

Southern Ontario's Natural Heritage Estate: Ecological Perspectives and Information, Research and Science Needs

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Abstract

More than nine million people (90% of Ontario's population) live in southern Ontario, a comparatively small region which contains only about 10% of the provincial landbase. Southern Ontario is comprised of two distinctive ecoregions, the Carolinian Life Zone (Site Region 7E) and that portion of the Great lakes St. Lawrence Forest Region lying south of the Canadian Shield (Site Region 6E). These regions are dominated by rural and agricultural lands, densely populated urban areas, and an extensive network of road, rail and other utility corridors. As a result the landscape is heavily fragmented, and the remaining natural areas are relatively small and often isolated placing a number of species and their habitats at risk. Currently, only about 2% of the region is formally designated under protected areas legislation. Within this context, the protection of existing natural areas and the restoration of other potential natural areas requires an ecologically oriented approach based on: long-term commitment; an improved knowledge of ecosystem structure and function; a comprehensive data and information system; and, an extensive partnership involving all sectors of society. This paper identifies important conservation challenges facing those working to conserve the region's unique natural heritage, and it provides some ideas for strategic actions and associated program needs in areas most reliant on ecological information, research and science.

Introduction

Future accounts of Canadian conservation efforts might well look back on the 1990s as a pinnacle in the movement to establish parks and other protected areas. Indeed, the past decade has seen impressive gains in the creation of parks and protected areas worldwide, with a greater increase in progress in Canada during this period than in the previous 100 years. Driven by modern views of ecological sustainability and biodiversity conservation, many jurisdictions have acted to protect representative and special ecological areas as one important means to conserve natural diversity for scientific study, education and heritage appreciation (Green and Paine, 1997).

Canada may well be regarded as a world leader in this important conservation pursuit. Unprecedented public support and political commitment have driven impressive gains in parks and protected areas in many parts of the country, with outstanding achievements in British Columbia, Nova Scotia, Ontario and other regions. Altogether, the total area of parks and protected areas has virtually doubled in Canada in the past decade (Figure 1). Yet, under scrutiny, the gains have not

been equitable in ecological terms, with most of the progress being made on existing Crown lands across mid- and high northern latitudes, and with comparatively modest gains in the settled southern regions of the country.

Ontario has done much to bolster the impressive Canadian progress. Ontario's contribution includes new protected areas achieved through the *Keep It Wild* (KIW) initiative in the first half of the decade (PNHS, 1995), the associated expansion of Wabakimi Wilderness Park in 1995, and the commitment of new parks and other protected areas through *Ontario's Living Legacy* (OLL) announced in July of 1999

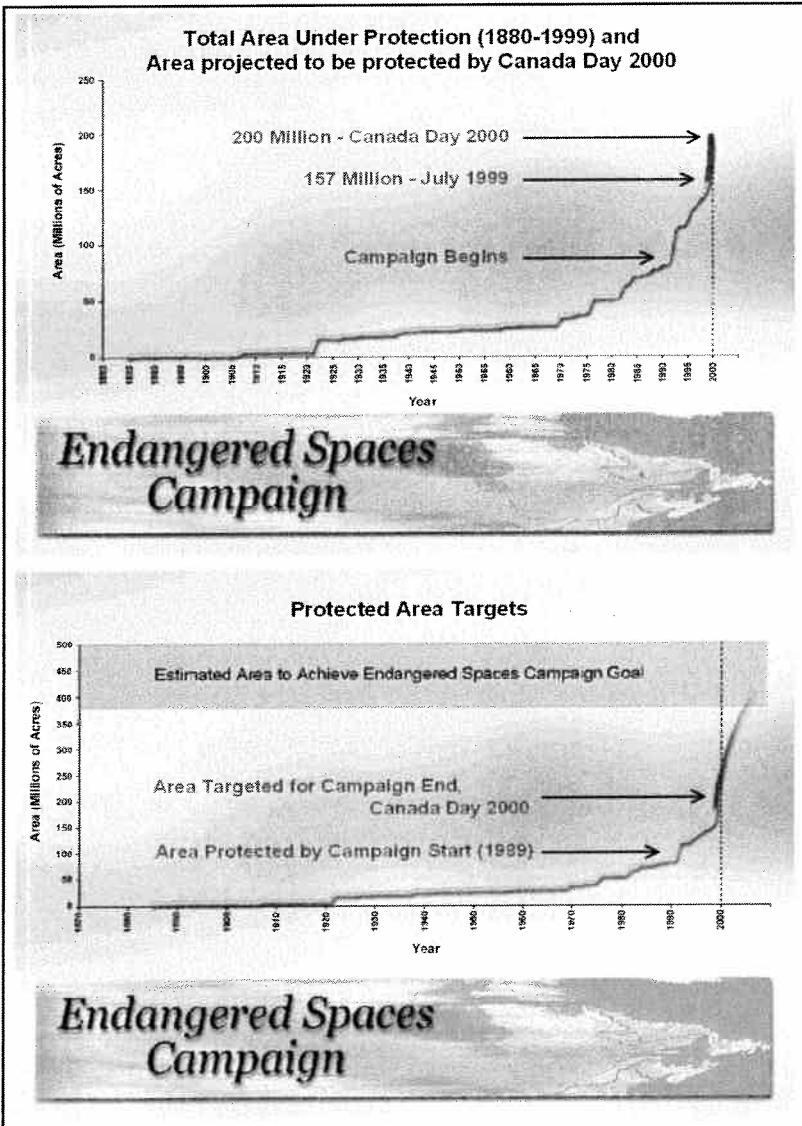


Figure 1: Growth of Protected Areas in Canada in the 20th Century (World Wildlife Fund).

(OMNR, 1999). Altogether, more than three million hectares of new parks and protected areas have been committed for protection on the Canadian Shield in this decade. When fully implemented, the OLL commitment, alone, will more than double the area of the parks and protected areas system in this vast region of the province (Figure 2), making this the largest single expansion ever of the parks and protected areas system in Ontario. Indeed, the existing provincial parks and conservation reserves, together with the newly announced areas, constitute an area larger than southern Ontario.

Against this backdrop, the purpose of this paper is threefold:

- 1) to provide context and an overview for the state of parks and protected areas in southern Ontario;
- 2) to present a preliminary enumeration and synopsis on the status of parks and protected areas in southern Ontario; and,
- 3) to offer ideas on strategic directions for the protection and enhancement of

