Towards Climate Change Adaptation in Canada's Protected Natural Areas: an Ontario Parks Case Study

by

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Author’s Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Climate is a major catalyst of change in the composition, structure and function of the Ecosphere. Empirical studies of species response to climate consistently reveal that the anomalous warming occurring over roughly the past half-century is having a discernible impact on contemporary biodiversity. Climate change has also been implicated in several species extinctions, a phenomenon projected to be exacerbated in the future.

These studies and events indicate that the implications of climate change for biodiversity conservation are considerable. Biodiversity conservation is one of the major modern rationales behind formal protected natural areas establishment, planning and management. However, most protected natural areas have been designed to protect in perpetuity specific natural features, species and communities *in-situ*, and don't take into account shifts in ecosystem composition, structure and function that are being induced by climatic change. The ecological manifestations of climate change will be such that the established species management objectives of some protected natural areas will no longer be viable. Consequently, protected natural areas agencies will need to be adaptive in order to be able to respond to climate change-induced impacts and improve their ability to deliver their various protected natural area- and biodiversity-related mandates, such as the perpetual protection of representative elements of natural heritage.

The principal goal of this dissertation was to begin the process of climate change adaptation (mainstreaming) within the Canadian protected natural areas community, thereby facilitating the ability of jurisdictions, agencies and organizations to adapt to climate change-related impacts and implement adaptation decisions. To realize this goal, four objectives were formulated: i) to synthesize the *state of knowledge* on climate change, biodiversity and protected natural areas policy, planning and management; ii) to establish the *state of climate change adaptation* with respect to Canadian protected natural areas agencies; iii) to assess the current *position*, *priorities*, and *challenges* of, and *barriers* to, Canadian protected natural areas agencies with respect to climate change adaptation; and iv) to develop a *climate change adaptation portfolio* and *evaluate* the suitability of the portfolio for implementation by a Canadian protected natural areas agency, Ontario Parks.

The research revealed that while mainstreaming climate change into protected natural areas policy, planning and management will be essential for the persistence of biodiversity and the continued viability of current planning and management practices under a changing climate, there is a clear disconnect between the perceived salience of climate change and a lack of available resources

(e.g., financial resources and staffing) and scientific capacity required to respond to the issue. Moreover, the limited protected natural areas climate change literature to-date provides little guidance to the planners and managers of already established protected natural areas. Accordingly, there is an indicated need to assist Canadian protected natural areas agencies in the identification and evaluation of adaptation options as a strategic starting point in working towards mainstreaming climate change into relevant program areas.

In response to this indicated need, a policy Delphi survey method was used to facilitate the identification and evaluation of adaptation options tailored specifically to Ontario Parks. A panel of protected natural areas experts identified 165 adaptation options within Ontario Parks' six major program areas [(i) Policy, System Planning & Legislation; (ii) Management Direction; (iii) Operations & Development; (iv) Research, Monitoring & Reporting; (v) Corporate Culture & Function; and (vi) Education, Interpretation & Outreach) in the first iteration of the policy Delphi. Adaptation options were subsequently evaluated individually for their perceived level of desirability, feasibility and implementation time-frame by the panel via a second iteration of the policy Delphi. In so doing, the research evaluated the relative merit (or practicality) of alternative adaptation options in these program areas in order to help identify priority (or 'first-order') adaptations for consideration in an official climate change adaptation strategy by Ontario Parks.

The research provides a solid conceptual and methodological framework with important practical 'lessons learned' that will help Canadian protected natural areas jurisdictions understand, address and begin mainstreaming climate change into policy, planning and management decision-making. Collectively, the research includes the first practical discussion of adaptation to climate change within the institutional framework of any Canadian protected natural areas jurisdiction, representing a significant contribution to the protected natural areas planning literature at the science-policy interface.

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Table of Contents

List of Figures

List of Tables

Abbreviations and Acronyms

AGO	Auditor General of Ontario
AHTEG	United Nations Convention on Biological Diversity Ad Hoc Technical Expert Group
AR4	Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007)
BP	Before Present
CCME	Canadian Council on Minister's of the Environment
CBS	Canadian Biodiversity Strategy
CCEA	Canadian Council on Ecological Areas
COP	Conference of the Parties
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CO_2	Carbon Dioxide
CPAWS	Canadian Parks and Wilderness Society
EBR	Environmental Bill of Rights (Ontario)
ECO	Environmental Commissioner of Ontario
ENGOs	Environmental Non-Government Organizations
ESA	Endangered Species Act
GCMs	General Circulation Models
GFDL	Geophysical Fluid Dynamics Laboratory
GHGs	Greenhouse Gases
GISS	Goddard Institute for Space Studies
GVMs	Global Vegetation Models
HadCM2	Second Hadley Centre Coupled Ocean-Atmosphere GCM
IBP	United Nations International Biological Program
IGS	Idea Generating Strategy
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MAPSS	Mapped-Atmosphere-Plant-Soil System
MBS	Environment Canada Migratory Bird Sanctuaries
MNR	Ontario Ministry of Natural Resources
MOE	Ontario Ministry of the Environment
MPI	Max Planck Institute for Meteorology, Germany
MVP	Minimum Viable Population
NRCan	Natural Resources Canada
NHIC	National Heritage Information Centre
NWA	Environment Canada National Wildlife Areas
OLL	Ontario's Living Legacy
OP-CCAWG	Ontario Parks Climate Change Adaptation Working Group
PAs	Protected Natural Areas
PACC	University of Waterloo and Canadian Council on Ecological Areas (CCEA) Protected Areas and Climate Change Survey
PCIC	Pacific Climate Impacts Consortium
PPCRA	Provincial Parks and Conservation Reserves Act (Ontario)
PRFO	Parks Research Forum of Ontario
SBSTTA	United Nations Convention on Biological Diversity Subsidiary Body on Scientific,

	Technical and Technological Advice
UNDP	United Nations Development Program
UKMO	United Kingdom Meteorological Office
RMR	Required Migration Rate
SPA	Ontario Parks Special Purpose Account
SRES	Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios
TAR	Intergovernmental Panel on Climate Change Third Assessment Report (2001)
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
UNFCC-NAPA	United Nations Framework Convention on Climate Change - National Adaptation Programmes of Action (NAPAs)
USAID	United States Agency for International Development
WCPA	World Commission on Protected areas
WWF	World Wildlife Fund

List of Publications

This dissertation is based on the following papers:

Refereed papers

Scott, D.J. and C.J. Lemieux. 2007. Climate change and the management of protected areas in the boreal forest. *The Forestry Chronicle,* 83(3): 347-357.

Lemieux, C.J. and D.J. Scott. 2005. Climate change, biodiversity conservation and protected areas planning in Canada. *The Canadian Geographer,* 49(4): 384-399.

Scott, D.J. and C.J. Lemieux. 2005. Climate change and protected areas planning in Canada. *The Forestry Chronicle,* 81(5): 696-703.

Scott, D., J. Malcolm and C.J. Lemieux. 2002. Climate change and modelled biome representation in Canada's national parks system: implications for planning and park mandates. *Global Ecology and Biogeography,* (11): 475-484.

Research reports and case studies

Lemieux, C.J., T.J. Beechey and D.J. Scott. In prep. *The State of Climate Change Adaptation in Canada's Protected Natural Areas.* Canadian Council on Ecological Areas (CCEA) Technical Report. Ottawa: Ontario.

Lemieux, C.J. and D.J. Scott. In press. A Case Study on Climate Change and Ontario's Protected Areas. In: Dearden and Rollins (Eds.). *Parks and Protected Areas in Canada: Planning and Management.* Oxford University Press. 3rd edition.

Lemieux, C.J., D.J. Scott, R.G. Davis and P.A. Gray. 2008. *Changing Climate, Challenging Choices: Ontario Parks and Climate Change Adaptation.* Natural Resources Canada, Climate Change Impacts and Adaptation Program (CIAP): Ottawa, Ontario. 60 p.

Scott, D.J., C.J. Lemieux and L.J. Pentelow. 2008. *A Review of the Role of Protected Ecosystems in Climate Change Mitigation.* Parks Canada Agency: Gatineau, Québec. 22 p.

Scott, D.J., C.J. Lemieux and L.J. Pentelow. 2008. *A Synopsis of Protected Area Agency Climate Change Mitigation and Adaptation Activities.* Parks Canada Agency: Gatineau, Québec. 42 p.

Lemieux, C.J., D.J. Scott, P.A. Gray and R. Davis. 2007. *Climate Change and Ontario's Provincial Parks: Towards Adaptation.* Climate Change Research Report 06 (CCRR-06). Ontario Ministry of Natural Resources (OMNR): Peterborough, Ontario. 81 p.

Chapter 1

Dissertation Problem Statement, Goals and Objectives and Outline

1.1 Problem Statement

The last two decades have witnessed the greatest global expansion in formal protected natural areas[1] compared to any other in the era of human history. Area set aside for conservation more than doubled during this period and now covers approximately 11.5% of the globe's surface area (WCPA, 2008). In Canada, total surface area protected currently exceeds 10%, compared to approximately 4% in 1987 (Dearden and Dempsey, 2004; WCPA, 2008).[2] Despite this increase in overall protected area, there has been increasing concern amongst international and national agencies and organizations over the loss of biodiversity. This concern has been reflected globally in the ratification of the *United Nations Convention on Biological Diversity* (*UNCBD*) by 189 countries (UNCBD, 1992). In Canada, concern over loss of biodiversity has led to the development of the *Canadian Biodiversity Strategy* (CBS, 1995), the release of several national high-profile reports indicating the decline of ecological integrity within national parks [e.g., *Banff-Bow Valley Study* (1996) and *Unimpaired for Future Generations? Protecting Ecological Integrity with Canada's National Parks* (Parks Canada, 2000)] and other more recent provincial biodiversity-related initiatives, including *Protecting What Sustains Us: Ontario's Biodiversity Strategy* (MNR, 2005) and *Caring for Natural Environments: A Biodiversity Action Plan for Saskatchewan's Future (2004-2009)* (Government of Saskatchewan, 2004).

Despite these initiatives, global estimates of species extinction suggest that approximately 400 to 500 vertebrates, 400 invertebrates and 650 plant species have become extinct in the past 400 years, 1,000 to 10,000 times the normal background extinction rates expected in the absence of human influence (Wilson, 1989; IUCN, 2007). According to the 2007 International Union for Conservation of Nature (IUCN) *Red List of Threatened Species*, a total of 16,306 species are currently threatened with extinction, with more than 5,773 new species added to the list since 2000 (IUCN, 2007). These statistics parallel the findings of the recent United Nation's (UN) *Millennium Ecological Assessment* which reported that 60% of the world's ecosystem services are degraded or used

[1] The terms park, protected area, protected natural area and reserve will be used interchangeably throughout this dissertation to denote *"an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means."* (IUCN, 2007b) This IUCN definition is recognized by the Government of Canada (Government of Canada, 2006). The degree of protection afforded to protected natural areas in Canada varies widely and they take many different forms and functions [see Paleczny *et al.* (2000) and Gray *et al.* (2007) for a review].

[2] The total number of protected areas in Canada has increased 19% since 2000 (Government of Canada, 2006).

unsustainably (UN, 2005). Even in Canada, where relatively extensive natural areas persist, the number of species at risk of extinction is increasing rapidly (Sanderson *et al.*, 2002). As of 2007, 13 species have been declared extinct in Canada and a further 539 are currently considered to be 'endangered', of 'special concern', 'threatened' or 'extirpated' (an increase of over 24% since 2001) (COSEWIC, 2001 and 2007).

Climate plays a crucial role in determining the geographic distribution patterns of plant and animal species (Holdridge, 1987; UNCBD, 2003). In its *Fourth Assessment Report* (*AR4*), the Intergovernmental Panel on Climate Change (IPCC) estimated that global climate warming has been 0.74°C over the past 100 years (1896 to 2005) and the warming trend over the past 50 years is twice that for the past 100 years (IPCC, 2007a). An increasing number of empirical studies document the globally coherent ecological signals of climate change impacts (e.g., Hughes, 2000; McCarty, 2001; Parmesan and Yohe, 2003; Root *et al.,* 2003; CCME, 2003; Parmesan and Galbraith, 2004; Pounds *et al.,* 2005; Walther *et al.,* 2005; Parmesan, 2006; IPCC, 2007b) and, alarmingly, climate change has been implicated in several species extinctions (Pounds *et al.,* 1999, 2005 and 2006; Thomas *et al.,* 2006; Parmesan, 2006), a phenomenon projected to be exacerbated in the future (Thomas *et al.,* 2004; Bomhard *et al.,* 2005; Schwartz *et al.,* 2006; Parmesan, 2006; IPCC, 2007b).

The IPCC *AR4* projects that global mean temperatures could increase by 1.8 to 4.0°C by the end of the 21st century (IPCC, 2007a) and a review of recent evidence related to climate system feedbacks indicates that the probability of exceeding the IPCC *Third Assessment Report* (*TAR*) mid-range scenario (+3.0°C) has increased (Pittock, 2006). In Canada, projected increases in temperature by most *AR4* scenarios are more than double the global average (PCIC, 2008). Such increases in temperature, occurring over a relatively short period of time in terms of ecological evolution, are anticipated to have significant consequences for global biodiversity (IPCC, 2002; Malcolm and Markham, 2002; Root *et al.,* 2003; Thomas *et al.,* 2004; Lovejoy and Hannah, 2005; Parmesan, 2006; IPCC, 2007b; Huntley, 2007). It has been projected that between 15 to 37% of the world's species could be *"committed to extinction"* due to climate change by 2050 (under mid-range climate change scenarios and *without* the consideration of future habitat loss) (Thomas *et al.,* 2004). The IPCC *AR4* similarly estimated that approximately 20 to 30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperatures exceed 1.5 to 2.5°C (IPCC, 2007b). In Canada, the required migration rates (RMRs) of several forest species would need to be ≥1,000 m/year if they are to keep pace with projected climatic warming anticipated over the 21st century (Malcolm *et al.,* 2002). Furthermore, the recent listings of two coral species, staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmata*), and the polar bear (*Ursus maritimus*) as 'threatened' under the U.S. *Endangered Species Act* (*ESA*) have marked the first time any nation has listed species due to climate change-related impacts (U.S. Department of the Interior, 2008). Taken collectively, these studies and events indicate that the implications of climate change for biodiversity conservation are considerable.

Biodiversity conservation is one of the most important modern rationales behind protected natural areas establishment, planning and management. Concomitantly, protected natural areas are the most common response mechanism to biodiversity loss and are called for under the United Nations' *Convention on Biological Diversity* (UNCBD, 1992: Article 8). However, most protected natural areas have been designed to protect specific natural features, species and communities *in-situ*, and don't take into account shifts in ecosystem composition, structure and function that could be induced by climatic change. In this context, a recent report by the IUCN emphasized that *"Protected areas managers … cannot … fulfill our duties as stewards of Earth's last natural ecosystems if we plan and manage for a world that no longer exists."* (WCPA and ICUN, 2004: 1) A growing number of authors worldwide contend that climate change has the potential to undermine over a century of conservation efforts (Rutherford *et al.,* 1999; Scott and Suffling, 2000; Scott *et al.,* 2002; Hannah *et al.,* 2002, 2005 and 2007; Hossell *et al.,* 2003; Téllez-Valdés and Dávila-Aranda, 2003; Hannah and Salm, 2005; Lemieux and Scott, 2005; Scott and Lemieux, 2005; Welch, 2005; Pyke and Fisher, 2005; Araújo *et al.,* 2005; Thuiller et al., 2006a and 2006b; Harrison *et al.,* 2006; Scott and Lemieux, 2007; Lemieux *et al.,* 2007; Hannah *et al.,* 2007; Huntley, 2007).

Changes in ecosystem composition, structure and function brought about by climate change over the course of the 21st century may necessitate a fundamental rethinking in the approach to biodiversity conservation in Canada and indeed globally. Despite the recent advances in knowledge noted above, and considering the important role that protected natural areas could play in facilitating the long-term adaptation of biodiversity to climate change, *adaptation* studies *specific* to protected natural areas remain limited (Scott *et al.,* 2002, emphasis added). Despite repeated requests by the international biodiversity and protected natural areas community to 'mainstream'[3] climate change

[3] 'Mainstreaming' refers to the integration of climate change into decision-making processes (see Klein *et al.,* 2007). As Burton (2007) emphasized, the goal of mainstreaming is to ensure that climate change is not considered in isolation from the numerous other factors that influence decision-making, but rather is considered as one element of integrative analysis and policy development.

into protected natural areas planning, management strategies and the design of protected areas systems (e.g., WCPA, 2003; UNCBD, 2003, 2006 and 2007); no climate change adaptation strategy specific to protected natural areas has been implemented by any international or Canadian jurisdiction. Consequently, protected natural areas jurisdictions and protected natural areas themselves will need to be established, planned and managed differently if they are to meet the conservation challenges posed by climate change over the 21st century and beyond.

1.2 Goals and Objectives

In an effort to better understand and address the challenge described in the previous section, this dissertation seeks to accomplish several tasks. The principal goal of this dissertation is to begin the process of climate change adaptation (mainstreaming) within the Canadian protected natural areas community, thereby facilitating the ability of jurisdictions, agencies and organizations to adapt to climate change-related impacts and implement adaptation decisions. This dissertation expands upon recent research which has primarily focused on the potential impacts and policy, planning and management implications of climate change for Canadian protected natural areas jurisdictions (e.g., Scott *et al.,* 2002; Lemieux and Scott, 2005; Scott and Lemieux, 2005; Welch, 2005; Scott and Lemieux, 2007; Lemieux *et al.,* 2007) and contributes to mainstreaming climate change into the six major planning and management program areas specific to Ontario Parks [i.e., (i) Policy, System Planning & Legislation; (ii) Management Direction; (iii) Operations & Development; (iv) Research, Monitoring & Reporting; (v) Education, Interpretation & Outreach; and, (vi) Corporate Culture & Function]. To realize this goal, five *objectives* have been formulated:

i) to identify the Canadian protected natural areas *policy, planning and management sensitivities* with respect to climate change (with emphasis on Ontario Parks);

ii) to synthesize the *state of knowledge* on climate change, biodiversity and protected natural areas policy, planning and management;

iii) to establish the *state of climate change adaptation* with respect to Canadian protected natural areas agencies;

iv) to assess the current *position*, *priorities*, and *challenges* of, and *barriers* to, Canadian protected natural areas agencies with respect to climate change adaptation; and

v) to develop a *climate change adaptation portfolio* and *evaluate* the suitability of these adaptation options for implementation by a Canadian protected natural areas agency (Ontario Parks).

In doing so, this dissertation is the first known attempt to identify and evaluate climate change adaptation options specifically tailored to a protected natural areas jurisdiction. Furthermore, this dissertation presents a framework that helps achieve expert consensus on a complex issue that has no policy analogue and is confounded by significant uncertainty. While adapting to climate change will be a multifarious and incremental process for protected natural areas agencies, this dissertation marks a significant progression towards the development of potential solutions. The climate change adaptation portfolio and perspectives provided here are not implied to be a panacea for worldwide biodiversity loss and protected natural areas planning and management in an era of climate change. They do, however, offer a solid conceptual and methodological framework with important practical 'lessons learned' that will help Canadian protected natural areas jurisdictions understand, address and begin mainstreaming climate change into policy, planning and management decision-making and work towards achieving objectives inscribed within international treaties such as the *United Nations Convention on Biological Diversity* (*UNCBD*)[4] and the *United Nations Framework Convention on Climate Change* (*UNFCCC*).

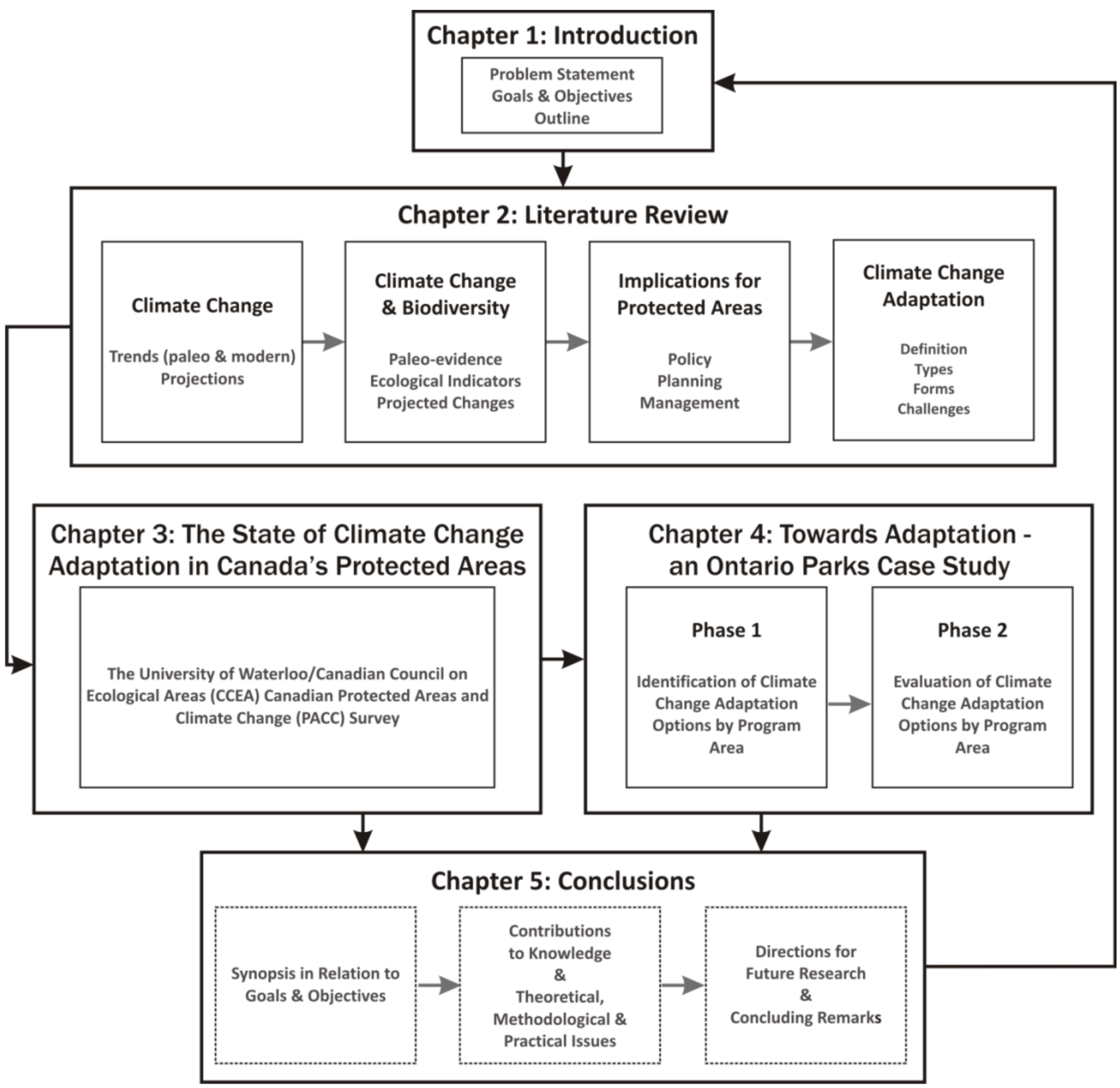
1.3 Outline

This dissertation has been organized into five chapters, comprising four main parts: Introduction; Literature Review; Analysis; and Conclusions. A schematic diagram of the dissertation layout is presented in Figure 1. Following this introductory chapter, Chapter 2 examines the scientific evidence of climate change and sets out the types of future climate and biophysical impacts anticipated to occur within and outside protected natural areas (both globally and within Canada). The Chapter proceeds with an analysis of the implications of climatic and ecological change for existing Canadian federal and provincial protected natural areas policy, planning and management

[4] The seventh meeting of the Conference of the Parties (COP) to the *UNCBD* recognized the need for Parties to *"Integrate climate change adaptation measures in protected area planning, management strategies, and in the design of protected area systems."* (decision VII/28/Goal 1.4.5)

frameworks. The Chapter concludes with a synthesis specifically pertaining to climate change adaptation. The distinctive features of climate change adaptation are identified (i.e., definitions, types and forms) and common elements and differentiated challenges of adaptation approaches are examined. Interspersed within this section are reviews of scholarship that have contributed to practical implementation of climate change adaptation in other sectors, such as agriculture and forestry. The general characteristics of adaptation in these sectors are identified, and institutional and sectoral adaptation barriers are explored. The analysis presented in Chapter 2 sets the climate change 'problem' in context thereby establishing the rationale for the remainder of the dissertation (i.e., the need for climate change adaptation in Canada's natural protected natural areas community).

Figure 1 Schematic of dissertation layout.



Given the policy, planning and management sensitivities and challenges set out in Chapter 2, a national survey of all federal and provincial/territorial jurisdictions and a number of leading environmental non-governmental organizations (ENGOs) responsible for the establishment, planning and management of protected natural areas was conducted in Chapter 3 to assess the state of climate change adaptation by Canadian protected natural areas agencies. The survey was conducted in cooperation with the Canadian Council on Ecological Areas (CCEA) whose jurisdictional members regard climate change as a critical issue of the future for protected natural areas. Climate change was recognized as an issue of high priority in its current *Business Plan* (CCEA, 2004) and its importance was further highlighted by all Canadian protected natural areas jurisdictions participating in a recent CCEA Northern Protected Areas (NPA) survey (Wiersma *et al.,* 2005). The purpose of this survey was to: i) determine the climate change impacts currently occurring and are anticipated in protected natural areas across Canada; ii) evaluate the perceived importance of climate change relative to other protected natural areas management issues within Canadian jurisdictions; and iii) identify what policy, planning and management response efforts (i.e., adaptations) have occurred or are being considered by protected natural areas agencies across Canada. The Chapter concludes with a discussion on key barriers and capacity challenges to effective climate change adaptation within the Canadian protected natural areas sector. The results provide the *first* national overview of the state of climate change adaptation and protected natural areas in any nation.

Chapter 3 reveals that climate change is perceived to be an issue that will rapidly alter the pace of protected natural areas policy development in Canada and that agencies currently do not have the capacity to respond to potential impacts. The analysis of the state of climate change adaptation in Canada's protected natural areas informed the scope and methodological design of an Ontario Parks case study presented in Chapter 4. A policy Delphi survey method is used to facilitate both the *identification* and *evaluation* of climate change adaptation options for consideration by Ontario Parks within the context of their six major program areas earlier noted (e.g., for their perceived level of desirability, feasibility and time-frame for implementation). The policy Delphi has recently been recommended by the United Nations Development Program (UNDP) as a strategic approach in framing climate change policy issues and in formulating adaptation options (UNDP, 2004: 201). The research systematically examines the types of adaptations that protected natural areas experts would like mainstreamed into Ontario Parks' policy, planning and management frameworks [including those that suggest radical departures from current approaches (e.g., protected natural areas system planning)] in order to offset potential negative impacts (e.g., species loss), take advantage of potential opportunities (e.g., increased visitation) and increase the overall resilience of 'the system' to climate change impacts. The analysis also examines the perceptional differences of adaptation options amongst expert groups. Such an analysis fits into what Burton *et al.* (2002) characterize as *Type 2*[5] adaptation research, which contributes directly to adaptation policy development by identifying which adaptation policies are needed and how they can be developed and applied. Overall, the Chapter includes the *first* practical discussion of adaptation to climate change within the institutional framework of any Canadian protected natural areas jurisdiction.

The final Chapter presents conclusions and is divided into four sections. In the first section, a synthesis of the achievements of the dissertation goals and objectives is presented. In the second section, potential opportunities, limitations and challenges associated with the identified adaptation options, and the methodological approach used to evaluate them, are considered. A number of recommendations and future research opportunities are provided in section three to help strengthen the method should it be adopted in the future by the broader conservation community. An integrated look at how this dissertation has contributed to and informed Ontario Parks' overall climate change adaptation process completes the dissertation.

[5] *Type 1* adaptation research is carried out as part of a climate impact assessment by providing aggregate estimates to what extent feasible adaptation might reduce adverse impacts of climate change. Such research has previously been conducted in a Canadian protected natural areas context by the author (and others) and can be found in in the following publications: Scott *et al.* (2002), Lemieux and Scott (2005), Scott and Lemieux (2005) and Scott and Lemieux (2007). Type 1 studies have often assumed that adaptation responses are known, whereas in fact this is often not the case (Burton *et al.,* 2002).

Chapter 2
Climate Change, Implications for Biodiversity and Protected Natural Areas Policy, Planning and Management and Adaptation

2.1 Chapter Introduction

In the six years following the release of the Intergovernmental Panel on Climate Change's (IPCC) *Third Assessment Report* (TAR) (IPCC, 2001a and 2001b), significant progress has been made in understanding past (i.e., paleo) and modern (i.e., 20th and early 21st century) climate change and related biophysical responses, as well as in projecting future change (e.g., IPCC, 2007a and 2001b; Parmesan, 2006). These advances have occurred due to increased availability of new data, more sophisticated analyses of data, improvements in the understanding and simulation of physical and ecological processes in models and more extensive consideration for uncertainty in model results (IPCC, 2007a and 2007b).

To assess the significance of modern (i.e., observed) and future (i.e., projected) climate change and related ecological change for protected natural areas policy, planning and management, it is essential to place such change in a longer-term context. This Chapter is organized into ten major sections each with several sub-sections. Sections 2.2 to 2.6 examine climate change and biodiversity related impacts. Specifically, these sections: i) review the climate change evidence from both 'proxy'[6] and 'modern' (i.e., 1850 to 2006) instrumental climate data; ii) review the paleo and observed ecological responses to climate; and iii) synthesize the results of relevant climate and ecological change projection analyses. Discussion of findings specifically relevant to Canada and Ontario are interspersed within each of these reviews. Section 2.7 provides a discussion on the challenges that climate change poses for current protected natural areas policy, planning and management approaches. The Chapter concludes with a synthesis pertaining to climate change adaptation generally and within the protected natural areas sector specifically (Section 2.9). The distinctive features of climate change adaptation are identified (i.e., definitions, types and forms) and common elements and differentiated challenges of adaptation approaches are examined. Interspersed within this section are reviews of scholarship that have contributed to practical implementation of climate change adaptation in other sectors, such as agriculture and forestry. The general characteristics of adaptation in these sectors are identified, and institutional adaptation barriers are explored. The syntheses presented within this Chapter set the context for the remainder of the dissertation.

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[6] 'Proxies' are climate sensitive biogeophysical measurements. The most frequently used proxies are tree ring widths and densities, borehole temperatures, ice cores, peat bog sediments and ocean floor sediments [see Bradley (1999) for a more detailed discussion].

2.2 Paleo and Modern Climate Change

Both paleo-climatic temperature data reconstructions and modern instrumental observations alike indicate that climate changes[7] occur on all resolvable timescales, from day-to-day (e.g., extreme events), the inter-annual (e.g., year-to-year) to the geological (e.g., millions of years and longer). This variability is known to result from a complex interaction between both internal (e.g., intrinsic modes of variability in the atmosphere and ocean) and external factors to the climate system (e.g., solar and volcanic radiative forcing) (IPCC, 2001a). Earth has been much warmer and much colder than the current +14 degrees Celsius (ºC) throughout the geologic record but the coupled atmosphere, ocean, ice and biological systems and external forcing influences were different at global, regional and local scales and so comparisons are difficult. Svenson *et al.* (2000) estimate that global surface temperatures increased 6 to 8ºC at the start of the Eocene Epoch approximately 55 million years before present (BP). It is reported that temperatures subsequently cooled approximately 3ºC corresponding to the advent of the Pliocene Epoch four million years BP (Ravelo *et al.,* 2004). The Pleistocene Epoch, beginning approximately two million years BP, was characterized by swings of many degrees Celsius, corresponding to glacial intervals and abrupt warming at the onset of interglacials (IPCC, 2001a; Mann, 2007).

Over the past 700,000 years, variability in global temperature has shown a close association with greenhouse gases (GHGs), especially carbon dioxide (CO_2) and methane (CH_4) (Figure 2) (IPCC, 2001a; Svensen *et al.,* 2004; EPICA, 2004; IPCC, 2007a).[8,9] Abrupt climatic changes[10] are also

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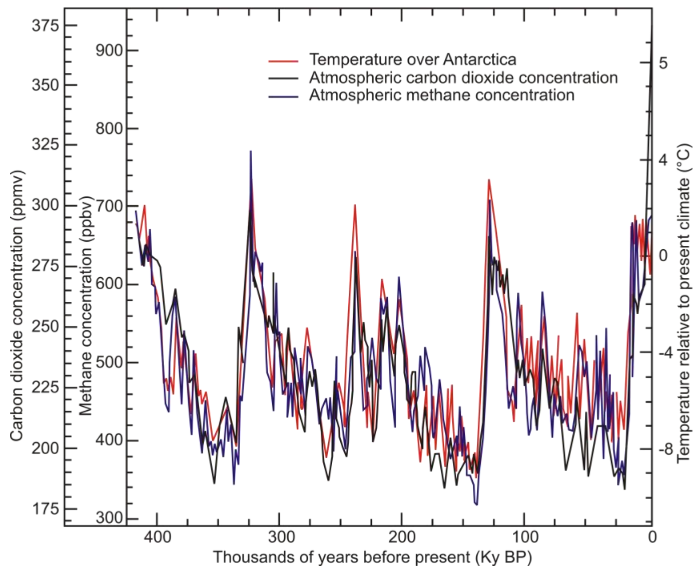
[7] This thesis adopts the Intergovernmental Panel on Climate Change's (IPCC) definition of climate change, which is *"any change in climate over time whether due to natural variability or as a result of human activity."* This definition is different than that of the *United Nations Framework Convention on Climate Change* (*UNFCCC*), which states that climate change is *"a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."* The definition of climate change adopted by the Government of Canada is consistent with that of the IPCC.

[8] The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005 and exceeds by far the natural range over the last 650,000 years (180 to 300 ppm) (IPCC, 2007a).

[9] It is important to note that is within the glacial-interglacial oscillations occurring over the past 700 thousand years that defined the envelope of natural climate variability familiar to most modern ecosystems (Overpeck *et al.,* 2002).

documented throughout the paleo record. For example, changes of up to 16°C and a factor of 2 in precipitation have occurred in some places in periods as short as decades to years (Alley and Clark, 1999; Lang *et al.,* 1999; Alley *et al.,* 2003).

Figure 2 Temperature (°C), carbon dioxide (CO_2) and methane (CH_4) history of the past 400,000 years. Adapted from: IPCC (2001a) and updated using IPCC (2007a).



More recently, the globe has experienced several temperature shifts, such as the Medieval Warm Period (9th to 14th century) and the Little Ice Age (15th to 19th century) (Figure 3). According to the IPCC (2007a), global average temperature has increased approximately 0.74°C (±0.18 °C) over the past 100 years (1896 to 2005) and the rate of warming has greatly accelerated since the 1950s[11] (Mann *et al.,* 2003; Mann and Jones, 2004; Mann, 2007; IPCC, 2007a; Hou, 2007). Since the instrumental record of global surface temperature began in 1850, 11 of the last 12 years (1995 to 2006) rank among the 12 warmest years. The IPCC (2007a) concluded that most of the observed increase in global average temperatures since the mid-20th century is "*very likely*" (>90% probability) the result of human activities that are increasing GHG concentrations in the atmosphere.

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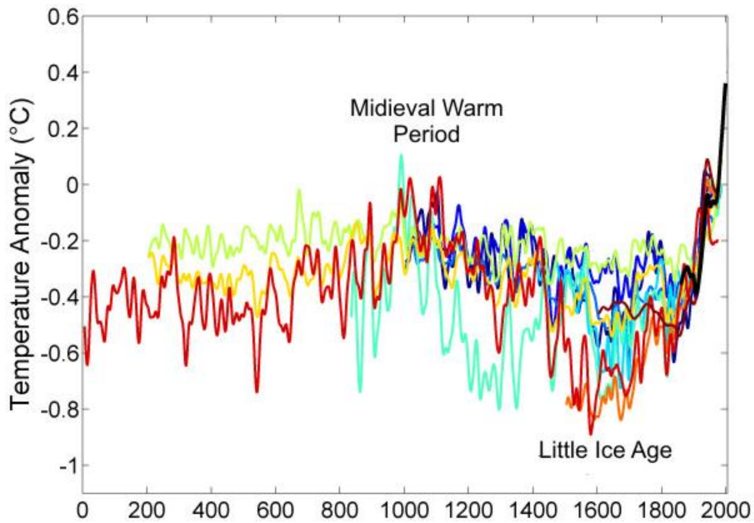
[10] *"Technically, an abrupt climate change occurs when the climate system is forced to cross some threshold, triggering a transition to a new state at a rate determined by the climate system itself and faster than the cause. Chaotic processes in the climate system may allow the cause of such an abrupt climate change to be undetectably small."* (National Research Council, 2002: 14)

[11] The linear warming trend over the last 50 years (0.13°C/decade) is nearly twice that of the last 100 years.

Figure 3 Northern Hemisphere temperature reconstructions for the past 1300 years (°C, with respect to the 1961 to 1990 mean). Source: Mann, 2007 and based on: Jones *et al.* (1998); Mann *et al.* (1999); Crowley (2000); Briffa *et al.* (2001); Esper *et al.* (2002); Mann and Jones (2003); Jones and Moberg (2003); Jones and Mann (2004); Huang (2004); Moberg *et al.* (2005); Oerlemans (2005).



Annual temperatures have been increasing across Canada over the instrumental record as well. Over the last 59 years, temperatures have increased 1.3°C[12] (Environment Canada, 2007) (Figure 4). Seven of the last 12 years (1995 to 2006) rank among the 12 warmest years in the instrumental record, with 1998 (+2.5°C) slightly edging out 2006 (+2.4°C) as the warmest year on record (Environment Canada, 2007). Conversely, 1972 was the coolest year on record (-1.8°C) (Environment Canada, 2007). The warming trend across Canada has not been uniform geographically (Table 1 and Figure 5) or seasonally (Figure 6). The trends, extremes and current year rankings presented in Table 1 illustrate that the Mackenzie District (Northwest Territories) has the largest warming trend of 2.2°C and the Atlantic region has the smallest warming trend of 0.3°C over the 59-year period of record. With the exception of the springs of 2002 and 2004, seasonal temperatures have remained above normal for more than nine years (Figure 6). Between 1947 and 2006, winter temperatures have increased 2.1°C, spring temperatures have increased 1.6°C, summer temperatures have increased 0.9°C and autumn temperatures have increased 0.6°C (Environment Canada, 2007).

[12] The Canadian increase in temperature over this period is one-tenth of a decimal point short of being double the global average temperature increase over the same period.

Figure 4 Canada annual temperature departures over the past 59 years (°C, with respect to the 1961 to 1990 mean). Drawn using data from: Environment Canada (2007).

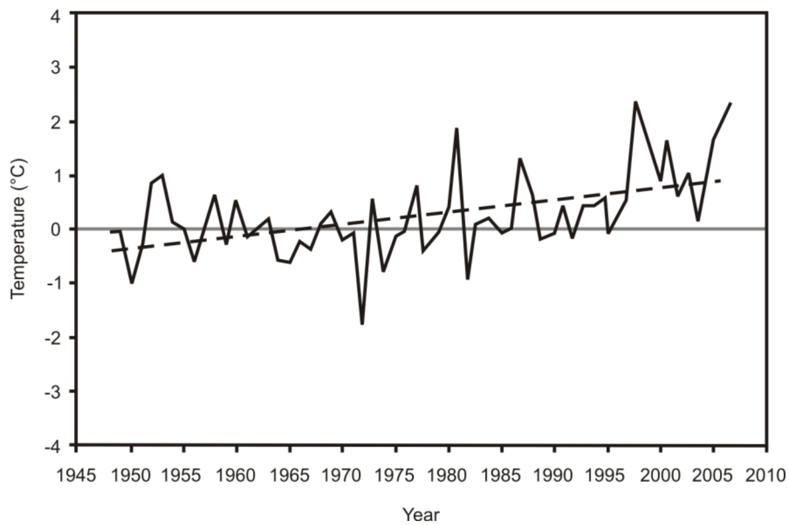


Table 1 Annual temperature trend, extremes and current annual ranking within Canadian climate regions over the past 59 years. Tabled using data from: Environment Canada (2007).

		EXTREME YEARS			
Region	**Trend (°C)**	**Warmest**	**Dep. (°C)**	**Coldest**	**Dep. (°C)**
Atlantic Canada	+0.3	1999	+2.0	1972	-1.4
Great Lakes/St. Lawrence Lowlands	+0.6	1998	+2.3	1978	-1.0
Northeastern Forest	+0.8	2006	+2.3	1972	-1.9
Northwestern Forest	+1.8	1987	+3.0	1950	-2.1
Prairies	+1.4	1987	+3.1	1950	-2.1
South British Columbia Mountains	+1.6	1998	+2.0	1955	-1.8
Pacific Coast	+1.3	1958	+1.6	1955	-1.2

North British Columbia Mountains/Yukon	+2.1	2005	+2.8	1982	-2.1
Mackenzie District	+**2.2**	1998	+3.9	1972	-1.5
Arctic Tundra	+1.5	2006	+3.4	1972	-2.4
Arctic Mountains and Fiords	+1.0	2006	+2.3	1972	-1.9
Canada	**+1.3**	**1998**	**+2.5**	**1972**	**-1.8**

Figure 5 Canadian climate regions and associated warming over the past 59 years (°C, with respect to the 1961 to 1990 mean). Drawn using data from: Environment Canada (2007).

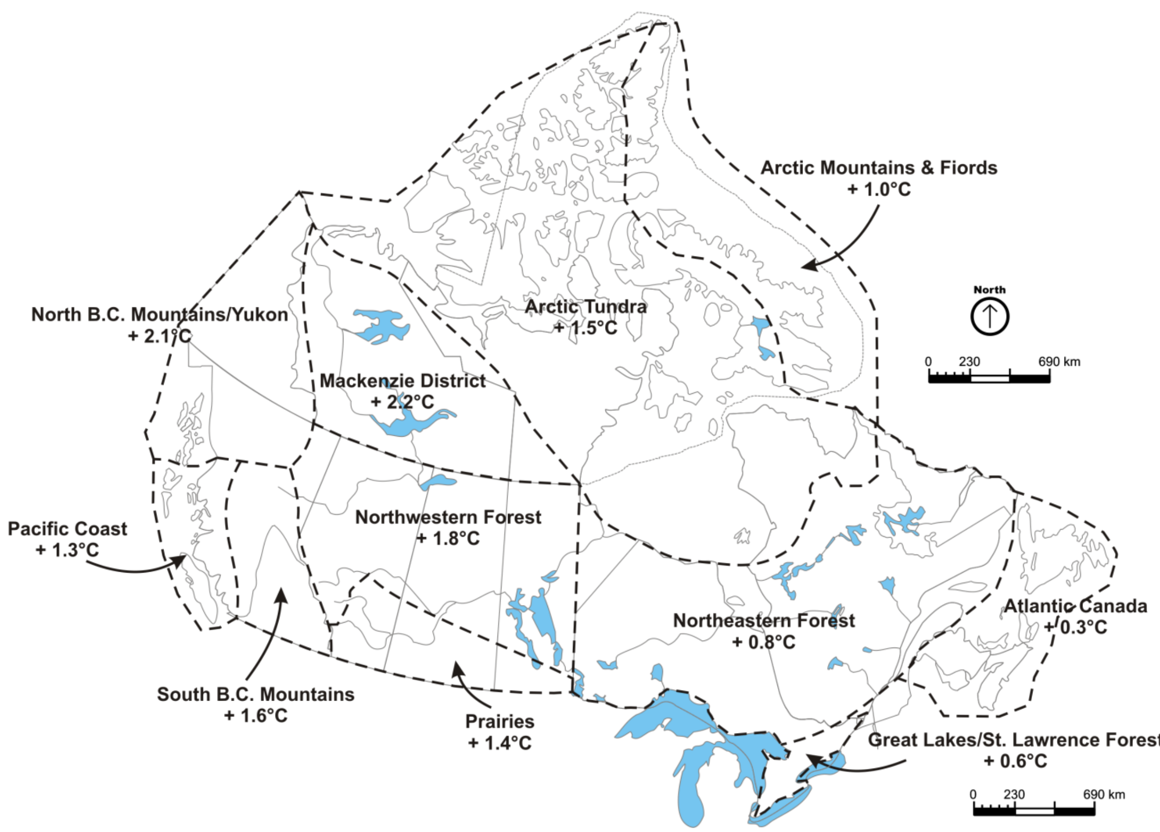
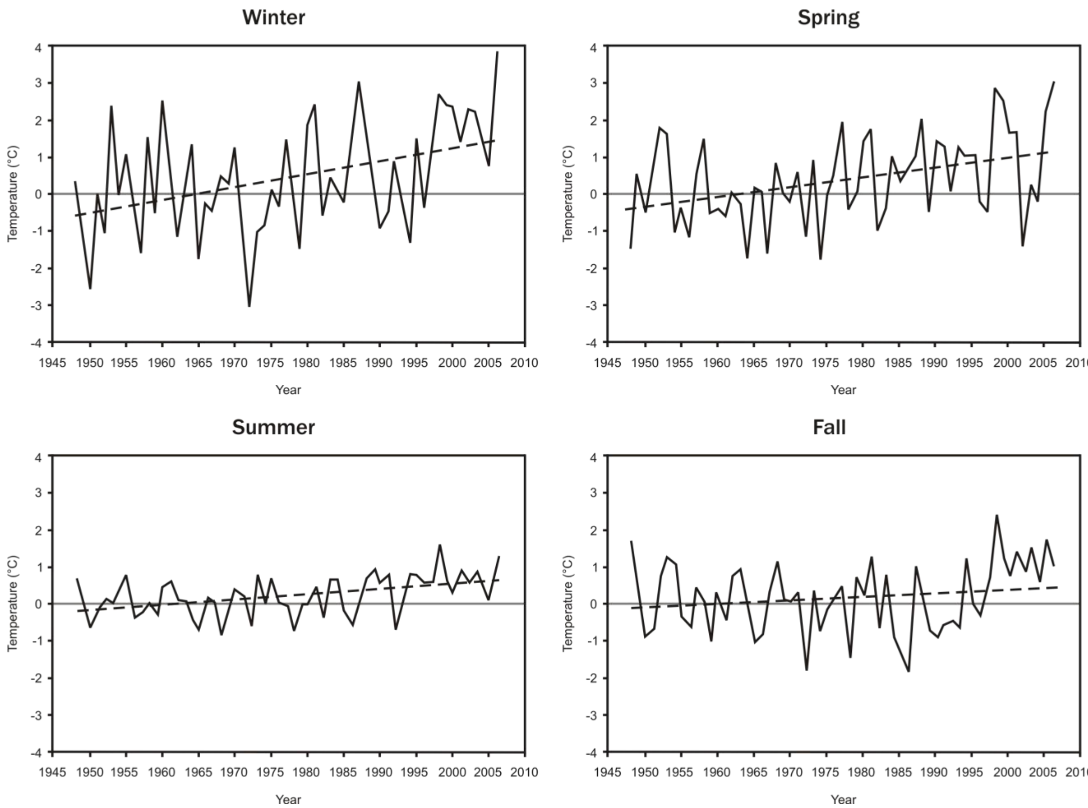


Figure 6 Canadian seasonal temperature departures over the past 59 years (°C, with respect to the 1961 to 1990 mean). Drawn using data from: Environment Canada (2007).



Climate modelling and studies indicate that the observed global warming trend since the 1950s cannot be fully explained by natural factors, but instead, requires a contribution from anthropogenic forcing factors, primarily from fossil fuel burning and the resultant increase in atmospheric CO_2 (Tett *et al.,* 1999; IPCC, 2001a; Braganza *et al.,* 2004; Mann, 2007; IPCC, 2007a). Reconstructions of northern hemispheric mean-surface temperature from both proxy and modern instrumental temperature records indicate that global twentieth-century and early 21st century warming is unprecedented over at least the past two millennia (Mann, 2003; Mann, 2007; Hou, 2007) and, as Mann (2007: 111) emphasized, this *"… anomalous warmth can only be explained by modern anthropogenic forcing."*

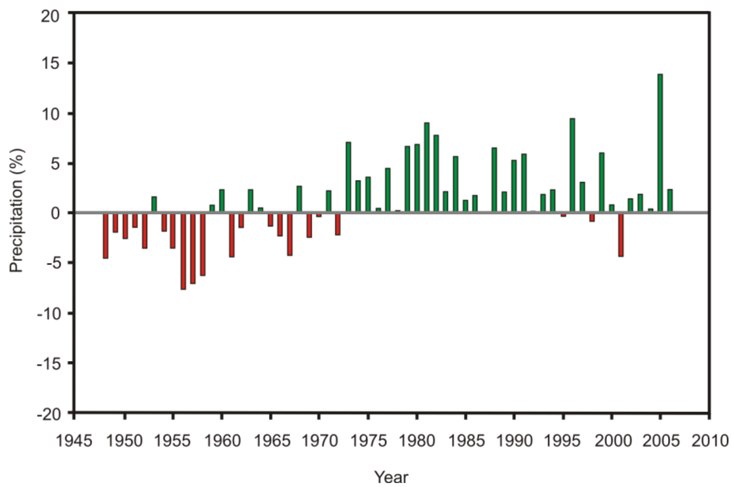
While anthropogenic influences on climate have been detected in surface air temperature, sea level pressure and ocean heat content, detecting an anthropogenic influence on precipitation has been difficult to detect until recently.[13] Zhang *et al.* (2007) were the first to demonstrate that anthropogenic forcing has contributed significantly to observed increases in precipitation in the Northern Hemisphere mid-latitudes, drying in the Northern Hemisphere subtropics and tropics, and moistening in the Southern Hemisphere subtropics and deep tropics.[14] Overall, global land-based precipitation has increased by about 2% since the beginning of the 20th century (IPCC, 2001a). While this increase is reported as being statistically significant, precipitation trends have been neither geographically or temporally uniform. For example, significant increased precipitation has been observed in the eastern parts of North and South America, northern Europe and northern and central Asia (IPCC, 2007a; Zhang *et al.,* 2007). Conversely, drying has been observed in the Sahel, the Mediterranean, southern Africa and parts of southern Asia (IPCC, 2007a; Zhang *et al.,* 2007).

While the annual precipitation trend in Canada over the past 59 years has generally been increasing (Figure 7: with the exception of 1972 and 2001, annual precipitation amounts have been above normal), it does reflect the global trend by exhibiting considerable geographic and temporal variability. The wettest year in Canada was 2005 (+13.4%) and the driest was 1956 (-7.3%) (Environment Canada, 2007). Seasonal precipitation levels have been at or above normal for eight of the last nine seasons, with the summer of 2006 being the lone exception (Environment Canada, 2007).

[13] Santer *et al.* (2007) also recently provided preliminary evidence of an emerging anthropogenic signal in the moisture content of Earth's atmosphere. The authors suggested that the 0.41 kg/m^2 per decade increase in atmospheric moisture content since 1988 is primarily due to human caused increases in GHGs, and not due to solar forcing or recovery from the eruption of Mount Pinatubo.

[14] It is interesting to note that the observed changes in precipitation identified by Zhang *et al.* (2007) are larger than those simulated by IPCC (2001a) *SRES* scenarios.

Figure 7 Canada annual national precipitation departures over the past 59 years (%, with respect to the 1961 to 1990 mean). Drawn using data provided by Environment Canada (2007).



2.3 Paleo Ecological Responses to Climate

Climate is the major factor controlling the global patterns of vegetation structure, productivity and plant and animal species composition. As Holdridge (1947), Woodward (1987) and others (e.g. Precht *et al.,* 1973) have shown, plants reproduce, grow and respond to a certain range of temperatures and seasonal patterns of precipitation. Likewise, animals have distinct thermal and precipitation tolerances and are dependent on the ongoing persistence of suitable habitat and associated food species for survival (Schwartzman, 2002). Changes in climatic variables, such as temperature and precipitation, affect biodiversity directly through changes in *phenology* (e.g., earlier flowering of trees or egg-laying in birds), changes in geographic *distribution* and *abundance*, resulting from migration (e.g., pole-ward/elevational shifts in ranges) and habitat change to more favourable conditions, and changes to *physiologically* (e.g., sex determination). Biodiversity is also affected *indirectly* by climate-induced alterations of inter-specific relationships (e.g., predator-prey relationships) (see Parmesan, 2006).

Spatially explicit analyses of pollen and macro-fossil datasets have indicated that past changes in climate resulted in major shifts in species ranges and marked reorganization of biological communities, landscapes and biomes in what was considered to be an unfragmented global landscape (e.g., Delcourt and Delcourt, 1987; Liu, 1990; Tallis, 1990; Overpeck *et al.,* 1991; Overpeck *et al.,* 1992; Williams, 2002). Species appeared to shift their geographical distributions as though tracking the changing climate, rather than remaining stationary and evolving new forms (e.g., Davis and Zabinski, 1992; Davis and Shaw, 2001). Paleo-climatic research has also revealed that species tended not to respond as cohesive units, but rather responded independently to changes in climate from which analogue patterns emerged (Liu, 1990; Graham and Grimm, 1990; Overpeck *et al.,* 1992; Prentice and Webb, 1998; Davis and Shaw, 2001; Hannah *et al.,* 2005; Huntley, 2007). Migration rates and routes of migration also differed among taxa (Davis and Shaw, 2001). As Overpeck *et al.* (1991) found, the distribution and combinations of pollen types occurring during a significant portion of the ice age and present interglacial transition provided 'no analog' associations to today's vegetation communities. Similarly, Webb (1986) and Webb *et al.* (1993) showed that the new combinations of climate variables arising out of the retreat of the Laurentide Ice Sheet allowed the co-occurrence of species whose ranges do not overlap today. Even with rapid changes in climate, biodiversity has been able to keep pace with relatively few extinctions (Huntley, 2005; Bush *et al.,* 2004; Roy and Pandolfi, 2005).[15]

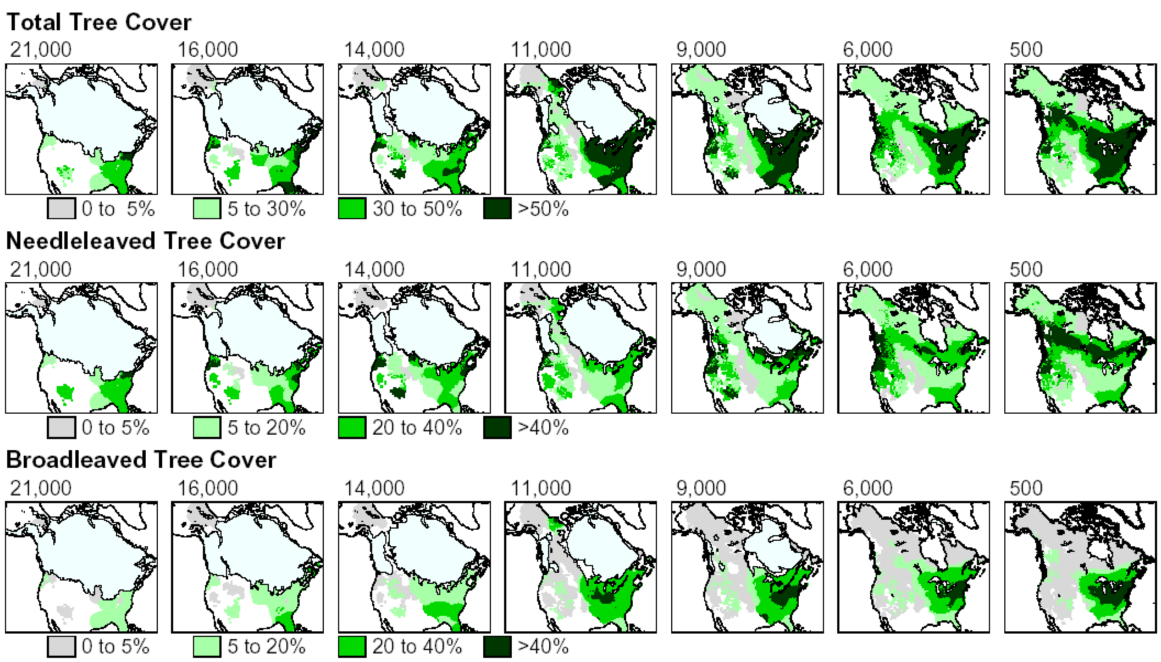
The arctic treeline advanced north and retreated south several times over the past 12,000 years. As recently as 4,000 years ago, the arctic treeline reached the arctic coast at several locations across Canada in response to warmer temperatures (MacDonald and Gajewski, 1992; Macdonald *et al.,* 1993). Williams (2002) presented estimates of the per cent cover for needleleaved and broadleaved trees in North America since the last glacial maximum (Figure 8). The temporally coarse reconstructions revealed a long-term increase in tree-cover densities from a low at the last full-glacial to a maximum during the late Holocene which the author attributed to general increases in temperature and precipitation levels and in CO_2 concentrations.

In Ontario, the early post-glacial boreal forest that colonized the Canadian Shield after 10,000 BP was dominated by white spruce (*Picea glauca)* and little or no black spruce (*Picae mariana*) (Figure 9) (Liu, 1990). White spruce declined and was replaced by jack pine (*Pinus banksiana*) after 9,000 BP in response to a warmer climate. Boreal forest was replaced with a complex mosaic of mixed-conifer northern hardwoods just south of Lakes Erie and Superior during this time (Delcourt and Delcourt, 1987). Central Ontario boreal forest was transformed into Great Lakes-St. Lawrence forest around 7,400 BP and white pine continued to spread northward during a warm period

[15] Davis and Shaw (2001: 678) noted that *"Although examples of persistence through repeated periods of unfavorable climate are documented in the fossil record, the record of extirpations and extinctions suggests that limits to adaptation are greatest during periods of rapid climate change, such as predicted for the future."*

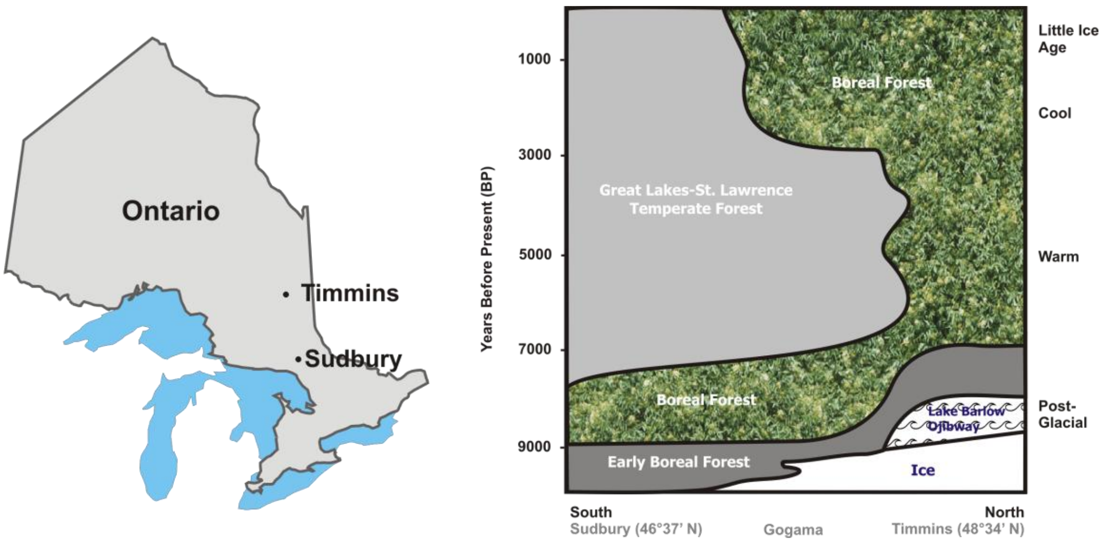
occurring from between 7,000 to 3,000 BP causing the boreal forest and the Great Lakes-St. Lawrence forest ecotone to advance approximately 140 km north of its present position (Delcourt and Delcourt, 1987; Liu, 1990). Over roughly this same period, Lessa *et al.* (2003) found that the ranges of several boreal animal species, including black bear (*Ursus americanus*) and northern flying squirrel (*Glaucomys sabrinus*), showed signs of rapid demographic and spatial expansion across Canada.[16]

Figure 8 Total tree cover, needleleaved tree cover and broadleaved tree cover from the last glacial maximum. Source: Williams (2002: 17).



16 Other studies have shown that North American species did not follow simple north/south shifts in habitat. While primarily responding to changes in climate, some species responded diachronically, in divergent directions and at variable rates (e.g., FAUNMAP Working Group, 1996).

Figure 9 Expansion and contraction of the Great Lakes-St. Lawrence/Boreal Forest ecotone in Ontario over the past 10,000 years. Adapted from: Liu (1990).



2.4 Modern Ecological Indicators of Climate Change

Continental, community and species scale evidence has consistently revealed that the anomalous warming occurring over roughly the past half-century is having a discernable impact on contemporary biodiversity (e.g., Parmesan, 1996; Parmesan *et al.,* 1999; Hughes, 2000; McCarty, 2001; Thomas *et al.,* 2001; IPCC, 2001b and 2007b; Walther *et al.,* 2002; McLaughlin *et al.,* 2002; Parmesan and Yohe, 2003; Root *et al.,* 2003; Parmesan and Galbraith, 2004, Parmesan, 2005; Menzel *et al.,* 2006; Walther *et al.,* 2006; Bradshaw and Holapzfel, 2006; Parmesan, 2006). Alarmingly, climate change has been attributed to several species extinctions (Pounds *et al.,* 1999, 2005 and 2006; McLaughlin *et al.,* 2002; Thomas *et al.,* 2006; Parmesan, 2006), a phenomenon projected to be exacerbated in the future (Thomas *et al.,* 2004; Bomhard *et al.,* 2005; Schwartz *et al.,* 2006; Parmesan, 2006; IPCC, 2007b).

Due to the rapid increase in correlation-based published studies occurring in recent years[17] (Figure 10), individual studies have become too numerous to review exhaustively. Therefore, the

[17] While it is acknowledged that the study of the biological impacts of climate change does have a rich history in the scientific literature [dating back to Grinnell (1917)], it is the relatively newly identified political ramifications of climatic and ecological change that has driven the increase in published correlation studies (Parmesan, 2006). An

following discussion reviews multi-species (i.e., cross-taxonomic) impacts occurring across diverse global ecosystems (e.g., from temperate grasslands to tropical cloud forests) to provide insight into the rate, extent and magnitude of recent climate change-related ecological impacts.[18,19] Interspersed within this discussion are examples of modern climate-related ecological changes across Canada and in Ontario.

Parmesan and Yohe (2003) estimated overall climate change-related ecological impacts by conducting meta-analyses on a set of more than 30 studies covering over 1,700 species representing a wide variety of taxa (e.g., insects, vertebrates, and plants). Despite the very different levels of detail, design, and scale, the analysis revealed more than half of the species experienced changes in their phenologies and/or their distributions. The changes reported were not random but were systematically in the direction expected from regional changes in the climate. On average, northern hemispheric geographic range boundaries moved 6.1 km northward per decade (Parmesan and Yohe, 2003). Quantitative analyses of phenological responses gave estimates of an advancement of 2.3 days per decade across all species. As a further indicator of climate change-attributed ecological impacts, the authors found that 279 (or 82%) of the species included in their analysis exhibited *"sign-switches"* (i.e., boundaries shifting northward in warm decades and southward in cool decades) and the authors concluded that no other factor (other than climate) could be responsible for such changes. Parmesan and Yohe (2003) also emphasized that the unexpectedly strong response of a high number of species across multiple scales is outweighing other potentially counteractive global change forces, such as habitat loss.

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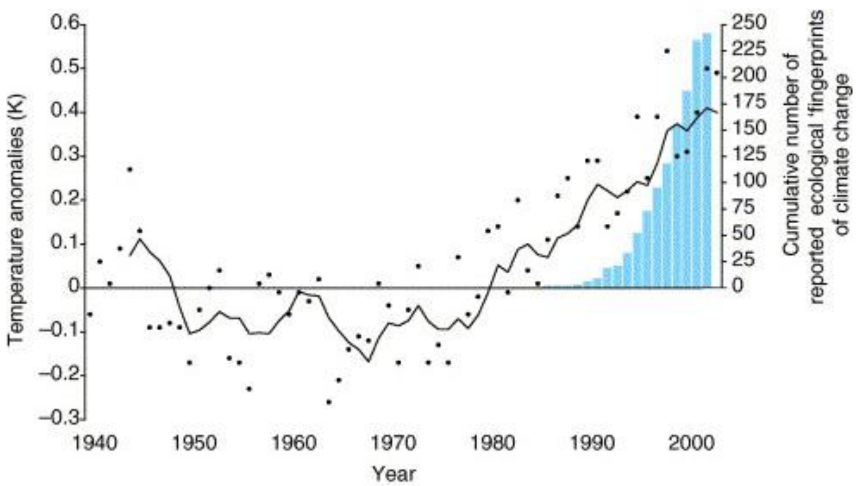
extensive literature search by Parmesan (2006) identified 866 peer-reviewed papers documenting changes in species or systems that could, in whole or in part, be attributed to anthropogenic climate change. Of these, approximately 40% were published from January 2003 to January 2006. See also Walther *et al.* (2005) and Figure 10 in this dissertation.

18 As Parmesan (2005) noted, the key advantage to multi-species studies is that these studies document species that have not responded to climate change, along with those exhibiting responses. This allows an unbiased estimate of overall impact of recent climate change to be made.

19 While the studies reviewed here do represent a broad spectrum of ecosystems across the globe, it is important to note that there are significant ecosystem-type and geographical biases. Of the nearly 29,000 observed changes tabled by the IPCC (2007b), 28,586 (99.7%) are from terrestrial ecosystems and only 85 (0.3%) are from marine and freshwater ecosystems. Moreover, 28,115 (98.3%) of the observed changes are from Europe and 455 (1.5%) are from North America (only 0.2% of the observed changes have been identified over the rest of Earth -- 90% of the world's terrestrial base).

A parallel can be drawn from the results of Root *et al.* (2003) who found that more than 80% of the 1,468 species included in their analysis were responding to climate change in the direction expected on the basis of known physiological constraints. The average shift in spring phenology (such as breeding or blooming) for temperate-zone species was 5.1 ± 0.1 days per decade earlier (Root *et al.,* 2003). These trends are greater than the results obtained by Walther *et al.* (2002) who found earlier leaf unfolding in both the United Kingdom (1.4 to 3.1 days per decade earlier) and North America (1.2 to 2.0 days per decade earlier). These trends are also greater than those of Parmesan and Yohe (2003) (noted previously).

Figure 10 Annual global temperature anomalies relative to 1961 to 1990 average and number of case studies reporting ecological fingerprints of climate change. Annual values (dots) and five-year smoothed averages (line) and the cumulative number of case studies (columns) reporting ecological 'fingerprints' of climate change. Source: Walther *et al.* (2005: 649).[20]



2.4.1 Modern Ecological Response to Climate Change in Canada

Despite the renewed interest in climate change-related ecological impact studies and the general lack of observational records (i.e., detailed survey data) needed to rigorously test hypotheses, a number of meta-analyses suggest that Canadian species and ecosystems are also responding to recent climate change (Figure 11 and Tables 2 to 4). Some of the reported impacts include changes

[20] The cumulative number of case studies in this study was totaled using Parmesan and Yohe (2003), Roote *et al.* (2003), and Walther *et al.* (2002). Temperature data was taken from Jones *et al.* (2004).

in the geographic distribution, migratory pathway, and abundance of species, changes in the timing of reproduction of species, changes in phenology (e.g., onset, end, and length of growing season), changes in the geographical occurrence and magnitude of pest outbreaks, changes in inter-specific interactions, and widespread aquatic responses to increasing temperatures in both arctic and boreal lakes.

Figure 11 Examples of recent ecological responses to climate change across Canada. See Tables 2 to 4 for more detailed information, including sources (by superscript number).

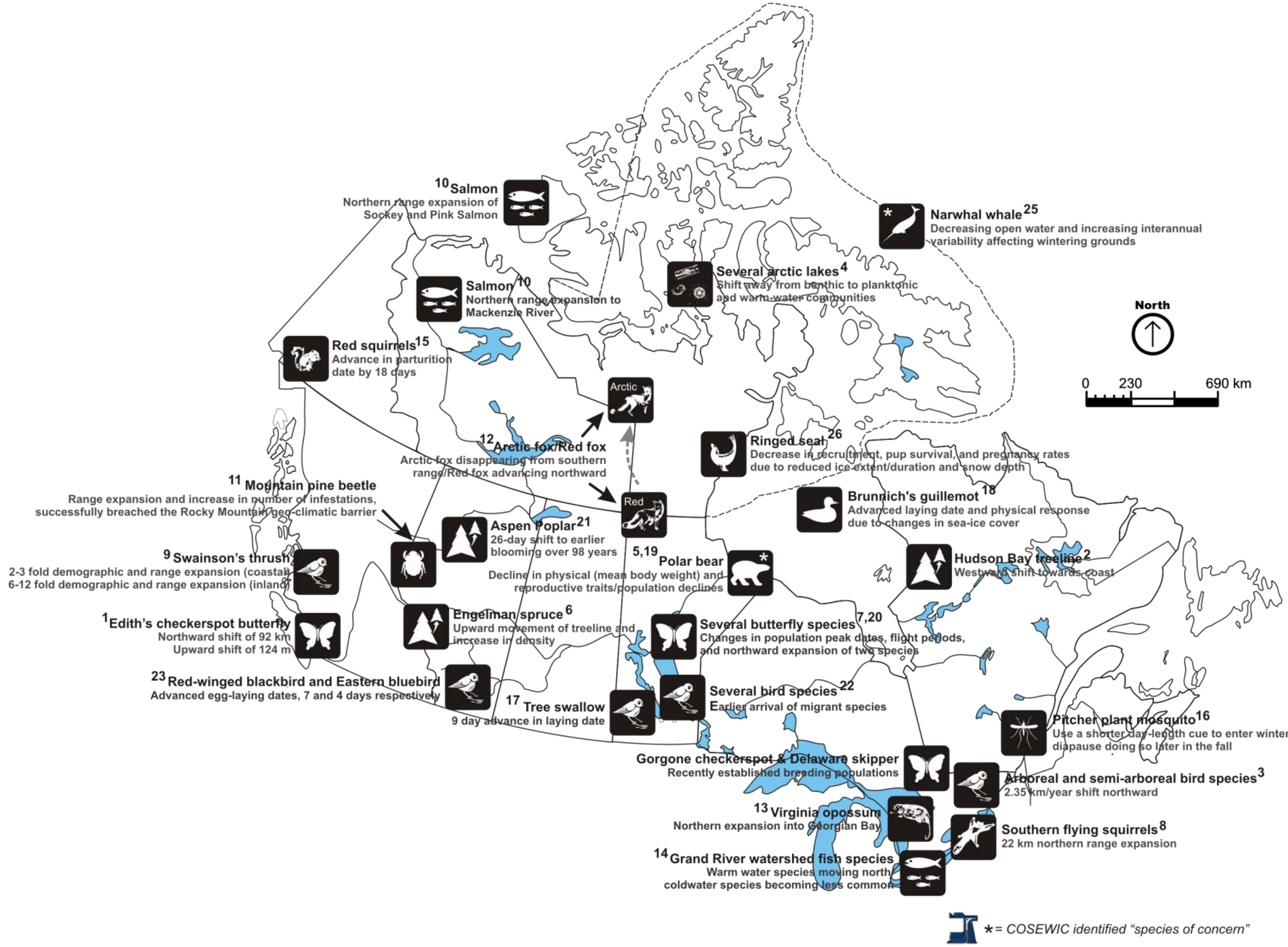


Table 2 Ecological indicators of climate change in Canada – changes in geographic distribution and abundance (including migratory pathway, wintering area and breeding ground).

