Climate Change and Ontario's Provincial Parks: A Preliminary Analysis of Potential Impacts and Implications for Policy, Planning and Management

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Abstract

In collaboration with Ontario Parks, the University of Waterloo and the Parks Research Forum of Ontario (PRFO), a preliminary analysis was completed on the impacts of climate change on Ontario's system of provincial parks. First, historical climate trend analyses illustrated mean temperature increases ranging from 0.26-1.2°C in a representative sample of provincial parks. Second, General Circulation Models (GCMs) projected increases in annual temperature of about 1.8-3.2°C in the 2020s, 1.8-7°C in the 2050s, and 2.5°C-10°C in the 2080s in the same representative sample of provincial parks. Third, results of the fire-severity change analysis generally indicated a considerable decrease in the 'low' fire severity rankings and increases in the 'high', 'very high' and 'severe' fire severity rankings for the majority of Ontario's provincial parks by the 2050s (ca. 2 x CO_2) and especially the 2090s (ca. 3 x CO_2). Finally, vegetation modeling results showed the potential for substantial change in biome-type in Ontario's provincial park system (64-93% depending on the scenario used). The study identified a number of park policy and planning sensitivities (notably, that the Ontario Parks system plan has been designed to protect specific natural features, species and communities in-situ*, and not take into account shifts in ecosystem structure and distribution that could be induced by global climatic change). Ultimately, however, the anticipated changes in ecosystem structure and composition expected under climatic change, coupled with some species' inability to genetically adapt to new climatic conditions or migrate to suitable climatic and vegetation zones, could hinder the ability of Ontario's*

protected area managers to maintain some habitats and species populations in the future.

Introduction

Recent reconstructions of global mean-surface temperature from both 'proxy' (e.g., tree rings, ice cores, and lake sediments) and modern (i.e., 1850-2000) instrumental temperature records indicate that global 20th century warming is unprecedented over the past two millennia (Houghton *et al.,* 2001; Mann *et al.,* 2003). Warming trends in Canada over the 20th century have averaged approximately 1^{o}C with regional variations ranging from about 1.5^{o}C in the western Northwest Territories (NWT) to 1^{o}C in southern portions of Canada. In contrast, a cooling of 0.8^{o}C has been recorded in Nunavut over roughly the same period (Environment Canada, 1998). Modeling and statistical studies indicate that such anomalous patterns cannot be fully explained by natural factors, but instead, require an anthropogenic forcing during the late-19th and 20th centuries (Mann *et al.,* 2003; Braganza *et al.,* 2004). Globally, the Intergovernmental Panel on Climate Change (IPCC) *Third Assessment Report* (TAR) has indicated that temperatures could rise between 1.4 and 5.8°C over the 21st century (Houghton *et al.,* 2001). As a northern country, Canada is projected to warm more than most other countries – in some areas, more than double the global average increase. Climate change of this magnitude, projected to occur over a relatively short period of time, would have significant consequences for Canadian ecosystems.

Climate plays a crucial role in determining the geographic distribution patterns of major biomes or vegetation communities (Holdridge, 1947; Woodward, 1987). An increasing number of empirical studies document the ecological effects (e.g., changes in phenology, distribution, and physiology) of recent climate change (Parmesan, 1999; Hughes, 2000; McCarty, 2001; Warren *et al.,* 2001; Walther *et al.,* 2002; Parmesan and Yohe, 2003; Root *et al.,* 2003; Thomas *et al.,* 2004; Parmesan and Galbraith, 2004), and climate change has been linked to several recent species extinctions (Pounds *et al.,* 1999; Thomas *et al.,* 2004; McLaughlin *et al.,* 2002). Compounding these impacts, projections of biome-type change indicate that the required migration rates of several Canadian species would need to be greater than 1000 m year^{-1} if they were to keep up with projected climatic warming and vegetation change anticipated in the 21st century (Malcolm *et al.,* 2002).

Taken collectively, these studies indicate that the implications of projected climate change and ecosystem change on global biodiversity conservation could be considerable. Most protected areas have been designed to protect specific natural features, species and communities *in-situ*, not taking into account shifts in ecosystem structures that could be induced by climatic change. A recent report by the World Wildlife Fund (WWF) emphasized that:

> "…*protected areas offer a limited defense against problems posed by rapid environmental change [and] protected areas will themselves need to be changed and adapted if they are to meet the challenges posed by global warming*." (WWF 2003: 1).

A number of authors (Peters and Darling, 1985; Scott and Suffling, 2000; Scott *et al.,* 2002; Hannah *et al.,* 2002; Lemieux and Scott, submitted) contend that climate change has the potential to undermine over a century of conservation efforts. Furthermore, the IPCC *Special Report on Climate Change and Biodiversity* states that:

> "*Despite the uncertainties… the overall conclusions … establish that anthropogenic climate warming at least ranks alongside other recognized threats to global biodiversity [and] contrary to previous projections, it is likely to be the greatest threat in many if not most regions*." (Thomas *et al.,* 2004: 147).