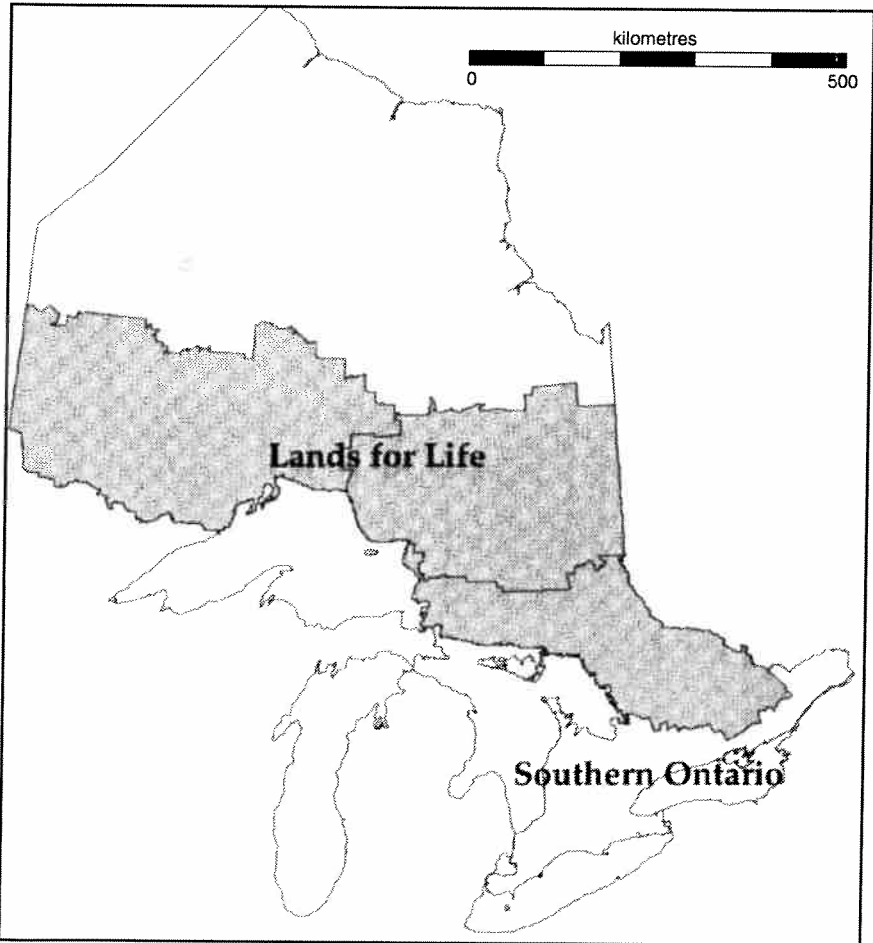


Figure 2: The Lands for Life Planning Area in Ontario

parks and protected areas in southern Ontario, particularly in areas demanding of research, information and knowledge.

For the purpose of this review, parks and protected areas correspond to categories I-IV in the classification system for parks and protected areas developed by the World Conservation Union's (IUCN) Commission on Parks and Protected Areas (IUCN, 1994). Southern Ontario is defined to include Site Region 7E (corresponding to the Carolinian Life Zone), and Site Region 6E (corresponding to that portion of the Great Lakes St. Lawrence Region south of the Canadian Shield) *sensu* Jalava (1996) and Jalava et al (1997) (Figure 3).

Context and Need

The rationale for parks and protected areas is well-founded and now widely accepted, particularly in relation to modern constructs for ecological sustainability and biodiversity conservation (Onysko and Usher, 1998; Green and Paine, 1997; BCO, 1995; Mosquin, Whiting and McAllister, 1995; CCFM, 1992; UNEP, 1992; WWF, no date). In essence, parks and protected areas serve three primary functions:

- 1) parks and protected areas are ecological storehouses of natural diversity that make important contributions to ecological sustainability and biodiversity conservation;
- 2) parks and protected areas serve as social and cultural benchmarks that connect societies—past and present—with the natural world; and,
- 3) parks and protected areas are important economic engines that provide op-

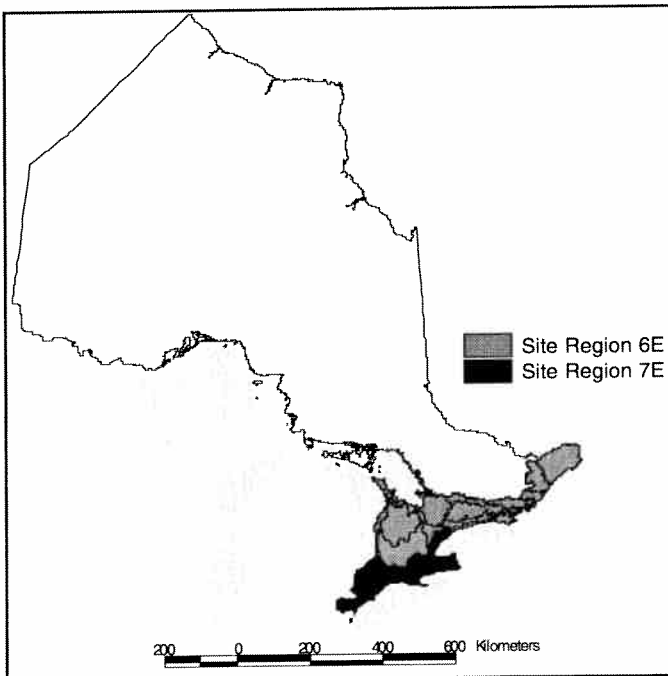


Figure 3: Site Regions of Southern Ontario.

portunities for revenue generation through, for example, outdoor recreation and tourism.

The goal of completing a network of parks and protected areas in southern Ontario is well justified in ecological, social and economic terms. From an ecological perspective, southern Ontario contains a unique assemblage of natural heritage features and systems. The region features a classic assemblage of glacial landscapes and landforms atop a palaeozoic platform crowned by the Niagara Escarpment and bisected by the Frontenac Axis (Davidson, 1989a; 1989b). The region offers the only expression of the Carolinian Life Zone in Canada, replete with many special biotic communities and many vulnerable, threatened and endangered species found nowhere else in the country (Allen, Eagles and Price, 1990; Eagles and Beechey, 1985). The entire region falls within the Great Lakes basin, and it features thousands of kilometres of contemporary and abandoned glacial shorelines along the lower Great Lakes, which harbour unique coastal ecosystems, plants and animals. This rich tapestry is crosscut by numerous rivers and waterways, some of national significance in ecological, cultural and recreational terms (Theberge, 1989).

In social and cultural terms, southern Ontario has been an important region for human habitation since the initial occupation of paleocultures after the Wisconsinan glaciation, some 10,000 years ago. Many of the values important to these earliest peoples—although now altered, modified or even extirpated—remain relevant to society today. The natural and cultural diversity of the region, even fragmented as it now is, still provides home for the majority of Ontarians. Transcending the region's cultural evolution, today's countryside persists with spiritual meaning to inform and to edify us of our roots and to provide relief from fast-paced livelihoods and lifestyles. In this setting, parks and protected areas are priceless assets for public education, heritage appreciation, and psychological retreat and re-creation (Beechey and McLeod, 1997).

Parks and protected areas are also an important asset in economic terms. For example, from a recreational and tourism perspective, provincial parks alone received more than nine million visitations in 1998 (Ontario Parks, 1998). The proximity of southern provincial parks to large urban centres in the south results in a disproportionately high level of visitation concentrated in these areas compared to more remote parks. Together with the many other types of protected areas, including national parks, park commission lands, conservation areas, municipal and private parks, the overall network of areas is an important revenue generator certain to escalate in value with increasing future demand for accessible high quality day use, passive heritage appreciation, and camping and associated outdoor recreational experiences.

Supporting this already compelling case for parks and protected areas in southern Ontario is the sobering reality of landscape conversion and habitat loss in this unique region, which is continuing to erode many natural heritage values. Since settlement, most of the region has been cleared for agriculture, urban development and the infrastructure to sustain these enterprises. Southern Ontario is the most densely developed region in the nation, with road densities in excess of 8.3km/km² in urban settings, with an average road density throughout the region amounting to

more than 3.5km/km². As a consequence, there are no remaining natural areas of sufficient size to even meet Ontario's minimum size criterion of 50 000 hectares for a wilderness park. This level of clearing and landscape fragmentation has created an extensive patchwork of remnant natural areas, which has caused significant degradation and loss of native ecosystems and species. For example, more than 75% of original wetlands have been drained (OMNR and OMMA, 1992; Snell, 1987); more than 80% of original woodlands have been cleared (Larson et al., 1999; Riley, 1999); only 0.1% of former prairies persist (Bakowsky and Riley, 1994); alien species have been widely introduced and established; large carnivores and several birds and plants have been extirpated; and in excess of 100 native plants and animals are now listed as vulnerable, threatened or endangered (COSEWIC, 1999).

