canada and the OMNR set out to document the ecological values of the Georgian Bay east coast, drawing boundaries for an ecologically based study area presented a typical set of challenges. The offshore boundary was relatively easy – where the islands stop and deeper water takes over. But how far inland to include, and how to define northern and southern limits, took more thought.

James Sidney

Island in Georgian Bay

According to Wendy Cooper, one of the authors of the Ecological Survey of the Eastern Georgian Bay Coast (Jalava *et al*. 2005), one starting point was the OMNR site district 5E-7 mapping, which is based primarily on shallow rocklands associated with the coast. However, a review of more detailed biophysical units (Noble 1983) revealed a pattern of deeper soils in most of the easterly sections of the site district, which were not felt to relate closely to the coastal features. Another factor considered was watersheds, with the intent of including the small coastal watersheds, but not the larger watersheds such as the Muskoka River.

One other factor was decisive. The Highway 400/69 corridor represents a major barrier for the movement of many species, and is located close to transitions in soil depth and watersheds, so it made a logical eastern boundary. In one area, the study boundary extended inland past the highway to incorporate all of an existing conservation reserve.

The southern boundary was set as the Severn River, a major break in the landscape. On the north, a block of First Nations land formed an approximate boundary with the French River mouth area.

As this case illustrates, ecological boundaries are seldom clear-cut; instead they often take the form of a gradual transition from one set of characteristics to another. Defining the boundaries of a planning region is always somewhat arbitrary but careful consideration of ecological features and potential "break points" in the landscape can result in workable and rational boundaries.

Figure 8: Ecozones, Ecoregions and Ecodistricts of Ontario

3.1.1 Assembling Existing Biodiversity Information

In order to identify priorities, it is important to have an understanding of the species, communities and ecosystems that occur within the planning region. Assembling local and regional information on biodiversity is getting much easier, largely thanks to improved local and regional mapping and Conservation Data Centres (CDCs).

All North American CDCs are linked to NatureServe, the central repository of biodiversity information for the western hemisphere. Central repositories provide data consolidation that can identify data gaps, reduce redundancy and promote data integrity through standardization. NatureServe provides information on the distribution and conservation status of species and communities in states and provinces surrounding Ontario (see http://nhic.mnr.gov.on.ca).

The NHIC maintains databases on the distribution, condition and status of species, ecological communities, and natural areas in Ontario. These databases can be queried to provide lists of rare species, select vegetation communities and natural areas within a planning region. Furthermore, depending on the user's level of access these data are all geographically referenced and their occurrence distribution can be visually represented on a map.

Some parts of Ontario have detailed ecological information already available, such as the Niagara Escarpment and the Oak Ridges Moraine. Mapping of ANSIs, wetlands, and wildlife concentration areas such as deer yards is available from OMNR. Conservation Authority watershed plans and municipal Environmentally Sensitive Areas (ESA), Greenlands, or Natural Heritage studies also often have useful detailed mapping and documentation of natural features.

A useful starting point is accessing existing broad-scale mapping that has been developed to review conservation priorities across all of southern Ontario. A coalition of conservation organizations and agencies published mapping called *The Big Picture*, which identifies key natural areas and potential linkages (NHIC and NCC 2002). The *Great Lakes Conservation Blueprint for Biodiversity*, prepared by NHIC and NCC, identifies a portfolio of high-priority core biodiversity areas which will be a valuable starting point for local mapping (see Appendix C). As well as identifying potential priority sites for many conservation targets, the Conservation Blueprint project provides "biodiversity report cards" for individual ecodistricts and tertiary watersheds, to assist in identifying gaps in habitat protection and opportunities for securement and restoration (Henson and Brodribb 2005; Henson *et al.* 2005, Phair *et al.* 2005, Wichert *et al.* 2005).

> **Key Principle:**
>
> Incorporate conservation goals and data relevant to the planning region that have been identified in previous conservation planning initiatives.

Many Important Bird Areas (IBAs) also have plans that identify conservation goals and strategies within the IBA planning area.

Often, the best sources of information for a planning area are local residents. Expert workshops can also be an important tool for gathering information. Local agency staff and amateur naturalists are often aware of significant natural habitats or species occurrences which are not yet well documented. Some nature clubs have carried out extensive field studies, such as the Hamilton Natural Areas inventory (Heagy 1993).

CWS

Inspecting a potential nature reserve property

Maps are a critical component of conservation planning. The advancement of GIS has increased the availability of accurately mapped data, with large datasets main-tained by OMNR, Conservation Authorities, and municipalities. GIS are data management tools which allow analysis of data visually as a digital map.

The power of GIS is in the ability to layer multiple datasets or thematic maps, allowing an exploration of relationships among features that are distributed unevenly over an area, seeking patterns and trends that might not be apparent in written or tabular form. This can be valuable in ecological investigations where a GIS can provide a visual "big picture" of the dynamics and possible relationships among landscape variables and influences of surrounding land uses. Since information within a GIS can be presented at different scales, it is possible to undertake ecological and biodiversity investigations within a hierarchy, from a site-specific occurrence to a regional trend or even beyond.

Spatial analysis of habitats can be used to rank habitat patches by size, provide patch perimeter-to-area ratios, and establish patch proximity to other features (e.g., proximity to roads can be used to estimate degree of disturbance and proximity to open water can be used to assess a patch as turtle habitat). GIS can be used explore habitat fragmentation through noting patch separation from hydrological linkages or habitat linkages. Each ranked consideration can then be combined to establish priority conservation areas.

As a planning tool, GIS can be invaluable to share information among stakeholders, both digitally and in mapped form; to provide a common ground from which to select conservation targets; establish and evaluate priorities; and make better conservation decisions. Assessing these data maps can be very helpful in identifying potential natural heritage sites, and this process is often used by municipalities and Conservation Authorities to develop natural heritage systems.

CWS

Visitor Damage

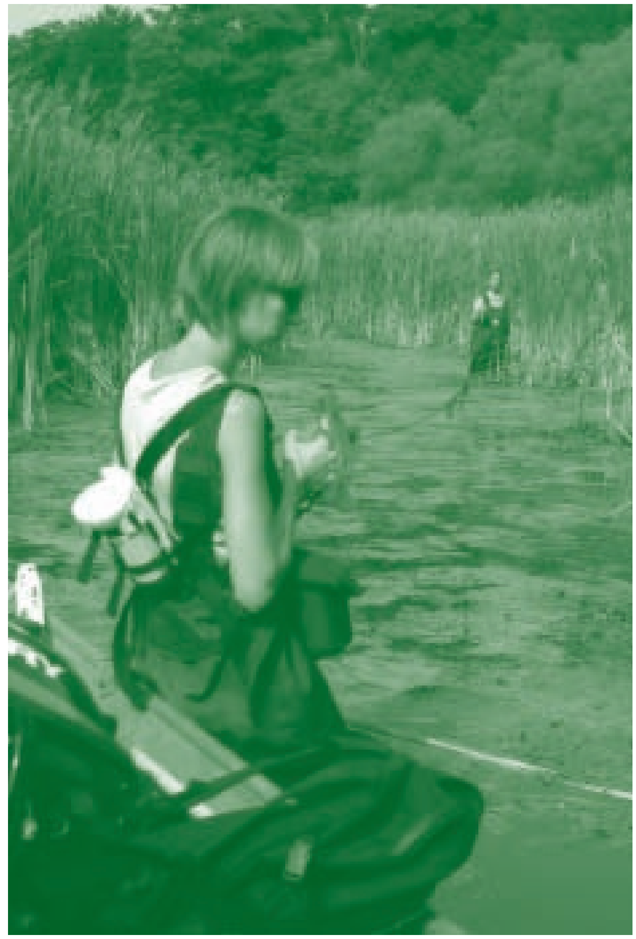
Table 6: A Checklist of Potential Information Sources

TYPE OF INFORMATION	DATA SOURCES
Rare species and communities	NHIC, COSEWIC, COSSARO, Species at Risk Recovery Teams
Natural areas, wetlands, ANSIs	NHIC, OMNR Districts, CAs, Nature Clubs, municipalities, special policy areas
Significant woodlands	Ontario Nature, municipalities
Important bird habitats	Bird Studies Canada, Canadian Wildlife Service
Significant aquatic habitats	NCC, OMNR, CAs
Significant wildlife areas	OMNR Districts
Core areas and regional corridors	NHIC, NCC

However, GIS can be a costly investment. To maximize the effectiveness and efficiency of the system requires high-powered computer equipment and skilled technicians. There are lower-end systems available for agencies wanting to create basic maps with limited analysis but the costs can still be high. Another consideration is that access to certain datasets is often restricted to agencies with data-sharing agreements. For rare species, agencies may be unwilling to share site-specific locations because of confidentiality concerns, and some records may be out of date.

For local organizations, often the most useful approach to overcome these difficulties is to work closely or cooperatively with local OMNR or Conservation Authority staff to access the best available mapping and status information through their networks of experts. In some cases, municipal planning staff may be able to assist in the same way. The upfront assistance of local government partners can make mapping easier and more efficient, and they can help identify mapping limitations or weaknesses that are important to understand.

Data gaps will almost always exist for any area. Some of these gaps might be filled by using remotely sensed information on the type, size and landscape context of different habitat types (e.g., aerial photography or satellite imagery). Other data gaps will require field work. A GIS was never intended to replace field visits. Field work is required for data confirmation, or ground truthing, and is pertinent in gaining local area knowledge to truly understand the site.


CWS

Wetland field survey

Getting Out There

In today's world of GIS-based landscape analysis and multiple data layers, it is easy to overlook the limitations of these tools, particularly at the scale of individual sites. There is no substitute for actually getting out on the ground to verify the value of potential project areas, to add to a site-specific database, and to look for unexpected concerns. This is especially true for assessing the condition and potential viability of a site. If necessary, recruit a knowledgeable local naturalist or agency staffer to assist with site visits, but make sure they are part of your work plan.

Information from GIS exercises can also be used to strategically direct field surveys, by identifying major information gaps and communicating these gaps to local universities, other conservation groups, and resource agencies. Especially in southern Ontario where land uses can change relatively quickly, up-to-date field information is vital to complement GIS-based planning approaches. Local organizations may be able to provide a valuable service by collecting accurate field data using GPS technology in support of cooperative efforts.

Field studies allow for the gathering of missing data and can also provide new data to describe, summarize or characterize an area from a different perspective. Standard methods have been developed for inventorying birds (Ontario Breeding Bird Atlas), frogs (CWS) and the field classification of ecological communities (Lee *et al.* 1998).

▸ CASE STUDY

A Blueprint for Action: The Thames Talbot Land Trust

As the Thames Talbot Land Trust (TTLT) was being formed to help protect natural habitats in the Middlesex-Elgin County area of southwestern Ontario, it developed a *Blueprint for Action* to assist in planning its activities. This project was sponsored by the McIlwraith Field Naturalists of London in 2001. It was funded by the Ontario Trillium Foundation, and based largely on mapping and analysis for the Carolinian region provided by *The Big Picture* project.

The Big Picture goals envision a future rural landscape with at least 30 percent natural cover, core natural areas of at least 200 hectares that represent the diversity of each ecodistrict, upland and wetland components approximating pre-settlement proportions, and connections at least 200 metres wide linking the core natural areas (Jalava *et al.* 2000).

The TTLT project examined in more detail the core areas and connections identified within its region by *The Big Picture*, and documented the degree of protection already provided by existing agencies and programs. Among the 267 significant natural areas identified within their region, 73 sites were protected by the province, a Conservation Authority or a non-government organization. Another 66 sites were protected in part by municipal Official Plan designations. The remaining one-third of natural areas were considered potential priority areas to be addressed by TTLT.

Through this analysis, three sites were identified as a strategic focus for the land trust – the Catfish, Kettle and Talbot Creek core areas that lie within adjacent valleys close to the Lake Erie shoreline. As well, the Dingman Creek corridor was identified as an

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Thames Talbot conservation easement

alternative key focus area, since this corridor forms a band between two significant core areas; much of the corridor lies within the City of London and is experiencing significant development pressures.

The TTLT was able to use this *Blueprint for Action* to subsequently develop a landowner-contact program within the Dingman Creek corridor, in partnership with the Upper Thames River Conservation Authority. With funding from Environment Canada (EcoAction Program), TTLT completed seven tree planting and naturalization projects on private lands by school groups and contracted services to enhance the natural heritage system of the Dingman Creek corridor. The TTLT is presently in discussions with several landowners within the Dingman Creek corridor regarding long-term conservation options for their lands. Options under consideration include donations of title or of conservation easements.

3.2 Selecting Potential Conservation Targets

A key, and perhaps the most critical, step in developing an effective nature reserve program is to develop a list of priority species, communities and ecological systems of interest for each region. These become conservation targets that play a major role in influencing the selection and design of conservation sites where nature reserves will be created.

As outlined above, a good starting point for regional conservation targets are those that have already been identified in a broader scale conservation plan (e.g., Great Lakes Conservation Blueprint; a Species at Risk Recovery Plan; an IBA Conservation Plan; a regional inventory such as the Georgian Bay inventory). Regional or local priorities can then be added, based on several factors.

The following table presents several categories of potential targets that are typically included within protected-areas systems – all of these might be included in a relatively broad system, or an organization may choose to focus on a short list of more specific targets.

Table 7: Types of Potential Conservation Targets

TYPES OF TARGETS	SPECIFIC ELEMENTS
Rare or distinctive species and communities	Lists of globally-rare (G1 to G3) and provincially-rare (S1 to S3) species and ecological communities (based on ELC community types) which occur in a region (can be obtained from NHIC); species on the IUCN Red List; nationally endangered, threatened or of special concern species as assessed by COSEWIC; provincially endangered, threatened or species of special concern listed by COSSARO. Within the category of distinctiveness or rarity are also disjunct and peripheral populations. These species and communities are more likely to be genetically distinct than the main portion of the population. Endemic species, which occur within a limited area, are also of high conservation concern. These species have been identified in the Great Lakes region by NCC and NHIC.
High quality representation	OMNR Life Science and Earth Science ANSI reports for site districts identify landform/vegetation types characteristic of that region that are represented in various ANSIs, as well as gaps in representation. Areas that include ecological communities or ecosystems of exceptional quality serve as important reference sites for ecological functions and interrelationships. Exceptional areas could include community types that are common, but have outstanding attributes such as old growth forests. Likewise, Parks Canada selects national park sites representative of ecoregions. Sites with a very high diversity of one particular taxon (such as breeding birds or reptiles) can also be considered a priority. Often the diversity of this one group is responding to a diversity of habitats, or to a high degree of landscape heterogeneity, such as wet and dry habitats intermixed in complex patterns.

TYPES OF TARGETS	SPECIFIC ELEMENTS
Other areas of regional significance	A number of other elements may be identified as significant at the local or regional level. These include wildlife concentration or aggregation areas (e.g., heronries, deer-wintering areas, amphibian-breeding ponds); keystone species, wide-ranging species and umbrella species; wildland areas with minimal human disturbance; specialized wildlife habitats; animal movement corridors; or habitats for regionally-rare species. Many of these sites may have been identified through previous studies of ESAs, or they may have been documented by OMNR, Conservation Authorities, or naturalist clubs. The province has prepared Technical Guidelines for identifying Significant Wildlife Habitat (OMNR 2000) that provides comprehensive information on finding provincial and local information on wildlife habitats.
Ecological functions	Some areas carry out ecological functions that help to sustain the broader landscape. For example, riparian zones along the shorelines of lakes and stream valleys play an important role in protecting water quality and habitat links. Groundwater recharge areas also perform a vital ecological function. Mapping of both of these features may be available from Conservation Authorities. In recent years, many planning documents have recognized the importance of habitat cores and corridors in protecting the healthy functioning of regional ecosystems. While many of these areas will be covered in other categories, the primary importance of some sites may be their role in providing linkages among other natural areas.

Considering all of these categories can result in a long list of potential conservation targets for a planning region, which may appear confusing or overwhelming. Several principles can help begin the process of identifying priorities within that list.

Key Principle:

Begin at the community and landscape level (coarse-filter targets) in setting conservation targets.

Where possible, conservation goals should try to nest important species within the community type that they occur. For example, instead of listing every provincial species of conservation concern from a prairie as a priority, the tallgrass prairie community should be the priority. Individual species should only be identified as a priority when they have specific requirements or face particular threats that may not be met by the conservation or management of the related community. Certain provincially or federally listed species at risk may require such individual treatment. For example, while Wood Turtles may be effectively conserved by protecting riparian forests, specific management may be required to prevent illegal collecting.

▸ CASE STUDY

Alvar Ecosystems Recovery Strategy

Alvars are naturally open ecosystems found on shallow soils over relatively flat, glaciated limestone bedrock, with less than 60 percent tree canopy cover (Reschke *et al.* 1999, Brownell and Riley 2000). Alvar communities occur in clusters across the Great Lakes basin, including concentrations of high-quality sites on the Bruce Peninsula and Manitoulin Island regions. The alvars of these regions are internationally recognized for their rarity, their distinct ecological character, and because they are home to an exceptional variety of globally and provincially-rare vegetation community types and species, including species listed by COSEWIC and COSSARO. Seven distinct alvar community types occur in these regions. As well, 19 vascular plant species, three species of lichens and mosses, four species of reptiles, at least nine species of insects and 11 molluscs found on these alvars are globally or provincially-rare. However, these alvar habitats and the associated species are increasingly threatened by a variety of human activities.