TAXON	GEOGRAPHIC LOCATION	ECOLOGICAL RESPONSE/PERIOD OF RECORD	SOURCE(S)
Edith's checkerspot butterfly (*E. editha*)	Mexico to Canada (range)	• Northward shift of 92 km • Upward shift of 124 m • Population extinctions are four times as high along the southern range boundary (Baja, Mexico) than along the northern range boundary (Canada) • Recolonizations are rare (14% over 30 year period) Period of Record: 98 years	[1]Parmesan (1996), Parmesan (2005)
Black spruce (*Picea mariana*)	Eastern Hudson Bay coast (Quebec)	• 12 km westward shift in treeline towards coast Period of Record: 100 years	[2]Lescop-Sinclair and Payette (1995)
27 bird species (arboreal and semiarboreal insectivors and granivors)	Continental U.S., southern Canada, and northern Mexico	• 2.35 km/year shift northward Period of Record: 1967 to 1971 and 1998 to 2002 (26 years)	[3]Hitch and Leberg (2007)
Diatom and invertebrate assemblages	Canadian arctic lakes	• Shift away from benthic species towards more planktonic and warm-water-associated communities Period of Record: 150 years of proxy data (diatoms, chironomids, chrysophytes)	[4]Smol *et al.* (2005)
Polar bears (*Ursus maritimus*)	Hudson Bay (southern range boundary)	• Population declines in opposite geographic boundaries Period of Record: 1981 to 1998 and 1980 to 2004	[5]Stirling *et al.* (1999) Stirling *et al.* (2006)
Engelmann spruce (*Picea engelmannii*)	Canadian Rocky Mountains (Banff, Yoho and Jasper national parks)	• Upward (elevational) movement of treeline and increase in density Period of Record: Various sampling dates	[6]Luckman and Kavanagh (2000)
Common buckeye (*Junonia coenia*) and Baltimore checkerspot (*Euphydryas phaeton*)	Manitoba	• Northward expansion of Common buckeye (*Junonia coenia*) and Baltimore checkerspot (*Euphydryas phaeton*) Period of Record: 1970 to 2004 (35 years)	[7]Westwood and Blair (2003)

TAXON	GEOGRAPHIC LOCATION	ECOLOGICAL RESPONSE/PERIOD OF RECORD	SOURCE(S)
butterflies			
Southern flying squirrel (*Glaucomys volans*)	Ontario	• 22 km estimated rate of spread • Expanded northern range boundary in Ontario by about 200 km between mid-1980s and 2003 • Currently rare or absent in a number of sites in southern or southwestern Ontario • Possibility that southern flying squirrels have expanded their range through the contiguous forests of central Ontario and Quebec, but not through the fragmented forests of the southwest Period of Record: 1994 to 2004	[8]Bowman *et al.* (2005)
Swainson's thrush (*Catharus ustulatus*)	Boreal forest regions of the U.S. and Canada	• Coastal group has undergone a 2- to 3-fold demographic and range expansion, while the inland group has undergone a 6- to 12-fold demographic and range expansion since the last glacial maximum • Bioclimatic analyses strongly support the hypothesis that populations expanding out of the east into previously glaciated areas in the west were undergoing a natural extension of their range by tracking the changes in climatic conditions Period of Record: last glacial maximum (~21,000 yr BP) to 2006	[9]Ruegg *et al.* (2006)
Sockeye (*Oncorhynchus nerka*) and Pink salmon (*O. gorbuscha*)	Banks Island (NWT)	• Capture locations are well outside the known distributions for the species Period of Record: 2000	[10]Babaluk *et al.* (2000)
Mountain pine beetle (*Dendroctonus ponderosae*)	Canada (primarily BC and Alberta)	• Increase in the range of benign habitats and an increase (at an increasing rate) in the number of infestations since 1970 in formerly climatically unsuitable habitats • Successfully breached the Rocky Mountain geo-climatic barrier and established in north-eastern BC and adjacent Alberta Period of Record: 10 year increments between 1921 to 1950 and 1971 to 2000	[11]Carroll *et al.* (2006)
Arctic fox (*Alopex vulpes*) and Red fox (*Vulpes vulpes*)	Canada (Nunavut)	• The red fox expanded it's range northward into traditional Arctic fox territory, as much as 965 km (Baffin Island) • Arctic fox has retracted its range northward either due to inferior competition with the red fox to the warming trend or both Period of Record: 30 years	[12]Hersteinnson and Macdonald (1992)
Virginia opossum	Southwestern Ontario (Georgian Bay)	• Virtually non-existent in Ontario in the 1980s, the Virginia opossum has expanded its range northward into Georgian Bay Period of Record: n/a	[13]CCME (2003)

TAXON	GEOGRAPHIC LOCATION	ECOLOGICAL RESPONSE/PERIOD OF RECORD	SOURCE(S)
Several Grand River fish species	Grand River Watershed (Southwestern Ontario)	• Warm-water fish species are now colonizing the upper portions of the Grand River watershed, while coldwater species have become less common Period of Record: 1983 to 1996 (14 years)	[14]CCME (2003)

Table 3 Ecological indicators of climate change across Canada – changes in phenology and evolutionary traits (i.e., life-cycle events).

TAXON	GEOGRAPHIC LOCATION	ECOLOGICAL RESPONSE/PERIOD OF RECORD	SOURCE(S)
Red squirrels (*Tamiasciurus hudsonicus*) 664 female, 325 followed throughout lifetime	Kluane region, Yukon Territory	• Parturition date advanced 18 days or 6 days per generation • Result of phenotype plasticity change (62%) and genetic change in population (13%) Period of Record: 1989 to 2002 (13 years)	[15]Reale *et al.* (2004), Berteaux *et al.* (2004)
Pitcher plant mosquito (*Wyeomyia Smithii*)	Florida to Canada (range)	• Evolved a shorter critical photo period in association with a longer growing season • Northern populations now use a shorter day-length cue to enter winter diapauses, doing so later in the fall than they did 24 years ago Period of Record: four sample collections -- 1972 compared to 1996 and 1988 compared to 1993	[16]Bradshaw and Holzapfel (2001)
Tree swallows (*Tachycineta bicolor*)	Contiguous U.S. and Canada	• 9 day advance in laying date highly correlated with mean May temperature Period of Record: 1959 to 1991 (32 years) (3,400 nest records)	[17]Dunn and Winkler (1999)
Brunnich's guillemot (*Uria lamvia*)	Northern Hudson Bay (southern boundary)	• Advanced laying date and increased weight trends correlated with changes in sea ice cover (area of open water) Period of Record: 1975 to 1977 and 2001 to 2003	[18]Gaston *et al.* (2005)
Polar bears (*Ursus maritimus*)	Hudson Bay (southern range boundary)	• Decline in physical (mean body weight) and reproductive traits (birth numbers) • Population declines in opposite geographic boundaries Period of Record: 1981 to 1998 and 1980 to 2004	[19]Stirling *et al.* (1999) Stirling *et al.* (2006)
16 butterfly species	Manitoba	• Extending adult activity periods into the late summer and fall in response to longer frost-free	[20]Westwood and

TAXON	GEOGRAPHIC LOCATION	ECOLOGICAL RESPONSE/PERIOD OF RECORD	SOURCE(S)
		periods • Change in the length of certain life stages, including population peak periods and longer flight periods Period of Record: 1970 to 2004	Blair (2006)
Aspen poplar (*Populus tremuloides*), Saskatoon (*Amelanchier Alnifolia*) and Chokecherry (*Prunus virginiana*)	Edmonton, Alberta	• The timing of flowering by several species is largely a response to temperature, with earlier blooms seen in years of higher spring temperatures • Overall, spring flowering events have advanced 8 days over a 60 year period • Aspen poplar showed a 26-day shift to earlier blooming over a 98 year period Period of Record: various years dating back as far as 1901	[21]Beaubien and Freeland (2000)
96 migrant bird species	Delta Marsh, Manitoba	• Fifteen species showed significantly earlier arrivals due to increases in temperature Period of Record: 63 years	[22]Murphy-Klassen *et al.* (2005)
6 bird species	Continental U.S. and southern Canada	• Laying dates for four of six species were earlier when spring temperatures were warmer • Over the long-term, laying dates advanced over time for two species [red-winged blackbirds, *Agelaius phoeniceus*, 7.5 days and eastern bluebirds (*Sialia sialis*), 4 days)] • Laying date of song sparrows (*Melospiza melodia*) also advanced with increasing temperature when the analysis was restricted to eastern populations • The study showed that the relationship between climate change and breeding in birds is variable within and among species Period of Record: 50 years	[23]Torti and Dunn (2005)

Table 4 Ecological indicators of climate change across Canada – changes resulting from indirect effects.

TAXON	GEOGRAPHIC LOCATION	ECOLOGICAL RESPONSE/PERIOD OF RECORD	SOURCE(S)
Ringed seal (*Phoca hispida*)	Western Hudson Bay	• Decrease in ice extent and snow depth corresponded to decrease in ringed seal recruitment, reduced pup survival, and a reduction in pregnancy rates Period of Record: 20 year old seals from two datasets 1999 to 2001 and 1991 to 1992	[24]Ferguson *et al.* (2005)
Narwhal whale (*Monodon monoceros*)	Baffin Bay	• Limited number of leads and cracks available to narwhals during the winter and localized decreasing trends in open water and high site fidelity • Decreasing trends in the fraction of open water, together with increasing trends in interannual variability, were detected on wintering grounds Period of Record: 1978 to 2001 (26 years)	[25]Laidre and Heide-Jorgensen (2005)

2.4.2 Changes in Geographic Distribution and Abundance

A number of ecosystems, communities and individual species across Canada have exhibited changes in their geographic distribution, migratory pathway (including wintering area, migration route and breeding grounds) and abundance in recent years due to direct (Tables 2 and 3) or indirect (Table 4) climate change-related impacts. For example, the red fox (*Vulpes vulpes*) has expanded northward over the past 70 years, while the arctic fox (*Alopex lagopus*) has contracted its geographic range toward the Arctic Ocean (Hersteinson and MacDonald, 1992). The timings of the red fox's boundary changes have tracked climatic warming phases. Despite the fact that the red fox has physical attributes which make it less well-adapted to cold conditions than the arctic fox (e.g., longer ears and limbs), the synergy between warmer temperatures and competitive inferiority to the red fox has caused the arctic fox to retreat northward (Hersteinson and MacDonald, 1992).

The southern flying squirrel (*Glaucomys volans*) and the Virginia opossum (*Didelphis virginiana virginiana*) are expanding their range margins north in Ontario (CCME, 2003; Bowman *et al.,* 2005). From about the mid-1980s to 2003, it is estimated that the southern flying squirrel has expanded its northern range margin by approximately 200 km. The authors importantly pointed out that while the expansion of the species was possible through the contiguous forests of central Ontario and Quebec, expansion did not occur through the fragmented forests of southwestern Ontario (i.e., through Carolinian-type forests). Consequently, squirrel populations have become rare or even absent in previously suitable habitats (Bowman *et al.,* 2005). Similarly, the Virginia opossum, which was virtually non-existent in Ontario in the 1980s, has expanded its range as far north as Georgian Bay (CCME, 2003).

The long-term warming trend occurring throughout the majority of the Canadian arctic has influenced the distribution and annual duration of sea ice in both the Arctic Ocean and western Hudson Bay. This has had a significant influence on the population ecology of arctic mammals, including the polar bear (*Ursus maritimus*), ringed seal (*Phoca hispida*) and narwhal (*Monodon monoceros*). For example, the progressively earlier ice break-up in western Hudson Bay has resulted in population declines of the polar bear[21] at opposing geographic boundaries due to declines in physical (e.g., weight) and reproductive (e.g., cub survivability) parameters (Stirling *et al.,* 1999; Stirling *et al.,*

[21] The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified the polar bear as a 'species of concern' in 2002 (COSEWIC, 2007).

2006).[22] The decrease in ice extent and snow depth in western Hudson Bay has also resulted in decreased ringed seal recruitment, reduced pup survival and a reduction in pregnancy rates (Ferguson *et al.,* 2005). Conversely, the decreasing trends in the fraction of open water (i.e., increase in ice duration), together with increasing trends in interannual variability on wintering grounds, has limited the number of leads and cracks available to narwhal[23] in Baffin Bay (Laidre and Heide-Jorgensen, 2005). The high site fidelity typical amongst this population of narwhals, in addition to the increasing duration and density of sea ice in this region, has put the species at greater risk of ice entrapment in recent years (Laidre and Heide-Jorgensen, 2005).

Examining distribution data for 27 bird species occurring across Mexico, the U.S. and Canada, Hitch and Leberg (2007) found that the northern limit of birds with a southern distribution showed a significant shift northward (2.35 km/year).[24] Similarly, Ruegg *et al.* (2006) found a 2- to 3- and 6- to 12-fold demographic and range expansion of the Swainson's Thrush (*Catharus ustulatus*) amongst both coastal and inland boreal forest regions of the northern United States and Canada, respectively.

Parmesan (1996, 2005) found significant latitudinal and altitudinal clines in population extinctions of Edith's checkerspot butterfly (*Euphydryas editha*) at sites undegraded by human activities.[25] Sites where previously recorded populations still existed were on average 2°

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[22] Derocher *et al.* (2004) emphasized that most of the characteristic mammals in the arctic marine ecosystem are specifically adapted to the sea ice environment. Sea ice is a vital substrate for both pagophilic (i.e., ice-loving) mammals and epontic marine communities so that significant reduction or disappearance of ice from some areas will fundamentally alter the arctic marine ecosystem.

[23] The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified the narwhal as a 'species of concern' in 2004 (COSEWIC, 2007).

[24] The northward shift discovered by Hitch and Leberge (2007) is greater than observed shifts found in previous work conducted in Great Britain. Thomas and Lennon (1999) found an 18.9 km shift over a 20 year period (0.945 km/year). As Hitch and Leberge (2007) noted, *"The observation of two independent northward expansions of distributions of multispecies groups supports the contention of Thomas and Lennon (1999) that the northward expansions are due to climatic warming."* (538) The results of Hitch and Leberge (2007) are also consistent with the IPCC's (2001b, 2007b) conclusion that, generally speaking, the ecological impacts of climate change will be greater for continents than for islands (where climate is more regulated due to proximity to oceans).

[25] Parmesan (1996) defined an undisturbed site by the availability and abundance of host plants (species within the snapdragon family) and adequate nectar resources.

(approximately 222 km)[26] further north than sites where populations were extinct. Parmesan (1996) revealed that the northern establishments of new populations corresponded almost exactly with northward shifts in temperature isotherms. Interestingly, populations in Mexico were four times more likely to be extinct than those in Canada and, because habitat degradation was latitudinally symmetrical (i.e., low at the extremes of the range and higher for all other latitudes), it is highly unlikely that the net extinctions were caused by differences in initial population isolation or subsequent land-use changes (Parmesan, 1999).[27] Altitudinal shifts (i.e., elevational shifts) were also identified – populations above 2,400 m were significantly more persistent than those at all lower elevations (Parmesan, 1999).

Westwood and Blair (2006) similarly found several Manitoba butterfly species to be responding to recent climate change. Common buckeye (*Junonia coenia*) and Baltimore checkerspot (*Euphydryas phaeton*) butterfly populations have expanded their range margin north and have extended their adult activity periods into the late summer and fall, largely in response to longer frost-free periods (Westwood and Blair, 2006). The authors raised an important point regarding this type of response in their discussion: increased temperatures occurring later in the summer may induce species to produce extra generations later in the season, which in turn may place species at increasing risk if they are not in the correct stage to survive the winter (i.e., population failures may result due to insufficient time for the completion of their lifecycle) (Westwood and Blair, 2006). It also appears that there is great uncertainty with the respect to the synergistic response of host-plants to climate change. The authors pointed out that the caterpillar host plants and the adult nectar sources needed to sustain butterfly populations in northern range margins may not be responding concomitantly (i.e., in unison).

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[26]In a separate study examining 36 non-migratory European butterflies, Parmesan *et al.* (1999) discovered that 63% shifted their range north by 35 to 240 km during the 19th century (and only 3% shifted to the south).

[27] In Parmesan's (1996) analysis, butterfly populations were able to track changes in climate and expand their range margins north due to the availability of *similar* suitable habitat (i.e., host plants) in Canada (which offset population extinctions in the south). However, Thomas *et al.* (2001) found that *increased habitat breadth* (i.e., increase in the variety of habitat types that populations colonize) and *dispersal tendencies* (i.e., longer winged individuals) have resulted in about 3- to 15-fold increases in expansion rates of four butterfly species in Britain, allowing these insects to cross habitat disjunctions that would have represented major or complete barriers to dispersal before the expansions started. Thomas *et al.* (2001) noted that climate change and both ecological and evolutionary processes are probably responsible for these changes.

Lescop-Sinclair and Payette (1999) measured changes in the longitudinal position of black spruce (*Picea mariana*) along the eastern Hudson Bay coast (northern Québec) and found a 12 km displacement towards Hudson Bay since the late 1800s. Dendroecological analyses revealed that stem growth occurred as a direct response to favourable summer growth conditions, reduced wind-driven snow abrasion and super-cold wind-chill. Elevational treeline response to climate change in the Canadian Rocky Mountains has also been documented. Luckman and Kavanagh (2000) reported the upward migration and increase in density of Engelmann spruce (*Picea engelmanni*) in several Canadian national parks, including Jasper, Yoho and Banff.

While aquatic ecosystems have been studied less globally and in Canada, a few studies revealed similar climate change ecological responses to those of terrestrial systems. Babaluk *et al.* (2000) documented the first capture locations of both Sockeye salmon (*Oncorhynchus nerka*) and Pink salmon (*Oncorhynchus gorbuscha*) on Banks Island (Northwest Territories) in 1999. The capture locations noted in their study are well outside the known distribution of the species. Northern advancements of fish species have also been documented in southern Canada. Fish surveys conducted between 1983 and 1996 showed that many warm-water fish species are now colonizing the upper portions of the Grand River (Ontario) watershed, while coldwater species have become less common (CCME, 2003). Shifts away from benthic species towards more planktonic and warm-water-associated species in several Canadian arctic lakes have also been reported (Smol *et al.,* 2005). Given the widespread distribution and similar character of these changes across several arctic lakes located in one of the most remote areas of the world, the authors concluded that *"…the opportunity to study arctic ecosystems unaffected by human influences may have disappeared."* (Smol *et al.,* 2005: 4397)

Climate change has also recently been implicated in the latitudinal and elevational expansion of several forest pests in Canada, including the mountain pine beetle (MPB). Historically, the current latitudinal and elevational range of MPB was not limited by available hosts (Caroll *et al.,* 2006). Instead, its potential to expand north and east has been restricted by climatic conditions unfavourable for broad development (Carroll *et al.,* 2006). To determine if the beetle has expanded its range due to changing climatic conditions in British Columbia and Alberta, Carroll *et al.* (2006) overlaid MPB occurrence with the distribution of climatically suitable habitats in 10-year increments derived from climate normals (1921-1950 to 1971-2000). Results clearly showed an increase in the range of MPB benign habitats and an increase in the number of infestations since 1970 across several formerly climatically unsuitable habitats (Caroll *et al.,* 2006).

2.4.3 Changes in Species Phenology and Evolutionary Traits

Because species phenology (i.e., the time frame for any natural seasonal phenomena) is directly correlated to variations in climate (e.g., the date of emergence of leaves and flowers, the first flight of butterflies and the first appearance of migratory birds), phenological records can be a useful proxy for temperature in the study of climate change ecological impacts occurring across Canada. Analyzing changes in breeding for tree swallows (*Tachycineta bicolor*) from 1959 to 1991 over the contiguous U.S. and Canada, Dunn and Winkler (1999) discovered that laying dates were significantly correlated with mean May temperature. Over a 32-year period, the authors found that egg laying dates have advanced by an average of nine days. Similarly, Torti and Dunn (2005) found advanced laying dates for two species, the red-winged blackbird (*Agelaius phoeniceus*) (seven days) and eastern bluebirds (*Sialia sialis*) (four days). The arctic seabird, Brunnich's guillemot (*Uria lomvia*), has similarly advanced its egg-laying date at its southern-most boundary (Hudson Bay). No change was reported at its northern-most boundary (Prince Leopold Island) (Torti and Dunn, 2005). Both trends were found to be closely correlated with the duration of sea-ice cover (Torti and Dunn, 2005). Murphy-Klassen *et al.* (2005) provided evidence that climate warming has influenced spring migration arrival dates of several bird species in Manitoba. Over a 63-year period, the authors found that fifteen species showed significantly earlier arrivals in relation to increasing temperature trends.

In addition to extending their northern range margins, several Manitoba butterfly species have extended their adult activity periods (e.g., population peak periods and flight periods) into the late summer and fall in response to longer frost-free periods. From 1901 to 1997, aspen poplars (*Populus tremuloides*) in Alberta shifted their blooming dates 26 days earlier (Beubien and Freeland, 2000). Interestingly, a significant link was found between yearly flowering dates in Edmonton and sea surface temperature in the Pacific Ocean, nearly 900 km away (Beubien and Freeland, 2000).

A recent study by Berteaux *et al.* (2004), examining reproductive phenological change associated with climate change in red squirrels (*Tamiasciurus hudsonicus*) in the Kluane region of the Yukon, showed that evolution can be fast, and successful, under climate change[28]. In response to general increases in spring temperature (~2.0°C) and decreases in precipitation over the past 27

[28] Stockwell and Ashley (2003) recently introduced contemporary evolution to conservation ecology but did not address climate change specifically.

years, Berteaux *et al.* (2004) revealed that female red squirrels have advanced their mean lifetime parturition date by 18 days, a change of about six days per generation. The authors concluded that the combined effects of phenotype plasticity (to increased food abundance) and micro-evolutionary change (response to selection) have allowed the population of squirrels to keep pace with rapid changes in environmental conditions. While not considered a pest, the pitcher plant mosquito (*Wyeomia Smithii*) has also recently exhibited evolutionary responses to climate change. Traditionally, as winter approached and day-lengths were shortened, the mosquito was genetically programmed to hibernate and protect itself inside the pitcher plant (Bradshaw and Holapzfel, 2001). However, northern populations are now entering hibernation later in the fall due to more favourable climatic conditions (Bradshaw and Holapzfel, 2001). The authors hypothesized that such a response could lead to the eventual domination of pitcher plant mosquito populations should such favourable climate trends continue (Bradshaw and Holapzfel, 2001).

Overall, the balance of evidence from these studies strongly suggests that although we are only at an early stage in the projected trends of climate change, ecological responses are indeed discernable both globally and across Canada. Moreover, if such ecological changes are being detected with global estimates of temperature increases of only 0.74ºC over the past century (IPCC, 2007a), many more far-reaching effects on biodiversity are likely to occur in response to projected increases in mean annual temperature over the 21st century, with temperature increase projections running as high as 4.0ºC[29] (IPCC, 2007a).

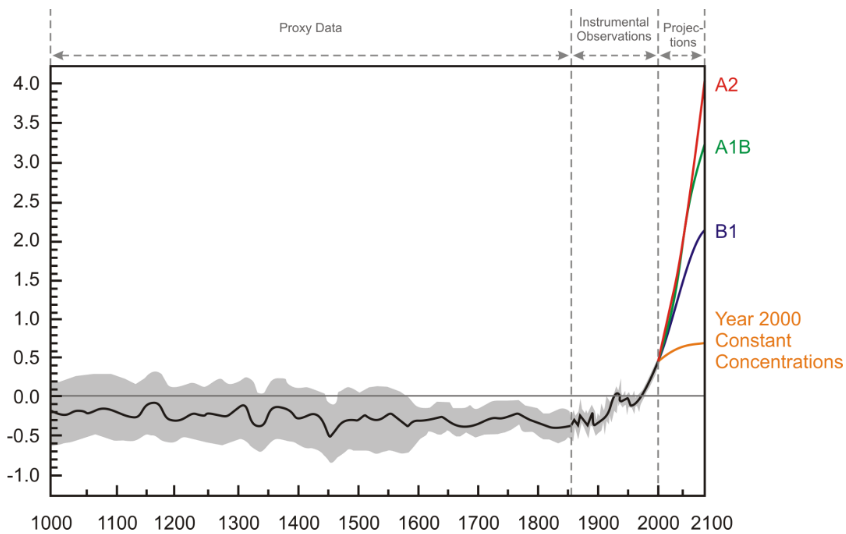
2.5 Projections of Future Climate Change

The broad statistical convergence of historical climate reconstructions based on both proxy and instrumental records, as reviewed in Section 2.2, has resulted in an increasing confidence in the detection of anthropogenic GHG signal in the 20th and early 21st century. Comprehensive General Circulation Models (GCMs) are currently the only tools available that attempt to account for the complex set of processes which will determine future climate. The IPCC projected that the pace of climate change is '*very likely*' (>90% probability) to accelerate with continued GHG emissions at or

[29] It is important to note that the 4.0ºC increase in temperature projected by the IPCC is based on a 'best estimate' (see Section 2.5). However, 'likely range' estimates do run as high as 6.4ºC (A1F1 scenario) (IPCC, 2007a).

above current rates. Its best estimate is that globally averaged surface temperatures will rise by 1.8°C (low emission scenario) to 4.0°C (high emission scenario) by the end of the 21st century (Figure 12) (IPCC, 2007a). This range is due to the uncertainty about future GHG emissions linked to unpredictable socio-economic conditions and to the different responses of GCMs to the corresponding amount of emissions.[30]

Figure 12 Global temperature of the past 1,000 years (proxy data and instrumental observation) in relation to 21st century projected climate (IPCC SRES scenarios). Adapted from: IPCC (2001a).



The annual mean warming in North America is likely to exceed the global mean warming in most areas (IPCC, 2007a). Seasonally, warming is likely to be largest in the winter in northern regions and in summer in southern North America. Minimum winter temperatures are likely to increase more than the global average in northern North America (IPCC, 2007a). Maximum summer temperatures are likely to increase more than the average in the southwest (IPCC, 2007a). Since the IPCC *Third Assessment Report* (*TAR*) (IPCC, 2001a), there has been an improved understanding of projected patterns of precipitation. Increases in the amount of precipitation are *very likely* in high latitudes, while decreases are *likely* in most subtropical land regions (by as much as about 20%) continuing observed patterns in modern trends (IPCC, 2007a).

[30] A more detailed discussion on emission scenarios of the IPCC *Special Report on Emission Scenarios* (*SRES*) can be found on p. 18 of IPCC (2007a).

As a northern country, Canada is projected to warm more than most other countries (Figure 13) (PCIC, 2007). For example, 32 *SRES* GCM experiments projected annual mean temperature increases of 3.1 to 10.6°C by the 2080s over Canada's terrestrial area, about double the projected global average increase over the same period (PCIC, 2007). Similar to the recent trends, warming is not expected to be geographically uniform – the greatest temperature increases are projected to occur in the arctic territories (e.g., Nunavut and Northwest Territories) and the least change is projected for maritime provinces (e.g., Nova Scotia and Prince Edward Island) (Table 5). In Ontario, *SRES* GCM simulations suggest an increase in annual mean temperature between 0.7 and 3.1°C by the 2020s, 1.9 and 6.9°C by the 2050s, and 2.7 and 10.6°C by the 2080s (Figure 14).

Figure 13 Projected mean annual temperature change (°C) in Canada using a variety of general circulation models (GCM) and emission scenarios (SRES) for the 2020s, 2050s, and 2080s. Source: PCIC (2007).

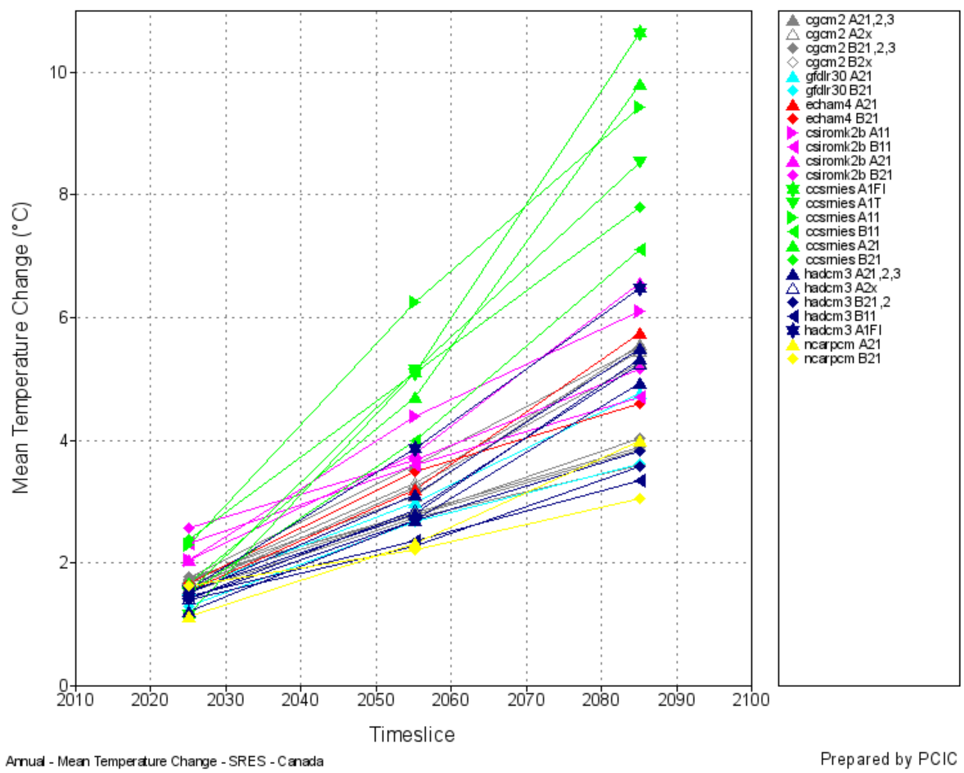


Table 5 Projected mean annual temperature change (°C) amongst Canadian provinces and territories using a variety of general circulation models (GCM) and emission scenarios (SRES) for the 2020s, 2050s and 2080s. Source: PCIC (2007).

PROVINCE/TERRITORY	PROJECTED MEAN ANNUAL TEMPERATURE CHANGE INCREASE (°C)		
	2020	2050	2080
Alberta	0.6-2.4	1.8-5.7	2.3-9.3
British Columbia	0.5-2.2	1.6-5.0	2.7-8.5
Manitoba	0.8-2.8	1.9-7.1	2.8-11.5
New Brunswick	0.9-2.6	2.1-5.7	2.7-8.8
Newfoundland/Labrador	0.8-2.5	2.3-4.4	3.2-7.7
Northwest Territories	1.1-2.9	2.2-6.8	3.2-11.7
Nova Scotia	1.0-2.6	2.0-4.9	2.7-8.8
Nunavut	1.2-2.8	2.8-6.9	3.9-11.6
Ontario	0.7-3.1	1.9-6.9	2.7-10.6
Prince Edward Island	1.0-2.6	2.0-5.7	2.8-8.8
Quebec	1.1-2.6	2.2-5.5	3.0-9.8
Saskatchewan	0.5-2.6	1.7-6.3	2.4-10.2
Yukon Territory	0.7-2.7	1.9-5.8	2.4-10.2
Canada	**1.1-2.6**	**2.2-5.1**	**3.1-10.6**

Generally, total annual precipitation is also projected to increase across Canada (Figure 15). 32 GCM experiments project mean annual precipitation changes of -0.2- to +8.7% for the 2020s, +0.3 to 16.7% for the 2050s and +2.5 to 19.2% for the 2080s (PCIC, 2007). In southern Canada, precipitation is likely to increase in winter and spring but decrease in summer (IPCC, 2007a). Snow season length and snow depth are very likely to decrease in most of North America, except in the northernmost part of Canada where maximum snow depth is likely to increase (IPCC, 2007a).

Figure 14 Projected mean annual temperature change (°C) in Ontario using a variety of general circulation models (GCM) and emission scenarios (SRES) for the 2020s, 2050s, and 2080s. Source: PCIC (2007).

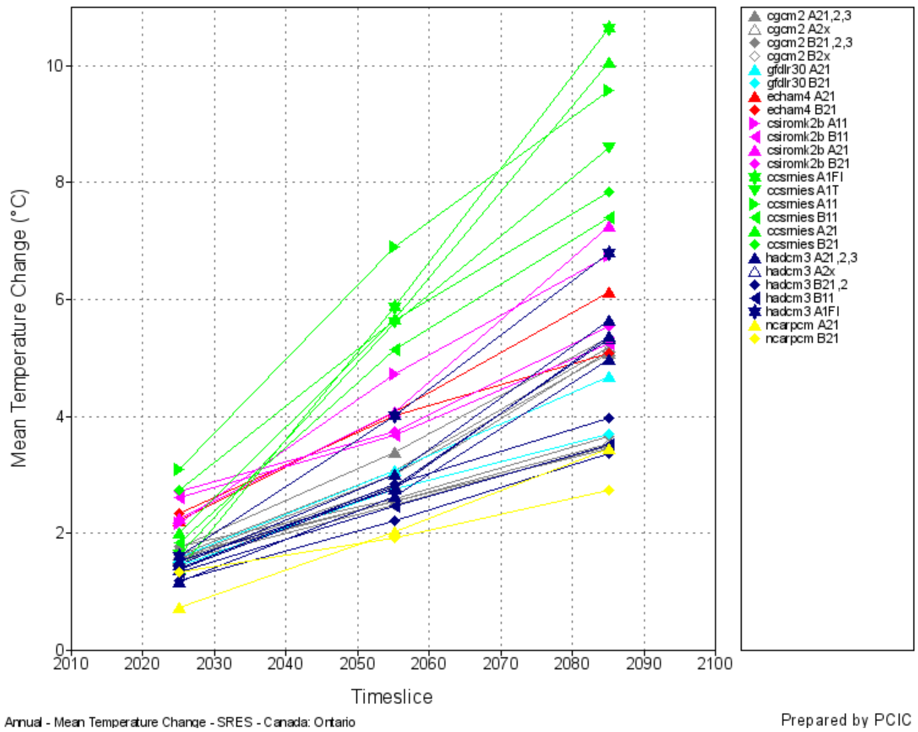
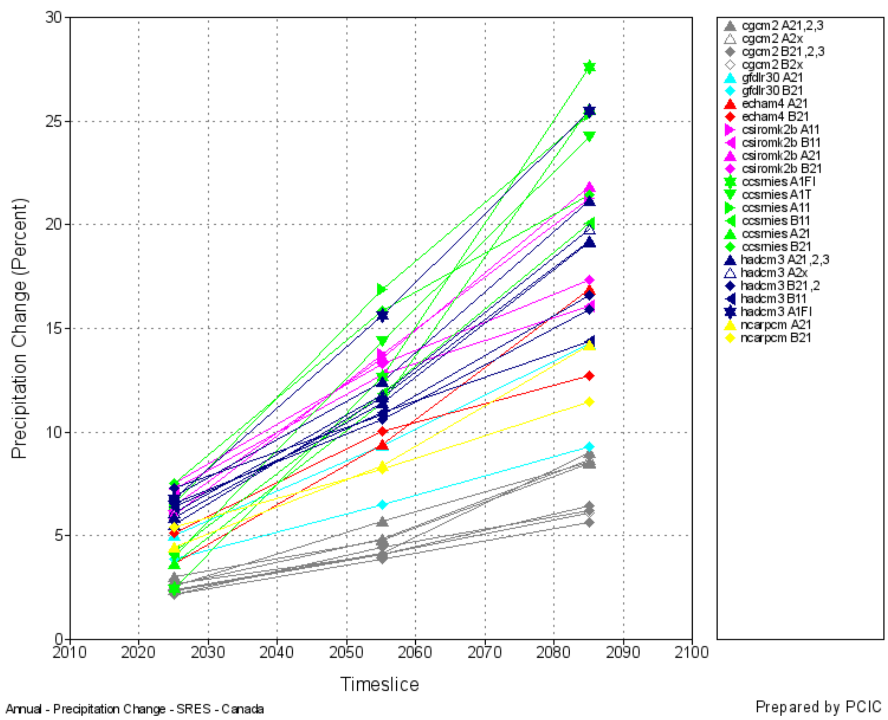


Figure 15 Projected mean annual precipitation change (%) in Canada using a variety of general circulation models (GCM) and emission scenarios (SRES) for the 2020s, 2050s and 2080s. Source: PCIC (2007).



An increasing number of studies indicate that the temperature change projections of the IPCC (2001a and 2007a) may have been underestimated. For example, analyzing emissions projections of GHGs, Webster *et al.* (2003) found that with a policy of 'no restrictions' on GHG emissions, there is a one in two chance that the increase in global mean temperature over the next century will exceed 2.4°C. Even with aggressive GHG emission reductions over time, the authors emphasized that there is a one in two chance of temperature increases exceeding 1.6°C. More recently, Raupach *et al.* (2007) revealed that the recent growth of GHG emissions is on a trajectory that exceeds even the most aggressive *SRES* scenarios. Furthermore, Pittock *et al.* (2006) emphasized that there is a risk of feedbacks in the climate system that may increase warming. Consequently, the author suggests that the probability of global temperatures exceeding 3°C has increased in recent years (Pittock *et al.* 2006). Taken collectively, these studies call attention to the likelihood that Earth is committed to climate change regardless of aggressive emissions reductions. Even if atmospheric concentrations of GHG were stabilized at current levels, Earth would continue to warm as a result of past GHG emissions and the thermal inertia of the oceans (IPCC, 2007a). Such changes in temperature, projected to occur over a relatively short period of time, fall within the 1.5 to 2.5 °C thresholds upon which the IPCC projects 20 to 30% of Earth's species would be at increased risk of extinction.

2.6 Projections of Future Ecological Response to Climate Change

As previous discussions have shown, future climates may not only be quite different from recent climates, they also may be quite different from those inferred from paleoclimatic data and from those to which some existing species are evolutionary adapted (Hannah *et al.,* 2007). The first to assess climate change induced ecological change was Emanuel *et al.* (1985). Their study concluded that about 45% of all the world's ecosystems would change under a doubled-CO_2 climate. Since then, several others have found that changes to the composition, structure and function of the Earth's ecosystems may be even more significant over the remainder of the 21st century and beyond, particularly under warmer scenarios (e.g., Malcolm and Markham, 2000; Root *et al.,* 2003; Malcolm *et al.,* 2002a and 2002b; Malcolm *et al.,* 2004; Thomas *et al.,* 2004; McKenney *et al.,* 2007).

Correlative 'climatic envelope' methods have been applied to species modelling to project the future impacts of climate change on terrestrial ecosystems and species. Studies consistently project major shifts in species, ecosystems and landscapes. At the global scale, Malcolm *et al.*

(2002a) found that more than 80% of Earth's ecoregions[31] could experience extinctions as a result of climate change. Northern ecoregions in Canada, Russia and Asia were found to be especially vulnerable[32] -- seven ecoregions within these areas showed 70% or more change in at least one vegetation model [Ural Mountains Taiga (Russia); Canadian Low Arctic Tundra; Altai-Sayan Montane Forests (Russia/Mongolia); Muskwa/Slave Lake Boreal Forests (Canada); Kamchatka Taiga and Grasslands (Russia); Canadian Boreal Taiga, and Southwestern Australia Forests and Scrub]. Moreover, average required migration rates (RMRs) (i.e., the rates at which major biomes would need to move if they were to be able to successfully keep up with climate change) were unusually high, especially in Canada, often exceeding 1,000 $m/year^{-1}$. Rates of change of this magnitude are approximately ten times faster than the rapid migrations during the last postglacial period and signal the possibility of future species extinctions, as some species may fail to re-establish in areas that are climatically, physiologically and ecologically unsuitable.

Both national (e.g., Rizzo and Wiken, 1992; Lenihan and Neilson, 1995; McKenney *et al.,* 2007) and provincially-specific [e.g., British Columbia, Hogg and Hurdle (1995), Hamann and Wang (2005); Saskatchewan, Henderson *et al.* (2002); Ontario, Malcolm *et al.* (2004), Goldblum and Rigg (2005)] bioclimatic envelope modelling studies alike show the possibility of strong latitudinal and altitudinal effects, with the greatest changes occurring at high latitudes and altitudes and relatively less change in temperate areas. Over the next century, the traditional geographical range of some ecoregions (e.g., Canada's boreal forest) may shift as much as 300 to 700 km north (Rizzo and Wiken, 1992; McKenney *et al.,* 2007). Substantial declines in the extent of northern ecozones (e.g., taiga and tundra) and the expansion of more southerly ecozones (e.g., temperate forests and grasslands) are consistently projected by distinct studies utilizing different methods and spatial resolutions (Rizzo and Wiken, 1992; Lenihan and Neilson, 1995; Malcolm and Markham, 2000; Malcolm *et al.,* 2002a and 2002b; Malcolm *et al.,* 2004; McKenney *et al.,* 2007). For example, even with a major shift into the current distribution of taiga and tundra ecozones, substantial losses in geographical extent and density are consistently projected for Canada's boreal forest. Some

[31] Ecological Land Classification (ELC) systems are used to classify and describe ecosystems at many scales. For exact definitions of ELC classification terminology used throughout this dissertation including ecoregions, ecozones and ecodistricts, please refer to: http://www.ec.gc.ca/soer-ree/English/Framework/Nardesc/1-2.cfm

[32] Leemans and Eickhout (2004) similarly found that even a modest 1˚C temperature increase would result in a 47% net change in extent of the Earth's tundra biome. Globally, the authors project a 10.4 to 21.9% net change of extent amongst all ecosystems with temperature increases of 1˚C and 3˚C, respectively.

projections estimate that the extent of the boreal forest could be reduced by as much as 50%, with more southern areas being replaced by temperate type forests, aspen parklands, or grasslands (Rizzo and Wiken, 1992; Malcolm *et al.,* 2002; Gray, 2005).

Malcolm and Markham (2000) projected changes in climate envelope biome type in excess of 50% in seven provinces/territories (Yukon Territory – 64.1%, Newfoundland and Labrador – 63.6%, British Columbia – 60.4%, Ontario – 61.4%, Québec – 59.5%, Alberta – 56.4%, and the Manitoba – 52.9%). New Brunswick (44.7%), Nova Scotia (34.2%), Northwest Territories and Nunavut (33%), Saskatchewan (24.8%) and Prince Edward Island (0%) were projected to change the least. The highest 'required migration rates' (RMRs) were projected for the taiga/tundra, temperate evergreen, temperate mixed and boreal coniferous forest biomes, indicating that species dependent on these systems may be amongst the most vulnerable to climate change. Barriers to migration had important effects in exacerbating these rates. The authors concluded that climate change *"…has the potential to eventually destroy 35% of the world's existing terrestrial habitats, with no certainty that they will be replaced by equally diverse systems or that similar ecosystems will establish themselves elsewhere."* (Malcolm and Markham, 2000: v)[33]

More recent species-specific climate change modelling analyses for Ontario suggest that many forest species could expand or contract in geographical extent, be displaced and increase or decrease in dominance depending on their location. For example, dominant forest types currently associated with the northwest section of the Ontario boreal shield ecosystem, such as black spruce (*Picea mariana*) (Figure 16) and jack pine (*Pinus banksiana*), are expected to contract in geographical extent and decline in their relative dominance (Malcolm *et al.,* 2004). Conversely, forest types such as red maple (*Acer rubrum*) (Figure 17), mixed poplar and birch, currently characteristic of the southern part of the Ontario boreal shield ecosystem, are projected to expand their ranges into the northwest and increase in relative dominance (Malcolm *et al.,* 2004). Forest types more common to the southern Lake Simcoe–Rideau Region Ecosystem, including sugar maple (*Acer saccharum*), red oak (*Quercus rubra*), white pine (*Pinus strobus*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*) and eastern white cedar (*Thuja occidentalis*) are projected to expand their geographical range into the southern section of the Ontario boreal shield ecosystem (Malcolm *et al.,* 2004). Interestingly, Malcolm *et al.* (2004) found that as many as 30 tree species currently not found in Ontario could

[33] Malcolm and Markham (2000) used the term *"destroy"* in this context to denote any change in current vegetation type.

appear under the projected warmer climate of the late 21st century. Both conservation and extreme climate change scenarios alike projected the northward migration of several species currently restricted to the U.S. into the Lake Simcoe-Rideau region, including black hickory (*Carya texana*) and shortleaf pine (*Pinus echinata*) (Malcolm *et al.,* 2004). These scenarios also project the migration of osage-orange (*Maclura pomifera*) and post oak (*Quercus stellata*) into the Carolinian ecosystems of southwestern Ontario. Assuming that suitable conditions exist to allow for the successful migration of these southern species (i.e., seed dispersal and establishment), this is one of the first studies to suggest that climate change may result in an increased number of tree species in Ontario.

Figure 16 Modelled current and future distribution of black spruce (*Picae mariana*) in Ontario using six climate model scenarios. Source: Malcolm et al. (2004).

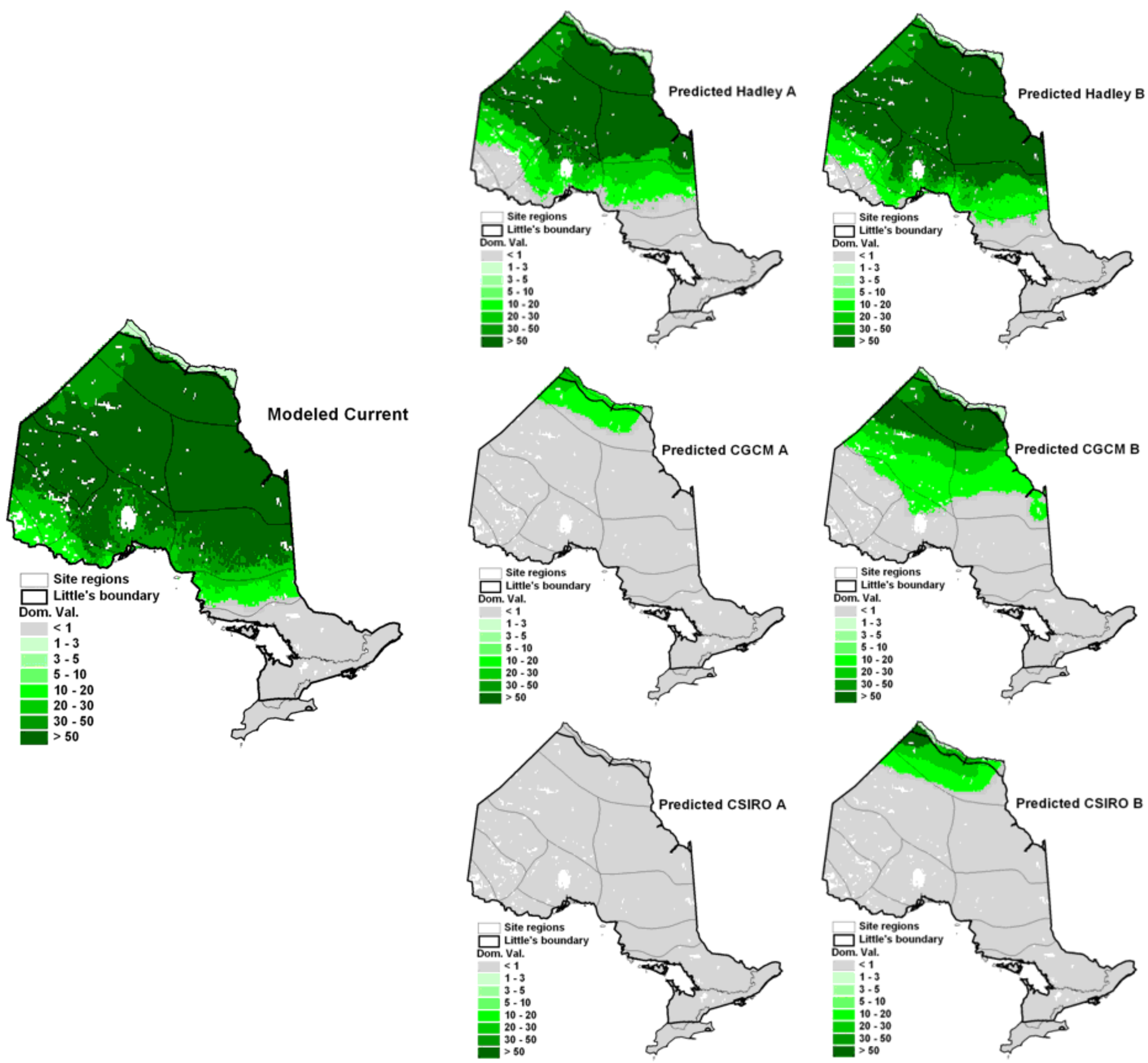
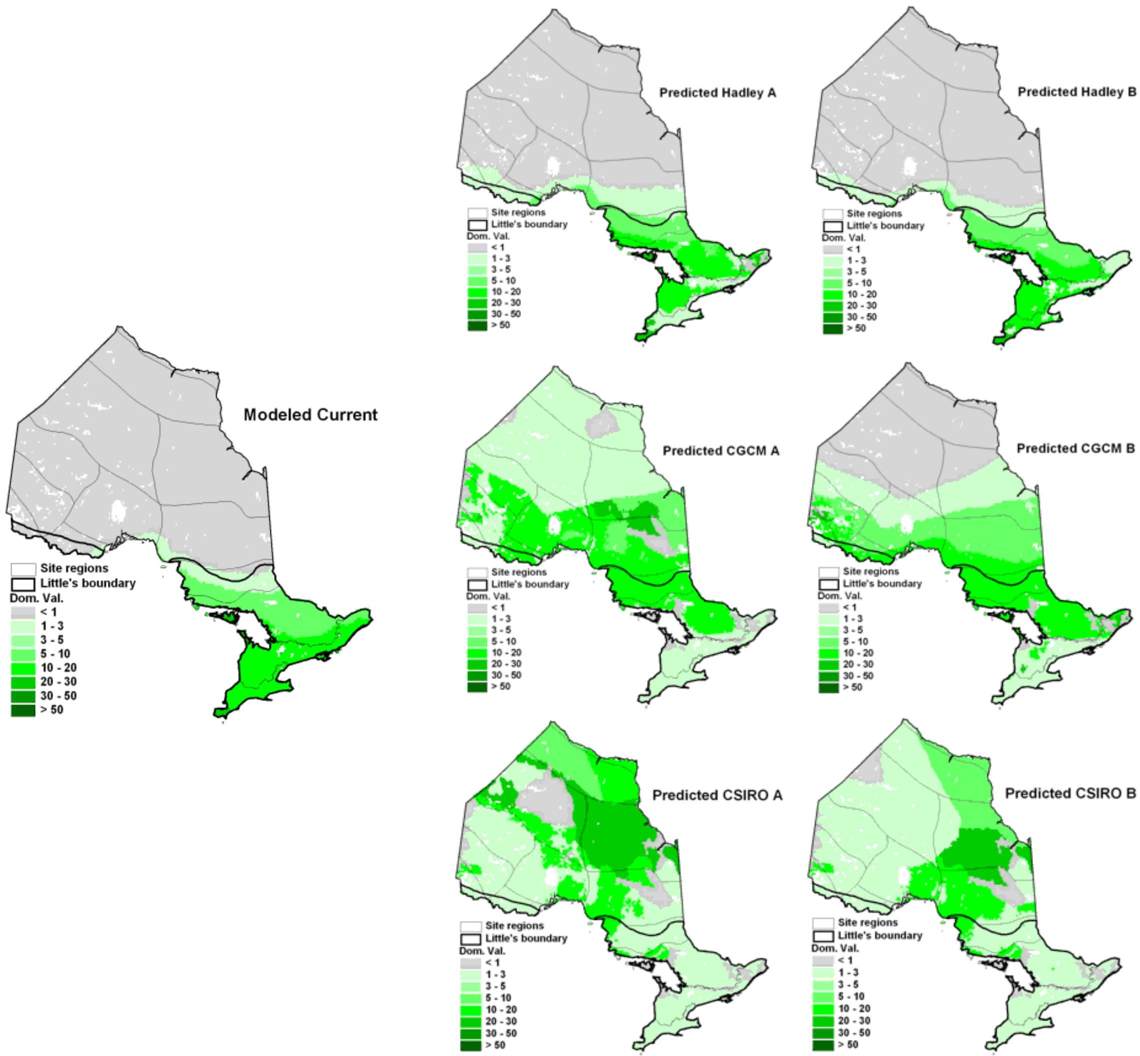


Figure 17 Modelled current and future distribution of red maple (*Acer rubrum*) in Ontario using six climate model scenarios. Source: Malcolm et al. (2004).



It is anticipated that the synergistic interactions between, and cumulative impacts of, fire and insect outbreaks resulting from climate change will emerge to be more important agents of biological change and re-organization in global ecosystems than increases in temperature and precipitation alone (Johnstone and Chapin, 2005; Candau *et al.,* 2007). Historically, the return interval of fire in the boreal forest has ranged from 263 to 288 years (Parisien *et al.,* 2004), with well established relationships between fire-cycle, species composition and age-class distribution (Larsen, 1997). However, a number of studies project an increased frequency and severity of forest fire outbreaks resulting from climate change over the next century and beyond. Flannigan and Van Wagner (1991) projected a 40 to 50% increase in area burned in the Canadian boreal under a doubled CO_2 climate.

A more recent analysis suggested that the total area burned in Canada could increase between 74 and 118% by the end of this century under a tripled CO_2 scenario (Flannigan *et al.,* 2005). Using a GCM driven fire model provided by Stocks *et al.* (1998) to project future forest fire intensity in Ontario's provincial parks, Lemieux *et al.* (2007) found declines in the 'low' forest fire severity rankings and significant increases in 'high' and 'extreme' forest fire severity rankings in the next forty to eighty years. The authors found that during the 1980 to 1989 baseline period, only 3% of Ontario's provincial parks were classified within the 'extreme' fire severity ranking. By the 2050s this percentage was projected to increase to 10% and by the 2090s 'extreme' fire severity is projected to expand into over a fifth of all provincial parks (21%).

Such projections suggest that Canada's forests could potentially undergo rapid ecological change resulting from increased forest fire disturbance activity, especially when compared to other forested regions, such as tropical forests, where fire is of lesser ecological importance and managerial concern. Increased forest fire frequency could result in permanent losses of forest cover following disturbance and an increase in the proportion of exposed edge habitat in remaining stands (Hogg and Hurdle, 1995). Flannigan *et al.* (2005) and Johnstone and Chapin (2006) similarly suggested that increased forest fire frequency will remove standing forests. This will lead to an increased number of early-successional and deciduous ecosystems dominated by fire-adapted species such as black spruce (*Picea mariana*), white birch (*Betula papyrifera*) and trembling aspen (*Populus tremuloides*), with consequential effects on ecosystem processes. As Thompson *et al.* (1996: 213) emphasized, *"Anthropogenically altered species compositions in current forests, coupled with fire suppression over the past 50 years, may lead to forest landscapes that are different then were seen in the Holocene period, as described by paleoecological reconstructions."*

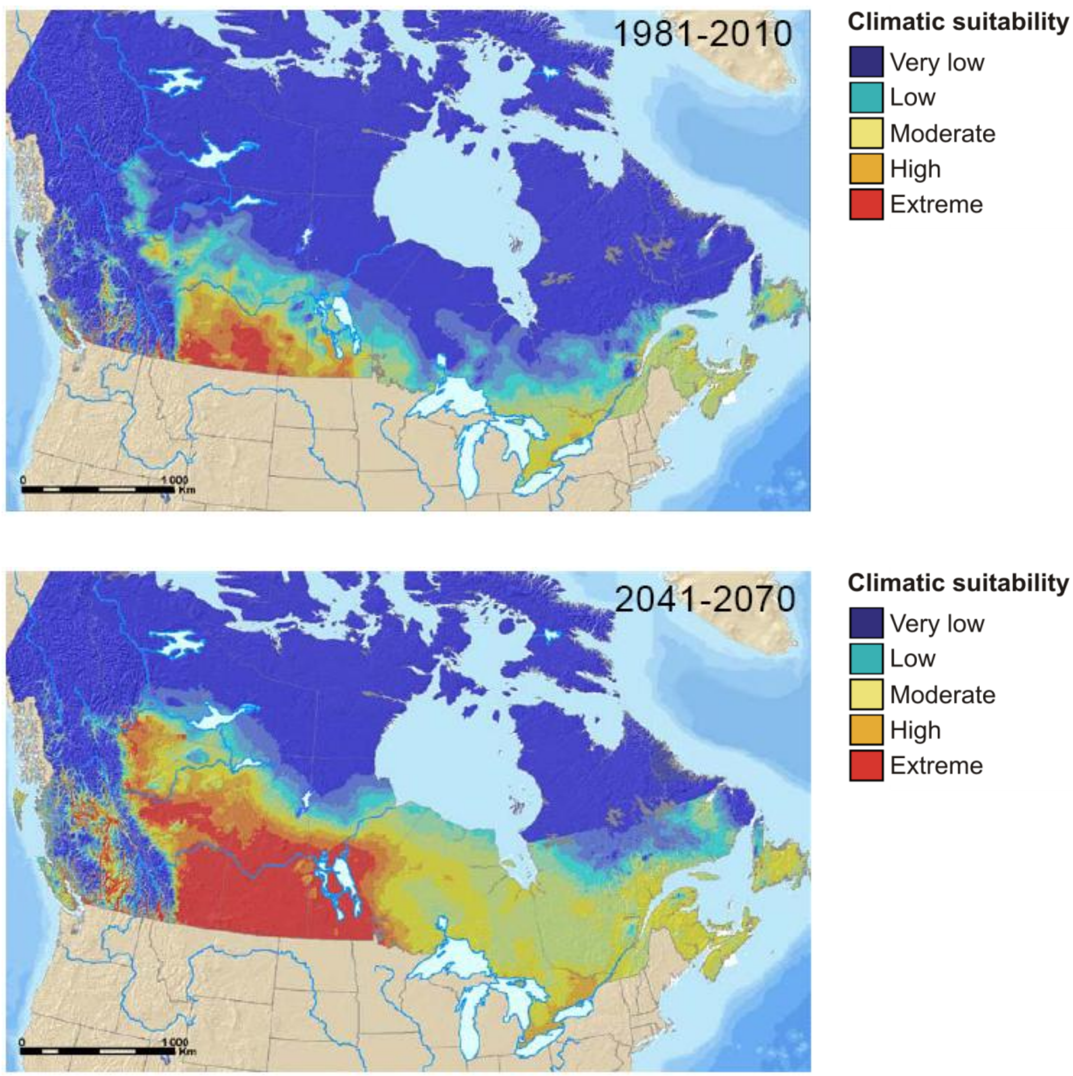
The ecological ramifications of increased forest fire frequency in Canada's boreal forest (i.e., increase in forest-fire-dominated species) could offset the projected retreat and decline of northerly-dominated species [e.g., black spruce as modeled by Malcolm *et al.* (2004) who did not incorporate fire into their climate change and vegetation response scenarios]. Due to the uncertainties associated with ecosystem compositional, structural and functional response to climate change and to disturbances such as fire, projections of the future distribution of species, ecosystems and biomes will remain uncertain until models that more accurately capture these diverse forcings are developed, or the specific response mechanisms begin to be revealed on the ground.

As previously discussed, temperature is a major variable limiting the geographical ranges, over-wintering success, population growth rates and dispersal and migration of pest insects and disease. Climate change will affect the distribution and the intensity of infestation of insect pests and disease, such as mountain pine beetle (MPB), spruce budworm and lyme disease, which will indirectly and directly affect the geographic distribution and abundance of other species. Spruce budworm (*Choristoneura fumiferana*) is projected to become more damaging in northern parts of the boreal and less damaging in southern parts of boreal Ontario (Candau *et al.,* 2007). Assessing the potential for additional range expansion by MPB under continued climate change, Carroll *et al.* (2006) discovered that most of the western and central regions of Canada (north of the prairies) could become climatically optimal (i.e., high or extreme climatic suitability) for MPB by 2041 to 2070 (Figure 18). Similarly, predicting the effect of climate change on Lyme disease risk, Brownstein *et al.* (2005) revealed the potential for a significant northern expansion of blacklegged tick (*I. scapularis*) into Canada due to a projected 213% increase in suitable habitat by the 2080s. The authors also projected a retraction of the vector from the southern U.S. and an expansion into the central U.S.

The synergistic interactions between climate and pests may allow the insects to improve their niches to the point where they could escape natural enemy regulation, making outbreak frequencies increase and destruction more severe (e.g., Fleming and Volney, 1995). Assessing the white pine weevil (*Pissodes strobi* Peck [Coleoptera: Curculionidae]) hazard in the Mackenzie Basin, Northwest Territories, Sieben *et al.* (1997) discovered that 'high hazard' areas of white pine weevil could increase by as much as 24 to 75%. The geographical range of the weevil could also expand both more to the north and in elevation by 2050. With the greatest amounts of warming expected to occur in winter, warmer temperatures may allow insect pests to improve their over-wintering success and expand their range into protected natural areas currently unaffected by the insect pests (Sieben *et al.,* 1997) (see Section 2.3 for recent evidence related to this phenomenon).

Another important projected ecological impact of climate change will be on freshwater species. In some rivers and lakes, there will be a significant decrease in cool and coldwater fish species and a significant increase in the distribution and abundance of warm-water fish species. Climate warming anticipated by the 2050s could result in a 500 to 600 km northward shift in the zoogeographical boundary of freshwater fish species (Magnuson *et al.,* 1997).

Figure 18 Current (1981-2010) and future (2041-2070) potential distribution of climatically suitable habitats for mountain pine beetle in Canada. Source: Carroll *et al.* (2006: 12).



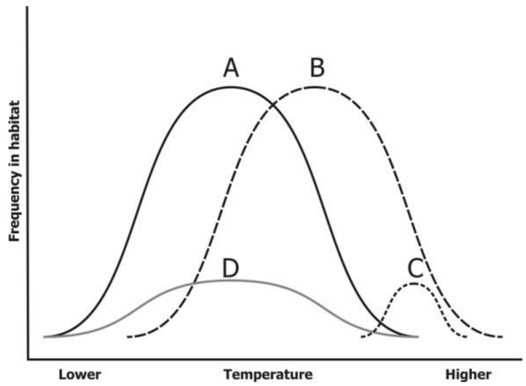
Given the high RMRs reported above, and the potential for large shifts in ecological composition, structure and function, there has been increasing concern over the ability of Earth's species to adapt to changing climatic conditions. Because biomes and ecosystems do not shift as complete entities in response to climate change but through the responses of individual species, some believe that current species communities will begin to break down and novel species associations with no current analogue will begin to evolve (Malcolm *et al.,* 2004; Gray, 2005; Hamann and Wang, 2005; Overpeck *et al.,* 2005; Huntley, 2007). Others believe that the complete disappearance of critical climate types and dependent species is possible (Williams *et al.,* 2003; Thomas *et al.,* 2004; Araúgo *et al.,* 2004).

Regardless of the type of response, the overwhelming majority of the extant literature suggests that projected climate change will have predominantly negative consequences for biodiversity especially when combined with human fragmented ecosystems. Examining over 1,100 animal and plants species for sample regions covering some 20% of the Earth's terrestrial surface, Thomas *et al.* (2004) estimated that between 15 to 37% (depending on the climate change scenario used and the migration capacity of species) could be *"committed to extinction"* by 2050. Similarly, Malcolm *et al.* (2006) found that 39 to 43% of biota in 'biodiversity hotspots' could face extinction under a 2 x CO_2 climate (representing the potential loss of some 56,000 endemic plant species and 3,700 endemic vertebrate species). The IPCC (2007b) estimated that approximately 20 to 30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5°C. According to Pounds and Puschendorf (2004) and others (e.g., Opdam and Wascher, 2004), such estimates may be optimistic when the synergistic effects of habitat fragmentation, habitat destruction and climate change on the landscape are considered (Figure 19).[34] Given the significance of these results, Thomas *et al.* (2004) concluded that *"… anthropogenic climate warming at least ranks alongside other recognized threats to biodiversity…* [and]… *it is likely to be the greatest threat in many if not most regions."* (147)

Davis and Shaw (2001: 678) noted that *"Although examples of persistence through repeated periods of unfavorable climate are documented in the fossil record, the record of extirpations and extinctions suggests that limits to adaptation are greatest during periods of rapid climate change, such as predicted for the future."* Changes in ecosystem composition, structure and function resulting from climate change will require a re-assessment of approaches to biodiversity conservation globally and indeed in Canada. Such changes raise important questions about protected natural area systems with a mandate to include a representative sample of ecosystems and unique or rare species of global, national and/or provincial significance.

[34] Malcolm *et al.* (2004) revealed that estimated global-warming induced rates of species extinctions in tropical hotspots in some cases exceeded those due to deforestation, further supporting suggestions that global warming is one of the most serious threats to biodiversity.

Figure 19 Illustration of the potential impact of a combination of habitat loss and climate change on the frequency of environmental conditions in a theoretical landscape. Source: Pyke and Fischer (2005: 430).



(A) Historic distribution of temperature within a given habitat type. (B) The historic distribution is shifted toward warmer conditions under climate change. (C) A combination of habitat loss and warming result in a climatically biased sample of remaining habitat. (D) Proportional representation of the original distribution of conditions despite an overall loss in habitat and shift climate.

2.7 The Implications of Climate Change for Protected Natural Areas Policy, Planning and Management

2.7.1 Biodiversity Conservation and Protected Natural Areas System Planning in Context

Protected natural areas were first established to provide recreational, medicinal, spiritual and economic benefits (Marsh and Hodgins, 1998). In the late 1800s, the protection of natural heritage features was perceived as a secondary benefit. Now, however, protected natural areas are viewed as the most common and effective response to ecosystem decay and biodiversity loss and are called for under the United Nations' (UN) *Convention on Biological Diversity* (*UNCBD*) (Article 8). Systematic protected natural areas planning was not introduced as a planning tool until the mid-20th century and largely arose out of recommendations put forth by the International Union for Conservation of Nature (IUCN) to establish a network of 'representative' samples of the world's ecosystems (Dasmann, 1972 and 1973). Globally, support for this representation-based approach to system planning manifested itself in the early 1960s, and was substantiated by the preparation of a hierarchical classification system of natural regions for the purpose of conservation by the IUCN and the establishment of UN International Biological Program (IBP) in 1963 (Dasmann, 1972 and 1973). The IUCN classification system utilized 'uniform' or 'homogeneous' features of climatic variables (i.e., temperature and precipitation) and vegetation as the basis to form a hierarchical classification of ecosystems. The IBP surveyed for the protection of 'representative habitats' around the world and, before the program was terminated in 1974, had inventoried 1,651 sites across Canada for representation purposes (Dasmann, 1972 and 1973). The ecoregion classification approach to protected natural areas establishment introduced by the IUCN would later be adopted and tailored for specific application by many of the globe's protected natural areas jurisdictions starting in the late 1970s, including Parks Canada (Parks Canada, 1997).

Federal and provincial/territorial system planning primarily focusing on representing samples of Canada's biodiversity reached a pinnacle in the early 1990s with the launch of the World Wildlife Fund's (WWF) *Endangered Spaces Campaign* (WWF, 1990) and the signing of the *Statement of Commitment* to complete Canada's networks of protected natural areas by Canadian Parks Ministers in 1992 (FPPC, 2000). Through this commitment, Ministers agreed 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"* and to *"…adopt frameworks, strategies, and timeframes for the completion of protected areas networks."* (FPPC, 2000: 5)

Across Canada, almost 100 million hectares of terrestrial protected natural areas have been set aside, an amount equal to 10% of the country's total land mass (Government of Canada, 2006) (Figure 20). While the national protected natural areas network has grown about 19% since 2000, no federal, provincial or territorial government has yet fulfilled the 1992 *Statement of Commitment* to complete a network of protected natural areas representative of Canada's land-based natural regions (Government of Canada, 2006). From an 'ecoregion representation' perspective, 29% of Canada's ecoregions are considered to be provided a 'high' level of protection (>12%), 12.4% 'moderate' protection (6 to 12%), 41.9% 'low' protection (<6%), and 16.6% have no protected natural areas at all (Government of Canada, 2006) (Figure 21).

Currently, *Canada's National Parks System Plan* (Parks Canada, 1997) and all provincially/territorially-based system plans, with the exception of Nunavut, have adopted some form of enduring features-based, ecoregional, or biogeoclimatic classification framework as the main system-planning tool for their terrestrial protected natural areas system (Table 6). For example, as of 2006, 46 national parks represent 25 'natural regions'. 72% of Parks Canada's natural regions are represented in the system (Government of Canada, 2006).[35] Similarly, in Ontario, 71 'site districts' and 14 'site regions' are used for setting the geographic representation needs for protected natural areas and the stated intent of *Ontario's Provincial Park Planning and Management Policies* (MNR, 1992) is to establish a protected area in each ecodistrict. As of 2006, 647 provincial parks, conservation reserves, wilderness areas and national parks are used to represent the province's biodiversity (Government of Canada, 2006). Furthermore, the 'representation principle' was recently reiterated to be the primary concept used to identify and establish protected natural areas within the province's new *Provincial Parks and Conservation Reserves Act* (*PPCRA*) (Government of Ontario, S.O. 2006, Chapter 12) which came into effect in September 2007 (the first update of the Act in over 50 years).[36] A more detailed discussion pertaining to Ontario Parks' protected natural areas and ecodistrict representation status is presented in Chapter 4.

Overall, 'representation' has become the primary systematic protected natural areas establishment criteria and planning policy for the majority of the globe's conservation-oriented programs and it is currently promoted internationally by the World Commission on Protected Areas (WCPA, 1998), the World Wildlife Fund (WWF) (Olson and Dinerstein, 1998) and non-government organizations such as Conservation International (Myers *et al.,* 2000). However, as previous discussions have revealed, climate change poses a new threat to long-term persistence of biodiversity and places in jeopardy the planning and management practices that have developed within the 'envelope' of current climate and ecosystem distribution (Scott *et al.,* 2002). Consequently, existing commitments inscribed in protected natural areas system and individual park management plans may be difficult to attain (and, perhaps more importantly, retain) because of climate change impacts.