This paper examines the implications of climate change for Ontario's system of provincial parks. The objectives are four-fold: (i) review the evidence for recent climate change in a representative sample of provincial parks; (ii) assess projected vegetation change within the provincial park system utilizing outputs from global vegetation model (GVMs); (iii) assess projected fire severity change within the provincial park system utilizing outputs from global circulation models (GCMs); and, (iv) consider the implications these impacts have for park and protected areas management, policy and planning (at both the system and individual park levels). Due to space restrictions, the methods provided here consist of general descriptions only; sources containing more detailed descriptions of data sets and model methodologies are provided. The limitations associated with the use of instrumental temperature records, GCMs and GVMs are also noted in these sources.

Methods

Historical Climate Trend Analysis and Climate Change Projections

Using climate stations, a representative sample of provincial parks in each of the Ontario Ministry of Natural Resources (OMNR) Ontario Parks park management zones was utilized to examine recent climatic trends (departures from the 1961-1990 norm) in these parks over the historic record. The availability of continuous climatic data sets was a major determining factor in both park and station selection.

Monthly values of mean temperature and total annual precipitation were acquired for each station from Environment Canada (2003a; 2003b). The Environment Canada Historical Adjusted Climate Database (Environment Canada, 2003a) of homogenized and long-term temperature time series, which has been specifically designed for climate change analyses over Canada, was used for the majority of stations utilized in the study and the identifier (adj) is used in this paper to illustrate these data sets.

This study also examined the projected range of temperature and precipitation changes for the same representative sample of provincial parks for the 2020s, 2050s and 2080s utilizing the results of the Intergovernmental Panel on Climate Change's (IPCC) *Special Report on Emissions Scenarios* (SRES) family of Global Circulation Models (GCMs). The results from this analysis were derived from the Canadian Climate Impacts and Scenarios data centre (CICS, 2004).

Biome-type Change Analysis

The vegetation change scenarios for this analysis were based on modeling results developed for the IPCC-Working Group 2 (Neilson, 1998). The two Global Vegetation Models (GVMs) used were BIOME3 (Haxeltine and Prentice, 1996) and MAPSS (Neilson, 1995). A concise comparison of the vegetation discrimination criteria and ecophysiological processes modeled by BIOME3 and MAPSS is provided in Peng (2000: 43).

Fire Severity Change Analysis

The methodology of this analysis is based on the modeling results of Stocks *et al.* (1998) and Stocks *et al.* (2000). In these studies, fire weather data from the 1980s and the Second Generation Canadian Global Circulation Model (CGCM2) (Boer *et al.,* 1992; McFarlane *et al.,* 1992) were utilized to compare the intensity and spatial distribution of current and projected (2050s and 2090s) seasonal levels of fire weather severity across Canada. In this approach, values are used to provide an assessment of relative fire potential based solely on weather, independent of forest vegetation and fuel conditions.

Results

Historical Climate Trend Analysis

Historical climate analysis was completed for a representative sample of provincial parks to illustrate trends in mean annual temperature (MAT) and total annual precipitation (TAP) over the historical records (Figure 1). Results of this analysis are displayed as MAT (°C) and TAP (mm) relative to the average of the 1961-1990 period. All stations utilized in the analysis illustrated an increase in MAT over their respective historical records compared to the 1961-1990 period. Results showed that the greatest increase in MAT over the instrumental record occurred in Tidewater (Moosonee [adjusted] station – +1.2°C) and Quetico (Thunder Bay [adjusted] station – +1.14°C) Provincial Parks. Conversely, results illustrated that Rondeau Provincial Park has experienced the least temperature change over the historical record (Ridgetown ACS [adjusted] station – +.26°C). Interestingly, eight of the ten stations utilized in this analysis illustrated MAT trends greater than +0.8°C (two stations had increases greater than 1°C).

For the five-year grouped period of 1997-2001, eight of the ten climate stations analyzed for MAT experienced the warmest five-year mean temperatures on record (Table 1). However, it is important to note that the Parry Sound station used for Massasauga Provincial Park only contained data up to 1990, and 1986-1990 was the warmest five year period on record for this station. So, for nine of the ten stations utilized in this study, the last five years on record were the warmest. Interestingly, the 1997-2001 grouped record for Tidewater Provincial Park was the only five-year grouping to show a mean above 0°C