To ensure the continued survival of species at risk that are present, the Bruce Peninsula-Manitoulin Island Alvar Ecosystem Recovery Team (RT) was formed in 2004, with the overall objective of developing an ecosystem-based recovery strategy for their globally significant habitats (Jalava and Jones 2005). This ecosystem approach recognizes the links between species, communities, and the biophysical processes that support them. Three species that are almost entirely dependent on alvar habitats (Gattinger's Agalinis, Houghton's Goldenrod and Lakeside Daisy) are being addressed as part of the draft Strategy approach, with two other threatened species to be addressed at a later point. Dextrase *et al.* (2003) list the following benefits of an ecosystem approach:

- Recovery actions are selected that benefit several species at risk (including species of special concern, which are not normally addressed in recovery strategies).
- Implementation is generally more cost-effective than for a single-species approach.
- It addresses issues of scale.
- It targets mitigation and rehabilitation of impacts, and it restores ecosystem health to prevent the decline of other native species.
- It ensures that actions taken to benefit individual species do not negatively impact on other species at risk in the area.

Similar ecosystem-based approaches have been developed for a few other specialized community types, such as Tallgrass Prairies and Carolinian Woodlands in Ontario, and this shift from species-based to ecosystem-based recovery plans is expected to continue in future.

G.Bryan

Lakeside Daisy

Key Principle:

Give highest priority to species, communities, and features that are globally at risk.

Areas that contain one or more rare or unique species should be given higher priority over areas charac-terized by common and widespread species. Many species, such as coyotes, thrive in the landscapes that humans create, and do not need special conservation considerations. Common species and habitats, having demonstrated they may be able to co-exist in modified environments, also have a lower urgency.

Species in danger of extinction, extirpation or where significant decline has been documented throughout their range or within a region should be considered a priority. Vegetation communities with limited distribution that are threatened with destruction should also be given priority. These habitat types may contain species, particularly invertebrates, that are also rare and threatened, but have not yet been documented.

Priority should be given to species of global conservation concern, which are irreplaceable, versus locally-rare species which may be well protected elsewhere.

Key Principle:

In landscapes with little inventory information, make use of indicators of special biodiversity values, including unique landscape features, an exceptionally-high richness of species, and a high diversity of ecological systems including landscape ecotones.

As outlined in Section 2.4, rare species are often associated with specialized habitats. By focussing on these habitat types, it is often possible to identify areas of interest even without detailed species inventories. A more detailed field assessment will likely be necessary when a particular project is under consideration, but not necessarily at the regional planning level.

The relative number of species occurring in a natural area can also be an important factor in its conservation value. Where this information is available, it should be compared to typical figures for the region (e.g., a typical upland woodland in the region might have 200 vascular plants; 350 species would be exceptionally rich). Another important factor to consider is the relationship of the number of species to the overall size of the site – a larger site can be expected to have more species, although this relationship becomes less relevant with very large sites.

It is often not possible to find detailed species data for individual natural areas, but as outlined in Section 2.4, areas with a diversity of landforms and associated ecological systems typically meet the habitat needs for a wide range of species. This appears to be particularly true where different kinds of landscapes come together in transition zones known as ecotones. For example, the transition zone between the limestone plains of southern Ontario and the southern edge of the Canadian Shield is characterized by marked changes in elevation, geology, and climate, a strong degree of landscape heterogeneity (complex patterns of interspersion), and an exceptional diversity of plants, breeding birds and herptiles (Alley 2003).

▸ CASE STUDY

The Land Between

One of the dominant methodologies used in Ontario to identify potential protected areas is based on representation of the range of ecological communities occurring within ecodistricts (Crins and Kor 2000). This approach has guided the selection of Earth and Life Science ANSIs across the province, as well as the OMNR selection process for protected areas under the Ontario's Living Legacy program. However, some observers have pointed out that the representation approach fails to adequately recognize and assess complex ecological transition zones (ecotones), such as the corridor along the southern edge of the Canadian Shield from Georgian Bay to the Frontenac Axis north of Kingston (Alley 2003).

This ecotone, which has been coined "The Land Between", is characterized by strong transitions in geology (from limestone plains to granite barrens), elevation and climate, as represented by plant hardiness zones. It also shows a high degree of mosaic complexity with irregular interspersions of rock and soil types, degrees of wetness, and pH differences.

This diversity in habitat conditions is reflected in a high diversity of associated species, including breeding birds, vascular plants and herptiles. The ecotone characteristics are also seen in plant and animal species, with range boundaries for both northern and southern species.

Risser (1995) notes that research over the past two decades has revealed a new dimension to ecotones:

> *They are recognized as being dynamic components of an active landscape, frequently playing significant roles in supporting high levels of biological diversity as well as primary and secondary productivity; modulating flows of water, nutrients, and materials across the landscape; providing important components of wildlife habitat; and acting as sensitive indicators of global change.*

A collaborative project to analyze the ecological values and adequacy of protective measures within The Land Between has recently been developed by The Couchiching Conservancy and the Kawartha Heritage Conservancy. This project, which is anticipated to extend over three years, is intended to document the special nature of this ecotone, raise agency and public awareness of its values, and encourage additional protection initiatives where needed.

Figure 9: The Land Between – Granite Barrens and Limestone Plains

> **Key Principle:**
>
> Include habitats and species with a high frequency of good-quality sites within the planning region, especially for groupings of species of conservation concern.

Eric Dresser

Particular emphasis should be placed on groups of species and habitat types for which a region has a high jurisdictional responsibility (i.e., a relatively high frequency of good-quality sites), and major groupings of species that share common natural processes or have similar conservation requirements. Examples could include birds dependent on upland forest interiors, large patches of grasslands or large marshlands. Lists of priority breeding bird species for each region can be obtained from Bird Studies Canada. Data for other species is less complete, but some information is available from NHIC for reptiles/amphibians or other groups of species.

3.3 Evaluating the Priority of Potential Targets

Through the previous series of steps, a wide range of species and communities have been identified which have the potential to become conservation targets for a region. But not all of these potential targets are equally urgent. Some are already being effectively addressed by others. Some may be facing a low level of immediate threat. Some may have low long-term viability.

On the other hand, some are not being addressed by current programs, are actively threatened, and offer good prospects for future viability. Winnowing out these priority elements can form the core of a strategic approach to protecting biodiversity in the region. Several steps, as outlined below, can assist in this process.

Eric Dresser

3.3.1 Assessing the Viability of Conservation Targets

Nature reserves can be used to protect, maintain and enhance the viability (long-term health of occurrences or populations) of conservation targets. While in many cases targets and their significance are well identified, the viability of these features is rarely determined in a coherent manner. Viability assessment is essential for good decision making and refining conservation goals. This step, in combination with information on threats and existing conservation lands, can help determine the best sites for conservation actions. For example, sites with high viability occurrences of a species or community can be given priority for protection over sites with poor quality examples.

Three factors have been identified to assess and compare the viability of species and communities – site condition, size, and landscape context (NatureServe 2005). Each of these factors can be rated on a scale of A to D to determine overall viability of a particular species or community. In some cases, the overall viability of a particular species or community may have already been determined by the NHIC or criteria to assess viability may have been determined (see NatureServe, Section 2.2).

SITE CONDITION

The ranking of site conditions is based on an assessment of the degree of human disturbance and its impact on the quality and integrity of the site. An A-ranked site would have little evidence of disturbance, with a good diversity of characteristic plant and animal species. B-ranked sites may have some evidence of disturbance (such as ruts, grazing, fences, logging) but little apparent impact on the overall composition of the natural community. C-ranked sites have substantial evidence of human disturbance, resulting in impacts such as the invasion of exotic species or reduction in natural diversity or abundance. D-ranked sites are so severely degraded that restoration would not be feasible.

SIZE

Size rankings will vary considerably depending on the characteristics of the species or natural community involved. For example, some species of forest, wetland or grassland birds require large patches of suitable habitat for nesting success. Species recovery plans or experts in particular fields may need to be consulted to determine whether there are specific size thresholds that need to be considered.

In general, large natural areas will have greater viability than smaller areas. To assess potential target areas for woodlands, for example, one could look at the range of sizes that occur in the region, and come up with classes corresponding to size rankings within that range. (Refer to *How Much Habitat is Enough?* [Environment Canada, 2004] for forest size guidelines in southern Ontario) Woodlots larger than 100 ha (assuming there are relatively few this large) might be classed as A-ranked; from 50 to 99 ha as B-ranked; two to 49 ha as C-ranked; and anything below two ha as D-ranked.

LANDSCAPE CONTEXT

Natural areas are greatly affected by land uses in the adjacent landscape. A site that is surrounded by a mosaic of intact natural landscapes would receive an A-rank for this criterion. If the landscape surrounding the site is partially disturbed but still provides good connections to other natural areas, it receives a B-rank. Sites with surrounding landscapes that are fragmented with a mix of urban, agricultural or industrial uses along with some patches of natural habitat would be C-ranked. Finally, isolated sites completely surrounded by intensive agriculture, residential or commercial uses would receive a D-rank for landscape context.

Key Principle:

Assess the viability of potential target sites based on size, condition, and character of the surrounding landscape to identify the best prospects for conservation action.

Even in the absence of existing viability information, this evaluation of condition, size, and context can be especially useful to compare multiple sites for each conservation target. Often information in the literature can be used to generate general preliminary guidelines for the conservation targets (i.e., how big does the forest need to be?). By comparing the three site ranks, the best prospects can be identified to create a suite of sites that are likely to be viable (generally those that have A or B ranks in all three categories).

Ranking Natural Areas

Figure 10: Landscape context – A

Figure 11: Landscape context – B

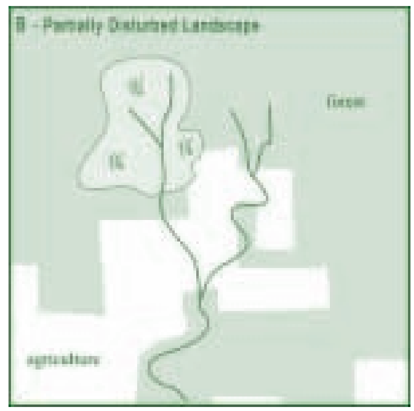


Figure 12: Landscape context – C

Figure 13: Landscape context – D

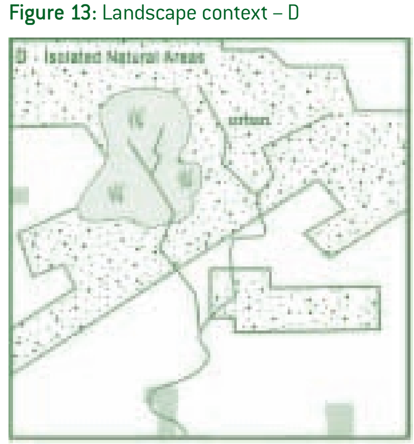


Table 8 provides an example of very detailed viability specifications that were developed as part of the International Alvar Conservation Initiative (Reschke *et al.* 1999) to guide the assessment of alvar habitats across the Great Lakes basin. For many types of conservation targets, a less comprehensive viability assessment may be sufficient.

Table 8: Example of Viability Assessment for Juniper alvar shrubland

CONDITION SPECS
A - rated condition: shrubland has minimal human disturbance evident with few or no ruts or vehicle tracks, no barbed wire fences, no artificial berms, no structures, and no evidence of plant harvesting (e.g., digging up stunted trees, shrubs, or wildflowers for cultivation, or cutting trees for fence posts). The shrubland has no more than trace amounts of exotic species; and there is little or no evidence of past grazing or deer browsing. Diversity of the invertebrate fauna has not been reduced by pesticide spraying. Fires may have occurred, but they are infrequent. There have been no alterations to soil cover or drainage that would ameliorate (e.g., contribute additional moisture to) the characteristic mid-summer drought conditions.
B - rated condition: there may be some evidence of human disturbance, such as ruts, berms, cut stumps, barbed-wire fences, or some light trampling, past grazing, or deer browsing; but the disturbance has had little apparent impact on overall composition of the community. The shrubland is predominantly native species. Characteristic invertebrate fauna are present. There have been minimal alterations to soil cover or drainage that would ameliorate the characteristic mid-summer drought conditions.
C - rated condition: there is substantial evidence of human disturbance, and the disturbance has resulted in the reduction in the abundance or diversity of characteristic native plants, establishment of exotic plants, or reduction in the diversity of characteristic invertebrate fauna. There may have been some alterations to soil cover or drainage that would ameliorate (e.g., contribute additional moisture to) the characteristic mid-summer drought conditions. There is substantial evidence of past grazing or heavy deer browsing; exotics may be common to widespread. Abundances of native species have been reduced, but native species are persistent and restoration would be feasible with appropriate management techniques.
D - rated condition: severely degraded by trampling, clearing, plant harvesting, grazing, severe deer browsing, creation of berms, or removal of rocks and/or soil; exotics may be abundant to dominant. The community is so severely disturbed that restoration would not be feasible.
Justification for A - rated criteria: The soil moisture regime characterized by severe summer drought (usually in late July or August) is a key ecological process that seems to maintain the shrubland vegetation and may prevent the establishment of most trees. Disturbances from trampling or moving the shallow soils may alter surface flow hydrology, altering the natural drainage and drought regime.
Justification for C/D threshold: Native herb composition is severely altered and unlikely to replace exotics, even with careful management.
SIZE SPECS
A - rated size: over 125 acres (50 + ha)
B - rated size: 25 to 125 acres (10 to 50 ha)
C - rated size: 5 to 25 acres (2 to 10 ha)
D - rated size: less than 5 acres (< 2 ha)
Justification for A - rated criteria: Few occurrences are larger than 125 acres (50 ha); the median size from our sites sampled with plots is 75 acres (30 ha). Stands over 125 acres are likely to have intact natural processes.
Justification for C/D threshold: Occurrences this small may have limited viability; they may succeed to a different alvar community type; small patches are best considered a habitat variation of the surrounding community type.

Table 8: Example of Viability Assessment for Juniper alvar shrubland *(continued)*

LANDSCAPE CONTEXT SPECS
A - rated landscape context: The surrounding landscape is an intact natural landscape with natural ecological communities that may include a mosaic of forests, woodlands, sparse woodlands, shrublands, grasslands, and sparsely vegetated pavements. The shrubland element occurance (EO) is completely surrounded by other viable communities with at least a 500 m to 1,000 m buffer of viable communities surrounding the shrubland EO.
B - rated landscape context: The surrounding landscape includes partially disturbed natural or semi-natural communities; some of the surrounding communities may be other viable communities, but at least some of the surrounding area does not have viable natural communities.
C - rated landscape context: The surrounding landscape is fragmented; the surrounding landscape has a mix of agricultural, residential, and/or commercial land uses along with some patches of natural or semi-natural areas.
D - rated landscape context: The surrounding landscape is primarily intensive agriculture, active commercial (e.g., quarrying operations), or residential development.
Justification for A - rated criteria: Large landscapes can sustain natural disturbance regimes such as droughty summer soil moisture regime, and infrequent natural fire regime. Large landscapes would reduce invasion of widespread exotic species that can become established in naturally disturbed soils (turned by needle-ice action) by providing a larger buffer from seed sources.
Justification for C/D threshold: Intensive use of surrounding landscape would alter natural processes beyond a point where they could be restored.

Viability also needs to be considered for the emerging nature reserve network and its effectiveness. For conservation to be effective and for resources to be efficiently allocated, nature reserve networks need to be based on both the current distribution of conservation targets and an understanding of the region's long-term ability to support these populations (Cabeza and Moilanen 2001; Caroll *et al*. 2003).

Sometimes species can persist in an area for many decades after the habitat has become unsuitable. This unsuitability could have resulted from declining condition of the habitat, reductions in size of the habitat or loss of connections to critical habitat elements or other populations. This is sometimes referred to as the "extinction debt" (Tilman *et al*. 1994) – the number of species that still exist in an area even though the habitat no longer meets their needs.

Often these species are important conservation targets, which make it important to identify if they fall into this extinction debt category. Decisions must then be made on whether conservation can save these species or if the habitat in or around the nature reserve is so degraded (or will become so) that any resources allocated to these targets would not change the result that they will eventually no longer occur in this area.

▸ CASE STUDY

Using Viability Assessment to Guide Management

Lambton Wildlife Inc. and the Nature Conservancy of Canada secured a key property on the Port Franks Forested Dunes on the shores of Lake Huron. The forested dunes community, one of the key conservation targets, consists of Black Oak Woodland and Savanna, a globally rare vegetation community.

Detailed inventories of the property included assessing the viability of this community type. Analysis of historic air photos showed that while the natural areas around the property had remained relatively stable, the size of the woodland community had declined by over 80 percent in less than 50 years as open savanna developed into a more closed canopy system dominated by Red Maple and White Ash. The study also showed that even in areas where the canopy was still dominated by Black Oak, there was virtually no oak regeneration. In addition, many of the prairie species that are characteristic of oak woodlands had become restricted to small openings in the canopy.