The Existing Natural Heritage Estate

The origins of Ontario's commitment to parks and protected areas can be traced to the creation of some of its earliest parks in southern Ontario—Queen Victoria Niagara Falls Park in 1887, and Rondeau Park in 1894 (Killan, 1993). These initiatives were an early public and political response to guard significant natural areas against growing land-use pressures associated with the early settlement of southern Ontario. Driven by escalating land-use pressures, conservation needs and recreational demands, throughout the 20th Century incremental progress was made in the establishment of many parks and other conservation areas with similar protection and recreation objectives.

Today a complex series of protected areas including sites under federal, provincial, municipal and private jurisdictions has given rise to a rudimentary network of parks and protected areas in southern Ontario (Figure 4). Key federal properties include four national parks—Point Pelee, St. Lawrence Islands, Bruce Peninsula and Georgian Bay Islands; Fathom Five Marine Conservation Area; national wildlife sanctu-

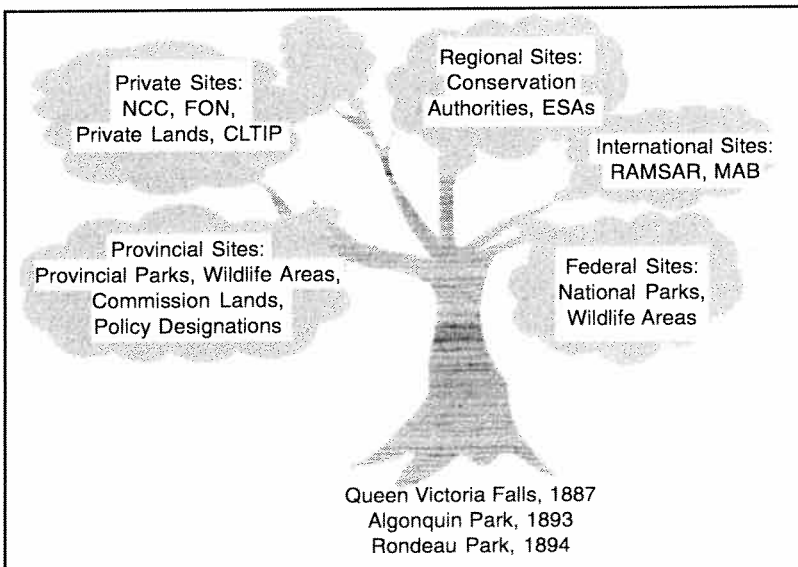


Figure 4: Origin and Affiliation of Protected Areas in Ontario.

aries, for example those at Long Point and Lake St. Clair; and migratory bird sanctuaries. Among provincial lands, 77 provincial parks including nature reserves, natural environment, historical and recreation classes are among the most important holdings together with properties held by the St. Clair, Niagara and St. Lawrence Park Commissions. More than 300 conservation areas administered by the 33 conservation authorities in southern Ontario make a highly significant contribution to the overall network. And increasingly, private lands acquired and held by organization such as The Nature Conservancy of Canada, the Federation of Ontario Naturalists and its affiliate members, and various trust organizations, are assuming prominence (Figures 5 and 6).

In addition to the foregoing protected areas component, many other complementary initiatives have been taken to augment efforts on natural heritage conservation. Through the 1980s and the 1990s, wetlands have been evaluated and classified, numerous areas of natural and scientific interest have been identified and documented, and vulnerable, threatened and endangered species have been assessed. On the regulatory side, official plans of upper tier municipalities provide for the designation of such important natural heritage areas which add force to provincial policies for protecting wetlands, areas of natural and scientific interest, woodlands and other important natural heritage areas. On the private stewardship side, various initiatives complement the regulatory approaches. The Conservation Land Tax Incentive Program (CLTIP), for example, provides property tax relief to qualifying landowners of conservation lands determined to be in the provincial interest. Land acquisition continues through innovative programmes such as *Ontario Parks Legacy 2000* (see Beechey et al., this volume), *Eastern Habitat Joint Venture*, *Natural Areas Protection Program*, *Community Conservancy*, enterprising initiatives of local land trusts, and recently formulated stewardship councils.

Notwithstanding the substantial past progress on natural heritage conservation in southern Ontario, the collective achievements on parks and protected areas are still quite modest in relation to the conservation needs in the region. For example, national parks in Ontario have a combined area of only 18 000 ha—a total area far smaller than Pukaskwa National Park in northern Ontario and most other national parks across Canada. The total area of provincial parks (nature reserve, natural environment, historical and recreation); conservation reserves and wilderness areas amounts to less than 43 000 ha, an area smaller than Killarney Provincial Park. Conservation areas administered by the 33 conservation authorities in southern Ontario contribute more than 40 000 ha, comparable to the total area of provincial parks in the south, but again an area smaller than many individual provincial parks in northern Ontario (Figure 7).

Indeed a number of agencies already operate with a 'systems' perspective. For example, Parks Canada has a national system plan calling for a national park to represent each of Canada's 39 Natural Regions (Lopoukhine, 1998). Only two of these regions coincide with southern Ontario, with existing national parks already meeting these targets. Ontario Parks operates within a policy framework that seeks to represent each of Ontario's 14 site regions and 65 site districts within the provincial parks system. Although serious gaps exist in natural environment, waterway and nature reserve park classes in southern Ontario, new parks to fulfill these