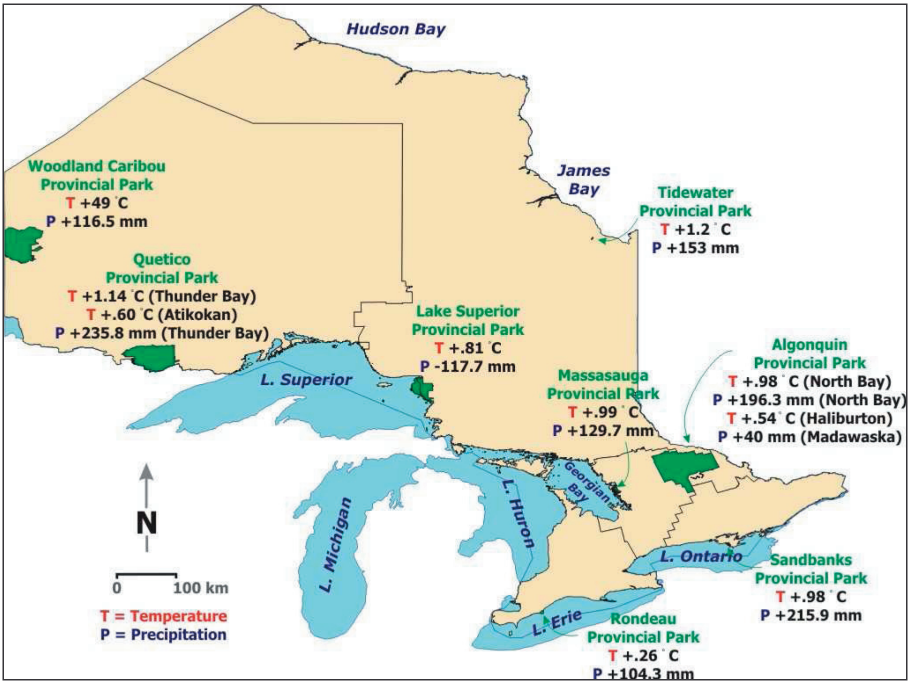

Figure 1. *Mean annual temperature (°C) and total annual precipitation (mm) trends over the historical records.*

(1.08°C). Rondeau Provincial Park was the only park to not display the warmest grouped five year MAT in the last five years of its respective historical record (1951-1955).

Climate Change Projections

Based on the outputs from the SRES scenarios utilized in this study, most parks are projected to experience annual temperature changes of about +1.8-3.2°C in the 2020s, +1.8-7°C in the 2050s and +2.5°C-10.0°C in the 2080s (Figure 2). The greatest changes in temperature were projected for the northern parks, including Tidewater Provincial Park and Woodland Caribou Provincial Park. The greatest change in precipitation was projected for Tidewater Provincial Park in the Northeast Zone and the least precipitation change was projected for Rondeau Provincial Park in the Southwest Zone (Figure 3).

Station	Warmest 5-year Period	Five Warmest Years	Coolest 5-year Period	Five Coolest Years
Rondeau Provincial Park (Southwest Zone)				
Ridgetown ACS (adj)	1951-1955	1998, 1987, 1949, 1953, 1951	1976-1980	1924, 1926, 1978, 1940, 1976
Algonquin Provincial Park (Central Zone)				
North Bay A (adj)	1997-2001	1998, 2001, 1999, 1987, 1953	1962-1956	1940, 1972, 1943, 1976, 1980
Haliburton (adj)	1997-2001	1932, 1931, 2001, 1999, 1998	1902-1906	1904, 1917, 1940, 1943, 1934
Sandbanks Provincial Park (Southeast Zone)				
Belleville (adj)	1997-2001	1998, 1999, 1953, 1991, 1987	1921-1925	1923, 1926, 1940, 1924, 1934
Massasauga Provincial Park (Central Zone)				
Parry Sound	1986-1990	1921, 1987, 1931, 1949, 1990	1884-1888	1885, 1883, 1888, 1904, 1926
Quetico Provincial Park (Northwest Zone)				
Thunder Bay A (adj)	1997-2001	1999, 2001, 1987, 1998, 1931	1912-1916	1917, 1912, 1950, 1907, 1936
Atikokan‡	1997-2001	1998, 2001, 1931, 1987, 1999	1978-1982	1972, 1979, 1957, 1985, 1929
Woodland Caribou Provincial Park (Northwest Zone)				
Red Lake A	1997-2001	1987, 1998, 2001, 1999, 1941	1992-1996	1950, 1979, 1955, 1972, 1996
Lake Superior Provincial Park (Northeast Zone)				
Wawa A (adj)	1997-2001	1991, 1999, 1987, 2001, 1998	1972-1976	1950, 1972, 1956, 1976, 1989
Tidewater Provincial Park (Northeast Zone)				
Moosonee (adj)	1997-2001*	2001, 1998, 1999, 1987, 1952	1932-1936	1917, 1933, 1936, 1912, 1972