The viability of this community was determined to be poor – it is small and in poor condition due to a lack of recruitment of the very species that define the system and lack of savanna indicators in the understorey. Plans are underway to increase the size and open the canopy of the system through prescribed burning. While this system had developed under a regular fire regime, fires had been actively suppressed in the area for many years. By reintroducing fire back into the system, it is expected that the long-term viability of the Black Oak Woodland and Savanna can be increased.

3.3.2 Gap Analysis

Conservation priorities can be refined by completing a gap analysis – a review of conservation goals that are identified or already met through other conservation lands programs.

A gap analysis incorporates two elements, which can often be examined through the same information-gathering process:

- First, which natural areas or conservation targets in the planning region have already been identified and/or mapped by other agencies?
- Second, what degree of protection is already in place for potential targets and associated natural habitats?

For example, a species that is regulated under Ontario's *Endangered Species Act* is likely to have a greater degree of protection than a threatened species with no legislative backing. Provincial or municipal planning policies discourage some forms of destructive activities in significant wetlands or ANSIs, but these policies do not address threats such as logging, and sometimes change over time. Public ownership may provide strong protection, or in the case of County Forests and some Conservation Authority lands, forest management may take precedence.

Gap analysis can compare the level of protection afforded lands in public ownership or subject to particular policies against standards such as the IUCN protected-area categories.

The outcome of a gap analysis process is usually straightforward: the lower the level of existing protection for a potential conservation target, the higher its priority for conservation action.

Among the sources to check as part of a gap analysis:

- Municipal official plan policies and mapping relating to significant wetlands and woodlands, valleylands and shorelines, and other natural heritage features or systems. Many municipalities have natural-heritage or environmentally sensitive area inventories; some have Environmental Advisory Committees. Some municipalities (especially at the County/Regional level) own tracts of forest.
- Conservation Authorities are usually major landowners of natural habitats, and may have active land securement programs. Watershed or sub-watershed plans often define significant natural areas, and source-water protection plans will also identify key areas for protection.

> **Key Principle:**
>
> Use a gap analysis to evaluate the degree of protection already in place for conservation targets to focus efforts on species or communities of highest need.

- Crown lands managed by the Ontario Ministry of Natural Resources are a significant factor in some areas; some Crown lands will have special protective designations such as Conservation Reserve or remote access area. Federal lands are less widespread, but federal agencies such as Parks Canada and Environment Canada own significant natural habitats in some areas, and are often interested in regional conservation projects to enhance National Parks and National Wildlife Areas.
- Within Areas of Concern formally designated along the Great Lakes coast, multi-agency teams have prepared Remedial Action Plans which include habitat components. Other special policy areas, such as the Oak Ridges Moraine and Niagara Escarpment, have conservation-based plans that identify priorities for protection.
- Canadian Wildlife Service and Ontario Ministry of Natural Resources staff, together with partners, are involved in producing Recovery Plans for many species at risk.
- Other non-government organizations are involved in a wide range of conservation projects, and are often receptive to working with local partners. These organizations include the Nature Conservancy of Canada, Ontario Nature, and Ducks Unlimited Canada, often working with local nature clubs, land trusts, and rod and gun clubs.

Partnering for Protection

Contact with other agencies and organizations is not simply an exercise in gathering data – it can also lead to opportunities for partnership on future conservation projects. Much of the strength of land trusts lies in their flexibility and their ability to work creatively with others to achieve common goals. In some cases, reaching out to neighbouring land trusts will strengthen an ability to attract grants; partnering local land trusts with provincial or national conservation organizations can be a powerful combination. Most successful land trusts have good relationships with municipalities, Conservation Authorities and Ministries, and look for creative partnerships whenever these would be advantageous.

3.3.3 Assessing Future Threats

To protect natural habitats for the long-term, it is vital to consider how these landscapes are changing over time, which changes may threaten or benefit natural areas and biodiversity, and what the areas surrounding nature reserves might look like in several decades or more.

Official plans and other planning documents for municipalities usually include population projections, policies to direct development in certain ways, and maps showing general patterns of future land use. Other planning documents such as Ontario's Smart Growth panel reports and recent growth plans and projections provide indications of probable future trends (e.g., Central Ontario Region Smart Growth Panel 2003). Community profile information from Statistics Canada can provide information on population change and structure. Long-term planning for new infrastructure such as highways can also signal ongoing changes in land use. In some cases, industry-specific studies, such as identification of source areas for long-term aggregate supply, can be important factors.

Looking at past trends which are likely to continue into the future can also yield useful insights. Trends that conservation organizations have used include assessing whether woodland area has declined rapidly, stabilized, or increased, noting if sizes of individual natural areas have become smaller through fragmentation, and monitoring if farm practices have changed, leading to a loss of grassland or pasture habitats. Information on trends over time will likely be spotty and incomplete, but municipal staff, conservation organizations, provincial agency staff, or universities may be aware of studies or data that can be useful.

Identification of three or four key trends that are having significant effects on natural habitats in a region can focus attention on certain parts of the landscape. In cottage country, for instance, almost any shoreline on a major lake is highly vulnerable. The completion of a new highway corridor may increase pressures for rural housing in attractive wooded landscapes.

Key Principle:

When identifying conservation priorities, consider underlying socio-economic factors impacting the landscape and how those factors will influence the rate and type of landscape changes.

This analysis of landscape trends, coupled with knowledge of the distribution of biodiversity in a region, can help predict which types of natural areas or species are likely to be threatened in a region in the coming decades, and to begin assessing whether existing programs are adequate. Some landscape units may warrant special attention, so that key natural areas can be protected before development threats intensify. The value of individual sites may also be viewed differently depending on the landscape context – a small woodlot that is fated to be surrounded by urban growth may look less attractive as a reserve; a wooded valley that can provide a continuous corridor through that urban growth might become a higher priority for protection.

▸ CASE STUDY

Examining the Landscape Context Changes Conservation Priority

In 2002, the Nature Conservancy of Canada (NCC) had an opportunity to purchase a two hectare wetland area and associated uplands along the Detroit River in Essex County. Initial information looked promising. The property had important biodiversity elements: a Great Lakes coastal wetland and provincially-rare species. There was also urgency for the project, as the property was owned by a developer who was willing to sell at full market value. This combination seemed to have the elements of a good project – important values and a significant threat.

Further investigation revealed that the property did contain good quality coastal wetland and an upland area of fill material. All of the conservation targets occurring on the site were associated with the wetland, which was identified as provincially significant in the local Official Plan, a land-use designation that had a strict policy of no development. Given that the wetland was an emergent and free-floating marsh, there was little threat of any other impacts.

In addition, adjacent to the property over 400 hectares of the same habitat type was under conservation ownership and/or management with no-development zoning. Was the addition of five acres going to have a significant impact on conservation? After considering the potential threats and benefits, NCC decided not to purchase the property. While limited development may occur on the uplands, NCC considered that existing zoning and protected lands provide sufficient protection for the conservation targets.

Landscape changes

OMNR

Lynde Creek, 1954

OMNR

Lynde Creek, 2002

3.3.4 Threats, Vulnerability, and Urgency

Without knowing how individual species and ecosystems are threatened, credible priorities for action and effective strategies cannot be developed. The endangerment or vulnerability of a particular conservation target is also a key decision tool for setting conservation priorities (Margules and Pressey 2000). For example, establishing nature reserves to protect Butternut would be completely ineffective, since this species is threatened by a disease that spreads throughout forest areas with no regard for reserve boundaries.

Threats are the destruction or impairment of conservation targets resulting indirectly or directly from human causes. For conservation planning purposes, natural disturbances are not considered threats (although their absence from the landscape could be). The degree and nature of current and anticipated threats to conservation targets will assist in defining regional priorities.

Conceptually, it can be useful to divide threats into two key components (The Nature Conservancy 2004):

Stresses: *How is the viability of the conservation target being negatively effected?*

Sources: *What is causing the stress?*

For a tallgrass prairie ecosystem, the viability may be stressed by the growth of shrubs, which shade out the target species and communities. The source of this stress may be fire suppression. It is important to consider the threats for each conservation target, and identify how that threat specifically impacts, or could potentially impact, the viability of the conservation target. Creating a matrix of targets and threats can be a useful tool to identify important threats.

The relative importance of the stresses is a function of the severity and scope of the impact. Severity is the level of damage that the stress will likely cause to the conservation targets within the next 10 years. Scope is the distribution of the stresses (i.e., impacting the conservation targets over their entire distribution or in just one location).

Another useful strategy in evaluating threats is to consider two categories of urgency – securement urgency and management urgency. For example, a high-ranking site which is currently listed for sale or has been zoned for aggregate extraction could receive a very high securement urgency rating. On the other hand, it would be less urgent to secure sites with most of their area in protective ownership, or in remote areas with little development pressure.

Key Principle:

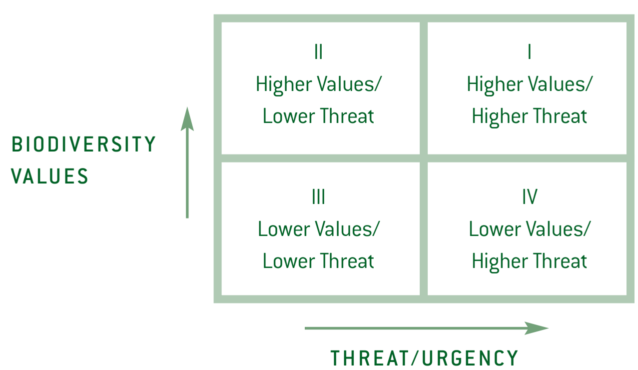
Consider the effectiveness of nature reserves in countering threats, the urgency for action, and irreplaceability.

Management urgency relates to threats that are independent of who owns the land, such as invasion of exotic species or abuse by all-terrain vehicles. Depending on the scope, severity and immediacy of the threat, these sites could be ranked from very high to low management urgency.

An important factor in assessing the importance of various types of threats is their potential effects on the overall conservation status of the community or species involved. Assess if the same conservation values could be protected on another site, or is this particular area "irreplaceable" – in effect, one-of-a-kind. Balancing the threat faced by an area with its irreplaceability is an important tool for setting priorities.

Another way to manage risk when assessing threats is to assess the severity of the stress and the likelihood of the stress occurring.

Figure 14: Four Quadrats of Threat and Irreplaceability
(from Margules and Pressey 2000)



3.3.5 Setting Goals and Mapping Potential Priority Sites

For each of the conservation targets identified as priorities through this process, the next step is to map their known viable occurrences in the planning region. In reality, many of these sites will already have been identified through the process of gathering information on potential targets and assessing their viability. If provincially-significant wetlands (PSWs) are a target, for example, OMNR can provide a map of all PSWs in the region. If declining grassland birds are a target, mapping of pasture or range lands would be a key information source. If a particular rare species has been identified as a target for conservation efforts, NHIC or a species recovery team may be able to provide element occurrence information.

A useful check may be to also conduct community-based mapping. By asking local residents and/or select groups to map what they consider significant, potential new sites can be identified, additional input can be gained, and potential discrepancies or conflicts with local knowledge can be identified. For a conservation charity, effectively garnering local knowledge of and support for its priorities is key for later success in acquiring and managing lands. Community mapping or other communication tools can be seen as a "reality check" and a useful feedback mechanism.

Conservation goals can be defined for each of the selected targets, based on such factors as:

- the significance of the species or communities involved
- the number of viable sites mapped within the region
- guidelines provided by recovery teams or other studies
- the degree of on-the-ground overlap among the selected targets
- acknowledgement of natural heritage goals of the local community.

Key Principle:

Establish conservation goals to specify the number and type of nature reserves needed to protect the future of selected target communities and species.

In some cases, conservation goals may call for the protection of all viable occurrences of a particular species or community, or identify large habitat blocks with multiple values, or suggest a minimum threshold number of occurrences to be protected. Restoration of habitats or of population levels can also be part of conservation goals for a region. Recovery teams or recovery plans for species at risk are often a good source of information to assist in setting these goals; for other targets, a review of scientific literature may be necessary. In some cases, the guidelines established in *How Much Habitat is Enough?* (Environment Canada 2004) may be very helpful as well. Table 9 provides an example of using rarity of conservation targets according to NatureServe's Global Ranks (see Glossary) as the basis for setting conservation goals.

Table 9: Example of a framework for setting conservation goals based on target type and status
(from *The Conservation Blueprint* – see Appendix C)

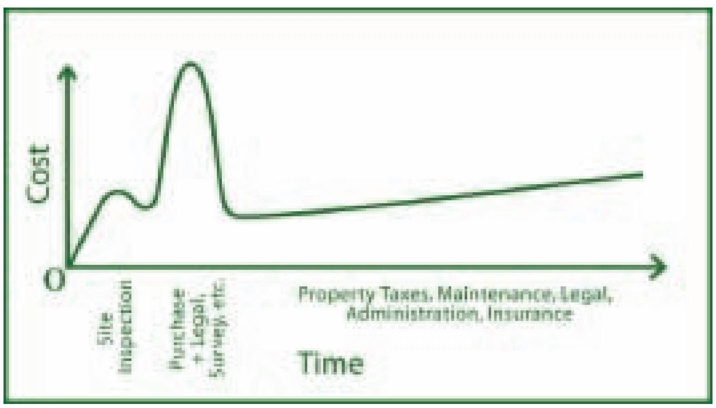
	GLOBAL RANK OF CONSERVATION TARGET			
Distribution of conservation target	**G1 - critically imperilled**	**G2 - imperilled**	**G3 - vulnerable**	**G4 - G5 - secure to abundant**
Widespread	All viable occurrences	All viable occurrences	2 per ecodistrict	secondary target
Peripheral	All viable occurrences	All viable occurrences	2 per ecodistrict	secondary target
Limited	All viable occurrences	All viable occurrences	4 per ecodistrict	secondary target
Disjunct	All viable occurrences	All viable occurrences	4 per ecodistrict	3 per planning area
Endemic	All viable occurrences	All viable occurrences	4 per ecodistrict	4 per planning area
Wide-ranging	All viable occurrences	All viable occurrences	1 per ecoregion	1 per planning area

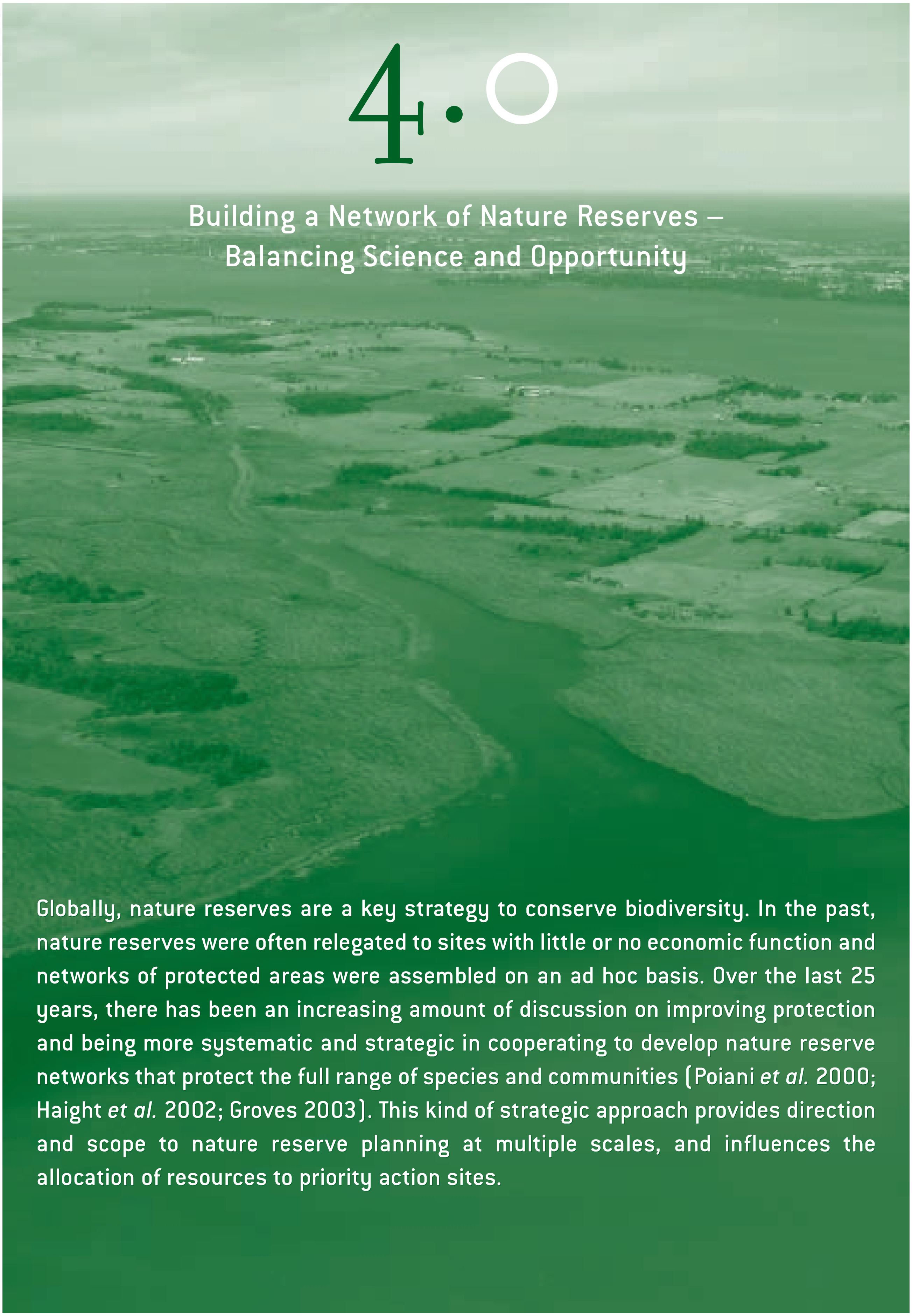
Other factors can also be considered. Identifying the ecological services (such as water quality improvement by wetlands or carbon sequestration by forests) associated with a natural area can also be important for setting achievable goals. These services are the functions performed by nature that benefit human health, commerce and well-being. Areas with high values to humans, such as deer yards or fish spawning areas, are often given a higher priority by a wider constituency. Ecological services and human values can be important leverage for protecting areas that also have high biodiversity values, as well as justification in themselves for creating protected areas. Incorporating cultural elements into goals may also be useful for building partnerships.