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[35] The total includes 42 National Parks and National Park Reserves and four areas that have been given interim protection formally by means of Order in Council, pursuant to legislation. It is also interesting to note that approximately 40% of Parks Canada's National Parks and National Parks Reserves were established *prior* to the adoption of the 'natural region representation approach' to system planning.

[36] The purpose of Ontario's *Provincial Parks and Conservation Reserves Act* (*PPCRA*) is *"to <u>permanently protect</u> a system of provincial parks and conservation reserves that includes ecosystems that are representative of all of Ontario's natural regions, protects provincially significant elements of Ontario's natural and cultural heritage, maintains biodiversity and provides opportunities for compatible, ecologically sustainable recreation."* (2006, c. 12, s. 1.) (emphasis added)

Figure 20 Protected natural areas map of Canada. Source: Government of Canada (2006: 4).

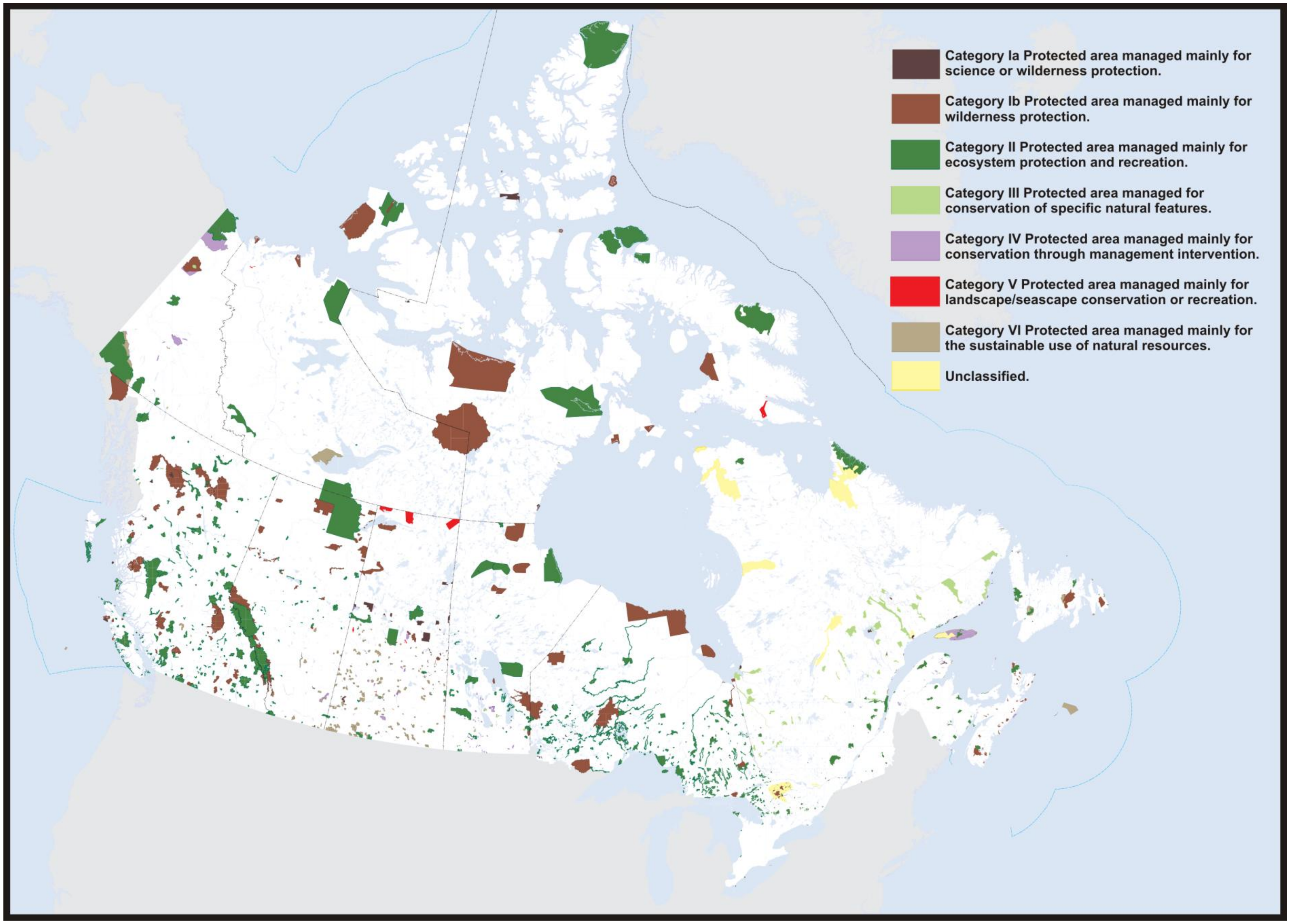


Figure 21 Percentage of ecoregion protected. Source: Natural Resources Canada (2008).

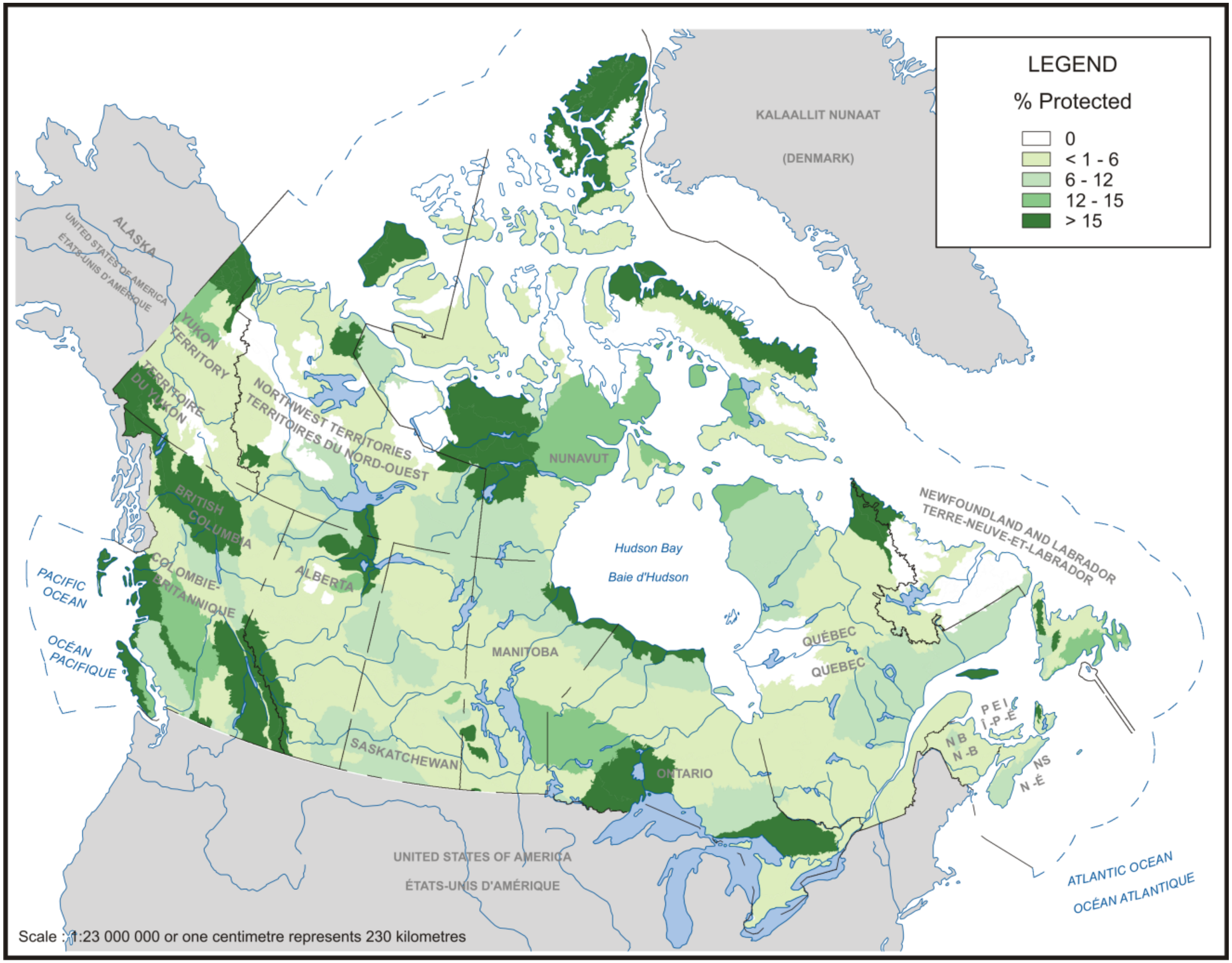


Table 6 Provincial/territorial protected natural areas strategies, identification and selection premise, land classification framework, number of protected natural areas, total area protected (ha) and % of terrestrial base protected. Sources: Lemieux and Scott (2005), Government of Canada (2006) and Ontario Parks (2008).

PROVINCE	PROTECTED NATURAL AREAS STRATEGY	PROTECTED NATURAL AREAS IDENTIFICATION AND SELECTION PREMISE	LAND CLASSIFICATION FRAMEWORK	STATISTICS
Alberta	*Special Places Plan* (1995)	Natural region representation	6 natural regions/ 167 'Natural History Theme' landscapes	Number of protected areas: 537 Total area protected: 8,250,133 ha % of land protected: 12.5%
British Columbia	*A Protected Areas Strategy for British Columbia* (1998)	Ecoregion representation	14 biogeoclimatic zones/112 eco-sections	Number of protected areas: 948 Total area protected: 13,313,151 ha % of land protected: 14.1%
Manitoba	*An Action Plan for Manitoba's Network of Protected Areas* (2000)	Natural region representation based on enduring features analysis	18 natural regions and subregions	Number of protected areas: 122 Total area protected: 5,470,018 ha % of land protected: 8.4%
New Brunswick	*Protected Areas Strategy* (1999)	Ecoregion representation	7 ecoregions	Number of protected areas: 106 Total area protected: 237,095 ha % of land protected: 3.3%
Newfoundland and Labrador	*Wilderness and Ecological Reserves Program* (1980)	Ecoregion representation	9 ecoregions and 21 subregions (Newfoundland) and 10 subregions (Labrador)	Number of protected areas: 63 Total area protected: 1,838,275 ha % of land protected: 4.5%
Northwest Territories	*Protected Areas Strategy: A Balanced Approach to Establishing Protected Areas in the Northwest Territories* (1999)	Ecoregion representation	9 ecozones/69 ecoregions	Number of protected areas: 19 Total area protected: 13,853,314 ha % of land protected: 10.3%
Nova Scotia	Protected Areas Strategy (1997)	Natural landscape representation	80 natural landscapes	Number of protected areas: 75 Total area protected: 472,671 ha % of land protected: 8.6%
Nunavut	*Parks and Conservation Areas System Plan* (in development)	n/a	n/a	Number of protected areas: 27 Total area protected: 23,223,025 ha % of land protected: 11.1%

Ontario	*Ontario Parks: Planning and Management Policies* (1992) *Nature's Best* (1997)	Broad park class targets (e.g., one large Wilderness class park per ecoregion) and finer life science and earth science criteria (e.g., representation, condition, diversity, ecological functions and special features)	14 ecoregions/71 ecodistricts	Number of protected areas: 658 Total area protected: 9,862,896 ha % of land protected: 9.1%
Prince Edward Island	*Significant Areas Plan* (1991)	Habitat type representation	7 habitat types/94 sites	Number of protected areas: 184 Total area protected: 17,994 ha % of land protected: 3.2%
Québec	*Action Plan for Parks: Nature's Heritage/Plan d'action sur les parcs: La nature en héritage* (1992)	Natural region representation	43 natural regions	Number of protected areas: 1,096 Total area protected: 9,339,320ha % of land protected: 6.2%
Saskatchewan	*Saskatchewan Representative Areas Network* (1997)	Ecoregion representation based on enduring features analysis	4 ecozones/11 ecoregions/150 'Landscape Areas'	Number of protected areas: 4,608 Total area protected: 5,939,460 ha % of land protected: 9.1 %
Yukon	*Wild Spaces and Protected Places: Yukon Protected Areas Strategy* (1998)	Ecoregion representation	23 ecoregions	Number of protected areas: 24 Total area protected: 6,419,928 ha % of land protected: 13.3 %

2.7.2 Limitations of Conventional Approaches to Protected Natural Areas System Planning and Management

2.7.2.1 Advancements in Conservation Ecology

Recent evidence has questioned the effectiveness of protected natural areas as long-term conservation tools. This evidence has paralleled theoretical and empirical advancements in conservation ecology, such as island biogeography (MacArthur and Wilson, 1967), landscape ecology (Forman, 1995) and conservation biology (Meffe and Carrol, 1997), which have proved to be important in addressing a wide range of issues related to biodiversity conservation (Table 7). While parts of these understandings are by no means all recent [Shelford (1933) and the *first* World Parks Congress indicated that parks were generally too small in 1962 (Adams, 1962)], a number of recent analyses have further called attention to the shortcomings of traditional protected natural areas planning and design approaches and are consequently elaborated on here (Table 8).

Table 7 Contributions of 'conservation ecology' to protected natural areas planning and design. Sources: MacArthur and Wilson (1967); Diamond (1975); Soulé (1985); Forman (1995); Meffe and Carroll (1997); Hobbs (1997); Sportza and Nelson (1999); Lindenmayer and Franklin (2002).

	ISLAND BIOGEOGRAPHY	LANDSCAPE ECOLOGY	CONSERVATION BIOLOGY
General Focus	• Species/area relationships	• Characteristics of 'mosaics' of the landscape • Considers the study of landscape structure, function, and change	• Links traditional academic disciplines in the interest of biodiversity conservation • Guiding principles include: evolutionary change; dynamic ecology; and, human presence
Central Themes and Contributions	• Critical in raising geometric issues of protected natural areas (size, shape, relation, isolation) • Critical in understanding the effects of habitat fragmentation on patches	• Importance of patch size, shape, quality • Consideration of corridors, the matrix, and natural disturbance regimes • Important to addressing populations dynamics in fragmented landscapes (metapopulations)	• Investigate human impacts • Crisis oriented and value laden – focuses on approaches to prevent further loss of biodiversity • Recognizes 'inherent' value of biodiversity • Guidance on how much protected area (minimum viable area) needed to conserve biodiversity (minimum viable population)

Table 8 Limitations of conventional protected natural areas planning and design.

• Inadequate size, location, and design, i.e., too small, too isolated, too fragmented
• Increasingly difficult to establish new protected natural areas
• Subject to numerous internal and external stresses, e.g., incompatible land-uses in matrix, climate change
• Inappropriate boundaries not based on ecology
• Inconsistency in multi-agency classifications systems
• Establishment is often systematically biased towards remote, rugged, scenic landscapes, e.g., 'left-overs'
• Ecosystem dynamics, process and persistence treated inadequately
• Inadequate 'one-size-fits-all' conservation targets, e.g., 12% representation of world's ecoregions

Overall, current protected natural areas have been criticized as being: (i) too small to conserve large mammals (including migratory) over the long-term (Newmark, 1985; Noss, 1987; Gurd *et al.,* 2001; Nudds and Wiersma, 2005); (ii) seldom located in landscapes where land productivity and opportunity costs are high (Presssey *et al.,* 1996; Scott *et al.,* 2001); (iii) based on inadequate, percentage-based, uniform targets (Rodrigues *et al.,* 2004; Coulston and Riitters, 2005); (iv) not based on ecological reality (Noss, 1987); narrowly focused on biodiversity pattern over process (due to a focus on representation complementarity) (Pressey, 1994); and (v) sensitive to climatic and ecological change (e.g., Scott *et al.,* 2002; Hannah *et al.,* 2002a and 2002b; Lemieux and Scott, 2005; Scott and Lemieux, 2005; Scott and Lemieux*,* 2007).

Pressey *et al.* (1996) and Scott *et al.* (2001) found that protected natural areas are systematically biased towards marginal landscapes by tending to be remote, rugged and scenic [what Hall and Shultice (1991) refer to as the "*worthless lands"*]. With regards to uniform, percentage-based targets, Soulé and Sanjayan (1998) found that 50% of tropical taxa would be extinct within the next few decades even if more than 10% of the tropical forests were protected. Perhaps a more important implication of such targets to conservation planning is the fact that the 'percentage of area already protected' in a given country or biome is a very poor indicator of additional conservation needs (e.g., Warman *et al.,* 2004). Rodrigues *et al.* (2004) similarly emphasized that uniform targets inappropriately ignore the fact that ecosystems with higher diversity and/or higher levels of endemism require substantially large fractions of their areas to be protected. It has been suggested that between 33 to 93% of a given region might require some degree of protection in order to meet standard conservation goals (e.g., Mosquin *et al.,* 1995; Soulé and Sanjayan, 1998; Noss *et al.,* 2002; Rodrigues and Gaston, 2001; Carrol *et al.,* 2003; Rodrigues *et al.,* 2004). These figures are well in excess of the 10 and 12% goals suggested by the *Bruntland Commission* (WCED, 1987), the *Caracas Congress on Parks* (WCPA, 1993) and the IUCN (1994), respectively. Collectively, the studies reviewed here question the effectiveness of such uniform, one-size-fits-all conservation targets which, if viewed as a politically expedient, area-based, conservation ceiling, could potentially impede biodiversity protection over the long-term.

Protected area establishment approaches adopting representation-based principles are based on recent information about the distribution and abundance of ecological features. Pressey (1994) noted that such representation-based approaches to conservation results in bias in the content of reserve systems, leaving some species, communities or ecosystems without protection. Moreover, significant differences in boundary delineations by different agencies upon which representation is based have essentially created a consistency problem in determining a 'common denominator' of classification boundaries [e.g., Parks Canada's *System Plan* (Parks Canada 1997) versus the World Wildlife Fund (Olson and Dinerstein, 1998)]. In this regard, since ecoregion classifications by nature have been tailored idiosyncratically and without consensus, and because many protected natural areas were established prior to formal 'system planning' efforts, an incoherent system for identifying sites for inclusion in a system of protected natural areas has manifested itself and their long-term viability in an era of climate change must be examined.

2.7.2.2 Limitations of Conventional Approaches to Protected Natural Areas System Planning and Management with Climate Change Considerations

As noted, Earth's network of protected natural areas has been designed to protect specific natural features, species and communities *in-situ*, not taking into account shifts in ecosystem composition, structure and function that could be induced by climate change. The syntheses presented within this Chapter suggest that climate change and its ecological effects will have considerable implications for Earth's biodiversity and, consequently, for the protected natural areas policy, planning and management approaches employed by respective agencies.

Table 9 synthesizes the implications of climate change for several protected natural area management themes, including i) policy, planning and legislation; ii) establishment and design; iii) habitat and new/invasive species; iv) recreation and tourism assets; and v) ecological disturbances. In this context, a recent report by the World Wildlife Fund (WWF) (2003a: 1) 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."* A growing number of authors worldwide contend that climate change has the potential to undermine over a century of conservation efforts (Halpin, 1997; Rutherford *et al.,* 1999; Scott and Suffling, 2000; Scott *et al.,* 2002; Hannah *et al.,* 2002a,b, 2005, 2007; Hossell *et al.,* 2003; Téllez-Valdés and Dávila-Aranda, 2003; Hannah and Salm, 2005; Lemieux and Scott, 2005; Scott and Lemieux, 2005; Welch, 2005; Pyke and Fisher, 2005; Araújo *et al.,* 2005; Harrison *et al.,* 2006; Scott and Lemieux, 2007; Hannah *et al.,* 2007).

Table 9 The implications of climate change for protected natural areas policy, planning and management. Adapted from: Scott and Lemieux (2005), Lemieux and Scott (2005), Scott and Lemieux (2007) and Lemieux *et al.* (2007).

PROTECTED NATURAL AREAS POLICY AND/OR MANAGEMENT ISSUE	CLIMATE CHANGE IMPLICATIONS
Protected Natural Areas Policy, Planning and Legislation	• Species' biogeoclimatic envelopes will change. Protected natural area representation targets may be compromised as they emerge to under-represent or not represent all the species, ecosystems and habitats they were originally designed to protect. • Protected natural areas managers may be forced to try to "hit a moving target" of ecological representativeness. • System goals as tabled in legislation and system plans may require interpretation (what to protect: historic-current-future species/ecological processes and not species?) and possible revision.
Protected Natural Areas Establishment and Design	• Future non-analogue species are excluded from current steady-state establishment frameworks. • Intervening areas may emerge as important areas to help achieve protection commitments. • Protected natural areas boundaries may require adjustment to help achieve protection commitments. • Protected natural areas management plans and conservation targets will require revision if established management objectives are no longer viable.
Protected Natural Areas Habitat and New/Invasive Species	• Current protected natural area habitat may emerge to be unsuitable for species that it currently supports (e.g., species unable to acclimatize to changing climatic and ecological conditions). • Current protected natural area habitat may emerge to be suitable for species it was originally unable to support (i.e., species currently occupying niches in more southerly located ecosystems). • Invasive species may expand their biogeoclimatic envelopes northward and emerge to be a more pervasive management issue in protected natural areas

	located in these areas.
Recreation and Tourism Assets	• The availability of some recreational opportunities may decline in some areas (e.g., cross-country skiing) while other/new recreational opportunities may increase/emerge (e.g., climatic suitability for camping in shoulder seasons). • A range of management issues could be affected, such as user-fee collection, environmental operations (e.g., increased fire bans and beach closures) and staffing needs (i.e., to take advantage of an extended operating period). • Visitor management plans may need to be revised (e.g., how manage for potentially large increases in visitation due to extended and improved warm-tourism season?).
Ecological Disturbances	• Many ecosystems, such as the boreal forest, depend on fire and pest outbreak frequency patterns of disturbance for renewal and maintenance of ecological integrity and may emerge to be more important agents of change than increased temperature and precipitation levels alone. • Ecologically, increased distribution and frequency of disturbances may result in increased distribution and dominance of early successional ecosystems dominated by fire adapted species. • Wildfire management plans may require revision (utilize to re-establish or maintain current ecological representation or facilitation adaptation)? • Natural resource managers may find it increasingly difficult to achieve a balance between protecting socio-economic values (such as forestry interests), protecting representative natural values (such as rare or endangered species and ecosystems), promoting the use of fire in restoring and maintaining ecosystem health, managing for carbon, and managing pest outbreaks (e.g., spruce budworm and mountain pine beetle) under climate change.

One of the more important policy implications of climate change concerns protected area system planning frameworks. As noted, all federal and provincial/territorial jurisdictions in Canada have adopted (or are about to adopt) some form of enduring features-based, ecoregion, or biogeoclimatic land classification system as the main system planning framework for their terrestrial protected natural area systems (refer back to Table 6). For example, in the 1970s, Parks Canada delineated 'natural regions' based on the appearance of land and vegetation formations with the goal to "…*protect for <u>all time</u> representative natural areas of Canadian significance in a system of national parks, to encourage public understanding, appreciation and enjoyment of this natural heritage so as to leave it unimpaired for future generations*." (Parks Canada, 1997, emphasis added) Such frameworks are based on static climatic and ecological parameters. Consequently, these system planning approaches are essentially conserving snapshots of the current bioclimatic landscape at a given space and time. Protected natural areas established under this principle may prove to under-represent or not represent the species they were originally designed to protect in an era of climate change.

For example, Scott *et al.* (2002) examined the extent to which vegetation distribution might be altered in Canada's national park system as a result of climate change. In five of six global vegetation model (GVM) scenarios, a novel biome type appeared in more than half of the national parks and greater than 50% of all vegetation grid boxes changed biome type. A similar study by Lemieux and Scott (2005) showed the potential for substantial change in vegetation distribution throughout Canada's entire terrestrial protected natural areas system. Of the nearly 3,000 protected natural areas included in the study, vegetation modelling results projected that 28 (conservative scenario) to 48% (extreme scenario) of Canada's protected natural areas could experience a change bioclimatic-envelope type under 2 x CO_2 conditions (Table 10). As would be expected, the greatest bioclimatic-envelope representation losses were projected for the more northerly found biomes, including tundra, taiga and boreal conifer forest (with representation losses running as high as 87% for the taiga biome). Conversely, increased representation was projected for more southerly found biomes, such as temperate evergreen forest and temperate mixed forest.

Table 10 Projected biome change in Canada's protected natural areas network (by designation type). Source: Lemieux and Scott (2005: 391).

PROTECTED NATURAL AREAS DESIGNATION	# OF PAs*	MAPSS (change %)				BIOME3 (change %)	
		UKMO	GFDL	GISS	Had CM2	Had CM2	MPI
National Parks	38	61%	58%	58%	47%	42%	39%
RAMSAR Sites	44	48%	43%	36%	18%	34%	34%
Migratory Bird Sanctuaries	66	33%	50%	30%	17%	36%	35%
National Wildlife Areas	40	40%	45%	25%	15%	30%	18%
Ecological Reserves	464	52%	44%	42%	34%	55%	44%
Provincial Parks	946	49%	31%	38%	34%	71%	54%
Wilderness Areas	234	38%	44%	41%	38%	56%	31%
Total Change	**2,979**	**1,426**	**1,371**	**1,168**	**832**	**1,418**	**1,093**
Change (%)		**48%**	**46%**	**39%**	**28%**	**48%**	**37%**

**PAs=Protected areas. Full GCM scenario names can be found in Abbreviations and Acronyms section of the dissertation.*

Modelling studies for protected natural areas located in other parts of the globe indicated similar results (Figure 22). A number of analyses suggested significant changes to ecosystem composition, structure and function in South Africa (e.g., Rutherford *et al.,* 1999; Bomhard *et al.,* 2005; Thuiller *et al.,* 2006a and 2006b). For example, the first regional modelling of climate-change effects on a biodiversity hotspot suggested major vegetation shifts in the Succulent Karoo and Cape Floristic Regions of South Africa (Rutherford *et al.,* 1999). The highly diverse and endemic arid flora of the Succulent Karoo is projected to collapse southward under a 2 x CO_2 scenario. Under this scenario, the Succulent Karoo hotspot is projected to lose more than 80% of its bioclimatic range (Rutherford *et al.,* 1999). Furthermore, five South African parks were projected to lose more than 40% of their plant species (Rutherford *et al.,* 1999). In a separate study, Bomhard *et al.* (2005) examined the potential impacts of climate change for the conservation of 227 Proteaceae taxa (plants) endemic to the Cape Floristic Region. The authors discovered that up to a third of the 227 Proteaceae taxa listed on the IUCN *Red List* would be uplisted (i.e., become more threatened) by up to three 'threat categories' if future climate change threats as predicted for the 2020s are included. In addition, the proportion of threatened Proteaceae taxa rises on average by 9% (with a range of 2 to 16%, depending on the scenario). With increasing severity of the climate change scenarios, the proportion of 'critically endangered' taxa increases from about 1 to 7% and almost 2% of the 227 Proteaceae taxa are projected to become extinct (Bomhard *et al.* 2005).

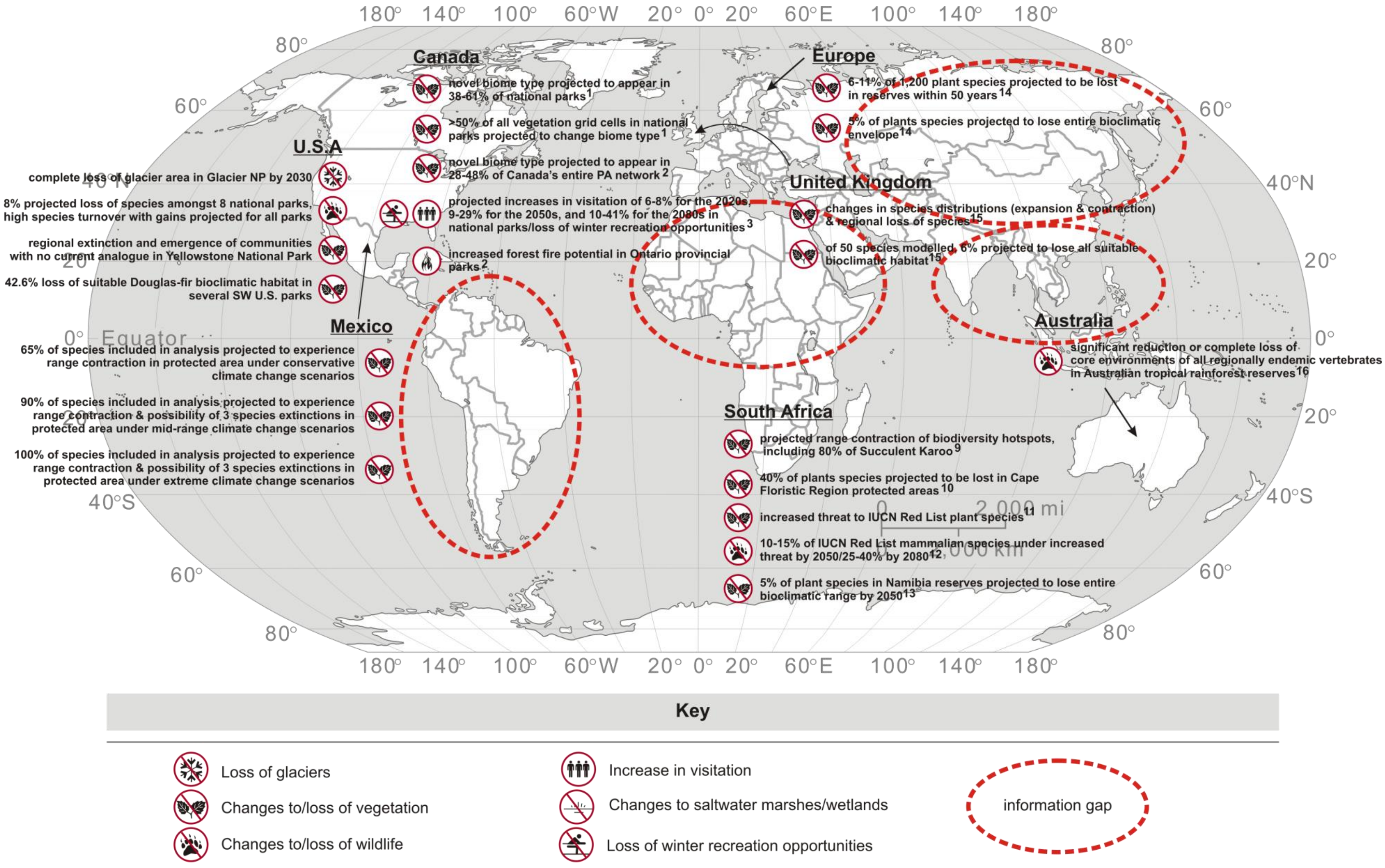
In addition for South Africa, Thuillier *et al.* (2006a) estimated the sensitivity of 141 national parks in terms of both mammalian species richness and turnover. Assuming 'no spread' of species, the authors revealed that 10 to 15% of the species are projected to fall within the 'critically endangered' or 'extinct' IUCN *Red List* categories by 2050 and it will rise to between 25 and 40% by 2080 (Thuiller *et al.,* 2006a). Assuming 'unlimited spread' of species, the authors found less extreme results, with proportions dropping to approximately 10 to 20% by 2080. Thuiller *et al.* (2006b) similarly assessed the impacts of climate change on vegetation structure and function of 159 species endemic to Namibia. The authors discovered that fewer than 5% are predicted to experience complete range loss by 2080. However, more than 47% of the species are expected to be vulnerable (with a range reduction of up to 430%) by 2080 if they are assumed unable to migrate (Thuiller *et al.,* 2006b).

Assessing the ability of existing reserve-selection methods (i.e., representation) to protect species under a changed climate in Europe, Araújo *et al.* (2004) found that 6 to 11% of 1,200 plant species modelled would be potentially lost from selected reserves within 50 years. Within this range, the authors projected that 5% of the species would lose their entire climatic envelope and 2% of the species modeled would have non-overlapping distributions. Examining the northwestern U.S., Coulston and Riitters (2005) also used a climate envelope approach to identify the effectiveness of current protected natural areas in maintaining suitable Douglas-fir (*Psuedotsuga menziesii*) bioclimatic habitat under future climate change. The authors found that as much as 42.6% of current protected natural areas could lose suitable bioclimatic habitat for the species within the next century.

Taken collectively, these modelling studies indicate that representation-based approaches to conservation may not be optimal for the perpetual persistence of biodiversity. Moreover, modelling of individual species response to projected climate change in North America also reveals another policy dilemma for protected natural area agencies in North America: the northward shift of species from the U.S. Ranges not currently in Canada would meet Parks Canada's existing definition of 'alien species' and it could be interpreted that these species should be subject to management interventions (i.e., control and removal) (Scott and Lemieux, 2005). Provincial level definitions of invasive species, generally considered a species beyond its 'historical range', also do not anticipate or account for species response to climate change.

Although the arrival of a new species may be identified as a negative outcome of climate change and a negative impact on a protected natural area, it can also be interpreted as successful autonomous adaptation by a species to anthropogenic climate change thereby adding further complexity to species management decisions (Scott and Lemieux, 2005). Further to this point, the *Canadian Species at Risk Act* defines a 'wildlife species' as a species 'native' to Canada and one that has been present in Canada for at least 50 years (Government of Canada, 2003). A literal interpretation of this definition indicates that a species classified as endangered in the U.S. that naturally expands its range into Canada under changing climate would not qualify for protection as a species at risk under the *Canadian Species at Risk Act* (Scott and Lemieux, 2005). Overall, such 'representation-first' principles face significant interpretation challenges in an era of climate change, since what is chosen to be representative may prove to be under represented or not represented at all in protected natural area systems of the future.

Figure 22 Examples of potential climate change impacts in protected natural areas around the world.



1=Scott *et al.* (2002); 2=Lemieux and Scott (2005); 3=Jones and Scott (2006a and 2006); 4=Hall and Fagre (2003); 5=Burns *et al.* (2003); 6=Bartlein *et al.* (1997); 7=Coulston and Riitters (2005); 8=Téllez-Valdéz and Davila-Aranda (2003); 9=Rutherford *et al.* (1999); 10=Hannah *et al.* (2005); 11=Bomhard *et al.* (2005); 12=Thuiller *et al.* (2006a); 13=Thuiller *et al.* (2006b); 14=Araújo *et al.* (2004); 15=U.K. Climate Impacts Programme (2001); 16=Williams *et al.* (2003).

Similar to protected natural areas around the world, certain protected natural areas in Canada were established with the intent of perpetually protecting highly valued individual species and their habitats. The primary goal of protected natural areas management planning is to ensure that there is a clearly defined direction for the maintenance or restoration of ecological integrity and, in light of this primary goal, for guiding appropriate use of these areas. Each of Canada's national parks is responsible for protecting ecosystems representative of the natural region within which it is located. Scott *et al.* (2002), Lemieux and Scott (2005), Scott and Lemieux (2005) and Lemieux *et al.* (2007) have drawn on a number of specific examples from protected natural areas management plans to highlight management implications of climate change at the individual protected area level.

For example, the stated purpose of Prince Albert National Park is to, *"Protect for <u>all time</u> the ecological integrity of a natural area of Canadian significance representative of the southern boreal plains and plateaux …"* (emphasis added) All six vegetation change scenarios examined by Scott *et al.* (2002) projected the eventual loss of boreal forest in this park, suggesting that the park's mandate would be unsustainable in the long term. Similarly, Lemieux and Scott (2005) found that the stated purpose of Pukaskwa National Park to "…*protect, for all time, a representative sample of the Central Boreal Uplands*" and to protect woodland caribou using "special preservation areas" (Parks Canada, 1995) may not in fact be realized 'for all time' as species begin to migrate northward in response to climate change. Finally, using Quetico Provincial Park as an example (also located in Ontario's boreal forest), Lemieux and Scott (2005) emphasized that the goal of the park's management plan to *"…protect a representative portion… [of]… modern biological environments…associated with site region 4W"* (Ontario Parks, 1995) is operationally vulnerable to changing climatic and ecological conditions because of its stated commitment to protect 'modern' biological environments.

Ultimately, the ecological manifestations of climate change will be such that the established species management objectives of some protected natural areas will no longer be viable. Other examples can be found in both federal and provincial/territorial management plans, including polar bears in Wapusk National Park and Polar Bear Provincial Park (Ontario) and woodland caribou in Nopiming Natural Park (Manitoba), Seager Wheeler Lake Representative Area (Saskatchewan) and Woodland Caribou Provincial Park (Ontario) [see Scott *et al.* (2002), Lemieux and Scott (2005), Scott and Lemieux (2005), Scott and Lemieux (2007) and Lemieux *et al.* (2007) for more examples]. In all instances, the established management and protection commitments inscribed in individual protected natural area management plans will no longer be sustainable and will require revision under changing climatic and ecological conditions.

Climate change also has potentially important implications for protected natural areas recreation and tourism which is an important mandate of many protected natural areas. Visitation to Canada's protected natural areas is strongly influenced by climate. Climate influences the physical resources (e.g., water levels, snow cover and wildlife species) that provide the foundation for outdoor recreation (e.g., boating, cross-country skiing, bird watching), defines when specific activities can take place (e.g., beach use, swimming) and influences the level of visitor satisfaction (Jones and Scott, 2006a and 2006b). Canada's national and provincial parks are major resources for nature-based tourism and any changes in the length and quality of recreation seasons induced by climate change would have considerable implications for park visitation, revenue and management.

Two recent analyses indicate that Canada's protected natural areas could experience an increase in visitors under climate change due to a lengthened and improved warm-weather tourism season (Jones and Scott, 2006a and 2006b). Examining Canadian national parks specifically, Jones and Scott (2006a) found that overall visitation levels could increase 6 to 8% in the 2020s, 9 to 29% in the 2050s and between 10 and 41% in the 2080s, with the largest increases in visitation to occur during the spring and fall months as climate conditions become more suitable for a wide range of warm-weather recreation activities. Some of the larger increases were projected for national parks located in more northerly locations, such as Pukaskwa (Ontario) (2020s: +12.2 to 22.6%; 2050s: +14.2 to 40.2%; 2080s: +16.4 to 58.8%) and Prince Albert (Saskatchewan) (2020s: +6.7 to 14.6%; 2050s: 10.4 to 35.7%; 2080s: +11.7 to 55.1%). Similar results were projected for Ontario's provincial parks (Jones and Scott, 2006b) where visitation could potentially increase between 11 and 27% system wide in the 2020s and between 15 and 56% in the 2050s. In the 2080s, the number of people visiting Ontario's provincial parks was projected to increase between 19 and 82%.

Changes in the seasonal timing of increases in visitation will be an important issue for protected areas managers in Canada, since these changes will influence a range of management issues such as user-fee collection, environmental operations and staffing needs (Scott and Lemieux, 2007). Protected area jurisdictions would benefit economically from increased visitors. However, an increase in visitors during the peak tourism period will place extra strain on park resources that can be operating near capacity during summer months (Scott and Lemieux, 2007). It is likely that more intensive visitor management strategies will be needed to offset ecological degradation and reduce potential conflicts among park users (Jones and Scott, 2006a).

The evidence presented in this section underscores the importance and in some regions the immediacy of the climate change 'problem' facing biodiversity and the conservation thereof.

Representation-based protected natural areas system planning approaches are based on contemporary information about the distribution and abundance of natural features and share the fundamental assumption of climatic and biogeographic stability. Compositionally speaking, current protected natural areas are essentially conserving a snapshot of biodiversity at a given space and time and therefore have a limited life-span when considering the long-term persistence of biodiversity under changing climatic and ecological conditions. As the evidence presented in this Chapter overwhelmingly suggests, a growing body of research indicates that climate change will render this assumption untenable in the 21st century and beyond.

It has been estimated that species are currently within a 'first-order' of ecological response to the modern anthropogenic global warming episode (i.e., adjusting phenotypes and minor adjustments in geographic ranges) (Barnoskey *et al.,* 2003). However, a growing number of authors contend that if climate change goes outside the bounds within which species and ecosystems have adapted to over the past several interglacial periods, widespread extinctions may result (Thomas *et al.,* 2004; Parmesan, 2006; IPCC, 2007b). Although there is much uncertainty over the timing, extent and manner in which ecosystems and other protected natural areas assets (e.g., tourism and recreational opportunities) might respond to evolving climatic conditions, this does not diminish the need for identifying, assessing and implementing adaptation options that could reduce the vulnerability of Canada's protected natural areas system (and the biodiversity contained within) to anticipated climate change. Indeed, many authors call for substantial investment in climate change adaptation by the conservation community (Hannah *et al.,* 2002a; WWF, 2003a; Scott and Lemieux, 2005; Lemieux and Scott, 2005; Welch, 2005; Hannah *et al.,* 2005; Lovejoy and Hannah, 2005; Hannah *et al.,* 2007).

2.8 The Case for Climate Change Adaptation in the Protected Natural Areas Sector

As previous discussions have shown, among the many challenges confronting protected natural areas agencies and organizations (e.g., habitat loss and pollution), climate change has emerged as a topic of significant concern internationally and in Canada. The existing state of protected natural areas has largely been rationalized on the notions of ecological representation and stable heritage assets, usually within a defined political or eco-regional context. This has resulted in a fixed assemblage of lands and waters housing elements of biodiversity. Such approaches to conservation, designed to protect species, ecological communities and natural systems *in-situ*, typically have not taken into account potential shifts in ecosystem composition, structure and function, especially those large scale, multifaceted and potentially non-linear changes which could be induced by global climate change.

While there is significant uncertainty with respect to how ecosystems and species will respond to geographically varied magnitude, rate and type of climate change, this does not negate the necessity for protected area agencies to develop appropriate strategies of response (i.e., adaptations). A *laissez-faire* approach to climate change adaptation could have significant consequences for biodiversity and could ultimately erode the foundations upon which biodiversity conservation has traditionally been based. Moreover, because Earth is committed to some degree of additional anthropogenic climate change (IPCC, 2007a), even with aggressive greenhouse gas emission reductions, most of the 'response burden' will be placed on adaptation (Stehr and Von Storch, 2005). Therefore, adaptation as a response to climate change will be imperative for protected natural areas agencies and organizations.

As there is no policy, planning and management analogue for protected natural areas agencies and organizations for dealing with the climate change impacts currently being experienced, adaptation will be a significant challenge for policy-makers and decision-makers. Having said that, stable climates and ecosystems can no longer be assumed. A proactive, strategic and coordinated response will be essential if agency mandates to protect elements of Canada's natural diversity for perpetuity are to be realized and if agencies are to take advantage of the associated benefits of climate change, such as the potential economic benefits associated with increased visitation.

Important issues pertaining to the adequacy of protected natural areas system planning and management objectives under climate change scenarios, as well as the use of active management strategies, such as prescribed burning, species re-introduction and species translocation (i.e., assisted migration), will need to be addressed. The major crux for protected area jurisdictions, agencies and organizations, therefore, will be how to go about identifying and evaluating various climate change adaptation options and efficiently and effectively mainstreaming these options into major program areas (i.e., policy, system planning and legislation; management direction; operations and development; research, monitoring and reporting; corporate culture and function; and education, interpretation and outreach).

The following section examines the climate change adaptation issue with specific reference to protected natural areas. First, the theoretical and practical foundations of climate change adaptation are reviewed. The distinctive features of adaptation are outlined (i.e., definitions, types and forms) and the common elements between adaptation-related concepts are described. Interspersed within this section are reviews of scholarship that contribute to the pragmatic application of adaptation in other sectors such as agriculture, water and forestry. The goal of this review is to identify the conceptual and methodological foundations and practical aspects (i.e., barriers and opportunities) of adaptation important to successfully mainstreaming climate change into the program areas specific to the protected natural areas sector.

2.9 Climate Change Adaptation

In the context of the human dimensions of global change, various definitions of adaptation are found in the literature (e.g., Pielke, 1998; Smit *et al.,* 1999; Smit *et al.,* 2000; Brooks, 2003; Smit and Wandel, 2006) (Figure 23). At the core of these various definitions, however, a unifying and dominant theme does emerge -- adaptation usually refers to a *process*, *action* or *outcome* in a system (e.g., sector, region, country) in order for the system to *better cope with*, *manage* or *adjust* to some changing *condition*, *stress*, *hazard*, *risk* or *opportunity* (Smit and Wandel, 2006)[37] While bases for adaptation differ (Table 11), in general, adaptation measures serve to *reduce vulnerability* and *increase resiliency* in a system (Smit and Pilifosova, 2003). Often considered as a government policy response, adaptations also involve decision-making at other levels, including at the business/industry, local and individual (Smithers and Smit, 1997; Smit and Skinner, 2002; Smit and Pilifosova, 2003). Based on their timing, adaptations can be *anticipatory* (i.e., proactive or *ex ante*), *concurrent* (i.e., during) or *reactive* (i.e., responsive or *ex post*) to environmental change (Smit and Pilifosova, 2003). Furthermore, depending on their degree of spontaneity, they can be *autonomous* or *planned* (i.e., strategic, active, and consciously planned responses which require or result from deliberate *policy or planning decisions*) (Frankhauser *et al.,* 1999; Smit *et al.,* 2000; Smit and Pilifosova, 2003). While socio-economic systems have the capacity to adapt to climate change in an anticipatory manner, it is widely accepted

[37] For consistency purposes, this dissertation adopts the definition of adaptation provided by the IPCC (2007b: 869) which is any *"Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."*

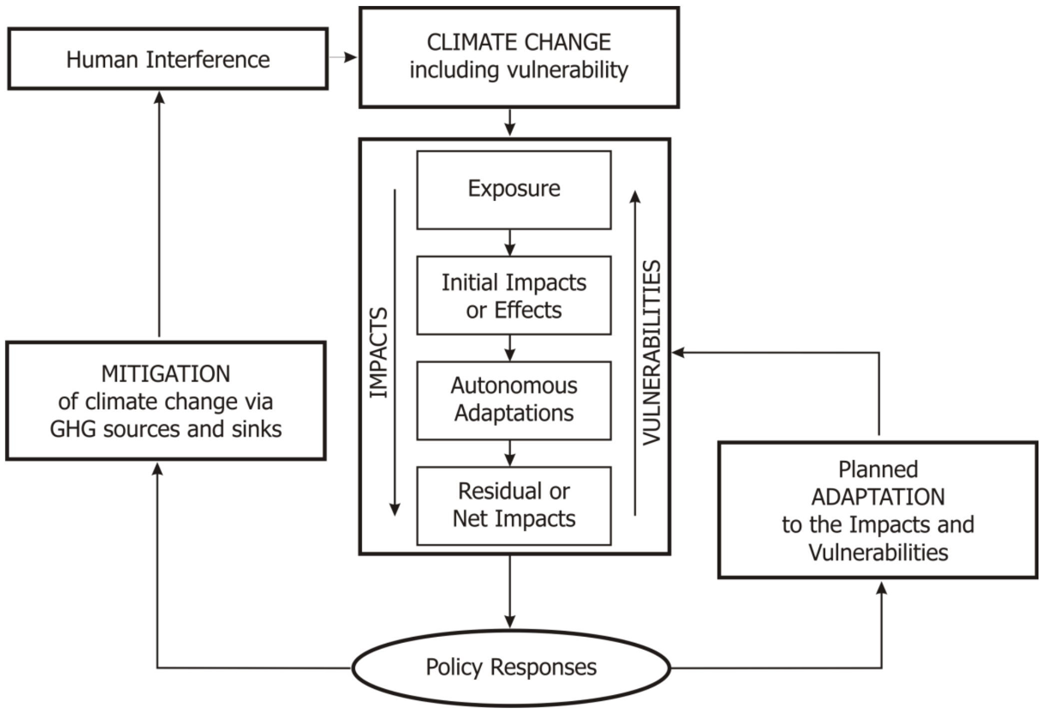
that (unmanaged) biophysical systems are limited to autonomous and invariably reactive adaptations (Smit *et al.,* 2000). Part of the difficult challenge of protected natural areas agencies and organizations is to anticipate the autonomous adaptation of species and ecosystems and incorporate these into planned adaptations of protected natural areas policy and management.

Table 11 Bases for differentiating adaptations. Modified from: Smit *et al.* (1999) and as presented in Burton (2008).

<table>
<tr><th colspan="7">ADAPTATION</th></tr>
<tr><th>Based on</th><th colspan="6">Type of Adaptation</th></tr>
<tr><td>Intent
In relation to climatic stimulus</td><td colspan="3">Autonomous
(e.g., unmanaged natural systems)</td><td colspan="3">Planned
(e.g., public agencies)</td></tr>
<tr><td>Action</td><td colspan="2">Reactive
(post)
(From observed modification)</td><td colspan="2">Concurrent
(during)</td><td colspan="2">Anticipatory
(ante)
(prior modification)</td></tr>
<tr><td>Temporal Scope</td><td colspan="3">Short term
Adjustments, instantaneous, autonomous</td><td colspan="3">Long Term
Adaptation, cumulative, policy</td></tr>
<tr><td>Spatial Scope</td><td colspan="3">Localized</td><td colspan="3">Widespread</td></tr>
</table>

A major concern for policy development is whether adaptation should be a matter of responding to climate change as it manifests (i.e., reactive) or whether steps should be taken in advance to anticipate the potential effects of climate change (i.e., anticipatory). While some adaptations will inevitably have to be reactive (i.e., in response to unexpected impacts), in general the literature suggests that *laissez-faire* approaches to adaptation have several potential drawbacks (see Burton 1996; Smit *et al.* 1996; Smith, 1997). These drawbacks include the possibilities that: (i) forced, last-minute, emergency adaptation or retrofitting will be less effective and more costly than anticipatory or precautionary adaptation over the long-term (e.g., see *Stern Report*, 2006); (ii) climate change may be more rapid or pronounced than current estimates suggest and, consequently, may result in increased vulnerability of socio-ecological systems to unexpected events (e.g., see Pittock *et al.,* 2006); and (iii) not adapting now may result in irreversible impacts (e.g., species extinction) (e.g., see Thomas *et al.,* 2004). Furthermore, some forms of adaptation will require considerable lead-time, especially where major policies, institutional changes or innovations are required (Smit *et al.,* 1996). In such cases, institutional changes would need to be devised and implemented in advance in order to offset the effects or even take advantage of an abrupt, expected or unexpected climate change event.

Figure 23 Adaptation in the climate change issue. Source: Smit and Pilifosova (2003: 2).

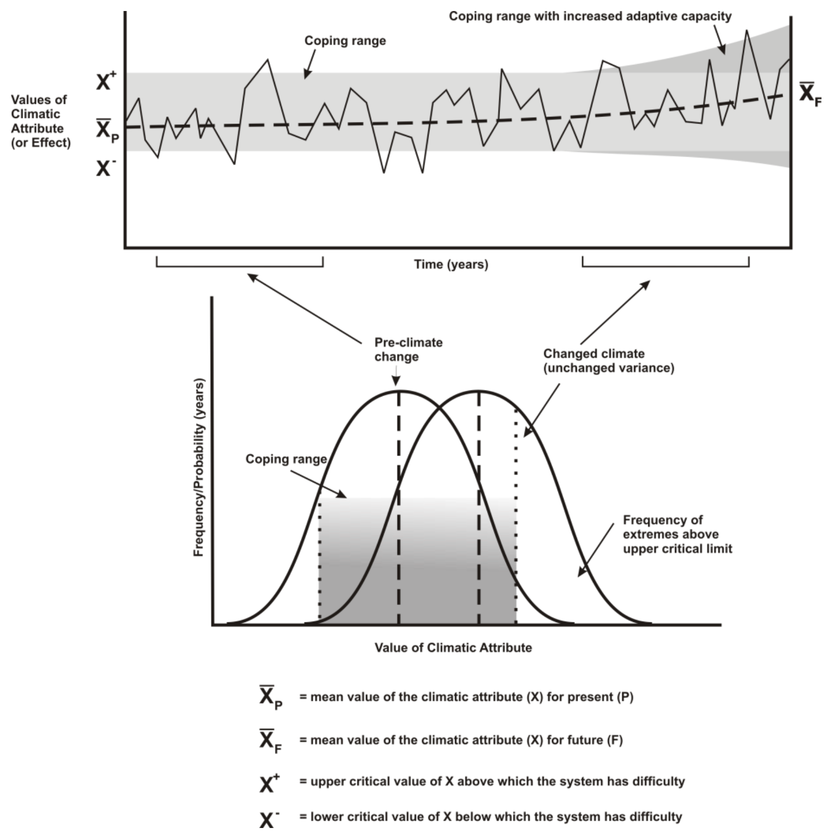


Smit and Pilifosova (2003) identified three interrelated developments in the field of climate change adaptation: (i) the recognition that key adaptations are less often related to changes in long-term averages and more often related to extremes; (ii) the importance of identifying vulnerabilities and linking adaptive management options to decision processes already in place (i.e., strengthening an ongoing process to deal with cumulative risks); and (iii) the promotion of adaptive capacity in human agency (i.e., the capacity to prepare for, avoid or moderate and to recover from climate change effects). Adaptation is intimately associated with the concepts of 'vulnerability', 'adaptive capacity' and 'resilience'. Adaptive capacity is reflective of a system's coping range and is shaped and constrained temporally (i.e., it is dynamic and flexible) with changes in socio-economic, political and institutional conditions (Figure 24) (Smit and Pilifosova, 2003; Smit and Wandel, 2006). A system's coping range is defined by the conditions that a system can deal with, accommodate, adapt to and recover from (de Loë and Kreutzwiser, 2000; Smit *et al.,* 2000; Smit and Pilifosova, 2003). Similarly, vulnerability and its elements of exposure, sensitivity and adaptive capacity and their determinants are dynamic (i.e., they vary by type and from stimulus to stimulus and are place- and system-specific) (Smit and Wandel, 2006).

While vulnerability and adaptive capacity have been increasingly connected with eachother, the resilience knowledge domain, which has a background in ecology and mathematics with a focus on theoretical models (see Holling, 1973), has been less integrated (Janssen and Ostrom, 2006). However, the concept of resilience is integral to the conceptual framework used to study climate change adaptation. The resilience perspective emphasizes non-linear dynamics, thresholds, uncertainty and surprise, and examines how periods of gradual change interplay with periods of rapid change and how such dynamics interact across temporal and spatial scales (Folke, 2006). With respect to climate change, biodiversity and protected natural areas, the resilience concept further challenges the 'dominant stable equilibrium approach' (i.e., 'representation- or enduring features-based' system planning approaches) used by protected natural areas agencies worldwide to protect for perpetuity ecosystems and species of significance. The resilience perspective shifts policies from those that aspire to control change in systems assumed to be stable, to managing the capacity of social-ecological systems to cope with, adapt to, and shape change (Berkes *et al.,* 2003; Smit and Wandel, 2006). Folke (2006) emphasized that resilience is not only about being persistent or robust to disturbance – it is also about the opportunities that disturbances open up in terms of recombination of evolved structures and process, renewals of the sysem and emergence of new trajectories. Walker *et al.* (2004) and Adger *et al.* (2005a) have argued that managing for resilience enhances the likelihood of sustaining desirable pathways for development in changing environments where the future is unpredictable and surprise is likely (such as that under rapid climate change).

In broad terms, a system's adaptive capacity, vulnerability and resilience are all functions of various dynamic factors acting synergistically. These factors include: (i) the range of available technological options; (ii) available resources (and the distribution of resources); (iii) the structure of critical institutions (and the criteria used for decision-making); (iv) human and social infrastructures; (v) access to risk-spreading mechanisms; (vi) access and ability to create credible information; and (vii) the public's perception of the significance of the impact (Yohe and Tol, 2002). In this context, Diaz and Gauthier (2005) emphasized that the adaptive capacity of public institutions is related to their ability to anticipate problems and to manage risk and challenges in a way that balance social, economic and natural interests. Moreover, Adger and Vincent (2005) make the important point that the degree of uncertainty in determining vulnerability and adaptive capacity, as potential future states, is of similar scope and dimension to the uncertainty involved in future climate projections.

Figure 24 Climate change, extremes and coping range. Sources: Smit and Pilifosova (2003) and Smit and Wandel (2006).



There are many forms of adaptations and these can be classified in different ways (depending on who or what is adapting), such as timing relative to the stimulus (e.g., anticipatory, concurrent, reactive), intent (e.g., autonomous, planned), spatial scope (e.g., local, widespread) and form (e.g., technological, behavioural, financial, institutional, informational) (Smit *et al.,* 2000; Smit and Skinner, 2002; Smit and Pilifosova, 2003; Smit and Wandel, 2006; Burton, 2008) (refer back to Table 11). It is also possible to distinguish adaptations according to the degree of adjustment or change required from (or to) the original system (Risbey *et al.,* 1999). Scholarship has recently progressed from identifying types and forms of climate change adaptation to focusing on specific adaptation options or measures for a particular system subject to climate change stimuli (Smit and Wandel, 2006). The process of incrementally integrating climate change into policy, planning and management programs is often referred to as 'mainstreaming' (Smit and Wandel, 2006; IPCC, 2007b; Klein *et al.,* 2007; Burton, 2008).

2.9.1 Institutional and Sectoral Experiences with Climate Change Adaptation

Traditionally, policy interest in adaptation as a response to climate change has been considerably low and often even absent (Burton *et al.,* 2006; Burton, 2008). To the extent that adaptation has been present in policy at all, it has primarily been in the context of mitigation negotiations (Burton *et al.,* 2006). As Prins and Rayner (2007: 975) emphasized in this context *"the policy community suppressed discussion of adaptation out of fear that it would blunt the arguments for greenhouse-gas mitigation."* More recently, however, interest in adaptation as a legitimate policy response has increased in recognition of the following factors: (i) the realization that climate change is indeed occurring; (ii) climate change impacts are being observed; and (iii) the inevitability of future climate change even with aggressive GHG emission reductions (see previous discussions in this Chapter) (Smit and Wandel, 2006; Burton *et al.,* 2006; Burton, 2008). Moreover, faced with imminent warming, adaptation has a faster response time, a closer coupling with innovation and incentive structures, and thereby confers more protection more quickly (Prins and Rayner, 2007).

Early adaptation analyses focused on estimating the degree to which modelled impacts of climate change scenarios could be moderated or offset by 'adaptation to the impacts' (Smit and Wandel, 2006). However, as Smit and Wandel (2006: 284) emphasized, this work characteristically did *"...not empirically investigate adaptations, examine the actual processes of adaptation or adaptive capacity, explore the conditions or drivers that facilitate or constrain adaptations, or document the decision-making processes, authorities and mechanisms involved in adaptation."* The major limitation of such studies, the authors noted, is that they rarely investigated the processes through which adaptation measures are undertaken, either in light of climatic change specifically or as part of policy and decision-making processes to which adaptations to climate change might relate (Smit and Wandel, 2006).

Climate change adaptation scholarship has incrementally moved from theoretical adaptation towards examining pragmatic adaptation and a number of Canadian resource management-specific case studies now exist primarily within the agricultural (e.g.., Smit *et al.,* 1996; Bryant *et al.,* 2000; Smit and Skinner, 2002), water (e.g., de Loë and Krutzwiser, 2000; de Loë *et al.,* 2001; Ivey *et al.,* 2004) and forestry (e.g., Spittlehouse *et al.,* 2003; Spittlehouse, 2005; Ohlson *et al.,* 2005; Johnston and Williamson, 2007) sectors. While it is beyond the scope of this review to examine each of these case studies comprehensively, outlined below are some of the commonly noted drivers, barriers and constraints, enabling factors and broad lessons learned that have influenced the institutional adaptation process in these sectors (Table 12). As subsequent reviews will reveal, there has been a limited contribution from the protected natural areas sector thus far to this literature.

Based on an extensive review of practical applications of climate change adaptation, Smit *et al.* (2000: 241) concluded that *"… adaptation tends to be incremental and ad hoc, to assume multiple forms, to be in response to multiple stimuli (usually involving a particular catalyst) and to be constrained by economic, technological and socio-economic conditions."* Empirical results from the literature suggest that many factors shape the character of adaptation experiences and processes, including: i) interpretation of the signal relative to context; ii) newness of the approach; iii) consumer values; and iv) local and provincial political agendas (Shepherd *et al.,* 2006). As such, it is often the current context unrelated to climate change that can encourage or prevent adaptation.

One of the 'early' studies pertaining to climate change adaptation and adaptive capacity by Tol *et al.* (1998) revealed a number of shortcomings that are very much still largely relevant today, including: i) making simple assumptions about adaptation (e.g., assuming complete changes in behaviour); ii) neglecting or ignoring the costs and feasibility of transition (which will be a transitory, not an equilibrium process); iii) seldom reporting the consequences of policy options; iv) assuming that maintaining certain conditions is optimal despite the fact that different standards may be optimal in a future climate; v) assuming that the wants, needs, constraints, preferences and motives of societies will be the same in the future as they are now; vi) lacking comparative analysis; and vii) assuming perfect foresight and ignoring the propensity for rapid, unexpected events.

Table 12 Common barriers and challenges to climate change adaptation ('mainstreaming') based on the extant literature.

Governance	Policy, Planning & Management	Human & Financial Capital	Informational
• 'political discontinuity': short political and funding horizons (expectation of realizing return on investments) impede long-term approach to adaptation • high turnover of governments and loss of key 'champions': mean the loss of skills and capacity as well as the political will to continue with adaptation • poor coordination and integration: between levels of governments, between relevant departments and across geographic scales • 'spatial spillover' of actions: which potentially increase impacts on others or reduce their capacity to adapt not well understood • institutional fragmentation: climate change adaptation isolated from other agendas due to its institutional location usually within 'environmental' ministries and departments • not engaged with scientific community • general unwillingness to involve stakeholders in policy-making processes • more immediate perceived problems/issues • unwillingness to accept/incorporate uncertainty into decision-making	• unknown roles and responsibilities and general lack of awareness by policy-makers about risks posed by climate change, and how these relate to other mandates and management priorities • lack of supportive policies, standards, regulations and design guidance • existing legal or regulatory restrictions • low priority item in the course of daily duties (thus operating on short- to medium-term planning horizons for both political and financial reasons) • institutional and policy barriers (no requirements for adaptation strategies nor are there guidelines and sufficient experienced personnel to aid in such activities) • no authority to select let alone implement adaptive measures	• funding unrealistically low • competition for public funds • uncertainty of future markets • lack of incentives for climate change adaptation actions beyond that currently available • lack of internal expertise in climate change science, including risks and vulnerabilities, and experience with adaptation • 'mainstreaming fatigue' experienced by those actually engaged in climate change adaptation issue	• uncertainty in magnitude and timing of future climate change and impacts • appropriate tools not readily available for decision-making and implementing organizations • limited knowledge of risk and vulnerability • limited access to climate risk information • lack of information at scales relevant to different stakeholders • data sharing at all levels, between jurisdictions, and across scales is generally non-existent or poor

Judging the success of adaptations at different institutional and geographical scales, Adger *et al.* (2005b) concluded that: i) the integration of adaptation actions and policies across sectors remains a key challenge to achieve effective adaptation in practice; ii) the dynamic linkages between levels of governance are not well-understood; and iii) the politics of the construction of scale (and the negative externalities and spatial spillovers which potentially increase impacts on other or reduce their capacity to adapt) are often ignored in climate change adaptation analyses. Similar to Adger *et al.'s* (2005b) later conclusions, de Loë and Kreutzwiser (2000) emphasized that the distributional inequalities of benefits and costs within specific resource use sectors (issues related to jurisdictional and legal authority) and across various institutional and geographic scales will challenge the social acceptability, and even the political realism, of certain adaptation options.

While there are significant barriers and challenges associated with formulating and executing an effective response to the climate change issue (such as those noted in Table 12), a number of useful principles and criteria necessary for the development of effective anticipatory adaptation policies have been identified. The use of the 'precautionary principle' or 'no-regrets' actions can help decision-makers identify policy options which respond to the concerns about the costs of action, possibility of maladaptation and scientific uncertainty (Smith *et al.,* 2001; de Loë *et al.,* 2001). The *Stern Report* (2006) also emphasized that it is more economical to take measures that are proactive and support no-regrets measures. While they may not be sufficient on their own, no-regrets measures are consistent with sound environmental management (i.e., sustainable management) and wise resource use and are beneficial and cost effective even in the absence of climate change (Asian Development Bank, 2005).

Smith (1997) stressed that policy should be 'flexibly designed' to enable quick adaptive responses under a variety of conditions (i.e., given uncertainty). Characteristics of a flexible policy would include its ability to be 'robust' (i.e., able to function under a wide range of conditions) and 'resilient' (i.e., a system that can quickly repair or adapt itself after a perturbation) [Smith (1997) and see previous discussion]. Consistent with the concept of flexibility, de Loë *et al.* (2001) emphasized that adaptations should be 'reversible' given the considerable uncertainty associated with future climate change impacts. Smit *et al.* (2000) recommended that future climate change adaptation analysis should: (i) address real local vulnerabilities (to ensure that stakeholders buy into the issue); (ii) involve real stakeholders early and substantively (to increase the likelihood that adaptation options are realistic and designed to be consistent with existing institutions and processes); and (iii) connect with local decision-making processes (so that adaptation initiatives are developed relative to other conditions and have the best chance of actually being implemented).

While the pragmatic literature on climate change adaptation to date does provide a number of generic concepts upon which to evaluate the merit of various adaptation options (e.g., *costs*, *benefits*, *equity*, *efficiency*, *urgency* and *implementability*), overall, there is considerable semantic ambiguity associated with their definition and operational contexts. This has invariably limited adaptation understanding and action-to-date by those actually responsible for decion-making and policy-development. Moreover, the pragmatic realities of climate change adaptation options, including the temporal dimensions and dynamic aspects of the system under consideration and the nature of cross-scale relationships, commonly are not addressed explicitly in the literature (Füssel and Klein, 2005). Smit *et al.'s* (1996: 12) statement over a decade ago that *"Few impact studies have explored actual or reported adaptive responses to climatic perturbations… In particular, the distinctions between short- and long-term, consequential and purposeful, tactical and strategic, autonomous and planned adaptations have rarely been addressed empirically"* is thus still very applicable today.

The most common and important limitations that can be extrapolated from the extant adaptation literature are: (i) the lack of guidelines and robust methods that can be used by institutions in their efforts to transform capacity into action; and (ii) very little scholarship has been completed on identifying the principles and evaluation mechanisms that characterize successful institutional adaptation to climate change (*ex poste* evaluation, after uncertainty has been resolved) (Burton, 2008). Given the limitations and broad challenges related to climate change adaptation, there is a salient need in the literature not only to systematically characterize the likely adaptations of a system, but also to evaluate the merit of their utility (i.e., in terms of desirability and feasibility) and to identify the required mechanisms for their implementation (i.e., who would be involved, time frame of implementation, resource acquisition and other aspects required to facilitate or encourage their adoption) (Smit *et al.,* 1999). This is the focus of Chapter 4 of this thesis.

2.9.2 Guidelines for Helping Shape Adaptation Policies

Given the challenges noted in Table 12, to assist in the process and implementation of an adaptation policy, several scholarly articles and international organizations have prepared tools or guidelines to help facilitate adaptation policy formulation. Burton *et al.* (2002: 146) defined what is meant by climate change adaptation policy, stating that *"Climate change adaptation policy refers to actions by* *governments, including legislation, regulations and incentives to mandate or facilitate changes in socio-economic systems aimed at reducing vulnerability to climate change, including variability and extremes."* Changes can be made in *practices*, *processes* or *structures* of systems in response to projected or actual changes in climate (Burton *et al.,* 2002).

The United Nations Development Programme (UNDP) has prepared a comprehensive users' guidebook entitled *Adaptation Policy Framework* (UNDP, 2004) which includes a series of technical papers, case studies and related tools and resources designed to provide technical guidance to stakeholders for developing and assessing climate change adaptation policies and measures. Four guiding principles underpin this framework:

i) Placing adaptation in a development context;
ii) Building on current adaptive experience to cope with future climate variability;
iii) Recognizing that adaptation occurs at different levels – in particular, at the local level; and
iv) Recognizing that adaptation will be an ongoing process (UNDP, 2004).

Similarly, the Asian Development Bank (2005) developed a set of guidelines to facilitate the implementation of adaptation policies (Table 13). While these guidelines are not natural resource management specific and were primarily devised for developing countries, they are relevant to the protected natural areas and biodiversity conservation sector. This framework aims to enhance the adaptive capacities of stakeholders and their resilience to climate change and variability. The overarching goal of the risk-based approach to climate change adaptation is to manage both current and future risks associated with actual and potential climate hazards. The case studies within the guidebook identified three levels of adaptation activity: (i) project/community level; (ii) sector level (e.g., natural resource management); and, (iii) policy and planning at regional/national levels.

Both the UNDP (2004) and the Asian Development Bank (2005) frameworks recognize the continuous process-nature of adaptation (i.e., the adaptive management process), and the role of human agency, choice and values. They also recognize that many decision-making processes are occurring at different scales with different agendas, and are occurring simultaneously each influencing the other through time (UNEP, 2008). Such guidelines can be used by protected natural area agencies and conservation-oriented civic agencies to help tailor, implement and evaluate their own adaptation strategies.

Table 13 Guidelines for adaptation mainstreaming. Adapted from: Asian Development Bank (2005). * = adaptation guidelines particularly relevant to the protected natural areas sector.