‡ = joined record (adj) = adjusted

Table 1. *Warmest and coolest periods in historic climate records.*

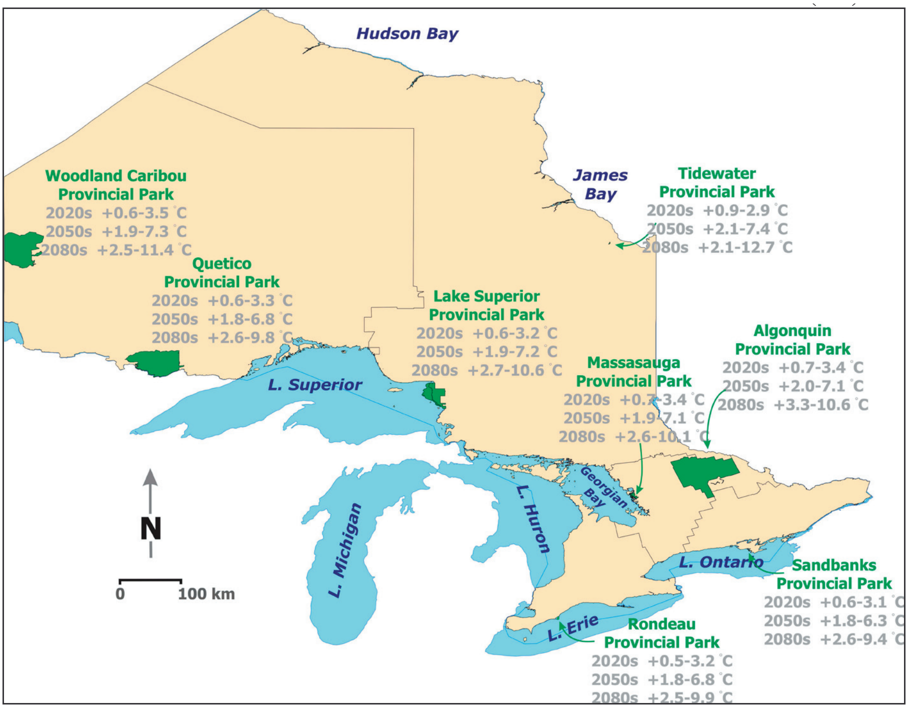

Figure 2. *Climate change projections – temperature (°C).*

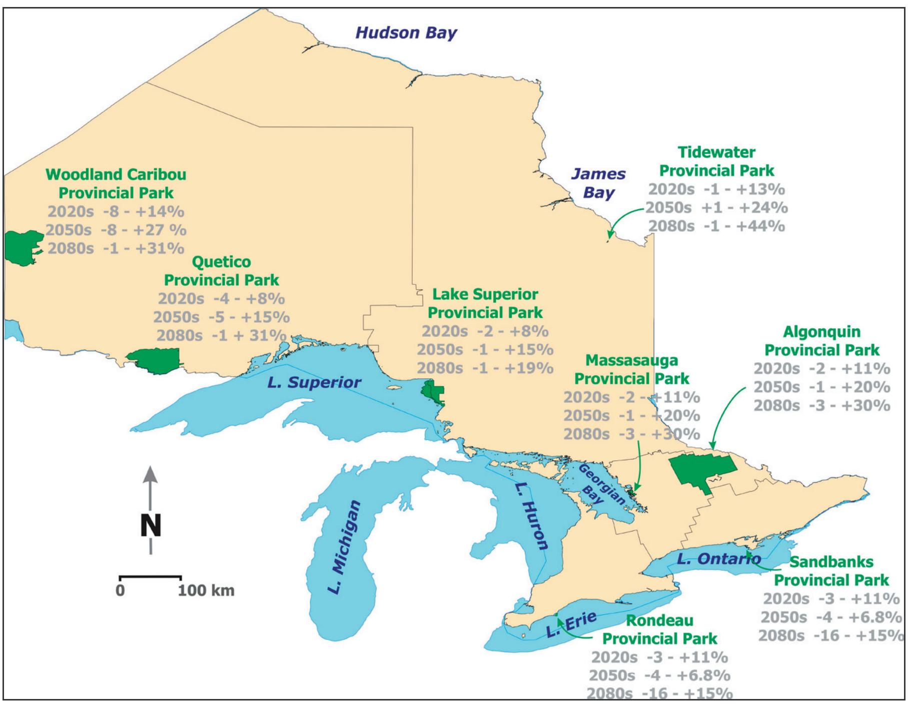

Figure 3. *Climate change projections – precipitation (%).*

Fire Severity Change Analysis

The results of the fire-severity change analysis generally indicated a considerable decrease in the 'low' fire severity rankings and increases in the 'high', 'very high' and 'severe' fire severity rankings for the majority of Ontario's provincial parks under the 2050s (ca. 2 x CO_2) and especially the 2090s (ca. 3 x CO_2) scenarios (Figure 4). The scale shown is relative, with values above six being extreme. A real value of zero is only possible in remote cold regions where no fire danger exists in the summer months. For the 1980-1990 baseline, 13% of Ontario's provincial parks are classified within the 'low' (<1) fire severity ranking. By the 2050s and 2090s respectively, it is projected that only 5% and 1% of Ontario's provincial parks will be classified within the 'low' (<1) fire severity ranking.