Lands that do not directly emerge as priorities but complement other conservation values may also be important. These properties may enhance the viability of priority sites by increasing the size of a habitat, providing a buffer to adjacent-land uses or a stepping stone between areas. In some cases, "leverage" properties are part of a portfolio. These are sites that may not directly contribute to conservation goals, but might be important for getting a larger project started. For example, a property that provided public access to a site or linked it to an existing conservation area, might be an important component of an overall project area.

One other aspect to be considered in setting conservation goals is the role and capacity of the organizations involved. The objects of incorporation of a community land trust or other organization may restrict its mandate, or a strategic planning process may have identified particular topics for priority consideration. If the organization is volunteer-based with no budget for staff, it will be difficult to successfully complete multi-million dollar land deals. An emphasis on partnerships may be a useful strategy, particularly partnerships that combine local knowledge and credibility with the greater capacity of a large organization.

Figure 15: Typical acquisition and stewardship pattern





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4.0

Building a Network of Nature Reserves – Balancing Science and Opportunity

Globally, nature reserves are a key strategy to conserve biodiversity. In the past, nature reserves were often relegated to sites with little or no economic function and networks of protected areas were assembled on an ad hoc basis. Over the last 25 years, there has been an increasing amount of discussion on improving protection and being more systematic and strategic in cooperating to develop nature reserve networks that protect the full range of species and communities (Poiani *et al.* 2000; Haight *et al.* 2002; Groves 2003). This kind of strategic approach provides direction and scope to nature reserve planning at multiple scales, and influences the allocation of resources to priority action sites.

While systematic conservation plans can provide a much-needed framework for priority setting and establish the context for individual projects, they must be used in combination with, and not as a substitute for, local knowledge and understanding of biodiversity, threats and opportunities for conservation. Conservation plans are often static, while the ecological and human context is often very dynamic, especially in threatened landscapes (Meir *et al.* 2004). Ideally, conservation planners need to design plans that identify and justify priority biodiversity values and general sites, and local conservation practitioners should use this information to recognize and design effective nature reserves.

The conservation targets and goals identified through the previous section, along with the associated mapping of potential sites, form the basis for this strategic-planning approach. However, within that framework it is almost never possible to simply start with the most significant site and work downwards through the priority list. In the real world of private land conservation projects, opportunity will always play a major role – the opportunity created when a particular property becomes available, or a funding program becomes available, or a donor comes forward. Land availability, funding, political support and local champions all play a major role in how and where lands are conserved.

Good conservation planning allows land trusts and other organizations to respond quickly and effectively to opportunities as they arise, and also to better decide which projects should not be pursued. It also encourages a more proactive approach, to focus biological inventories, landowner contact programs or other outreach activities on sites with the highest strategic value.

This section looks at factors to consider in selecting a network of sites for conservation action within a region, based on the priority conservation goals and targets already defined. Section 5 provides more detailed guidance on how to map out preferred boundaries for each individual site.

Key Principle:

Aim for a network of reserves that will capture the full range of target species and communities and be spread across the region rather than concentrated in one area.

In planning the portfolio of nature reserves, it is helpful to consider the three Rs – representation, resiliency and redundancy (Shaffer and Stein 2000) – before looking at the context and role of individual projects.

Representation

The network should contain as many examples as possible of the different species and communities from a region (this may be defined more specifically by the conservation goals). While the network should include elements that are common as well as rare, a focus should be given to priority species and communities (such as globally imperilled species), habitats that are not adequately protected in existing conservation lands, and habitats that benefit the most from conservation ownership (such as older growth forests).

Resiliency

The network needs to be made up of conservation lands that are viable, and capable of responding to anticipated natural or human stresses. This means having reasonable confidence that lands acquired as reserves will actually protect the desired conservation values in perpetuity. The resiliency can be based on the general viability of the site (how big is it, what kind of condition is it in and what's around it?) and how well it is managed for conservation.

Redundancy

The network should contain enough examples of the same habitat type that if something happens to one, other viable examples will remain.

A series of other principles can be added to this list, as follows.

Restorable

Sites with elements of biodiversity that are not viable or have a low probability of persistence should be differentiated from sites with higher levels of integrity (Groves 2003). However, some properties that have limited natural significance at present may offer excellent potential for restoration to strengthen a nature reserve network in future. For example, a small agricultural field in the centre of a tract of forest could present an ideal opportunity to restore a larger block of interior forest.

Sufficient Habitat

Another key consideration in designing a network of reserves is deciding how much habitat of various types is necessary within a landscape to ensure that its ecological functions are protected. This question has been addressed in depth in *How Much Habitat is Enough?* (Environment Canada 2004) for riparian habitats, wetlands, and forest. These habitat quantity guidelines can be useful in addressing broader landscape-level issues effecting biodiversity.

Table 10: Summary of Wetland, Riparian and Forest Habitat Restoration Guidelines
(from *How Much Habitat is Enough?* [Environment Canada])

WETLAND HABITAT GUIDELINES	
Parameter	**Guideline**
Percent wetlands in watersheds and subwatersheds	Greater than 10 percent of each major watershed in wetland habitat; greater than six percent of each subwatershed in wetland habitat; or restore to original percentage of wetlands in the watershed.
Amount of natural vegetation adjacent to the wetland	For key wetland functions and attributes, the identification and maintenance of the Critical Function Zone and its protection, along with an appropriate Protection Zone, is the primary concern. Where this is not derived from site-specific characteristics, the following are minimum guidelines: • Bog: the total catchment area • Fen: 100 m or as determined by hydrogeological study, whichever is greater • Marsh: 100 m • Swamp: 100 m
Wetland type	The only two wetland types suitable for widespread rehabilitation are marshes and swamps.
Wetland location	Wetlands can provide benefits anywhere in a watershed, but particular wetland functions can be achieved by rehabilitating wetlands in key locations, such as headwater areas for groundwater discharge and recharge, flood plains for flood attenuation, and coastal wetlands for fish production. Special attention should be paid to historic wetland locations or the site and soil conditions.
Wetland size	Wetlands of a variety of sizes, types, and hydroperiods should be maintained across a landscape. Swamps and marshes of sufficient size to support habitat heterogeneity are particularly important.
Wetland shape	As with upland forests, in order to maximize habitat opportunities for edge-intolerant species, and where the surrounding matrix is not natural habitat, swamps should be regularly shaped with minimum edge and maximum interior habitat.

RIPARIAN HABITAT GUIDELINES	
Parameter	**Guideline**
Percent of stream naturally vegetated	75 percent of stream length should be naturally vegetated.
Amount of natural vegetation adjacent to streams	Streams should have a minimum 30 m wide naturally vegetated adjacent-lands area on both sides, greater depending on site-specific conditions.
Total suspended sediments	Where and when possible suspended sediment concentrations should be below 25 milligrams/litre or be consistent with Canadian Council of Ministers of the Environment (1999) guidelines.
Percent of an urbanizing watershed that is impervious	Less than 10 percent imperviousness in an urbanizing watershed should maintain stream water quality and quantity, and preserve aquatic species density and biodiversity. An upper limit of 30 percent represents a threshold for degraded systems.
Fish communities	Watershed guidelines for fish communities can be established based on knowledge of underlying characteristics of a watershed (e.g., drainage area, surficial geology, flow regime), historic and current fish communities, and factors (and their relative magnitudes) that currently impact the system.

FOREST HABITAT GUIDELINES	
Parameter	**Guideline**
Percent forest cover	At least 30 percent of the Area of Concern (AOC) watershed should be in forest cover.
Size of largest forest patch	A watershed or other land unit should have at least one 200-ha forest patch that is a minimum 500 m in width.
Percent of watershed that is forest cover 100 m and 200 m from forest edge	The proportion of the watershed that is forest cover 100 m or further from the forest edge should be greater than 10 percent. The proportion of the watershed that is forest cover 200 m or further from the forest edge should be greater than five percent.
Forest shape	To be of maximum use to species such as forest-breeding birds that are intolerant of edge habitat, forest patches should be circular or square in shape.
Proximity to other forested patches	To be of maximum use to species such as forest-interior birds, forest patches should be within two km of one another or other supporting habitat features.
Fragmented landscapes and the role of corridors	Connectivity width will vary depending on the objectives of the project and the attributes of the nodes that will be connected. Corridors designed to facilitate species movement should be a minimum of 50 m to 100 m in width. Corridors designed to accommodate breeding habitat for specialist species need to be designed to meet the habitat requirements of those target species.
Forest quality – species composition and age structure	Watershed forest cover should be representative of the full diversity of forest types found at that latitude.

Key Principle:

Use multi-scale approaches, based on an understanding of the geographical scales at which conservation targets function, to ensure that all elements of biodiversity are sustained.

As noted in Section 2.3, various target communities and species occur in patches of different scales, and depend on ecological processes that vary greatly in scale as well. In order to maintain the full range of biodiversity in a region, conservation planning has to consider not just the relatively small areas that may be contained within nature reserves, but also the broader landscape questions of scale and amount of habitat for species that operate at a broader scale.

Good conservation planning needs to occur at multiple scales (Poiani *et al*. 2000, Noss *et al.* 1997) and to take place within a landscape context. Even in regions with large protected areas, some significant species will probably not be conserved (Grand *et al.* 2004). Fortunately, identifying and protecting species that operate at local geographic scales requires relatively simple approaches. More complex conservation planning may need to occur for the identification of wide-ranging and area-sensitive species (Carroll 2003) and large-scale disturbances.

Flexibility

The conservation of some habitat types is flexible – one parcel or another can be protected and it probably will have the same net result towards achievement of a conservation goal. If the goal of a project is to maintain connectivity between two existing nature reserves, or to protect 10 percent of the land in a watershed, there may be multiple options for achieving this goal. Other types of habitats are critical or irreplaceable for conservation, particularly when dealing with species or communities at risk. These target habitats may only exist at one site – if the property cannot be protected the conservation goals will not be met.

Where flexibility in selecting and designing sites is possible, the *Significant Wildlife Habitat Technical Guide* (OMNR, 2000) provides several guidelines on factors that should be considered:

- Habitat patches, or clusters of patches, that meet several of the habitat needs of one or more species are more valuable than patches that meet fewer habitat needs.
- Natural areas, or clusters of natural areas, that contain more than one natural heritage feature or area (such as woodland, wetland, valleyland) may be more valuable than patches with a single natural heritage feature or area.

- Patches that contain a high diversity of species are usually more valuable than patches that contain fewer species.
- Patches that contain rare species are generally more valuable than patches without.
- Patches that are relatively unaffected by human use are more valuable than more disturbed patches.
- Patches that contain waterbodies (i.e., ponds, wetlands, streams) are generally more important than those that do not.

Planning for Entire Natural Heritage Sites

> **Key Principle:**
>
> Use natural heritage sites such as entire wetlands or forests rather than individual properties as the minimum scale for nature reserve planning.

The question of minimum scale for effective nature reserve planning also needs to be considered. Most land trusts spend their early years responding to opportunities based on specific properties – accepting the donation of a 20-hectare parcel of wetland, for example. Within a few years, an organization may have properties and conservation easements scattered across the region. Questions are likely to arise about where the land protection program is going, how to make the most of limited resources, and how to respond to new opportunities.

In most cases, the preferred future will be not a random scattering of small sites, but rather a system of key natural areas that are arranged on the landscape in such a way that they are effective in protecting biodiversity. In order to consider how current projects fit into such a long-term strategy, a fundamental change in perspective is needed to begin looking at broader sites – a whole wetland or forest, for example – rather than simply individual properties. How does that site compare with others in terms of its ecological values? Is this a natural heritage site with the potential to create a larger nature reserve over time, involving several properties? If so, what properties would be included?

Connectivity

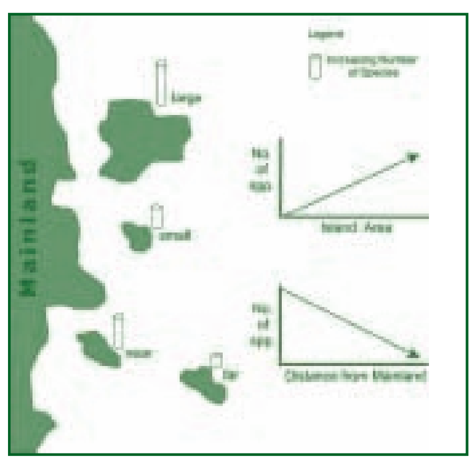
> **Key Principle:**
>
> Incorporate ways to interconnect nature reserves, since this is usually preferable to isolated sites, with the type and configuration of these connections based on the needs of target species.

Species and communities move on the landscape. Often this movement is very rapid, such as waterfowl migration – or it can occur over much longer periods as plant communities shift in response to changes in climate.

Movements can be divided into two general categories – life cycle migrations and dispersal movements. Some species need to use different habitats for different aspects of their life cycle. For example, Spring Peepers move from upland forest to vernal pools or shrubby swamps for breeding. These migrations occur on a regular basis, and disruptions can result in very rapid changes to populations.

Individuals from one population also move to other populations or to new unoccupied habitats, known as metapopulation movement. This dispersal occurs with both plants and animals. Some species disperse very quickly, such as birds and plants with wind-dispersed seeds (e.g., Common Milkweed). These species typically occupy new suitable habitats within a short period of time. Other species are not as mobile, and disperse over much longer periods of time. Within a longer time frame, ecological communities also expand and contract within the landscape in response to changes in climate and disturbance.

Figure 16: Island Biogeography



Linkages between natural areas have been the subject of much debate (Noss and Harris 1986), but are generally considered one of the best strategies for conserving biodiversity (Mann and Plummer 1995). Many studies have demonstrated that corridors do increase movements between patches and increase gene flow (Beier and Noss 1998; Mech and Hallett 2001; Haddad *et al.* 2003), thus reducing the isolation and in-breeding of populations and providing conduits for colonization after disturbance. In addition, corridors can also provide habitat for target species.

Generally the type and size of desirable linkages are determined by the conservation targets within a reserve and the state of the existing landscape. Environment Canada (Environment Canada, 2004) recommends 50 to 100 metre wide corridors with an emphasis on individual species' needs and the attributes of the nodes to be connected. For example, while large carnivores may require wide roadless corridors between reserves, woodland frogs may move between forest patches through pasture lands.

In the past, protected areas were often seen as "islands of green" (Hilts *et al.* 1986). Initial comparison of extinction rates between isolated protected areas were based on oceanic islands and led to the theory of Island Biogeography (MacArthur and Wilson 1967). This theory states that smaller and more isolated protected areas (islands) will lose more species than those that are big and well connected. However, this principle has been more recently refined with the understanding that the matrix landscape surrounding a protected area also has a major influence on rates of species loss (Newmark 1987). While the island effect may be true for some species, many readily move between natural areas, even across areas that might be seen as very inhospitable.

For the past decade in Ontario, there has been an increased emphasis on "natural heritage systems" which incorporate core conservation lands, corridors and connecting links, and countryside areas (Riley and Mohr 1994). *The Big Picture* provided the first mapping of how a natural heritage system might connect core areas with corridors, and many municipalities have identified these systems on a local level.

▸ CASE STUDY

Protecting the Headwaters of Duffins Creek

Duffins Creek, in the eastern part of the Greater Toronto Area rises from the Oak Ridges Moraine and flows southward into an increasingly urban landscape. In this part of Ontario, large blocks of forest are rare, land tends to be under pressure to be developed and properties are expensive. Small wonder that the forested lands in the upper reaches of the Duffins Creek watershed, around Glen Major, were identified as one of the highest quality landscapes in the jurisdiction of Toronto and Region Conservation Authority (TRCA).

A terrestrial natural heritage study sponsored by TRCA highlighted the importance of this natural area, since it is large enough to provide good habitat for forest birds and to have redundant habitat patches. Some lands within the area had already been purchased by TRCA, and there were other blocks of Durham Regional Forest, municipal lands, and federal lands that could contribute to a larger protected area.

TRCA has been actively working on this site to acquire other forest lands and a series of conservation easements, to knit together existing conservation lands into a larger overall site. As well, the Oak Ridges Moraine Land Trust has negotiated conservation easements on adjacent lands which contribute to the same goal.