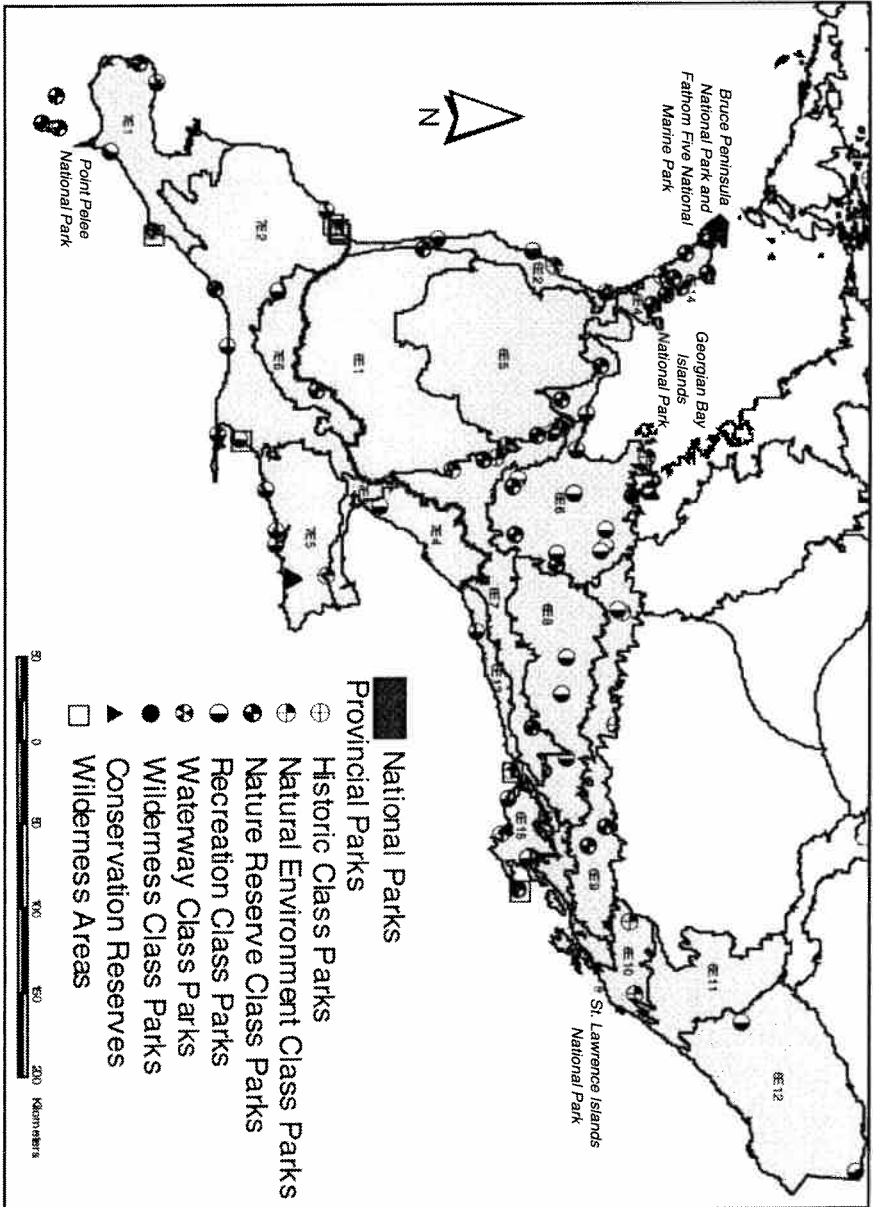


Figure 5: National Parks, Provincial Parks, Conservation Reserves and Wilderness Areas in Site Regions 6E and 7E.

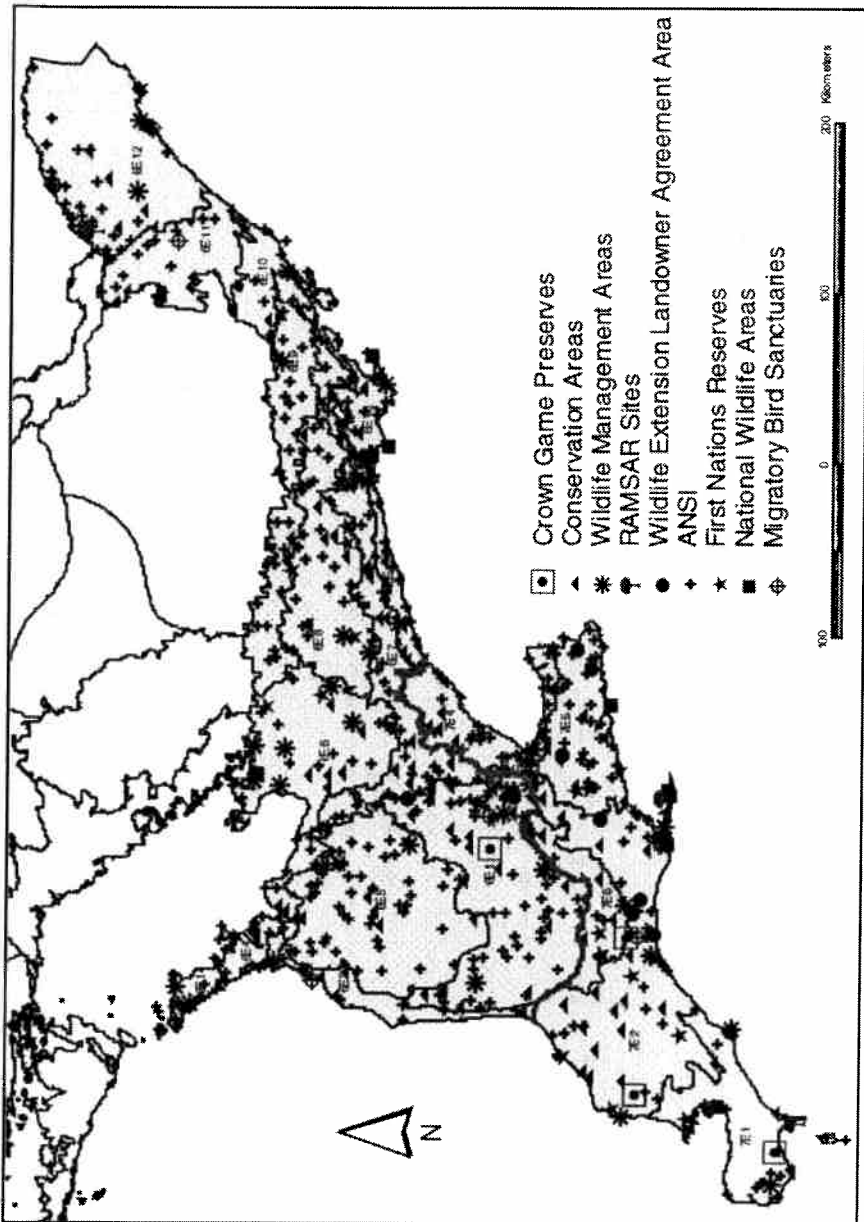


Figure 6: Other Parks and Designated Areas in Site Regions 6E and 7E.

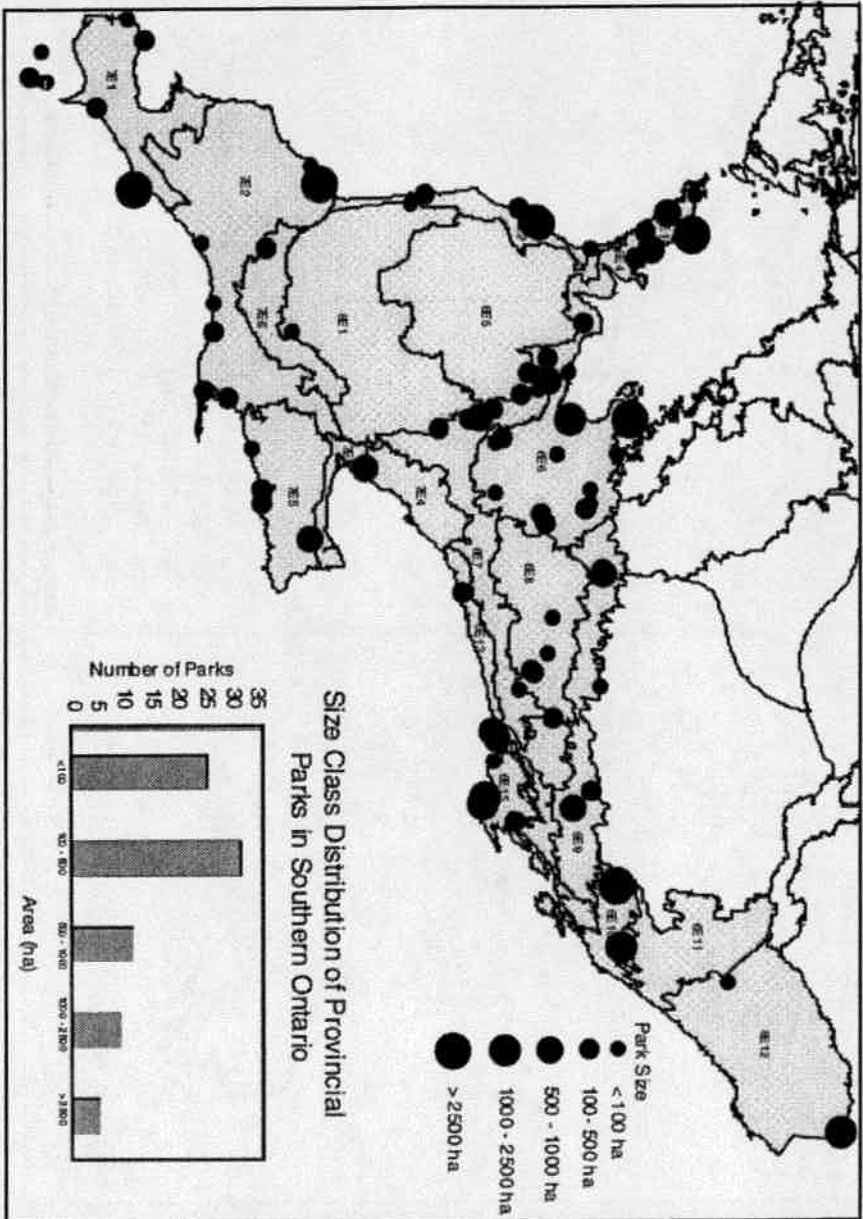


Figure 7: Approximate Areas of National Parks, Provincial Parks and Conservation Areas in Site Regions 6E and 7E.