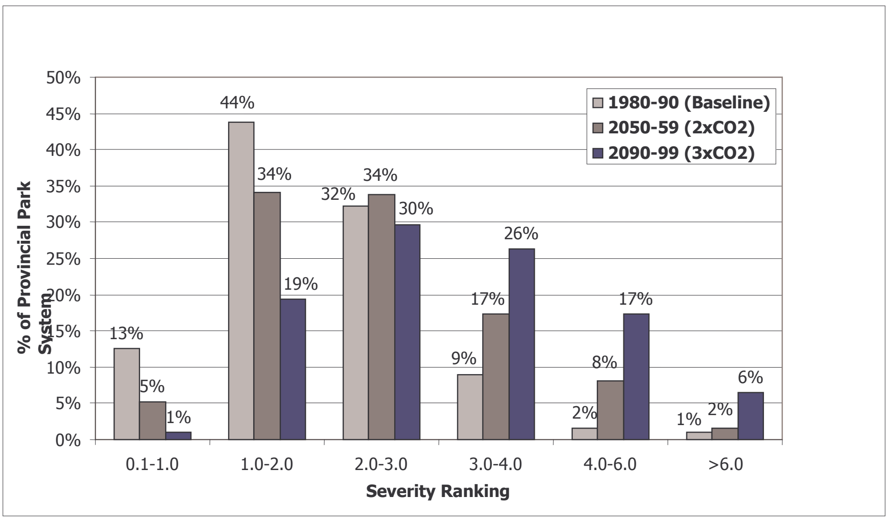

Figure 4. *Fire severity change in Ontario provincial parks for the 1980-1990 (baseline) and the 2050s (ca. 2 x CO_2) and 2080s (ca. 3 x CO_2) utilizing the CGCM2 GCM†.*

† Low severity ranking = <1.0, Moderate severity ranking = 1-3; High severity ranking = 3-4; Very high severity ranking = 4-6; Severe severity ranking = >6. The scale shown is relative, with values above 6 being extreme. A real value of zero is only possible in remote cold regions where no fire danger exists in the summer months.

Under the 1980-1990 baseline scenario, only 12% of Ontario's provincial parks fell into the 'high' (3-4), 'very high' (4-6) and 'extreme' (>6) fire severity ranking range. However, in the 2050s and 2090s scenarios, the number of provincial parks projected to experience these 'high' (>3) fire severity ratings increases considerably. The proportion of Ontario's provincial parks projected to be classified within the 'high', 'very high' and 'extreme' forest fire severity rankings is projected to increase to 27% by the 2050s and 49% by the 2090s.

Because of the high concentration of provincial parks in the south, a regional bias is evident – the majority of provincial parks utilized in this analysis are projected to experience 'moderate' levels (1-3) of fire severity under both the ca. 2 x CO_2 (68%) and ca. 3 x CO_2 (49%) scenarios. This is because the 'moderate' forest fire severity ranking is dominant throughout southern Ontario where a high number of relatively small provincial parks are located. Despite the relatively 'high' fire severity rankings projected for parks south of 46°N, wildfires in these forests will continue to be of negligible size under a warmer climate – this is a reflection of the relatively small forest patches which, in most instances, surround municipal infrastructures currently in place (e.g., roads, agriculture, telecommunication lines). Overall, the large numbers of provincial parks in southern Ontario comprise only a small proportion of the total protected area system area. However, many of these provincial parks are significant for biodiversity conservation as they protect many rare or endangered Carolinian species.

Biome-type Change Analysis

Regardless of the Global Vegetation Model (GVM) and climate change scenario used, the vegetation modeling results showed the potential for substantial change in biome-type and biome-representation in Ontario's provincial park system (Figures 5; Figure 6). The MAPSS GVM scenarios projected that the majority (72% HadCM2; 93% UKMO) of Ontario's provincial parks could experience a change in biome-type (Table 2). The BIOME3 GVM scenario showed only slightly fewer provincial parks with a change in biome-type (64% HadCM2).