The task of securing priority lands on this site is not complete, but its progress to date shows how a strong strategic approach can be balanced with opportunities as they arise to create a desirable outcome.

Thinking Beyond Nature Reserve Boundaries

Key Principle:

Recognize the role of good stewardship and strong public and institutional support for nature reserves and surrounding landscapes.

Nature reserves are by themselves not adequate for nature conservation, but are the cornerstones on which effective regional strategies can be built (Margules and Pressey 2000). Effective conservation requires a landscape vision beyond protected areas — a vision that includes farmlands, working forests and even urban areas. The recipe for good conservation in an area needs four key ingredients:

- The identification and protection of key areas of biological diversity and ecosystem function (the focus of this report)
- Sustainable use of land and water (e.g., good agricultural and forestry practices)

- Strong institutional support for conservation (e.g., natural heritage protection in Official Plans)
- Community support and partnerships.

The amount of each of these ingredients will vary between landscapes and between projects. In some cases, many conservation goals can be achieved by good stewardship and clear planning policy. In other situations, reserves are critical for protecting and maintaining the long-term viability of nature.

Developing and maintaining local public support for both nature reserves and associated stewardship actions on the rest of the landscape are critical elements for success. In some cases, this may mean that a land trust takes on a nature reserve project with relatively limited biodiversity values, but with high public profile and support. Such a project can demonstrate to a wide audience the relevance of a land trust to its community, and result in an increased ability to undertake other projects.

Public Benefit

Especially for charitable organizations, a clear demonstration of public benefit for conservation projects is essential. For example, a project that protects a small fragment of woodland surrounded by residential area, without public access, may benefit only the adjacent landowners unless there is some particular ecological value present that warrants special management. On the other hand, a site with a public walking trail as well as natural heritage features may be quite desirable. Most organizations will also want to avoid projects that give the perception of conflict of interest, or that may be lacking in public support.

Reality

> **Key Principle:**
>
> Recognize the role of good stewardship and strong public and institutional support for nature reserves and surrounding landscapes.

Can these lands actually be acquired and managed? In developing a network of sites for conservation action, it may become clear that some sites offer practical advantages over others. For example, one site may be broken up into multiple small ownership parcels, while a comparable site has only a few large properties. Prior development commitments may put a site financially out of reach.

Management needs, and an organization's ability to meet those needs, are also important factors in evaluating a nature reserve project, especially where certification of a donation under the Ecological Gifts Program imposes a binding responsibility and income tax liability to maintain its values.

Some nature reserves will require minimal management, but others demand a much more active approach. A site with past industrial contamination, for example, brings the responsibility for clean-up. Buildings or other structures such as bridges can quickly complicate management needs.

Some habitat types also require ongoing management. Maintaining grassland habitats, for example, will likely require active grazing (which means good fences, a suitable water supply, and overseeing leasing arrangements) or periodic burning. Taking on responsibility for a nature reserve is pointless if the management necessary to sustain the target species or communities cannot be provided. Projected stewardship costs should be determined and included in the initial project costs.

Financial feasibility is inevitably an important factor. Is funding available for immediate acquisition costs such as surveys, appraisals, and legal fees, as well as ongoing management costs? Partnerships with other organizations and funding organizations are an essential part of nature conservation; one of the benefits of a systematic approach to nature reserves is a greatly increased ability to attract the involvement of other partners.

A simple checklist of evaluation criteria developed by The Couchiching Conservancy to assist in assessing these factors for potential projects is included as Appendix B.

G. Bryan

Impacts on a Nature Reserve – Trail Erosion

G. Bryan

5.0

Designing Nature Reserves That Work

Nature reserves can protect valued species and communities by directly sheltering them from ongoing threats; by strengthening regional connectivity; and by providing access to land managers to inventory, assess and steward the land so that the viability of conservation targets is maintained. Nature reserves can also provide an opportunity to enhance community awareness, appreciation and concern about local natural heritage.

This section summarizes some general principles that can be useful for conceptualizing the design of individual nature reserves. Many of these have been touched upon in previous sections. These are simple principles but they often apply to complicated situations. Caution should be exercised in how they are applied, as every conservation project requires special consideration.

This section applies to situations where a site has been selected as an important area to be included in the conservation portfolio of nature reserves within a region. Four general design principles are presented:

1. Purpose and values
2. Overlap and efficiency
3. Size and shape
4. Buffers

5.1 Purpose and Values

It is critical to be clear about why a particular site is worthy of protection (i.e., its relationship to conservation targets). The needs of the species or communities making up these conservation targets will ultimately drive the optimal design and management of the nature reserve. Mapping the conservation needs and threats related to the selected targets, both within the core natural area and the surrounding landscape, will help draw boundaries for a viable and effective nature reserve. In effect, this process is identifying the local ecosystem that sustains the natural values within the reserve.

By looking at the distribution of target species or communities within a natural area and identifying the key areas needed for these targets to remain viable, as well as the pattern of property ownership, it should be possible to draw an approximate boundary for lands that are desirable to eventually secure in some way. Within that boundary, the timing of individual property projects will depend on opportunity (i.e., landowners willing to sell or donate), the degree of urgency for securement or management, and organizational capacity to raise the necessary funds or to enlist other partners.

If the project cannot cover the entire area needed to protect a conservation target, it is preferable to focus on the most essential habitat elements, those factors that might limit the distribution and abundance of the target. For example, while many amphibians can forage in a variety of woodland habitats, they need areas that are flooded in the spring for breeding. Regardless of the amount of woodland protected, the population will not persist if these essential breeding areas are not protected.

One useful approach which has been developed for wetland habitats is the definition of "critical function zones", which are adjacent upland habitat areas that support functions or attributes directly related to the functioning of the wetland (Environment Canada 2004).

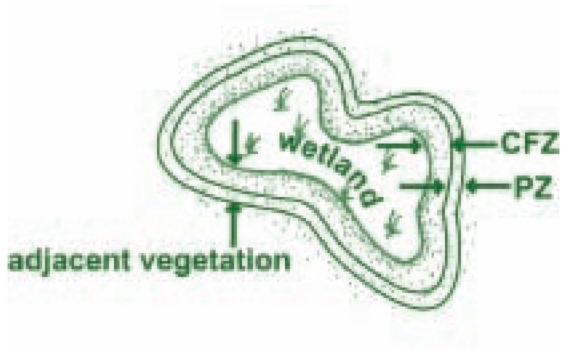
Key Principle:

Base the design of each nature reserve on a clear understanding of its purpose and the critical habitats and other habitat features that contribute to the viability of conservation targets.

For example, adjacent grassy fields used for waterfowl nesting can be critical to the success of waterfowl nesting in a marsh. Understanding the needs of the target species on a site and how those needs are expressed on the landscape throughout their life cycle, are vital factors in ensuring that a nature reserve will be adequate for long-term sustainability.

In many cases, it is not necessary or even desirable to bring all of the critical function zones into a formal nature reserve designation. Compatible land uses may provide the conditions necessary for some functions, and an assessment of the degree of protection necessary for each area can identify which ones need to be within a nature reserve boundary.

Figure 17: Critical Function Zone (CFZ) and Protection Zone (PZ)



▸ CASE STUDY

Kinghurst Forest and Petrel Point

Ontario Nature (formerly Federation of Ontario Naturalists) has been acquiring nature reserves since 1961. The circumstances around two of those reserves provide contrasting illustrations of how future viability may be affected by reserve design.

Kinghurst Forest is a spectacular old-growth forest in Grey County, totalling nearly 280 hectares (600 acres) in size. It was donated to Ontario Nature in 1998 by Howard Krug. Its management plan identifies as a conservation goal, "to maintain or increase the area of contiguous mature forest and links to adjacent natural areas", as well as goals relating to public education and good stewardship.

One of the primary conservation values of this nature reserve is its extensive area of upland hardwood forest, an ecological community that has been much reduced in southern Ontario. However, the continuity of the Kinghurst Forest is greatly affected by an area of old field habitats which extends well into the core of this forest block. To secure a better configuration for the nature reserve, Ontario Nature purchased this 37-hectare old field property, and has developed a restoration plan to eventually convert it to native forest.

A strategy of active restoration has been chosen to speed the conversion of this meadow area to deciduous forest. Some small-scale planting has taken place, and another restoration area will be modified to create pit-and-mound habitats, one of the characteristics of old-growth forests. Ontario Nature has also identified priority opportunities to further expand Kinghurst Forest and to maintain linkages to adjacent wooded areas.

In contrast, the Petrel Point Nature Reserve, which is located near the Lake Huron shore at the base of the Bruce Peninsula, totals only 21 hectares, with very limited opportunity for expansion. This site is one of the finest shoreline fens in Ontario, with a bed of wet sand overlying dolostone bedrock. In early summer, it is a garden of wildflowers, including 14 species of orchids and many other rare plants.

This ecological community is extremely fragile, since it depends on groundwater percolating through the alkaline bedrock to sustain its specialized conditions. Unfortunately, the reserve is mostly surrounded by cottage developments, and increased drainage created for those developments is thought to be creating drier than normal conditions in parts of the fen. Over time, this may affect the very character of those portions of this wetland.

Ontario Nature has taken several significant steps to protect the fen and its plant life, including purchase of additional property, installation of boardwalks to control access, and designation of parts of the property as a scientific reserve off-limits to visitors. However, the small size of the Petrel Point Reserve and its vulnerability to impacts from adjacent land uses, may well threaten its viability in the long term.

John Riley

Kinghurst Forest – old field amidst old growth forest

5.2 Overlap and Efficiency

If multiple conservation targets are involved, it may be possible to identify areas of overlap. A site that includes several targets is very likely going to be of higher interest than single-value sites. In some instances, sites adjacent to each other (e.g., a forest next to a marsh) or connected to each other by a natural linkage such as a stream corridor will take on added significance.

▸ CASE STUDY

Carden Plain Conservation Action Plan

The Carden limestone plain, located mid-way between Orillia and Lindsay, contains a complex mosaic of natural values:

- a series of alvar sites with various community types and associated species
- a concentration of breeding sites for the endangered Eastern Loggerhead Shrike
- extensive areas of grassland and shrubland habitats, with associated communities of area-sensitive and declining breeding birds
- high-quality wetland and woodland complexes

In 1998, the Carden Plain was designated an Important Bird Area of national significance, and in 2001 a committee of local naturalists and landowners, in association with several conservation groups, completed a conservation action plan (Coxon and Reid 2001). This plan specifically identified Eastern Loggerhead Shrikes as a conservation target, as well as a list of 30 grassland/shrubland species selected on the basis of meeting two or more of the following criteria: 1) identified as historical breeders on the Carden Plain; 2) known to be declining either nationally or locally; 3) known to be area-sensitive; and 4) identified as a priority species for Victoria County by Bird Studies Canada (*Carden Alvar Important Bird Area Conservation Action Plan*, Coxon and Reid 2001). As well, significant areas of wetland and alvar habitats were mapped and considered within the conservationaction plan.

Considerable field work was carried out, including habitat mapping and standardized point counts of breeding birds. Population estimates for each of the 30 target species were developed. An analysis of data from this field work resulted in mapping of high priority grassland and shrubland bird habitats, as well as formulation of goals, objectives, and priority actions to address conservation gaps.

Since the publication of the conservation action plan, the local committee has continued to be active in building local support and encouraging conservation projects. The Couchiching Conservancy, the Nature Conservancy of Canada, and other groups have undertaken several major protection projects, with one 1,200-hectare ranch now secured and another 650-hectare adjacent ranch intended for conservation purchase. Long-term planning for future conservation activity is underway among the partners involved on the Carden Plain, and the municipality is being encouraged to incorporate appropriate protective designations within its Official Plan.

Key Principle:

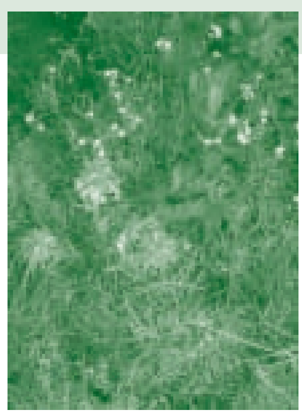
Identify sites that will protect several conservation targets on the same land base as an efficient way to protect biodiversity.


CWS

Carden Plain Alvar


© emeleg@bmts.com

Eastern Loggerhead Shrike


CWS

Carden Plain grassland species - Indian Paintbrush


CWS

Wetland and pond

5.3 Size and Shape

There has been much debate among conservation scientists on how large nature reserves need to be. This debate includes discussion about whether it is better to have nature reserve networks that are dominated by a single large protected area that maximizes representation or by many smaller sites. This single-large or several-small (a.k.a. SLOSS) debate (Soulé and Simberloff 1986; Noss and Cooperrider 1994) does not provide much utility for most real-life conservation situations. In areas with fragmented and threatened habitats, there is rarely the luxury of making such choices.

In determining the size of an individual nature reserve, the primary concern is maintaining the long-term viability of the conservation targets. The reserve should include those key elements that are needed for the survival of the species or community. If the nature reserve is being established to protect a rare plant in a prairie, five or 10 hectares might be more than enough, but if the conservation target is a population of Pine Marten, a much larger area of land will be needed.

In general, larger sites are preferred for protecting biological diversity. Large areas are more likely to contain a greater diversity of viable species and communities, include species that are area-sensitive or have large home ranges, have intact ecological processes, and minimize edge effects (Schwartz 1999; Soulé and Terborgh 1999).

The context of the conservation targets needs to be considered within the principle of "bigger is better". Many species and communities are naturally restricted to small patches (e.g., cliffs, shorelines, seeps). As well, small reserves have been shown to be effective in maintaining some communities and species that once occurred over large areas. For example, prairie reserves in Windsor continue to support rare communities and species. In reality, a network of nature reserves is likely to contain a mix of large and small sites.

Reducing the amount of edge of targeted habitat types through restoration can be an important conservation strategy. As discussed in Section 2.5, edge habitats are generally different in composition and function than interior habitats, and typically have a higher proportion of common generalist species – species that occupy a wide variety of habitat types. Edges can reduce the overall quality of the habitat patch by allowing increased penetration of light, heat, wind, invasive plants and predators, making the patch less hospitable for more sensitive species. While some species and communities may depend on edges or linear systems, reducing edge habitat will generally increase the amount of habitat available for more conservative species.

Key Principle:

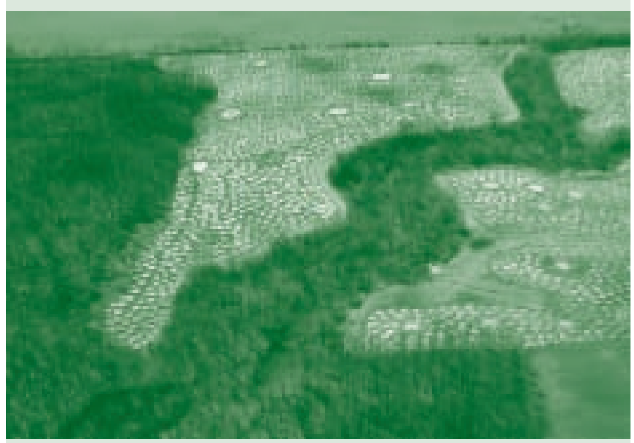
Plan for nature reserves to be sufficiently large to sustain related conservation targets for the long term; in general, larger sites with minimal edges are more effective for conservation.

Ideally nature reserve networks should include conservation lands that are more than large enough to protect all conservation values. This opportunity rarely exists. In many instances, the best that can be achieved is to protect critical habitats and look to neighbouring lands and linkages to other habitats to help protect conservation values and ecological functions.

▸ **CASE STUDY**

Clear Creek Forest

The local community, the Nature Conservancy of Canada and Ontario Parks have been working for many years to establish a nature reserve along the north shore of Lake Erie at Clear Creek. This area will be one of the largest protected forests in south-western Ontario, and includes restoration of several agricultural fields. Conservation targets from the natural area include old growth forest, riparian systems and the Eastern Fox Snake.



Bronwen Smith

Clear Creek Forest pit and mound restoration

The final land purchase for this site was not more forest or even meadow, but a 60-hectare soybean field. This land parcel was located in what will eventually be the centre of the forested reserve as adjacent plantings mature. Securing and restoring this field converts a property that currently contributes substantially to the amount of edge habitat in the nature reserve to one that will enhance the quality of surrounding forested habitats, and in time become forest interior.

5.4 Buffers and Adjacent Lands

Buffers mitigate potential negative impacts from incompatible land uses that occur adjacent to the nature reserve. The need for buffers and their design and management should be based on two factors: the needs of the conservation target, and how adjacent land use effects those needs.

Buffer lands in private hands may already be managed for conservation. Many farmers and rural property owners have done a great job in maintaining the health of species and communities. These "natural area neighbours" can be allies in conservation and may be willing to steward their lands in a way that complements the conservation goals of the protected area. The concept of a "nature reserve without boundaries" uses tools that go beyond simple land securement, including stewardship programs and public relations.

Buffers can provide overall protection to a reserve in terms of mitigating negative exterior influences but can also be specifically designed to provide protective zones around critical function zones. Consideration of the habitat needs of the target species or communities involved in the nature reserve should be a major factor in determining the type and width of buffers needed.