A. Guidelines Relating to the Principles Underpinning the Mainstreaming of Adaptation
Guideline 1: Manage Climate Risks as an Integral Part of Sustainable Development* *Guideline 2:* Ensure Intergenerational Equity Related to Climate Risks *Guideline 3:* Adopt a Coordinated, Integrated and Long-term Approach to Adaptation* *Guideline 4:* Achieve the Full Potential of Partnerships* *Guideline 5:* Adaptation Should Exploit the Potential of Sustainable Technologies* *Guideline 6:* Base Decisions on Credible, Comparable and Objective Information* *Guideline 7:* Maximize the Use of Existing Information and Management Systems* *Guideline 8:* Strengthen and Utilize In-country Expertise* *Guideline 9:* Strengthen and Maximize Use of Existing Regulations, Codes, Tools*
B. Guidelines Relating to Enhancing the Enabling Environment for Adaptation
Guideline 10: "Climate Proof" Relevant Legislation and Regulations* *Guideline 11:* Strengthen Institutions to Support the "Climate Proofing" of Development *Guideline 12:* Ensure Macroeconomic Policies and Conditions Favour "Climate Proofing" *Guideline 13:* Ensure Favourable Access to Affordable Financing of "Climate Proofed" Development Initiatives
C. Guidelines Relating to the Process of Mainstreaming Adaptation
Guideline 14: Characterize Climate-Related Risks that Require Sustained Attention* *Guideline 15:* Replicate the Knowledge, Motivation and Skills that Facilitate Successful Adaptation * *Guideline 16:* Enhance the Capacity for Continuous Adaptation* *Guideline 17:* Ensure "Climate Proofing" Activities Complement Other Development Initiatives *Guideline 18:* A Process of Continual Improvement in Adaptation Outcomes*

2.9.3 Climate Change and Protected Natural Areas Adaptation

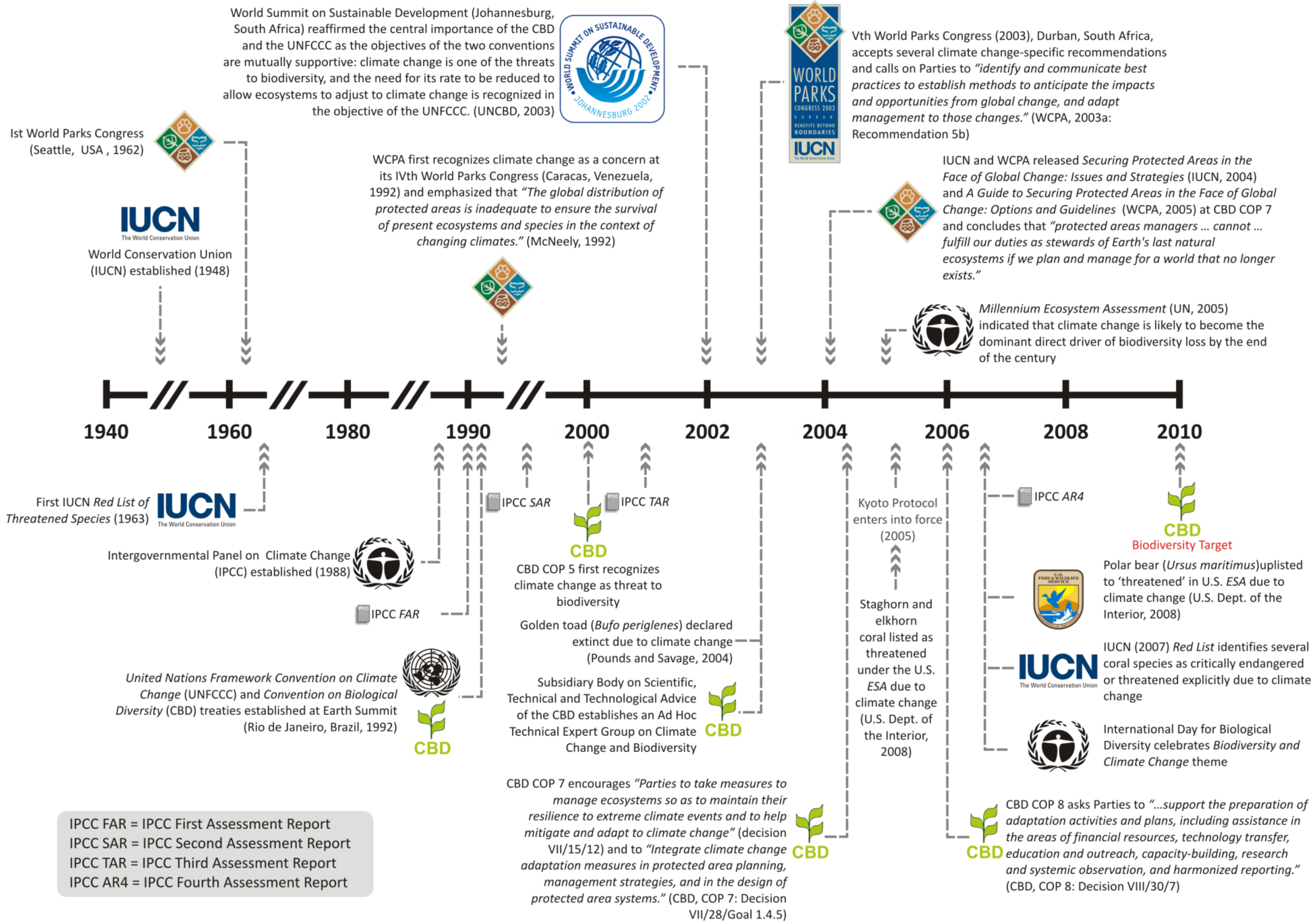
2.9.3.1 International Calls for Adaptation

At the first Conference of the Parties (COP)[38] to the *United Nations Framework Convention on Climate Change* (*UNFCCC*) in 1995, the parties established a three-stage framework for addressing adaptation. *Stage 1*, to be carried out in the 'short-term', was to focus on identifying the most vulnerable countries or regions and adaptation options. *Stage 2* was to entail implementing measures, including capacity building, to prepare for adaptation. *Stage 3* was to entail implementing measures to

[38] All decisions related to the UNFCCC COP can be found at: http://unfccc.int/2860.php.

facilitate adaptation. The response of the international biodiversity and protected natural areas-oriented communities to the challenge of climate change has visibly increased over the last half-decade. Figure 25 presents a timeline of major international events and activities related to climate change, biodiversity and protected natural areas with specific reference to the Convention on Biological Diversity (UNCBD) and the World Commission on Protected Areas (WCPA). Broadly speaking, efforts to date have centered primarily on *Type 1* activities (identifying vulnerabilities) and have, on occasion, (conservatively) explored *Type 2* type activities (i.e., capacity building) more often concurrently than sequentially.

Figure 25 Timeline of major international events and activities related to climate change, biodiversity and protected areas.



2.9.3.2 The United Nations Convention on Biological Diversity Actions on Climate Change Adaptation

The realized and potential impacts of climate change have recently become a significant concern to the Conference of the Parties (COP)[39] of the *United Nations Convention on Biological Diversity* (UNCBD)[40]. At its fifth meeting (Nairobi, Kenya, Africa, May 2000), the COP highlighted the risks of climate change for coral reefs (decision V/3) and forested ecosystems (decision V/4) in particular, and drew attention to the significant potential impacts for biodiversity in these systems. In response to a request by the CBD, the IPCC prepared the technical report entitled *IPCC Special Report on Climate Change and Biodiversity* (IPCC, 2002). This report looked at the potential impacts of climate change for biodiversity and conservation consequences, and concluded that expanded partnerships are needed between international bodies and their respective agreements [e.g., the UNCBD and the *United Nations Framework Convention on Climate Change* (UNFCCC)] in order to effectively deal with climate change and biodiversity issues. With specific reference to protected natural areas, the report emphasized that *"The placement and management of reserves and protected areas will need to take into account potential climate change if the reserve systems are to continue to achieve their full potential"* (IPCC, 2002: 41).

Shortly after the fifth meeting in 2000, and in response to the findings of the IPCC technical report in 2002, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the UNCBD established an Ad Hoc Technical Expert Group (AHTEG) to carry out their own assessment of the interlinkages between biodiversity and climate change. The report of this expert group was published as UNCBD Technical Series No. 10 in 2003 (UNCBD, 2003) and further recognized the important role that protected natural areas could play in monitoring 'indicators' of climate change and in facilitating biological adaptation to climate change. The report stated that "*the establishment of a mosaic of interconnected terrestrial, freshwater and marine multiple-use reserve protected areas designed to take into account projected changes in climate can be beneficial to biodiversity."* (76) At approximately this same time, the World Wildlife Fund (WWF) reached a similar conclusion, emphasizing that

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[39] All decisions related to the UNCBD COP can be accessed at: http://www.cbd.int/convention/cops.shtml

[40] The *Convention on Biological Diversity* (UNCBD, 1992) is an international treaty that was adopted at the Earth Summit in Rio de Janeiro in 1992. The Convention has three main goals: (i) conservation of biological diversity; (ii) sustainable use of its components; and (iii) fair and equitable sharing of benefits arising from genetic resources. In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity. It is often seen as the key document regarding sustainable development.

"…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, 2003b: 1).

The UNCBD technical report was tabled at its seventh meeting (Kuala Lumpur, Malaysia, February 2004) and the COP encouraged *"Parties to take measures to manage ecosystems so as to maintain their resilience to extreme climate events and to help mitigate and adapt to climate change."* (decision VII/15/12) The SBSTTA was requested further to provide advice and guidance for promoting synergy among activities to address climate change, including activities related to the sustainable use of biodiversity, and the SBSTTA invited the UNFCC to collaborate with the UNCBD to this end.[41] The seventh meeting also recognized the need for Parties to *"Integrate climate change adaptation measures in protected area planning, management strategies, and in the design of protected area systems."* (decision VII/28/Goal 1.4.5)

In 2006, at its eighth meeting (Curitiba, Brazil, March 2006), the COP further emphasized the importance of integrating biodiversity considerations into all relevant national policies, programs and plans in response to climate change and stated that Parties should work *"…to develop rapid assessment tools for the design and implementation of biodiversity conservation and sustainable use activities which contribute to adaptation to climate change."* (decision VIII/30/2) The COP 8 also reiterated the recommendations initially coming out of COP 7 to identify mutually supportive activities of the three Rio Conventions[42], the *Ramsar Convention on Wetlands*, the *World Heritage Convention*, the *Convention on Migratory Species* and other relevant multilateral environmental agreements, in order to promote better understanding and functioning of synergy among these agreements in relation to climate change (decision VIII/30/6). The eighth meeting also recognized the need for Parties to *"…support the preparation of adaptation activities and plans, including assistance in the areas of financial resources, technology transfer, education and outreach, capacity-building, research and systemic observation, and harmonized*

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[41] As the CBD Technical Report No. 10 (CBD, 2003: iii) emphasized, *"The objectives of these two conventions are closely inter-related: Climate change is a major cause of biodiversity loss and one of the obligations under the Convention on Biological Diversity (CBD) is to identify and address such threats. At the same time, the ultimate objective of United Nations Framework Convention on Climate Change (UNFCCC) includes the stabilization of greenhouse gas concentrations within a timeframe sufficient to allow ecosystems to adapt to climate change…"* Further to this point, complementarities can be found in Article 4.1(e) of the UNFCCC which states all Parties shall *"Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods."*

[42] The three Rio Conventions include the *United Nations Framework Convention on Climate Change* (UNFCC), the *Convention on Biological Diversity* (UNCBD) and the *United Nations Convention to Combat Desertification* (UNCCD).

reporting" (decision VIII/30/7) and again requested Parties to take into account the important role that protected natural areas can play in response activities (decision VIII/30/8).

In paragraph 8 of decision VIII/30, the COP to the UNCBD requested the SBSTTA to develop draft guidelines on how to integrate relevant climate change impacts and response activities into the programs of work of the *Convention*. In response to this request, the AHTEG on Biodiversity and Adaptation to Climate Change released the technical report entitled *Guidance for Promoting Synergy Among Activities Addressing Biological Diversity, Desertification, Land Degradation and Climate Change* which proffered such guidance in 2006 (UNCBD, 2006). Coming out of this report of particular relevance to this dissertation was the reiterated need to *"…integrate climate change adaptation measures in protected area planning, management, and design."* (28) In preparation for developing further guidance mechanisms, the UNCBD organized a *Roundtable on the Interlinkages between Biodiversity and Climate Change* in Montreal in March, 2007.

Overall, the UNCBD's involvement in climate change initiatives has largely been an outcome of their work focusing on achieving the COP 2010 Biodiversity Target: *"to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth."* In order to achieve this target, the COP were requested, *inter-alia*, to ensure *"At least 10% of each of the world's ecological regions is effectively conserved"* (including marine and coastal biodiversity, inland waters, mountain biodiversity, dry and sub-humid lands biodiversity and island biodiversity) (COP 8, Goal 1, Target 1.1) and to *"Maintain and enhance resilience of the components of biodiversity to adapt to climate change"* (COP 8, Goal 7, Target 7.1). This target was established by the COP in 2002 and was later endorsed by the World Summit on Sustainable Development (2002) and the UN General Assembly and incorporated as a new target under the *Millennium Development Goals* (2006) (COP 6 decision VI/6, COP 7 VII/30, and COP 8 VIII/18).

2.9.3.3 The International Union for Conservation of Nature (IUCN) World Commission on Protected Areas (WCPA) Actions on Climate Change Adaptation

The International Union for Conservation of Nature's (IUCN) World Commission on Protected Areas (WCPA) first recognized climate change as a 'theoretical concern' over 15 years ago at its *IVth World Congress on National Parks and Protected Areas* (Caracas, Venezuela, 1992) (McNeely, 1992). At the Congress, a workshop entitled *The Impacts of Climate Change on Protected Areas* (Workshop II.8) was held to provide information on the implications of current (at the time) climate change scenarios for protected natural areas management and planning. Although no policy statements were prepared, both the recommendations and the proposed guidelines did contain policy elements emphasizing the urgency of the problem and the need for the development of an appropriate scientific basis for future protected natural areas planning and management. Similar to the findings of the UNCBD Technical Series No. 10 report (UNCBD, 2002), published over a decade later, the workshop recognized the important role that protected natural areas could play as long-term monitoring sites for the impacts of climate change given the relative security of the area (conclusion 'g'). The workshop also concluded that present knowledge concerning ecosystem and species response to climate change was inadequate to develop management strategies aimed at reducing or mitigating the impacts of climate change (conclusion 'e'). The workshop concluded that *"The global distribution of protected areas is inadequate to ensure the survival of present ecosystems and species in the context of changing climates"* (conclusion b), a position that is often reflected in the scientific literature today (see previous discussions).

In response to the initial discussions that occurred at the *IVth World Parks Congress,* the IUCN released a scoping report entitled *Impacts of Climate Change and Ecosystems and Species: Implications for Protected Areas* (Pernetta *et al.,* 1995). Through a literature review, the report examined projected changes across 'thermal zones' (e.g., cold regions, temperate regions, tropical regions, etc.) and highlighted the scientific issues and associated protected area management concerns.

More recently, the position of the IUCN and the WCPA has evolved from one that has traditionally focused on the 'theoretical concerns' of climate change to one that now recognizes climate change as a major and measurable threat to protected natural areas worldwide. The UN and the IUCN have implemented a program of work on climate change and have primarily focused on developing policy positions (including recommendations). Activities have included: (i) providing input into the UNFCC and the UNCBD [e.g., WCPA WPC 2003 Recommendation 05 *Climate Change and Protected Areas* (WCPA, 2003a); IUCN World Conservation Congress 2004 Recommendation 3.084 *Ratification of the Kyoto Protocol to the UNFCCC* and Resolution 3.057 *Adapting to Climate Change: a Framework for Conservation Action* (IUCN, 2004)]; (ii) providing guidance on conservation response to climate change, including protected natural areas (e.g., IUCN, 2004; UNESCO, 2004; WCPA, 2003b); and (iii) documenting the impact of climate change on individual species, ecosystems and world heritage sites (IUCN, 2003; IUCN, 2007a; UNESCO, 2007).

Climate change was a prominent issue at the most recent World Parks Congress held in Durban, South Africa (Vth World Parks Congress; WCPA, 2003a). A session entitled *Climate Change* *and Nature: Adapting for the Future* was held to address the following two climate change-related questions: (i) *Taking into account climate change, is the current protected natural areas system sufficient to save the world's biodiversity over the next century?*; and (ii) *If not, then what changes need to be made to conservation policy and practice to adapt?* The session examined the salience of climate change impacts occurring or anticipated to occur within protected natural areas and identified the need to carefully consider the consequences of climate change for policy and planning. The session also discussed the obligation of the sector to be part of the solution by reducing its greenhouse gas (GHG) emissions, educating the public, and identifying and implementing adaptation options.

Unfortunately no proceedings were produced from the session, but a major recommendation was formulated and approved by the Congress. *Recommendation 05 Climate Change and Protected Areas* emphasized the need to protect biodiversity in the face of climate change through a two-fold response. Firstly, through the mitigation of climate change by stabilizing GHG concentrations (a task largely outside of the purview and capabilities of protected natural areas agencies and organizations) (WCPA, 2003a). Secondly, by the institution of new conservation strategies, including the establishment of new protected natural areas that are specifically designed to be resilient to climate change-related impacts and the creation of corridors to facilitate the migration of biodiversity (WCPA, 2003a). The statement also recognized the need for protected area agencies to *"identify and communicate best practices to establish methods to anticipate the impacts and opportunities from global change, and adapt management to those changes"* (WCPA, 2003a: Recommendation b.). It also recommended that *"Governments, and protected area managers and planners, include concepts of resilience and adaptive management of protected areas to mitigate the impacts of climate change, including designing and managing protected area networks flexibly to accommodate adaptations to change."* (WCPA, 2003a: Recommendation 9) It is clear that many of the important concepts associated with climate change adaptation discussed in previous sections are reiterated here, including the need to: enhance the *resiliency* of systems to climate change impacts; to incorporate *adaptive management* (i.e., learning by doing) into policy; and to maintain some degree of *flexibility* to accommodate adaptations.

In response to the 2003 World Parks Congress recommendations and to aid protected natural area managers and planners in their efforts to respond to global change issues, the IUCN released a report entitled *Securing Protected Areas in the Face of Global Change: Issues and Strategies* in 2004 (IUCN, 2004). This report explicitly recognized that global biophysical changes due to climate change have not been sufficiently taken into account in protected natural areas system design and, as such, emphasized that *"protected areas managers … cannot … fulfill our duties as stewards of Earth's last* *natural ecosystems if we plan and manage for a world that no longer exists."*(1) To further aid protected natural areas managers and planners in their efforts to address the global change issues identified in the report (IUCN, 2004), the WCPA released a follow-up report entitled *A Guide to Securing Protected Areas in the Face of Global Change: Options and Guidelines* (WCPA, 2005). The report was provided to the CBD at COP 7 as a contribution from the WCPA and the World Parks Congress to the development of the CBD's program of work on protected natural areas. Both reports identified and characterized selected 'factors' of global change that are impacting the viability of protected natural areas and did provide some generic recommendations and guidelines that could be used by agencies in their efforts to address global change issues (e.g., enhancing internal ability to anticipate problems with global change; making protected natural areas as large as possible; supplementing core zones with buffer zones; and linking core zones). However, they do very little to address what the title of the report suggests and offer very little in terms of guidelines relevant to 'practical adaptation'.[43]

Most recently, the 2007 IUCN *Red List of Threatened Species*[44] for the first time in its history listed several ocean corals endemic to the Galapagos as critically endangered [Floreana coral (*Tubastraea floreana*) and Wellington's solitary coral (*Rhizopsammia wellingtoni*)] and vulnerable (*Polycyathus isabela*) to extinction and specifically attributed their endangerment to short-term climatic events, such as El Niño, and longer-term climatic change (IUCN, 2007b). The IUCN also has recently acknowledged that the current status of the polar bear (vulnerable) (*Ursus maritimus*) may have to be uplisted in the 'very near future' to critical due to the rapid reduction of sea ice extent occurring in the arctic and other climate change-related impacts (IUCN, 2007b). In fact, the U.S. Department of the Interior recently uplisted the polar bear as 'threatened' on its federal *Endangered Species Act* in part due to climate change-related impacts (U.S. Department of the Interior, 2008).

Overall, the UNCBD and the IUCN have begun to recognize the complex interlinkages between biodiversity, protected natural areas and climate change. International efforts-to-date have helped advance the biodiversity, protected natural areas and climate change discourse through various conferences, outputs (e.g., technical reports), recommendations and policy statements and

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[43] Similar criticisms have been leveled in the academic literature by protected natural area practitioners (Halpin, 1997; Welch, 2005).

[44] The IUCN *Red List of Threatened Species* (also known as the IUCN *Red List* or *Red Data List*), created in 1963, is the world's most comprehensive inventory of the global conservation status of plant and animal species. The International Union for the Conservation of Nature (IUCN) is the world's main authority on the conservation status of species.

have played an important role in motivating and contributing to capacity building. However, despite the important role that these international organizations have had in shaping this discourse, they have had minimal influence on generating national-level (or otherwise) pragmatic responses. This is perhaps because outputs and recommendations to-date have suffered from ambiguities and lack the practical guidance needed to help facilitate the identification, evaluation and implementation of practical (and institutionally specific) adaptation options by protected natural areas agencies. Moreover, the scale of the discourse (largely global) that these international organizations have used to address the climate change, biodiversity and protected natural areas issue has not matched the scale of the solutions needed by protected natural areas planners, managers and policy-makers. Given the regional and local nature of impacts and implications associated with climate change, and the lack of engagement of many agencies and stakeholders whose participation is essential in this regard, the scale of the international discourse has had limited effects on practical decision-making related to proactive, planned adaptations.

2.9.4 Mainstreaming Climate Change into Protected Natural Areas Policy, Planning and Management

Though the recent body of research and discourses into adaptation seems to be burgeoning, there continues to be a relatively slow response by the international biodiversity conservation and protected natural areas community. As Scott and Lemieux (2005) emphasized, there are factors that make climate change adaptation more challenging for protected natural areas professionals than some other natural resource sectors. Unlike other managed resource systems (e.g., water, agriculture, fisheries), there are no past exposures or climate change analogues to learn from at the system planning or protected natural area management levels. Furthermore, the objectives of protected natural areas management have very long time horizons (e.g., 22nd century and beyond) and fewer adaptation options exist than for lands and waters that are actively and extensively manipulated.

As a result of these challenges, there have been a limited number of publications that address climate change adaptation options specifically for protected natural areas (Welch, 2005; Scott and Lemieux, 2005; and Huntley, 2007 are some of the exceptions). While many adaptation recommendations for biodiversity conservation identified in the scientific literature may be of immediate benefit to protected natural areas agencies, others have been suggested as generic solutions to possible climate change impacts with no or relatively little direct investigation into their real world practicality or effectiveness. Despite this, these recommendations have provided a useful foundation upon which climate change-specific protected area adaptation responses can be considered.

Based on the publication frequency of various academic literature and institutional-specific reports and on the frequency and duration of other activities, including conferences and workshops, Australia (Australian Government, 2008), South Africa (e.g., IUCN, 2003; Bomhard and Midgley, 2005), the European Union (e.g., Huntley, 2007), Canada (Scott and Suffling, 2000; Scott *et al.,* 2002; Scott and Lemieux, 2005; Lemieux and Scott, 2005; Scott and Lemieux, 2007) and more recently the U.K. (ENPAA, 2008) in particular, appear to be taking the lead in capacity building initiatives pertaining specifically to protected natural areas and climate change adaptation (including mitigation). As discussed in Chapter 2, a number of empirical studies have examined the potential impacts and policy, planning and management implications of climate change for Canada's protected natural areas network (including migratory bird sanctuaries, Ramsar sites, national parks, national wildlife areas, provincial parks and reserves, and conservation areas) (Lemieux and Scott, 2005), national parks (Scott and Suffling, 2000; Suffling and Scott, 2002; Scott *et al.,* 2002; Jones and Scott, 2006a; Jones and Scott, 2006b; Scott and Lemieux, 2007), provincial parks and conservation reserves (Lemieux *et al.,* 2007) and, more recently, highly valued ecosystems and ecoregions (e.g., Canada's prairie plains and boreal forests, see Henderson *et al.,* 2002; Vandal *et al.,* 2006; Scott and Lemieux, 2007). Studies recently have progressed from examining potential impacts and policy, planning and management implications to identifying and characterizing adaptation options (Scott and Lemieux, 2005; Welch, 2005; Vandall *et al.,* 2006).

Scott and Lemieux (2005) noted that climate change adaptation in protected natural areas will occur in two ways: (i) protected natural area managers and Canadian society will have to accept and adjust to the autonomous response of natural systems; and (ii) protected natural area managers can use planned adjustments in socio-economic processes, practices and structures to moderate potential risks or to benefit from opportunities associated with climate change. To aid managers and planners in identifying and understanding adaptations associated with the latter, the authors developed a 'climate change adaptation portfolio' based on recommendations evident within the extant climate change and conservation-oriented literature (Table 14). Additional portfolios have subsequently emerged in the literature from other nations, including the European Union (Huntley, 2007) and Australia (Australian Government, 2008).

Table 14 Climate change adaptation portfolio for protected area managers and planners. Source: Scott and Lemieux (2005: 700).

SYSTEM PLANNING AND POLICY	• Expand the protected natural areas network where possible and enlarge protected natural areas where appropriate. • Improve natural resource planning and management to focus on preserving and restoring ecosystem functionality and processes across regional landscapes. • Selection of redundant reserves. • Selection of new protected natural areas on ecotones. • Selection of new protected natural areas in close proximity to existing reserves. • Improve connectivity or protected area systems. • Continually assess protected natural areas legislation and regulation in relation to past, anticipated or observed impacts of climate change.
MANAGEMENT (INCLUDING ACTIVE, ADAPTIVE ECOSYSTEM MANAGEMENT)	• Include adaptation to climate change in the management objectives and strategies of protected adaptive ecosystem management) areas. • Implement adaptive management. • Enhance the resiliency of protected natural areas to allow for the management of ecosystems, their processes and services, in addition to "valued" species. • Minimize external stresses to facilitate autonomous adaptation. • Eliminate non-climatic in-situ threats. • Create and restore buffer zones around protected natural areas. • Implement ex-situ conservation and translocation strategies if appropriate. • Increased management of the landscape matrix for conservation. • Mimic natural disturbance regimes where appropriate. • Revise protected area objectives to reflect dynamic biogeography.
RESEARCH AND MONITORING	• Make resources available to aid research on the impacts of past (e.g., paleo-ecological change) and future climate change (e.g., projected species composition changes). • Utilize parks as long-term integrated monitoring sites for climate change (e.g., monitoring of species, especially those at risk or extinction-prone). • Identify specific "values" at risk to climate change. • Regional modelling of biodiversity response to climate change. • Incorporate climate change impacts in protected natural areas "state-of-the-environment" reporting.
CAPACITY BUILDING AND AWARENESS	• Strengthen professional training and research capacity of protected area staff with regards to climate change. • Capacity building and awareness should proceed with the goal of securing public acceptance for climate change adaptation. • Partnerships/collaboration with greater (regional) park ecosystems stakeholders to respond to the need for climate change adaptations. • Improved collaboration/stewardship from local to international scales. • Make resources available for investing in active, adaptive management. • Develop precautionary approaches (such as disaster preparedness and recovery systems) through forecasting, early warning and rapid response measures, where appropriate.

Over a decade ago, Halpin (1997) criticized the generic nature of adaptation strategies being proposed in the scientific literature and recommended that much greater investigation into their practicality and effectiveness was needed. Welch (2005) reiterated these concerns almost a decade later, emphasizing that the limited protected-area climate change literature provided little guidance to the managers of already established protected natural areas. In an attempt to address this limitation, Welch (2005) provided protected natural areas managers, planners and decision-makers with some broad principles, goals and actions to consider in dealing with the climate change issue (Table 15).

Table 15 Principles, goals and actions pertaining to institutional adaptation to climate change. Adapted from: Welch (2005).

PRINCIPLES	**House-in-order and public communications:** High profile public agencies have a unique opportunity to explain global change issues to a wide citizenry through interpretation and outreach. House-in-order and demonstration projects add credibility. Examples include the elimination of cosmetic pesticide use, reduction of greenhouse gas emissions and waste reduction and recycling.
	Risk management to foster resilience: Some species and ecosystems may be able to adapt to climate change by migration or in situ change. However, there are many other stresses impinging on natural areas and their greater ecosystems. A risk management approach will reduce or eliminate these confounding stresses through collaborative efforts.
	Focus on mandate, complement with partnerships: Tourism, regional development and foreign policy should not be put ahead of restoring and protecting natural and cultural heritage. Priority should be accorded to actions within the direct responsibility of the agency and its staff. So, for example, ecological integrity must supercede carbon sequestration in protected ecosystems. However, to the extent that resources allow and that its prime mandate is respected, a park should cooperate in activities like education, emission reduction, climate science and landscape stewardship.
	Permeable landscapes: Parks should be part of networks of ecological areas within which biodiversity can survive, move and be appreciated. Park agencies should promote the importance of regional ecosystems characterized by connectivity and permeable for wildlife movement.
ACTIONS	**Awareness:** staff and stakeholder orientation; visitor interpretation and outreach to the general public.
	Leading by example: reduce greenhouse gas emissions; promote personal action plans for staff; adapt natural region representation strategy; address climate change adaptation in management plans; report on natural and management adaptations to climate change.
	Active ecosystem management: eliminate or mitigate in situ non-climate threats; apply adaptive management; use science results; adjust park boundaries as needed for climate change adaptation.
	Research: understand the impact of past and future climate change; identify values at risk of being significantly impacted by climate change; support downscaled climate modelling.
	Monitoring: promote parks as long term integrated monitoring sites; data gathering and reporting.
GOALS	Specific actions should be phased to achieve three targets. The actions need not be sequential.

Short-term: appropriate climate change information is available to all aspects of park management.

Mid-term: climate change is factored into all aspects of ecosystem and asset management, and duly reflected in park management plans.

Long-term: natural areas are nested within regional landscapes that are permeable for the movement of native species and are free from significant threats to ecological integrity.

With the exception of a small number of initiatives and activities currently occurring in South Africa and the U.K., there are very few examples or case studies of 'on-the-ground' (i.e., region or park-specific) adaptation found in the extant literature (see Scott *et al.,* 2008 for a review). To adapt to the impacts of climate change in Cape Floral Region (South Africa)[45], stakeholders have begun implementing adaptation strategies (IUCN, 2003; Bomhard and Midgley, 2005). Examples of adaptation activities occurring within the ecoregion include: (i) several monitoring and risk assessment studies; (ii) implementation of programs to reduce or remove external sources of stress; (iii) development of risk preparedness strategies for wildfire management; (iv) the redefinition of protected natural areas designed to allow threatened species to shift geographic ranges; (v) aggressive active management considerations (e.g., translocation) for threatened species; and (vi) the establishment of seed banks. In Tunisia (northern Africa), authorities have begun water supply planning and have tailored a scientific climate change monitoring program in Ichkeul National Park (UNESCO, 2007). The water planning activities and monitoring program have enhanced the Park's ability to supply migratory birds with water over the long-term and, as a result, have enhanced the Park's resiliency to short term climatic variability and longer-term climate change. In so doing, the Park is also working towards maintaining the natural resource base upon which tourists and bird watchers have traditionally relied.

2.10 Chapter Summary

On the whole, adaptation has figured less prominently in climate change research on biodiversity conservation and protected natural areas than in other sectors, such as agriculture and

[45] The Cape Floral Region of South Africa is considered to be one of the world's biodiversity hotspots where endemics constitute over 30% of biota (Bomhard and Midgley, 2005).

forestry, and remains an important knowledge gap particularly with respect to policy and planning. While a number of adaptation options suggest that protected area management may need to become more aggressive and intervening than in the past (Table 14), the literature has done little beyond providing generic guidelines and has not directly investigated the desirability or feasibility of these types of adaptation options (i.e., investigated the applicability or practicality of various adaptation options). Moreover, the protected natural areas research community has not been engaged in any serious way in a dialogue about the implications of climate change for current approaches to conservation nor begun to address the central question of what they will try to protect. The 'adaptation challenge' to biodiversity and protected natural areas policy, planning and management is not well understood both in pragmatic or philosophical terms. This is critical because as Scott and Lemieux (2005) emphasized, *"…considering the length of time required for ecosystems to respond to some management interventions and the length of time to implement new policies and strategic plans, the time for protected areas jurisdictions, agencies and organizations to begin developing proactive and integrative climate change adaptation strategies is now."*

Consequently, a high priority for the Canadian climate change and protected natural areas research agenda, therefore, is to: (i) gauge agency perceptions of climate change; (ii) evaluate where the climate change issue ranks in relation to current (and often perceived more immediate) management issues; (iii) 'inventory' climate change impacts occurring or anticipated to occur in protected natural areas across Canada; and (iv) 'inventory' the types and forms of adaptations that have occurred, or are being considered, by protected natural areas jurisdictions. Such research is important to strengthening the overall climate change and protected natural areas adaptation knowledge-base and is an important precursor to formulating and implementing response strategies (i.e., climate change mainstreaming). These issues are the focus of the analyses presented in Chapter 3.

Chapter 3
Climate Change Adaptation in Canada's System of Protected Natural Areas

3.1 An Introduction to the University of Waterloo and Canadian Council on Ecological Areas (CCEA) Protected Areas and Climate Change Survey

As noted in the previous Chapter, understanding how protected natural area agencies view climate change (both independent of and with respect to adaptation) is an important precursor to any attempt at developing an adaptation strategy. Pielke (1998) and Vedwan and Rhoades (2001) stressed that the way in which decision-makers perceive climate change is a significant factor influencing the climate adaptations that are actually adopted. Moreover, there is an urgent need identified in the literature for ongoing, rigorous 'accounting' of climate change adaptation (Thompson *et al.,* 2006). While Scott and Lemieux (2005) and others (e.g., Welch, 2005; Huntley, 2007) have produced climate change adaptation portfolios for protected natural areas based on a synthesis of the scientific literature (Chapter 2, Table 14), these are 'potential adaptations' and do not reflect what adaptation is occurring in or could occur in practice.

In response to these identified research needs in the field of climate change adaptation generally, but particularly in the protected natural areas sector, and with the endorsement of the North American Chapter of the International Union for Conservation of Nature's (IUCN) World Commission on Protected Areas (WCPA), the University of Waterloo and the Canadian Council on Ecological Areas (CCEA)[46] initiated a collaborative *Protected Areas and Climate Change* (*PACC*) *Survey* to provide the Canadian protected area community to assess the state of climate change adaptation in the Canadian protected natural areas community (Appendix 1).

The CCEA was incorporated in 1982 as a national, non-profit organization with a mission *"to facilitate and assist Canadians with the establishment and management of a comprehensive network of protected areas representative of Canada's terrestrial and aquatic ecological natural diversity."* (CCEA, 2008) CCEA's objectives are to:

i) inform and to educate Canadian about the importance and roles of protected areas;

ii) guide the design and completion of a network of Canadian protected areas including the full range of terrestrial and aquatic environments;

iii) determine the ecological requirements and institutional arrangements needed to secure the integrity of protected area networks;

[46] See Table 16 for CCEA jurisdictional representatives.

iv) advance sound stewardship, social and economic values of protected areas in an ecosystem context; and

v) facilitate the exchange of relevant information among interested partners through regional and national forums (CCEA, 2008).

A central function of the CCEA is to mobilize experts and practitioners to advance work on subject areas and issues that are critical for designing, planning and managing protected natural areas. Climate change has been recognized as an issue of high priority in the CCEA's current *Business Plan* (CCEA, 2004). Its importance has been further highlighted by all Canadian protected areas jurisdictions participating in a recent CCEA *Northern Protected Areas Survey* (Wiersma *et al.,* 2005).

This Chapter presents the results of the *PACC Survey*. The purpose of the survey was to:

i) identify what climate change impacts are currently occurring and are anticipated in protected natural areas across Canada;

ii) evaluate the perceived importance of climate change relative to other protected natural areas management issues within Canadian jurisdictions; and

iii) determine what policy, planning and management response efforts (i.e., adaptations) have occurred or are being considered by protected natural areas agencies across Canada.

The results of the *PACC Survey* help build upon the CCEA initiatives previously noted and the Canadian protected natural areas climate change adaptation work by Scott and Lemieux (2005) and others (e.g., Welch, 2005) by providing an important overview of the state of climate change adaptation in protected natural areas in Canada and establishing an indication of the current capacity (as self evaluated) of agencies to respond to the climate change issue. The results also help determine further steps that need to be taken as part of a coordinated response to climate change adaptation in Canada and sets the context for a more specific and applied case study that works towards identifying and evaluating climate change adaptation options within the major planning and management program areas of a Canadian protected natural areas jurisdiction (Ontario Parks). This case study will be presented in the proceeding Chapter.

3.2 Methods

3.2.1 Sampling Method, Participants, Response Rates and Mode of Distribution

A survey of protected natural areas stakeholders was undertaken in order to investigate the current state of knowledge on climate change and adaptation and to identify the barriers and constraints to formulating a strategic response to climate change, including research informational needs. The survey instrument was designed by the author in consultation with the CCEA. The survey underwent a review by an advisory committee, comprised of jurisdictional representatives of the CCEA, and the Office of Research Ethics at the University of Waterloo. A pre-test was administered to several CCEA jurisdictional representatives in order to assess the clarity of the survey design, its appropriateness to the audience, and whether in fact it achieved the aims of the research. Minor revisions were made to improve the survey instrument prior to distribution to the full sample (Table 16).

The sample was selected to be specific to the context and representative of the Canadian protected areas community. As such, purposive sampling was used and survey participation was based on the single common determinant that a jurisdiction, agency or organization (referred to collectively as 'agencies' from this point forward) had a role in planning, establishing and/or managing protected natural areas in Canada. Given the clear advantages of e-mail distribution to both the research team (e.g., broad geographic coverage and limited costs, faster distribution and response time, ease of data collection) and to participants (e.g., the provision of ample time to consider responses unimpeded by the presence of an interviewer or limited space often provided in paper copies), e-mail was the sole mode of survey distribution and response, even though the option of a paper copy of the survey was offered to participants. The survey was forwarded to CCEA jurisdictional representatives and senior staff within environmental non-government organizations (ENGOs) (e.g., directors, managers and coordinators) who either completed the questionnaire themselves (sometimes in cooperation with other staff) or forwarded the survey onto appropriate personnel. To this extent, all federal departments (n=4) and provincial/territorial ministries/departments (n=13) engaged in protected areas planning and management were included in the survey. In addition, a number of other agencies who operate at finer jurisdictional scales than federal and provincial governments, such as municipalities and conservation authorities, were included (n=5). First Nations and ENGOs who plan and establish protected natural areas independently or provide important research, capacity building and/or outreach functions within the

Canadian protected natural areas community were also included in the survey (n=13). The survey sample was selected in cooperation with the CCEA in order to represent the full spectrum of agencies operating at varying geographical and jurisdictional scales across Canada (n=35) (Figure 26). Collectively, agencies included in the survey are responsible for over 7,500 protected natural areas, about 95% of Canada's entire protected natural areas network both in terms of total number or protected natural areas and total hectares protected (Government of Canada, 2006).

Several steps were taken in an effort to maximize response rates: (i) the forwarding of a notification letter introducing selected participants to the research and alerting them as to the survey's arrival (March 29, 2006); (ii) the forwarding of a follow-up reminder letter and an additional copy of the survey where necessary (April 19, 2006); (iii) the placement of a survey notification in the bi-annual CCEA Newsletter (April 2006) which detailed the intent of the survey, reminded participants to complete the survey and provided other stakeholders and interested persons with follow-up contact information; and (iv) the allowance of ample time to complete the survey, including a one-month extension because of the busy summer period. Letters of appreciation were distributed upon completion of the survey and participants and interested stakeholders were informed of preliminary survey results through a summary published in the CCEA May 2007 Newsletter (Appendix 1). Survey materials can be found in Appendix 1.

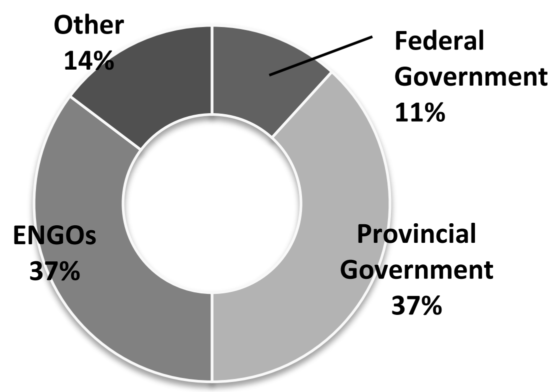
Table 16 Protected Areas and Climate Change (PACC) in Canada survey participants and response rates. * = CCEA member agency.

FEDERAL GOVERNMENT (N=4/SRR=80%)	• Environment Canada, Canadian Wildlife Service* • Parks Canada* • Canadian Heritage Rivers (Parks Canada)* • Department of Fisheries and Oceans, Marine Protected Areas*
PROVINCIAL GOVERNMENT (N=13/SRR=100%)	• Government of Alberta, Alberta Community Development, Parks and Protected Areas* • Government of British Columbia, British Columbia Ministry of Environment* • Government of Manitoba, Manitoba Conservation* • Government of New Brunswick, Department of Natural Resources* • Government of Newfoundland and Labrador, Department of Environment and Conservation, Parks and Protected Areas Division* • Government of Nova Scotia, Environment and Labour, Protected Areas Branch* • Government of Nunavut, Department of Environment, Nunavut Parks and Special Places* • Government of Ontario, Ontario Ministry of Natural Resources (MNR), Ontario Parks* • Government of Prince Edward Island, Forests, Fish and Wildlife Division, Department of Environment, Energy and Forestry*

	• Govournement du Québec, Ministère du Développement durable de l'Environnement et des Parcs* • Government of Saskatchewan, Saskatchewan Environment* • Government of Yukon, Yukon Environment , Parks Branch* • Government of Northwest Territories, Department of Industry, Tourism and Investment, Tourism and Parks Division*
ENVIRONMENTAL NON-GOVERNMENTAL ORGANIZATIONS (ENGOS) (N=13/SRR=72.2%)	• Canadian Boreal Initiative (CBI) • Canadian Biosphere Reserves Association (CBRA) • Clayquot Biosphere Trust • Deh Cho Land Use Plan • Long Point Biosphere Reserve • Nature Canada • Nature Conservancy of Canada • Wildlife Habitat Canada (WHC) • World Wildlife Fun (WWF) Canada • Carolinian Canada Coalition (CCC) • Ontario Nature • Yellowstone to Yukon (Y2Y) • Canadian Parks and Wilderness Society (CPAWS)
OTHER (N=5/SRR=83.3%)	• Federation of Canadian Municipalities • Conservation Ontario (including Toronto and Region Conservation Authority and Credit Valley Conservation Authority) • Niagara Escarpment Commission (NEC)

Total N=35/Survey Response Rate (SRR) = 81.3%

Figure 26 Protected Areas and Climate Change (PACC) in Canada survey participants (by % of total # of respondents).



3.2.2 Survey Design and Format

The survey primarily utilized closed-ended questions to elicit opinions on climate change and related impacts and to gather pertinent information related to climate change impacts, adaptation initiatives, and barriers and constraints to adaptation. Closed-ended questions asked respondents to select categories, rank items as an indicative measure of attitudes or opinions, or select a point on a scale as indicative of the intensity with which an attitude or opinion is held. To aid respondents in conceptualizing different categories of importance, a description for each importance category was provided (Table 17). A major benefit of closed-ended questions is that their responses are easily analyzed. On the other hand, they also require that researchers have a clear understanding of what the range of answers to a question will be (Hay, 2005).

Table 17 Importance scale and description provided to respondents.

IMPORTANCE SCALE	DESCRIPTION
Very Important	• A most relevant issue • First order priority • Has direct bearing on major issues • Must be resolved, dealt with, or treated
Important	• Is a relevant issue • Second-order priority • Significant impact but not until other times are treated • This issue does not have to be fully resolved
Slightly Important	• Marginally relevant • Third-order priority • Has little importance • Not a determining factor to major issue
Unimportant	• No relevance • No priority • No measurable effect • Should be dropped as an item to consider

To overcome this potential limitation, an 'other' fill-in-the-blank option was often provided to ensure that the research team did not omit the possibility of an opinion (i.e., protected natural area management issue) falling outside of the pre-determined list provided. These open-ended response options provided respondents with the freedom and flexibility to recount understandings, experiences or opinions in their own terms. Providing such an option also helps overcome the assumption that words, categories and concepts carry the same meaning for all respondents which may not always be the case (Hay, 2005). An entirely open-ended question was placed towards the end of the questionnaire to enhance the respondent's inclination to offer full and more considered responses to previous questions (if desired) or to add any information they felt relevant to the issues addressed in the survey. This question had no restrictions in terms of rating scales, space for comments and rationale and, as such, was more open to yielding valuable insights, some of which were often unanticipated (see Results, section 3.3.1).

Questions were grouped into sections of related questions and simple instructions also were provided. Questions were grouped by themes in order to ensure the flow and sequence of the survey was fundamental to the respondents understanding of the research purpose and to maintain their willingness to provide meaningful responses and to complete the questionnaire to its conclusion. In total 23 questions were asked of respondents and, depending on how they responded to these questions (i.e., *"Yes"* or *"No"*), it was possible for participants to respond to an additional nine follow-up questions.

3.3 Results and Discussion: the State of Climate Change Adaptation in Canada Protected Natural Areas

3.3.1 Perceptions of Climate Change Risk and Vulnerability

The survey revealed that all agencies considered climate change to be an important management issue for protected areas *now* (91.4%) or in the *very near future* (i.e., 2020s) (100%). Further, 71.4% of the agencies surveyed either *strongly agreed* or *somewhat agreed* with the statement that *"climate change will substantially alter protected area policy and planning over the next 10 years"*. When asked the same question, but in the context of the next 25 years, virtually all agencies (94.3%) *strongly agreed* or *somewhat agreed* with the statement. Departments representing the governments of Alberta and New Brunswick were the only two respondents to *somewhat disagree* with the statement.

While climate change was perceived to be an important issue to protected areas *now*, it was perceived to be of *least* importance compared to other current management issues (Table 18). However, when asked the same question in the context of 25 years from now, 60% of the agencies surveyed ranked climate change as an issue of greater importance than currently perceived. Climate change was rated as the *second most important management issue* to protected areas 25 years from now, ranking only behind external threats and tied with human land-use patterns.

Table 18 Current and future perceived importance of climate change relative to other protected natural areas management issues by Canadian protected areas agencies.

RANK	CURRENT PERCEIVED IMPORTANCE OF CLIMATE CHANGE RELATIVE TO OTHER PROTECTED NATURAL AREAS MANAGEMENT ISSUES	RANK (Δ)	FUTURE PERCEIVED IMPORTANCE OF CLIMATE CHANGE RELATIVE TO OTHER PROTECTED NATURAL AREAS MANAGEMENT ISSUES (25 YEARS FROM NOW)
1	External Threats (e.g., surrounding land-use, habitat fragmentation)	1 (nc)	External Threats (e.g., surrounding land-use, habitat fragmentation)
2	Human Land-use Patters (e.g., roads, population density)	**T-2 (+8)**	**Climate Change**
3	Rare/Endangered Species Management	T-2 (nc)	Human Land-use Patterns (e.g., roads, population density)
T-4	Wildlife Management (e.g., species richness, population dynamics, trophic structure)	T-4 (nc)	Wildlife Management (e.g., species richness, population dynamics, trophic structure)
T-4	Water quality/Air quality	T-4 (-1)	Rare/Endangered Species Management
T-4	Visitor Stresses (e.g., public facilities, interpretation centres)	T-6 (-2)	Water Quality/Air Quality
7	Exotic Species (e.g., animal and plant)	T-6 (+1)	Exotic Species (e.g., animal and plant)
T-8	Contamination/Pollution	8 (nc)	Disturbance Frequencies (e.g., fire, insects, floods)
T-8	Disturbance Frequencies (e.g., fire, insects, floods)	T-9 (-5)	Visitor Stresses (e.g., public facilities, interpretation centres)
10	**Climate Change**	T-9 (-1)	Contamination/Pollution

With respect to the range of climate change impacts expected to occur within protected natural areas, respondents felt that the most important impacts will be on watersheds (including wetlands, water quality and quantity), wildlife and vegetation, with 88.6% of the agencies surveyed identifying climate change impacts on these features as either *very important* or *important*. Impacts of climate change on protected natural areas policy and management also ranked high, with 80% and 74.3% of respondents identifying impacts on these programs as either *very important* or *important* respectively. Conversely, respondents felt that the least important climate change-related impacts on protected natural areas will be those associated with revenues (with over a quarter assessing this issue to be *unimportant* and 31.4% assessing it to be *slightly important*), operations and development (i.e., infrastructure) and interpretation programs (with 37.1% agencies assessing these issues to be *unimportant* or *slightly important*).

3.3.2 Climate Change Impacts, Adaptation and Information Needs

Interestingly, 73.3% of survey respondents indicated that protected natural areas within their agency were *currently affected* by climate change-related impacts. [47] All provincial/territorial jurisdictions and all federal departments indicated that at least one climate change-related impact was occurring within their protected areas. The remaining respondents (26.7%) indicated that they were *not sure* whether or not protected natural areas within their jurisdiction were experiencing climate change-related impacts. This figure is rather alarming, considering the fact that two of the seven agencies that were *not sure* are responsible for protected natural areas positioned in Canada's most biologically diverse and ecologically-stressed ecoregion (Carolinian Canada, Southwestern Ontario). Carolinian Canada is home to 40% of Canada's species-at-risk and is used by over 50% of Canada's bird species (Carolinian Canada, 2008).

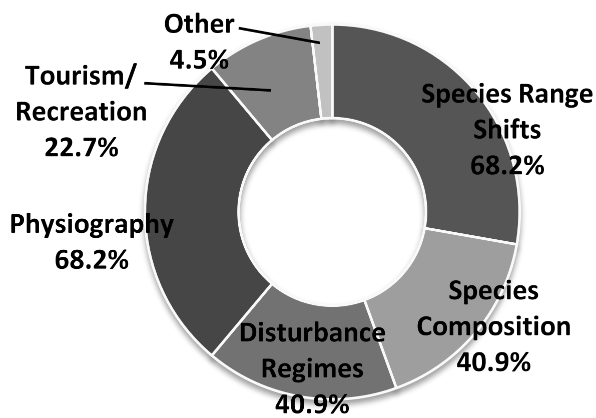
Figure 27 illustrates the range of climate change-related impacts reported to be occurring within Canada's protected natural areas network. Species range shifts and changes in physiography (e.g., shoreline erosion and glacial retreat) are reported to be the most common climate change-related impact occurring within Canada's protected natural areas with nearly three-quarters of respondents reporting such impacts. Changes in species composition (i.e., the character of the vegetation within a protected natural area) and changes in disturbance regimes (e.g., forest fire frequency and pest/disease outbreaks) were also reported to be occurring within protected natural areas by nearly half of the respondents (40.9%). 'Other' reported climate change impacts included sea level rise within MBSs and NWAs by Environment Canada, for examples.

Despite agency perceptions of the salience of the climate change issue over the next 25 years and considering that a range of climate change impacts are reported to already be occurring within Canada's protected natural areas, the majority of respondents (82.9%) noted that their agency had not completed a comprehensive assessment on the potential impacts and implications of climate

[47] Agencies that have no jurisdictional authority over protected natural areas were left out of the denominator when calculating results for some survey questions (e.g., those pertaining to climate change impacts within protected natural areas).

change for their respective policy, planning and management frameworks. This leads to the conclusion that jurisdictional and agency-specific climate change impacts and implications for protected natural areas are largely unknown in Canada. Ontario Parks (Lemieux *et al.,* 2007), Saskatchewan Parks (Henderson *et al.,* 2003; Vandal *et al.,* 2005) and New Brunswick's Department of Tourism and Parks (no external publication) are the only provinces/territories known to have undertaken a climate change vulnerability assessment of protected natural areas and, with the exception of the World Wildlife Fund (WWF, 2003), none of the other 12 ENGOs (92.3%) who responded to the survey have completed such an assessment. Parks Canada was the only federal department to have completed a climate change scoping report (Scott and Suffling, 2000) and no assessments had been conducted pertaining to Environment Canada's network of MBAs and NWAs [which contains 144 sites protecting over 14 million hectares, equating to nearly half of Parks Canada's total ha protected (Government of Canada, 2006)] or specifically on species-at-risk.

Figure 27 The range of climate change impacts reported to be occurring within Canada's protected areas network (by % of agencies reporting impact type).



These results reflect the limited scientific information available to protected natural area agencies and the scarcity of resources that agencies have to devote to the climate change issue. Figure 28 illustrates the types of additional information that agencies would like to have on various climate change-related issues. Generally speaking, agencies did not want more information on issues associated with atmospheric processes and climate modelling or on errors in and challenges with modelling the climate system. Agencies expressed informational needs on the ecological consequences of climate change (100% of agencies noted that they would like *much more information* or *some more information* on the issue) and the implications of climate change for policy, planning and management strategies (with 92.3% of agencies noting that they would like *much more information* or *some more information* on the issue). Specifically relevant to the policy Delphi research discussed in Chapter 4, 94.3% of the respondents indicated that they wanted *much more information* or *some more information* on strategies for managerial response (adaptation) to climate change impacts and strategies for effective communication of climate change issues respectively.

With the exception of a few federal and provincial/territorial departments (i.e., Parks Canada, Ontario Parks, Government of Saskatchewan and Government of British Columbia) and a single ENGO (WWF), no other agencies had a budget allocated *specifically* to respond to climate change. Nearly half of the agencies surveyed (45.7%) noted that they *do not have an individual* within their agency responsible for climate change-related issues (including legislation, policy, research, planning, management and research and monitoring) and, for the agencies that do, climate change was perceived to be a less immediate priority (see Tables 18 and 19).

As Figure 29 illustrates, little response is currently being undertaken or being considered by the majority of protected natural area agencies to deal with climate change-related issues. Moreover, despite the important role that protected natural areas could play in climate change detection, monitoring and research and in facilitating species adaptation, only half of the agencies reporting climate-change related impacts in their protected natural areas are actually investigating their magnitude and extent. While 97.1% of the agencies surveyed *strongly agreed* or *somewhat agreed* with the statement that *"climate change detecting and monitoring should be a priority for protected area agencies"*, only a third reported that they specifically monitor for climate change impacts. Moreover, only five organizations (14.3%) have developed climate change indicators for monitoring purposes and the extent of monitoring activities appears to be limited to solitary impacts, such as glacial retreat or single-species monitoring. Of the agencies who are conducting research on climate change-related impacts, much of the work had been conducted outside of their respective departments/agencies (Figure 30). Finally, despite the leading role that protected natural areas could play in educating the public about climate change and in demonstrating its impacts and in providing solutions, only six agencies (17.1%) have incorporated climate change into public education, interpretation and outreach programs (and the types of activities occurring in these programs are limited to informational posters for children and brief information provided on websites[48]).

[48] See Parks Canada's website, http://www.pc.gc.ca/docs/v-g/ie-ei/cc/actions_e.asp and the MNR's website, http://www.mnr.gov.on.ca/en/Business/ClimateChange/2ColumnSubPage/STEL02_168613.html for examples.

Figure 28 Types of additional information Canadian protected natural areas agencies would like to have on various climate change-related issues (by % of total number of responses).

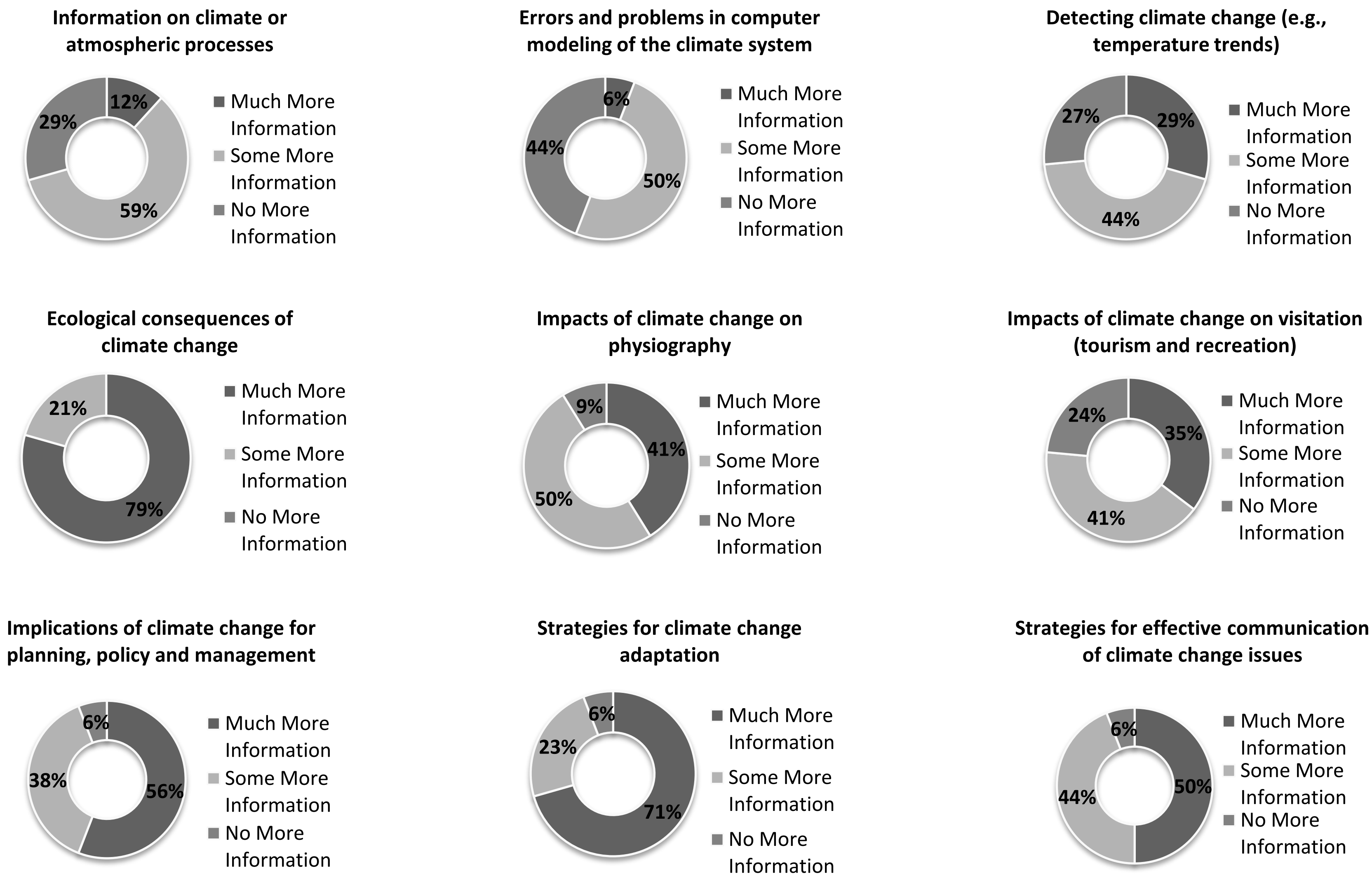


Figure 29 Climate change responses being undertaken or being considered by Canadian protected natural areas agencies (by major program area).

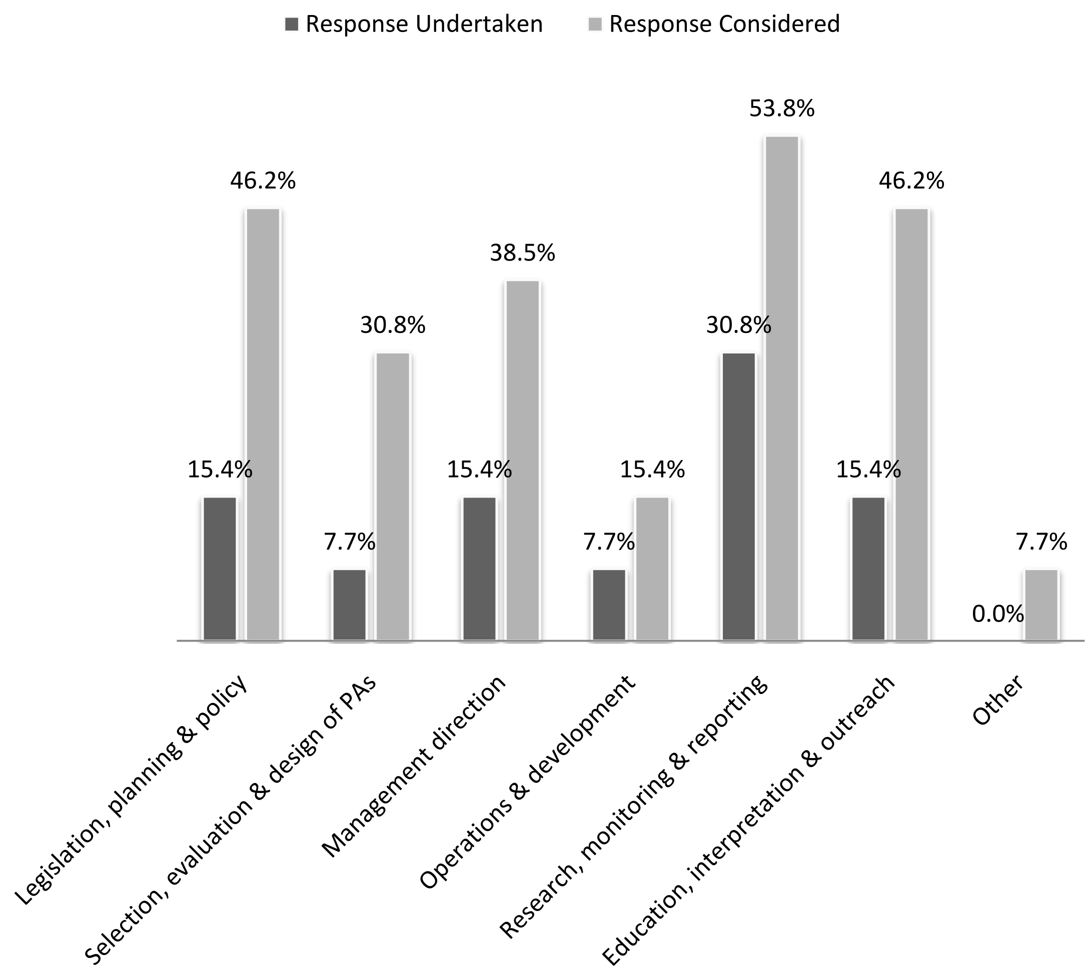
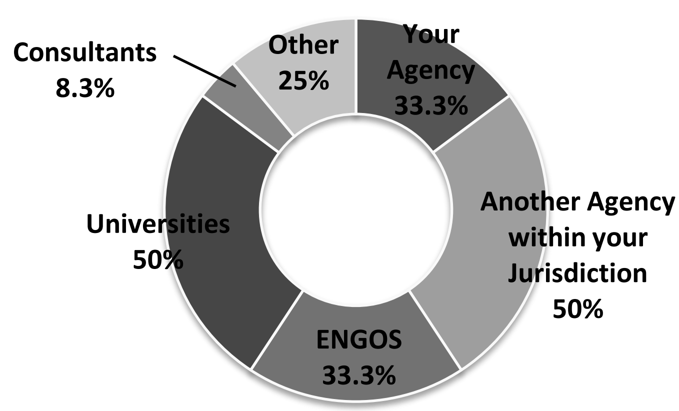


Figure 30 Climate change-related research being conducted in Canada's protected natural areas by 'researcher type' (respondents could select more than one category).



3.3.3 Capacity Issues Related to Climate Change Adaptation

Despite the limited response thus far to climate change by Canadian protected natural areas agencies, there seems to be a concern and motivation to move forward on the issue. Over two-thirds of the agencies strongly disagreed or somewhat disagreed with the statement that *"there are too many uncertainties regarding climate change to develop adaptation strategies for protected areas"* and nearly two-thirds indicated that formal climate change discussions have taken place within their agency. Most of these discussions have occurred through various awareness and capacity building initiatives, including workshops and other expert meetings. Nevertheless, protected natural area agencies appear uncertain as how to proceed – 91.2% of the agencies responding to the question *"do you feel that your jurisdiction currently has the capacity necessary to deal with climate change issues affecting protected areas?"* held the position that they currently *do not have the capacity necessary to effectively respond to climate change*. It comes as little surprise therefore that 82.9% of the agencies surveyed do not have a climate change policy or adaptation strategy specifically pertaining to protected natural areas or biodiversity, or a climate change mitigation strategy (i.e., in-house plan to reduce greenhouse gas emissions).

Moreover, of the 29 agencies currently without a climate change policy or adaptation strategy directly related to protected natural areas in development, only four (11.8%) stated they were currently in the process of developing one. Parks Canada is currently the only protected natural areas agency in Canada to have a draft climate change strategy available for review (Parks Canada, in prep.). While the strategy sets out an ambitious plan for climate change adaptation through the identification of several guiding principles (e.g., 'house-in-order and public education' and 'risk management'), actions (e.g., 'awareness' and 'leading by example') and goals (e.g., 'natural areas nested within permeable landscapes') (Parks Canada, in prep.), a number of important issues pertaining to climate change adaptation are omitted. The strategy does not explicitly address who will be accountable for its implementation nor where and how additional resources required to implement the strategy will be attained, has no time-frame for implementation, monitoring or reporting, and does not identify 'capacity building' as a goal despite the obvious need for it. Indeed, as the *Panel on Ecological Integrity* revealed nearly a decade ago, Parks Canada does not have the capacity to manage for ecological integrity (Parks Canada, 2000), which was an assessment made irrespective of the consideration of climate change impacts. Accordingly, the strategy may contain some unrealistic commitments and consequential unfulfilled expectations.

Capacity constraints at the provincial/territorial level appear to be no different than at the federal level. All but one province (New Brunswick) stated that they *do not* have the capacity to respond to climate change. This was rather alarming considering that the remaining provinces and territories comprise over 85% of Canada's protected natural areas in terms of total number of sites (and approximately 50% in terms of total ha protected) (Government of Canada, 2006). Respondent comments further elucidate some of the reasons behind the lack of response by protected areas agencies on climate change-related issues (Table 19). Common stated capacity constraints provided by provincial and territorial respondents included lack of staff and financial resources and inadequate internal scientific capacity to deal with climate change. Such findings are consistent with other sectors (e.g., agriculture, water and forestry) who are also finding it difficult to mainstream climate change into current policy, planning and management frameworks (see Table 12 in Chapter 2).

These findings are also consistent with the findings of national and provincial/territorial protected natural areas audits and assessments, such as the *Canadian Protected Areas Status Report 2000-2005* (Government of Canada, 2006), the 2008 March *Status Report of the Commissioner of the Environment and Sustainable Development* (Office of the Auditor General of Canada, 2008a), *The State of Alberta's Parks and Protected Areas Report* (CPAWS, 2008), *Doing Less with Less: How Shortfalls in Budget, Staffing and In-house Expertise are Hampering the Effectiveness of MOE and MNR* (ECO, 2007) and the *Ontario Parks Program Audit* (AGO, 2002 and 2004), which have all raised concerns about the inability protected natural areas agencies to properly fulfill their mandates which are diversifying and growing in complexity. The Government of Canada's *Budget 2007* revealed dramatic cuts to several Environment Canada departments, including the Environmental Monitoring and Assessment Network (EMAN) (-50%) and the Canadian Wildlife Service's Migratory Bird Sanctuary (MBS) (-50%) and National Wildlife Areas (NWAs) programs (-100%). During the *Alberta Special Places 2000* program (1995-2001), Alberta's parks network land base was expanded by nearly 700%. However, during that same time, the Department of Tourism, Parks and Recreation lost over 50% of its staff and over 30% of its funding (CPAWS, 2008). Similarly, the Ontario Ministry of Natural Resources' (MNR) total operating budget has decreased by 35% since 1992 (ECO, 2007). These cutbacks and reduction in staffing levels have resulted in inadequate capacity in the areas of management planning, enforcement, ecological monitoring and staff expertise (AGO, 2002; ECO, 2007; Office of the Auditor General of Canada, 2008a and 2008b) and has even forced the de-regulation of 15 protected natural areas in Ontario (MNR, 1996). As the *Canadian Protected Areas Status Report (2000-*

2005) concluded, such cutbacks are impacting the management effectiveness of protected natural areas agencies across Canada, and agencies are finding it increasingly difficult to implement actions identified in management plans[49], maintain and monitor the ecological integrity of their networks, and report systematically on the state of their protected natural areas and species-at-risk (Government of Canada, 2006; Office of the Auditor General of Canada, 2008a and 2008b).

Table 19 Respondent feedback on capacity issues related to climate change and protected natural areas adaptation.

"Priorities are not focused on climate change – lack of staff and financial resources for dealing with climate change are the main capacity issues." Government of Alberta, Alberta Community Development, Parks and Protected Areas
"We don't have confidence in science's ability in this instance to predict in a suitable time frame what issues will emerge; therefore, issues will likely have to be addressed as they emerge…Climate change is inevitable but there is not much you can hang your hat on in terms of ecosystem and species responses." Government of New Brunswick, Department of Natural Resources
"We haven't had the resources to even investigate what climate change could mean to our protected areas system but assume expansion is a way to mitigate, so that is where our focus is right now." Government of Nova Scotia, Environment and Labour, Protected Areas Branch
"We are under-sourced with no research/knowledge base and have difficulties meeting our current program needs." Government of Nunavut, Department of Environment, Nunavut Parks and Special Places
"Financial and human resources are in short supply for all aspects of ecological integrity." Government of Ontario, Ontario Ministry of Natural Resources (MNR), Ontario Parks
"No staff, no financial resources, knowledgeable/scientifically trained staff to deal with the climate change issue." Govournement du Québec, Ministère du Développement durable de l'Environnement et des Parcs
"More human and financial resources are needed to address arising issues and questions." Government of Saskatchewan, Saskatchewan Environment
"Only one person is focusing on climate change issues and is self-appointed." Government of British Columbia, British Columbia Ministry of Environment

[49] The *Canadian Protected Areas Status Report (2000-2005)* revealed that less than a quarter of Canada's protected natural areas have up-to-date management plans (Government of Canada, 2006).

Overall, the survey revealed a clear disconnect between the perceived salience of climate change for protected natural areas policy, planning and management within protected natural areas and a lack of available resources (e.g., financial resources and staffing) and capacity required to respond to the issue. Currently, both institutional understanding of adaptation and access to important resources remain inadequate and most agencies do not fully understand what their role needs to be in terms of climate change adaptation. While constraints such as limited financial resources, very limited capacity and lack of understanding of real or anticipated climate change impacts need to be overcome, an immediate concern for protected natural areas agencies is the further strengthening and development of networks. Climate change education, capacity building and information dissemination has largely occurred through external conferences (i.e., piggybacking) rather than through formally established networks. Moreover, only about half of the agencies participating in the *PACC Survey* are actively involved in climate change dialogue and capacity-building initiatives (e.g., staff participation in workshops and conferences, staff training, etc.), which suggests that adaptive capacity will remain low for the foreseeable future.

Given the multi-scale and cross-jurisdictional nature of climate change impacts, independent top-down approaches will not suffice in the long-term. A more integrated and collaborative approach will be needed if protected area agencies are to address effectively the climate change issue. Nearly all protected natural area agencies participating in the survey (85.7%) noted that they would be willing to participate in either a nation-wide working group or workshop on climate change and protected natural areas. Furthermore, 82.9% held the position that a nation-wide collaborative effort on climate change would be a suitable approach to adaptation (Figure 31). Networks will need to be established for adaptation strategies at the policy-making, and implementation and reporting levels. A logical next step, therefore, would be for the protected natural areas community to establish a climate change working group and/or to hold a national conference on issues associated with climate change and protected natural areas. Since the institutional ramifications of climate change extend beyond the operational boundaries of government organizations, the CCEA is structured strategically to facilitate the development and implementation of comprehensive support mechanisms that will improve the capacity of cross-jurisdictional sectors to adapt to climate change. In fact, many respondents specifically identified that they would be interested in working with the CCEA in this regard.

Recognizing complementary strengths and weaknesses between agencies will be critical in any collaborative effort to address the climate change issue. In general, there appears to be adequate capacity to get climate change messages out to staff, members of specific associations and groups and to the general public. Over a third of the respondents noted that they would be prepared to provide advocacy and communications support if a nation-wide working group were to be established or if a national workshop were held on the subject (Figure 32). However, many indicated that they would not be able to provide much in terms of financial or human resources (i.e., scientific expertise).

Figure 31 Protected areas agency response to suggested approaches to climate change adaptation (by % of agencies; agencies could select more than one option).