With regards to biome representation change in the Ontario park system (Table 3; Table 4), there was general agreement among the scenarios. The GVM scenarios generally projected that Ontario provincial parks could experience increased representation of southern biome types, such as 'tree savanna decidu-

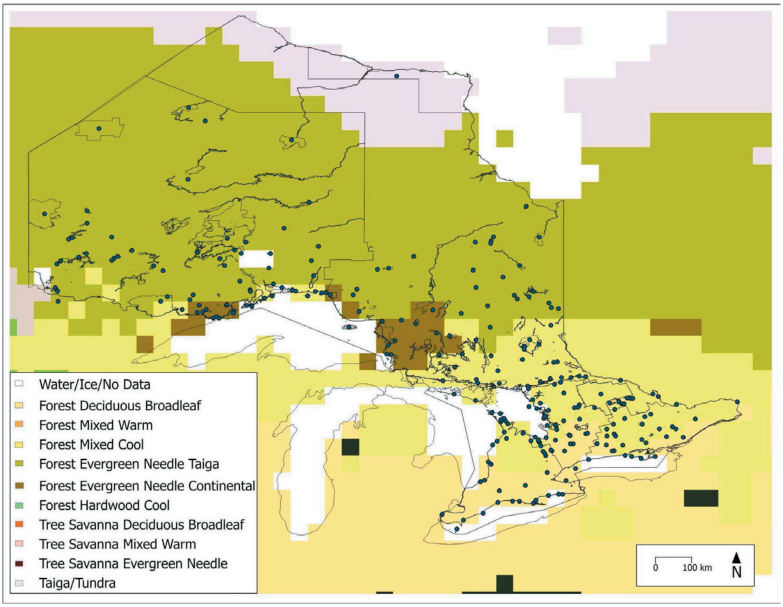

Figure 5. *Biome change in Ontario provincial parks – MAPSS current.*

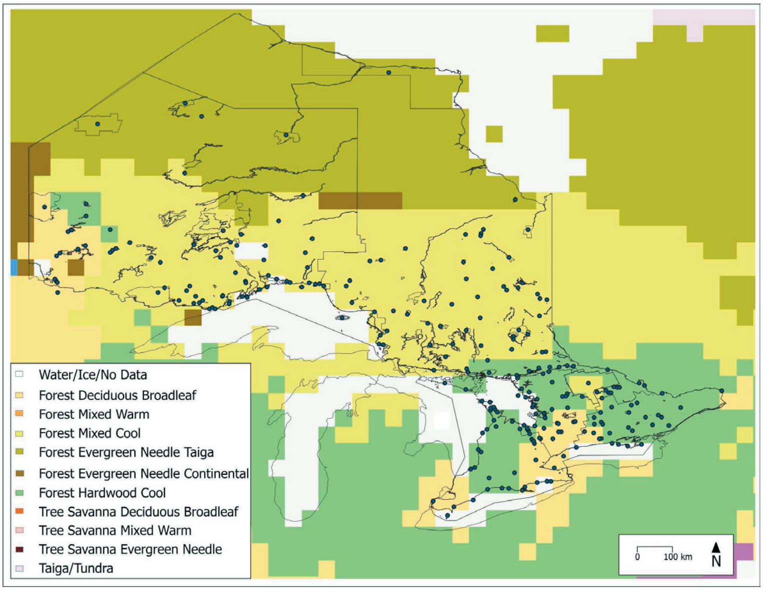

Figure 6. *Biome change in Ontario provincial parks – MAPSS HadCM2.*

Table 2. *Biome-type change within Ontario provincial parks.*

	MAPSS		BIOME3
	HadCM2	UKMO	HadCM2
Change	72%	93%	64%

Table 3. *Biome-type representation change of Ontario provincial parks – MAPSS.*

Classification	Number of Provincial Parks under MAPSS Current	Number of Provincial Parks under HadCM2	Number of Provincial Parks under UKMO
Water/error	28	28	24
Forest deciduous broadleaf	36	37	153
Forest mixed warm	0	0	15
Forest mixed cool	95	101	1
Forest evergreen needle taiga	73	6	0
Forest evergreen needle continental	20	0	0
Forest hardwood cool	0	81	0
Tree savanna deciduous broadleaf	0	0	15
Tree savanna mixed warm	0	0	41
Tree savanna evergreen needle continental	0	0	4
Taiga/tundra	1	0	0

Table 4. *Biome-type representation change of Ontario provincial parks – BIOME3.*

Classification	Number of Provincial Parks under BIOME3 Current	Number of Provincial Parks under HadCM2
Water/Error	40	32
Boreal Evergreen forest/woodland	29	1
Temperate conifer forest	125	101
Temperate/boreal mixed forest	32	0
Temperate deciduous forest	27	119

ous broadleaf' and 'tree savanna mixed warm'. Conversely, the more northern biome types, such as 'forest mixed cool', 'forest evergreen needle-taiga', and 'forest evergreen needle continental', could decrease considerably within the provincial park system. Both the MAPSS HadCM2 and UKMO scenarios projected that the 'forest evergreen continental needle' biome-type will experience a complete loss in representation. While both MAPSS scenarios (HadCM2 and UKMO) projected generally similar changes in biome representation for Ontario provincial parks, there were some discrepancies. For example, where the HadCM2 scenario projected an increase in the 'forest mixed cool' biome (+6%), the UKMO scenario projected a considerable decrease (-94%).