The need for buffers is also closely linked to the types of land use surrounding a nature reserve. In an area of low-intensity farming, minimal or no buffers may be needed. On the other hand, most urban areas (especially residential areas) subject adjacent natural areas to vandalism, roaming pets and children, pesticide drift, and a host of other stresses. Buffering is a much more important factor in these situations.

Key Principle:

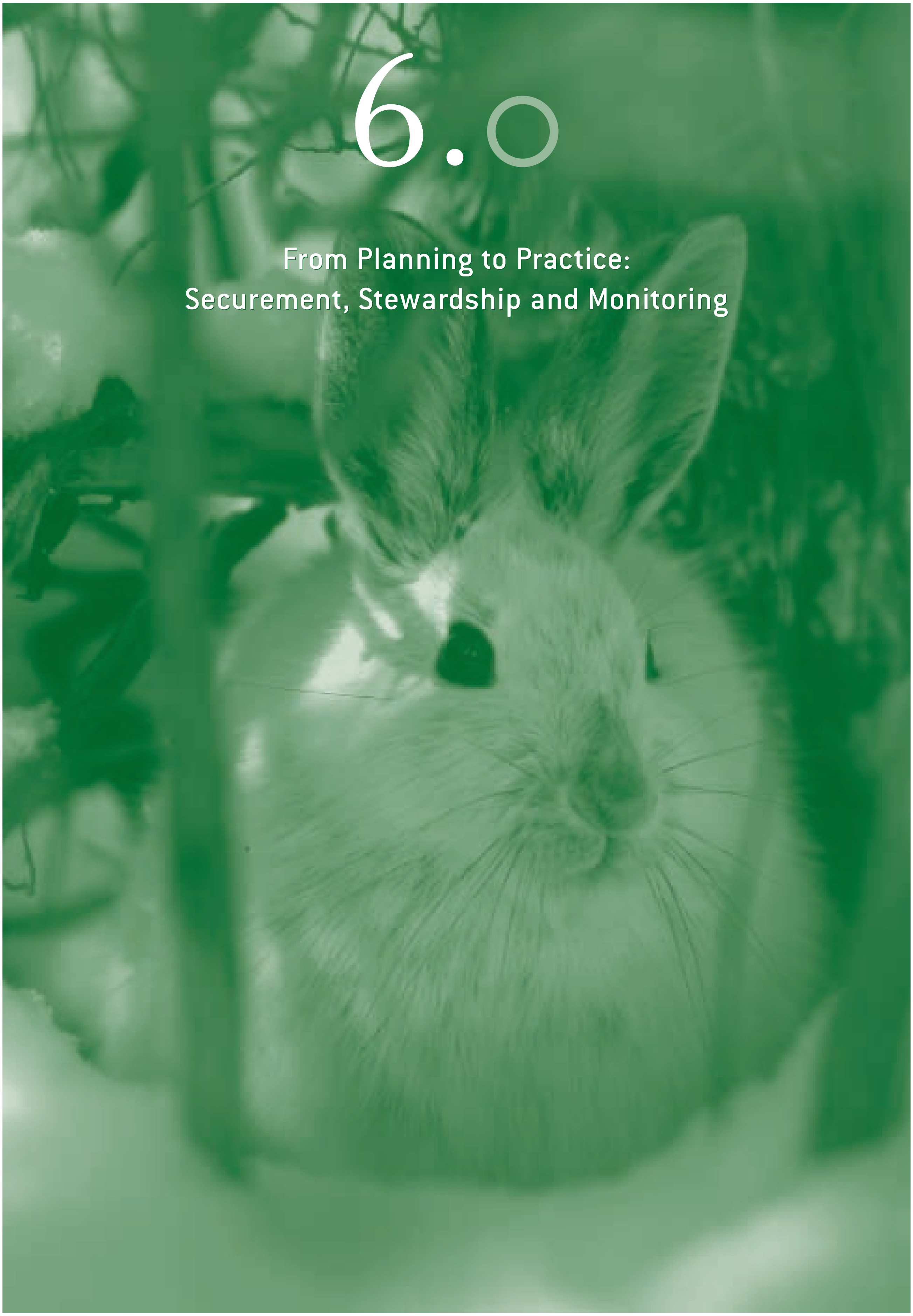
Incorporate buffers of complementary land use between reserves and adjacent lands when necessary to protect conservation values.

CWS

Shrub buffer between field and protected swamp

6.0

From Planning to Practice: Securement, Stewardship and Monitoring



Eric Dresser

6.1 Responding to Securement Opportunities

The principles in this report focus on the process of identifying and selecting the most important sites for conservation. But of course, the key step is actually securing those sites, a task which often takes years, and is not always successful.

Considerable information is available elsewhere to describe the range of securement options for natural areas, and some of the advantages and drawbacks of each option (Gonzalez 1996; Reid 2002; OMNR 2005; OLTA 2005). One trend which is clear is the increasingly significant role of non-government organizations in the land securement process in recent years (Barla *et al*. 2001).

Securement is the "tipping point" of nature conservation: the ability to provide some form of long-term protection for natural areas often determines their fate. It is also the point at which the balance between science and opportunity is most frequently played out. In the period before a land trust or other conservation organization has gone through the process outlined in this report to clearly establish its priorities, or even to some extent afterwards, responding to opportunities is likely to raise difficult issues.

The following checklist provides guidance on some of the key factors to consider when such opportunities arise. See also Appendix B for criteria to consider that go beyond ecological significance.

Table 11: 10 Questions to Ask When Someone Offers Land

1. Does acquisition of this property match well with the mandate of your organization, and serve a clear conservation purpose (e.g., target species or communities)?
2. Have any of the natural values associated with this property been identified by other conservation agencies or studies as priorities?
3. Does this property have unique features or other indicators of special diversity values?
4. Is this property an example of exceptionally high quality for its natural features?
5. What factors threaten the natural values of the property, and is your ownership likely to be effective in countering those threats?
6. Is the property likely to be viable in sustaining its natural features, or does it offer opportunities for future expansion to achieve viability?
7. Is the property connected to other habitats in the vicinity, and does that matter for the species or communities involved?
8. Are surrounding land uses compatible with protecting the site, or likely to cause future conflicts?
9. What are the long-term stewardship costs going to be?
10. What will happen if you choose not to accept the property?

6.2 Stewardship

Even after establishment in protective ownership, nature reserves are not completely immune to many threats that face biodiversity. Indeed many threats just become more subtle and complex, and they may go unchecked in the general perception that these places are "saved".

Purchase of a natural area or giving it a planning designation does not necessarily equal long-term protection. Without monitoring and stewardship, the ecological values for which lands were originally protected can be lost. A metropolitan park in Boston, Massachusetts with 338 plant species in 1894 was reduced to only 227 species when surveyed 98 years later, including the loss of 14 species previously recorded as common (Drayton and Primack 1996). Regular monitoring is needed to identify changes in nature reserves that may threaten conservation targets.

Management of nature reserves needs to be adaptive and should be focused on two primary objectives: maintaining or enhancing the viability of the conservation targets on the property or abating threats to conservation targets.

Several useful guides to sound stewardship of natural areas are available, including *A Guide to Stewardship Planning for Natural Areas* (OMNR 2003) and the Nature Conservancy of Canada's *Stewardship Manual* (NCC 2004).

G. Bryan

Stewardship activity – interpretive trail maintenance

6.3 Measuring Conservation Success

Monitoring of success should take place both at the project level and the program level. The timing and frequency of these evaluations may vary, from a simple review of individual projects once per year to a more comprehensive look at the success of the overall program perhaps every three to five years.

At the project level, relevant questions to address include:

- *Is there ongoing evidence that the target species and communities continue to be present? Are they expanding or shrinking significantly?*
- *Is an adequate amount of the natural heritage site currently protected to ensure the viability of target elements? Are there upcoming opportunities to do more?*
- *Have management or restoration actions been successful in maintaining or enhancing the site and its natural values?*
- *Are new or expanding threats occurring, and have they been adequately addressed?*
- *Are conservation, protection or management measures being successfully applied and maintained? For example, is there compliance with the terms of a conservation easement on a property within the project site?*

At the program level, the key task is measuring success at conserving biodiversity across the entire region (or in a series of sub-regions):

- *Are populations of targeted species and communities expanding or shrinking on a regional basis? Are factors causing any significant changes understood?*
- *How much of the priority lands identified as potential nature reserves has been secured? Do the original planning targets still appear valid and appropriate?*
- *How much of the priority lands are being lost to other uses? Are new region-wide threats appearing that need to be addressed?*
- *Is the program attracting a growing level of public support? Are new partners being engaged?*

It may be possible to measure progress in protecting individual conservation values by tracking viability measures. These are the key elements that are needed to keep a species or community around for the next 100 years based on an assessment of its size, condition and landscape context.

It may also be useful to examine program success in conjunction with partner organizations and other stakeholders, to gain their perspectives and suggestions. An important element of that discussion should be brainstorming about how to improve areas of the program that are not currently achieving the desired results.

▸ CASE STUDY

Area, Quality and Protection of Alvar Communities

As part of the ongoing work of the bi-national State of the Lakes Ecosystem Conference (SOLEC), a series of ecological, social, and economic indicators has been developed, some of which relate to the nearshore terrestrial area of the Great Lakes. One of 12 special lakeshore communities identified within this suite of indicators is alvar communities. Over 2/3 of known Great Lakes basin alvars occur close to the shoreline, and six alvar community types show a strong association with nearshore settings.

A SOLEC assessment (Reid and Potter 2000) identified several indicators to evaluate the status of these imperilled communities and progress in their conservation:

- 18.8 percent of nearshore alvars were classed as fully protected, 9.1 percent partly protected, 11.9 percent with limited protection, and 60.2 percent at high risk.
- The degree of fully protected acreage varied considerably by jurisdiction, with Michigan having 66 percent of its nearshore alvar acreage in that category, versus only 7 percent in Ontario.
- Protection of nearshore alvars has clearly focused on the most valuable sites, with over 30 percent of the high-quality occurrences protected (based on A and AB Element Occurrence ranks – see section 3.3.1 Assessing the Viability of Conservation Targets), while less than 5 percent of the less valuable sites (BC and C Element Occurrence ranks) were protected.
- Over the two years leading up to the assessment, 10 securement projects had protected over 2,000 hectares of alvars across the Great Lakes basin, raising the overall percentage of fully or partly protected communities from 11 percent to 28 percent.

A database of nearshore and basin-wide alvar occurrences, developed in conjunction with this assessment, provides a baseline for periodic reassessments in future.

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Glossary of Terms

The following glossary, adapted from the Nature Conservancy of Canada, is based primarily on the "Terminology of ecological land classification in Canada" (Cauboue *et al*., 1996), but several terms are specific to Ecological Land Classification in southern Ontario. Some terms have been taken from Harris *et al*. (1996), Roberge and Angelstam (2004), the Yellowstone to Yukon Conservation Initiative website (www.y2y.net/science/conservation/conbio/terminology.asp) and from the Natural Heritage Information Centre.

Alvar: Bedrock-controlled sites on more or less level expanses of limestone. There is a patchy mosaic of exposed limestone 'pavement' and scant soil which mainly accumulates in cracks or 'grykes'. There is seasonal inundation of water alternating with extreme drought in summer.

Aquatic: Living or growing in water. Referring to ecosites which are in water generally greater than 2m deep and which have less than 25 percent emergent vegetation.

Barren: Usually open sites on bedrock or unconsolidated material, such as sand, where the major limiting factor is drought. Stunted individual trees and tall shrubs may be present, but tallgrass prairie species are not.

Biodiversity: The word "biodiversity" is a contraction of "biological diversity" and is commonly used to describe the number, variety and variability of living organisms. Biodiversity is commonly defined in terms of the variability of genes, species and ecosystems, corresponding to these three fundamental and hierarchically related levels of biological organization.

Community: An assemblage of organisms that exist and interact with one another on the same site.

Community type: A group of similar vegetation stands that share common characteristics, of vegetation, structure and soils.

Conservation Data Centre: An organization or provincial or state government program dedicated to the compilation, maintenance and dissemination of biodiversity information pertinent to the jurisdiction(s) the CDC serves, following methodologies standardized across the international CDC network (Natural Heritage Network). "Natural heritage program" is another term that refers to a CDC. NatureServe is the non-profit body that links and helps coordinate CDCs worldwide.

Conservation target: Species, community, or other element selected as a focus for conservation efforts

COSEWIC: Committee on the Status of Endangered Wildlife in Canada COSEWIC is an independent body that assesses the national status of wild species, subspecies and separate populations. COSEWIC decisions are based on science and Aboriginal Traditional Knowledge. Committee members are drawn from each province and territory and four federal agencies, as well as three nonjurisdictional members, co-chairs of the Species Specialist Subcommittees, and the co-chairs of the Aboriginal Traditional Knowledge Subcommittees.

COSSARO: The Committee on the Status of Species at Risk in Ontario. The Ministry of Natural Resources (MNR) committee that evaluates the conservation status of species occurring in Ontario, and leads or cooperates in recovery work for species at risk in Ontario.

CWS: Canadian Wildlife Service

Deciduous: Refers to perennial plants from which the leaves abscise and fall off at the end of the growing season.

Deciduous forest: A plant community with a cover made up of 75 percent or more of deciduous trees.

Diversity: The richness of species within a given area. Diversity includes two distinct concepts: richness of species and evenness in the abundance of the species.

Dominant: A plant with the greatest cover and/or biomass within a plant community and represented throughout the community by large numbers of individuals. Visually more abundant than other species in the same stratum and forming greater than 10 percent ground cover, and greater than 35 percent of the vegetation cover in any one stratum.

Dune: A low hill or ridge of sand that has been sorted and deposited by wind.

Ecodistrict: A subdivision of an ecoregion based on distinct assemblages of relief, geology, landform, soils, vegetation, water and fauna. Canadian ecological land classification (ELC) system unit. Scale 1:500,000 to 1:125,000. The subdivision is based on distinct physiographic and/or geological patterns. Originally referred to as a land district. Also: ecological district.

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Ecological Community: Conservation data centres define communities as recurring assemblages of plants and animals, having a consistent composition, structure, and habitat. The community, as defined above, is generally quite similar to the ecosystem, though with much greater emphasis on living elements and their respective interconnections. Groups of biota common to a given community are understood to be functionally linked through the influences they directly or indirectly have on one another. Communities are also defined as multi-scalar. The very expansive boreal forest or tallgrass prairie could be thought of as communities, much in the same respect as the smaller group of biota living together in a backyard pond.

Biologists have attempted to narrow this concept's scope of focus by concentrating on particular types of communities. Variants include fungal, microbial, plant, animal, ecological, biotic, and natural communities amongst others. Biotic communities are multiple species groupings of biota, such as assemblages of both plants and animals. Ecological communities attribute various patterns of community distribution to underlying abiotic factors, attempting to better integrate some non-living features into their definitions. Natural communities focus on communities shaped by primarily non-human factors. Many conservation data centres collect and share information on ecological communities that are largely natural in origin.

Ecological Land Classification (ELC): The Canadian classification of lands from an ecological perspective, an approach that attempts to identify ecologically similar areas. The original system proposed by the Subcommittee on Biophysical Land Classification in 1969 included four hierarchical levels that are currently called ecoregion, ecodistrict, ecosection and ecosite. Ecoprovince and ecoelement were later added to the upper and lower levels of the hierarchy.

Ecological System: Ecological systems represent recurring groups of biological communities that are found in similar physical environments and are influenced by similar dynamic ecological processes, such as fire or flooding. They are intended to provide a classification unit that is readily mapable, often from remote imagery, and readily identifiable by conservation and resource managers in the field. Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients.

Ecology: Science that studies the living conditions of living beings and all types of interactions that take place between living beings and between living beings and their environment.

Ecoregion: An area characterized by a distinctive regional climate as expressed by vegetation. Canadian ecological land classification (ELC) system unit. Scale 1:3,000,000 to 1:1,000,000. Originally referred to as a land region. Also ecological region and biogeoclimatic zone.

Ecosystem: A complex, multi-scale unit of interacting organisms (e.g., plants, animals, fungi) and the non-living resources (e.g., water, soil) on which they depend within a particular area, at whatever size scale of the world is chosen for study.

Ecotone: The transition zone between two adjacent types of vegetation that are different.

Element: Refers to an element of biodiversity, a term used by CDCs and NatureServe to refer to the forms of biodiversity upon which CDCs and NatureServe compile information: species (including sub-species, varieties and hybrids) and natural communities.

Element Occurrence (EO): A term used by CDCs and NatureServe that refers to an occurrence of an element of biodiversity on the landscape; an area of land and/or water on/in which an element (e.g. species or ecological community) is or was present. An EO has conservation value for the element: it is a location important to the conservation of the species or community. For a species, an EO is generally the habitat occupied by a local population. What constitutes an occurrence varies among species. Breeding colonies, breeding ponds, denning sites and hibernacula are general examples of different types of animal EOs. For an ecological community, an EO may be the area containing a patch of that community type.

Endemic: Species that occur only in a limited geographic area.

Forest: A terrestrial vegetation community with at least 60 percent tree cover.