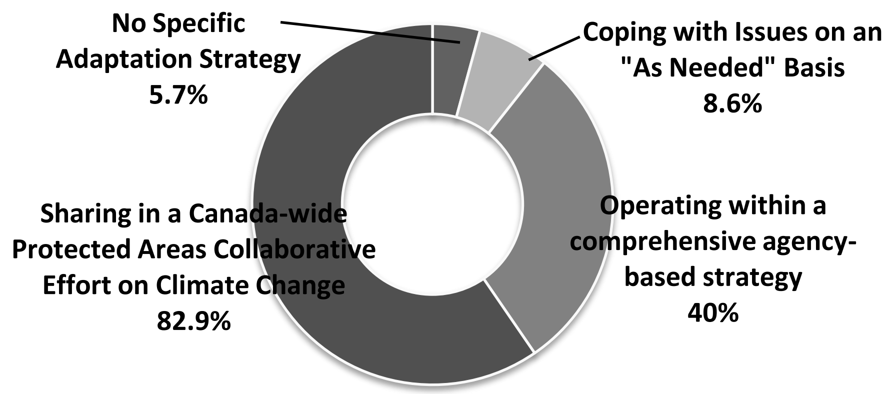
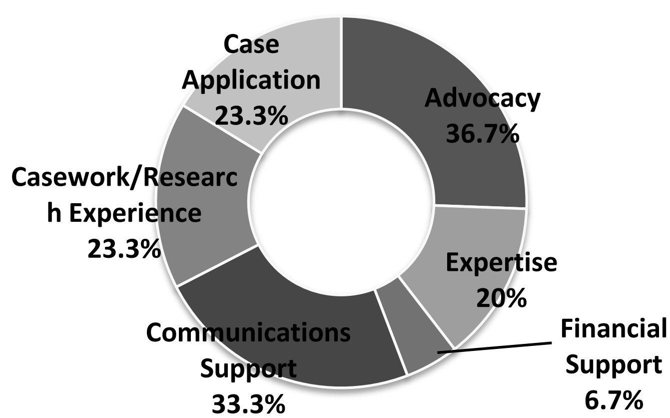


Figure 32 Resources protected areas agencies would be willing to provide for a climate change and protected natural areas working group or a nation-wide conference on the topic (agencies could select more than one option).



3.4 Some Concluding Remarks on Protected Natural Areas and Climate Change Adaptation

The international and national protected natural areas community faces a host of difficult issues stemming from the uncertainties related to climate change, the institutional contexts for adaptation decision-making and action, and inherent limits of available resources. However, the results presented here are consistent with other research from other government sectors that has found that, without adapting, existing institutions are unlikely to be able to cope efficiently and equitably with climate change (e.g., Kane and Yohe, 2000). As Smithers and Smit (1997: 132) have stated, *"In some cases, social and economic systems may actually be becoming so thoroughly adapted to political, cultural and economic stimuli that they are effectively decoupled from the natural environments in which they operate. As a consequence, they are increasingly vulnerable to climate extremes regardless of the future climate scenario."* Similarly, Smith (1997) emphasized that, on the whole, the effects of climate change most likely will be more severe for natural ecosystems than for social systems and that current policy may even exacerbate many of the negative impacts associated with climate change. As discussions in Chapter 2 revealed, this certainly may be the case for protected natural areas policy in Canada.

Climate change is not a remote future event for biodiversity and protected natural areas planning and management. The varied impacts of a changing climate are becoming more and more evident at locations around the world including Canada (see Chapter 2). Parry *et al.* (1998) and others (e.g., Stehr and von Storch, 2005) have stressed that the risks and dangers of failing mitigation efforts (i.e., reductions in greenhouse gas emissions) without adaptive strategies would have serious implications for society and to ignore adaptation would be similarly perilous for nature. The recent *Report of the Commissioner of the Environment of Sustainable Development* similarly noted that failing to adequately invest in the area of climate change adaptation will *"undermine Canada's ability to make wise decisions."* (Office of the Auditor General of Canada, 2006) The *Report* also called on all governments to begin developing action plans that cut across all departments, to work with other levels of government to develop clear priorities, and to find new ways to connect researchers with decision-makers (Office of the Auditor General of Canada, 2006).

Considering the length of time required for ecosystems to respond to some management interventions and to implement new policies and strategic plans, the time for protected natural areas jurisdictions, agencies and organizations to begin developing proactive and integrative climate change adaptation strategies is now (Scott and Lemieux, 2005). Agency response to climate change remains inadequate and while the climate change adaptation literature specific to protected natural areas has done an adequate job in identifying hypothetical adaptation options that could be considered by protected natural area agencies, little has been done to assess them for relevancy to real-world policy and planning decision-making. This may not be too surprising considering the recency of the climate change 'problem' to protected natural areas and the progress of adaptation as a legitimate policy response to climate change.

Despite these hurdles, protected natural areas agencies must begin thinking now about how to effectively and efficiently mainstream climate change into program areas. As noted in the introduction to this Chapter, adopting a *laissez-faire* approach to climate change could have many negative ramifications for biodiversity. Irreversible impacts, such as species extinction could result, for example, and the potential for more rapid or pronounced change than expected could leave protected natural area managers and planners unprepared to effectively deal with climate change impacts. Issues that protected natural area agencies will soon have to begin considering include: (i) how to go about enhancing adaptive capacity; (ii) identifying and evaluating adaptation options and determining the appropriate balance between proactive and reactive approaches; (iii) determining where adaptation intersects with, and can be integrated into, other policy areas and priorities (e.g., forestry, invasive species, species-at-risk, etc.); and (iv) implementing, evaluating and adjusting specific adaptations.

Climate change will challenge protected natural area managers and conservation objectives in ways like never experienced before. Difficult choices will have to be made as to what climate change adaptation options are desirable, feasible and politically acceptable. Since the capacity for adaptation in the protected natural areas sector remains limited, there is a clearly indicated need to assist agencies in the identification and evaluation of adaptation options as a strategic starting point in working towards mainstreaming climate change into relevant program areas. This task is the focus of Chapter 4.

Chapter 4
Overcoming Uncertainty: A Climate Change Adaptation Framework for Ontario Parks

4.1 Chapter Introduction

Chapter 3 revealed that there is a clear disconnect between the perceived salience of climate change for protected natural areas management in Canada and a lack of available resources (e.g., financial resources, human resources and scientific expertise) to adapt. Institutional capacity as it relates to climate change adaptation remains limited among protected natural areas agencies and most remain unclear as to what their role should be. Agencies will need to decide, *inter alia*, whether to manage protected natural areas in a manner that forestalls undesired impacts of ecosystem change or facilitates ecosystem change 'naturally' or through active adaptive measures (e.g., assisted migration).

This Chapter responds to the capacity limitations identified by the Canadian protected natural areas community (and by the broader international climate change adaptation literature) by helping formulate a framework to help respond to the climate change issue within the real world context of a protected natural areas agency (Ontario Parks). The need to mainstream climate change into policy, planning and management program areas has been recognized by the province (Government of Ontario, 2007a) and specifically the Ministry of Natural Resources (MNR)[50] in their *Draft Climate Change Strategy* (MNR, 2005a), *Climate Change Action Plan* (MNR, 2005b), *Protecting What Sustains Us: Ontario's Biodiversity Strategy* (MNR, 2005c) and *Our Sustainable Future: Ministry of Natural Resources Strategic Directions* (MNR, 2005d).

First, an overview of Ontario Parks' current protected natural areas system and institutional structure is detailed (e.g., number and types of protected natural areas, current management issues and priorities, etc.). Second, adaptation actions to-date on climate change at the 'corporate' and 'park zone' levels are identified via a survey of managers. The Chapter next proceeds to utilize a policy Delphi-based methodology to aid in the identification and evaluation of climate change adaptation options within Ontario Parks' six major program areas: (i) Policy, System Planning and Legislation (PSPL); (ii) Management Direction (MD); (iii) Operations and Development (OD); (iv) Research, Monitoring and Reporting (RMR); (v) Corporate Culture and Function (CCF); and (vi) Education, Interpretation and Outreach (EIO). The adaptation options are analyzed individually for their perceived level of desirability, feasibility and implementation time-frame wise by a panel of

[50] Ontario Parks is a branch of the Ontario Ministry of Natural Resources (MNR).

protected natural areas experts. Differences of opinion among respondent groups (i.e., Parks Canada, Ontario Parks, academics) as revealed by evaluation ratings and panelist comments are discussed. The central goal of the Chapter is to assess the relative merit (or practicality) of alternative adaptation options in order to help identify priority (or 'first-order') adaptations.

The research builds on the recent collaborative efforts of the Parks Research Forum of Ontario (PRFO) (e.g., Beveridge *et al.,* 2005), the Ontario Parks and the broader MNR (e.g., Colombo *et al.,* 2007; Brown and Hunt, 2007; Varrin *et al.,* 2007) and the University of Waterloo (Lemieux *et al.,* 2007). This research has primarily focused on examining the potential impacts and policy, planning and management implications of climate change for Ontario's biodiversity, protected natural areas and other natural assets (e.g., forests) and, ultimately, works towards strengthening Ontario Parks' and the broader MNR's ongoing climate change adaptation process (discussed in more detail in Chapter 5).

4.2 Ontario Parks' Protected Natural Areas and Institutional Context

Ontario is home to over 25,000 species of plants and animals (including invertebrates) located over 1.1 million square kilometers, 250,000 inland lakes, the Great Lakes and countless watersheds (NHIC, 2007). Ontario is also home to nearly 50% of Canada's rare/endangered species, 40% of which are located in Ecological Site Region 7E (Carolinian Canada) (Lussier *et al.,* 2000). The institutional environment in which protected natural areas and biodiversity conservation is embedded in Ontario is hierarchical and strongly compartmentalized. Playing significant roles are two federal departments (i.e., Parks Canada, Environment Canada), a provincial ministry [Ontario Parks, a branch of the Ontario Ministry of Natural Resources (MNR)], watershed management agencies (i.e., Ontario's 36 Conservation Authorities), municipalities and a number of civic-oriented agencies and organizations (e.g., Nature Conservancy of Canada) operating at various, and sometimes overlapping ecological and jurisdictional scales.

In terms of total number of protected natural areas and total hectares (ha) protected, Ontario Parks is the most salient land manager (Figures 33 and 34). Ontario Parks' system of protected natural areas includes 331 provincial parks, 303 conservation reserves and 11 wilderness areas[51] (Figure 33). Ontario has at least 40 additional protected area designations on publicly and privately owned lands and waters (Gray *et al.,* 2007). These areas cover 9.5 million ha, approximately 9% of the province's land base and represent over 87% of Ontario's total protected area (in terms of total ha protected) (CCEA, 2007; Ontario Parks, in prep.). Ontario's provincial parks system attracts approximately 10 million visitors per year, with economic benefits extending far beyond park boundaries (Ontario Parks, 2005). The MNR estimates that provincial parks generate annual gross provincial economic impacts of $344.5 million[52] and provide 6,261 person-years of employment (Ontario Parks, 2005).

As explained in Chapter 2, Ontario Parks' protected natural area selection and planning process has focused on identifying areas that contribute to the 'representation' of the spectrum of the province's ecosystems and natural features, including both biological and geological. Ontario's approach to establishing a province-wide system of representative protected natural areas was introduced in the 1970s. The establishment of protected natural areas has been impressive over the past 20 years. The *Keep it Wild* campaign of the early 1990s dedicated more than 60 new areas and 900,000 ha to the province's protected natural area system, and established conservation reserves under the *Public Lands Act* (Government of Ontario, 1990). In the late 1990s, the MNR adopted the *Nature's Best Action Plan* (MNR, 1997), a policy framework aimed at completing Ontario's system of protected natural areas designed to 'represent the full diversity' of the province's natural features.

Ontario's most recent major land-use planning process, *Ontario's Living Legacy* (MNR, 1999), resulted in the rapid establishment or expansion of 370 provincial parks and conservation reserves and contributed substantially to Ontario Parks' goal of representing the full diversity of the province's natural diversity. More recently, the new *Provincial Parks and Conservation Reserves Act* (*PPCRA*) (Government of Ontario, 2007b) reiterated that the representation principle shall be used as the primary criteria in the selection of new provincial parks and conservation reserves.

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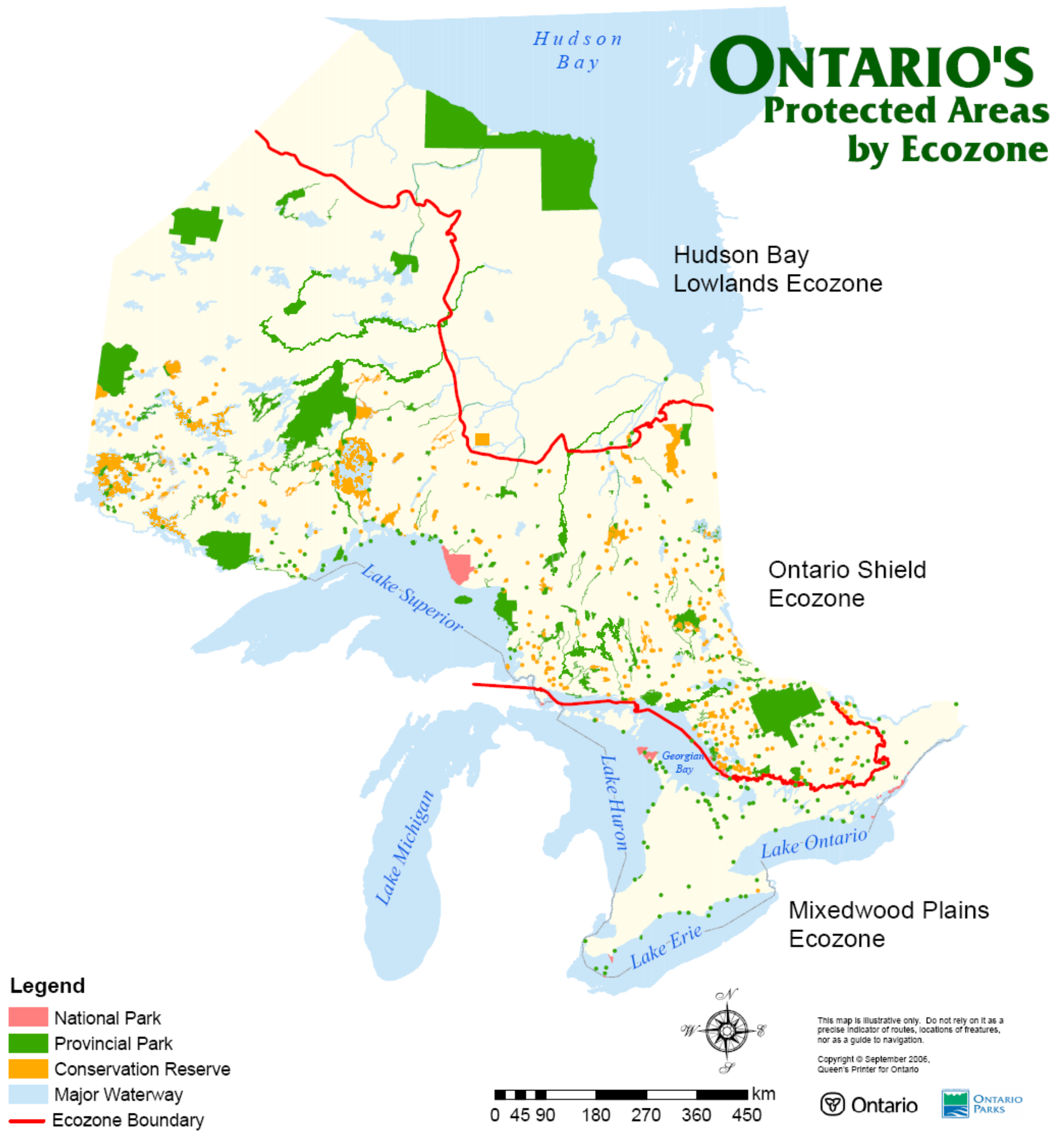
51 Another 22 wilderness areas are located within provincial parks and conservation reserves.

52 Represents the Value Added total. Value added is a measure of net output. It avoids double counting of products sold during the accounting period by including only final goods. It is equal to income (GPI). Added Value may be calculated by adding wages, interest, rent and profits. Alternatively, it is equal to revenues minus the total cost of purchased inputs (Ontario Parks, 2005).

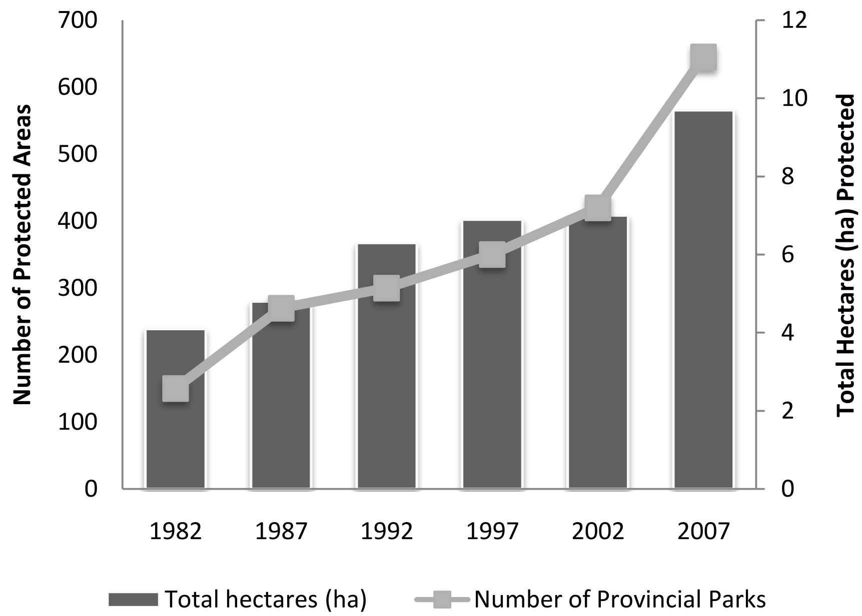
Furthermore, the *PPCRA* emphasizes that attempts will be made to ensure the permanent representation of these valued elements.[53]

Figure 33 Ontario's system of provincial parks, conservation reserves and wilderness areas. Source: Ontario Parks (in prep).



[53] Specifically, the *PPCRA* states that the objective of provincial parks and conservation reserves is: *"To <u>permanently</u> protect representative ecosystems, biodiversity and provincially significant elements of Ontario's natural and cultural heritage and to manage these areas to ensure that ecological integrity is maintained."* (emphasis added) (Government of Ontario, 2007a: c. 12, s. 1)

Figure 34 Total number and area (million ha) of protected natural areas in Ontario over the past 25 years. Source: Ontario Parks (in prep.)



Despite these initiatives, many natural features in each of Ontario's three ecozones remain under-represented or unrepresented entirely in regulated protected natural areas (Ontario Parks, in prep.) (Table 20). For example, lack of systematic conservation planning in the Hudson Bay Lowlands Ecozone has left ecological features in at least three ecodistricts almost entirely unrepresented (Ontario Parks, in prep.). The most commonly under-represented features in the Ontario Shield Ecozone include relatively rare landform/vegetation associations, some forest types with high commercial values, and certain landform features (Ontario Parks, in prep.). Finally, most of the land in the Mixedwood Plains Ecozone is privately owned and is therefore not eligible for regulation as provincial protected areas, leaving nearly all natural features in this ecozone under-represented in regulated protected areas (Ontario Parks, in prep.).

Ontario Parks' and the broader MNR's parks- and biodiversity-related responsibilities have increased dramatically over the past 25 years as a result of the unprecedented increase in both the number and total area of the protected natural areas system under their jurisdiction[54], as well as a

[54] When the *Provincial Parks Act* was introduced in 1954, there were only eight provincial parks established in Ontario.

result of its expanded duties under a number of recent initiatives, including *Ontario's Living Legacy Land Use Strategy* (MNR, 1999), the province's new *Biodiversity Strategy* (MNR, 2005c), the *Great Lakes Conservation Blueprint for Biodiversity* (e.g., Hensen *et al.,* 2005), and the new *Provincial Parks and Conservation Reserves Act*[55] (Government of Ontario, 2007b) and *Endangered Species Act*[56] (*ESA*) (Government of Ontario, 2007c). Of these initiatives, only one acknowledges climate change (*Biodiversity Strategy*) but fails address how climate change will be mainstreamed into program areas (e.g., research, monitoring and reporting) that pertain to biodiversity conservation (such as protected natural areas).

Table 20 Ontario provincial park class targets and status. Source: Ontario Parks (in prep.).

PROVINCIAL PARK CLASS	CLASS TARGETS	CLASS TARGET STATUS
Wilderness	• One park of at least 50,000 ha per ecoregion • One additional wilderness zone of at least 2,000 ha within another class of park per ecoregion	• Nine of fourteen ecoregions (64%) contain wilderness class parks • Five ecoregions lack wilderness class parks and fall below minimum size guidelines • Five of fourteen ecoregions (36%) contain an additional wilderness zone within another park class
Natural Environment	• One natural environment class park of at least 2,000 per ecodistrict	• 32 of 71 ecodistricts (45%) contain at least one natural environment class park that meets the 2,000 ha minimum size guideline
Waterway	• One waterway class park per district, with boundaries at least 200 m inland	• 38 of 71 ecodistricts (54%) contain waterway class parks that meet the minimum length criterion

While Ontario Parks and the broader MNR are to be commended for the rapid creation of new protected natural areas since the mid 1990s, there is increasing concern that it will be extremely difficult for the MNR to adequately administer and enforce the more scientific mandate and more rigorous requirements inscribed within the new *PPCRA* (i.e., the new commitments to maintain ecological integrity[57]) (ECO, 2007). As noted in the previous Chapter, the MNR's operating

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[55] The *Provincial Parks and Conservation Reserves Act* (*PPCRA*) came into force September 4, 2007.

[56] The *Endangered Species Act* (*ESA*) received Royal Assent in May, 2007 and is the first update in over 35 years.

[57] The concept of ecological integrity is central to the *PPCRA*. The planning and management principle associated with the *PPCRA* indicates that: *"Maintenance of ecological integrity shall be the first priority and the restoration of ecological integrity shall be considered."* The *PPCRA* provides the following definition of ecological integrity: *"Ecological integrity refers to a condition in which biotic and abiotic components of ecosystems and the composition and abundance of native species and biological communities are*

budget[58] between 1992/1993 and 2004/2005 decreased 35% (ECO, 2007) (Figure 36) which has had a relatively direct effect on staffing levels[59] and forced the de-regulation of 15 protected natural areas (ECO, 2007; MNR, 1996).[60] While a Special Purpose Account (SPA) was established for retaining park revenues, such as park user fees, this did not compensate for the cuts occurring throughout the decade (ECO, 2007). Moreover, while the MNR's budget declined 35% between 1992/1993 and 2004/2005, the number of provincial parks and conservation reserves increased by 138% and the amount of land in the protected natural areas system has increased by 51%.

As a result of the MNR's declining budget, the Environmental Commissioner of Ontario (ECO) (ECO, 2007) and the Auditor General of Ontario (AGO) (AGO, 2002; 2004) have both raised concerns that the Ontario Parks branch of MNR does not have sufficient resources (i.e., capacity) to properly fulfill its mandates, which are diversifying and growing in complexity. The reduction in staffing levels has resulted in inadequate capacity in the areas of management planning, enforcement, ecological monitoring and staff expertise (AGO, 2002; ECO, 2007). For example, while more than 80 mammalian species are found in Ontario, populations of less than 10% of the species are currently being inventoried (ECO, 2007). Consequently, there is a growing concern that the MNR has limited capacity to inventory and monitor even the 'high priority' species such as moose, black bear and white-tailed deer, let alone species-at-risk (ECO, 2007). In fact, of the 29 species deemed by the *Ontario Species at Risk Act* to be 'at risk', only five have recovery plans in place. Alarmingly, three species that did not have recovery plans in place are no longer found in Ontario (ECO, 2007). The cumulative effects of budget government cutbacks within each of Ontario Parks' major policy, planning and management program areas are outlined in Table 21.

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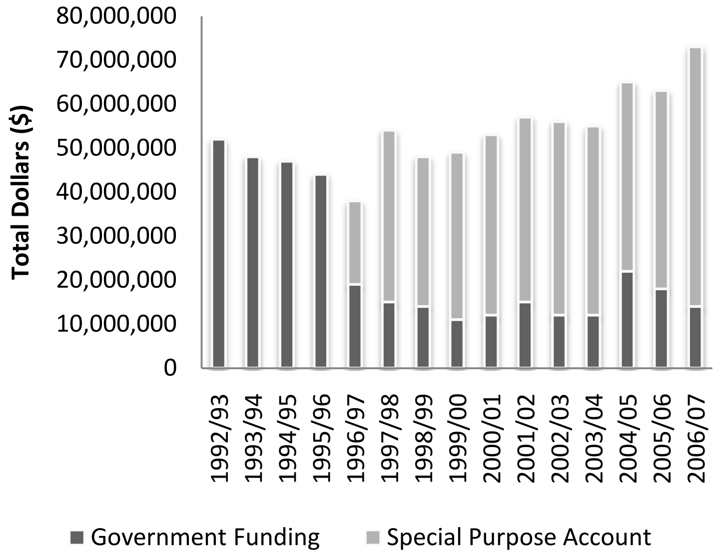
characteristic for their natural regions and rates of change and ecosystem processes are unimpeded." Government of Ontario, 2007a: c. 12, s. 1)

58 Currently, the MNR budget represents 0.73% of the total provincial budget (ECO, 2007).

59 MNR's staffing level has fallen since 1992/1993, but has remained almost constant since 1997/1998 at about 3,500 full-time equivalent positions. In 1992/1993 the MNR had approximately 5,500 full-time equivalent positions (ECO, 2007).

60 The total estimated savings by de-regulating these parks was estimated to (only) be approximately $515,000 in 1996 (MNR, 1996).

Figure 35 Trend in government and Special Purpose Account (SPA) funding for Ontario Parks (1992-2007). Source: ECO (2007).



MNR's limited budget for acquiring properties of high ecological significance has remained virtually frozen for the past decade, in spite of land values in Southern Ontario increasing dramatically (ECO, 2007; AGO, 2004). The province has also recently withdrawn from ecological restoration activities despite being involved in such activities in concert with municipalities and conservation authorities for over 75 years (ECO, 2007). The withdrawal from such activities has eliminated one of the few levers available for encouraging reforestation in southern Ontario (ECO, 2007).

Overall, the net effect of government policies and budget priorities over the last 15 years has limited the capacity of the Ontario Parks and the broader MNR to undertake their basic functions in a timely, effective and comprehensive manner (AGO, 2002) without considering the impact of climate change. Consequently, Ontario Parks and the broader MNR have had to reprioritize and find alternative strategies to deliver programs and activities (ECO, 2007). In a number of cases, especially with regard to climate change, the agency has established strategic relationships with 'third parties' (e.g., ENGOs and universities) to carry out research and other activities formerly done by Ministry staff. This has been done in order to offset internal capacity deficiencies (ECO, 2007). Collectively, it could be argued that Ontario Parks and the broader MNR's limited budget has increased its exposure to climate change impacts and diluted their capacity to adapt.

Table 21 The cumulative effects of budget cutbacks on Ontario Parks' policy, planning and management program areas.*

MAJOR POLICY, PLANNING AND MANAGEMENT PROGRAM AREA					
POLICY, PLANNING & MANAGEMENT (PSPL)	MANAGEMENT DIRECTION (MD)	OPERATIONS & DEVELOPMENT (OD)	RESEARCH, MONITORING & REPORTING (RMR)	CORPORATE CULTURE & FUNCTION (CCF)	EDUCATION, INTERPRETATION & OUTREACH (EIO)
Non-compliance with the legislation and policies designed to ensure the sustainable use and development of park resources. Reduced budget for land acquisition.	Reduction in management capacity and planning, only 40% of provincial parks currently have an approved management plan (which states how resources will be protected and will happen inside a park over a 20-year period) and 72% of those plans are at least 10 years old; only 19% of non-operating parks have approved management plans. Withdrawal from ecological restoration activities.	Staff reductions, most parks have no resident staff for most of the year. Customer service standards are declining for Ontario Parks' Computer Reservation and Registration Accounting System.	Reduced ecological monitoring, inventorying and research capacity: of the 29 species deemed by regulation to be at risk by the Province, only five had recovery plans in place; three species that did not have recovery plans in place can no longer be found in Ontario. Reliance on the revenue generation from hunters and anglers, park user-fees, and on partnerships to support existing inventory, monitoring, assessment and reporting activities. Lack of adequate procedures in place to measure and report on the effectiveness of the parks program.	Lack of staff expertise: few parks have professionally trained natural resource managers.	Reliance on volunteers for park operation, 'Friends of the Park' organizations provide essential services, such as paying for staff positions to provide natural heritage education programs.

**Interpreted from AGO (2002) and ECO (2007).*

4.3 The Need for a Climate Change Adaptation Strategy Specific to Protected Natural Areas

In the face of rapid population growth, land-use change, natural resource extraction and other human incursions on the natural environment, protected natural area stakeholders in the province are already concerned about biodiversity loss, irrespective of current and future anticipated climate change impacts. However, since public institutions are expected to serve the needs of civil society it is therefore important that institutions develop their capacity to identify and implement climate change adaptation options in an efficient manner. They must also be held accountable through reporting on the effectiveness of their decisions. Indeed, as the recent Report of the Commissioner of the Environment and Sustainable Development to the House of Commons concluded, *"Effective governance and accountability are fundamental in all policy areas and are especially crucial elements of complex, horizontal, long-term files like climate change."* (Office of the Auditor General of Canada, 2006: 15)

Brooks *et al.* (2005) found government effectiveness to be the most important indicator of vulnerability and adaptive capacity. As climate change exceeds critical thresholds, a *laissez-faire* approach to climate change adaptation may push institutional systems to a state which may require more resources for rehabilitation than needed presently. Accordingly, the adaptive capacity and overall effectiveness of public institutions will be reflective of their ability to anticipate problems (i.e., reduce vulnerability) and to manage risk and challenges in a way that balances social, economic and natural interests (Diaz and Gauthier, 2005). The literature review presented in Chapter 2 clearly made the *a priori* argument that early planned adaptation, facing a wider choice of feasible options, will be more flexible and cost effective than late reactive measures (Crabbé and Robin, 2005).[61] Consequently, political leaders and environmental managers must learn and adapt to new information and changing conditions when faced with complex and evolving problems (Thompson *et al.,* 2006).

Climate change will affect Ontario Parks' and the broader MNR's ability to deliver their various protected natural area- and biodiversity-related mandates, such as the perpetual protection of representative elements of Ontario's natural heritage. As a result, Ontario Parks will need to

[61] However, it is acknowledged that an enhanced ability to deal with unexpected climate change events, which will inherently require reactive responses, is also necessary for effective adaptation.

enhance its ability to cope with unanticipated and undesirable events associated with climate change and begin strategically integrating climate change into its major policy, planning and management program areas. The remainder of this Chapter identifies Ontario Parks' actions-to-date on climate change and uses a policy Delphi methodology to identify and evaluate climate change adaptation options within Ontario Parks' major program areas. The goal of this work is to establish a strategic starting point (or foundation) upon which mainstreaming climate change into Ontario Parks' relevant program areas can develop.

4.4 Ontario Parks' Actions-to-Date on Climate Change

The first step of the research was to identify Ontario Parks' and the broader MNR's current adaptation actions, strategies and policies already in place to address current climate related risks [referred to as 'preparatory adaptation research', see UNEP (2008)]. A survey aimed at identifying adaptive actions within each of Ontario Parks' major program areas was administered in September 2007 and completed by managers within each of Ontario Parks' seven administrative zones (i.e., Head Office, Northeast, Northwest, Southeast, Southwest, Central and Algonquin).

The survey revealed that a number of adaptive actions have occurred already at various jurisdictional and geographical scales (Table 22). At the 'corporate' level, adaptations have tended to concentrate on scenario formulation, risk and vulnerability assessments, capacity building and awareness campaigns. The MNR's *Climate Change Program* has played an important supporting function by means of research, information dissemination, public education and the provision of financial or other incentives for workshops and conferences. In just over two years, the Program has published nine *Climate Change Research Reports* (Wotton *et al.,* 2005; Boivin *et al.,* 2005; Colombo *et al.,* 2005; Hunt and Moore, 2006; Colombo *et al.,* 2007; Lemieux *et al.,* 2007; Carter *et al.,* 2007; Brown and Hunt, 2007) and six *Climate Change Information Notes* (Warner *et al.,* 2004; Colombo, 2006; Obbard *et al.,* 2006; Jackson, 2007; Bird and Boysen, 2007; Colombo *et al.,* 2006).

A scoping report examining potential impacts and implications of climate change for Ontario Parks' policy, planning and management frameworks was completed in 2007 (Lemieux *et al.,* 2007). Managers, planners and decision-makers from head office have participated in several capacity building initiatives as well, such as the Parks Research Forum of Ontario's (PRFO) *State of the Art Workshop on Climate Change and Protected Areas* (Beveridge *et al.,* 2005). The aim of this Workshop was to help foster climate change understanding and define critical impacts and adaptation issues in the sector. While these reports and capacity building initiatives have addressed the potential impacts and critical issues relevant to Ontario Parks and the broader MNR, none has addressed the adaptation issue specifically.

Within respective park regions, adaptations have often been localized, disjointed and incremental, *a posteriori* and many fall under the realm of 'mitigation' [i.e., focused on reducing greenhouse gas emissions (GHG)]. Examples of adaptations to Operations & Development include increased operations in the fall to accommodate increased visitation, alternative vehicle solutions, energy conservation initiatives and building retrofitting focused on reducing GHG emissions and reducing energy costs. There also has been increased monitoring of climate change-related impacts – four regions are now specifically monitoring for region- or park-specific climate change impacts (Northeast, Northwest, Central and Algonquin) and two provincial parks (Algonquin and Rondeau) recently have installed weather stations for climate monitoring purposes.

Taken collectively, however, very little has occurred in the area of autonomous (planned), proactive and strategic climate change adaptation in the major policy, planning and management program areas specific to Ontario Parks. There is an evident lack of strategic response in the Policy, System Planning & Legislation and Management Direction program areas. Only one provincial park has integrated climate change into its (draft) management plan (Charleston Lake Provincial Park, Eastern Zone) and no strategy (or action plan) specific to Ontario Parks has been developed to help guide decision-making at the zone or park levels. This lack of response in most of the policy, planning and management program areas gives the impression that Ontario Parks may be unprepared to deal effectively with the more widespread and complex impacts that are anticipated under future climate change. This impression is further substantiated through feedback from zone managers who specifically attributed the lack of integration of climate change into their major policy, planning and management program areas as being a consequence of *"lack of direction"* from head office (e.g., Mosley, 2007).

Table 22 Ontario Parks' actions to-date on climate change (by park zone and major program area).

	Major Policy, Planning and Management Program Area				
Provincial Level/ Park Zone	**Policy, System Planning & Legislation (PSPL)**	**Management Direction (MD)**	**Operations & Development (OD)**	**Research, Monitoring & Reporting (RMR)**	**Corporate Culture & Function (CCF) & Education, Interpretation & Outreach**
MNR & Ontario Parks (Provincial Level)	MNR has official *Strategic Approach*[1] (2005) and *Action Plan*[2] on climate change (2005). Climate change is not incorporated into official park planning and management policies. Some recognition for 'ecological change' but no specific mention of climate change in *Provincial Parks and Conservation Reserves Act* (Bill 11). No overall strategy on climate change at the system or park level. No climate change *Guidebook* or *Strategic Recommendations* for protected area managers.	Climate change has not been specifically addressed in protected area management plans or strategies (e.g., fire, invasive species, environmental assessment, etc.) to date. However, climate change is acknowledged as a potential stressor in one draft management plan.	**No actions-to-date.**	MNR – has sponsored 183 publications, reports and posters related to climate change (as of 2007).[3] 2003 – no studies on climate change and parks. 2007 – seven studies on climate change and parks including a provincial impacts assessment *Climate Change and Ontario's Provincial Parks: Towards An Adaptation Strategy* (CCRR-06).[4] No official monitoring strategy, but climate change considerations are beginning to be incorporated into some park monitoring strategies.	Recently active in climate change dialogue and capacity building initiatives. Several supported conferences & workshops on climate change (e.g., PRFO, 2005 proceedings available).[5] MNR *Hop-to-It* educational program. Incorporated into natural heritage education programming in a number of parks beginning 2007.
Eastern Zone	**No actions-to-date.**	Climate change considerations are proposed to be incorporated into Charleston Lake PP management plan.	Increased operations in fall to accommodate increased visitation (Charleston Lake). Alternative vehicle solutions (land-based and	**No actions-to-date.**	2005 *Background Information for Frontenac* includes note on climate change impacts and importance of monitoring.

Provincial Level/ Park Zone	Major Policy, Planning and Management Program Area Policy, System Planning & Legislation (PSPL)	Management Direction (MD)	Operations & Development (OD)	Research, Monitoring & Reporting (RMR)	Corporate Culture & Function (CCF) & Education, Interpretation & Outreach
			freshwater): cars, snowmobiles, bicycles – reduced emissions (Emily, Charleston Lake, Frontenac).		
Southwestern Zone	**No actions-to-date.**	**No actions-to-date.**	Alternative vehicle solutions – reduced emissions. Alternative energy solutions.	Weather station installed to monitor climate conditions	*Park Once Challenge* (2005) which encourages campers to park once during their visit.
Northeastern Zone	**No actions-to-date.**	**No actions-to-date.**	Alternative vehicle solutions – reduced emissions. Energy conservation solutions (e.g., Green Buildings). Retrofitting of buildings for better insulation.	Supported University of Minnesota research project on Climate Change monitoring. Use of water temperature loggers in several lakes in Quetico. Long-term fire modelling project with the Nature Conservancy of Minnesota which includes a climate change component. Production of research strategies that promote climate change research.	**No actions-to-date.**
Northwestern Zone	**No actions-to-date.**	**No actions-to-date.**	**No actions-to-date.**	Plans to begin stratified temperature readings throughout the park and water level and flow monitoring.	Workshop on climate change in the Northwest Region (Quetico Centre, 2004) which produced a list of 77 recommendations related to climate change (available as a

PROVINCIAL LEVEL/ PARK ZONE	MAJOR POLICY, PLANNING AND MANAGEMENT PROGRAM AREA POLICY, SYSTEM PLANNING & LEGISLATION (PSPL)	MANAGEMENT DIRECTION (MD)	OPERATIONS & DEVELOPMENT (OD)	RESEARCH, MONITORING & REPORTING (RMR)	CORPORATE CULTURE & FUNCTION (CCF) & EDUCATION, INTERPRETATION & OUTREACH
					technical report).[6]
CENTRAL ZONE	**No actions-to-date.**	**No actions-to-date.**	Alternative vehicle solutions – reduced emissions.	Preparing draft monitoring strategy which will include section on climate change.	*Park Once Challenge* (2005) which encourages campers to park once during their visit.
ALGONQUIN ZONE	**No actions-to-date.**	**No actions-to-date.**	Many operations specific solutions (vehicle, buildings – thermal energy, Green Roof, etc.). Participated in the *One-Tonne Challenge*.	Weather stations have been installed at Lake of Two Rivers, the East Gate, and at Kioshkokwi Lake on the Amable du Fond.	**No actions-to-date.**

(1) Ontario Ministry of Natural Resources (MNR). 2003. *Climate Change and the Ministry of Natural Resources: A Strategic Approach.* Ontario Ministry of Natural Resources Climate Change Program: Peterborough, Ontario.
(2) Ontario Ministry of Natural Resources (MNR). 2004. *Climate Change and MNR: A (Draft) Strategy and Action Plan.* Ontario Ministry of Natural Resources Climate Change Program: Peterborough, Ontario.
(3) Ontario Ministry of Natural Resources (MNR). 2005. *Climate Change Publications, Reports, and Posters Sponsored by MNR and/or Involving MNR Staff.* Ontario Ministry of Natural Resources Climate Change Program: Peterborough, Ontario.
(4) Lemieux, C.J., D.J. Scott, P.A. Gray and R.D. Davis. 2007. *Climate Change and Ontario's Provincial Parks: A Scoping Report.* Ontario Ministry of Natural Resources Climate Change Program: Peterborough, Ontario.
(5) Beveridge, M., J.G. Nelson and S. Janetos. 2005. *Climate Change and Ontario's Parks.* State of the Art Workshop Series #1. Parks Research Forum of Ontario (PRFO), University of Waterloo: Waterloo, Ontario. 88 pp.
(6) Racey, G.D. 2005. *Preparing for Change: Climate Change and Resource Management in the Northwest Region.* NWSI Technical Workshop Report TWR-04. Ontario Ministry of Natural Resources, Northwest Science and Information. Queen's Printer for Ontario: Thunder Bay, Ontario.

Creating an efficient, effective, comprehensive and integrative climate change strategy is much more challenging than implementing *a posteriori, ad-hoc* and generally disjointed and localized adaptations (such as those noted in Table 22). The next section of this dissertation uses a policy Delphi methodology in order to identify and evaluate climate change adaptation options within Ontario Parks' major program areas. The purpose of the section is to provide Ontario Parks with a range of options for consideration from which further dialogue may develop. Such research is seen as a necessary precursor of and important foundation to the development of a comprehensive, strategic and integrative climate change adaptation strategy specific to protected natural areas.

4.5 A Methodology for Identifying and Evaluating Climate Change Adaptation Options for Ontario Parks' Major Policy, Planning and Management Program Areas

As the reviews in Chapter 2 revealed, studies on climate change adaptation in the protected natural areas sector have commonly assumed that all of the hypothetically available adaptation options should be adopted by protected natural areas policy- and decision-makers without direct investigation into their desirability or feasibility by those actually responsible for the planning and management of protected natural areas. The literature also has paid scant attention to the policy context of adaptation or to the key actors or stakeholders involved (Burton *et al.,* 2002). Despite the several impediments associated with anticipatory and proactive adaptation, such as uncertainties about the timing and magnitude of ecological impacts and how institutions will adapt to climate change (i.e., what resources will be made available in the future), the literature overwhelmingly suggests that adapting now will be more advantageous than adapting later (i.e., more cost-effective, prevention of irreversible impacts such as species extinction, etc., see Chapter 2). Furthermore, as the empirical *Protected Area and Climate Change (PACC) Survey* presented in Chapter 3 revealed, protected natural area agencies are motivated to move forward on the climate change issue, but are uncertain as to how to do so effectively and efficiently.

This section uses a policy Delphi methodology to help identify and evaluate systematically climate change adaptation options for Ontario Parks' major policy, planning and management program areas. This policy Delphi was executed by University of Waterloo and Ontario Parks throughout 2006 and 2007 to generate climate change adaptation options from an expert protected natural areas panel (i.e., academics, practitioners and other stakeholders). Such an analysis fits into what Burton *et al.* (2002) characterize as *Type 2*[62] adaptation research, which contributes directly to adaptation policy development by identifying which adaptation policies are needed and how they can be developed and applied.

The specific objectives of this research are to: (i) identify a range of climate change adaptation options pertaining to Ontario Parks' major policy, planning and management program areas from a panel of protected natural areas experts; and (ii) seek out information which may generate points of agreement and disagreement of judgment on the part of the panel. Secondary objectives of this research are to: (i) explore or expose some of the underlying assumptions or information leading to differing judgments (including rationale that explains adaptation enabling mechanisms and adaptation barriers and constraints); and (ii) educate the respondent group as to the diverse and complex aspects associated with climate change, protected natural areas and adaptation. As Burton *et al.* (2002) emphasized *"The purpose of policy-related research for adaptation to climate change, as for other policy domains, is not to decide or to advocate policy, but to provide the policy-makers with policy choices, an analysis of the rationale of alternative policy choices, and additional information upon which they can base their judgments."* (156) Taking this into consideration, the objectives of the research deal less with decision-making per-se, and focus more on decision-facilitation. Further, the study primarily deals with planned, anticipatory adaptation and deals less with reactive adaptation where options are much more restricted (Burton *et al.,* 2002).

4.4.1 The Policy Delphi Approach: an Overview

In its broadest sense, a policy Delphi is a group-oriented 'idea generating strategy' (IGS) (de Loë, 1995) which *"seeks to generate the strongest possible opposing views on the potential resolutions of a major policy issue"* (Turoff, 1975: 84). The approach permits a diverse group of people, selected for their expertise, to interact anonymously on a defined policy issue and provides a constructive forum and an organized method for correlating views and information pertaining to a specific policy issue. It also allows the respondents representing such views and information the opportunity to react to and assess differing judgments (Turoff, 1970; Rayens and Hahn, 2000). As de Loë and Wojtanowski

[62] 'Type 1' adaptation research is carried out as part of a climate impact assessment by providing aggregate estimates to what extent feasible adaptation might reduce adverse impacts of climate change. Type 1 studies have often assumed that adaptation responses are known, whereas in fact this is often not the case (Burton *et al.,* 2002).

(2001) emphasized, unlike the conventional Delphi, which explicitly seeks to create a consensus, a policy Delphi aims to uncover and explore both consensus and disagreement surrounding policy issues. Therefore, consensus may be only one desired outcome of the policy Delphi process (Lindstone and Turoff, 2002).

There are many possible designs to a policy Delphi (Turoff, 1970 and 1975; Lindstone and Turoff, 2002). However, some common characteristics of the approach are fundamental to its application. First, a policy Delphi is a multi-stage process characterized by at least two rounds. de Loë (1995) suggested that the first round of policy Delphi should present respondents with policy issues and elicit their opinions on these issues. After responses from the first round are collated, a second round survey is administered which focuses on evaluating the opinions provided by respondents in the first round. Considering Turoff's (1975: 87) statement that the objectives of a policy Delphi are *"to ensure that all possible options have been put on the table for consideration, to estimate impact and consequences of any particular option, and to examine and estimate the acceptability of any particular option"*, all of the statements (or recommendations in this case) generated in the first round should be reflected in the second round to ensure all opinions are given equal importance (i.e., regardless of the researcher's perceptions of the opinions).

Second, statements should be assessed utilizing at least two rating scales/evaluation criteria (i.e., desirability, feasibility, importance, etc.) (Turoff, 1970 and 1975; Lindstone and Turoff, 2002). Ideally, respondents should be asked to justify their ratings. The second round survey also provides respondents with the opportunity to reconsider their initial position on a particular policy issue in light of the views of other panelists. It could be the case that a respondent feels more strongly about their initial opinion after reviewing the perceived inferior opinions of others. Conversely, in the face of an opposing opinion or argument, a respondent may decide that the opinion of another respondent is superior to their own initial opinion. By quantitatively analyzing the group's responses, it is possible to determine 'points of agreement' or 'disagreement' on respective recommended adaptation options.

de Loë (1991) emphasized that the policy Delphi overcomes many of the limitations associated with other IGSs, such as workshops or brain-storming sessions. These limitations include the propensities for: (i) one or a few vocal individuals to dominate the discussion; (ii) people to remain silent, possibly due to shyness or fear of censure (i.e., participation in the policy Delphi is anonymous); and (iii) the 'rut effect' (i.e., participants getting hung-up on one thought and staying in that rut for the duration of the meeting) (Table 23). Turoff (1970: 152) similarly emphasized that *"In* *an atmosphere of budget cuts, belt tightening, and competition for limited funds, it may appear advantageous not to advocate, not be noticed, and especially not to be held accountable for views, promises, or positions which require effort to document or substantiate."* In this regard, the policy Delphi provides respondents with the opportunity to present innovative and sometimes controversial ideas anonymously to the panel without fear of repercussions (i.e., to either the panelist proposing the idea or to the panelist supporting it). This is particularly important in the area of climate change adaptation in the protected natural areas sector, as some adaptations proposed in the scientific literature (see Table 14 in Chapter 2) would require fundamental changes in the way protected natural areas agencies plan and manage lands and may be highly controversial within agencies. A general overview of the strengths and weaknesses associated with the policy Delphi approach are presented in Table 24.

Table 23 Comparison of interacting, nominal group and Delphi techniques in terms of technique characteristics. Source: Needham and de Loë (1990: 137).

			Delphi Techniques	
Characteristics	**Interacting Group Technique[1]**	**Nominal Group Technique[2]**	**Consensus[3]**	**Policy[4]**
Objectives	To examine & discuss issues. To attempt to arrive at a consensus.	To identify problems. To solve problems.	To derive a consensus on long-range forecasts and ambitions.	To produce critical debate about opposing options on a policy issue.
Procedures				
a. Format	Loosely structured meetings.	Tightly structured meetings.	Structured series of questionnaires and feedback reports.	
b. Final Response Interval	Variable, some control.	Variable, controlled.	Iteration variable; some control.	
c. Participant Commitment	Short time on site; variable time in transit.	Variable time on site; variable time in transit.	Participant decides based on the task at hand; participant centered.	
d. Administrator Commitment	Preparatory, operational and assessment phase demands are heavy and complex.	Preparatory, operational and assessment phase demands are heavy.	Preparatory phase is rigorous.	
Underlying Assumptions	Experts consulted may be decision makers, facilitators, or opinion leaders.	Experts consulted are often members of organization. Group makes the decision.	Experts consulted are the decision-makers. An information package forms the decision.	Experts consulted are decision facilitators. An information package forms one input into the decision-making process.
Questions Posed	Questions may be well- or ill-defined. Questions may	Questions have rigid parameters. Questions have a	Questions have well-defined parameters.	Questions may have specific parameters.

	have broad or narrow scope.	very limited scope.	Questions have narrow scope.	Questions may have specific scope.
PRODUCT	A list of informed opinions. A statement of informed consensus.	A best option or options' set.	An option, or specific range of options, with associated probabilities.	A list of the most relevant alternative potions and their rationales.
QUANTITY OF IDEAS	Low to medium; potential influence from the rut effect.	Medium to high; independent and directed group thinking.	High; due to independent, reflective thinking and iteration.	
QUALITY OF IDEAS	Low; low specificity forced generalization.	High; high specificity due to directed group thinking.	High; due to independent, reflective thinking and iteration.	
CLOSURE LEVELS	Low; lack of structure and control.	High; structured with a specific termination point.	High for the individual participant; independent, reflective thinking and iteration; participant centered. Variable for the Delphi administrators, as the process is participant centered.	

1=Discussion groups, workshops, brainstorming sessions; 2=Delbecq et al. (1975); 3=Conventional Delphi, where the object is consensus in expert opinion; 4=Turoff (1970, 1975) Policy Delphi when objective is divergence in expert opinion.

The policy Delphi is a cost-effective way to engage stakeholders who are geographically dispersed in dialogue on relevant policy issues (de Loë, 1995). It also allows the utilization of larger numbers of more participants than can be employed effectively by committee or workshop-style approaches. This advantage was especially important in this particular survey, given the broad geographic dispersal of Ontario Parks' staff, academics and other stakeholders. The approach also overcomes scheduling conflicts often associated with committee- or workshop-style approaches.

Despite its limited use[63], the policy Delphi approach has proved to be an effective stimulus for creative thinking and innovation. This approach lends itself to identifying solutions to complex policy problems characterized by significant uncertainty and with no historical precedent, such as climate change. Even given the uncertainties and weaknesses associated with the implementation of this technique, there is little controversy about its utility (Turoff, 1970; Turoff, 195; de Loë, 1995; de Loë and Wojtanowski, 2001). Overall, the policy Delphi was deemed an effective instrument for achieving the research goals. It has also recently been recommended by the United Nations

[63] As de Loë (1995) and de Loë and Wojtanowski (2001) noted, published examples of policy Delphi surveys have been few since Turoff (1970 and 1975) introduced the tool.

Development Program (UNDP) as a strategic approach in framing climate change policy issues and in formulating adaptation options (UNDP, 2004: 201).

Table 24 Strengths and weaknesses associated with the policy Delphi approach.

STRENGTHS	WEAKNESSES
• Panelists can think more deeply on the issue (i.e., stimulates creative thinking and innovation) and are provided with the opportunity to re-evaluate their initial positions • Participants are more likely to indulge in pre-emptive self-criticism and invoke more complex modes of research • Overcomes the limitations associated with committee or workshop processes, including: dominating personalities, taking positions that contradict individuals in higher positions (i.e., through anonymity); unwillingness to abandon a position; fear of bringing up/supporting an uncertain idea that might turn out to result in a loss of face • Cost effective way to engage stakeholders dispersed over large geographic regions (economic and efficient) • Can be implemented in a wide variety of ways (flexible) • Results can be used as the foundation for a workshop or committee involving a much smaller core group	• Significant use of time and human resources to prepare, complete and analyze (labour intensive for both the researcher and the respondent) • Limits discussion and favours voting/ranking workshops or brainstorming sessions • Use of group average (nomothetic) rather than individual (analysis)/i.e., averages • Pressure on consensus produces its own pressure for conformity • Lack of opportunity for spontaneous discussion that can occur at face-to-face • Evidence that participants are inconsistent when judging less predictable tasks • Overwhelming amounts of information can be produced • Depends on volunteer time which may result in non-substantive arguments/ideas (lack depth) • No quick results (due to dependence on volunteer time) • More rounds may be needed than initially anticipated to produce more significant results

Sources: Turoff (1970 and 1975); Ayton et al. (1999); Needham and de Loë (1990); de Loë (1991); de Loë (1995); de Loë and Wojtanowski, (2001).

4.5 Identifying and Evaluating Climate Change Adaptation Options: The Policy Delphi Process

4.5.1 Selection of Policy Delphi Panel

Adger and Vincent (2005) emphasized that expert judgment data is useful in identifying the most important indicators for climate change adaptation response through its inherent consideration of 'processes' and 'contexts'. The case study that is the focus of this chapter utilized protected natural areas experts (i.e., academics, practitioners and other stakeholders) across Ontario to help identify and evaluate climate change adaptation options within Ontario Parks' major policy, planning and management program areas. The selection of the expert panel was based on a number of recommendations from the extant literature. For instance, Smit *et al.* (2000) recommended that climate change adaptation analysis should: (i) address real local vulnerabilities (to ensure that stakeholders buy into the issue); (ii) involve real stakeholders early and substantively (to increase the likelihood that adaptation options are realistic and designed to be consistent with existing institutions and processes); and (iii) connect with decision-making processes (so that adaptation initiatives are developed relative to other conditions and have the best chance of actually being implemented). Turoff (1970: 155) also recommended that *"the use of a heterogeneous group is the best way to stimulate a systematic exploration of all the pros and cons on specific resolutions."*

Incorporating the recommendations of Adger and Vincent (2005), Turoff (1970 and 1975) and Smit *et al.* (2000), a draft list of diverse types of expertise desired for the panel was developed in consultation with Ontario Parks to identify individuals with geographical, professional and disciplinary representation and having varying degrees of institutional influence. Turoff (1970 and 1975) recommended that a minimum of 10 and a maximum of 50 participants be included in a policy Delphi exercise. This study attempted to achieve the higher range of Turoff's (1970 and 1975) recommendation given Rayens and Hahn's (2000) finding that as the complexity of a given policy issue increases, policy Delphi sample sizes need to be larger to better attempt to obtain a range of opinion. Diversity of participants was deemed beneficial since each stakeholder group identified different interests and varying perspectives regarding protected natural area issues (Figure 36).

To formulate recommendations workable within Ontario Parks' institutional context and processes, including decision-making, the largest proportion of surveys was sent to Ontario Parks and the broader MNR practitioners. Furthermore, to ensure that information elicited from panelists reflected regional vulnerabilities, an attempt was made to include panelists who had an area of expertise and/or practice protected natural areas planning and/or management within each of Ontario's diverse ecoregions (Figure 36). Specifically, it was ensured that: (i) Ontario Parks and the broader MNR's panelists represented head office and each of the Ontario Parks administrative zones (i.e., Northeast, Northwest, Algonquin, Central, Southeast and Southwest); (ii) federal government panelists represented head-office and Ontario field units; (iii) academic panelists represented universities across Ontario (e.g., University of Waterloo, Lakehead University, York University, etc.); and (iv) other stakeholders who serve important protected areas planning, management and/or research functions at the national (e.g., Canadian Council on Ecological Areas) and regional (e.g., Nature Conservancy of Canada) levels, were included in the survey. A total of 60 individuals were invited to participate in the first round of the survey. The breakdown of participants by affiliation is outlined in Table 25. 46 responses were received from the first round questionnaire representing a survey response rate (SRR) of 75.0%. 34 of the 46 panelists who completed the first round responses also completed the second round survey (SRR=75.5%).

Table 25 Major respondent groups, survey response rates and other information pertaining to the policy Delphi survey process.

RESPONDENT GROUP	ROUND 1 SENT	ROUND 1 RECEIVED & ROUND 2 SENT	RESPONSE TIME (# OF DAYS)	ROUND 2 RECEIVED	RESPONSE TIME (# OF DAYS)
ONTARIO PARKS/ MNR	36	25	Min= 14 Max= 83 Mean= 48.5	18	Min= 4 Max= 41 Mean= 19.3
FEDERAL GOVERNMENT	5	5	Min= 28 Max= 62 Mean= 55.2	4	Min= 11 Max= 44 Mean=17.6
ACADEMICS	9	8	Min= 18 Max= 60 Mean= 50.4	8*	Min= 12 Max= 111 Mean= 34.2
OTHER	10	7	Min= 26 Max= 62 Mean= 53.5	4	Min= 12 Max= 33 Mean= 25.3
TOTAL	**60**	**45 (SRR=75.0%)**	**Min= 14 Max= 83 Mean= 51.9**	**34 (SRR=75.5%)**	**Min= 4 Max= 111 Mean= 24.1**

**= one academic was unable to participate in the second iteration; however, an academic who was unable to participate in the first iteration participated in the second iteration.*

4.5.2 Policy Delphi Panel Characteristics

Turoff (1970) emphasized that the success of a policy Delphi is dependent upon the background of the respondent group. As noted previously, four major respondent groups were selected for the policy Delphi. These groups were Ontario Parks and the broader MNR staff, federal government staff, academics from universities across Ontario and other stakeholders with both national and/or regional expertise and/or experience (Figure 36).

Figure 36 Profile of the policy Delphi expert panel.

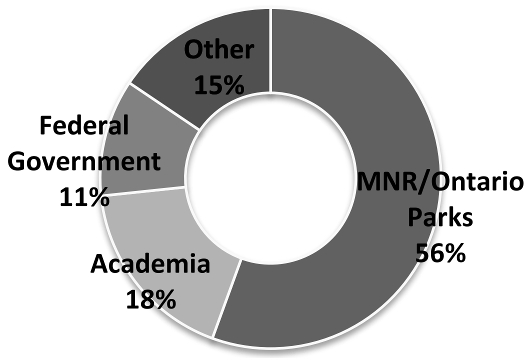


Figure 36.1: Number of panelists within each major respondent group.

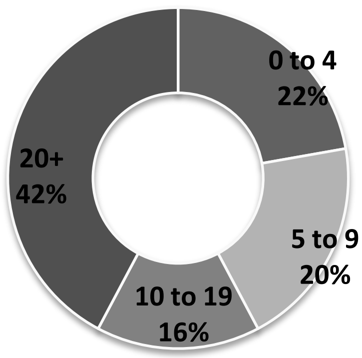


Figure 36.2: Years with current organization.

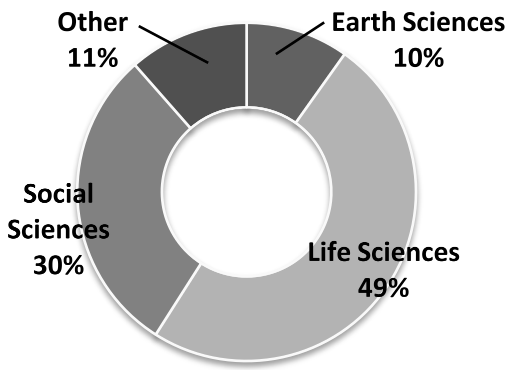


Figure 36.3: Educational background (panelists could select more than one option).

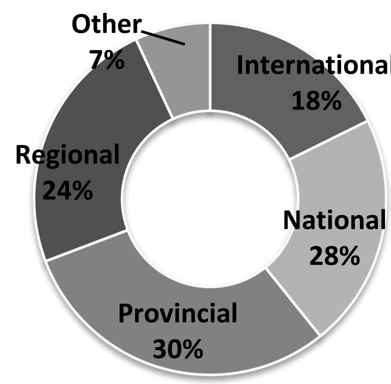


Figure 36.4: Geographical protected areas scale where knowledge and/or experience are concentrated (panelists could select more than one option).

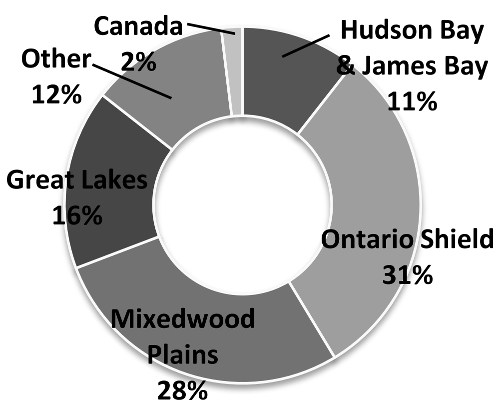


Figure 36.5: Geographical knowledge and/or experience within Ontario ecozones (panelists could select more than one option).

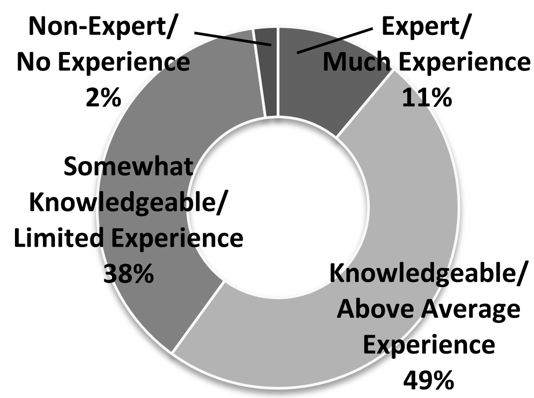


Figure 36.6: Perceived level of knowledge with respect to climate change.

The Ontario Parks and broader MNR respondent group comprised approximately 55% of the panel. Of the group, eight panelists were from head office, five were from the Northwest Zone, one was from the Northeast Zone, three were from the Algonquin Zone and two were from each of the Southwest, Southeast and Central Zones. Two other staff members came from the Operations and Development department within the MNR. The majority of panelists had been with their current organization for more than 20 years (42.2%); however, an equal percentage of the panel had been with their current organization for less than ten years (42.2%). The panel was well balanced with a proportional number of senior managers and coordinators and junior staff participating. While panelists' backgrounds were heavily skewed towards the 'life sciences', this was deemed satisfactory given Ontario Parks' emphasis on, and the primary role that protected natural areas play in, the conservation of biodiversity. Furthermore, the relatively high number of panelists with a 'social science' background (30.0%) provided balance and also addressed the recommendations of Lovejoy and Hannah (2005) and Heller and Zavaleta (in press) to better integrate social sciences into conservation and climate change adaptation-oriented research.

The geographical knowledge and experience related to protected natural areas policy, planning and management of panelists was well represented internationally, nationally, provincially and regionally. Over half of the respondents noted that the geographic protected areas scales in which their knowledge and experience are concentrated were at the international and national scales. Importantly, 86.7% of the respondents noted that their knowledge and experience was concentrated at the provincial protected natural areas scale. The respondent panel's geographical knowledge and experience across Ontario's ecozones was also well represented (Ontario Shield: 71.1%; Mixedwood Plains: 64.4%; Great Lakes: 37.7%). Overall, the inclusion of experts with geographical knowledge and experiences across geographical and jurisdictional scales overcomes one of the major limitations of the extant climate change adaptation literature, namely, the tendency to ignore cross-scale issues and scales relevant to decision-making (e.g., see Adger *et al.,* 2005).

Respondents were also asked to rate their level of knowledge with respect to climate change. Importantly, 60.0% of the panel perceived themselves as either 'expert' (i.e., high level of knowledge/much experience) (11.1%) or 'knowledgeable' (i.e., above average experience) with respect to climate change (49.9%). Additionally, 37.8% of panelists perceived themselves as 'somewhat knowledgeable' (i.e., limited experience). Only a single individual (2.2%) claimed to be a 'non-expert' (i.e., no experience). Consistent with the recommendations presented in Section 4.5, panelists were anonymous of each other throughout the entire policy Delphi process. Panelists never met face-to-face nor were their identities revealed to other panel members.

4.6 Round One: Identification of Climate Change Adaptation Options

The first round survey administered to respondents is perceived as the most important exercise in the policy Delphi process (Turoff, 1970 and 1975; Lindstone and Turoff, 2002). Because the first round survey is developed by the researcher from the literature and is the impetus for all remaining surveys in the process, it is critical that initial themes and questions reflect the key elements of the research topic (Franklin and Hart, 2007). The research partner (Ontario Parks) set one major condition that guided the initial questionnaire design: research design had to be undertaken through consultation with protected natural area practitioners and decision-makers. In this context, Turoff (1970 and 1975) and Lindstone and Turoff (2002) emphasized that the utility of the results of the policy Delphi process depends upon the close cooperation between researchers and the intended agency or at least a clear understanding by the researchers of the goals or requirements of the agency.

It was decided that the purpose of the first round policy Delphi survey would be to start the process of generating climate change adaptation options within each of Ontario Parks' major policy, planning and management program areas. The first draft of the survey, which contained a number of directed opinion-oriented questions, was reviewed several times and pre-tested by Ontario Parks representatives that were agency advisors to the project and then also by senior management. It was decided that a number of entirely open-ended questions would be used in the first-round Delphi survey to elicit climate change adaptation options from panelists. The first round survey was divided into six sections reflecting each of the following program areas:

- i) Policy, System Planning & Management (3 Questions);
- ii) Management Direction (1 Question);
- iii) Operations & Development (5 Questions);
- iv) Research, Monitoring & Reporting (2 Questions);
- v) Corporate Culture & Function (1 Question); and,
- vi) Education, Interpretation & Outreach (2 Questions).

The first round policy Delphi survey was administered to panelists via e-mail and hard-copy September 6, 2006 and contained a total of 14 questions (Table 26) (see also Appendix 2.5). The cover-letter forwarded to potential panelists introduced them to the research project, explained the need for and purpose of the research and emphasized the importance and necessity of their participation (Appendix 2.2). A letter of support from Ontario Parks' Manager of Planning and Research was included in the survey package further emphasizing the importance of participating in the research project and to encourage participation (Appendix 2.3). In light of the heterogeneity of respondents and their differing knowledge levels with regards to climate change, an educational climate change and protected natural areas 'background document' was included in the survey package (Appendix 2.4).

This document, *Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas: Background Document*, summarized the science of climate change (e.g., evidence of climate change and future climate change projections, including uncertainties associated with projections), the policy, planning and management implications of climate change for biodiversity and protected natural areas planning and management identified in the literature and calls in the scientific literature and conservation community for agencies to begin the adaptation process.[64] Panelists also received a comprehensive reference list, providing them the opportunity to seek out additional information on climate change-, protected natural areas- and biodiversity-related issues if they wanted to review this additional scientific literature before responding to the policy Delphi survey. Including such background documentation in the survey package adhered to Turoff's (1970 and 1975) and Lindstone and Turoff (2002) recommendations to ensure that panelists 'understand the issues'. It was also perceived by the researcher that including such information would help stimulate the generation of ideas. The background document was designed in a manner that ensured to the greatest extent possible that the policy issues presented were neither biased toward a particular viewpoint nor prompted predetermined decisions.

[64] The degree of influence of the background document on panelist's perceived level of knowledge with regards to climate change is not known (Figure 36.6). Approximately 70% of the MNR/Ontario Parks panelists participated in the 2005 Parks Research Forum of Ontario (PRFO) *State of the Art Workshop on Climate Change and Protected Areas* for protected areas managers and planners.

Table 26 Panellist questions used within each of Ontario Parks' major program areas to elicit climate change adaptation options from panellists.

POLICY, PLANNING AND MANAGEMENT PROGRAM AREA	QUESTION
POLICY, PLANNING AND LEGISLATION (PSPL)	1. What aspects of protected area *policies* (e.g., *Ontario Provincial Parks Planning and Management Policies*) may be need to be modified to address the impacts of climate change? 2. Given that protected areas *legislation* such as the *Provincial Parks and Conservation Reserves Act (2006)* and *the Canada National Parks Act (2000)* recognize ecological integrity as a guiding concept, how could climate change be integrated into their implementation? 3. What considerations could be factored into protected areas *system planning* with regard to climate change (i.e., what protected area selection and design principles could be incorporated into system planning to account for ecological change)?
MANAGEMENT DIRECTION (MD)	1. What are some specific considerations with regard to climate change that should be taken in account when preparing management direction for Ontario's protected areas (e.g., how would you integrate climate change into individual protected area management plans, and resource management plans such as forest fire management, prescribed burning, vegetation management, invasive species, species at risk, environmental assessment, protected area operations, visitor management, etc.)?
OPERATIONS & DEVELOPMENT (OD)	1. What would you suggest protected area agencies and organizations do 'in-house' to reduce greenhouse gas emissions (e.g., within buildings and offices, alternative vehicle solutions, energy conservation initiatives, etc.). 2. Given that lower water levels in the Great Lakes will likely result from climate change, what adaptations to operations and development would you suggest to address lower water levels in protected areas? 3. Given that climate change will likely increase the rates at which invasive species spread into Ontario's protected areas, what adaptations to operations and development would you suggest to help manage the impacts of new invasive species which migrate into protected area boundaries? 4. Given that climate change will likely change the habitat ranges of fish species, what adaptations to operations and development would you suggest to address changes in fish species distribution (e.g., the migration of warm water species into traditionally cool water species territory)? 5. Given that climate change is projected to expand warm-weather recreation seasons and threaten winter-recreation, what adaptations to visitor infrastructure and services would you suggest to reduce risks and take advantage of new opportunities?
RESEARCH, MONITORING & REPORTING (RMR)	1. What are the research and monitoring priorities with respect to climate change that could be integrated into current programs at the protected area level and the system level?

	2. What indicators should be monitored and reported upon in relation to climate change in protected areas?
CORPORATE CULTURE & FUNCTION (CCF)	1. Can you describe (a) the contents of an education program and (b) an approach for training that ensures climate change issues are addressed by people working in protected areas?
EDUCATION, INTERPRETATION & OUTREACH (EIO)	1. How could public interpretation, outreach, and education be enhanced with regard to climate change impacts and initiatives by protected areas agencies in Ontario? 2. How could conservation 'partner' awareness related to climate change impacts and adaptations be enhanced, and their cooperation and participation in climate change initiatives be fostered?
OTHER	1. Are there additional protected areas and climate change adaptation ideas or suggestions you wish to convey?