The BIOME3 HadCM2 scenario (Table 4) projected generally similar changes in biome representation to that of the MAPSS HadCM2 scenario, although it is acknowledged that different classification schemes were utilized between the two GVMs, thereby limiting a more detailed comparative analysis. Generally, the BIOME3 HadCM2 scenario projected losses of all of the northern biome types, including the 'boreal evergreen forest/woodland' biome-type (-97%). Conversely, because the BIOME3 HadCM2 scenario projected great expansion of the 'temperate deciduous forest' biome into Ontario, considerable increases in representation of this biome-type by Ontario provincial parks resulted (92 provincial parks). Under all GVM and GCM scenarios, the only provincial park located on the 'taiga/tundra' biome (Polar Bear Provincial Park) is projected to change biome type, leading to the loss of representation of this biome in the provincial park system.

Implications for Ontario Parks Policy, Planning and Management

On November 25, 1992, the Canadian Parks Ministers Council met jointly with the Canadian Council of Ministers of the Environment and Wildlife Ministers Council of Canada and signed a *Statement of Commitment to Complete Canada's Networks of Protected Areas* (FPPC, 2000). In so doing, the key commitment for Parks Ministers was to:

> *"make every effort to complete Canada's networks of protected areas representative of Canada's land-based natural regions by the year 2000 and accelerate the protection of areas representative of Canada's marine natural regions."* (FPPC, 2000: 5).

As a result, most jurisdictions in Canada have adopted some type of ecoregion or biogeoclimatic classification framework as the main system-planning tool for their terrestrial protected area system.

In response to the *Statement of Commitment*, the most recent planning and management policy adopted by Ontario Parks, *Ontario Provincial Parks – Planning and Management Policies* emphasized that:

> *"...provincial parks are established to ensure that features representing the most significant aspects of Ontario's natural and social history are protected, now and in the future."* (OMNR, 1992a: 2).

Each of Ontario's provincial parks makes a particular contribution to the system based on the resources it contains. Ecoregion representation is defined as one of nine principles utilized to guide the management of the Ontario provincial park system (in addition to the principles of 'permanence', 'distinctiveness', 'variety', 'accessibility', 'coordination', 'system', and 'classification'), and to achieve the system's overall objectives. The *Planning and Management Policy* document states that:

> *"Provincial Parks are established to secure for posterity representative features of Ontario's natural and cultural heritage. Wherever possible the best representations of our heritage will be included in the park system."* (OMNR, 1992a: 13).

Three classification schemes – one each for life science, earth science, and cultural resources – form the basis for the park program's representation targets (OMNR, 1992a: 12).

The potential impacts of climate change have important implications for Ontario Parks' current policy and planning frameworks. Ontario Parks' approach to protected areas establishment is based on the works of Hills (1952, 1959, 1960, 1961, 1976) and Hills and Pierpoint (1960) who recognized the fundamental importance of climate in the classification of forest sites. Hills (1952, 1959, 1960, 1961, 1976) and Hills and Pierpoint (1960) utilized what they referred to as 'normal', 'uniform', 'homogenous' or 'definite' reference points for the development of vegetation for the surrounding region. In a changing climate, conservation planning based on 'normal' or 'homogenous' reference points and protecting representative samples of natural areas as an *in-situ* entity will have to deal with many challenges. As Scott and Suffling (2000) emphasize, protected area system planners will have to attempt to 'hit a moving target' of ecological representativeness as current protected area system plans are based on current species assemblages. Moreover, because possible non-analogue assemblages are unknown, comprehensive representation in a system of protected areas could become an increasingly difficult objective (Scott and Suffling, 2000).

Provincial park management plans are prepared for each park, in accordance with the *Provincial Park Management Planning Manual* (OMNR, 1992b). A review of management plans for several Ontario provincial parks revealed additional climate change implications for the management of individual protected areas. These include park objective statements; fire management strategies: individual species management plans and species at risk; non-native species management programs; and visitor management plans. For example, the management plan of each individual park defines the purpose of the park. The *Quetico Provincial Park Management Plan* states that:

> *"Quetico Provincial Park will protect a representative portion of the ancient geological history, modern biological environments, and cultural features associated with site region 4W."* (OMNR, 1995a, emphasis added).

The emphasis on the protection of 'modern' biological environments in these management plans renders them sensitive to changing climatic and vegetative conditions. And, as a result, these parks may no longer represent the ecological communities they are mandated to protect. Again, the principles of 'representation' and 'modern biological environments' are problematic as they assume climatic and biogeographic stability. Similar sensitivities can be found in virtually all park management plans examined to date.