GIS or Geographic Information System: a tool that combines mapping and database storage functions that are designed to manipulate, analyze, display and interpret spatially referenced data.

GPS or Global Positioning Systems: systems of satellites and receiving devices used to compute positions on the Earth. GPS is used in navigation, and its precision supports cadastral surveying (identification of publicly recorded land parcels), as well as species occurrence and habitat boundaries.

Global Rank (GRANK): Global ranks are assigned by a consensus of the network of CDCs, scientific experts, and The Nature Conservancy to designate a rarity rank based on the range-wide status of a species, subspecies or variety. The most important factors considered in assigning global (and provincial) ranks are the total number of known, extant sites world-wide, and the degree to which they are potentially or actively threatened with destruction. Other criteria include the number of known populations considered to be securely protected, the size of the various populations, and the ability of the taxon to persist at its known sites. The taxonomic distinctness of each taxon has also been considered. Hybrids, introduced species, and taxonomically dubious species, subspecies and varieties have not been included.

G1 = critically imperilled

G2 = imperilled

G3 = vulnerable to extirpation or extinction

G4 = apparently secure

G5 = demonstrably widespread, abundant, and secure.

(NatureServe: www.natureserve.org/explorer/ranking.htm#interpret)

See also 'Provincial Rank' and 'rarity rank'.

Habitat: The place in which an animal or plant lives. The sum of environmental circumstances in the place inhabited by an organism, population or community.

Herpetofauna or Herptiles: Reptiles and amphibians.

Indicator species: Species, usually plants, used to indicate an ecological condition such as soil moisture or nutrient regime that may not be directly measured.

Inventory: The systematic survey, sampling, classification, and mapping of natural resources.

Keystone Species: A keystone species is a species whose very presence contributes to a diversity of life and whose extinction would consequently lead to the extinction of other forms of life. Keystone species help to support the ecosystem (entire community of life) of which they are a part.

Lake: A standing water body >2 ha in area.

Land type: An area of land characterized by its drainage and deposits (nature, origin, thickness, texture and stoniness).

Landform: A topographic feature. The various shapes of the land surface resulting from a variety of actions such as deposition or sedimentation, erosion and movements of the earth crust.

Landscape: A land area composed of interacting ecosystems that are repeated in similar form throughout. Landscapes can vary in size, down to a few kilometres in diameter.

Landscape ecology: A study of the structure, function and change in a heterogeneous land area composed of interacting ecosystems.

Landscape element: The basic, relatively homogenous, ecological unit, whether of natural or human origin, on land at the scale of a landscape.

Marsh: A wetland with a mineral or peat substrate inundated by nutrient rich water and characterized by emergent vegetation.

Mature: A seral (successional or developmental) stage in which a community is dominated primarily by species which are replacing themselves and are likely to remain an important component of the community if it is not disturbed again. Significant remnants of early seral stages may still be present.

Moisture regime: Refers to the available moisture supply for plant growth estimated in relative or absolute terms; classifications for moisture regimes come from the integration of several factors, including soil drainage.

Natural Area: An area identified as having significant or unique natural heritage features. For example Natural Areas listed in the Natural Areas Database may be identified by the Ontario Ministry of Natural Resources, Conservation Authorities, the International Biological Program (IBP) or by non-governmental organizations such as Ontario Nature, the Nature Conservancy of Canada or Bird Studies Canada. Natural areas include evaluated wetlands, Areas of Natural and Scientific Interest (both life science and earth science), provincial and national parks, Conservation Areas, IBP Sites and nature reserves.

Natural Areas Database: A database maintained by the Natural Heritage Information Centre (NHIC) containing information on significant and unique natural areas in Ontario. The database contains a general site description as well as information on the location of the area, its vegetation communities, features represented, condition, biological diversity and ecological functions. The database can be queried through the NHIC website.

Natural Communities: See 'Ecological Community'.

Natural Heritage: Natural heritage is all living organisms, natural areas and ecological communities which we inherit and leave to future generations.

Natural Heritage Network: The network of CDCs throughout the Americas. All network members use the same methodology and database structure to maintain information on the elements of biodiversity in their jurisdictions.

Natural Heritage Program: See 'Conservation Data Centre'.

Nature Reserve:

1. International Union for the Conservation of Nature (IUCN) protected areas category Ia: Strict Reserve: Protected area managed mainly for science.
2. Designation pertaining to areas set aside for the conservation or preservation of nature/biodiversity as defined and designated through policy or statute by appropriate nature/natural resources/environment agency in subject jurisdiction – may have varying degrees of conformity with IUCN designation, e.g., Ontario Ministry of Natural Resources: Nature Reserves are areas selected to represent the distinctive natural habitats and landforms of the province, and are protected for educational purposes and as gene pools for research to benefit present and future generations (OMNR, 1992).
3. Generally, specific tracts of land or water set aside to conserve natural features and functions through protective ownership and/or regulation.

Old field: A general term to describe early successional communities which have regenerated from abandoned agricultural land.


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Old growth: A self-perpetuating community composed primarily of late successional species which usually show uneven age distribution including large old trees without open-grown characteristics.

OMNR: Ontario Ministry of Natural Resources, also commonly cited within Ontario as MNR.

Overstory: The uppermost continuous layer of a vegetation cover; e.g., the tree canopy in a forest ecosystem or the uppermost layer of a shrub stand.

Physiographic region: Topographically similar landscapes with similar relief, structural geology and elevation at a mapping scale of 1:1,000,000 to 1:3,000,000.

Physiography: The study of the genesis and evolution of land forms.

Pioneer community: A community which has invaded disturbed or newly created sites, and represents the early stages of either primary or secondary succession.

Plant community: A concrete or real unit of vegetation or a stand of vegetation.

Polygon: A GIS feature class used to represent a homogeneous area. Examples: provinces, municipalities, lakes, land-use areas, wetlands and ecozones.

Population: Biologically, a population is a group of organisms of one species occupying a defined area and usually isolated geographically or otherwise to some degree from other similar groups.

Prairie: An area of native grassland controlled by a combination of moisture deficiency and fire. Usually containing a distinctive assemblage of species.

Provincial Rank (SRANK): Provincial (or Subnational) ranks are used by the NHIC to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario. By comparing the global and provincial ranks, the status, rarity, and the urgency of conservation, needs can be ascertained. The NHIC evaluates provincial ranks on a continual basis and produces updated lists at least annually.

S1 = critically imperilled (within province)

S2 = imperilled (within province)

S3 = vulnerable to extirpation or extinction (within province)

S4 = apparently secure (within province)

S5 = demonstrably widespread, abundant, and secure. (within province)

(NatureServe: www.natureserve.org/explorer/ranking.htm#interpret)

See also 'Global Rank' and 'Rarity Rank'.

Rare: An assessment of cover or abundance of a plant species that is represented in the area of interest by only one to a few individuals.

Rarity Rank: A G-rank (Global), N-rank (National) or S-rank (Subnational) assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global, national or sub-national level, respectively.

Remote Sensing: A method of acquiring information about an object without contacting it physically. Methods include aerial photography, radar, and satellite imaging.

Riparian: Having to do with a river. In ELC, refers to aquatic communities adjacent to or associated with a river or stream as opposed to a lake or pond.

Savanna: A treed community with 11-35 percent cover of coniferous or deciduous trees.

Site: The place or the category of places, considered from an environmental perspective, that determines the type and quality of plants that can grow there.

Site district: See 'Ecodistrict'.

Site region: A region with a relatively uniform climate. Equivalent to an ecoregion.

Species: The lowest principal unit of biological classification formally recognized as a group of organisms distinct from other groups. In sexually producing organisms, "species" is more narrowly characterized as a group of organisms that in natural conditions freely interbreed with members of the same group but not with members of other groups.

Species Diversity: Refers to the number of different species within an assemblage, ecological community, area or sample; also known as species richness.

Species at Risk: Species that are at risk of extinction, extirpation or endangerment globally or within a jurisdiction or region.

Sub-species: A taxonomically distinct subdivision of a species. A group of interbreeding natural populations differing morphologically and genetically, and often isolated geographically, from other such groups within a biological species; sub-species interbreed successfully where their ranges overlap.

Succession: The progression within a community whereby one plant species is replaced by another over time. Primary succession occurs on newly created surface while secondary succession involves the development or replacement of one stable successional species by another. Secondary succession occurs on a site after a disturbance (fire, cutting, etc.) in existing communities.

Successional series: All the plant communities that can be present on the same site through time, and that result from the combined action of climate, soil and perturbations. Depending on the type of perturbation, succession of plant communities (chronosequence) can differ.

Successional stage: Stage in a vegetation chronosequence in a given site.

Tallgrass prairie: A mesic prairie maintained by fire; containing an assemblage of large grasses such as *Androgon gerardii*, *Sorgastrum nutans* and *Panicum virgatum*, as well as a variety of other species. Tallgrass prairie species are also found in some savanna and woodland habitats.

Terrestrial: Pertaining to land as opposed to water. Specifically referring to the community where the water table is rarely or briefly above the substrate surface and there has not been the development of hydric soils.

Theme or layer: Terms often used interchangeably to define a digital dataset of a feature, or set of features that represents a single entity on a landscape. The term comes from a GIS capability to layer multiple-feature datasets occurring in the same area and visually represent them together on a map. GIS layers are defined as either point (e.g., site occurrence), line (e.g., road or stream) or polygon (e.g., watershed boundary) features on a map.

Umbrella species: A species whose conservation is expected to confer protection to a large number of naturally co-occurring species. (Roberge and Angelstam, 2004)

Vegetation: The general cover of plants growing on the landscape. The total of the plant communities of a region.

Vegetation type: An abstract vegetation classification unit, based on the species present in a site. The smallest unit in the provisional ELC in southern Ontario.

Wetland: An area of land that is saturated with water long enough to promote hydric soils or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity that are adapted to wet environments. This includes shallow waters generally less than two metres deep.

Wildlife: All wild mammals, birds, reptiles, amphibians, fishes, invertebrates, plants, fungi, algae, bacteria and other wild organisms. Often used to refer specifically to fauna.

Wildlife habitat: Habitat providing food or shelter for wildlife for a significant part of their life cycle.

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Appendix A

Disjunct and Endemic Insects and Vascular Plants from Ontario

Rankings:

1 = Critically imperilled

2 = Imperilled (within province)

3 = Vulnerable to extirpation or extinction (within province)

4 = Apparently secure (within province)

5 = Demonstrably widespread, abundant, and secure (within province)

G = Global Status

S = Provincial Status

T = Sub-species/variety rank

H = Historical record – possibly extirpated

? = Inexact or uncertain ranking

Q = Questionable taxonomy – Taxonomic distinctiveness of this entity at the current level is questionable

Scientific Name	Common Name	GRANK	SRANK	Justification
Insects				
Oarisma garita	Garita Skipperling	G5	S1	Disjunct
Chlosyne gorgone	Gorgone Crescentspot	G5	S2	Disjunct
Vascular Plants				
Osmorhiza berterii	Sweet-cicely	G5	S4	Disjunct
Osmorhiza depauperata	Blunt-fruited Sweet-cicely	G5	S4	Disjunct
Oplopanax horridus	Devil's Club	G4	S1	Disjunct
Adenocaulon bicolor	Trail-plant	G5?	S1	Disjunct
Antennaria parvifolia	Pussy-toes	G5	S1	Disjunct
Arnica cordifolia	Heartleaf Arnica	G5	S1	Disjunct
Arnica lonchophylla ssp. chionopappa	Arnica	G1G2Q	S1	Disjunct
Symphyotrichum dumosum var. strictior	Bushy Aster	G5T4	S2	Disjunct
Cirsium drummondii	Drummond's Thistle	G5	S1	Disjunct
Cirsium pitcheri	Pitcher's Thistle	G3	S2	Endemic
Senecio congestus	Marsh Ragwort	G5	S5	Disjunct
Senecio eremophilus	Desert Groundsel	G5	S1	Disjunct
Solidago hispida var. huronensis	Lake Huron Hairy Goldenrod		S3?	Endemic
Solidago houghtonii	Houghton's Goldenrod	G3	S2	Endemic
Solidago multiradiata	Alpine Goldenrod	G5	S5	Disjunct
Solidago lepida	Elegant Goldenrod	G4	S4?	Disjunct
Solidago simplex var. gillmanii	Gillman's Goldenrod	G5T3?	S1	Endemic
Solidago simplex var. ontarioensis	Ontario Goldenrod	G5T3?	S3?	Endemic
Tanacetum bipinnatum ssp. huronense	St John Tansy	G5T4T5	S4	Disjunct
Taraxacum ceratophorum	Horned Dandelion	G5	S5	Disjunct
Hymenoxys herbacea	Lakeside Daisy	G2	S2	Endemic
Erigeron lonchophyllus	Short-ray Fleabane	G5	S4?	Disjunct
Arabis holboellii	Holboell Rock-cress	G5	S4?	Disjunct
Cakile edentula	American Sea-rocket	G5	S4	Disjunct
Draba aurea	Golden Draba	G5	S5	Disjunct
Draba cana	Hoary Draba	G5	S4	Disjunct
Draba glabella	Rock Whitlow-grass	G4G5	S4S5	Disjunct
Opuntia fragilis	Little Prickly Pear Cactus	G4G5	S2	Disjunct

Disjunct and Endemic Insects and Vascular Plants from Ontario *(continued)*

Scientific Name	Common Name	GRANK	SRANK	Justification
Arenaria humifusa	Low Sandwort	G4	S2S3	Disjunct
Cerastium alpinum	Alpine Mouse-ear Chickweed	G5?	S3?	Disjunct
Moehringia macrophylla	Large-leaved Sandwort	G4	S2	Disjunct
Sagina nodosa	Knotted Pearlwort	G5	S4S5	Disjunct
Silene acaulis	Moss Campion	G5	S1	Disjunct
Lechea pulchella	Pinweed	G5	S1	Disjunct
Triosteum angustifolium	Yellowleaf Tinker's-weed	G5	S1	Disjunct
Empetrum nigrum	Black Crowberry	G5	S5	Disjunct
Vaccinium membranaceum	Mountain Bilberry	G5Q	S1	Disjunct
Vaccinium ovalifolium	Blue Bilberry	G5	S2	Disjunct
Chamaesyce polygonifolia	Seaside Spurge	G5?	S4	Disjunct
Astragalus adsurgens	Rattle Milk-vetch	G5	SH	Disjunct
Astragalus alpinus	Alpine Milk-vetch	G5	S5	Disjunct
Hedysarum alpinum	Alpine Sweet-vetch	G5	S4S5	Disjunct
Oxytropis splendens	Showy Oxytrope	G5	S3	Disjunct
Oxytropis viscida var. viscida	Nuttall's Oxytrope	G5T4?	S1	Disjunct
Quercus ilicifolia	Scrub Oak	G5	S1	Disjunct
Bartonia paniculata ssp. paniculata	Branched Bartonia	G5T5	S1	Disjunct
Phacelia franklinii	Wild Heliotrope	G5	S2	Disjunct
Linum medium var. medium	Stiff Yellow Flax	G5T?	S3	Endemic
Linum striatum	Ridged Yellow Flax	G5	S1	Disjunct
Pinguicula vulgaris	Common Butterwort	G5	S5	Disjunct
Utricularia geminiscapa	Hidden-fruited Bladderwort	G4G5	S3	Disjunct
Myrica pensylvanica	Bayberry	G5	S1	Disjunct
Rhexia virginica	Virginia Meadow-beauty	G5	S3S4	Disjunct
Nymphoides cordata	Floating-heart	G5	S4?	Disjunct
Epilobium hornemannii	Hornemann's Willow-herb	G5	S1	Disjunct
Orobanche fasciculata	Broomrape	G4	S1	Disjunct
Polygonum careyi	Carey's Smartweed	G4	S3S4	Disjunct
Polygonum pensylvanicum var. eglandulosum	Lake Erie Pinkweed	G5T4Q	SH	Endemic
Polygonum viviparum	Viviparous Knotweed	G5	S5	Disjunct
Pyrola grandiflora	Arctic Wintergreen	G5	S4	Disjunct
Anemone multifida	Early Anemone	G5	S5	Disjunct
Anemone parviflora	Small-flower Anemone	G5	S5	Disjunct
Crataegus beata	A Hawthorn	G2G4Q	S1	Endemic
Crataegus douglasii	Douglas's Hawthorn	G5	S4	Disjunct
Crataegus formosa	A Hawthorn	G2G3Q	S2	Endemic
Crataegus perjucunda	Middlesex Frosted Hawthorn	G1?Q	S1?	Endemic
Dryas drummondii	Yellow Dryas	G5	S1	Disjunct
Dryas integrifolia	Entire-leaved Mountain-avens	G5	S4	Disjunct
Potentilla gracilis	Cinquefoil	G5	S2	Disjunct
Potentilla hippiana	Cinquefoil	G5	S1	Disjunct
Potentilla multifida	Cinquefoil	G5	SH	Disjunct
Potentilla paradoxa	Bushy Cinquefoil	G5	S3	Disjunct
Potentilla rivalis	Cinquefoil	G5	SH	Disjunct