targets would only make a modest addition to the provincial parks system (OMNR, 1992). Still other 'system' perspectives have been developed for the Niagara Escarpment (NEC, 1985), and by conservation authorities, park commissions and other agencies.

The current scale of the existing 'protected areas network', the anticipated future need for more areas, and the myriad of players with a joint interest in parks and protected areas prompts a number of basic questions: Is there a need for a collective goal? To what extent do existing parks and protected areas meet that goal? What remains to be done? What resources are required to attain the goal? What are the priorities for action? What are the science, research and information needs? In short—what are the ingredients for a collective strategy for parks and protected areas and complementary natural heritage initiatives to fully meet heritage conservation needs for southern Ontario in the 21st Century?

Although further analysis and assessment is required, the existing heritage estate in southern Ontario can be characterized in general terms to establish some of the strategic needs and directions for systems planning and area management. Overall the 'protected areas network' is relatively small in total area, comprised of small to moderate sized areas with no wilderness dimension. Parks and protected areas are typically isolated and located mostly in highly modified landscapes. By virtue of their relatively small size and isolation, most areas are lacking in ecological integrity making them vulnerable to a wide variety of internal and external stressors. In addition, the 'network' is very incomplete in terms of representative and special features. And finally, the jurisdictional complexity highlights the need for cooperative approaches and coordinated action.

Strategic Directions

Given the existing state of parks and protected areas in southern Ontario, a number of strategic directions can be proposed to address systems planning and conservation management needs in the 21st Century (Table 1). Common to all of these measures is the requirement for improved information and research to impart better understanding and knowledge about key aspects of site identification, protection and management.

Systems Valuation	Ecological Integrity
Area Documentation	Area Restoration
Systems Design	Monitoring
Gap Analysis	Information Management
Area Surveys	Coordination of Effort

Table 1: Strategic Directions for Parks and Protected Areas Planning and Management.

Systems Valuation

Efforts to complete a comprehensive accounting of natural capital offer powerful approaches to analyze and to demonstrate the full value of ecosystems and the services that they provide over various spatial and temporal scales (Costanza et al., 1997). In connection with such global accounting, the valuing of both the ecological and human dimensions of parks and protected areas are increasingly coming to be realized as critical cornerstones in efforts to plan and to manage systems of protected areas. For example, studies over the past two decades have underscored the value that Canadians place on nature and natural areas (e.g., DuWors et al., 1999). Associated with this is the realization of the full worth of natural areas in ecological, social and economic terms (Mosquin, Whiting and McAllister, 1995). Business planning and assessments undertaken by Parks Canada (Parks Canada, 1995), British Columbia Parks (Coopers and Lybrand, 1995) and Ontario Parks (Whiting and Mulrooney, 1998) have all concluded that parks are highly significant assets that function as important economic generators, in addition to providing a wide range of ecological services. Since no complete valuation has been done on the full suite of parks and other protected areas in southern Ontario, a comprehensive accounting of this heritage estate would be useful, in order to quantify its full ecological, economic and amenity value. Such accounting also needs to assess the value of future protected areas scenarios based on projections of the need for additional parks and protected areas.

Area Documentation

Science-based information and knowledge are essential for all facets of planning and managing parks and protected areas. Among Canadian jurisdictions, southern Ontario may well be the most mature region in terms of ecosystem assessment and natural heritage evaluation. For example, between 1968-1974, Ontario's participation in the International Biological Programme resulted in an initial standardized survey of almost 600 significant ecological areas, most of which occur in southern Ontario. Subsequently, wetlands have been evaluated in a comprehensive fashion, areas of natural and scientific interest have been documented through methodical surveys of the site districts throughout the region, and thematic studies have been initiated. Such 'provincial' efforts have been supplemented by municipal and county level studies to identify environmentally sensitive areas. These many reconnaissance assessments have been augmented by more intensive inventories of national parks, many provincial parks, and other conservation areas. At a species level, a variety of taxonomic, geographic and atlasing projects have greatly expanded our knowledge of plant and animal distributions with more intimate understanding of the conservation status of species (Riley et al., 1997).

While *de novo* surveys of species and ecological areas need to continue, there is also a pressing need to integrate any new work with the existing information to enhance efforts for conservation planning and management. Work by the Natural Heritage Information Centre (NHIC) involving the verification and assimilation of natural areas and species surveys records are increasingly important in developing standardized documentation, analysis and reporting on the state of Ontario's ecosystems and natural heritage conservation efforts. In association with GIS tools and techniques, such as those available through the Natural Resources Values Information System (NRVIS) of the Ministry of Natural Resources, the information outputs make significant contributions to conservation planning and management.

A key component of documentation is a provincial registry with a framework to categorize parks and protected areas in a standardized fashion. This need is especially important for southern Ontario, where the complexity of public and private sector interests requires a comprehensive registry to document, analyze and report on collective efforts to protect natural areas. The Canadian Conservation Areas Database (CCAD) is a prototype that utilizes the IUCN classification (IUCN, 1994) for protected areas to document, categorize and report on the status of protected areas throughout Canada. Since the coverage of Ontario's protected areas is incomplete in CCAD, a provincial registry would provide a mechanism to feed into it on a regular basis to insure that provincial information is current and correct. Such a process would bring added recognition to the important contribution that both public and private sector interests are making toward the conservation of Ontario's natural heritage, and it would help all parties to work toward a common goal for protected areas.

Systems Design

Traditional efforts to conserve natural areas have often been driven mainly by a 'collector's' mentality, with a terrestrial bias. The idea is to capture the range of ecological diversity in a suite of 'representative' areas. This approach has long been the mindset behind system planning for national parks, provincial parks and various sub-provincial efforts. While 'representation' remains an important construct for systems planning, new understandings of ecological processes and functions argue persuasively for a more comprehensive ecosystem or bio-regional approach. Today, jurisdictions are moving toward the protection of natural heritage systems—integrated, functional landscape segments that house both representative and special areas together with the ecological features and functions necessary to sustain them (Noss, 1995, 1992; Noss and Cooperider, 1994; Riley and Mohr, 1994).

In existing, isolated protected areas, more attention needs to be given to management with an 'intervening landscape' or 'greater area ecosystem' outlook. While such systems purviews are often still more conceptual than applied, forward thinking examples like the Niagara Escarpment Plan (NEC, 1985) and planning for the Oak Ridges Moraine (Geomatics International, 1993) offer interesting prototypes to stimulate the development and application of more comprehensive, ecosystem-based, natural heritage conservation plans.