OMNR mandates at the species level are also sensitive when climate change impacts are considered. For example, Polar Bear Provincial Park, as the name implies, was established to protect one of the world's largest denning areas for polar bears. Under climate and vegetation change scenarios and future sea-ice projections, the park would no longer provide suitable habitat for the species it was originally designed to protect. Reduced ice-cover in Hudson and James Bay may force polar bears northward in search of more suitable habitat and where they can more effectively hunt ringed seal. Changing vegetative conditions would force woodland caribou northward to more suitable habitat in

Woodland Caribou Provincial Park, a park specifically set up to protect this keystone species. Similarly, a re-introduced population of Woodland Caribou in Lake Superior Provincial Park may be forced northward to more suitable habitat, largely undoing the value of this conservation initiative. As a final example, the objective of Pinery Provincial Park is:

> *"…to protect an extensive, provincially significant, freshwater dune system with associated representative floral, faunal and cultural features and to provide high quality educational and recreational experiences."* (OMNR, 1986: 1).

Moreover, the *Pinery Provincial Park Management Plan* states that the park will:

> *"…ensure that Pinery harbours the richest <u>naturally</u> occurring communities inherent to its unique microclimate and topography."* (OMNR, 1986: 4, emphasis added).

What is considered 'natural' will become more difficult to define as species ranges change, and new species, currently regarded as 'unnatural', may find suitable refuge within Pinery. As a consequence, the species requiring protection will increasingly be open to interpretation. In these cases, the ecological manifestations of climate change may be such that the established management objectives of the park are no longer viable.

Perhaps most important from a species conservation perspective are the potential effects that climate changes poses for rare or endangered species. Many species at risk have very restricted habitat requirements or habitat availability and are the most vulnerable to changes. Without active intervention (i.e., translocation), many significant species are likely to be lost. The *Canadian Species at Risk Act* defines a 'wildlife species' as a species 'native' to Canada and that has been present in Canada for at least 50 years (Government of Canada, 2002: 7). By this definition, species that have expanded (or will expand) their range into Canada under changing climate and ecological conditions, possibly classified as endangered in the United States, would not qualify as a species at risk under the *Canadian Species at Risk Act*, complicating the issue of endangered species conservation in Ontario and all Canadian jurisdictions.

Other OMNR strategies, such as those for control of invasive species, will also require review because of climate change. For example, the *Lake Supe-*

rior Provincial Park Management Plan (OMNR, 1995b) states that non-native plant species will be removed if they conflict with the representational values for which the park has been established. This statement does not allow for ecosystem change, and the very definition of a non-native species (a species beyond its historical range) is challenged under climate change and resultant biogeographic shifts. Other policies, such as the *Fire Management Policy for Provincial Parks and Conservation Reserves* (OMNR, 2004), may also be tested for their effectiveness in re-establishing ecological representation (one of the reasons why the policy was developed in the first place) under changing climate and fire severity conditions.

A New Approach

It is emphasized here that the traditional systematic approach to park system planning is indeed problematic; and, a new approach – one that incorporates ecosystem dynamics and change – is needed to safeguard against the fundamental flaws of *in-situ* representation and species loss in Ontario. Like the Canadian national park system plan, Ontario's provincial park planning frameworks were designed with the assumption of essentially static biogeography and will be challenged by the dynamic nature of ecosystem evolution brought about by projected climate change in the 21st century. Ultimately, the results of this study contribute to a growing body of research that questions the capacity of existing protected area networks to fulfill this objective in an era of global climate change.

Although there is much uncertainty over the timing, extent and manner in which ecosystems will respond to new climatic conditions, this does not negate the necessity of identifying and assessing adaptation strategies that might reduce the vulnerability of Ontario's system of protected areas to anticipated climate change. Recent discussions at a Parks Research Forum of Ontario (PRFO) workshop on climate change (Leslie Frost Research Centre, Dorset, Ontario, March, 2004) and an OMNR northwest zone climate change workshop (Quetico Centre, Atikokan, Ontario, December, 2004) revealed that incorporating climate change into protected area system planning and individual park management decision-making processes will be a complex and incremental process, but one that the majority of Ontario Parks' managers and planners strongly agreed was essential. Interestingly, all participants (approximately 30) who completed a survey distributed at the PRFO climate change workshop stated that they believed that either climate change is occurring or climate change is certain to occur. Results of the survey also indicated that the majority of respondents strongly agreed (67%) or somewhat agreed (22%) to the statement that climate change is going to substantially alter protected area policy and planning over the next 20 years. Finally, respondents strongly disagreed (67%) or somewhat disagreed (33%) with the statement that climate change is too far in the future to consider it in current planning activities.

The issues related to the strategic response of Ontario Parks to the challenges of climate change are very complex and will require significant input from many conservation stakeholders. Institutional financial commitment, capacity enhancement, cooperation, direction and communication are a number of facets that will be essential to the successful implementation of any climate change adaptation related strategies in Ontario.

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