Scientific Name	Common Name	GRANK	SRANK	Justification
Rubus parviflorus	A Bramble	G5	S4	Disjunct
Galium kamtschaticum	Boreal Bedstraw	G5	S2	Disjunct
Salix myrtillifolia	Myrtle-leaf Willow	G5	S5	Disjunct
Saxifraga oppositifolia	Purple Mountain Saxifrage	G4G5	S1	Disjunct
Saxifraga paniculata	White Mountain Saxifrage	G5	S4	Disjunct
Saxifraga tricuspidata	Prickly Saxifrage	G4G5	S4	Disjunct
Castilleja septentrionalis	Labrador Indian-paintbrush	G5	S5	Disjunct
Collinsia parviflora	Small-flowered Blue-eyed Mary	G5	S3	Disjunct
Euphrasia hudsoniana	Hudson Eyebright	G5?	S4?	Disjunct
Gratiola aurea	Golden Hedge-hyssop	G5	S4?	Disjunct
Mimulus moschatus	Muskflower	G4G5	S2?	Disjunct
Viola epipsila	Northern Marsh Violet	G4	S3	Disjunct
Carex atratiformis	Black Sedge	G5	S2	Disjunct
Carex glacialis	Alpine Sedge	G5	S4	Disjunct
Carex nigromarginata	Black-edged Sedge	G5	S1	Disjunct
Carex rossii	Ross' Sedge	G5	S2	Disjunct
Carex saxatilis	Russett Sedge	G5	S5	Disjunct
Carex scirpoidea ssp. convoluta	Sedge		S3?	Endemic
Carex scirpoidea ssp. scirpoidea	Sedge		S5	Disjunct
Carex supina	Sedge	G5	S1	Disjunct
Carex xerantica	White-scaled Sedge	G5	S1	Disjunct
Cyperus dentatus	Toothed Umbrella-sedge	G4	S1	Disjunct
Eleocharis equisetoides	Horsetail Spike-rush	G4	S1	Disjunct
Eleocharis geniculata	Spike-rush	G5	S1	Disjunct
Iris lacustris	Dwarf Lake Iris	G3	S3	Endemic
Juncus militaris	Bayonet Rush	G4	S3S4	Disjunct
Allium schoenoprasum var. sibiricum	Wild Chives	G5T5	S4	Disjunct
Polygonatum biflorum var. melleum	Honey-flowered Solomon-seal	G5TH	SH	Endemic
Tofieldia pusilla	Scotch False Asphodel	G5	S5	Disjunct
Cypripedium passerinum	Sparrow's-egg Lady's-slipper	G4G5	S4	Disjunct
Goodyera oblongifolia	Giant Rattlesnake-plantain	G5?	S4	Disjunct
Listera auriculata	Auricled Twayblade	G3	S3	GRANK
Listera borealis	Northern Twayblade	G4	SH	Disjunct
Piperia unalascensis	Alaskan Rein-orchid	G5	S4	Disjunct
Ammophila breviligulata	American Beachgrass	G5	S3	Disjunct
Bromus inermis ssp. pumpellianus	Pumpell's Brome Grass	G5T?	SH	Disjunct
Calamagrostis purpurascens	Purple Reed Grass	G5?	S1	Disjunct
Calamovilfa longifolia var. magna	Sand Reed Grass	G5T3T5	S3	Endemic
Panicum spretum	Panic Grass	G5	S2	Disjunct
Panicum meridionale	Panic Grass	G5	S1	Disjunct
Elymus glaucus	Blue Wild-rye	G5	S1	Disjunct
Elymus lanceolatus ssp. psammophilus	Great Lakes Wheatgrass	G5T3	S3	Endemic
Festuca occidentalis	Western Fescue	G5	S4?	Disjunct
Melica smithii	Smith Melic Grass	G4	S4?	Disjunct
Muhlenbergia richardsonis	Soft-leaf Muhly	G5	S2	Disjunct

Disjunct and Endemic Insects and Vascular Plants from Ontario *(continued)*

Scientific Name	Common Name	GRANK	SRANK	Justification
Piptochaetium avenaceum	Black Oat-grass	G5	SH	Disjunct
Poa alpina	Alpine Bluegrass	G5	S4	Disjunct
Poa glauca	White Bluegrass	G5	S4	Disjunct
Poa glauca ssp. glauca	White Bluegrass	G5T5?	S4	Disjunct
Poa secunda	Canby Bluegrass	G5	S1	Disjunct
Leymus mollis	Sea Lyme-grass	G5	S4	Disjunct
Potamogeton bicupulatus	Snail-seed Pondweed	G4?	S3S4	Disjunct
Potamogeton confervoides	Algae-like Pondweed	G4	S2	Disjunct
Potamogeton pulcher	Spotted Pondweed	G5	SH	Disjunct
Xyris difformis	Carolina Yellow-eyed-grass	G5	S3?	Disjunct
Cryptogramma acrostichoides	Mountain Parsley	G5	S2	Disjunct
Cystopteris montana	Mountain Bladder Fern	G5	S1	Disjunct
Dryopteris filix-mas	Male Fern	G5	S4	Disjunct
Polystichum lonchitis	Northern Holly-fern	G5	S4	Disjunct
Woodsia alpina	Northern Woodsia	G4	S2	Disjunct
Woodsia glabella	Smooth Woodsia	G5	S3	Disjunct
Isoetes engelmannii	Engelmann's Quillwort	G4	S1	Disjunct
Isoetes tuckermanii	Tuckerman's Quillwort	G4?	S1	Disjunct
Huperzia porophila	Rock Fir-clubmoss	G4	S1	Disjunct
Huperzia appalachiana	Appalachian Fir-clubmoss	G4G5	S3?	Disjunct
Botrychium hesperium	Western Moonwort	G3	S1	Disjunct
Botrychium campestre	Prairie Dunewort	G3	S1	Disjunct
Botrychium acuminatum	Moonwort	G1	S1	Endemic
Botrychium pseudopinnatum	Moonwort	G1	S1	Endemic
Selaginella selaginoides	Low Spike-moss	G5	S4	Disjunct
Thelypteris simulata	Bog Fern	G4G5	S1	Disjunct


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Appendix B

Criteria to Evaluate Land Protection Projects – Couchiching Conservancy

Criteria	Comments	Positive Factor	Neutral or N/A	Negative Factor
A. Ecological significance:				
Do the lands fall within a core or corridor in the Conservancy's natural heritage system mapping?				
Are the lands likely to meet the Ontario criteria for Ecogift certification?				
Do the lands offer opportunities to buffer or create connections between natural habitats?				
B. Context:				
Are the lands adjacent to existing reserves or parklands, or to County forest or Crown lands?				
Is the project area sufficiently large to warrant our involvement? (As a general guide, most properties we consider would be over 10 acres for a land donation, over 40 acres for a conservation easement, but no size limit on "trade lands" to be sold.)				
Are the lands actively threatened, or do existing municipal policies or ownership provide an effective degree of protection already?				
C. Public benefit:				
Will the project provide a clear benefit to the public, as opposed to a small group of nearby landowners or the donor only?				
Is there evidence of community support or opposition to the proposed project?				
Does the project fall within the goals and strategic objectives of the Conservancy, or would it conflict with our desired image and credibility?				
D. Management needs:				
Is there any evidence of toxic contamination, safety hazards, or other potential liabilities on the property? (See Adverse Conditions checklist)				
Are there buildings or other structures; what is their condition; are there viable options for their use/disposal?				
Will the natural features on the property be largely self-sustaining, or will they require ongoing management intervention?				
Are there existing incompatible uses (such as All Terrain Vehicle or Off Road Vehicle use) on the property, or are there neighbouring land uses that would be incompatible?				
Are local volunteers likely to be available to assist in future monitoring and management of the property?				

Criteria	Comments	Positive Factor	Neutral or N/A	Negative Factor
E. Financial feasibility:				
Have all securement options (donation, conservation easement, bargain sale, purchase) been explored to determine the most cost-effective option?				
Are funds available for immediate acquisition costs (survey, appraisal, legal, signage, etc)?				
Are stewardship funds available, or feasible to raise, for anticipated ongoing management costs (taxes, fencing, monitoring, etc)?				
Is there a potential for partnerships to share the costs of the project?				
Are lands jointly held or under some form of ownership dispute which could complicate legal transfer?				

Developed Sept 2004

Note: These criteria are not intended for application or acceptance of "trade lands" to be sold to generate revenue.

Appendix C

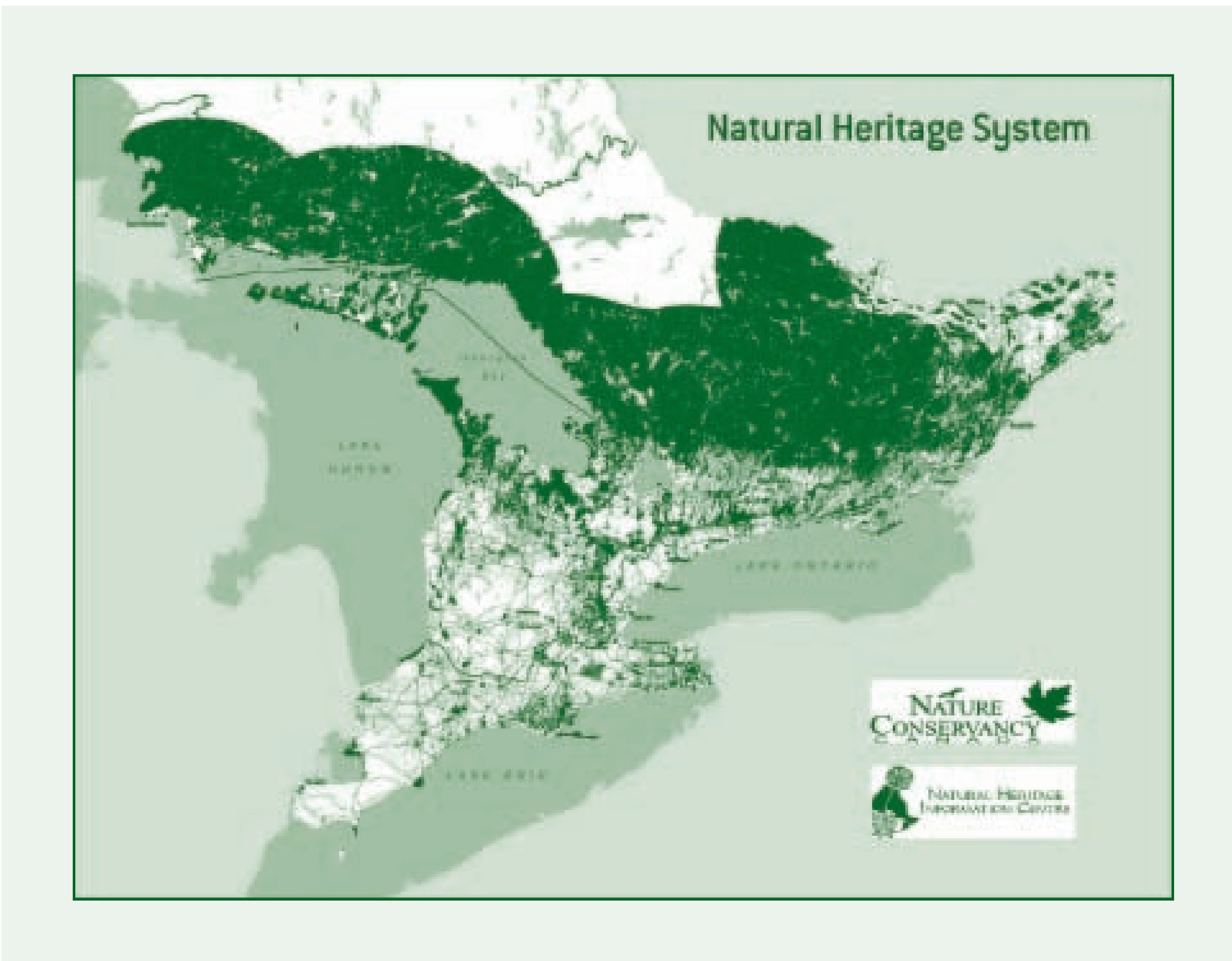
The Big Picture and The Great Lakes Conservation Blueprint

The Big Picture project provides a spatial image that highlights existing natural cores and connections, and potential areas for connection, rehabilitation and restoration. Maps, posters, methods and data are posted on the Carolinian Canada website (www.carolinian.org).

The purpose of *The Big Picture* analysis was:

- To assemble and interpret the best available, digitally mapped data on the biological diversity of southern Ontario
- To identify high-value core natural areas and highest probability linkages, and adjacent areas of existing natural vegetation
- To generate replicable, rule-based mapping of a landscape-scale "natural heritage system" for southern Ontario.

Big Picture 2002

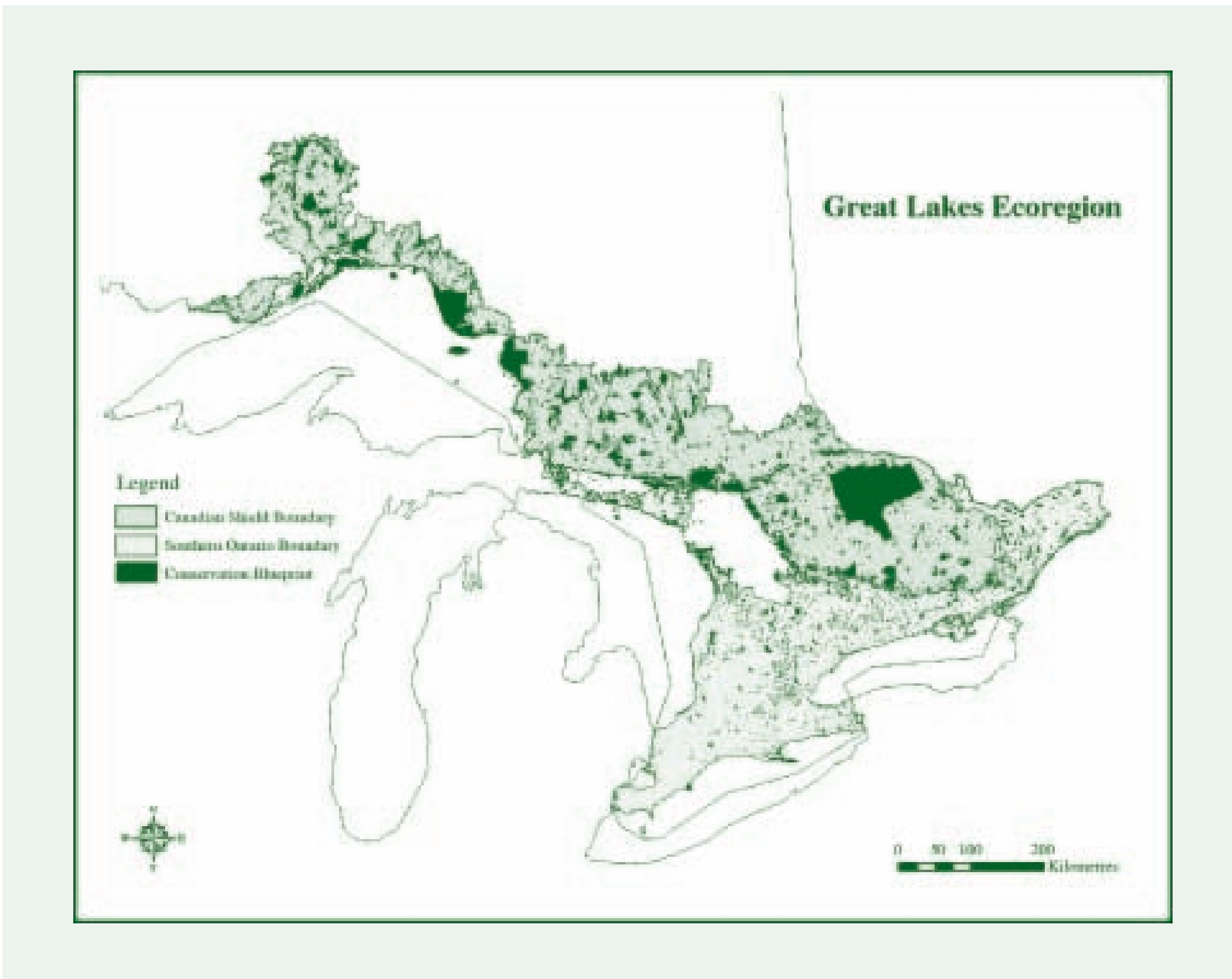


NCC and OMNR

The Conservation Blueprint

The Conservation Blueprint project was conceived in 1999, inspired by a successful ecoregional assessment of the United States portion of the Great Lakes basin by The (United States) Nature Conservancy, based on their general methods, which were in turn influenced by the history of Ontario's systematic assessments of significant natural areas for its Park and Areas of Natural and Scientific Interest (ANSI) program. These were both methods to identify and classify the biological diversity on a natural region basis; and to use replicable methods to identify priority conservation areas as a result. The project was treated as two assessments; (1) of aquatic biodiversity in the Great Lakes basin, and (2) of the terrestrial biodiversity in the basin.

Great Lakes Conservation Blueprint – Terrestrial



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► Conservation science is ultimately a science of hope.

While conservation science recognizes the negative consequences that sometimes occur when people interact with nature, it is founded in optimism that positive actions can conserve the integrity and diversity of biological systems.