Another aspect of southern Ontario's natural heritage that deserves special consideration is the need to represent aquatic and marine environments more fully in parks and protected areas. This need has received some attention through efforts of The Nature Conservancy to advance bio-regional planning and conservation efforts for the Great Lakes basin (TNC, 1994, 1997). As a starting point for such work, classifications such as the "Classification and Inventory of Great Lakes Habitats" (CIGLAH) initiated by the Great Lakes Fishery Commission and the International Joint Commission in 1987, and extended by the work of Sly and Busch (1992), provide frameworks for consideration, refinement and application.

In addition to terrestrial and aquatic representation, special consideration is also required for geological conservation that applies and builds upon provincial efforts to protect Ontario's rich geological heritage in provincial parks and areas of natural and scientific interest (Davidson et al., 1999).

Gap Analysis

Gap analysis is a key aspect of systems planning that has motivated much of the work on protected areas across Canada over the past decade. Early guidance offered by the Canadian Council on Ecological Areas (Gauthier, 1992; Gauthier et al., 1995) and World Wildlife Fund Canada (see Kavanagh and Iacobelli, no date) has prompted provincial and territorial planning efforts to embrace gap analysis as an approach to identify representative ecological areas. In Ontario, an automated gap analysis was developed as the primary tool to assess representation of vegetation-landform units in existing provincial parks and conservation reserves, to identify critical gaps in representation, and to identify candidate areas to fulfill outstanding representation targets (Crins and Kor, 1998) in the *Lands for Life* planning area (Figure 2). This assessment offers a prototype for a much-needed parallel assessment of significant ecological areas throughout southern Ontario.

In southern Ontario, the manual survey and assessment of areas of natural and scientific interest, since the early 1980s, has incorporated considerations of vegetation-landform representation within a site district context in order to identify a suite of natural areas that best represents the vegetation-landform units in the district. This approach has been refined in the more recent surveys on the Niagara Escarpment (Riley, Jalava and Varga, 1996), and most recently on the Carolinian Canada *Big Picture* project where GIS analyses are being applied for the modeling of natural heritage systems and conservation scenarios (Jalava and Sorrill, 1999). Together with the *Lands for Life* model, these southern initiatives provide templates for a consistent assessment of significant natural areas from both representational and functional perspectives. With available fine-scale data sets for soils, comprehensive ELC (ecological land classification) vegetation classification (Lee et al., 1998), and existing documentation and mapping for many areas, GIS applications can enable automated assessments of representation and functional considerations for natural areas across southern Ontario. Such an assessment is necessary to inform efforts on priorities for area securement and management.

At the most refined scale, detailed, spatially-based data on species' occurrences assembled by the Natural Heritage Information Centre can be used with GIS analyses to assess the extent to which vulnerable, threatened and endangered species and communities are represented in existing parks and protected areas, and where "hotspots" of element occurrences reside outside of the protected areas network (see Jalava, Sorrill and Godschalk, this volume, and Line et al., this volume; Jalava and Godschalk, 1998)). These types of analyses can be used to document and to assess 'species representation' and to set priorities for conservation planning, area securement and management for featured VTE species and their habitats.

Area Surveys

The foregoing steps dealing with area documentation, systems design and gap analysis are crucial to guide future investment on new ecological area surveys. The foregoing analyses will disclose limitations and deficiencies in the current data sets for already documented sites, and it will reveal geographic and thematic gaps that require attention. Of these, thematic surveys such as those that have already been conducted for old-growth cedars on the Niagara Escarpment (see Kelly and Larson, this volume), prairies in southern Ontario (Bakowsky and Riley, 1994), and

alvars in the Great Lakes region (Reschke et al., 1999) are valuable in enabling range-wide assessments of particular ecosystem types and suites of species. Other thematic studies to be considered include specialized Great lakes coastal environments, such as dune systems, pannes, estuaries, and abandoned glacial shorelines; all aquatic habitats including deepwater and littoral Great Lakes systems, interior lakes, rivers, streams and ponds; Great Lakes islands; certain wetland types, especially bogs, fens and calcareous seeps; woodlands and other communities associated with particular site types, such as classic loams which have been largely converted to agriculture; heritage and old-growth woodlands; certain bedrock barrens and talus slopes; specialized floral and faunal sites, such as rookeries or hibernacula, habitat for colonial species and disjunct species; and critical functional areas, such as headwater and catchments important to sustain protected areas and natural heritage systems.

Area Restoration

Another area in need of serious attention is ecological restoration. Accepted by some only as a concept or an ideal, restoration does set an important goal for efforts on ecosystem rehabilitation and species recovery. Since pre-settlement times, southern Ontario has experienced severe losses of critical ecological features and functions calling for remedial action at micro-, meso-, and macro-scales. In the extreme southwest, this degradation and loss is most apparent in the flat treeless vistas, local species extirpations, and arguably the highest concentrations of vulnerable, threatened and endangered species in the nation. Small, highly isolated woodlots, channelized streams, pervasive drainage systems, cleared river and stream banks, and converted wetlands are symptomatic of wholesale landscape conversion (Figure 8). By comparison, lowly populated remote areas in eastern Ontario and along the fringe of the Canadian Shield have as much as 50% of the original natural area remaining intact (Figure 9). Elsewhere in southern Ontario there is a parallel, if less urgent need, to assess the extent and impact of large scale landscape conversion. Such an assessment, together with the former system planning steps, is necessary to inform heritage system designs, and more sensitive development and land-use including the restoration of key ecological areas. Visionaries calling for a long-term landscape scale restoration plans will prove to be the environmental luminaries of the 21st Century (Hounsell, 1999).

While the emerging constituency for natural areas restoration is a relatively youthful movement, there are inspirational examples of earlier ecosystem rehabilitation in southern Ontario that we would do well to emulate today. Noteworthy are the efforts to re-forest large tracts of the Norfolk Sand Plain and the Oak Ridges Moraine, which, indeed, helped to inspire the conservation authorities movement in the 1940s (Richardson, 1974). As well, remedial action on rehabilitating the Great Lakes is further evidence of how restoration work can proceed at a grand scale where there is the vision and the commitment to pursue this goal (Environment Canada, OMOE, 1999; Environment Canada, OMNR and OMOE, 1998). As a further 'beginning', situations need to be addressed on a case-by-case basis to avert further losses of critical features and functions, supplemented with increased efforts to replace key elements that have been extirpated, impaired or degraded. Other priorities for restoration might include areas adjacent to existing protected areas, corridors to re-connect existing protected areas, and cleared patches in meta-sites with the aim of re-constituting relatively large natural areas.