4.7 Round Two: Evaluation of Climate Change Adaptation Options

Smit *et al.* (1999) emphasized that the formulation and implementation of climate change adaptation measures and policies involve an additional analytical step as compared to the analysis of adaptation as part of impact assessment, namely an evaluation. As the author's stressed *"It is not sufficient to specify an adaptation and its likelihood; some judgment as to appropriateness, effectiveness or acceptability is also required in order to make recommendations as part of a response by governments."* (202) Evaluation of the adaptation options identified in the first round survey was the objective of the second round survey.

The second round survey was administered exclusively by email (Appendix 2.9) and, as previously noted, was completed by 33 panelists (representing a panelist drop-out rate of 24.5%). The greatest number of panelist drop-outs occurred within the Ontario Parks and broader MNR respondent group (8 panelists). However, the proportional representation between respondent groups remained nearly the same in the second round questionnaire as it was in the first round [i.e., the maximum proportional respondent group representation declined 5.6% (Ontario Parks and broader MNR) and increased 0.7% (federal government) within any one respondent group].

The second round survey asked panelists to review the list of adaptation options recommended by panelists in the first round and rate them for their perceived level of desirability, feasibility, and implementation time-frame. A Likert-type scale was used to provide expressions of judgment on each adaptation option. The respondents were asked to keep the qualifiers noted in Table 27 in mind when evaluating the adaptation options or when providing comments (i.e., rationale). This was considered important by the researcher in order to promote consistency and compatibility in responses.

Table 27 Rating scale and descriptions provided to policy Delphi panellists to aid in the assessment of climate change adaptation options. Adapted from: Turoff (1975).

DESIRABILITY (EFFECTIVENESS OR BENEFITS)	**Very Desirable**	**Desirable**	**Undesirable**	**Very Undesirable**
	Will have a positive effect and little or no negative effect Extremely beneficial Justifiable on its own merit	Will have a positive effect and little or no negative effect Beneficial Justifiable as a by-product or in conjunction with other items	Will have a negative effect Harmful May be justified only as a by - product of a very desirable item, not justified as a by-product of a desirable item	Will have a major negative effect Extremely harmful Not justifiable
FEASIBILITY (PRACTICALITY)	**Definitely Feasible**	**Possibly Feasible**	**Possibly Unfeasible**	**Definitely Unfeasible**
	No hindrance to implementation No R&D required No political roadblocks/barriers Acceptable to the public	Some indication this is implementable Some R&D still required Further consideration or preparation to be given to political or public reaction	Some indication this is unworkable Significant unanswered questions/barriers	All indications are negative Unworkable Cannot be implemented
IMPLEMENTATION TIME-FRAME (PRIORITY OR RELEVANCE)	**Short Term (0-9 years)**	**Medium Term (10-19 years)**	**Long Term (20+ years)**	**'Wait & See' (Reactive)**
	A most relevant point First-order priority Must be resolved, dealt with, or treated immediately	Is relevant to the issue Second-order priority Significant impact but response should be deferred until other items are treated Does not have to be fully resolved	Insignificantly relevant Third-order priority Has little importance Not a determining factor to major issue	Not a priority now Should be dropped as an item to consider for now Respond as impact(s)/issue(s) emerge 'on the ground'

Typically, policy Delphi response choices are often rated on a 4-point Likert-type scale (e.g., Very Desirable, Desirable, Undesirable and Very Undesirable) in order to elicit conflict and disagreement as well as to clarify opinions on policy issues; however, considering the relatively high complexity and uncertainty associated with the range of climate change-related impacts for biodiversity and protected natural areas, a 5-point Likert-type scale which provided a 'neutral' position was used in this analysis to avoid forcing panelists to take positions on issues with which they were not comfortable with or had a limited level of expertise or experience in. For Desirability, a rating of 1 indicated that the panelist felt the item was *Very Desirable* (*VD*) for Ontario Parks, while a rating of 4 indicated that the item was *Very Undesirable* (*VU*). A rating of 5 indicated that the respondent was *Not Sure* if the recommendation was desirable or undesirable. Similarly, a Feasibility rating of 1 indicated that the panelist perceived the recommendation to be *Definitely Feasible* (*DF*) to implement within Ontario Parks, while a rating of 4 indicated that the panelist's felt that the recommendation was *Definitely Unfeasible* (*DU*). A rating of 5 indicated that the respondent was *Not Sure* whether or not the recommendation was feasible or unfeasible. The rating scale for the Implementation Time-Frame varied from *Short-term* (*S*) (0-9 years), *Medium-term* (*M*) (10-19 years), *Long-term* (20+ years), *'Wait-and-See'* (*W&S*) (i.e., reactive response) and *Not Sure* (*NS*). In addition to ranking the statements, panelists were encouraged to provide comments (i.e., rationale, justification and/or clarity) on a given adaptation option.

4.8 Results and Discussion

4.8.1 Round One: Identification of Adaptation Options

The 45 panelists responding to the first round survey identified a broad range of climate change adaptation options within each of Ontario Parks' major program areas. Table 28 highlights the total number of adaptation options within each program area by respondent group. Collectively, 1,130 climate change adaptation options were identified and the ratio of 'number of climate change adaptation recommendations per-panelist' was found to vary marginally across respondent groups. Whereas the federal government respondent group provided the largest number of recommendations per-panelist (33.6), the academic respondent group provided the least number (20.8). However, the raw numbers do not reflect the quality or uniqueness of various recommended adaptation options. The largest respondent group, Ontario Parks and the broader MNR, provided 56.5% of all recommendations and had a recommendation per-panelist ratio of 25.5 which was almost equivalent to the overall per-panelist ratio of 25.1. Interestingly, the percentage of all adaptation options provided by the Ontario Parks and the broader MNR (56.5%) was nearly equivalent to their proportional representation within the expert panel (55.6%) (Figure 36.1).

The ratio of recommendations per panelist by major program area revealed that the greatest number of recommendations was provided within the Operations & Development (OD) (368) and Policy, System Planning & Legislation (PSPL) (272). Conversely, the least number of recommendations were provided within the Education, Interpretation & Outreach (EIO) (94) and Corporate Culture & Function (CCF) (84) program areas. More recommendations were provided within the OD and PSPL program areas simply due, for the most part, to the fact that more questions were asked within each of these areas.

Table 28 Aggregate number of recommended climate change adaptation options identified within Ontario Parks' major program area and by each respondent group.

RESPONDENT GROUP	ONTARIO PARKS MAJOR PROGRAM AREA							
	PSPL	MD	OD	RMR	CCF	EIO	TOTAL	AOPP[1]
MNR/Ontario Parks	133	63	214	107	66	55	**638**	**25.5:1**
Federal Government	41	20	50	39	10	8	**168**	**33.6:1**
Academics	47	15	54	27	3	20	**166**	**20.8:1**
Other (e.g., ENGOs)	51	11	50	30	5	11	**155**	**22.1:1**
TOTAL	**272**	**109**	**368**	**203**	**84**	**94**	**1,130**	**25.1:1**
AOPPA[2]	**6.0**	**2.4**	**8.2**	**4.5**	**1.9**	**2.1**		

PSPL=Policy, Planning & Legislation; MD=Management Direction; OD=Operations & Development; RMR=Research, Monitoring & Reporting; CCF=Corporate, Culture & Function; EIO=Education, Interpretation & Outreach; [1] *adaptation options per panelist;* [2]*=adaptation options per program area.*

The ratios revealed some capacity limitations in terms of the identification of climate change adaptation options by the panel. For example, nearly 80% of recommendations within the Corporate Culture & Function (CCF) program area came from the Ontario Parks and broader MNR panelists, even though questions were framed in such a way that ensured they were relevant to any institutional context. Moreover, half of the major program areas, including Management Direction (MD), Corporate Culture & Function (CCF) and Education, Interpretation & Outreach (EIO) comprised only 25.4% of all recommended adaptation options. As such, the Policy, Planning &

Legislation (PSPL), Operations & Development (OD), and Research, Monitoring & Reporting (RMR) program areas contained approximately 75% of all recommended adaptation options.

Recommendations ranged in length from brief sentences (i.e., via bulleted lists) to detailed arguments expressed in paragraphs. Recommendations also ranged from what some may consider obvious (especially considering the results found in Chapter 3) (e.g., PSPL 2: "*A strategic and corporate policy on climate change and protected areas is needed to provide sufficient direction for planning and management"*) to innovative (e.g., PSPL.36: "*The establishment of new protected areas 'classes' should be considered. 'Evolutionary baseline' class parks, for example, could allow for natural evolution and be used to research, monitor and demonstrate ecosystem changes"*), to requiring significant changes to Ontario Parks' institutional *status-quo* (e.g., OD.43: *"Camping seasons should be extended in selected provincial parks to take advantage of the potential increase in visitor use"*), to controversial (e.g., PSPL.22: "*Ecological representation should no longer be used as one of the five criteria for selecting and designing protected areas"*; PSPL.32: *"Deregulating parks should be explored as an option should a protected area no longer achieve its original protection mandate"*; PSPL.33: *"Floating protected areas, temporal reserves, and protected areas swapping approaches (i.e., strategic de-regulation and establishment) should be explored as a planning option in order to facilitate the movement of non-migratory species and increase the overall resiliency of the protected areas system to climate change related impacts"*). A detailed review of recommended adaptations options is provided in Sections 4.5.2 to 4.5.8.

4.8.2 Round Two: Evaluation of Adaptation Options

As noted earlier, the purpose of the second round survey was to allow the panel as a whole to assess the various adaptation options recommended by panelists in the first round survey. Panelists also were given the opportunity to re-evaluate their initial positions and provide reasons (i.e., justifications and clarity) for their assessment. Recommendations from the first round were collated and grouped into subsections in the second round survey in a manner consistent with the major program areas used in the first round survey. Since recommendations ranged in length from brief sentences to detailed arguments outlined in paragraphs, and because many panelists provided similar (often exact) recommendations, a large amount of synthesizing and paraphrasing were necessary when analyzing first round responses. Ontario Parks' senior management requested the removal of any recommended adaptation that did not occur on Ontario Parks lands (e.g., buffers) because it was not deemed their jurisdiction. Throughout this process, however, the integrity of each recommendation was preserved and all recommendations were presented to the panel regardless of the researcher's perceptions of the statement.

Despite the fact that the 1,130 recommendations identified by the panel in the first round were synthesized into 165 recommendations in the second round, the survey remained considerably long (30 pages) and necessitated a significant time commitment from the panel to complete (see methodological limitations discussion in Chapter 5) (all recommendations can be found in Appendix 3).[65] Table 29 summarizes the frequency of recommendations by major program area and by question requiring assessment by the expert panel.

Table 29 Number of recommended adaptation options within each of Ontario Parks' major program areas requiring assessment by the expert panel.

PROGRAM AREA	QUESTION	TOTAL
POLICY, SYSTEM PLANNING AND LEGISLATION (PSPL)	1. What aspects of protected area *policies* (e.g., *Ontario Provincial Parks Planning and Management Policies*) may be need to be modified to address the impacts of climate change?	**14**
	2. Given that protected areas *legislation* such as the *Provincial Parks and Conservation Reserves Act (2006)* and *the Canada National Parks Act (2000)* recognize ecological integrity as a guiding concept, how could climate change be integrated into their implementation?	**5**
	3. What considerations could be factored into protected areas *system planning* with regard to climate change (i.e., what protected area selection and design principles could be incorporated into system planning to account for ecological change)?	**25** **(44 total)**
MANAGEMENT DIRECTION (MD)	1. What are some specific considerations with regard to climate change that should be taken in account when preparing management direction for Ontario's protected areas (e.g., how would you integrate climate change into individual protected area management plans, and resource management plans such as forest fire management, prescribed burning, vegetation management, invasive species, species at risk, environmental assessment, protected area operations, visitor management, etc.)?	**22** **(22 total)**

[65] In addition to the large amount of synthesizing, recommendations pertaining to 'climate change indicators' were removed from the research altogether. Climate change indicators were regarded by the researcher to be an exercise warranting specific attention given relatively local (i.e., park-specific) and/or regional (i.e., park region) relevance of such recommendations and the large number of recommendations provided by the panel.

OPERATIONS & DEVELOPMENT (OD)	1. What would you suggest protected area agencies and organizations do 'in-house' to reduce greenhouse gas emissions (e.g., within buildings and offices, alternative vehicle solutions, energy conservation initiatives, etc.).	**8**
	2. Given that lower water levels in the Great Lakes will likely result from climate change, what adaptations to operations and development would you suggest to address lower water levels in protected areas?	**7**
	3. Given that climate change will likely increase the rates at which invasive species spread into Ontario's protected areas, what adaptations to operations and development would you suggest to help manage the impacts of new invasive species which migrate into protected area boundaries?	**14**
	4. Given that climate change will likely change the habitat ranges of fish species, what adaptations to operations and development would you suggest to address changes in fish species distribution (e.g., the migration of warm water species into traditionally cool water species territory)?	**7**
	5. Given that climate change is projected to expand warm-weather recreation seasons and threaten winter-recreation, what adaptations to visitor infrastructure and services would you suggest to reduce risks and take advantage of new opportunities?	**10** **(45 total)**
RESEARCH, MONITORING & REPORTING (RMR)	1. What are the research and monitoring priorities with respect to climate change that could be integrated into current programs at the protected area level and the system level?	**22**
	2. What indicators should be monitored and reported upon in relation to climate change in protected areas?	**4** **(26 total)**
CORPORATE CULTURE & FUNCTION (CCF)	1. Can you describe (a) the contents of an education program and (b) an approach for training that ensures climate change issues are addressed by people working in protected areas?	**13** **(13 total)**
EDUCATION, INTERPRETATION & OUTREACH (EIO)	1. How could public interpretation, outreach, and education be enhanced with regard to climate change impacts and initiatives by protected areas agencies in Ontario?	**9**
	2. How could conservation 'partner' awareness related to climate change impacts and adaptations be enhanced, and their cooperation and participation in climate change initiatives be fostered?	**6** **(15 total)**
OTHER	1. Are there additional protected areas and climate change adaptation ideas or suggestions you wish to convey?	**None**

Table 30 summarizes recommended climate change adaptation options by adaptation scale, function/effect, form and temporal scope. Generically applicable to all sectors, Smit and Pilifosova

(2003) outlined these bases for differentiating climate change adaptation options to illustrate how adaptations can be differentiated between whether they occur in natural or human systems, are undertaken by governments or private interests, are autonomous or planned, are taken in advance or after impacts are experienced, are tactical or strategic, are local or broad in application, serve to protect, retreat or tolerate, take one of several forms, and perform on any of numerous evaluation criteria. Adaptive responses can also be grouped according to their scale of implementation. Recognizing that definitions of some bases will vary by sector, the authors did not provide literal definitions of terms. For example, 'retreat' may mean to physically retreat (e.g., due to coastal erosion) or retreat from a current policy position or statement. Despite the fact that the interpretations of terms may not be universally agreeable, the bases do present a useful mechanism to differentiate adaptations and provide insight into the complexity associated with adaptation in the protected natural areas sector.

Most recommendations were relevant at the system or protected natural area scale, required changes to some institutional aspect, and necessitated changes to existing regulations. Interestingly, relatively few recommendations were 'retreat-oriented' or 'technological' in form. Recommendations suggesting retreat from the existing policy and/or management practices were limited to 'de-regulation' of parks (e.g., PSPL.32: see Appendix 3.1) and withdrawal from the protection of highly 'vulnerable' ecosystems (e.g., PSPL.40: see Appendix 3.1). Similarly, technological recommendations were limited to the installation of weather stations for climate monitoring (e.g., RMR.118: see Appendix 3.4), computer modelling requiring significant processing power (e.g., RMR.126: see Appendix 3.4) and implementation of greenhouse gas (GHG) reduction technology and alternative vehicle solutions (e.g., OD.70, OD.71: see Appendix 3.3).

Measuring consensus is traditionally the least-developed component of the policy Delphi method (Crisp *et al.,* 1997) and varies from study to study [see de Loë (1995) for a review]. The use of different thresholds of consensus strongly influenced the results (see discussion in Chapter 5). Often 51% or more responding to any given response category is thought to represent consensus (see McKenna, 1989). Mean rankings and variations have been used by some researchers while others have used the interquartile range to determine consensus [see de Loë (1991) and de Loë (1995)]. Stability of response has also been suggested as an indicator of consensus (Crisp *et al.,* 1997), but this can only be achieved through several survey iterations and is impractical where a large number of options are being considered as in this study. The thresholds used in this study are consistent with de Loë and Wojtanowski (2001) who adopted a more stringent interpretation of consensus and are considered conservative when compared to other policy Delphi studies.

Table 30 Classification of adaptation options by adaptation scale, function/effect, form and temporal scope (recommendations could be relevant in more than one category).

TYPE OF ADAPTATION		ONTARIO PARKS PROGRAM AREA						
		PSPL	MD	OD	RMR	CCF	EIO	TOTAL
SCALE	**Park**	13	17	35	12	1	6	**84**
	Region	5	3	2	6	2	0	**18**
	System	30	8	9	15	11	7	**80**
FUNCTION/ EFFECT	**Retreat**	3	1	10	0	0	0	**14**
	Accommodate	14	7	10	6	11	14	**62**
	Protect	16	6	3	4	0	1	**30**
	Prevent	10	5	9	5	1	1	**31**
	Tolerate	6	0	1	1	0	0	**8**
	Spread	3	1	2	2	0	0	**8**
	Change	30	20	24	21	12	13	**120**
	Restore	1	0	9	0	0	0	**10**
FORM	**Structural**	0	0	6	1	0	0	**7**
	Legal	7	2	0	3	2	0	**14**
	Institutional	13	12	33	22	12	13	**105**
	Regulatory	34	19	12	11	2	0	**78**
	Financial	1	0	5	0	0	0	**6**
	Technological	0	0	3	3	0	0	**6**
TEMPORAL SCOPE	**Tactical**	23	5	30	10	4	2	**74**
	Strategic	23	20	19	18	12	13	**105**

PSPL=Policy, System Planning & Legislation; MD=Management Direction; OD=Operations & Development; RMR=Research, Monitoring & Reporting; CCF=Corporate, Culture & Function; EIO=Education, Interpretation & Outreach.

Data from the second round survey were analyzed using the system outlined in Table 31. The level of 'consensus' was established by determining the percentage of ratings in the various categories. The 'point of agreement' (if such occurs) was determined when calculating whether or not a consensus existed. Consensus is a measure of the degree to which the group agreed on the importance of the statement (e.g., Very Desirable, Definitely Feasible, etc.).

Table 31 Consensus and point-of-agreement thresholds for desirability, feasibility and implementation time-frame descriptions.

DESIRABILITY	FEASIBILITY	IMPLEMENTATION TIME-FRAME
VD = Very Desirable	DF = Definitely Feasible	S = Short-term
D = Desirable	PF = Possibly Feasible	M = Medium-term
U = Undesirable	PU = Possibly Unfeasible	L = Long-term
VU = Very Undesirable	DU = Definitely Unfeasible	S to M = Short- to Medium-term
VD to D = Very Desirable to Desirable	DF to PF = Definitely Feasible to Possibly Feasible	M to L = Medium- to Long-term
U to VU = Undesirable to Very Undesirable	PU to DU = Possibly Unfeasible to Definitely Unfeasible	W&S = Wait & See (Reactive)
NS = Not Sure	NS = Not Sure	NS = Not Sure

Consensus is a measure of the degree to which the group *agreed* on the importance of the statement (e.g., Very Desirable, Definitely Feasible, etc.). The following categories are used:

High: 70% of ratings in one agreement category or 80% in two related categories[1]
Medium: 60% of ratings in one agreement category or 70% in two related categories
Low: 50% of ratings in one agreement category or 60% in two related categories
None: Less than 60% of ratings in two related categories[2]

[1]=Related agreement categories for descriptors include: Desirability (Very Desirable to Desirable, Undesirable to Very Undesirable); Feasibility (Definitely Feasible to Possibly Feasible, Possibly Unfeasible to Definitely Unfeasible); and Implementation Time-frame (Short to Medium term, Medium to Long Term)

[2]=When consensus is 'None', agreement is always ambiguous. Thus, the respondent group is polarized on the assessment of the statement.

While non-responses and *Not Sure* responses were left out of the denominator in calculating percentages, they were considered when evaluating the results of the analysis. Specifically, a non-response or *Not Sure* response rate of one-third (i.e., ≥33.3%) or more for a particular recommendation was chosen as the boundary between a satisfactory and unsatisfactory respondent evaluation [consistent with de Loë and Wojtanowski (2001)]. An example of the system used to analyze second round data is presented in Figure 37.

Figure 37 Example of system used to analyze second-round survey data.

Recommendation

PSPL.2: A strategic and corporate policy on climate change and protected areas is needed to provide sufficient direction for planning and management.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	25	6	0	1	2	**HIGH**	**Very Desirable**
% with opinion	78.1%	18.8%	0.0%	3.1%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	19	13	1	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	57.6%	39.4%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	ST	MT	LT	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	32	1	0	0	1	**HIGH**	**Short-term**
% with opinion	97.0%	3.0%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

S=Short Term; M=Medium Term; L=Long Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

The results were interpreted as follows. If a heterogeneous group of people with pertinent expertise agree with a recommended adaptation option (i.e., high consensus on points of desirability, feasibility and implementation time-frame), then it should be considered by Ontario Parks as an applicable (and justifiable) climate change adaptation option (and *vice-versa*). Statements over which the panel was polarized (i.e., those assessed to be ambiguous), should be further investigated before they are accepted or rejected. Ambiguity existed when one-third of the panel evaluated the recommendation as *Not Sure* within each descriptor (which resulted in the N/A of the feasibility and implementation time-frame descriptors) or when <60% of responses fell within related categories (i.e., *Desirable* and *Very Desirable*; *Definitely Feasible* and *Possibly Feasible*), which indicate there was no consensus. However, the recommendation was not ambiguous if assessed as *Undesirable* or *Very Undesirable* (or *Undesirable to Very Undesirable*) since the feasibility and implementation time-frame descriptors would be irrelevant in such cases. Since the policy Delphi approach utilized in this study also collected written arguments to support/justify ratings, the strength of evidence provided in support of/against positions can be determined and, as well, the bases for agreement and disagreement within the panel can be identified and be used as a foundation for further dialogue.

Evaluations for each of the 165 adaptation options identified by the panel are contained in Appendix 3 and are organized by Ontario Parks' major program areas (3.1: Policy, System Planning & Legislation; 3.2: Management Direction; 3.3: Operations & Development; 3.4: Research, Monitoring & Reporting; 3.5: Corporate Culture & Function; and 3.6: Education, Interpretation & Outreach). Tables 32 to 35 summarize consensus and points-of-agreement aggregate frequencies across the suite of 164 climate change adaptation options identified by the panel (by level of consensus and descriptor). Based on the thresholds used in Table 31, consensus was assessed to be *High* within related categories among the majority of recommened climate change adaptations. The majority of recommendations were evaluated to be *Very Desirable* (*VD*) or *Desirable* (*D*) (or *VD to D*) (>80%) (Table 32), *Definitely Feasible* (*DF*) or *Possibly Feasible* (*PF*) (or *DF to PF*) (>85%) (Table 33), and required implementation in the *Short-* (*S*) and *Medium-term* (*M*) (or *S to M*) (>88%) (Table 34).

This was a surprisingly high level of agreement for such a diverse set of panelists and diverse areas of policy, planning and management program areas. The policy Delphi process produced too many recommendations to discuss their ratings individually (all are presented in Appendix 3). What follows is a selective discussion on 'adaptation-options-of-interest', areas of disagreement, and adaptations evaluated to be ambiguous within each major program area.

Table 32 Consensus and Desirability point-of-agreement matrix and frequencies amongst all recommended climate change adaptation options (n=165).

	DESIRABILITY									
CONSENSUS	VD	D	VD to D	U	VU	U to VU	Not Sure	None	TOTAL	TOTAL (%)
High	18	10	99	1	3	12	0	0	**143**	**87.2%**
Medium	0	0	5	0	0	1	0	0	**6**	**3.7%**
Low	0	0	2	0	0	2	0	0	**4**	**2.4%**
N/A	0	0	0	0	0	0	12	0	**12**	**7.3%**
None	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**18**	**10**	**106**	**1**	**3**	**15**	**12**	**0**		
TOTAL (%)	**11.0%**	**6.1%**	**64.6%**	**0.6%**	**1.8%**	**9.1%**	**7.3%**	**0.0%**		

*VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 33 Consensus and Feasibility point-of-agreement matrix and frequencies amongst all recommended climate change adaptation options (n=165).

	FEASIBILITY										
CONSENSUS	DF	PF	PF to DF	PU	DU	PU to PF	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	4	13	101	0	0	0	0	0	0	**118**	**72.0%**
Medium	0	0	16	0	0	0	0	0	0	**16**	**9.8%**
Low	0	1	8	0	0	0	0	0	0	**9**	**5.5%**
N/A	0	0	0	0	0	0	3	0	0	**3**	**1.8%**
None	0	0	0	0	0	0	0	1	0	**1**	**0.6%**
TOTAL	**4**	**14**	**125**	**0**	**0**	**0**	**3**	**1**	**0**		
TOTAL (%)	**2.4%**	**8.5%**	**76.2%**	**0.0%**	**0.0%**	**0.0%**	**1.8%**	**0.6%**	**0.0%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 34 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies amongst all recommended climate change adaptation options (n=165).

	IMPLEMENTATION TIME-FRAME										
CONSENSUS	S	M	L	S to M	M to L	W&S	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	59	4	0	48	0	0	0	0	0	**111**	**67.7%**
Medium	0	0	0	11	0	0	0	0	0	**11**	**6.7%**
Low	0	0	0	12	0	0	0	0	0	**12**	**7.3%**
N/A	0	0	0	0	0	0	5	2	0	**7**	**4.3%**
None	0	0	0	0	0	0	0	3	0	**3**	**1.8%**
TOTAL	**59**	**4**	**0**	**71**	**0**	**0**	**5**	**5**	**0**		
TOTAL (%)	**36.0%**	**2.4%**	**0.0%**	**43.3%**	**0.0%**	**0.0%**	**3.0%**	**3.0%**	**0.0%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 35 Desirability and Feasibility point-of-agreement matrix amongst all recommended climate change adaptation options (n=165).

	FEASIBILITY								
DESIRABILITY	DF	PF	PF to DF	PU	DU	PU to DU	Not Sure	None	N/A
VD	3	0	15	0	0	0	0	0	0
D	0	4	6	0	0	0	0	0	0
VD to D	1	9	95	0	0	0	1	0	0
U	0	0	0	0	0	0	0	1	0
VU	0	0	0	0	0	0	0	0	2
U to VU	0	0	0	0	0	0	0	4	12
Not Sure	0	1	3	0	0	0	2	0	0
None	0	0	6	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = ambiguity.

4.8.3 Policy, System Planning and Legislation (PSPL) Policy Delphi Results: a Summary

Climate change adaptation options recommended by the panel for Policy, System Planning & Legislation (PSPL) (n=44) generally were assessed to be *Very Desirable* (*VD*) *to Desirable* (*D*) (75%) (Table 36), *Possibly Feasible* (PF) *to Definitely Feasible* (*DF*) (>80%) (Table 37) and required implementation in the *Short-to Medium-term* (*S to M*) (>85%) (Table 38). Only eight recommended adaptation options were evaluated as *Undesirable* (U), half of which suggested that policy and legislation *not be adapted* to account for climate change. Such strong agreement indicates that the panel strongly rejects the idea of maintaining the status-quo within this program area. A number of recommendations called for greater integration of climate change into Ontario Parks' mandates, frameworks, management plans, system planning approaches, guiding principles, and goals/objectives (e.g., ecological integrity). These recommendations are perhaps not surprising as many have been recommended in the scientific literature for over ten years (e.g., Halpin, 1997). A number of new and innovative adaptations with unexpected results were also revealed and are discussed in more detail below.

A single adaptation option (PSPL.23) was evaluated as *VD to D and DF* with *High* (*H*) consensus. This statement recommended that *"representation should <u>continue</u> to be used in protected areas system planning as a wider variety (diversity) of landform/vegetation associations being protected may increase the likelihood that different species and habitats will remain protected under climate change"* (see discussion in Chapter 2). This result was somewhat unexpected considering the position of the extant literature which has emphasized that the ecological manifestations of climate change could render 'representation-based' targets untenable over the long-term since what is represented now may manifest to be under-represented or not represented at all in protected natural areas of the future [e.g., see Scott *et al.* (2002) and Lemieux and Scott (2005) for a discussion]. However, as one panelist emphasized *"Retention of 'representation' as a core system design construct will guarantee that a representative physiographic (landform, topography, ecological sites, etc.) base will always be housed in the system irrespective of shifts in the biotic realm – this is an important construct in the 'baseline' value of protected areas."* While consensus was assessed to be *H* for this recommendation, a substantial number of panelists (20.6%) were *Not Sure* (NS) whether the recommendation was desirable. A 'counter-recommendation' (PSPL. 22) produced a similar result, with nearly 85% of the panel *rejecting* (i.e., rating the recommendation as *VU* or *U*) the recommendation that *"ecological representation should <u>no longer be used</u> as one of the five criteria used by Ontario Parks for selecting and designing protected areas."* An almost equal percentage of panelists

(23.5%) who were *Not Sure* whether or not PSPL.23 was desirable also rated PSPL.22 *Not Sure*. One panelist, who evaluated the recommendation as *Not Sure*, justified their evaluation, stressing *"The representation principle is not undesirable per-se, but it partly depends on how 'representative' is defined."* While perhaps obvious, it was not just Ontario Parks and broader MNR staff that held the position to retain this system planning design concept.

Instead of eliminating the use of representation-based approaches, the panel stressed that 'persistence parameters' should be incorporated into system planning and park establishment to better ensure the 'perpetual representation' of species through time (PSPL. 24: *VD to D* and *DF to PF* with *H* consensus). Despite the fact that panelists agreed that eliminating the use of representation-based approaches was generally undesirable, they did suggest that Ontario Parks' policies and guiding principles (e.g., 'representation' and 'permanence') should be re-evaluated in light of climate change (PSPL.9: *VD to D* and *PF to DF* with *H* consensus). Specifically, panelists stressed strongly that policies should focus less on ecological 'pattern' and more on ecological 'processes'. Furthermore, panelists held strong opinions that Ontario Parks should adopt a 'science-based adaptive management approach' to deal more effectively with potential climate change impacts (i.e., acknowledge the dynamic nature of ecosystems and increased flexibility needed to better manage uncertainty associated with climate change – see discussion on 'resilience' in Chapter 2) (see PSPL.10 for more information).

Panelists also held the strong position that a strategic and corporate policy on climate change and protected areas was needed to provide sufficient direction for planning and management (PSPL. 2: *VD* and *DF to PF* with *H* consensus). This recommendation supports findings discussed previously, specifically that managers at the park-level feel they are lacking necessary guidance and direction needed from the head office. Such guidance is necessary to effectively adapt regional and park-level policy, planning and management frameworks to climate change-related impacts and implement climate change-related decisions.

Despite the fact that Ontario Parks' *Provincial Parks and Conservation Reserves Act* (*PPCRA*), passed in September 2007, specifically notes that the primary goal of provincial parks and conservation reserves is to manage them in a way that *maintains ecological integrity* (see Government of Ontario, 2007b: section 2.1 and 2.2), the majority of panelists felt that the concept of ecological integrity, including what exactly constitutes 'acceptable rates of change' and species 'characteristic of a natural region', should be redefined with climate change considerations [PSPL.14: *VD to D* and *DF to PF* with *H* consensus; PSPL.18: *VD to D* (*M* consensus) and *PF to DF* (*H* consensus)]. While it is acknowledged that the likelihood of revising/updating legislation in the near-term is very unlikely (see discussion in Chapter 5), it could be argued that a large number of panelists (the majority of which are Ontario Parks and broader MNR staff) held the opinion that the ecological integrity concept itself is unsuitably defined and may have been adopted prematurely by Ontario Parks.[66] As one Ontario Parks panelist noted *"As an organization, we talk about 'ecological integrity' but I am not convinced that everyone is on the same page in terms of definition or implications. This would be an ideal time consider climate change within a redefinition of ecological integrity."*

While a number of recommendations were assessed as desirable by the panel, some may not be feasible to implement. For example, PSPL.29, which recommended that land-use activities adjacent to protected areas should allow for movement of wildlife and plants and help to 'feather' protected areas into the working landscape, was assessed to be *VD to D* with *H* consensus (96.6% of responses fell within these categories). In supporting the recommendation, one panelist stated *"It will be important to address climate change and changing ecological representation/protection needs on non-park lands. Climate change is a much bigger issue than simply parks – there is a need to address conservation on a more holistic level."* However, panelists were less certain on the feasibility of implementing the recommendation (*DF to PF* with only *M* consensus). Such a result is of no surprise given the common view of protected natural areas as being bounded by 'other interests' and given the inherent difficulties of 'managing the matrix' with conservation goals in mind (see Chapter 2) (also see PSPL.12 for a similar example).

A number of recommendations brought forth by the panel in the first round are considered controversial and warrant specific discussion here. For example, PSPL.32 recommended that the de-regulation of parks be explored as an option should a protected natural area no longer achieve its original mandate (i.e., no longer protect the species it was originally designed to protect). This recommendation was assessed as *U* to *VU* (with *L* consensus) (68.8% of responses fell within these related categories). In the words of one panelist *"Because my conception of parks includes the protection of values independent of the biotic realm and climate perturbation, e.g., landforms, I do not subscribe to this idea."*

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[66] Parks Canada was the first protected areas jurisdiction to 'adopt' the ecological integrity concept as a guiding principle in 1979. In 1998, the *Panel on Ecological Integrity* was established by the Minister of Canadian Heritage because of concerns about the health of some of Canada's national parks. This group provided recommendations for improvement and, as a result, Parks Canada has made ecological integrity central to every decision. This is clearly stated in Section 8.(2) of the *Canada National Parks Act*. Ontario Parks has since followed this precedence and has adopted the concept within its *PPCRA*.

However, when presented with a similar recommendation suggesting that 'floating protected areas', 'temporal reserves' and protected natural areas 'swapping' approaches (i.e., the strategic de-regulation and establishment of protected areas) should be explored as a planning option in order to facilitate the movement of non-migratory species under climate change and to increase the overall resiliency of the protected natural areas system to climate change-related impacts (PSPL.33), the panel was *Not Sure* (35.3%) whether the recommendation was desirable. Even more surprising was that of those panelists with an opinion, 63.6% held the position that this adaptation option was desirable. Several panelists provided comments on this particular recommendation. In support of the idea, one expressed the opinion that *"Conceptually, this is a good idea, but there needs to be a firm set of core areas as safeguards."* Providing a counter-argument, another panelist clearly stressed *"I am adamantly opposed to the 'floating reserve' concept. A protected area that was originally established to represent one feature may well represent others in the future. The 'floating reserve' idea is a concept that has been used in the past to argue that no permanent protected areas are needed, and that all areas can be pursued for extractive purposes of one sort or another, and the residual then handed over for temporary 'protection' (of what I'm not sure)."* The ambiguity associated with such a response means that further dialogue within Ontario Parks and with other stakeholders would be needed before acceptance or rejection of this adaptation option.

Finally, the recommendation that Ontario Parks should no longer attempt to protect highly vulnerable species and ecosystems (e.g., species-at-risk) and focus limited resources instead on areas with a reasonable chance of longer-term resilience (PSPL.40), was assessed to be *U to VU* by 64.3% of the panel (*L* consensus). Justifying their rejection, one panelist averred *"This recommendation could become the argument for collapsing the parks system."* However, a significant number of panelists evaluated the recommendation as *VD to D* (35.7%) or were *Not Sure* (17.6%) whether or not the recommendation was desirable. Similarly, when presented with the recommendation that highly vulnerable, disjunct/relict, and outlier species should receive *higher* protection in system planning (PSPL.39), the panel was *Not Sure* (41.2%) whether it was desirable. As one panelist explained *"These questions are really about values. While I think that rare/relict species have intrinsic value and deserve attention and funding, I do not believe that a largely disproportionate amount of funding should be directed toward them to the detriment of species which hold more promise for persistence."*

The position of the panel on these recommendations is important to elucidate given the current provincial focus on protecting species-at-risk (MNR, 2005) and considering the current review of the *Ontario Species at Risk Act* (Government of Ontario, 2007c). While no consensus was reached on the latter recommendation, both recommendations inherently suggest the withdrawal from one of the foundations upon which many protected areas were initially established and currently justified (i.e., the protection of highly vulnerable species, such as species-at-risk) and illustrates how panelists are willing to think outside the box and be innovative and adaptive when it comes to identifying and evaluating adaptation options.

Table 36 Consensus and Desirability point-of-agreement matrix and frequencies for Policy, System Planning & Legislation recommended climate change adaptation options (n=44).

CONSENSUS	FEASIBILITY: DF	PF	PF to DF	PU	DU	PU to PF	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	1	2	17	0	0	0	0	0	0	**20**	**45.5%**
Medium	0	0	9	0	0	0	0	0	0	**9**	**20.5%**
Low	0	1	6	0	0	0	0	0	0	**7**	**15.9%**
N/A	0	0	0	0	0	0	0	0	8	**8**	**18.2%**
None	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**1**	**3**	**32**	**0**	**0**	**0**	**0**	**0**	**8**		
TOTAL (%)	**2.3%**	**6.8%**	**72.7%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**18.2%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 37 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies for Policy, System Planning & Legislation recommended climate change adaptation options (n=44).

CONSENSUS	IMPLEMENTATION TIME-FRAME: S	M	L	S to M	M to L	W&S	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	5	0	0	18	0	0	0	0	0	**23**	**52.3%**
Medium	0	0	0	4	0	0	0	0	0	**4**	**9.1%**
Low	0	0	0	7	0	0	0	0	0	**7**	**15.9%**
N/A	0	0	0	0	0	0	0	2	0	**2**	**4.5%**
None	0	0	0	0	0	0	0	0	8	**8**	**18.2%**
TOTAL	**5**	**0**	**0**	**29**	**0**	**0**	**0**	**2**	**8**		
TOTAL (%)	**11.4%**	**0.0%**	**0.0%**	**65.9%**	**0.0%**	**0.0%**	**0.0%**	**4.5%**	**18.2%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 38 Desirability and Feasibility point-of-agreement matrix for Policy, System Planning & Legislation recommended climate change adaptation options (n=44).

	FEASIBILITY								
DESIRABILITY	DF	PF	PF to DF	PU	DU	PU to DU	Not Sure	None	N/A
VD	0	0	4	0	0	0	0	0	0
D	0	1	1	0	0	0	0	0	0
VD to D	1	1	25	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0
VU	0	0	0	0	0	0	0	0	0
U to VU	0	0	0	0	0	0	0	0	8
Not Sure	0	1	2	0	0	0	0	0	0
None	0	0	0	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = ambiguity.

4.8.4 Management Direction (MD) Policy Delphi Results: a Summary

Climate change adaptation options recommended by the panel for Management Direction were, generally, assessed as *Very Desirable* (*VD*) *to Desirable* (*D*) (>80%) (Table 39), *Possibly Feasible* (*PF*) *to Definitely Feasible* (*DF*) (>95%) (Table 40), and required implementation in the *Short- to Medium-term* (*S to M*) (>85%) (Table 41). Only one recommended adaptation option was evaluated as *Undesirable* (*U*) and it suggested that management direction should *not* be adapted to account for climate change. The majority of recommendations suggested the integration of climate change into Ontario Parks' park management plans, management statements and active management plans, such as those pertaining to invasive species, species-at-risk and visitor management.

Similar to the Policy, System Planning & Legislation program area, a number of recommendations within Management Direction suggested that the 'role' of protected areas in safeguarding *currently valued* ecosystems and/or species may have to be changed considering continually evolving climatic and ecological conditions. For example, while rejecting elimination of the use of the 'representation principle' in protected areas system planning (see the previous sub-section), the panel did indicate that reassessing the 'role' of protected areas at decadal intervals (MD.3) will be necessary under climate change (i.e., reassessing what exactly the park is 'representing' at a given time) and was assessed to be *VD to D* (93.6% with *H* consensus). Similarly, MD.4, which recommended that protected areas 'zoning' incorporate climate change considerations as the location of natural values shift (i.e., recognize that park zones may need to shift across the landscape to protect certain features as current values move, are lost, and new ones appear). This recommendation was assessed as *VD to D* by the panel (92.3% with *H* consensus). The acceptance of such recommendations by the panel suggests that the role of 'individual' protected natural areas may have to change concurrently with Ontario's changing landscape. However, a panelist rating the recommendation as *U* warned that *"While it would be good to move zones… I would not want to 'give up' a protected nature reserve zone (and allow it to be harvested) in order to 'add' Recreation/Utilization zone to the protected area. Although climate change might cause a Nature Reserve to lose some of the values for which it is created (e.g., vegetation communities), the value of that site is still very, very high simply because it is an area without roads. Adding new Nature Reserve zones would be great, but not at the expense of 'losing' areas with high protection."*

Similar to the panel's position on possibly changing protected natural areas 'zones' in parallel with changing ecological conditions, the panel also felt that it was *VD to D* (93.8% with *H* consensus) and *DF to PF* (84.8% with *H* consensus) to change protected natural area classifications (i.e., Nature Reserve, Natural Environment, and Recreation Class parks) to accommodate changing protection values arising due to climate change (MD.5). Some protected areas originally established by Ontario Parks for recreation purposes may manifest themselves to be more valuable in the protection of natural assets, such as species-at-risk, under changing climatic and ecological conditions. Flexible management classification would maximize the value of existing protected natural area lands/estate to better ensure the long-term protection of such species. However, that flexibility seems to go one way for some panelists – while some panelists may feel that it would be acceptable to reclassify a Recreation class park as a Nature Reserve class park, it is unlikely that they would be willing to accept the opposite (see MD.4 above).

It also was recommended that the use of 'clustered' management plans by Ontario Parks might provide the flexibility needed to incorporate climate change considerations at local and regional levels for protected natural areas having similar ecological conditions (MD. 8). As opposed to developing management plans for every provincial park, a single management plan would be used to guide the management of several provincial parks in a given ecoregion. This recommendation was assessed to be *D* by the panel (with *H* consensus) and, if implemented, could offset Ontario Parks' capacity limitations in the development of individual park management plans (see Table 21 in this Chapter). The panel also evaluated this recommendation as *PF* (with *H* consensus).

As noted in Chapter 2, it has been suggested that the basic operational definitions of 'native' and 'non-native' species and 'species-at-risk' should be reassessed as the ecological manifestations of climate change begin to challenge their current operational definitions [see Scott and Lemieux (2005) for a discussion]. As an example, the *Canadian Species at Risk Act* defines a 'wildlife species' as a species 'native' to Canada for at least 50 years (Government of Canada, 2003). A literal interpretation of this definition reveals that a species classified as endangered in the U.S. that naturally expands its range into Canada would not qualify for protection as a species-at- risk under the *Act* until it had been in Canada for 50 years or more, should it survive. The position of the expert panel appears to be consistent with that of the literature (i.e., Scott and Lemieux, 2005). MD.10, which suggested that Ontario Parks, and the MNR as a whole, should reconsider the basic definitions of non-native, native species and species-at-risk with climate change considerations, was assessed by the panel as *VD to D* (88.5% with *H* consensus and *DF to PF* with *H* consensus). In support of this recommendation, one panelist found irony in the fact that *"some invasive species are native plants, milkweed for example."* Similarly, the panel held the strong opinion that it was *VD to D* (100% with *H* consensus) to include protection provisions for the range expansions and contractions of species-at-risk (*PF* with *H* consensus) (MD.13).

The translocation of species-at-risk to areas of suitable habitat under changing climatic and ecological conditions has also been proposed and debated in the literature [e.g., Scott and Lemieux (2005); McLachlan *et al.* (2007); Hoegh-Guldberg *et al.* (2008)] as an approach to assist those species which are unable to adapt themselves (i.e., unable to migrate at the required pace or adapt *in-situ*). As Scott and Lemieux (2005) indicated, such a recommendation appears inconsistent with current interpretations of 'maintaining ecological integrity' if the species in question was not native to the destination region and might have adverse impacts on species in existing communities. When presented with the recommendation to consider species translocation as an active management option when species are unable to adapt themselves (MD.12), the panel was *Not Sure* (41.2%) as to the desirability of the recommendation. While a number of panelists indicated that translocation should be used to facilitate the migration of species-at-risk providing proper environmental monitoring and assessment, others indicated that single-species management is often ineffective and expensive. Of the panel members taking a position on the recommendation, 70% took the position that it was *VD to D*. While the feasibility of this recommendation was assessed to be *N/A* by default, over 60% of panel members did determine that it was *DF to PF*.

A 'hands-off' or 'non-interventionist' approach may not be acceptable to the Canadian public if a highly valued species (such as a species-at-risk or charismatic mega-fauna) is unable to adapt 'naturally' to climate change-related impacts. The ambiguity associated with recommendation MD.12 (species translocation/assisted migration) indicates that it requires further discussion within Ontario Parks and the broader MNR and among other stakeholders before its acceptance or rejection. Ontario Parks needs to further consider recommendations MD.19 and MD.22 as well, which suggest the development of climate change 'indicators' and specific 'thresholds' upon which management action will be taken (and justified). For example, thresholds using Minimum Viable Population (MVP) analysis could be established and used to assess approximately when the translocation of sedentary species would be desirable. Both recommendations were assessed to be *VD to D* with *H* consensus and to be *DF to PF* (MD.19) and *PF* (MD.22) with *H* consensus.

Table 39 Consensus and Desirability point-of-agreement matrix and frequencies for Management Direction recommended climate change adaptation options (n=22).

	DESIRABILITY									
CONSENSUS	VD	D	VD to D	U	VU	U to VU	Not Sure	None	TOTAL	TOTAL (%)
High	1	2	17	0	0	1	0	0	**21**	**95.5%**
Medium	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	1	0	**1**	**4.5%**
None	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**1**	**2**	**17**	**0**	**0**	**1**	**1**	**0**		
TOTAL (%)	**4.5%**	**9.1%**	**77.3%**	**0.0%**	**0.0%**	**4.5%**	**4.5%**	**0.0%**		

*VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 40 Consensus and Feasibility point-of-agreement matrix and frequencies for Management Direction recommended climate change adaptation options (n=22).

	FEASIBILITY										
CONSENSUS	DF	PF	PF to DF	PU	DU	PU to PF	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	1	6	12	0	0	0	0	0		**19**	**86.4%**
Medium	0	0	1	0	0	0	0	0		**1**	**4.5%**
Low	0	0	1	0	0	0	0	0		**1**	**4.5%**
N/A	0	0	0	0	0	0	0	0		**0**	**0.0%**
None	0	0	0	0	0	0	0	1		**1**	**4.5%**
TOTAL	**1**	**6**	**14**	**0**	**0**	**0**	**0**	**1**	**0**		
TOTAL (%)	**4.5%**	**27.3%**	**63.6%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**4.5%**	**0.0%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 41 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies for Management Direction recommended climate change adaptation options (n=22).

	IMPLEMENTATION TIME-FRAME										
CONSENSUS	S	M	L	S to M	M to L	W&S	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	4	0	0	11	0	0	0	0	0	**15**	**68.2%**
Medium	0	0	0	3	0	0	0	0	0	**3**	**13.6%**
Low	0	0	0	1	0	0	0	0	0	**1**	**4.5%**
N/A	0	0	0	0	0	0	0	0	1	**1**	**4.5%**
None	0	0	0	0	0	0	0	2	0	**2**	**9.1%**
TOTAL	**4**	**0**	**0**	**15**	**0**	**0**	**0**	**2**	**1**		
TOTAL (%)	**18.2%**	**0.0%**	**0.0%**	**68.2%**	**0.0%**	**0.0%**	**0.0%**	**9.1%**	**4.5%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure;* = *ambiguity.*

Table 42 Desirability and Feasibility point-of-agreement matrix for Management Direction recommended climate change adaptation options (n=22).

	FEASIBILITY								
DESIRABILITY	DF	PF	PF to DF	PU	DU	PU to DU	Not Sure	None	N/A
VD	1	0	0	0	0	0	0	0	0
D	0	1	1	0	0	0	0	0	0
VD to D	0	5	12	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0
VU	0	0	0	0	0	0	0	0	0
U to VU	0	0	0	0	0	0	0	0	1
Not Sure	0	0	1	0	0	0	0	0	0
None	0	0	0	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = *ambiguity.*

4.8.5 Operations & Development (OD) Policy Delphi Results: a Summary

Climate change adaptation options recommended by the panel for the Operations & Development program area were assessed, generally, as *Very Desirable* (*VD*) *to Desirable* (*D*) (75%) (Table 43) and *Possibly Feasible* (*PF*) *to Definitely Feasible* (*DF*) (>85%) (Table 44) and required implementation in the *Short-to Medium-term* (*S to M*) (>75%) (Table 45). Of the recommendations assessed to be *Undesirable* (*U*) or *Very Undesirable* (*VU*), all rejected the notion of *not* adapting differing aspects of Ontario Parks' Operations & Development management program areas to climate change (i.e., *not* reducing greenhouse gas emissions (GHGs), *not* adapting infrastructure to fluctuating Great Lakes water levels and *not* adapting visitor services to take advantage of extended warm-weather seasons). A number of recommendations suggested that it should be a priority for

Ontario Parks to become a 'leader' in GHG reduction emissions and in the identification and implementation of alternative energy solutions. Making changes to park infrastructure to reduce vulnerability to climate change-related impacts and taking advantage of opportunities associated with the possibility of an extended warm-weather recreation season also were often recommended by the panel.

OD.5 recommended that Ontario Parks begin exploring alternative vehicle solutions, energy efficient lighting options and waste reduction strategies in order to reduce GHGs 'in-house'. This finding is consistent with Parks Canada who identified GHG reductions as a priority in their *Sustainable Development Strategy* (2004-2007) (Parks Canada, 2005). Under the *Federal House in Order Initiative*, Parks Canada is required to reduce its GHG emissions by 5.2% from 2000-2001 levels by the year 2011 via the improvement of energy-efficiency in Agency buildings and fleet as well as increasing employee awareness (Parks Canada, 2004). The panel held the strong opinion that this option was *VD* and *DF* (with *H* consensus). Moreover, the panel determined that the protected natural areas sector in general should be a national and provincial leader and a showcase for curbing all emissions under its control (OD.2: *VD* and *DF* to *PF* with *H* consensus). The panel suggested that the installation of energy efficient lighting, the implementation of waste reduction strategies and the purchasing of hybrid vehicles would reduce GHG emissions in-house and would provide valuable demonstrations sites to the public. A number of panelists emphasized that such adaptation options would require a large culture shift, and significant budget allocation (or re-allocation), prior to implementation. The panel also held the strong opinion that the protected natural areas sector should play an advocacy role in garnering widespread public support for GHG reductions (OD.3: *VD to D* and *DF to PF* with *H* consensus). One panelist noted that Ontario Parks' Natural Heritage Education Program is already in a position to provide such a role through provincial park interpretive programs.

In order to change both park staff and visitor attitudes and behaviors with respect to energy use and conservation, the panel determined that incentives and disincentives should be used (OD.7: *VD to D* and *DF to PF* with *H* consensus). Despite their support for these recommendations, a number of panelists suggested that such changes to Operations & Development would be challenging. Commenting on recommendation OD.5 specifically, one panelist argued that *"These [recommendations] will require a large culture shift [and] will only happen when large energy inefficient vehicles are no longer available to staff. Enforcement staff view large vehicles as a symbol of power and superiority and few will choose bicycles if the large trucks are available."*

The first round survey identified a number of recommendations suggesting the replacement and redesign of built structures, such as roads, docks and boathouses in order to deal with changing water levels resulting from climate change. For example, the panel felt that it was *VD* and *DF to PF* (with *H* consensus) to rely less on permanent docks and boathouses (OD.12) and *D* and *DF to PF* (with *H* consensus) to begin replacing permanent docks with floating docks in order to facilitate annual relocations subject to water levels and reduce impacts on aquatic habitats (OD.10).

Some recommendations also suggested the revision of a variety of current MNR regulations, including those related to the use of live bait (OD.17) and personal firewood (OD.18), in order to reduce the risk of spreading invasive and disturbance-oriented species. While the former recommendation was assessed as *D* and *DF to PF* with *H* consensus, the latter was assessed as *VD to D* and *DF to PF* with *H* consensus. Implementing such recommendations would not only require revisions to existing regulations [such as MNR's *Recreational Fishing Regulations* (Government of Ontario, 2005)], but also would require more active enforcement operations within both operating and non-operating protected areas. Furthermore, there are some issues of equity associated with recommendation OD.18. As one panelist stated, *"If personal firewood is to be banned, I think that the park should look into providing one free bag per site. We want parks to remain economically accessible to everyone and the campfire experience should not be available only to those who can afford Ontario Parks' wood."*

Several recommendations were assessed as ambiguous within the Operations & Development program area and, therefore, will require further dialogue between Ontario Parks and the broader MNR and other stakeholders before their acceptance or rejection. While the panel held the strong opinion that camping seasons should be extended in selected provincial parks to take advantage of the potential increase in visitor use (OD.43: 100% of the panel felt that this option was *VD to D* and *PF to DF* with *H* consensus) and that Ontario Parks should begin identifying staffing needs and challenges due to the possibility of an extended warm-season in the future (OD.44), the panel was *Not Sure* whether or not divesting in winter programs (OD.41) and converting winter trails to multi-use/multi-season trails (OD.42) was desirable despite the potential for a significant reduction in seasonal use by park visitors. As one panelist clearly stressed *"I agree with the closure of winter facilities when no longer viable, but I do not agree with the development of additional or new warm-weather facilities to compensate for the winter closures. This gets to the point of reducing the 'footprint' in protected areas."* The position of the panel on recommendation OD.39, which suggested that usage 'caps' on trails should be used to proactively reduce the potential for additional stresses on ecosystems resulting from increased visitor use (*VD to D* with *H* consensus and *DF to PF* with *M* consensus) further emphasized the panel's position that minimizing ecological disturbances is a priority when considering various climate change adaptation options (which is consistent with the concept of ecological integrity).

Table 43 Consensus and Desirability point-of-agreement matrix and frequencies for Operations & Development recommended climate change adaptation options (n=45).

	DESIRABILITY									
CONSENSUS	VD	D	VD to D	U	VU	U to VU	Not Sure	None	TOTAL	TOTAL (%)
High	9	3	20	0	1	4	0	0	**37**	**84.1%**
Medium	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	1	0	0	0	0	0	**1**	**2.3%**
N/A	0	0	0	0	0	0	7	0	**7**	**15.9%**
None	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**9**	**3**	**21**	**0**	**1**	**4**	**7**	**0**		
TOTAL (%)	**20.5%**	**6.8%**	**47.7%**	**0.0%**	**2.3%**	**9.1%**	**15.9%**	**0.0%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 44 Consensus and Feasibility point-of-agreement matrix and frequencies for Operations & Development recommended climate change adaptation options (n=45).

	FEASIBILITY										
CONSENSUS	DF	PF	PF to DF	PU	DU	PU to PF	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	2	0	31	0	0	0	0	0	0	**33**	**75.0%**
Medium	0	0	5	0	0	0	0	0	0	**5**	**11.4%**
Low	0	0	1	0	0	0	0	0	0	**1**	**2.3%**
N/A	0	0	0	0	0	0	1	0	5	**6**	**13.6%**
None	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**2**	**0**	**37**	**0**	**0**	**0**	**1**	**0**	**5**		
TOTAL (%)	**4.5%**	**0.0%**	**84.1%**	**0.0%**	**0.0%**	**0.0%**	**2.3%**	**0.0%**	**11.4%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 45 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies for Operations & Development recommended climate change adaptation options (n=44).

CONSENSUS	IMPLEMENTATION TIME-FRAME S	M	L	S to M	M to L	W&S	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	16	0	0	12	0	0	0	0	0	**28**	**63.6%**
Medium	0	0	0	3	0	0	0	0	0	**3**	**6.8%**
Low	0	0	0	4	0	0	0	0	0	**4**	**9.1%**
N/A	0	0	0	0	0	0	2	0	5	**7**	**15.9%**
None	0	0	0	0	0	0	0	1	2	**3**	**6.8%**
TOTAL	**16**	**0**	**0**	**19**	**0**	**0**	**2**	**1**	**7**		
TOTAL (%)	**36.4%**	**0.0%**	**0.0%**	**43.2%**	**0.0%**	**0.0%**	**4.5%**	**2.3%**	**15.9%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure;* = *ambiguity.*

Table 46 Desirability and Feasibility point-of-agreement matrix for Operations & Development recommended climate change adaptation options (n=45).

DESIRABILITY	FEASIBILITY DF	PF	PF to DF	PU	DU	PU to DU	Not Sure	None	N/A
VD	2	0	7	0	0	0	0	0	0
D	0	0	3	0	0	0	0	0	0
VD to D	0	0	21	0	0	0	0	0	0
U	0	0	0	0	0	0	0	1	0
VU	0	0	0	0	0	0	0	0	0
U to VU	0	0	0	0	0	0	0	4	0
Not Sure	0	0	0	0	0	0	1	0	0
None	0	0	6	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = *ambiguity.*

4.8.6 Research, Monitoring & Reporting Policy Delphi Results: a Summary

Climate change adaptation options recommended by the panel for Research, Monitoring & Reporting were largely evaluated as *Very Desirable* (*VD*) *to Desirable* (*D*) (>85%) (Table 47), *Possibly Feasible* (*PF*) *to Definitely Feasible* (*DF*) (>80%) (Table 48) and required implementation in the *Short-to Medium-term* (*S to M*) (>80%) (Table 49). Two recommended adaptation options were evaluated to be *Undesirable* and were related to recommendations suggesting that Research, Monitoring & Reporting activities should *not* be adapted to account for climate change. Most recommendations provided by the panel were accepted (i.e., assessed to be Desirable and Feasible) and nine of the 26 recommendations contained 100% of the panel's response distribution within the *VD* and *D* categories.

The panel deemed strongly that a *specific monitoring strategy* should be developed related to climate change in order to detect and monitor trends and impacts (RMR.2: *VD to D* and *DF to PF* with *H* consensus), especially for regionally-threatened species, extinction-prone species and other 'target' species (RMR.3: 100% of respondents rated the recommendation as *VD* or *D* and *DF to PF* with *H* consensus). The panel also held the strong position that Ontario Parks should begin establishing long-term research and monitoring sites (RMR.5: *VD and DF* to *PF* with *H* consensus), specifically on ecotones (i.e., species at the northern limits of their range) (RMR.11: *VD to D* with *H* consensus and *DF to PF* with *M* consensus) and in non-disturbed protected natural areas (i.e., establish 'control sites', or 'benchmarks', for investigating climate change impacts) (RMR.13: *VD to D* with *H* consensus and *DF to PF* with *H* consensus). This was to be done in collaboration with other organizations and partners to ensure the standardization of indicators, assessment and reporting of data across jurisdictional scales.

Interestingly, the recommendation to establish a volunteer monitoring program (i.e., via NGOs, "Friends Of" groups, local schools, park users, etc.) (RMR.4) was assessed as *VD to D* (with 100% of responses falling within these categories) and *DF to PF* with *H* consensus. If implemented effectively, this recommendation could offset some of Ontario Parks' capacity limitations noted previously in this Chapter (i.e., reduced ecological monitoring, inventorying and research capacity). As one panelist explained, *"Adequate training would be necessary to ensure consistency in data collection but assuming adequate training, volunteers could enable us to collect data we otherwise wouldn't get to. In return for their time and effort, it will be important to show them how we use the data."* Despite overwhelming support for this recommendation by the panel, several panelists provided a few 'cautionary notes' that should be considered before the implementation of a volunteer-based research and monitoring program. As an example, one Ontario Parks panelist noted *"I am in the process of trying this exact thing and am finding the value of having volunteers do work that a trained professional should be doing is limited; Ontario Parks needs to do this work internally by qualified and trained staff."* Another Ontario Parks panelist similarly warned that *"We need to have our own programs up and running before we involve external groups. Training, consistency in reporting, etc. are key issues. We typically have much well-intentioned interest that needs to be utilized appropriately, not just a bunch of 'feel-good' stuff done that may actually reduce our limited resources. Use them, but cautiously."*

The recommendation suggesting that the role of protected natural areas in sequestering carbon needed to be explored in more detail to ensure that ecological integrity and biodiversity goals were not compromised by carbon sequestration goals (RM.21) was assessed to be *VD to D* with *H* consensus, but the panel was *Not Sure* (35.3%) whether the recommendation was actually feasible.

Even if implemented, one panelist observed "*The effect would be negligible considering the total area of protected areas.*"[67] As a final example, the panel was *Not Sure* (47.1%) as to the desirability of having the assessment of ecological integrity being made relative to the prevailing climate at the time of assessment rather than being made based on a historical benchmark that no longer exists (RM.22). The ambiguity associated with this recommendation further substantiates the findings revealed in the Policy, System Planning & Legislation section, namely that the panel may not be comfortable with the current operational definition of ecological integrity as outlined in Ontario's new *Provincial Parks and Conservation Reserves Act* (*PPCRA*) (Government of Ontario, 2007b). Indeed, as one panelist stressed *"That question needs a great deal of discussion around protected area goals."*

Table 47 Consensus and Desirability point-of-agreement matrix and frequencies for Research, Monitoring & Reporting recommended climate change adaptation options (n=26).

	DESIRABILITY									
CONSENSUS	**VD**	**D**	**VD to D**	**U**	**VU**	**U to VU**	**Not Sure**	**None**	**TOTAL**	**TOTAL (%)**
High	2	1	20	0	1	1	0	0	**25**	**96.2%**
Medium	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	1	0	**1**	**3.8%**
None	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**2**	**1**	**20**	**0**	**1**	**1**	**1**	**0**		
TOTAL (%)	**7.7%**	**3.8%**	**76.9%**	**0.0%**	**3.8%**	**3.8%**	**3.8%**	**0.0%**		

*VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

[67] See Scott et al., (2008) for a recent discussion on this issue.

Table 48 Consensus and Feasibility point-of-agreement matrix and frequencies for Research, Monitoring & Reporting recommended climate change adaptation options (n=26).

	FEASIBILITY										
CONSENSUS	**DF**	**PF**	**PF to DF**	**PU**	**DU**	**PU to PF**	**Not Sure**	**None**	**N/A**	**TOTAL**	**TOTAL (%)**
High	0	4	17	0	0	0	0	0	0	**21**	**80.8%**
Medium	0	0	1	0	0	0	0	0	0	**1**	**3.8%**
Low	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	2	0	0	**2**	**7.7%**
None	0	0	0	0	0	0	0	0	2	**2**	**7.7%**
TOTAL	**0**	**4**	**18**	**0**	**0**	**0**	**2**	**0**	**2**		
TOTAL (%)	**0.0%**	**15.4%**	**69.2%**	**0.0%**	**0.0%**	**0.0%**	**7.7%**	**0.0%**	**7.7%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 49 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies for Research, Monitoring & Reporting recommended climate change adaptation options (n=26).

	IMPLEMENTATION TIME-FRAME										
CONSENSUS	**S**	**M**	**L**	**S to M**	**M to L**	**W&S**	**Not Sure**	**None**	**N/A**	**TOTAL**	**TOTAL (%)**
High	14	0	0	6	0	0	0	0	0	**20**	**76.9%**
Medium	0	0	0	1	0	0	0	0	0	**1**	**3.8%**
Low	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	3	0	2	**5**	**19.2%**
None	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**14**	**0**	**0**	**7**	**0**	**0**	**3**	**0**	**2**		
TOTAL (%)	**53.8%**	**0.0%**	**0.0%**	**26.9%**	**0.0%**	**0.0%**	**11.5%**	**0.0%**	**7.7%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 50 Desirability and Feasibility point-of-agreement matrix for Research, Monitoring and Reporting recommended climate change adaptation options (n=26).

	FEASIBILITY								
DESIRABILITY	**DF**	**PF**	**PF to DF**	**PU**	**DU**	**PU to DU**	**Not Sure**	**None**	**N/A**
VD	0	0	2	0	0	0	0	0	0
D	0	1	0	0	0	0	0	0	0
VD to D	0	3	16	0	0	0	1	0	0
U	0	0	0	0	0	0	0	0	0
VU	0	0	0	0	0	0	0	0	1
U to VU	0	0	0	0	0	0	0	0	1
Not Sure	0	0	0	0	0	0	1	0	0
None	0	0	0	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = ambiguity.

4.8.7 Corporate Culture & Function Policy Delphi Results: a Summary

With the exception of a single recommendation (suggesting that climate change should *not* be integrated into Ontario Parks' staff education programs and training activities), all recommendations within the Corporate Culture & Function program area were assessed to be *Very Desirable* (*VD*) or *Desirable* (*D*) (Table 51), *Definitely Feasible* (*DF*) *to Possibly Feasible* (*PF*) (Table 52) and required implementation in the *Short-term* (S) (Table 53). A number of recommendations suggested internal capacity building, including the development of training sessions (CCF.3, CCF.7), scientific workshops (CCF.8, CCF.12) and orientation programs (CCF.9) to ensure that all staff understand and are capable to respond to climate change impacts. Recommendations within the Corporate Culture & Function program area also tended to be targeted, concise and directly relevant to Ontario Parks' staff (i.e., more tactical in form compared to recommendations provided in other program areas). For example, it was recommended that workshops should be developed for specific ecoregions and/or greater park ecosystems (CCF.8) and be geared to occupation (e.g., biologists, planners, mid- and upper-management, interpreters, etc.) (CCF.4). Of particular interest was the suggestion that Ontario Parks' parks certificate course should be reinstated[68] and include basic information and training on climate change (as well as other issues of concern) (CCF.11).

Table 51 Consensus and Desirability point-of-agreement matrix and frequencies for Corporate Culture & Function recommended climate change adaptation options (n=13).

	DESIRABILITY									
CONSENSUS	VD	D	VD to D	U	VU	U to VU	Not Sure	None	TOTAL	TOTAL (%)
High	2	0	9	1	0	0	0	0	**12**	**92.3%**
Medium	0	0	1	0	0	0	0	0	**1**	**7.7%**
Low	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	0	0	**0**	**0.0%**
None	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**2**	**0**	**10**	**1**	**0**	**0**	**0**	**0**		
TOTAL (%)	**15.4%**	**0.0%**	**76.9%**	**7.7%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**		

*VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure;* ▒ *= ambiguity.*

[68] The course was available through the 1980s and early 1990s. By the early 1990s, most of the participants who were applying to take the course were not working in the Parks program. The significant expenditures of time and dollars being made on the course did not seem justified, and when MNR began downsizing and reorganization, the course was terminated. From 1996 on, Ontario Parks has focused on its own implementation training (R. Davis, pers. comm.).

Table 52 Consensus and Feasibility point-of-agreement matrix and frequencies for Corporate Culture & Function recommended climate change adaptation options (n=13).

	FEASIBILITY										
CONSENSUS	DF	PF	PF to DF	PU	DU	PU to PF	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	0	0	12	0	0	0	0	0	0	**12**	**92.3%**
Medium	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
None	0	0	0	0	0	0	0	0	1	**1**	**7.7%**
TOTAL	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**1**		
TOTAL (%)	**0.0%**	**0.0%**	**92.3%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**7.7%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 53 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies for Corporate Culture & Function recommended climate change adaptation options (n=13).

	IMPLEMENTATION TIME-FRAME										
CONSENSUS	S	M	L	S to M	M to L	W&S	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	11	0	0	1	0	0	0	0	0	**12**	**100.0%**
Medium	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	0	0	1	**1**	**7.7%**
None	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**11**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**		
TOTAL (%)	**84.6%**	**0.0%**	**0.0%**	**7.7%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**7.7%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 54 Desirability and Feasibility point-of-agreement matrix for Corporate Culture & Function recommended climate change adaptation options (n=13).

	FEASIBILITY								
DESIRABILITY	DF	PF	PF to DF	PU	DU	PU to DU	Not Sure	None	N/A
VD	0	0	2	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0
VD to D	0	0	10	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0
VU	0	0	0	0	0	0	0	0	0
U to VU	0	0	0	0	0	0	0	0	1
Not Sure	0	0	0	0	0	0	0	0	0
None	0	0	0	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = ambiguity.

4.8.8 Education, Interpretation & Outreach Policy Delphi Results: a Summary

Climate change adaptation options recommended by the panel for Education, Interpretation & Outreach were assessed in the main as *Very Desirable* (*VD*) *to Desirable* (*D*) (>85%) (Table 55), *Possibly Feasible* (*PF*) *to Definitely Feasible* (*DF*) (>85%) (Table 56) and should be implemented in the *Short-to Medium-term* (*S to M*) (>85%) (Table 57). Two recommended adaptation options were evaluated as *Undesirable* and these were related to recommendations specifically suggesting that Education, Interpretation & Outreach activities should *not* be adapted to account for climate change.

Similar to the results revealed in the Operations & Development program area, the panel expressed the strong sentiment that Ontario Parks needed to be 'leaders' in public interpretation and education activities related to climate change (EIO.3: 100% of respondents rated this recommendation as either *VD* or *D*). Specifically, the panel stressed that that protected natural areas should be used to educate the public about climate change impacts as well as the implications of these impacts for park features (e.g., species, habitats, ecoregions, physiography, etc.). In the words of one panelist *"Climate change should be incorporated into interpretation about park 'themes' – e.g., show visitors how climate change can affect this rare vegetation community for which the park was created."* Despite overwhelming support for recommendation EIO.3, one panelist counter-argued *"Educating the public about climate change impacts should not be a specific role for parks. The idea is to get them up to speed to carry out their own responsibilities. There is a lot of information out there for the general public already, and lots more likely on the way now that climate change is topping the poles."*

While the panel agreed that Ontario Parks needed to provide visitors with climate change ideas and conservation-oriented activities that they could act on themselves (EIO.4) (*VD to D* and *DF to PF* with *H* consensus), similar to recommendation EIO.3, several counter-arguments were made by panel members justifying why they were *Not Sure* whether or not the recommendation was desirable. As an example, an Ontario Parks panelist cautioned *"I think this might fall outside the scope of our mandate. This is a huge overwhelming issue – one of the many we face in parks. We can't take them all on in our education programs. We don't educate users on urbanization, even though it affects our parks."* Similarly, another Ontario Parks panelist warned *"I think there is way too much emphasis on our protected areas interpretation programs. This should be done at home, as part of the school curriculum, other educational/volunteer groups such as Scouts, plus the media. Realize that many people come to parks to 'get away' from the day-to-day worries – it would be inappropriate and counterproductive to saturate them with climate change messages through natural heritage education programming. There is no doubt that there would be some tie-in; it is impossible to discuss* *local flora, fauna, and ecology without context of climate change, but leave the 'conservation' message to the greater masses who do not use our parks."*

Similar to the results revealed in the national *Protected Areas and Climate Change (PACC) Survey* (Chapter 3), the entire panel held the strong opinion that a national climate change working group with provincial/territorial representation should be established to address climate change and protected natural areas issues, including adaptation. The entire panel also evaluated the recommendation as *DF to PF*. Specifically, in order to avoid duplication of effort and maximize efficiencies, the panel expressed the strong sentiment that it was *VD to D* and *DF to PF* (with *H* consensus) for protected natural areas agencies to seek out partnership opportunities with research groups, such as the Canadian Council on Ecological Areas (CCEA), to stage workshops, develop guidelines and strategies to help managers and planners cope with climate change impacts and to help facilitate adaptation (EIO.15).