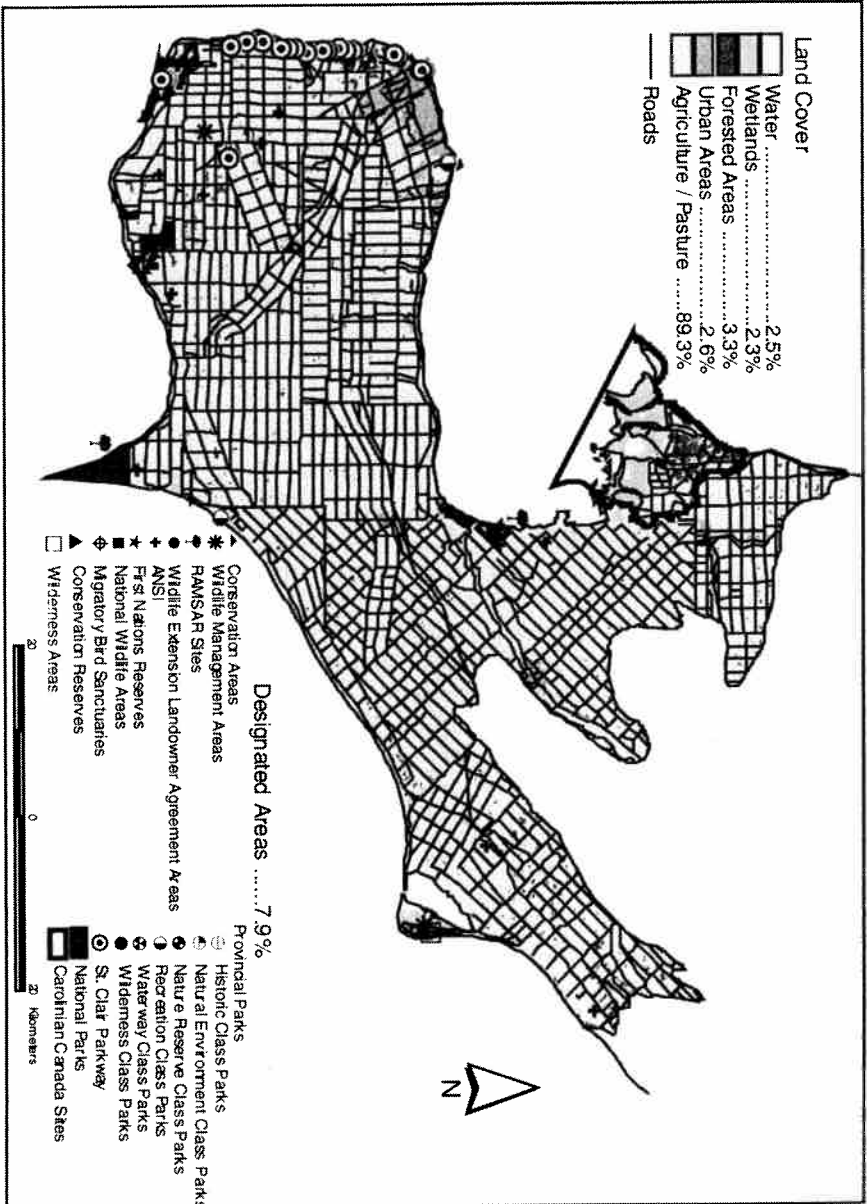


Figure 8: Fragmentation and Remnant Natural Areas in Site District 7E-1.

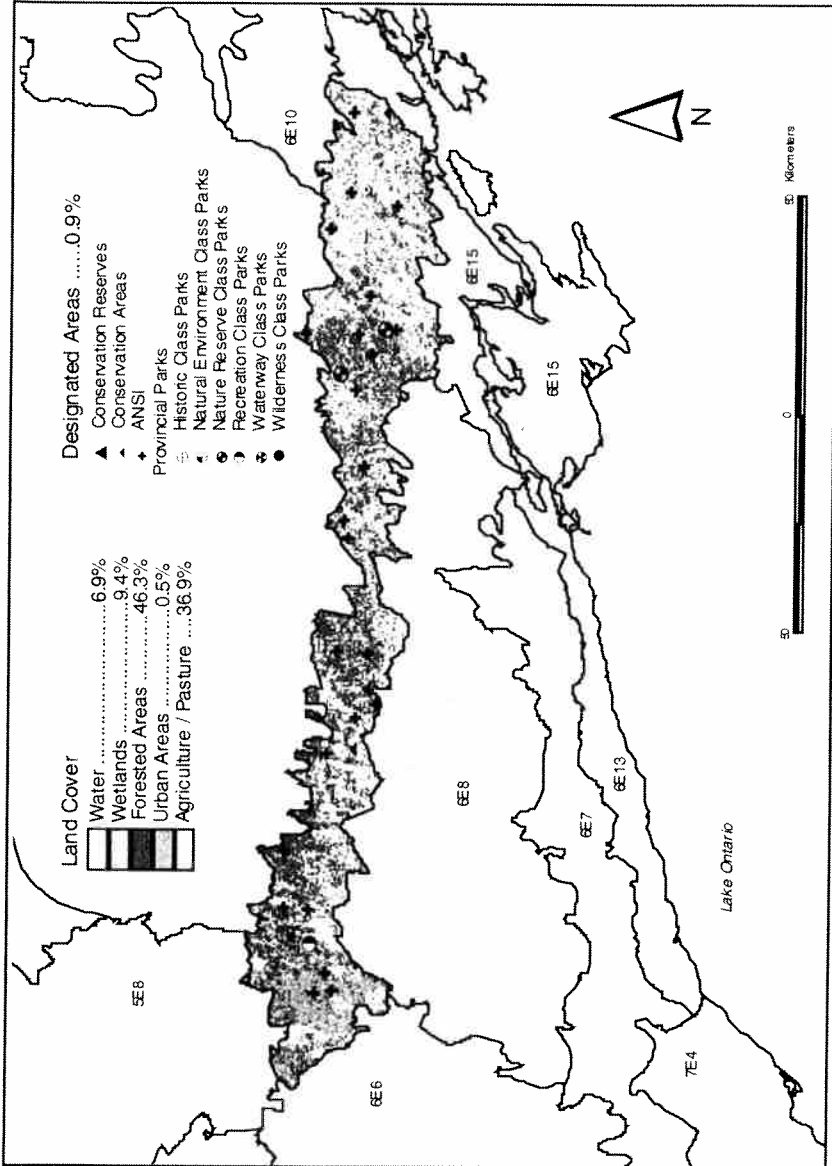


Figure 9: Fragmentation and Remnant Natural Areas in Site District 6E-9.

Ecological Integrity

In addition to the need to complete ecologically-based networks of parks and protected areas, the most pressing issue facing organizations charged with their protection and management is ecological integrity (Lopoukhine, 1998; Poser, Crins and Beechey, 1993; Woodley, Francis and Kay, 1993). In operational terms, ecological integrity is a homeostatic balance of ecosystem form and function where features, areas and systems persist in a harmonious state without loss or impairment arising from internal or external stressors. It is the nominal state or condition of ecosystem health in protected areas to which we need to aspire. Increasingly, ecological integrity needs to be assumed as a goal in both area and system design and subsequent management efforts.

The issue of ecological integrity is particularly critical in highly fragmented regions, such as southern Ontario. In such settings, the protected areas estate consists mainly of isolated areas that represent a small percentage of the human-modified matrix in which they exist. Accordingly, these areas exhibit high boundary/area ratios and they are poorly buffered, making them vulnerable to a wide array of internal and external stressors. Poor ecological integrity manifests itself in many ways: depletion of genetic vigor in isolated populations; extirpation of localized native populations; invasions of alien species; imbalances in predator-prey relationships; over-grazing by deer; elimination of wildfire dependent systems; modification of environmental regimes; pollution and nutrient loading; and others. These problems are very complicated and costly to remediate through conservation management actions, and indeed they pose a major challenge to parks and protected areas managers in the 21st Century.

In settled regions, the long-term integrity of parks and protected areas will depend on careful planning and management of internal stressors and the identification and mitigation of external forces that negatively impact upon these areas. Where the size and design of protected areas cannot be increased due to land-use constraints and limitations on rehabilitation, agencies may need to invoke more active management to maintain species and ecosystems that have been targeted for protection. Indeed there are a growing number of examples where such conservation management has been undertaken: for example, deer management in Rondeau and Pinery Provincial Parks; prescribed burns at Ojibway Prairie Provincial Nature Reserve; exotic vegetation management and savannah restoration at Point Pelee National Park; VTE species management and recovery work in a number of areas; and hydrological management for Wainfleet Bog (Frolich, Kim and WBAC, 1997)

In order to better deal with such conservation management needs, Parks Canada has made significant progress through the establishment of a legislated mandate for ecological integrity, the adoption of an ecosystem management perspective, programming and staff training (Lopoukhine, 1998). Current efforts of the Ecological Integrity Panel constituted by Parks Canada to investigate and report on this matter should yield findings helpful to all organizations faced with the challenges posed by ecological integrity and conservation management.

Monitoring

Effective planning and management of parks and protected areas is, in large part, based on monitoring programs designed to help managers to detect and under-

stand change, and to assess the extent to which remedial management efforts are successful. To that end, monitoring efforts can be grouped into three broad categories:

- 1) compliance monitoring to determine the extent to which management plans and conservation prescriptions are being implemented;
- 2) effectiveness monitoring to assess the results of applying conservation prescriptions and measures and to gauge their effectiveness in meeting the goals and objectives prescribed for ecosystem and species conservation; and,
- 3) environmental monitoring involving the use of parks and protected areas as benchmarks to assess global environmental change, such as climate warming, pollutant loading, carbon sequestration, ecosystem productivity, biodiversity loss, and ecologically sustainable land management.

In fragmented landscapes, such as those in southern Ontario, all three types of monitoring are critical to insure that the goals and objectives, as well as conservation commitments are being met. Compliance monitoring that reflects the particular conservation mandate of individual organizations needs to be conducted at area and agency-specific levels. Effectiveness monitoring must be more generic in nature to deal with specific ecological values, such as breeding birds (Cadman, 1999) or rare plants (Geomatics International, 1996), at both area specific and range-wide scales. Given its more generic nature, effectiveness monitoring should be standardized for application by multiple agencies. Environmental monitoring requires a rigorous standardized effort, with carefully defined indicators and protocols for data collection and assessment, as those being developed for Ecological Monitoring and Assessment Network (EMAN) sites (Geomatics International, 1999; EMAN, 1998a; 1998b).

Information Management

The use of new and evolving information management technologies to enhance the acquisition and application of data and information is critical to the establishment and management of parks and protected areas in southern Ontario. In many cases, agency-specific data sets can satisfy many organizational needs to improve intra-agency planning and management efforts. But increasingly, comprehensive data sets are required for the range-wide analysis and assessment of many facets of protected areas planning and management. Needs such as gap analysis, thematic studies, site identification, threat analyses, monitoring and other types of support programs are all predicated on the ability of an agency or organization to complete comprehensive assessments and to report with GIS outputs.

Data and information standards are key to efficient and effective information management. Indeed, a good deal of work has been done on establishing such standards for categorizing vulnerable, threatened and endangered species, describing biotic communities, mapping ecological areas and features, and assessing natural areas. Widespread adoption of consistent methodologies and assessment approaches facilitates information transfer and application without the risk of information loss, or the need for secondary interpretation. By applying such technologies and information conventions, efforts at various scales can be more readily integrated, analyzed and applied to help in meeting collective goals and objectives for natural heritage conservation.

Coordination of Effort

A complex suite of initiatives involving many agencies, organizations and individuals is required to establish and retain a functioning network of parks and protected areas in southern Ontario. First and foremost, this requires a commitment by Ontarions to work together on efforts to establish a comprehensive network of protected areas in southern Ontario. Second, this requires the development and implementation of an effective and practical planning and management process that accomodates local, regional and provincial interests. And central to these needs is the need to build broad-based public awareness, understanding and support that reflects the important human dimensions associated with parks and protected areas.

Perhaps the most formidable challenge in southern regions is the need for convergent efforts among the many interests, ranging from federal agencies to private landowners. To begin, good information management combined with sincere efforts to communicate it, is an important step to facilitate understanding, coordination and cooperation. Many of the tasks advanced in this paper can be applied at various scales. Some aspects of information collection and planning can be developed independently by individuals and community-based groups to collect and analyze information to serve local and regional conservation needs. Other aspects are more wide-ranging and demanding, and require more formality to develop and to apply them. Above this, overall plans and strategies require broad-based provincial commitment, involvement and support.

With regard to information management, there are many examples of conservation initiatives that provide templates for inter-organizational involvement and cooperation. For example, in the area of data collection, the extensive work on atlasing various groups of flora and fauna stand out as highly inspired efforts that have made a very significant contribution to our knowledge of Ontario's flora and fauna. Among them, the genre of "bird atlasing" efforts stand apart for the quality and scale of operation. With respect to natural areas, although surveys have largely been the domain of government agencies, such as the Ontario Ministry of Natural Resources, conservation authorities, and regional municipalities, hallmark efforts, such as the natural areas survey of Haldimand-Norfolk (Gartshore, Sutherland and McCracken, 1987), and others, have been executed through private interests (Beechey, Francis and Powell, 1999).

With regard to area protection and stewardship, there are also good examples of collaborative planning and implementation. The Carolinian Canada Program was conceived as a fraternity of interests that came together in the 1980s to advance the conservation of critical natural areas in the Carolinian Life Zone. Without a high degree of formality, Carolinian Canada can claim a number of successes to affect the identification, protection and management of targeted areas (van Hemessen, 1995; Nicholson, 1990). The Natural Heritage League, which operated through the 1980s, offers another model of cooperation involving both the public and private sectors representing national, provincial and regional interests. The League can also claim some major successes, especially in the area of property securement and stewardship (Killan, 1993). A third model is the Wildlife Working Group, which was constituted by the provincial government to develop a comprehensive strategy

for wild life conservation in Ontario (OWWG, 1991). And most recently, the *Lands for Life* planning program, which gave rise to the commitment for the largest single expansion of the Ontario's system of parks and protected areas, offers another example of a provincial planning program involving extensive collaboration and public consultation (OMNR, 1999).

Conclusion

The commitment to the establishment and maintenance of parks and protected areas has steadily increased through the 20th Century, with the most impressive gains being made in the last decade. The Canadian estate of parks and protected areas has more than doubled in the 1990s, and the recent commitment to establish more than 300 new areas on the Canadian Shield. places Ontario at the forefront of the parks and protected areas movement. While most of this growth coincides with Crown lands, modest, incremental gains have been made in southern regions, where progress is constrained by private ownership.

The completion of a system of parks and protected areas for both Ontario and Canada, will require more concerted attention to system planning in the southern settled regions. In light of the highly fragmented landscapes in the south, this work will necessitate re-evaluation of systems approaches that have been used in more northern regions where contiguous natural landscapes prevail. Important aspects to consider include the approach to systems design, modifications to gap analyses, and greater attention to ecological integrity and functional aspects of areas and networks. Together, these constitute a bio-regional approach.

Toward this goal, this paper presents a series of strategic directions, centred on information, research and science needs, for consideration in planning future efforts to identify, protect and manage parks and protected areas in southern Ontario. Many of the prescriptions that are offered can be applied at various scales to augment ongoing efforts. However, any goal to complete a comprehensive network of parks and protected areas for this region will necessitate a long-term commitment and a region-wide perspective, combined with broad-based participation and support of key agencies, organizations and individuals.

A tremendous amount of information exists to proceed with addressing these needs. New information technologies with powerful GIS capabilities can enable analyses capable of forecasting protected area scenarios built upon the many considerations addressed in this paper. Such scenarios can provide visions and plans that are necessary to gain broad-based public acceptance and support.

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