Table 55 Consensus and Desirability point-of-agreement matrix and frequencies for Education, Interpretation & Outreach recommended climate change adaptation options (n=15).

	DESIRABILITY									
CONSENSUS	VD	D	VD to D	U	VU	U to VU	Not Sure	None	TOTAL	TOTAL (%)
High	0	2	9	0	1	1	0	0	**13**	**86.7%**
Medium	0	0	2	0	0	0	0	0	**2**	**13.3%**
Low	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	0	0	**0**	**0.0%**
None	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**0**	**2**	**11**	**0**	**1**	**1**	**0**	**0**		
TOTAL (%)	**0.0%**	**13.3%**	**73.3%**	**0.0%**	**6.7%**	**6.7%**	**0.0%**	**0.0%**		

*VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 56 Consensus and Feasibility point-of-agreement matrix and frequencies for Education, Interpretation & Outreach recommended climate change adaptation options (n=15).

	FEASIBILITY										
CONSENSUS	DF	PF	PF to DF	PU	DU	PU to PF	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	0	1	12	0	0	0	0	0	0	**13**	**86.7%**
Medium	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	0	0	2	**2**	**13.3%**
None	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**0**	**1**	**12**	**0**	**0**	**0**	**0**	**0**	**2**		
TOTAL (%)	**0.0%**	**6.7%**	**80.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**13.3%**		

*DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 57 Consensus and Implementation Time-frame point-of-agreement matrix and frequencies for Education, Interpretation & Outreach recommended climate change adaptation options (n=15).

	IMPLEMENTATION TIME-FRAME										
CONSENSUS	S	M	L	S to M	M to L	W&S	Not Sure	None	N/A	TOTAL	TOTAL (%)
High	9	4	0	0	0	0	0	0	0	**13**	**86.7%**
Medium	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
Low	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
N/A	0	0	0	0	0	0	0	0	2	**2**	**13.3%**
None	0	0	0	0	0	0	0	0	0	**0**	**0.0%**
TOTAL	**9**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**2**		
TOTAL (%)	**60.0%**	**26.7%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**13.3%**		

*S=Short-term; M=Medium-term; L=Long-term; S to M= Short- to Medium-term; M to L=Medium- to Long-term; W&S=Wait & See (reactive); *an assessment was not applicable (N/A) in cases where 1/3 of the responses were either left blank and/or not sure; = ambiguity.*

Table 58 Desirability and Feasibility point-of-agreement matrix for Education, Interpretation & Outreach recommended climate change adaptation options (n=15).

	FEASIBILITY								
DESIRABILITY	DF	PF	PF to DF	PU	DU	PU to DU	Not Sure	None	N/A
VD	0	0	0	0	0	0	0	0	0
D	0	1	1	0	0	0	0	0	0
VD to D	0	0	11	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0
VU	0	0	0	0	0	0	0	0	1
U to VU	0	0	0	0	0	0	0	0	1
Not Sure	0	0	0	0	0	0	0	0	0
None	0	0	0	0	0	0	0	0	0

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable; DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible; = ambiguity.

4.8.9 Differences between Respondent Groups

Because the policy Delphi technique is not designed for statistical analysis and because of the sample size within the respondent groups, differences of opinion cannot be expressed in terms of statistical significance. However, there were some notable differences between respondent groups (i.e., Parks Canada, Ontario Parks, academics) and by years with current organization revealed by the evaluations which warrant further discussion.

While time spent with current organization appeared to have little influence on the panelists' evaluation of the desirability of adaptation options (Table 59), and despite the majority of recommendations being assessed in similar manner (in terms of both Desirability and Feasibility) by Ontario Parks (18 panelists) and the 'Other' panelists (17 panelists) (Table 60), there were some notable differences. First, and perhaps not surprisingly, a high percentage of Ontario Parks and broader MNR panelists rated the recommendation that *"a national protected areas strategy should be developed to ensure that protected areas systems are integrated into a plan to achieve broad goals of biodiversity conservation and ecosystem health"* (PSPL.4) *Not Sure*. While the 'Other' panelists held the strong opinion that this recommendation was *VD* (87.5%), only 27.8% of Ontario Parks and the broader MNR panelists rated the recommendation in a similar way.

Table 59 Notable differences between panel individuals who have been with their current agency/organization for 0-10 and 10+ years.

DIFFERENCE B/W YEARS	LEVEL OF DESIRABILITY						
	VD	D	U	VU	NS	VD to D	U to VU
High (>=50%)	1	1	0	0	3	1	0
Medium (>=30-49.9%)	12	13	0	1	3	3	1
Low (>=20-29%)	19	33	9	2	19	15	9
None	133	118	156	162	140	146	155

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable.

Table 60 Notable differences between Ontario Parks and the broader MNR and 'Other' respondent groups with regards to the Desirability of recommended adaptation options.

DIFFERENCE B/W RESP. GROUP	LEVEL OF DESIRABILITY						
	VD	D	U	VU	NS	VD to D	U to VU
High (>=50%)	4	2	0	0	1	8	5
Medium (>=30-49.9%)	23	32	6	5	9	20	12
Low (>=20-29%)	38	29	8	10	18	20	11
None	100	102	151	150	137	117	137

VD=Very Desirable; D=Desirable; VD to D=Very Desirable to Desirable; U=Undesirable; VU=Very Undesirable; U to VU=Undesirable to Very Undesirable.

Table 61 Notable differences between Ontario Parks and the broader MNR and 'Other' respondent groups with regards to the Feasibility of recommended adaptation options.

DIFFERENCE B/W RESP. GROUP	LEVEL OF FEASIBILITY						
	DF	PF	PU	DU	NS	DF to PF	PU to DU
High (>=50%)	11	7	0	0	0	0	0
Medium (>=30-49.9%)	36	38	3	2	3	20	10
Low (>=20-29%)	37	32	17	1	19	28	19
None	81	88	145	162	143	117	136

DF=Definitely Feasible; PF=Possibly Feasible; PF to DF=Possibly Feasible to Definitely Feasible; PU=Possibly Unfeasible; DU=Definitely Unfeasible; PU to DU=Possibly Unfeasible to Definitely Unfeasible.

The analysis also revealed a large difference between respondent groups for the recommendation to no longer use natural regions (i.e., ecoregions and ecodistricts) as the basis for protected natural areas system planning (i.e., representation requirements) and, alternatively, to use natural regions as 'administrative policy units' (PSPL.25) in the *VD to D* categories. While Ontario Parks and the broader MNR were adamantly opposed to the recommendation (with 100% of the panel rating the recommendation as *U* or *VU*), over 50% of the 'Other' panelists rated the recommendation as *VD* or *D*. Such organizational resistance to change is perhaps not surprising from either respondent group's perspectives. From an Ontario Parks perspective, the acceptance and implementation of such a recommendation would require a major conceptual change in how they have gone about rationalizing protected natural areas system planning over the past 30 years. Alternatively, the 'Other' respondent group would not have 'deal with' the transition nor the (largely unknown) consequences and ramifications associated with such a change.

Similarly, the panel was not in agreement on the recommendation to translocate species that are unable to migrate to suitable habitat naturally (MD.12). While 50% of the Ontario Parks and broader MNR panel was *Not Sure* whether the recommendation was desirable, nearly 70% of the 'Other' panelists evaluated the recommendation as *VD* or *D*. As noted previously, common barriers pertaining to the feasibility of this adaptation option included lack of financial resources, lack of knowledge on persistence parameters, and unknown impacts on host species. As one panelist emphasized with respect to assisted migration, *"We cannot start compensating for climate change--it will never end."* Similar to the finding that the panel appeared to be polarized on the desirability of the recommendation to translocate species unable to migrate naturally, the panel also seemed polarized on the feasibility of the recommendation (MD.12). While just over 25% of Ontario Parks and the broader MNR panelists evaluated the recommendation to be *DF* or *PF*, over 70% of 'Other' panelist took a similar position.

As a final example, Ontario Parks and the broader MNR and the 'Other' respondent groups were polarized on the recommendation to not develop specific climate change indicators for monitoring purposes (RRM.23). While all Ontario Parks and the broader MNR panelists rejected the recommendation, over 50% of the 'Other' respondents evaluated the recommendation as *VD*. This is also perhaps not surprising considering the additional workload that would be required by Ontario Parks' staff to develop, implement and report on monitoring results. However, the 'Other' respondents see protected natural areas as having a climate change role in society, namely using protected natural areas as benchmarks for change and sources of knowledge on climate change.

Respondent groups also were polarized on the perceived feasibility of several recommendations (Table 61). As an example, while a notable proportion of the Ontario Parks and broader MNR respondents (44.4%) evaluated the recommendation to ensure that land uses adjacent to protected areas didn't compromise integrity and connectivity functions and take into account the possible movement of species due to climate change as *PU to DU* (PSPL.6), virtually the entire 'Other' panel (93.8%) evaluated the recommendation to be *PU* to *DU*. Similarly, while the Ontario Parks and broader MNR panelists were less certain whether land use activities adjacent to protected areas should allow for the movement of wildlife and plants (PSPL.29, *DF* or *PF:* 55.6%), the majority of the 'Other' panelists (81.3%) evaluated the recommendation to be *DF* or *PF*.

Conversely, while the great majority of Ontario Parks and broader MNR panelists (88.9%) evaluated the recommendation that climate change should be addressed in a review of policies for provincial parks and conservation reserves to ensure they consider climate change, biodiversity conservation and ecological integrity goals (PSPL.7) *DF* or *PF*, 50% of the 'Other' panelists evaluated the recommendation to be *PU* or *DU*. Such a finding indicates that the 'Other' panelists may not have confidence in Ontario Parks' ability to follow through with such a recommendation.

4.9 Some Concluding Remarks on the Policy Delphi Survey

The policy Delphi process outlined in this Chapter provided a method for identifying and evaluating climate change adaptation options according to Ontario Parks' respective major program areas. The data gathered in the first round survey was substantial and addressed the basis for satisfying the research's objectives. 165 adaptation options were identified by the heterogeneous panel of protected natural areas experts. The second round survey provided panelists with the opportunity to react to and evaluate the various adaptation options for desirability, feasibility and implementation time-frame.

The evaluation of adaptation options was important in identifying priority (or '*first-order*') adaptation options (Table 62), those which should be dropped from consideration, and those that ultimately contribute to Ontario Parks' efforts in progressing from *ad-hoc* and *a posteriori* adaptation to proactive and strategic adaptation. The assessment of the numerous adaptation options identified by the expert panel also helps to advance the limited extant climate change and protected natural areas literature move from identifying and recommending 'hypothetical' adaptation options (with no assessment of relevancy within a 'real-world' protected natural areas agency context) to identifying options that are practical and justifiable. This is the first known study to address comprehensively climate change adaptation for a specific protected natural areas jurisdiction.

A number of 'first-order' adaptations are presented in Table 62. The recommendations listed were those assessed to be *Very Desirable* by the entire expert panel (i.e., 100% of those with an opinion). They are proffered to inform discussion within Ontario Parks and the broader MNR and to provide 'starting points' for the development of a more formal climate change adaptation strategy specific to its policy, planning and management program areas. The panel also was asked to rank the major program areas in terms of overall response priority (Table 63). Generally speaking, panelists were clear that adaptations within Policy, System Planning & Legislation and Research, Monitoring & Reporting program areas are the highest priority, whereas adaptations within Operations & Development and Corporate, Culture & Function were of least priority (which is perhaps surprising considering the acknowledged internal capacity constraints identified by the protected natural areas community and Ontario Parks specifically). The ratings generally were consistent between respondent groups. Addressing these recommendations in an effective and efficient manner through an implementation plan will help alleviate the concerns and challenges of regional managers caused by lack of direction from head office on climate change.

Table 62 First-order climate change adaptations within Ontario Parks' major policy, planning and management areas.*

Policy, System Planning and Legislation (PSPL)
PPL.3: Ontario Parks should consult with protected area organizations in adjacent provinces and states to help anticipate, plan and synergize cross-jurisdictional objectives to anticipate the "loss and gain" of species, communities and processes.
PPL.5: Policies for provincial parks and conservation reserves should embrace a science-based adaptive management approach to better deal with potential climate change impacts (i.e., acknowledgement of the dynamic nature of ecosystems and increased flexibility to better manage uncertainty)."
PPL.10: Policies and targets should not only address elements of biodiversity pattern, but should also include the spatial and temporal aspects of natural processes, including population sizes, movements, metapopulation dynamics, disturbance regimes, ecological refugia, and adjustments to climate change.
PPL.30: Protected areas system planning should incorporate 'redundancy' into representation requirements to offset potential species losses resulting from climatic and ecological change (giving high priority to species at risk and highly threatened species).
PPL.42: Ontario Parks' protected area selection criterion of "ecological functions" (i.e., processes) should receive greater emphasis in protected areas system design in order for protected areas to be sufficiently designed to better withstand increased natural disturbances and to help facilitate the movement of species in response to climate change.
Management Direction (MD)
MD.6: Management plans should incorporate a long-term trends analysis to help guide longer-term actions and priorities.
MD.13: Species at risk planning should include protection provisions for the range expansions and contractions of species.
MD.15: Invasive species management direction should be "fluid" and include new and upcoming invasives that could expand their range and affect ecological integrity because of climate change.
MD.17: Management direction should explicitly identify species, habitats, and ecosystems at risk due to possible climate change impacts.
MD.18: Principles of "adaptive management" and the "ecosystem approach" should be incorporated into all

management (e.g., preparing and implementing resource management plans and their subset of interventions) and planning (strategic/corporate, systems planning, site level management plans) directions of Ontario Parks.

Operations & Development (OD)

OD.5: Ontario Parks should explore opportunities for greenhouse gas reductions, including alternative vehicle solutions (e.g., increased use of bicycles, 4-cycle engines for boat motors, lawn mowers, snow blowers, opportunities for commuting, purchasing hybrid vehicles), energy efficient lighting options, and waste reduction strategies.

OD.6: Service-oriented protected areas should be better designed to reduce the need for vehicle use (e.g., campgrounds should be designed in a way that reduces vehicle use by visitors and park staff).

OD.8: Park staff should make greater use of alternative modes of transportation, including bicycles, golf carts, and foot patrols rather than mechanized modes such as trucks.

OD.10: Permanent docks should be replaced by floating docks to facilitate annual relocations subject to water levels and to reduce impacts on aquatic habitats.

OD.15: Recreational uses (e.g., swimming, walking, day-use, mechanized travel, etc.) could be altered (i.e., decreased, stopped) to protect newly exposed shorelines and allow for stabilization through natural succession to occur. Vulnerable coastal ecosystems and facilities should be inventoried and monitored - inventory and monitoring could lead to decisions about possible closures of some areas to public use.

OD.17: Live bait should be severely restricted, perhaps even regulated against, in order to avoid the spread of invasive species.

OD.19: A staff and public education program with standardized messaging should be implemented to help recognize, monitor and report on invasive species occurrences in protected areas.

OD.21: Ecological integrity should be maintained or restored wherever possible as intact ecosystems are more likely to naturally resist invasive species.

OD.23: Restoration and re-vegetation activities should use native species and grasses only (e.g., no ornamental, non-native plants).

OD.25: There should be an increased effort of using natural ecological processes (e.g., fire, prescribed burns) to control invasives.

OD.30: Populations and species associations should be allowed to equilibrate (migrate to suitable water habitats) as ecosystems change, unless the changes are due to over-exploitation or other artificial stresses.

OD.35: Anthropogenic lakes and ponds should be disconnected and restored to their proper bathymetry to the river to reduce water temperature and restore freshwater and groundwater influxes.

OD.43: Camping seasons should be extended in selected provincial parks to take advantage of the potential increase in visitor use.

OD.44: Ontario Parks should identify staffing needs and challenges due to the possibility an extended warm-season (e.g., the availability of students during non-peak season, increased visitation during warm-weather seasons).

OD.45: Efforts should focus on reducing, not increasing, the ecological footprint of human activities. As such, efforts should focus on new forms of recreation that are proactive and environmentally responsible.

Research, Monitoring & Reporting (RMR)

RM.3: An integrated and cooperative monitoring strategy related to climate change to detect and monitor trends and impacts, especially for regionally threatened species, extinction prone species, and management target species, should be established and should be implemented at the ecoregional/system level. Such a monitoring program should also be used to document and assess the success/failure of remedial actions.

RM.4: Natural Heritage staff and "volunteer" monitoring programs (e.g., NGOs, "Friends Of" groups, local schools, park users, etc.) to detect and monitor climate change impacts should be established by Ontario Parks, regional offices, and individual protected areas."

RM.5: Ontario Parks should establish long-term research and monitoring sites against which to quantitatively measure climate change impacts.

RM.9: Climate change impacts and actions should be explicitly recognized as an ecosystem management issue in state of the protected areas and ecological integrity reporting.

RM.14: Regional climate models should be used to predict current protected areas whose ecosystems will be most susceptible to alteration.

RM.15: Ontario Parks should assess major species, habitats, physical features, processes and other important ecosystem resources that are most likely to be impacted by climate change.

RM.19: Monitoring efforts should be coordinated across jurisdictions and with other organizations and partners (i.e., standardize indicators, protocols, etc. to enable seamless roll-ups, assessment, and reporting of time-trend data).

RM.24: A Climate change indicators should be built into existing monitoring programs and ecological integrity monitoring frameworks.

RM.26: There needs to be a balance between climate (driver) and feature/species (responder) indicators, and a clear distinction between regions and parks.

Corporate Culture & Function (CCF)

CCF.4: Staff orientation and training should be geared to occupation (e.g., biologists, planners, mid and upper management, interpreters, etc.) to ensure each understands the science of climate change, impacts, and potential adaptations. As such, training needs to be targeted, concise and directly relevant so employees so they can use it in their daily work.

CCF.5: A system-wide "culture of conservation" needs to be cultivated in order to address activities which can reduce the effects of climate change. Ontario Parks should become a model of "low impact" and positive action.

CCF.6: The contents of an education program could focus on: 1) current science; 2) potential impacts; 3) potential adaptations and limitations to response; 4) "the plan" on moving ahead; and, 5) the role of employees in implementing "the plan".

Education, Interpretation & Outreach (EIO)

EIO.3: Ontario Parks should be leading by example in public interpretation and education activities. Protected areas should be used to educate the public (e.g., through interpretation activities) about climate change impacts and the implications of these impacts for park features (e.g., species, habitats, ecoregions, physiography, etc.) and to build public support on climate change initiatives. Parks should be used to inform the public about climate change efforts to mitigate and adapt to it.

EIO.7: Interactive, hands-on displays, demonstration monitoring (demonstration sites, such as lake retreat), and mitigative/adaptive actions and techniques (e.g., ways to reduce emissions and conserve energy) should be used in protected areas to educate the public and engage multiple partners in climate change education and outreach.

EIO.8: Protected areas organizations should participate in broader landscape initiatives related to climate change.

EIO.9: Protected areas organizations should work in cooperation with other organizations outside of protected area boundaries to help reduce the impacts of climate change through approaches such as protected area system design, ecological restoration, and compatible land uses adjacent to protected areas.

EIO11: A national climate change working group with provincial/territorial representation should be established to address climate change and protected areas issues including adaptation.

EIO.13: A conference or series of workshops across the country to bring together partners involved in conservation to discuss and learn from leading edge researchers and practitioners who have been considering climate change and how to integrate it into protected areas planning and management should be developed.

*= *adaptation options assessed to be 100% in the Very Desirable category.*

Table 63 Response priority within Ontario Parks' major policy, planning and management programme areas as perceived by the expert panel.

POLICY, PLANNING AND MANAGEMENT PROGRAMME AREA	TOP-ORDER (%) TOP 2 RATINGS	LOW ORDER (%) LOWER 2 RATINGS	MEDIAN RANKING
Policy, System Planning & Legislation	44.4%	11.1%	**2 (High)**
Management Direction	0.0%	38.9%	3
Operations & Development	27.8%	61.1%	**5 (Low)**
Research, Monitoring & Reporting	83.3%	11.1%	**2 (High)**
Corporate Culture & Function	22.2%	55.6%	**5 (Low)**
Education, Interpretation & Outreach	33.3%	11.1%	4

Considering that the majority of recommendations identified in the first round survey were assessed to be *Very Desirable to Desirable* and *Definitely Feasible to Possibly Feasible* with *High* consensus, the results in this Chapter reveal that there is a balanced understanding among the expert group of the policy, planning and management issues related to climate change. However, the results presented within this Chapter also strongly suggest that Ontario Parks and the broader MNR can no longer afford to maintain its current institutional *status-quo* if they are to achieve for perpetuity the goals and mandates inscribed in policy and legislation.

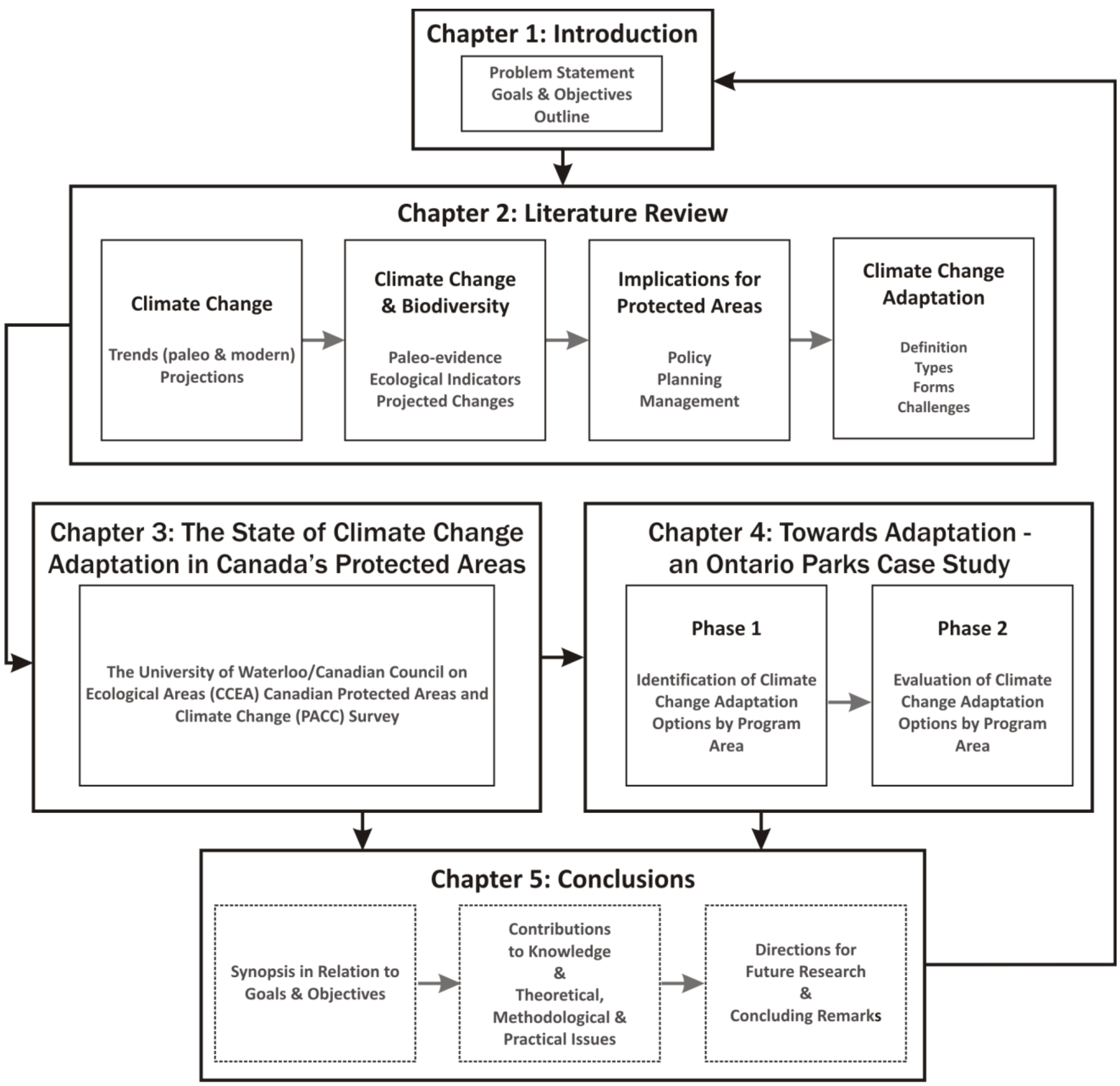
To cultivate an 'enabling adaptation environment' (see Asian Development Bank, 2005) that will reduce vulnerability, increase resiliency, and take advantage of the benefits and opportunities associated with climate change concomitantly, Ontario Parks' current policy, planning and management programs will have to undergo substantial changes in the near future. It is believed that the data produced in this Chapter provide a solid foundation upon which further dialogue can be based. Ultimately, for Ontario Parks to cultivate an enabling adaptation environment and to effectively 'manage the uncertainties' associated with climate change, its programs will have to 'learn' to become more flexible, dynamic and adaptive. The final Chapter of this thesis, Chapter 5, provides perspective on how the results presented within this thesis contribute to Ontario Parks' overall climate change adaptation process and discusses the opportunities, barriers and challenges to effective climate change adaptation.

Chapter 5
Synopsis and Conclusions

5.1 Chapter Overview

As Figure 38 illustrates, this Chapter provides a synopsis of the thesis *vis-a-vis* to the Goals & Objectives identified in Chapter 1. Chapter 5 summarizes the research's contributions to knowledge and methodological issues. It concludes with a philosophical and practical discussion on the major barriers and challenges involved in the protected natural areas and climate change adaptation process (including research recommendations and opportunities). Finally, the Chapter provides a perspective on what is required for Ontario Parks, and indeed the broader protected areas community, to adapt to climate change.

Figure 38 Schematic of dissertation layout in relation to Goals & Objectives identified in Chapter 1.



5.2 Results Synopsis

The writing of this dissertation was inspired by the current state of the literature and professional practice on climate change, biodiversity and protected natural areas. It has been estimated that significant global greenhouse gas emission (GHG) reductions are a distant goal at best (see Prins and Rayner, 2007) and, as a result, Intergovernmental Panel on Climate Change (IPCC) projections of future climate change may have been underestimated (Pittock, 2006). Consequently, climate change could prove to be the greatest driver of global biodiversity loss over the next century. In light of these implications, the long-term effectiveness of existing biodiversity conservation strategies is in question. The world's biodiversity and protected natural areas agencies will need to adapt if they are in perpetuity to meet their respective goals and mandates inscribed in legislation and policy. The principal goal of this dissertation was therefore to begin the process of climate change adaptation (mainstreaming) within the Canadian protected natural areas community, thereby increasing the ability of jurisdictions, agencies and organizations to adapt to climate change-related impacts and implement adaptation decisions. In order to address these needs and the dissertation's primary goal, the dissertation had four objectives:

vi) to identify Ontario Parks' protected natural areas *policy, planning and management sensitivities* with respect to climate change;

vii) to synthesize the *state of knowledge* on climate change, biodiversity and protected natural areas policy, planning and management;

viii) to establish the *state of climate change adaptation* with respect to Canadian protected natural areas agencies;

ix) to assess the current *position*, *priorities*, and *challenges* of, and *barriers* to, Canadian protected natural areas agencies with respect to climate change adaptation; and

x) to develop a *climate change adaptation portfolio* and *evaluate* the suitability of these adaptation options for implementation by a Canadian protected natural areas agency (Ontario Parks).

These objectives have been met in the following manner. As Chapter 2 revealed, the development and maintenance of protected areas 'systems' around the globe, including Canada, have become central elements of strategies to conserve biodiversity. Furthermore, protected areas are regarded as the most common and important strategy in implementing the *United Nations Convention on Biological Diversity (UNCBD)*. Ecosystems and species, however, already are beginning to respond to climate change and climate change has been implicated in several recent species extinctions (Chapter 2, Section 2.3). Projections of future ecological response to climate change overwhelmingly suggest negative consequences for biodiversity, including the potential for greater extinctions (Chapter 2, Section 2.6). Future ecological response to climate change will test like never before the utility and viability of current protected natural areas system planning approaches (i.e., representation), guiding concepts (e.g., ecological integrity), management objectives (i.e., the perpetual representation of natural heritage values) and operations (e.g., recreational opportunities) (Chapter 2, Section 2.7). Climate change, consequently, has become a significant issue of concern for protected natural area planners and managers requiring management intervention.

In actual fact protected natural areas across Canada are already experiencing climate change-related impacts, including changes to ecosystem composition, structure and function (e.g., shifts in species geographic ranges and population abundances), disturbance regimes (e.g., forest fire intensity), changes to physiography (e.g., shoreline erosion and glacial retreat) and visitation (e.g., increased visitation during shoulder seasons) (Chapter 3, Section 3.3). In addition, climate change is perceived by protected natural area agencies across Canada to be an issue that will substantially alter policy in the next 20 years. While most academic literature on climate change adaptation suggests that adapting now will be more effective than adapting later (i.e., more cost effective and efficient in reducing the potential for irreversible impacts, such as species extinction) (Chapter 2, Section 2.9), protected natural area planners, managers and decision-makers remain unsure as how to go about adapting in an effective and efficient manner (Chapter 3, Section 3.3.3). Clearly, there remains an important gap between the perceived salience of climate change and the capacity (i.e., funding, staff expertise, etc.) of protected natural areas agencies to respond (Chapter 3, Section 3.3.3).

The challenge for protected natural area planners, managers and decision-makers in the short-term, therefore, will be to create and maintain an 'enabling environment' that progressively can learn to proactively and strategically adapt and be robust and resilient to emerging climate change threats, and to better position themselves to take advantage of opportunities associated with climate change. While Ontario Parks and the broader Ontario Ministry of Natural Resources (MNR) have begun to cultivate such an environment by allocating resources (i.e., financial) in order to facilitate and promote climate change-related activities, including scientific research on emerging climate change issues and participating in several corporate culture and function and education and outreach activities (Chapter 4, Section 4.4), the present capacity of these agencies to effectively and efficiently respond to climate change autonomously is limited (Chapter 3, Section 4.2).

To offset the capacity limitations identified within the climate change adaptation literature and by the Canadian protected natural areas community in the *Protected Areas and Climate Change* (*PACC*) *Survey* results (Chapter 3), a policy Delphi survey was conducted. Its purpose was to aid in the identification and evaluation of climate change adaptation options for Ontario Parks' major policy, planning and management program areas (Chapter 4). An expert panel identified and evaluated 165 adaptation options for their level of desirability, feasibility and implementation time-frame. In addition to the substantial conceptual and practical contribution of the research to the climate change adaptation literature generally (Chapter 5, Section 5.3), and to Ontario Parks' ongoing climate change adaptation process specifically (Chapter 5, Section 5.5), a number of insights and recommendations have been developed (Chapter 5, Section 5.4). They are aimed at improving the relevance of the results should they be adopted other protected natural areas agencies to aid in the future identification and evaluation of adaptation options applicable to their respective socio-political and policy, planning and management contexts.

5.3 Contributions to Knowledge

The results of this dissertation are reflected in several important findings which are summarized as follows. Collectively speaking, the research of Scott *et al.* (2002), Scott and Lemieux (2005), Lemieux and Scott (2005), Scott and Lemieux (2007), Lemieux *et al.* (2007) has moved initially from helping the Canadian protected natural areas community understand the potential consequences of climate change for biodiversity and other natural resources and assets (i.e., tourism and recreation resources) to next identifying and characterizing the implications these impacts have for current protected natural areas policy, planning and management program areas (i.e., motivating a willingness to, and creating momentum for, change). The research presented within this dissertation has provided a perspective on what is needed to effectively and efficiently mainstream climate change into these program areas. Ultimately such work has provided a foundation upon which institutional climate change adaptation can progress.

The distinctive motivation of the research presented within this dissertation was to identify what can be done by protected natural areas agencies that is scientifically sound and institutionally possible, in order to: i) moderate the vulnerability to climate change conditions that are problematic to the community; and ii) better position themselves to take advantage of potential opportunities associated with climate change. Whereas the previous research noted above (e.g., Scott *et al.,* 2002;

Scott and Lemieux, 2005; Lemieux and Scott, 2005; Lemieux *et al.,* 2007) worked towards 'widening' or 'expanding' response space and opportunity (i.e., through modelling and vulnerability assessments), the research presented herein has worked towards enhancing response capacity (i.e., through the identification and evaluation of adaptation options) and narrowing response space to what is scientifically sound and institutionally possible. As such, the research contributes directly to adaptation initiatives that tangibly influence the vulnerability of protected natural areas (and their respective managing institutions) to climate change. It is the first known study to characterize the *'state of climate change adaptation'* among Canada's protected natural areas agencies and to also examine comprehensively climate change adaptation for a specific protected natural areas jurisdiction (Ontario Parks). The research also introduced a methodology to facilitate the identification and evaluation of adaptation measures tailored specifically to a protected natural areas jurisdiction. In so doing, the research focused on conditions important to the community rather than those assumed in the existing literature [as recommended by Smit and Wandel (2006)].

From a philosophical perspective, the research illucidated some of the ethical issues and moral dilemmas associated with the climate change, biodiversity and protected natural areas issue. Since whatever decisions are made with respect to climate change, biodiversity and protected natural areas will, in the end, be based on value judgements, there is clearly an indicated need to begin incorporating the intrinsic and extrinsic values of protected natural areas into the climate change adaptation dialogue. Sociological and biological values analysis and clarification will be important in this respect to guide reflection on personal moral dilemmas involving a great number of people and viewpoints and should be a priority area of future research focus.

On an international level, the research within this dissertation addressed the main objective of the *United Nations Framework Convention on Climate Change* (*UNFCCC*), which commits countries to avoid *"dangerous"* atmospheric changes in climate. *Adaptations* are considered to assess the degree to which countries can moderate or reduce negative impacts of climate change, or realize positive effects, to avoid the 'danger'. More specifically, this research addressed Article 4.1 of the *UNFCCC* that commits countries to *"formulate and implement… measures to facilitate adaptation to climate change."* This research also responded to the calls of the international biodiversity and protected natural areas communities (see Chapter 2, Sections 2.9.3a and 2.9.3.b), particularly the UNCBD's recommendation to *"Integrate climate change adaptation measures in protected area planning, management strategies, and in the design of protected area systems"* (decision VII/28/Goal 1.4.5) and *"…support the preparation of adaptation activities and plans, including assistance in the areas of financial resources, technology* *transfer, education and outreach, capacity-building, research and systemic observation, and harmonized reporting"* (decision VIII/30/7). This research also addressed the World Commission on Protected Areas' (WCPA) Vth World Parks Congress recommendation to *"identify and communicate best practices to establish methods to anticipate the impacts and opportunities from global change, and adapt management to those changes."* (WCPA, 2003: Recommendation b.)

Looked at provincially, the analyses in this dissertation contributed to the Ontario Ministry of Natural Resources' (MNR) objectives to encourage strategic thinking and planning in terms of identifying, establishing and modifying short-term and long-term direction as related to climate change and protected areas policy, planning and management. The research also supported the MNR's *Climate Change Strategy* (Strategy 7F) to *"Develop and implement adaptation strategies for parks and protected areas for natural resource-related recreational opportunities and activities that are pursued outside of parks and protected areas"* and Strategy 8 to *"ensure policy and legislation respond to climate change challenges."* (MNR, 2005a)

Due to the collaborative and heterogeneous nature of the study, the research took great steps in mutual learning and intellectual experimentation. It provided information central to effective decision-making, in light of significant uncertainty, and offset the operational capacity constraints that have inundated the protected natural areas sector generally and Ontario Parks specifically (see ECO, 2007). Finally, the research satisfied the intended Goals & Objectives of the dissertation identified in Chapter 1 through systematically characterizing a wide variety of types of adaptations to climate change and providing some order to these options in terms of both the forms adaptations can take and the barriers and challenges involved. Collectively, the research includes the first practical discussion of adaptation to climate change within the institutional framework of any Canadian protected natural areas jurisdiction. The research therefore represents a significant contribution to the conservation planning literature at the science-policy interface.

5.4 Discussion of Relevancy of Results and Recommendations for Future Research

Overall, the methods used to address the research objectives were successful. The *Canadian Protected Areas and Climate Change (PACC) Survey* that was carried out (Chapter 3) included jurisdictions, agencies and organizations that collectively constituted over 95% of Canada's protected natural areas network (both in terms of total number of protected areas and total hectares protected). From the national, provincial and territorial 'protected areas system' perspective, therefore, the survey was comprehensive and representative of the 'big picture'. Despite this high representation, there may be climate change impacts and adaptations occurring at the park-level that are not observed due to a lack of resources and capacity to identify and monitor such changes and because climate change is currently not integrated into 'state-of-the-park' reporting by respective jurisdictions, agencies and organizations. Elements of the *Protected Areas and Climate Change (PACC) Survey* should therefore be integrated into respective state-of-the-park reporting processes in order to achieve more comprehensive accounting of climate change impacts and adaptations and to better identify system, regional and park-specific challenges and opportunities.

The policy Delphi study resulted in highly diverse responses and was an excellent forum for the generation of ideas on a complex issue having no policy analogue and confounded by significant uncertainty. The findings presented within this dissertation reflect both 'positive' and 'normative' adaptation assessment: while the first round survey was largely an experimental exercise focused on identifying what adaptations should take place, the second round survey was a normative exercise that presented panelists the opportunity to evaluate options and identify those that could take place. While the sheer number of climate change adaptation options generated by the approach was impressive, in light of the desire to use the results as a foundation for further policy or strategy formulation, a discussion regarding their relevance is necessary.

First, while the policy Delphi exercise was an effective tool for the generation of ideas, the recommendations need to be further evaluated by Ontario Parks' policy-makers and decision-makers before being mainstreamed into official policies, strategies and regulations and prior to the development of a strategy tailored specifically for protected natural areas. Notably, most of the adaptation options were assessed to be *Very Desirable to Desirable*, *Definitely Feasible to Possibly Feasible* and to be implemented in the *Short-Term*. These ratings were not surprising considering the broad nature of certain recommendations (e.g., PSPL.2: *"A strategic and corporate policy on climate change and protected areas is needed to provide sufficient direction for planning and management."*) It was difficult for a panelist not to support such generic statements. Moreover, the criteria panelists used to assess other more specific and innovative adaptation options may have varied, despite the descriptions provided to them in Table 27 (Chapter 4). For example, even if a recommended adaptation option was perceived to be an immediate priority (i.e., perceived to be something that should be implemented in the short-term), implementing the option could require significant lead-time. Recommendations suggesting substantial changes to current policy or those requiring social and political acceptance, substantial financial investment, or research and development are unlikely to be implemented in the short-term.

In addition, several recommendations suggested that a large degree of land-use reform would be needed in order to facilitate the natural migration of species to more suitable habitat under changing climatic and ecological conditions (i.e., managing the matrix). Such adaptation options fall outside the jurisdiction of protected natural areas agencies and would no-doubt would require a substantial amount of consultation with communities, landowners and other stakeholders. This work would have to be done before new forms of management across land-use are implemented.

Mainstreaming concepts such as 'resiliency' into protected natural areas policy, planning and management programs would require a significant shift in institutional perspective. For example, protected natural area planners and managers would have to expand their definition of desirable ecosystem states, often inscribed in management plans, to accept maintaining processes (i.e., trophic complexity) but not necessarily species identity or ecological pattern (see Hulme, 2005). Panelists might have rated the implementation time-frame for such options as *Short-Term* (i.e., within five years), even though it may take 20+ years to actually implement them.

Furthermore, keep in mind the temporal context associated with reviews and revisions of protected natural areas legislation, policy and management plans. Although most respondents deemed it was desirable and feasible to integrate climate change into protected natural areas legislation, policies and regulations, this simply may not be achievable in the short-term. For instance, even if panelists believed that the concept of ecological integrity might be unsuitably defined and prematurely adopted in legislation and policy, it is highly unlikely that the operational definition of the concept will be revised considering that the new *Provincial Parks and Conservation Reserves Act* (*PPCRA*) was passed in September, 2007. Consequently, the short-term integration of climate change may in fact be limited to those policy, planning and management frameworks that are frequently reviewed (relatively speaking), such as individual park management plans[69] and *Ontario Provincial Parks Planning and Management Policies* (MNR, 1992) (the latter being over 15 years old itself).

Second, some adaptation option evaluations may have been influenced by the panelists' idealism and management philosophy. Many recommendations rated as desirable and feasible had major legal, financial or regulatory implications for Ontario Parks and the broader MNR (and fall

[69] Even this may not be achievable considering the capacity limitations noted in Table 21 in Chapter 4.

outside the traditional domain of protected natural areas). This included, for example, those that pertained to the expansion of the protected natural areas network (e.g., PSPL.26, PSPL.27, PSPL.30, PSPL.31); the alteration of the legal boundaries of protected areas to accommodate climate change induced ecological changes (e.g., PSPL.28); the strategic establishment and de-regulation of protected natural areas (e.g. PSPL.33); species translocation (e.g., OD.31, OD.32); the replacement and redesign of buildings and other built structures (e.g., OD.10); and the development of research and monitoring programs (e.g., RMR.2, RMR.3). While these could most definitely be considered desirable climate change adaptation initiatives, their short-term feasibility is debatable. Some panelists expressed concerns about the costs associated with such recommendations (see recommendations OD.4 and OD.8 in Appendix 3 for examples). Despite these concerns, many panelists deemed that a number of recommendations be pursued without consideration of the substantial changes and resources required to actually implement them. It is largely unknown how panelists characterized pertinent conditions (each with their own parameters) and the utility of the broad evaluation descriptions provided. Moreover, because expert perceptions reflect value judgments and are not independent of certain institutional and political contexts (Berkhout *et al.,* 2004) and because stakeholders may perceive adaptation options in numerous different ways due to the diversity of interests they hold (Adger *et al.,* 2003), in some cases, consensus might not have been an effective evaluation method since some panelists may not have fully understood the realities of the option (e.g., fiscal, legal, regulatory or otherwise).

Furthermore, the feasibility of some recommendations were often scale- and/or region-specific. Ecodistricts such as those located in southern Ontario are limited in the amount of Crown Land available for new protected natural areas. While the Great Lakes-St. Lawrence ecodistricts recently (i.e., 1997) met their protection targets through the *Lands for Life* and *Ontario's Living Legacy* (*OLL*) land-use projects, protected natural area establishment is now limited to small additions made through boundary adjustments and public donations. Consequently, the likelihood of incorporating climate change considerations into protected natural areas selection and boundary adjustments in these regions is highly unlikely. New protected natural area selection policies containing climate change considerations are likely limited to relatively undeveloped ecodistricts, such as those located in the boreal forest (e.g., via Ontario's Northern Boreal Initiative) and north of the *OLL* area of undertaking.

Given these implications, a further evaluation stage of the recommended adaptation options identified through the policy Delphi would be very useful and could overcome some of the ambiguity associated with the expert panel's decision-making process. A limitation of the policy Delphi method not recognized in the extant literature is that it does not factor in the process of decision-making, it focuses simply on the outcome of the decision-making process. Other feasibility criteria, such as 'cost', 'ease of implementation', 'institutional capacity' and 'capacity to sustain over time' could be used to achieve a better understanding of the 'real-world' feasibility (i.e., applicability) of recommended adaptation options.

Furthermore, it would also be useful to determine whether or not panelists perceived the policy Delphi process to be 'empowering' and whether or not they held the opinion that the approach facilitated a broader sense of 'ownership' in the identification of potential solutions (see Sharon and Wright, 2006). Further examination of the legitimacy, or the extent to which recommended adaptation options are acceptable to non-participants (e.g., other sectors, matrix stakeholders) affected by those decisions, would also be quite useful. Similarly, large questions remain as to how the public might be engaged in the climate change, biodiversity and protected natural areas dialogue. As Adger *et al.* (2005) emphasized, without legitimacy, developments pertaining to adaptation have less chance of full implementation.

The results of any policy Delphi analysis are highly influenced by the particular consensus method adopted by the researcher. The thresholds used for the analyses in this dissertation were very conservative, with *High* consensus defined as either >=70% in a single descriptor category (e.g., *Very Desirable*) or >=80 in related categories (e.g., *Very Desirable to Desirable*). However, as was noted in Chapter 4, 51% (or majority rules) has often been used in other policy Delphi studies to determine consensus. If the thresholds for consensus were dropped to >=51% in a single descriptor category and/or >=60% in related categories (defined as *Low* consensus in this study), *High* consensus for desirability, feasibility and implementation time-frame for virtually all recommendations within each major policy, planning and management program area would have been achieved.[70]

The willingness of panelists to participate in such a lengthy survey process may have reduced the effectiveness of the policy Delphi process. While 45 panelists began the study, only 34 continued to the end. Even with regular communication between researchers, senior Ontario Parks

[70] The number of recommendations assessed to be *Not Sure* (>=33.3% of responses in this category) (i.e., ambiguous) would remain the same.

management and panelists stressing the importance of continued participation, the willingness of panelists to continue diminished as the study proceeded. This 'adaptation fatigue' resulted in two significant caveats. First, the policy Delphi study process was limited to two rounds due to resource constraints (i.e., time) and the potential for even greater panelist attrition.[71] Second, some recommendations lacked substance (i.e., comments and rationale) and specific guidance on tactics for implementation. This missing information may hinder the development of future strategies or action plans geared to implementation of a given adaptation. Lacking tactical information necessary to develop a strategy, compounded by a low institutional capacity in terms of both financial resources and scientific expertise, adaptation options resulting from this research risk remaining as statements of intent, rather than guides for the policy, planning and management activities of Ontario Parks.

These caveats aside, adaptation fatigue did not occur during the first round survey, the most important part of the policy Delphi process. Pyke *et al.* (2007) recently emphasized that most climate-related decisions support resources are currently limited by the quantity and quality of available information. Innovative and novel recommendations accompanied by insightful comments were put forth by many panelists during the first round survey. In fact, the absolute number of unique adaptation options identified and evaluated by the panel (165) in the first round survey dwarfed the number of recommendations found within current scholarship on the subject, such as those summarized by Halpin (1997), Scott and Lemieux (2005) (n=28) and Heller and Zavalletta (in press) (n=24). The policy Delphi method provided a comprehensive portfolio (or inventory) of options important to advancing decisions related to climate change, biodiversity and protected natural areas. The advantages associated with the policy Delphi approach included minimizing the influence of dominant individuals, irrelevant and biasing communication, and group pressure for conformity (i.e., minimized influence of power relationships). This worked towards meeting the objectives of the research and clearly overcame the weaknesses implicit in relying on a single expert, a one-shot group average or workshop discussion (de Loë, 1991). Furthermore, the assessment methodology adopted in the second round survey identified a number of 'first-order'

[71] Of the 45 responses received for the first-round survey, 49% were submitted *after* the *extended* deadline. Similarly, 53% of the 34 responses received for the second-round survey were submitted *after* the *extended* deadline.

adaptations (based on the perceived level of desirability) which could be looked upon as near-term priorities by Ontario Parks (Table 62, Chapter 4).

Similar to other policy Delphi applications (e.g., Turoff, 1975, de Loë, 1991; de Loë, 1995; de Loë and Wojtanowski, 2001), and especially considering this was the first known application of the technique within the realm of the climate change, biodiversity and protected natural areas issue, procedures were customized to suit the purpose of the research. Consequently, comparative analysis is difficult to discern. This limitation is sometimes viewed as advantageous, however, as the non-rigid procedure provides the flexibility to tailor the application to specific needs (Needham and de Loë, 1990; de Loë, 1991).

Given the complex nature of climate change and its related uncertainty, the policy Delphi method proved to be an appropriate tool for identifying adaptation options within the major program areas specific to the protected natural areas sector. It was also useful for facilitating and determining consensus among a heterogeneous and geographically dispersed panel of experts. Overall, the information produced from this dissertation is exploratory in nature and provides a sound foundation for further dialogue. A smaller Ontario Parks Climate Change Adaptation Working Group (OP-CCAWG) consisting of decision- and policy-makers can profitably use these recommendations to discuss further the feasibility of adaptation options and identify and discuss the various barriers, challenges and opportunities associated with their implementation (see *Steps 5* and *6* of Ontario Parks' adaptation process outlined in the next section of this Chapter). As noted, criteria such as 'affordability', 'ease of implementation', 'institutional capacity' and 'ability to sustain over time' may be useful in the further evaluation of adaptation options by the working group. A policy Delphi study, therefore, is to be seen as one of many tools that can aid in the creation of a climate change adaptation strategy (Lindstone and Turoff, 2002).

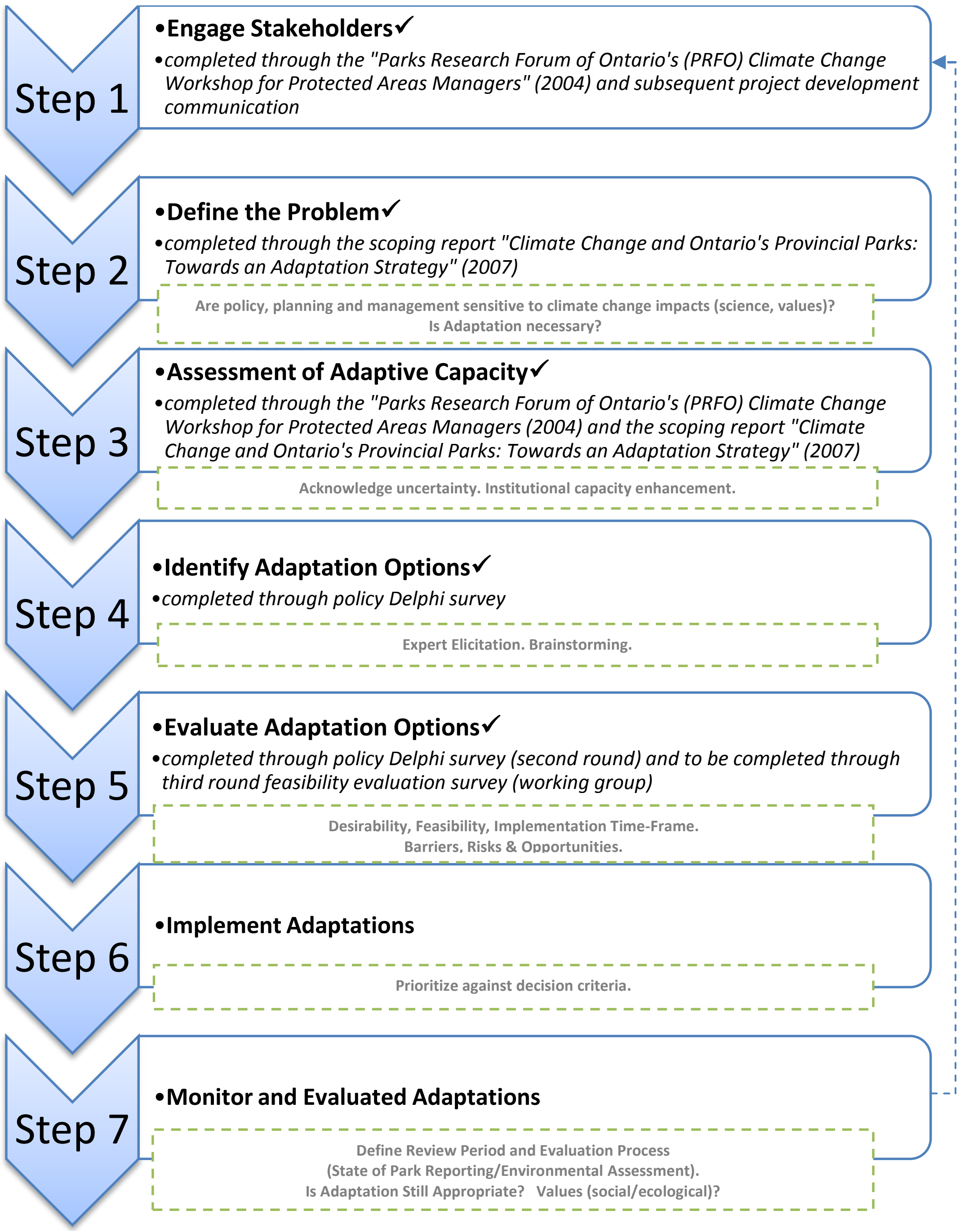
5.5 Ontario Parks' Adaptation Framework: Issues at the Science-Policy Interface

As discussed in Chapter 3, a limited range of methodologies and decision tools currently exist to identify and evaluate climate change adaptation options. There is no single 'correct' procedure to undertake climate change adaptation (UNEP, 2008) and none of these methodologies have been applied to the protected natural areas sector. Each has relative strengths and, consequently, their utility depends on the specific adaptation process and the stakeholders involved

(UNEP, 2008). The seven step adaptation framework outlined in Figure 39 represents an integration of the recommended frameworks developed by United Nations Environment Program (UNEP, 1998), the United Nations Framework Convention on Climate Change - National Adaptation Programmes of Action (NAPAs) (UNFCCC-NAPA, 2001), the United Nations Development Program (UNDP, 2004) and the United States Agency for International Development (USAID) (2007) and was the adaptation framework adopted in preceding research (e.g., Lemieux and Scott, 2005; Scott and Lemieux, 2005; Scott and Lemieux, 2007; Lemieux *et al.,* 2007) and this dissertation. The process should not be considered a linear sequence, but rather an iterative cycle of problem definition, adaptation implementation and evaluation of outcomes (UNEP, 2008).

Step 1, *Engage Stakeholders*, began in 2004 with a Parks Research Forum of Ontario (PRFO) state-of-the-art workshop on climate change. The aim of this PRFO workshop was to explore the evidence for climate change, the uncertainties involved, and the measures that might be taken to adapt to them. The workshop was primarily intended for Ontario Parks' park managers and other staff so that they: i) have an opportunity to gain state-of-the-art knowledge about climate change as it bears on their current and future responsibilities; and ii) can determine whether or not capacity existed within the organization to adequately address climate change (*Step 3*: *Assessment of Adaptive Capacity*). *Step 2, Define the Problem,* focused on identifying policy, planning and management sensitivities to climate change (via literature reviews and climate-envelope modelling) to help Ontario Parks understand the risks and opportunities associated with climate change. The results of the scoping assessment were published in Lemieux and Scott (2005) and Lemieux *et al.* (2007) and provided Ontario Parks with a summary of potential climate change impacts and the implications these impacts have for current policy, planning and management frameworks. *Step 4, Identifying Adaptation Options* focused on compiling both preparatory and participatory climate change adaptation activities (USAID, 2007). Preparatory activities began with the identification of current adaptation actions, strategies and policies in place to address current climate related risks (see Table 22, Chapter 4). Participatory activities, on the other hand, included the use of the policy Delphi technique with key experts to identify alternative management practices, policies and technologies that may enable Ontario Parks to better cope with the anticipated impacts of climate change (the focus of the research presented within this dissertation). Academic, federal government, private and environmental non-governmental organizations (ENGOs) experts were consulted in the policy Delphi to share ideas, information and experiences, and to help identify potential gaps that may have resulted from an 'Ontario Parks only' generated adaptation portfolio.

Figure 39 The climate change adaptation framework adopted in this research to facilitate climate change adaptation within Ontario Parks.



Step 5, *Evaluation of Adaptation Options and Select Course of Action,* was also partly conducted in this dissertation. The adaptation portfolio identified by the expert panel was evaluated for their perceived level of desirability, feasibility and implementation time-frame. As previously noted,

however, it is recommended that a third round survey or Ontario Parks Climate Change Adaptation Working Group (OP-CCAWG) be established to determine criteria by which to further evaluate adaptations (i.e., identify and discuss the barriers and opportunities associated with their implementation) for their real-world feasibility (i.e., applicability) and to further refine (and prioritize) the portfolio of adaptations to be considered for implementation. A range of criteria can be used to evaluate adaptation strategies, including the examples noted previously. Such a Working Group is currently being formulated collaboratively by the University of Waterloo and Ontario Parks with assistance from Natural Resource Canada's (NRCan) *Climate Change Adaptation Fund*. *Steps 6* (*Implement Adaptations*) and *7* (*Monitor and Evaluate Adaptations*), which focus on implementation, monitoring and reporting (i.e., adaptive management) of adaptation options will be, in the end, the responsibility of Ontario Parks and the broader MNR.

Ontario Parks will continue to face many challenges in learning how to adapt to climate change impacts. These challenges relate to uncertainty associated with the magnitude, rate and timing of climate change and its impacts as well as the uncertainty associated with the advantages (or benefits) resulting from adaptation options. In the context of an uncertain future, adaptation represents a major challenge to Ontario Parks and adaptation effectiveness, which is the capacity of an adaptation action to achieve its expressed objectives, and will be dependent on the sequences and interaction of adaptation over time (Adger *et al.,* 2005). As Adger *et al.* (2005) emphasized, the effectiveness of an adaptation option introduced by any organization is often reliant on the actions taken by others (for examples, those outside protected natural areas) and may well depend on the future-unknown-state of the world (i.e., future social and economic conditions). Furthermore, the protected natural areas sector needs to be cognizant that adaptations might result in 'spatial spillovers' – while an adaptation may be effective in reducing the impacts of climate change or increasing opportunities in one location or time period, it may also very well increase pressures 'downstream', or lesson the abilities of others to adapt to climate change (see Adger *et al.,* 2005).

Given this context, we must ask the very important question: *"What if Ontario Parks adapts and 'Others' do not?"* The relative importance placed on different adaptations varies with the perceived limits to an agent's area of responsibility (Haddad, 2005; Adger *et al.,* 2005) meaning that Ontario Parks and the broader MNR will need to decide at what point the effects of climate change (and adaptations) become 'someone else's problem' and/or when an issue or impact extends beyond the realm of protected natural areas themselves. As Adger *et al.* (2005) emphasized, 'adaptation success' depends on both the spatial and temporal scale and should not be assessed simply in terms of the stated objectives of individual adaptors.

Perceptions of what will precisely enhance the ability to respond (i.e., appropriate adaptation options) are also likely to change. Some of the adaptation options identified in this dissertation may very well prove to be 'maladaptations' in some contexts in the future. Accordingly, it is important to recognize that any capacity built or decision made can change in response to new information (i.e., recognize that adaptive management will be necessary) (Tompkins and Adger, 2005). Consequently, this dissertation could provide a departure point for additional areas of future research. Analyses could be conducted to assess the extent of Ontario Parks' adoption (and longer-term relevancy/sustainment) of the adaptation portfolio presented within this dissertation. The uncertainty over the effectiveness and 'success' of respective adaptation options will need further discussion within Ontario Parks and the broader MNR.

The existing institutional setting of protected natural area jurisdictions also has its limitations, as was demonstrated through the *CCEA PACC* survey in Chapter 3. These limitations appear related to the incapacity to deal with climate-related problems and the existence of very limited coordination between governments, institutions and departments. Decisions regarding climate change adaptation (i.e., what adaptation options to implement) will also be constrained and challenged by the current climate of fiscal constraint within the protected natural areas sector generally and within Ontario Parks specifically. Long time-frames, scientific uncertainty about climate change, related ecological impacts and social, political and economic futures will all conspire to test the abilities of Ontario Parks' existing decision-making processes at all levels.

Ontario Parks' institutional context suggests that, for the foreseeable future at least, the capacity of Ontario Parks to identify and implement independently more widespread, complex and strategic climate change adaptation measures is limited. To their credit, however, Ontario Parks and the broader MNR are beginning to create a flexible and enabling environment to promote mainstreaming adaptation, and have established an effective research network with other levels of government and academia to help offset internal capacity limitations and aid in the development of potential solutions. Despite limited internal capacity and lack of adequate resources to address the climate change issue, Ontario Parks has created a window of opportunity to conduct further research on climate change and adaptation. Also, since there are a number of 'champion' stakeholders with shared values interacting frequently, a communication channel has been established that may be capable of changing institutional mindsets and consequentially integrating climate change into Ontario Parks' major policy, planning and management program areas.

Adapting to climate change will also necessitate substantial changes to institutional 'routines'. Routines need to be modified or adapted when an organization experiences novel situations for which appropriate procedures have not yet been developed (such as climate change); when existing routines prove to be unsuccessful; or when alternative routines promising greater advantages are discovered internally or externally (Gavetti and Levinthal, 2000). Given the large turnover and loss of staff that has been common to protected natural areas agencies over the past decade (e.g., ECO, 2007; CPAWS, 2008; R. Davis, pers. comm.), mainstreaming climate change into institutional processes, as opposed to simply 'handing over the climate change file' from person-to-person, will be essential. As such, the 'dynamic capability' of Ontario Parks will determine the overall effectiveness of their adaptation process.[72]

More importantly, and of central importance to this research, policy failure (or maladaptation) may be the result of 'not addressing a significant problem' (see Weale, 1992: 43). In light of the climate change, biodiversity and protected natural areas issue being relatively 'young'[73]; the complexity and uncertainty associated with the projected magnitude, rate and geographic dispersal of climate change-related impacts; and the differing priorities on the part of the provincial government, it comes as little surprise that actions-to-date have been nominal, disjointed and non-strategic. Acceptance and implementation of recommendations presented in this dissertation will be dependent upon an appropriate political climate. As Orr (1990: 70) emphasized over 25 years ago *"there is no 'crisis of biological diversity' or even 'ecological crisis'. But there is a large and growing political crisis that has ecological and other consequences."* The biodiversity, protected natural areas and climate change issue is, therefore, a problem of political motivation. While the *First National Summit on Climate Change Adaptation* held in Toronto in April 2008 recognized the need for climate change to be embedded in many key policies and programs, discussion focused on water and agricultural sectors and not on

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[72] Zollo and Winter (2002) defined dynamic capability as *"…a learned and stable pattern of collective activity through which an organization systematically generates and modifies its operating routines in pursuit of improved effectiveness."* (340) Berkhout *et al.* (2002) found that while all organizations possess dynamic capabilities, the appropriate investment of resources in these capabilities varies depending on the perceived benefits.

[73] As Adger *et al.* (2005: 85) emphasized in this context, *"The whole issue of adaptation begins from a sub-optimal and 'unfair' starting position because of the intergenerational nature of the problem."*

protected natural areas and biodiversity. This raises the question: *"How can the lack of climate change integration in protected areas policy, planning and management be brought to the attention of the government and the public?"* The promotion of reform may fall to the Ontario Parks Board or the office of the Environmental Commissioner of Ontario (ECO) and its powers under the *Environmental Bill of Rights* (*EBR*), in conjunction with the public, exerting pressure on the provincial government to revise policies. In this regard, one of the central objectives of the *EBR* (Section 2.2.2) is *"The protection and conservation of biological, ecological and genetic diversity."* A possible future research avenue could include a study identifying and discussing the costs associated with not adapting at various operational levels. This research could also demonstrate how adaptation would increase the effectiveness and efficiency of Ontario Parks' various programs and mandates.

A fundamental finding emerging from the body of climate change adaptation literature (reviewed in Chapter 2) is that it is highly unlikely any type of adaptive action will be taken in light of climate change alone (Smit and Wandel, 2006). A further challenge for Ontario Parks and the broader MNR, and other conservation-oriented agencies, therefore, will be how they (invariably) integrate the climate change adaptation options noted above (and in Appendix 3) into other programs such as species-at-risk, invasive species and forest fire management. Climate change adaptation in the protected natural areas sector can only progress by means of a more integrated approach within government and institutions, among sectors, between a complex overlay of ecological and jurisdictional scales, from the international to the local. As Tompkins and Adger (2005) emphasized, decision-making in the climate change adaptation domain likely will lie along a continuum, with many groups interacting with one another and influencing the decision-making process.

Berkhout *et al.* (2002) concluded that there is a general resistance to drawing conclusions that challenge traditional frames of reference, so that organizational myths, beliefs and paradigms are maintained, often in the face of considerable counter-evidence. Adaptations to date within the protected natural areas sector have been *ad-hoc*, disjointed and non-strategic. Furthermore, Keeney and McDaniels (2001) observed that long time-frames for decision-making (see previous discussion in Section 5.4), lack of information and uncertainty about impacts increase the propensity of institutions to become 'locked' into a limited set of response options for climate change decision-making. It is to be hoped that extreme events, such as species extinctions, are not required to raise the consciousness of climate change within protected natural areas policy-making, correspondingly giving legitimacy to governmental action. In order to overcome this potential, Keeney and

McDaniels (2001) advocated that a shorter time-frame (i.e., less than 20 years) during which time preliminary policy objectives for climate change are developed, pursued, tested and evaluated is required. Ultimately whatever is done about climate change will be in the end a value judgment; however, values between provinces, countries and sectors will vary over time as attitudes and expectations change. Ontario Parks will have to decide how much uncertainty they are willing to adapt to without compromising their own values. All these issues have implications on how climate change adaptation processes are likely to unfold within Ontario Parks.

5.6 Conclusions

The research findings of this dissertation revealed that institutional adaptation to climate change impacts by the protected natural areas sector is necessary, that it is already occurring (albeit in an *ad-hoc*, disjointed and non-strategic manner) and will need to occur in the future in a more proactive and strategic manner if the objectives and mandates of protected natural area jurisdictions, agencies and organizations are to be achieved in perpetuity. The reviews and applications found in this dissertation have wide applicability to protected natural areas agencies worldwide and represent a meaningful step both towards enhancing adaptive capacity and facilitating institutional change with respect to climate change within Ontario Parks specifically and the protected natural areas sector generally.

This research explored a method of responding to a novel issue lacking any policy analogue and bounded by significant uncertainty. Effectively integrating climate change into current protected natural areas policy, planning and management program areas, however, will require an ideological shift since climate change possesses a set of principles and body of knowledge that are often contradictory to the currently accepted guiding principles and foundations of protected natural areas institutions. The potential fluctuation of ecosystems brings into question the validity of certain protected natural areas and it begs the question: *"What exactly are we protecting?"* The greatest challenge for the protected natural areas sector, including Ontario Parks, will be accessing adequate resources needed to enhance institutional capacity and effectively adapt (in the face of change) their extant policies, planning and management frameworks and guiding principles, and deciding what role protected natural areas should play in facilitating species adaptation to climate change. If natural communities within a protected natural area are able to gradually (dynamically) change in response to climate change, then perhaps relatively little effort should be expended in trying to maintain the *status-quo*. As discussions in Chapter 2 revealed, defending the original objectives of a protected natural area decades old may not viable.

The implementation of the various adaptation options arising from this research will depend on whether the impacts of climate change on ecological integrity will be accepted and adapted to or whether protected natural areas jurisdictions, agencies and organizations will continue to have a fixed idea of the guiding principle. If climate change impacts are accepted, and if adapting policy, planning and management frameworks is the preferred response to such impacts (and the results presented within this dissertation strongly suggest this is the case), then the most important policy objective is to identify new protected natural areas and to add to and/or modify existing protected natural areas so that connectivity can be enhanced and the principle of representation maintained in perpetuity.

Although the research presented in this dissertation is provincially focused, Ontario Parks cannot be insular in their approach to climate change adaptation. Ontario Parks needs to be outward-looking and catalyzing discussion and action across the full breadth of the protected natural areas fraternity. The 30+ categories of protected natural areas in Ontario with varying degrees of protection afforded to them (i.e., IUCN categories I-VI) will all need to be functioning in tandem and nestled within a common strategy to build nodes, linkages and connectivity. As such, the climate change adaptation issue is one that extends beyond Ontario and even Canada necessitating a continental response to enhance the overall effectiveness of 'the system'.

The recommendations provided within this dissertation hold potential to increase the resiliency of protected areas to perturbations resulting from climate change and extend far beyond those that solely have implications for biodiversity. They suggest that major changes to Ontario Parks' current policy, planning, management and operations will be required for the perpetual representation of the province's species and, as such, an effective strategy or action plan will be needed to unlock them. In their totality, the discussions and recommendations in this dissertation provide the necessary impetus from which such change can emanate. The *First National Climate Change Summit* held in Toronto in April 2008 and the release of *Go Green: Ontario's Action Plan on Climate Change* (Government of Ontario, 2007) indicates that political momentum on climate change is high both federally and provincially. Moreover, Canadians value protected natural areas highly (Environics International, 2000). Taken collectively, it appears that mainstreaming climate change into policy, planning and management program areas *now* will better allow Ontario Parks to efficiently and effectively deal with climate change impacts when they are revealed on the ground and institutional policies and practices are put to the test.

Appendix 1
The Canadian Protected Areas & Climate Change (PACC) Survey

Materials:

1.1 Survey Cover Letter
1.2 Canadian Protected Areas & Climate Change (PACC) Survey
1.3 Survey Notification in CCEA Newsletter (May 2006)
1.4 Letter of Appreciation
1.5 Summary of Results published in CCEA Newsletter (April 2007)
1.6 Canadian Protected Areas & Climate Change (PACC) Survey Results

Appendix 1.1.
Survey Cover Letter

March 27, 2006

Dear (name),

My name is Chris Lemieux and I am a PhD candidate within the Faculty of Environmental Studies at the University of Waterloo. I am writing to request your participation in an E-Survey involving the completion of a questionnaire aimed at gathering information on *climate change and protected areas in Canada*. The survey is a collaborative project being conducted by the *Canadian Council on Ecological Areas* (CCEA) and researchers at the *University of Waterloo,* with the endorsement of the North American chapter of IUCN's World Commission on Protected Areas (WCPA-NA).

A central function of CCEA is to mobilize experts and practitioners to advance work on subject areas and issues that are critical for designing, planning and managing protected areas. *Climate Change* has been recognized as an issue of high priority within the CCEA's current *Business Plan* (CCEA, 2004). Recent suggestions by the World Commission on Protected Areas (WCPA) that *"conservation actions are likely to fail unless they are adjusted to take account of climate change"* (WCPA, 2003), emphasizes the need for protected areas agencies to begin integrating climate change into policy, planning, management and research.

The survey seeks to gather information on: 1) climate change impacts currently being experienced, or anticipated to be experienced, in protected areas across Canada; 2) where the issue of climate change ranks in relation to other protected area management issues within Canadian jurisdictions; and, 3) what policy, planning and management, operations and development, monitoring and research, education, interpretation and outreach, and other climate change responses (adaptation) have occurred, or are being considered, by protected areas agencies across Canada. In short, the project will provide the CCEA with a state of the climate change issue across protected areas jurisdictions in Canada.

The *consent form* and *survey* are attached to this e-mail as MS-Word documents. Please save both of these documents to your hard drive and follow the instructions noted in the survey package. The time needed to complete the survey is estimated to be approximately 1 to 1.5 hours but will ultimately depend on how much information you wish to provide. Participation in this survey is voluntary and you may skip any question you prefer not to respond to. Also, you may withdraw your participation at any time. Your name will not be used in any report or publication resulting from this survey but we may use your agency's name to be able to compare climate change initiatives across Canada. The project has received ethics clearance through the Office or Research Ethics at the University of Waterloo. If you have any concerns with participation, please contact this office at (519) 888-4567 ext. 6005 or ssykes@uwaterloo.ca.

If you feel that someone else in your agency is better positioned to complete the survey, or if you can suggest additional contacts that you feel should be included in this survey, please forward their contact information (name, address, E-Mail address, etc.) directly to me and a copy will be forwarded to them immediately.

The results of this E-Survey will be compiled, analyzed and reported back to respondents. **We would appreciate confirmation by e-mail of your receipt of the questionnaire by April 7, 2006 and your completed questionnaire by April 28, 2006.** If you have any questions or concerns about the survey, please feel free to contact me. I thank you in advance for your participation.

Best Regards,

Christopher Lemieux
Protected Areas and Climate Change (PACC) Survey Coordinator
E.S.1, Room 103, Department of Geography
University of Waterloo, Waterloo, ON N2L 3G1

Tel. (519) 888-4567 ext. 5783 | E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of

Tom Beechey, Associate Director, Canadian Council on Ecological Areas (CCEA) and,

Dr. Daniel Scott, Canada Research Chair in Global Change and Tourism, Department of Geography, University of Waterloo

Appendix 1.2.
Canadian Protected Areas & Climate Change (PACC) Survey

Canadian Protected Areas and Climate Change (PACC) Survey

A Cooperative Survey by:

CCEA & University of Waterloo

Thank-you for your Participation!

AN E-SURVEY ON THE STATE OF PROTECTED AREAS AND CLIMATE CHANGE

**A Collaborative Project between the
Canadian Council on Ecological Areas (CCEA) and the University of Waterloo**

March 28, 2006

Dear Colleague,

I am writing in request of your participation in a survey involving the completion of the following questionnaire aimed at gathering information on climate change and protected areas. The survey is a collaborative project being conducted by the *Canadian Council on Ecological Areas* (CCEA) and the *University of Waterloo.*

A central function of the *Canadian Council on Ecological Areas* (CCEA) is to mobilize experts and practitioners to advance work on subject areas and issues that are critical for designing, planning and managing protected areas. *Climate Change* has been recognized as an issue of high priority within the CCEA's current *Business Plan*[1], and one that has been further highlighted by all Canadian protected areas jurisdictions participating in a recent CCEA Northern Protected Areas (NPA) survey and assessment (report in press). Recent suggestions by the Intergovernmental Panel on Climate Change (IPCC) that earth is committed to climate change regardless of greenhouse gas mitigation efforts[2], and the World Commission on Protected Areas (WCPA)[3] that *"conservation actions are likely to fail unless they are adjusted to take account of climate change"*, emphasizes the need for protected areas agencies to begin integrating climate change into policy, planning, management and research.

This E-Survey seeks to gather information on: 1) climate change impacts currently being experienced, or anticipated to be experienced, in protected areas across Canada; 2) where the issue of climate change ranks in relation to other protected areas management issues within Canadian jurisdictions; and, 3) what policy and management, operations and development, monitoring and research, education and outreach, and other climate change responses (adaptation) efforts have occurred, or are being considered, by protected areas agencies across Canada. Accordingly, the survey seeks to document such efforts on the full range of Canadian protected areas (i.e., IUCN Protected Area Management Categories I-VI), including national parks, provincial parks, ecological reserves, wildlife areas/sanctuaries, demonstration/forest reserves, marine/aquatic reserves and other designations relevant to your jurisdiction. We would ask that throughout the survey, you focus your answers on protected areas within your agency's jurisdiction only.

The results of this survey will be compiled, analyzed and reported to provide an overview of the state of climate change in protected areas in Canada. The results will help to determine longer term initiatives that the project sponsors may take in collaboration with participating agencies and organizations across Canada that share this concern.

Please return the E-Survey to **Christopher Lemieux** (contact information can be found on the following page) no later than **Friday, April 28, 2006**. The E-Survey is attached as an MS-Word document, so it can be intermittently saved and completed at your convenience – there is no need to complete the E-survey in a 'single-sitting'. You are requested to return the E-Survey via e-mail, or if that is not possible, please print your survey and return it via mail or fax. **If you feel that someone else in your agency is better positioned to complete the E-Survey, or if you can suggest additional contacts whom you feel should be included in this survey, please forward their contact information (name, address, E-Mail address, etc.) directly to Christopher Lemieux and a copy will forwarded to them immediately.**

Participation in this survey is voluntary. You may decline to answer any of the survey questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. **All questionnaire responses will be used only for the purposes of this survey with no disclosure of respondent's names but we may use your agency's name to be able to compare climate change initiatives across Canada.**

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics **at the University of Waterloo.** However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes of this office at (519) 888-4567 Ext. 6005 or ssykes@uwaterloo.ca.

If you have any questions or concerns regarding the survey, please feel free to contact me as soon as possible.

Please return the E-Survey via E-Mail, regular mail, or fax to:

Christopher Lemieux
Protected Areas and Climate Change (PACC) Survey Coordinator
E.S. 1, Room 103, Department of Geography
University of Waterloo
Waterloo, ON N2L 3G1
Tel. (519) 888-4567 ext. 5783
Fax. (519) 746-0658 – **PLEASE MAKE ATTENTION TO DR. DANIEL SCOTT**
E-mail. cjlemieu@fes.uwaterloo.ca

Thank-you for your time in completing this survey!

Protected Areas and Climate Change (PACC) Project Team Members:

Christopher Lemieux, PACC Survey Coordinator, Department of Geography, University of Waterloo
Tel. (519) 888-4567 ext. 5783 | E-mail. cjlemieu@fes.uwaterloo.ca

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Dr. Daniel Scott, Assistant Professor and Canada Research Chair in Global Change and Tourism, Department of Geography, University of Waterloo
Tel. (519) 888-4567 ext. 5497 | E-mail. dj2scott@fes.uwaterloo.ca

Section 1: Respondent Information

Primary survey respondent information.

Name:

Title:

Affiliation:

Years with Organization:

Mailing Address:

Phone:

E-Mail:

Where would you rank your level of understanding with regards to climate change? Please select one option from the dropdown menu.
Please Select

Secondary survey respondent information (if applicable).

Name:

Title:

Affiliation:

Years with Organization:

Mailing Address:

Phone:

E-Mail:

Where would you rank your level of understanding with regards to climate change? Please select one option from the dropdown menu.
Please Select

For some of the questions within this survey, you are asked to rate the 'importance' of a number of issues or perspectives. The following scale defines what is meant by each category on the importance scale.

Importance Scale	Validation
Very Important	• A most relevant issue • First-order priority • Has direct bearing on major issues • Must be resolved, dealt with, or treated
Important	• Is a relevant issue • Second-order priority • Significant impact but not until other items are treated • This issue does not have to be fully resolved
Slightly Important	• Marginally relevant • Third-order priority • Has little importance • Not a determining factor to major issue
Unimportant	• No relevance • No priority • No measurable effect • Should be dropped as an item to consider

Section 2: Survey Questions

****Please note that text form boxes will expand to accommodate however much text that you wish to provide – there are no restrictions in terms of space****

1. When do you think the issue of climate change will be relevant to protected areas planning and management in your agency?

☐ Now
☐ 2020s
☐ 2050s
☐ 2080s
☐ Never

2. How much do you agree with the following statements? Please select one option from the dropdown menu.

Climate change is going to substantially alter protected area policy and planning over the next <u>10 years</u>.	**Strongly Agree**
Climate change is going to substantially alter protected area policy and planning over the next <u>25 years</u>.	**Strongly Agree**

3. Have there been any formal climate change discussions within your agency (e.g., workshops, strategic/expert meetings, etc.)?

☐ Yes ☐ No

If <u>Yes</u>, briefly describe the nature of these discussions?

If <u>Yes</u>, please provide the reference for any proceedings/conference summary or forward as an <u>E-Mail attachment</u> if possible:

4. Has a comprehensive assessment on potential climate change <u>impacts and implications</u> for protected areas policy and management been completed by/for your agency?

☐ Yes ☐ No

If <u>Yes</u>, please provide study/report reference or forward as an <u>E-Mail attachment</u> if possible:

If <u>No</u>, have there been discussions regarding the need for such an assessment to be done?

☐ Yes ☐ No

5. For protected areas within your agency, how <u>important of an impact</u>, if any, do you think climate change will have on the following? Please select one option from the dropdown menu.

Policy	Very Important
Planning	Very Important
Management	Very Important
Infrastructure/Operations	Very Important
Wildlife	Very Important
Vegetation	Very Important
Watersheds (including wetlands, water quality and quantity)	Very Important
Tourism and Recreation	Very Important
Interpretation Programs	Very Important
Revenues	Very Important

6. The following question is designed to examine where you think the issue of climate change <u>currently</u> ranks in terms of importance relative to other protected areas management issues. Please rank each issue using the dropdown menu (Ranking of "1" = Most Important; Ranking of "11" = Least Important).

Climate change	Rank 1
Wildlife management (species richness, population dynamics, trophic structure)	Rank 1
Water quality/Air quality	Rank 1
Rare/endangered species management	Rank 1
Exotic species (animal and plant)	Rank 1
Visitor stresses (e.g., public facilities, interpretation centres, etc.)	Rank 1
Contamination/Pollution	Rank 1
External threats (surrounding land-use, habitat fragmentation)	Rank 1
Human land-use patterns (e.g., roads, population density, etc.)	Rank 1
Disturbance frequencies (e.g., fire, insects, flooding, etc.)	Rank 1
Other (please identify):	Rank 1

7. The following question is designed to examine where you think the issue of climate change ranks in terms of importance relative to other protected areas management issues <u>25 years from now</u>. Please rank each issue using the dropdown menu (Ranking of "1" = Most Important; Ranking of "11" = Least Important).

Climate change	Rank 1
Wildlife management (species richness, population dynamics, trophic structure)	Rank 1
Water quality/Air quality	Rank 1
Rare/endangered species management	Rank 1
Exotic species (animal and plant)	Rank 1
Visitor stresses (e.g., public facilities, interpretation centres, etc.)	Rank 1
Contamination/Pollution	Rank 1
External threats (surrounding land-use, habitat fragmentation)	Rank 1
Human land-use patterns (e.g., roads, population density, etc.)	Rank 1
Disturbance frequencies (e.g., fire, insects, flooding, etc.)	Rank 1
Other (please identify):	Rank 1

8. Are any types of protected areas within your agency <u>currently affected</u> by climate change related impacts?

☐ Yes ☐ No ☐ Not Sure

If <u>No</u>, please skip to <u>Question 9</u>.

If <u>Yes</u>, please complete the following questions.

Please check any relevant types of impacts being observed:

☐ Species range shifts
☐ Changes in species composition
☐ Changes in disturbance regimes (e.g., forest fires)
☐ Changes in protected area physiography (e.g., glacial extent, change in water levels, etc.)
☐ Tourism/Recreation (e.g., increase in visitation due to extended 'warm' seasons)
☐ Other (please identify):

Has the nature and scale of such impacts been investigated through research?

☐ Yes ☐ No

If <u>No</u>, skip to <u>Question 9</u>.

If <u>Yes</u>, have these studies been conducted by (check any that apply):

☐ Your agency
☐ Another agency within your jurisdiction [please identify which one(s)]:

☐ Non-governmental organizations (NGOs) [please identify which one(s)]:
☐ University researchers including graduate students [please identify which one(s)]:
☐ Consultants [please state which one(s)]:
☐ Other (please elaborate):

Please provide any relevant research references in the field below (i.e., author, date, title of research publication) or forward as an <u>E-Mail attachment</u> if possible:

Is any response being taken or being considered to deal with any of the identified climate related impacts (e.g., further research or adaptation measures)?

☐ Yes ☐ No

If <u>No,</u> skip to <u>Question 9</u>.

If <u>Yes</u>, briefly identify the specific climate change responses being undertaken or being considered.

	Responses Being Undertaken	Responses Being Considered
Legislation, Planning, and Policy	☐	☐
Selection, Evaluation and Design of Protected Areas	☐	☐
Management Direction	☐	☐
Operations and Development	☐	☐
Research, Monitoring and Reporting	☐	☐
Education, Interpretation and Outreach	☐	☐
Other (please identify):	☐	☐

If you checked any of the boxes above, please provide any more additional details you wish in the space provided:

9. Is anybody in your agency specifically responsible for climate change issues (this includes legislation, policy, research, planning, management and monitoring)?

☐ Yes (individual) ☐ Yes (more than one individual) ☐ No

Equivalent Person Years (PYs) (optional):

10. Does your agency have its own climate change <u>policy</u> (i.e., not a provincial government policy but one specific to your agency and protected areas)?

☐ Yes ☐ No ☐ In Development

If <u>Yes or In Development</u>, what was (or is) the actual (or anticipated) time-line for implementation?

11. Does your agency have a climate change <u>adaptation strategy</u> (or action plan) directly related to protected areas?

☐ Yes ☐ No ☐ In Development

If <u>Yes or In Development</u>, what was (or is) the actual (or anticipated) time-line for implementation?

If <u>Yes</u>, please provide a report reference or forward as an <u>E-Mail attachment</u> if possible:

12. Does your agency have a climate change <u>mitigation strategy</u> (or action plan) directly related to protected areas (e.g., related to greenhouse gas emissions)?

☐ Yes ☐ No ☐ In Development

If <u>Yes or In Development</u>, what was (or is) the actual (or anticipated) time-line for implementation?

If <u>Yes</u>, please provide a report reference or forward as an <u>E-Mail attachment</u> if possible:

13. Indicate the response that best represents your agency's view on each of the following statements. Please select one option from the dropdown menu.

There is a need for more research on the impacts of climate change before any policy, planning or managerial responses are made.	Strongly Agree
Detecting and monitoring climate change should be a priority for protected areas agencies.	Strongly Agree
There are too many uncertainties regarding climate change to develop adaptation strategies for protected areas.	Strongly Agree

14. Research is being done on many climate change issues. Please rate the level of additional information your agency would like to have on the following climate change related topics. Please select one option from the dropdown menu.

Information on climate or atmospheric processes.	Much More Info
Errors and problems in computer modelling of the climate system.	Much More Info
Detecting climate change (e.g., temperature trends).	Much More Info
Ecological consequences of climate change (e.g., species distribution, composition).	Much More Info
Information on the impacts of climate change on physiography (e.g., glacial retreat, fluvial dynamics, coastal processes).	Much More Info
Information on the impacts of climate change on visitation (tourism and recreation).	Much More Info
Information on the impacts of climate change on planning, policy and management.	Much More Info
Information on the impacts of climate change on interpretation programs.	Much More Info
Strategies for managerial response (adaptation) to climate change impacts.	Much More Info
Information and strategies on how to effectively communicate the facts, issues, consequences and solutions to climate change.	Much More Info

15. Does your agency <u>specifically monitor</u> for climate change impacts (e.g., distribution of flora and fauna, species tracking, etc.)?

☐ Yes ☐ No

If <u>Yes</u>, please briefly identify specific monitoring initiatives:

16. Has your agency developed <u>specific climate change indicators</u> for detecting or monitoring climate change impacts (e.g., through weather stations, species monitoring, etc.)?

☐ Yes ☐ No

If Yes, please elaborate:

17. Has climate change been incorporated or considered in the development of protected areas management plans or other active management plans relevant to protected areas (e.g., fire/prescribed burning, environmental assessment, invasive species, etc.)?

☐ Yes ☐ No

If Yes, please elaborate or forward a sample management plan as an E-Mail attachment if possible:

If No, is your agency in the process or considering the incorporation of climate change into park management plans or other management plans relevant to parks and protected areas?

☐ Yes ☐ No

If Yes, please elaborate:

18. Does your agency have a public education program specifically related to climate change and its possible effects (e.g., through posters, park interpretation, park brochures, etc.)?

☐ Yes ☐ No

If Yes, please briefly describe the program (e.g., information delivery mechanism, when and where implemented):

If No, does your agency have plans to develop one?

☐ Yes (next 1-5 years) ☐ Yes (next 6-10 years) ☐ Yes (10+ years)

☐ No

19. What should be the approach to climate change adaptation among Canada's protected areas agencies (within all levels of government)? You may select more than one option.

- ☐ No specific adaptation strategy
- ☐ Coping with issues on an 'as needed' basis
- ☐ Operating with a comprehensive agency-based strategy
- ☐ Sharing in a Canada-wide protected areas collaborative effort on climate change

Why (optional)?

20. Is your agency actively involved (directly or indirectly) in climate change dialogue and <u>capacity-building</u> initiatives (e.g., staff participation in workshops, conferences, etc.)?

☐ Yes ☐ No

If <u>Yes</u>, please elaborate on types of capacity-building initiatives:

21. Do you feel that your jurisdiction currently has the <u>capacity</u> necessary to deal with climate change issues affecting protected areas (e.g., committed financial resources, knowledgeable/scientifically trained staff, etc.)?

☐ Yes ☐ No

Please elaborate:

22. Would your agency be willing to participate in a nation-wide working group on climate change and protected areas (you may select more than one option) or a national workshop on the topic?

☐ Yes ☐ No

If <u>Yes</u>, please provide the name(s) of individuals whom you think would be willing to participate:

If <u>Yes</u>, what resources, if any, would your agency be prepared to provide (you may select more than one option)?

☐ Advocacy

- ☐ Expertise
- ☐ Financial Support
- ☐ Communications Support
- ☐ Casework Experience/Research Presentation
- ☐ Case Application

23. Are there any other issues or concerns regarding climate change and protected areas not covered in this survey that you feel are important to consider? Please elaborate.

Please save your survey to your hard drive before closing it.

Thank-you for taking the time to complete the survey!

Endnotes

1. CCEA (Canadian Council on Ecological Areas). 2004. *CCEA Business Plan.* Canadian Council on Ecological Areas: Ottawa, Ontario.
2. IPCC (Intergovernmental Panel on Climate Change). 2001. Summary for Policymakers, Climate Change 2001. Cambridge University Press: Cambridge, U.K.
3. WCPA (World Commission on Protected Areas). 2003. *Recommendation V.5: Climate Change and Protected Areas.* Vth World Conservation Union (IUCN) World Parks Congress: Durban, South Africa.

Appendix 1.3.
Survey Notification in CCEA Newsletter (May 2006)

- To communicate these guidelines and advocate their application toward the completion of an ecologically defined system of protected areas in northern regions.

As of March 2006, editing and layout of the NPA Phase 1 report was nearly complete and it is anticipated that the report will be printed, and distributed by the CCEA Secretariat before the end of April 2006. The intent is to print 250 copies for circulation to various CCEA supporters, as well as to post the document on the CCEA website. In the meantime, a follow-up case study analysis (Phase 2 of the NPA Project) of a subset of the northern ecozones that comprise the NPA study area is underway, for anticipated completion sometime later in 2006.

Protected Areas and Climate Change: A Call for Coordinated Action

Chris Lemieux, Dan Scott and Tom Beechey

Among the many challenges confronting protected area agencies and organizations, *Climate Change* has emerged in recent years as a topic of significant concern internationally and in Canada (Scott and Lemieux, 2005; Lemieux and Scott, 2005). As currently understood, the ecological manifestations of climate change will likely permeate all aspects of policy, planning and management for Canada's protected areas and other conservation lands, and they will have far-reaching consequences for the many organizations and personnel charged to manage them.

The existing estate of parks and protected areas throughout Canada has largely been rationalized on the notions of ecological representation and stable heritage assets, usually within a defined political or eco-regional context, which have resulted in a fixed assemblage of lands and waters housing elements of biodiversity. Such approaches to conservation, designed to protect species, ecological communities and natural systems, typically have not taken into account potential shifts in ecosystem composition, structure and function, especially those which could be induced by global climatic change. Important issues such as the adequacy of system planning and management objectives under climate change scenarios, and the use of active management strategies such as prescribed burning or species re-introduction, will need to be addressed if jurisdictional mandates to protect elements of Canada's natural diversity are to be achieved. Recent affirmations by the IUCN's World Commission on Protected Areas (WCPA, 2003) that *"conservation actions are likely to fail unless they are adjusted to take account of climate change"* collectively call on protected areas agencies to begin developing climate change-integrated conservation strategies.

Productive wetlands and forests in northern protected areas may be adversely affected by climate change. Nisutlin River Delta National Wildlife Area, Yukon. Photo by Jim Hawking, courtesy of the Canadian Wildlife Service.

Researchers from the University of Waterloo and the Canadian Council on Ecological Areas (CCEA) have initiated a collaborative *Protected Areas and Climate Change* (PACC) *Survey* to gather information on: 1) climate change impacts currently being attributed to, or anticipated to develop in protected areas across Canada; 2) the importance of climate change relative to other protected areas management issues within Canadian jurisdictions; and, 3) what policy and management, operations and development, monitoring and research, education and outreach, and other climate change responses (i.e., adaptation) efforts have occurred, or are being considered, by protected areas agencies across Canada.

CCEA recognizes climate change as an issue of high priority (CCEA, 2004), which has been further highlighted by many Canadian jurisdictions in a recent CCEA survey and assessment of Northern Protected Areas. The results of the PACC survey will build upon these previous initiatives by providing an overview of the state of climate change in protected areas in Canada, and establishing the concerns and the capacity of mandated organizations to respond to this important issue. The survey results, which will be published, will help to determine further steps that need to be taken as part of a coordinated response to address the impacts of climate change on protected areas.

For more information on the protected areas and climate change survey, please contact:

Chris Lemieux, PACC project coordinator, (519) 888-4567 ext. 5783, <cjlemieu@fes.uwaterloo.ca>

Tom Beechey (PACC project advisor), (519) 658-6086, <tombeechey@sympatico.ca>

Daniel Scott (PACC project advisor), (519) 888-4567 ext. 5743, <dj2scott@fes.uwaterloo.ca>

References:

Canadian Council on Ecological Areas (CCEA). 2004. *The Canadian Council on Ecological Areas Business Plan, 2004-2007.* CCEA Secretariat, Ottawa, Ontario.

Lemieux, C.J. and D.J. Scott. 2005. Climate change, biodiversity conservation and protected areas planning in Canada. *The Canadian Geographer*, 49 (4): 384-399.

Scott, D.J. and C.J. Lemieux. 2005. Climate change and protected areas planning in Canada. *The Forestry Chronicle*, 81(5): 696-703 .

World Commission on Protected Areas (WCPA). 2003. *Recommendation 5.05: Climate Change and Protected Areas.* Vth World Parks Congress: Durban, South Africa

News from Newfoundland and Labrador

Paul Taylor

What's happening in eastern Canada? Newfoundland and Labrador has recently doubled its protected areas land base with the announcement of the Torngat Mountains National Park Reserve in Labrador. Legally established under the Canada National Parks Act, on December 1st, 2005, our total protected areas land base rises to 18, 405 km^2 or 4.52% of the province.

Appendix 1.4.
Letter of Appreciation

July 15, 2006

Dear (name),

Thank you for your participation in the Canadian Council on Ecological Areas (CCEA)/University of Waterloo *Survey on Protected Areas and Climate Change (PACC)*. Overall, the response was very positive with survey returns received from 33 respondents representing key governmental agencies and ENGOs involved with protected areas across Canada.

As a reminder, the purpose of this survey was to canvass the protected areas community to capture information on: 1) the impacts of climate change currently being experienced, or anticipated to develop, in protected areas across Canada; 2) the ranking of climate change issues in relation to other protected areas management issues within Canadian jurisdictions; and, 3) the actual and proposed policy and programme developments (i.e., planning, management, operations and development, monitoring and research, education and outreach) and other climate change responses (adaptations) that have occurred, or are being considered, by protected areas agencies and ENGOs across Canada.

Once all of the data are compiled and analyzed from the survey, the information will be shared with the protected areas community through various meetings and reported in a CCEA occasional paper, which we aim to complete by the end of the year. It is anticipated that results of the survey will help to guide follow-up initiatives dealing with climate change and protected areas. If you are interested in receiving more information regarding the results of this exercise, or if you have any questions or concerns, please contact me at either the phone number or email address listed at the bottom of the page.

Thank you very much for participating in the PACC survey.

Best Regards,

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
Tel: (519) 888-4567 ext. 5783 | E-Mail: cjlemieu@fes.uwaterloo.ca

and on behalf of

Tom Beechey (survey advisor)
Canadian Council on Ecological Areas (CCEA)

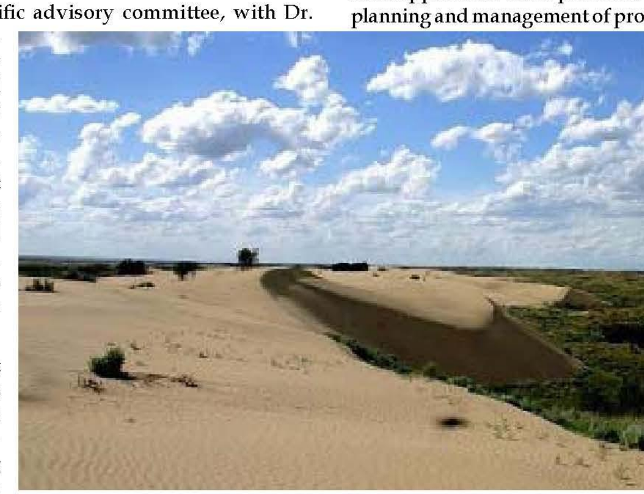
Dr. Daniel Scott (survey advisor)
Department of Geography, University of Waterloo

Appendix 1.5.
Summary of Results in CCEA Newsletter (April 2007)

include mule deer, white-tailed deer and antelope. Rare and endangered species, such as Sprague's Pipit are found in the ecoregion and within the Great Sand Hills.

The Great Sand Hills occupies over 1900 km^2 (750 mi^2) and is considered the largest protected prairie landscape in Saskatchewan, although not all of the landscape is recognized as a protected area. Ranching and natural gas extraction are the main economic drivers of the area. Protected areas in the Great Sand Hills include a Representative Area Ecological Reserve (366 km2, 141.25 mi^2), Wildlife Habitat Protection Act lands, Federal and provincial pastures and Federal National Wildlife Areas.

An independent scientific advisory committee, with Dr. Reed Noss as the senior scientist, is currently conducting a Regional Environmental Study for the area. This study is taking a strategic environmental assessment approach to characterize the ecological, social and economic conditions. This is the first time this approach has been taken in Saskatchewan.



The Great Sand Hills, located in southwest Saskatchewan.

Categorizing the Great Sand Hills study area has presented Saskatchewan protected areas managers with some interesting problems. In one way or another, the protected areas within the Great Sand Hills meet all of the management objectives of the IUCN categories. This has presented some unique problems when applying the Canadian Guidelines. Two particular problems not addressed adequately by the Canadian Guide book are grazing and gas development. Both of these activities are socially acceptable to maintaining the ecological integrity of the grasslands found in the Great Sand Hills.

If grazing in this area was seen to be mimicking the historic grazing patterns and keeping the ecological integrity of the area intact and not as a commercial use, then the Great Sand Hills protected areas particularly the ecological reserve could be categorized as a IUCN category III. On other lands where gas development occurs, best management practices are required to be used which helps preserve the integrity of these lands and the management intent of these lands as an IUCN category III.

In addition to these issues facing Saskatchewan protected area managers for the Great Sand Hills, other issues around climate change, management recommendations stemming from the Regional Environmental Study and interpretation of the Canadian Guidelines to see if the entire area can be classed as an IUCN category V protected area will need to be dealt with.

A survey on Protected Areas and Climate Change (PACC) in Canada: Survey update

Christopher Lemieux, Thomas Beechey, and Daniel Scott

For over a decade, the international scientific community and protected areas professionals have recognized that climate change may have critical implications for protected areas policy, planning, and management. Throughout Canada, existing protected areas are largely rationalized on the concept of ecological representation, which seeks to capture areas that represent landforms and their constituent species and biotic communities within an ecoregional context. While such approaches have provided a good foundation for the planning and management of protected areas, they generally have not taken into account potential shifts in ecosystem composition, structure, and function that could be induced by global climate change.

Researchers from the University of Waterloo and the Canadian Council on Ecological Areas (CCEA) have completed a collaborative Protected Areas and Climate Change (PACC) Survey that gathered information on three critical aspects: 1) climate change impacts currently being experienced, or anticipated to be experienced, in protected areas across Canada; 2) the importance of climate change relative to other protected areas management issues within Canadian jurisdictions; and, 3) programme initiatives (i.e., policy, planning and management, operations and development, monitoring and research, education and outreach, and other adaptive climate change responses) that have occurred, or are being considered, by protected areas agencies across Canada.

The survey was completed by representatives of 35 protected areas jurisdictions, agencies, and NGOs across Canada (including all federal and provincial protected areas jurisdictions). The responses revealed that a strong majority (89%) felt that climate change is considered to be an important management issue for protected areas now, and 91% strongly agreed or somewhat agreed with the statement that climate change will substantially alter protected area policy and planning over the next 25 years. Nevertheless, the majority of respondents (80%) noted that their agency has not completed a comprehensive assessment on the potential impacts and implications of climate change on policy and management leaving us to assume that jurisdictional and agency-specific impacts and implications are largely unknown. Moreover, while 71% of respondents noted that protected areas within their agency are currently affected by climate change related impacts, 80% of agencies surveyed do not have a climate change policy or adaptation strategy (or action plan) and 89% do not have a climate change mitigation strategy (i.e., in-house plan to reduce greenhouse gas emissions). Of the 80% currently without a climate change policy or adaptation strategy directly related to protected areas, only 11% are currently developing one.

Importantly, the survey revealed a clear disconnect between the perceived salience of the possible impacts of climate change on protected areas and a lack of available resources (e.g., financial resources and staffing) to respond to the issue. Over 40% of respondents noted that they do not have an individual within their agency responsible for climate change issues (this includes legislation, policy, research, planning, management and research and monitoring); and for the ones that do, climate change was noted as one of several responsibilities. The survey also revealed a strong motivation by protected areas agencies and organizations to move forward on the climate change issue. Nonetheless, protected area agencies and organizations appear uncertain about how to proceed; 86% of respondents felt that they currently do not have the capacity necessary to deal with climate change issues.

Adopting a laissez-faire approach to climate change could have many negative ramifications for Canada's biodiversity. For example, irreversible impacts, such as species extinction could result; and, the potential for more rapid or pronounced change than expected could leave protected areas managers and planners unprepared to effectively deal with climate change impacts. To safeguard against the limitations of traditional protected areas system planning, and to ensure the persistence of Canada's biodiversity over the 21st century and beyond, more rigorous and practical debate by Canadian protected areas agencies and organizations on the issue of climate change, and a collective and proactive management response, will be essential in the short-term.

The authors extend their gratitude to the many protected areas professionals who participated in the PACC survey. Work is proceeding on developing a CCEA occasional paper to fully report the survey results with a summary discussion, conclusions, and recommendations for follow-up initiatives. The authors continue to welcome feedback on the survey and expressions of interest from anyone who wishes to collaborate on advancing this work.

Federal government perspectives on the application of the Canadian Guidebook to Protected Areas: Outstanding issues and fine-tuning

Prepared for the CCEA 2006 AGM, October 2006, Nova Scotia

The Federal Departments responsible for protected areas in Canada, namely Parks Canada, Fisheries and Oceans Canada and Environment Canada have identified a number of issues that need to be addressed in the current draft of the guidebook for Canadian Protected Area Agencies: "Application of IUCN Protected Area Management Categories". The following provides a brief overview of the major issues with interpreting and applying the IUCN categories to federal government properties which relate to: Marine Protected Areas; cultural landscapes; community conserved areas; application of IUCN categories; and the issue of accuracy and consistency.

Marine Protected Areas often encompass a range of management objectives and levels of conservation and protection. Classifying such areas is a challenge since the usual practice is to apply a single IUCN classification to each protected area. It is recommended that more than one classification be assigned based on the zoning of the individual sectors within the larger MPA. Although there is some resistance to this internationally, it is the only practical approach.

The classification system should also be applied to areas that are primarily cultural in nature (cultural landscapes), yet contain important natural resources which provide nature conservation. This has occurred with several large national historic sites administered by Parks Canada. The current practice is to not apply the IUCN classification to such areas. The guidebook should provide instructions related to classifying such areas to standardize the practice by PA agencies in these situations - ie all such areas to be classified or none (on the basis that they do not have a dedicated conservation purpose).

The guidebook does not address the issue of classification of community conserved areas which is a big preoccupation among protected area professionals and NGOs in developing countries. This particular issue requires further guidance from IUCN task forces that are dealing with this issue. The results of this further analysis would be useful in terms of classifying Aboriginal protected areas which are the closest thing that Canada has to Community conserved areas as defined by Developing countries.

Application of IUCN Categories: All Canadian jurisdictions need to buy into the IUCN classification system and its application. A more detailed "key" should be developed to assist in determining how sites are classified. Training sessions on the application of the guidebook will be important to ensuring the proper classification of sites. A "train the trainer" or a "champion" approach, perhaps led by CCEA, would also help jurisdictions adopt the guidebook approach and address concerns.

Accuracy and Consistency: The guidebook has been useful in interpreting the IUCN categories for Canadian sites, yet there are still judgement calls by practitioners applying the guidelines that may not be consistent amongst the various PA agencies. An independent evaluation or audit of a random selection of sites from each jurisdiction would help ensure consistency in the application of IUCN categories.

Creative research partnerships for Nova Scotia protected areas

Rob Cameron, Nova Scotia Department of Environment and Labour

Research is critical to ensuring that ecological integrity is maintained in the management of protected areas. However, limited government budgets and resources necessitates the

Appendix 1.6.

Canadian Protected Areas & Climate Change (PACC) Survey Results

ALL RESPONSE SUMMARY n=35

Where would you rank your level of understanding with regards to climate change?

	Number*	%
Expert, High Level of Knowledge	1	2.9%
Knowledgeable, Above Average Knowledge	18	51.4%
Somewhat Knowledgeable, Limited Experience	17	48.6%
Non-Expert, No Experience	2	5.7%

* = total number of respondents is greater than 34 due to multiple persons completing individual surveys.

1. When do you think the issue of climate change will be relevant to protected areas planning and management in your agency?

	Number	%
Now	32	91.4%
2020s	3	8.6%
2050s	0	0.0%
2080s	0	0.0%
Never	0	0.0%

2. How much do you agree with the following statements?

Climate change is going to substantially alter protected area policy and planning over the next 10 years.

	Number	%
Strongly Agree	9	25.7%
Somewhat Agree	16	45.7%
Somewhat Disagree	9	25.7%
Strongly Disagree	1	2.9%

Climate change is going to substantially alter protected area policy and planning over the next 25 years.

	Number	%
Strongly Agree	21	60.0%
Somewhat Agree	12	34.3%
Somewhat Disagree	2	5.7%
Strongly Disagree	0	0.0%

3. Have there been any formal climate change discussions within your agency (e.g., workshops, strategic/expert meetings, etc.)?*

	Number	%
Yes	23	65.7%
No	12	34.3%

4. Has a comprehensive assessment on potential climate change impacts and implications for protected areas policy and management been completed by/for your agency?

	Number	%
Yes	5	14.3%
No	29	82.9%

If No, have there been discussions regarding the need for such an assessment to be done?

	Number	%	
Yes	13	44.8%	3 agencies were "not sure".
No	13	37.1%	

5. For protected areas within your agency, how important of an impact, if any, do you think climate change will have on the following?

	VI	I	SI	U	VI	I	SI	U	VI + I	SI + U
Policy	6	18	10	1	17.1%	51.4%	28.6%	2.9%	68.6%	31.4%
Planning	12	16	7	0	34.3%	45.7%	20.0%	0.0%	80.0%	20.0%
Management	11	15	9	0	31.4%	42.9%	25.7%	0.0%	74.3%	25.7%
Infrastructure/Operations	8	14	10	3	22.9%	40.0%	28.6%	8.6%	62.9%	37.1%
Wildlife	19	12	4	0	54.3%	34.3%	11.4%	0.0%	88.6%	11.4%
Vegetation	19	12	4	0	54.3%	34.3%	11.4%	0.0%	88.6%	11.4%
Watersheds (including wetlands, water quality and quantity)	21	10	4	0	60.0%	28.6%	11.4%	0.0%	88.6%	11.4%
Tourism and Recreation	8	18	7	2	22.9%	51.4%	20.0%	5.7%	74.3%	25.7%
Interpretation Programs	10	12	10	3	28.6%	34.3%	28.6%	8.6%	62.9%	37.1%
Revenues	7	8	11	9	20.0%	22.9%	31.4%	25.7%	42.9%	57.1%

VI = Very Important
I = Important
SI = Somewhat Important
U = Unimportant

6. The following question is designed to examine where you think the issue of climate change currently ranks in terms of importance relative to other protected areas management issues.

	Rank													
	1	2	3	4	5	6	7	8	9	10	11	High	Low	Median
Climate change	0	0	2	4	0	0	7	4	3	10	2	3	11	**8**
Wildlife management	2	2	7	4	3	2	6	3	1	1	1	1	11	5
Water quality/Air quality	4	3	1	6	4	2	2	3	3	3	1	1	11	5
Rare/endangered species management	3	4	4	5	6	4	2	3	0	1	0	1	10	4.5
Exotic species (animal and plant)	0	3	4	4	1	6	2	4	7	0	1	2	11	6
Visitor stresses	3	4	4	4	3	1	1	1	5	6	0	1	10	5
Contamination/pollution	0	2	4	1	3	3	5	4	7	2	1	2	11	7
External threats	11	4	5	1	3	3	1	2	2	0	0	1	9	3
Human land-use patterns	6	4	6	2	4	2	1	3	1	2	1	1	11	3.5
Disturbance frequencies	2	1	0	3	2	7	5	3	2	6	1	1	11	7

7. The following question is designed to examine where you think the issue of climate change ranks in terms of importance relative to other protected areas management issues 25 years from now.

	Rank													
	1	2	3	4	5	6	7	8	9	10	11	High	Low	Median
Climate change	2	3	5	6	3	1	4	1	2	2	1	1	11	**4**
Wildlife management	2	2	2	4	6	1	3	5	0	4	1	1	11	5
Water quality/Air quality	4	4	2	1	3	5	4	0	3	4	0	1	10	6
Rare/endangered species management	2	3	6	1	6	6	4	1	1	0	0	1	10	5
Exotic species (animal and plant)	2	4	2	2	2	4	3	7	2	1	1	1	11	6
Visitor stresses	4	1	3	3	2	1	0	5	3	7	1	1	11	8
Contamination/pollution	1	1	2	2	2	3	2	5	7	3	2	1	11	8
External threats	10	6	3	1	3	2	1	1	3	0	0	1	9	2
Human land-use patterns	4	5	3	4	3	1	4	1	4	1	0	1	10	4
Disturbance frequencies	2	1	1	1	2	3	6	4	5	4	1	1	11	7

8. Are any types of protected areas within your agency <u>currently affected</u> by climate change related impacts? (some agencies did not qualify to respond to the question and were omitted from the denominator when calculating percentages)

	Number	%
Yes	22	73.3%
No	0	0.0%
Not sure	8	26.7%

If <u>Yes</u>, please complete the following questions.
Please check any relevant types of impacts being observed:

	Number	%
Species range shifts	15	68.2%
Changes in species composition	9	40.9%
Changes in disturbance regimes (forest fires)	9	40.9%
Changes in protected area physiography (glacial extent, water levels)	15	68.2%
Tourism/recreation (increase in visitation)	5	22.7%
Other	1	4.5%

Has the nature and scale of such impacts been investigated through research?

	Number	%
Yes	11	50.0%
No	11	50.0%

If <u>Yes</u>, have these studies been conducted by (check any that apply):

	Number	%
Your agency	4	33.3%
Another agency within your jurisdiction	6	50.0%
ENGOs	4	33.3%
University researchers including graduate students	6	50.0%
Consultants	1	8.3%
Other	3	25.0%

Is any response being taken or being considered to deal with any of the identified climate related impacts (e.g., further research or adaptation measures)?

	Number	%
Yes	12	54.5%
No	10	45.5%

If <u>Yes</u>, briefly identify the specific climate change responses being undertaken or being considered.

	Undertaken		Considered	
	Number	%	Number	%
Legislation, planning & policy	1	8.3%	6	50.0%
Selection, evaluation & design of PAs	1	8.3%	3	25.0%
Management direction	2	16.7%	4	33.3%
Operations & development	1	8.3%	1	8.3%
Research, monitoring & reporting	4	33.3%	5	41.7%

Education, interpretation & outreach	1	8.3%	5	41.7%
Other	0	0.0%	1	8.3%

9. Is anybody in your agency specifically responsible for climate change issues (this includes legislation, policy, research, planning, management and monitoring)?

	Number	%
Yes (individual)	9	25.7%
Yes (more than one individual)	10	28.6%
No	16	45.7%

10. Does your agency have its own climate change <u>policy</u> (i.e., not a provincial government policy but one specific to your agency and protected areas)?

	Number	%
Yes	2	5.7%
No	29	82.9%
In Development	4	11.4%

If <u>Yes or In Development</u>, what was (or is) the actual (or anticipated) time-line for implementation?

11. Does your agency have a climate change <u>adaptation strategy</u> (or action plan) directly related to protected areas?

	Number	%
Yes	2	5.7%
No	29	82.9%
In Development	4	11.4%

If <u>Yes or In Development</u>, what was (or is) the actual (or anticipated) time-line for implementation?

12. Does your agency have a climate change <u>mitigation strategy</u> (or action plan) directly related to protected areas (e.g., related to greenhouse gas emissions)?

	Number	%
Yes	2	5.7%
No	32	91.4%
In Development	1	2.9%

If <u>Yes or In Development</u>, what was (or is) the actual (or anticipated) time-line for implementation?

No responses

13. Indicate the response that best represents your agency's view on each of the following statements.

There is a need for more research on the impacts of climate change before any policy, planning or managerial responses are made.

	Number	%
Strongly Agree	11	31.4%
Somewhat Agree	9	25.7%
Somewhat Disagree	12	34.3%
Strongly Disagree	3	8.6%

Detecting and monitoring climate change should be a priority for protected areas agencies.

	Number	%
Strongly Agree	16	45.7%
Somewhat Agree	18	51.4%
Somewhat Disagree	1	2.9%
Strongly Disagree	0	0.0%

There are too many uncertainties regarding climate change to develop adaptation strategies for protected areas.

	Number	%
Strongly Agree	2	5.7%
Somewhat Agree	9	25.7%
Somewhat Disagree	13	37.1%
Strongly Disagree	11	31.4%

14. Research is being done on many climate change issues. Please rate the level of additional information your agency would like to have on the following climate change related topics.

Information on climate or atmospheric processes.

	Number	%
Much More Information	5	14.3%
Some More Information	20	57.1%
No More Information	10	28.6%

Errors and problems in computer modelling of the climate system.

	Number	%
Much More Information	3	8.6%
Some More Information	17	48.6%
No More Information	15	42.9%

Detecting climate change (e.g., temperature trends).

	Number	%
Much More Information	11	31.4%
Some More Information	15	42.9%
No More Information	9	25.7%

Ecological consequences of climate change (e.g., species distribution, composition).

	Number	%
Much More Information	28	80.0%
Some More Information	7	20.0%
No More Information	0	0.0%

Information on the impacts of climate change on physiography (e.g., glacial retreat, fluvial dynamics, coastal processes).

	Number	%
Much More Information	15	42.9%
Some More Information	17	48.6%
No More Information	3	8.6%

Information on the impacts of climate change on visitation (tourism and recreation).

	Number	%
Much More Information	13	37.1%
Some More Information	14	40.0%
No More Information	8	22.9%

Information on the impacts of climate change on planning, policy and management.

	Number	%
Much More Information	20	57.1%
Some More Information	13	37.1%
No More Information	2	5.7%

Information on the impacts of climate change on interpretation programs.

	Number	%
Much More Information	9	25.7%
Some More Information	16	45.7%
No More Information	10	28.6%

Strategies for managerial response (adaptation) to climate change impacts.

	Number	%
Much More Information	25	71.4%
Some More Information	8	22.9%
No More Information	2	5.7%

Information and strategies on how to effectively communicate the facts, issues, consequences and solutions to climate change.

	Number	%
Much More Information	18	51.4%
Some More Information	15	42.9%
No More Information	2	5.7%

15. Does your agency specifically monitor for climate change impacts (e.g., distribution of flora and fauna, species tracking, etc.)?

	Number	%
Yes	12	34.3%

No	23	65.7%

16. Has your agency developed <u>specific climate change indicators</u> for detecting or monitoring climate change impacts (e.g., through weather stations, species monitoring, etc.)?

	Number	%
Yes	5	14.3%
No	30	85.7%

17. Has climate change been incorporated or considered in the development of protected areas <u>management plans</u> or other active management plans relevant to protected areas (e.g., fire/prescribed burning, environmental assessment, invasive species, etc.)?

	Number	%
Yes	5	17.9%
No	23	82.1%

If <u>No</u>, is your agency in the process or considering the incorporation of climate change into park management plans or other management plans relevant to parks and protected areas?

	Number	%
Yes	6	26.1%
No	17	73.9%

18. Does your agency have a <u>public education program</u> specifically related to climate change and its possible effects (e.g., through posters, park interpretation, park brochures, etc.)?

	Number	%
Yes	6	17.1%
No	29	82.9%

If <u>No</u>, does your agency have plans to develop one?

	Number	%	
Yes (1-5 years)	7	24.1%	1 respondent indicated that they were "not sure".
Yes (5-10 years)	0	0.0%	
Yes (10+ years)	0	0.0%	
No	21	72.4%	

19. What should be the approach to climate change adaptation among Canada's protected areas agencies (within all levels of government)? You may select more than one option.

	Number	%
No specific adaptation strategy	2	5.7%
Coping with issues on an 'as needed' basis	3	8.6%
Operating with a comprehensive agency-based strategy	14	40.0%
Sharing in a Canada-wide protected areas collaborative effort on climate change	29	82.9%

20. Is your agency actively involved (directly or indirectly) in climate change dialogue and <u>capacity-building</u> initiatives (e.g., staff participation in workshops, conferences, etc.)?

	Number	%
Yes	20	57.1%
No	15	42.9%

21. Do you feel that your jurisdiction currently has the <u>capacity</u> necessary to deal with climate change issues affecting protected areas (e.g., committed financial resources, knowledgeable/scientifically trained staff, etc.)?

	Number	%	
Yes	3	8.8%	1 agency did not respond
No	31	91.2%	

22. Would your agency be willing to participate in a nation-wide working group on climate change and protected areas (you may select more than one option) or a national workshop on the topic?

	Number	%	
Yes	30	85.7%	1 agency indicated that they were "not sure".
No	4	11.4%	

If Yes, what resources, if any, would your agency be prepared to provide (you may select more than one option)?

	Number	%
Advocacy	11	36.7%
Expertise	6	20.0%
Financial support	2	6.7%
Communications support	10	33.3%
Casework experience/Research presentation	7	23.3%
Case application	7	23.3%

Appendix 2:
The Policy Delphi

Materials:

2.1) Initial Survey Contact Letter
2.2) First Round Survey Cover Letter
2.3) Letter of Support from Ontario Parks' Manager of Planning & Research
2.4) Climate Change and Protected Areas Background Document
2.5) First Round Survey
2.6) First Round Survey Reminder Letter
2.7) First Round Survey Thank-you Letter
2.8) Second Round Survey Cover Letter
2.9) Second Round Survey
2.10) Second Round Survey Reminder Letter
2.11) Second Round Survey Final Call Letter
2.12) Second Round Survey Thank-you Letter

Appendix 2.1.
Initial Survey Contact Letter

April 6, 2006

Re. "An Invitation to a Pioneering Dialogue on Climate Change and Protected Areas"

Dear [Name of Participant],

Among the many challenges confronting protected area agencies and organizations, *climate change* has emerged in recent years as a topic of considerable global concern. The existing estate of parks and protected areas throughout Canada has largely been rationalized on the notions of ecological representation and stable heritage assets which has resulted in a fixed assemblage of lands and waters housing elements of biodiversity usually within a defined political and/or ecoregional context. Such approaches to conservation, designed to protect specific natural features, species and ecological communities *in-situ*, have not taken into account potential shifts in ecosystem distribution and composition that could be induced by global climatic change. Furthermore, the recognition of climate change as a significant stressor in several Canadian national parks (Parks Canada, 1997) and recent affirmations by the *World Commission on Protected Areas* (WCPA, 2003) that *"conservation actions are likely to fail unless they are adjusted to take account of climate change"* collectively calls on the conservation-oriented community to begin developing climate change-integrated conservation strategies.

We are writing to inform you that you have been selected to participate in a Delphi survey on climate change and protected areas. The purpose of this *multi-round* Delphi survey is to mobilize the conservation-oriented community to help *identify* and *assess* climate change adaptation options for Ontario's system of parks and protected areas. *Participation in this project is limited and you have been selected by the advisory team to participate in the first round of this survey based on your expertise and/or experiences with parks and protected areas policy, planning, management and research.* Accordingly, we feel that your views on the subject of climate change and protected areas are a *priority*. Your participation and input is *important* not only to the success of this project but also to the development of an effective climate change adaptation strategy for Ontario's system of parks and protected areas.

Further information on the survey, along with instructions, can be found within the survey package which you should receive via hard copy *and* e-mail in about three weeks. We anticipate that the survey will take approximately 30-45 minutes to complete but will ultimately depend on the amount of information you wish to provide. We sincerely hope you will choose to participate in this survey. As with all University of Waterloo projects involving human participants, this research has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at (519) 888-4567 ext. 6005.

If you have any questions or concerns, please feel free to contact the survey coordinator. We thank you in advance for your time and look forward to you input on this critical issue.

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
Tel: (519) 888-4567 ext. 5783 | E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of Dr. Daniel Scott (project advisor)
University of Waterloo

Rob Davis and Paul Gray (project advisors)
Ontario Ministry of Natural Resources

Appendix 2.2.
First Round Survey Cover Letter

September 6, 2006

Re. "An Invitation to a Pioneering Dialogue on Climate Change and Protected Areas"

Dear [Name of Participant],

Recently you should have received an initial contact letter from me requesting your participation in a Delphi survey entitled *Towards a Climate Change Strategy for Ontario's Parks and Protected Areas.* As noted in that letter, the purpose of this *multi-round* Delphi survey is to mobilize the conservation community to help *identify* and *assess* climate change adaptation options for Ontario's system of parks and protected areas. *Participation in this project is limited and you have been selected by the advisory team to participate in the first round of this survey based on your expertise and/or experiences with parks and protected areas policy, planning, management and research.* Accordingly, we feel that your views on the subject of climate change and protected areas are a *priority*. Your participation and input is *important* not only to the success of this project but also to the development of an effective climate change adaptation strategy for Ontario's system of parks and protected areas.

This package includes a *background document* (green cover) highlighting climate trends and climate change projections for Ontario park regions as well as potential impacts and implications of climate change for parks and protected area policy, planning and management. You are not required to read the background document prior to completing the survey, but it is included to support your participation. The *survey* (light grey cover) is about 20 pages long and is expected to take about 45 minutes to complete. **Please be aware that you should have also received the survey package via email.** The advantage of responding via email is that there are no restrictions in terms of space – you can provide as much information as you wish. In addition, e-mail responses are more easily compiled and collated by the research team. However, we appreciate whatever format you choose to respond in.

If you would like your position to be represented in this project, then please complete and return the attached questionnaire and consent form using the self-addressed stamped enveloped provided in the survey package. If you have any questions or concerns, please contact the survey coordinator.

We thank you in advance for your time and look forward to you input on this critical issue.

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
Tel: (519) 888-4567 ext. 5783 | E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of:

Dr. Daniel Scott (project advisor)
University of Waterloo

Rob Davis and Paul Gray (project advisors)
Ontario Ministry of Natural Resources

Appendix 2.3.
Letter of Support from Ontario Parks' Manager of Planning & Research

ONTARIO PARKS

P.O. Box 7000
300 Water Street
Peterborough, ON
K9J 8M5

Telephone: 705-755-1700
Facsimile: 705-755-1701
www.OntarioParks.com

August 29, 2006

RE: Towards a climate change adaptation strategy for Ontario's protected areas

Dear Climate Change Survey Recipient:

This letter is to advise you that Ontario Parks is working co-operatively with Mr. Christopher Lemieux to conduct a survey aimed toward developing a climate change adaptation strategy. As you may be aware, the impacts of climate change could permeate all aspects of policy, planning and management of Ontario's protected areas.

These impacts will have far-reaching consequences for those organizations involved with protected areas. The World Commission on Protected Areas (WCPA) suggests that *"conservation actions are likely to fail unless they are adjusted to take account of climate change".* These suggestions emphasize the need for protected areas agencies to begin integrating climate change into their policy, planning and management frameworks.

You have been specifically identified as an eligible and competent candidate to help identify and assess climate change adaptation options with regards to: 1) regulations, policy and planning; 2) management direction; 3) operations and development; 4) research and monitoring; and, 5) education, interpretation and outreach.

Your input is vital to the success of this important effort. Please read the enclosed background document, and complete and return the enclosed survey either by email to cjlemieu@fes.uwaterloo.ca or in hard copy by October 13, 2006. Your participation in this survey, and the responses you provide, will remain confidential.

If you have any questions or concerns, please contact Rob Davis (705-755-1731) or any of the other contacts listed in the accompanying background document.

Thank you in advance for your cooperation.

Sincerely,

Barton Feilders
Manager, Planning and Research
Ontario Parks
Ministry of Natural Resources

Appendix 2.4.

Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas Background Document

Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas

Background Document

A collaborative study between:

University of Waterloo

Ontario Parks

Introduction

Global warming is now impacting all people and all ecosystems around the world. According to the Intergovernmental Panel on Climate Change (IPCC), since 1900, the Earth's surface has warmed by 0.6 +/- 0.2°C (IPCC, 2001), and most of this warming is attributable to human activities (IPCC, 2001). Further, the Earth's surface is projected to warm by 1.4 to 5.8°C over the next 100 years, with land areas warming more than the oceans, and with the high latitudes warming more than the lower latitudes. At the Ministry of Natural Resources (OMNR), staff are concerned because it is possible that this climate change will rapidly change the composition, structure, and function of Ontario's ecosystems. It is also anticipated that climate change will cause social and economic impacts in communities throughout the province.

Given that many protected areas are managed in support of biodiversity conservation efforts, climate-induced changes to habitats and the distribution and abundance of plants and animals will alter natural assets in these areas.

This survey in which you are participating is designed to assist Ontario's protected areas agencies and organizations in the development of a climate change adaptation strategy. This ***Background Document*** highlights climate trends in Canada, projected climate change in Ontario protected areas as well as potential impacts and implications for protected area policy development, planning, and management, and is provided to support your participation.

Evidence of a Changing Climate

A fundamental characteristic of the Earth's evolution is that climate has changed in the past, is changing, and will change in the future. Glacial and interglacial periods have occurred due to the Earth's natural orbital fluctuations and other natural factors such as volcanic eruptions and fluctuations of energy from the sun. However, in addition to natural climate change, the industrial revolution marked the beginning of the period during which human activities also affected atmospheric composition and the global climate systems (IPCC, 2001). The IPCC concluded that the 1990s was the warmest decade on record for the Northern Hemisphere, that 1998 was the warmest year in the instrumental record (since 1861) and that the twentieth-century was the warmest century in the past 1,000 years.

Climate has changed, is changing, and will continue to change.

Changes have also occurred in other important aspects of climate. For example, winter snow-cover in the Northern Hemisphere has decreased about 60% since the late 1960s (IPCC, 2001). Similarly, there has been a reduction of about two weeks in the annual duration of lake and river ice cover in the mid- and high latitudes of the Northern Hemisphere (IPCC, 2001).

Consistent with the global warming trend that marked the late 20th century and early 21st century, Canada has experienced warmer than normal temperatures (Figure 1). Canada has experienced a warming trend of 1.2°C over the last 58 years and six of the last ten years have been among the ten warmest.

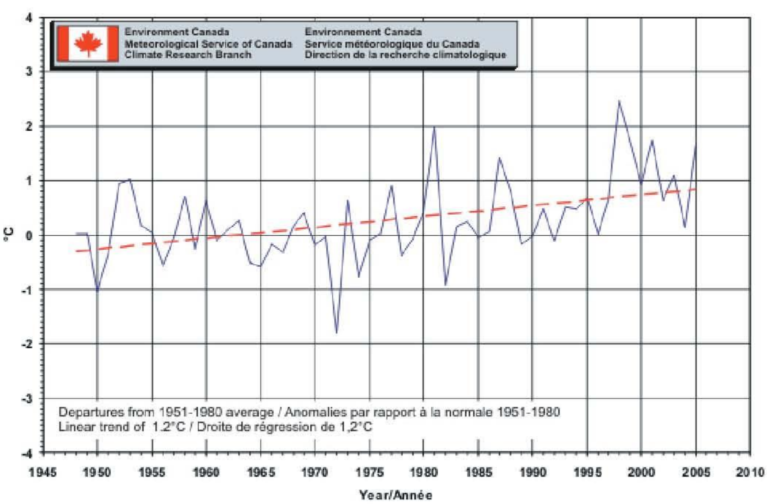


Figure 1: Annual national temperature departures and long-term trend (1948-2005) (°C)(Environment Canada, 2006).

Precipitation is changing as well. For example, with the exception of three annual values (1995, 1998 and 2001), Canada has experienced wetter than normal precipitation levels since 1973. The wettest year on record was 1996 (+9.1%, greater than in 1973) (Environment Canada, 2006).

Projections of Future Climate Change

Using a range of climate change scenarios made available by the *Canadian Climate Impacts and Scenarios* (CCIS), most Ontario provincial parks examined by Lemieux *et al.* (2005) are projected to experience annual temperature increases of about +1.8–3.2°C by the 2020s, +1.8–7°C by the 2050s and +2.5°C–10.0°C by the 2080s (Figure 2).

Potential Impacts of Climate Change

Climate is the major factor in the distribution and abundance of plants and animals. As Woodward (1987) and others (e.g., Bailey, 1996) have shown, plants reproduce and grow within a certain range of temperatures and respond to certain amounts and seasonal patterns of precipitation. Likewise, animals have distinct temperature and precipitation ranges.

Each species will respond uniquely to climate change (Liu, 1990). Generally speaking, species will either evolve in-situ, move to a more suitable climate, or be extirpated under changing climatic conditions.

Analyses of pollen and fossils indicate that past changes in climate resulted in major shifts in species ranges and marked reorganization of ecosystems (e.g., Delcourt and Delcourt, 1987; Liu, 1990, Williams, 2002). In Ontario, the early post-glacial boreal forest that colonized the Canadian Shield about 10,000 years ago was dominated by white spruce with little or no black spruce (Liu, 1990). White spruce declined and was replaced by jack pine after 9,000 years ago in response to a warmer climate. Boreal forest was replaced with a complex mosaic of mixed-conifers and northern hardwoods just south of Lakes Erie and Superior at this time (Delcourt and Delcourt, 1987). Central Ontario boreal forest was transformed into Great-Lakes St. Lawrence forest around 7,400 years ago and eastern white pine continued to spread northward during a warm period between 7000-3000 years ago causing the Great Lakes – St. Lawrence forest to advance about 140 km north of its present position (Delcourt and Delcourt, 1987; Liu, 1990). For this same period, Lessa *et al.* (2003) determined that the ranges of several boreal animal species, including black bear and northern flying squirrel, expanded in Canada.

The distribution and abundance of plants and animals may change.

The response of species to past climate changes has raised the possibility that anthropogenic climate change is acting as a cause of species migration now. An increasing number of scientific studies suggest that a coherent pattern of ecological change resulting from climate change is apparent (Bowman *et al.,* 2005; Hughes, 2000; Parmesan and Yohe, 2003; Root *et al.,* 2003). Climate change has also been attributed (directly or indirectly) to several species extinctions

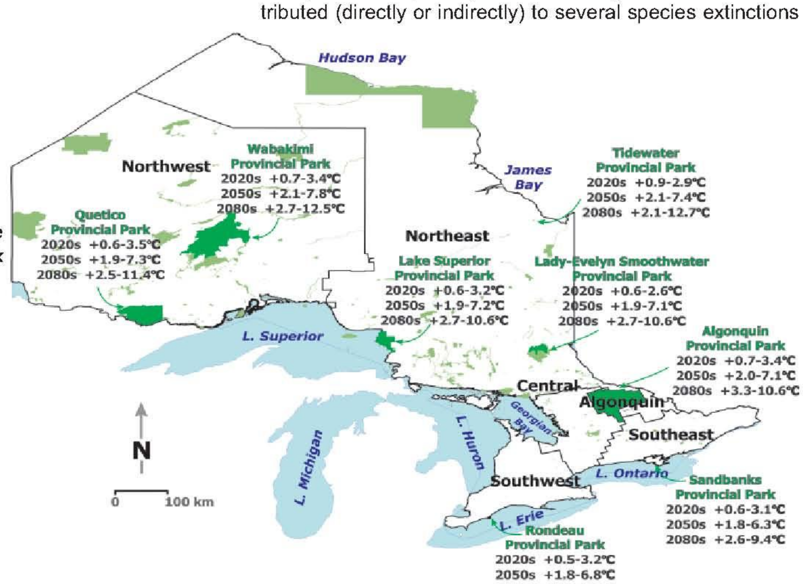


Figure 2: Temperature change (°C) projections for Ontario park regions (Lemieux et al., 2005).

(Pounds *et al.,* 1999; McLaughlin *et al.,* 2002).

Other impacts of climate change for protected areas are also projected. Changing water levels and temperatures in the Great Lakes system are likely to be one of the most important climate change related impacts in Ontario (IJC, 2003). Provincially rare Arctic-alpine species along the shores of Lake Superior protected areas are likely to be impacted.

Problems with invasive species will increase with climate change. Species currently limited to the U.S. may be able to extend their range northward. Malcolm *et al.* (2004) suggest that the new Ontario climate could be conducive to as many as 30 tree species currently not found within Ontario. Moreover, Stocks *et al.* (1998) and Wotton *et al.* (2005) have shown the potential for increase in forest fire extent and intensity in Ontario under changing climatic conditions.

Ontario's protected areas are a major resource for nature-based tourism; with more than 10 million person visitors to provincial parks in 2003. Climate change could influence the physical and biological resources (e.g., water levels, snow cover and wildlife species) that provide the foundation for tourism and related outdoor recreation activities in protected areas. Changes in the length and quality of tourism operating seasons induced by climate change are projected to have significant implications for park visitation. Jones and Scott (2006) project system-wide visitation could increase between 11% and 27% in the 2020s and between 15% and 56% in the 2050s because of climate change.

Implications for Ontario's Protected Areas

Ecosystem representation has become the primary criteria used to identify and design protected areas around the world. 'Representation' is used by Parks Canada (Parks Canada, 1997) and Ontario Parks (OMNR, 1992) and several non-governmental organizations have adopted ecological representation as mainstays of their approaches to system planning. According to the Cabinet-approved planning and management policy used by Ontario Parks, *"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, 1992: 2) Each provincial park contributes to the system. In this 1992 document, 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, 1992: 13). Box 1 identifies some of the many implications that climate change has for protected areas in Ontario.

Conservation strategies have not taken account of the potential impacts of climate change.

Protected area system planning is designed to conserve 'representative samples' of the bio-climatic landscape at a given time. Global warming will change the climate in these protected areas and influence the distribution and abundance of plants and animals. Therefore, representative examples of vegetation that exist today may not exist in the future. For example, Lemieux and Scott (2005) and Lemieux *et al.* (2005) showed the potential for substantial change in vegetation distribution in Canada's protected areas systems under climate change and cautioned that current representation-based approaches to conservation may not protect some species in the future.

Box 1: Selected policy and planning implications of climate change for protected areas (from Scott and Lemieux, 2005: 697).

System Planning for Protected Areas

- System planning frameworks (e.g., natural region representation) may not be optimal for the selection of new protected areas.
- System goals may require interpretation (what to protect – historic-current-future species, processes and not species?).
- Because future species assemblages are unknown, they are excluded from current steady-state planning frameworks.

Park Management Plans

- Established management objectives may no longer be achievable or relevant in some parks.
- Park objective statements (e.g., to protect a highly valued species) may force protected area managers to try to "hit a moving target" of ecological representativeness.

Resource Management Plans

- Fire management plans (utilize to re-establish or maintain current ecological representation or facilitate adaptation?).
- Individual species management plans (commit resources to species re-introduction?, how define invasive species?, exclude southern species from species at risk protection?).
- Visitor management plans (how manage for potentially large increases in visitation due to extended and improved warm-tourism season?).

Individual protected areas contain ecosystems representative of the natural region within which they are located. For example, the Killarney Provincial Park Management Plan (OMNR, 1986) states that *"The park will protect a representative portion and modern environments associated with La Cloche Mountains."* In some cases, parks may change so much that they no longer represent the ecosystems or species for which they were originally established. For example, climate change may eliminate polar bear habitat in and adjacent to Ontario. Given that the Polar Bear Provincial Park was established to protect bear habitat, the management plan could require revision.

Some protected areas may become unsuitable for some ecosystems and species they now support and able to support new ecosystems and species.

Individual protected areas in Ontario are often designed and managed to protect specific natural features, species, and ecosystems. Changes in ecosystem composition, structure and function induced by climate change could impair the ability of protected area managers to maintain current habitats and species populations in the future. For example, Thomas *et al.* (2004: 147) state 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."*

The Need to Adapt to Climate Change

Stehr and von Storch (2005) state that politically realistic mitigation objectives will leave most of the burden for coping with climate change to ***adaptation***. Adaptation is considered as an important policy option or response strategy to concerns about climate change (Smit *et al.,* 2000)

Adaptation to climate change refers to: (1) adjustments in socio-ecological and economic systems in response to actual or expected climatic stimuli and their effects or impacts, and; (2) changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change (Smit et al., 2000; Smit and Pilifosova, 2002).

In general, adaptation measures *reduce vulnerability and increase resiliency in a system.* Should agencies and organizations wait for change to adapt, or should they anticipate the changes and prepare to adapt in advance? Laissez-faire approaches to adaptation have several potential drawbacks, including the possibilities that: (1) forced, last-minute, emergency adaptation or retrofitting will be less effective and more costly than anticipatory or precautionary adaptation over the long term; (2) climate change may be more rapid or pronounced than current estimates suggest and, consequently, result in increased vulnerability of social and economic systems to unexpected events; and, (3) not adapting now may result in irreversible impacts (e.g., species extinction) (Burton, 1996; Smit *et al.,* 1996; Smith, 1997). Managing for climate change in Ontario's protected areas will require a commitment to adaptive management which may require changes to corporate culture and function and unique adaptation strategies for each park.

Conclusions

The impacts of climate change raise important questions about the adequacy of existing protected area systems. Protected area managers have some complex and difficult discussions ahead of them because climate change will affect legislation, policy, planning, and management. Natural assets in each protected area will respond uniquely to climate change and operations, development, research, monitoring, and education programs may all be affected.

The Purpose of this Survey

This survey is designed to aid the development of a ***Climate Change Adaptation Strategy for Ontario's Protected Areas*** -- a document that outlines the short, medium and long-term operational and strategic goals related to climate change and the management issues that it affects, and how these adaptation options may be implemented, monitored and evaluated.

This study responds to several OMNR strategic initiatives, including: 1) *Our Sustainable Future* (OMNR, 2005a) (Strategy 1.1.f - enhance OMNR efforts to understand, mitigate impacts on biodiversity, and adapt to climate change); 2) *Protecting What Sustains Us: Ontario's Biodiversity Strategy* (OMNR, 2005b); and 3) *Climate Change and MNR: A Program-Level Strategy and Action Plan* (OMNR, 2006) (Strategy 7f: Develop and implement adaptation strategies for parks and protected areas for natural resource-related recreational opportunities and activities that are pursued outside parks and protected areas).

We are going to use a multi-round survey to compile expert opinion on policy issues and to help identify adaptation options for Ontario's protected areas agencies and organizations through an evaluation of:

- Policy, Planning and Legislation;
- Management Direction;
- Operations and Development;
- Research, Monitoring and Reporting;
- Corporate Culture and Function; and,
- Education, Interpretation and Outreach.

Your Input is Vital!

As someone with recognized expertise in the conservation community, your participation is critical to the success of this project and to the development of an effective adaptation strategy related to climate change.

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If you have any questions or concerns, please contact the study coordinators:

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Appendix 2.5.
First Round Survey

TOWARDS A CLIMATE CHANGE ADAPTATION STRATEGY FOR ONTARIO'S PROTECTED AREAS

Introduction

Climate change impacts many aspects of policy, planning and stewardship for protected areas, and has far- reaching consequences for agencies, organizations and personnel who work to manage them. Several authors suggest that protected areas will need to be planned and managed differently if they are to meet the conservation needs of the twenty-first century and beyond (e.g., Scott and Lemieux, 2005; Welch, 2005; Hannah *et al.,* 2005).

This multi-round survey is designed to facilitate dialogue among people working to protect and manage Ontario's natural assets to *identify* and *assess* climate change adaptation options for Ontario's protected areas. *In this context, adaptation to climate change refers to a process to develop and implement strategies to moderate, cope with, and take advantage of the consequences of climate change events* (Smit and Pilifosova, 2002). The survey is also designed to elicit the ideas of experts on current protected area planning and management frameworks and concepts in relation to climate change. The survey is being circulated to selected individuals working for academic institutions, government, non-government organizations, and the private sector.

Provincially, the survey supports the recommendations of *Ontario's Biodiversity Strategy,* the Ontario Ministry of Natural Resources' (OMNR) strategic plan, *Our Sustainable Future,* and the OMNR *Climate Change Strategy* to:

1) develop and implement adaptation strategies for ecosystem health, including biodiversity (Strategy 7E);
2) develop and implement adaptation strategies for parks and protected areas (Strategy 7F);
3) develop and implement adaptation strategies for forested ecosystems (Strategy 7G); and,
4) ensure that policy and legislation respond to climate change challenges (Strategy 8).

The survey also supports national initiatives, such as the *Canadian Biodiversity Strategy* and the *Canadian Council on Ecological Areas (CCEA) Climate Change Working Group,* as well as recommendations and decisions contained in international agreements. For example, the *Convention on Biological Diversity* emphasizes the need to take immediate actions to reduce and mitigate the impacts of climate change on biological diversity and to take measures to manage ecosystems so as to maintain their resilience to extreme climate events (Recommendation VI/7 and Decision VII/15).

YOUR INPUT IS IMPORTANT!
It will help protected area management agencies prepare to adapt to climate change.

Research Team

This research is being undertaken by Chris Lemieux (PhD Candidate, University of Waterloo) and Dr. Daniel Scott (Canada Research Chair in Global Change and Tourism) of the Department of Geography at the University of Waterloo. The project is being conducted in collaboration with Rob Davis (Senior Protected Areas Ecologist with Ontario Parks, OMNR) and Paul Gray (Senior Advisor with the Applied Research and Development Branch, OMNR). If you have any questions or concerns, please feel free to contact the survey coordinator or advisors.

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Participation & Confidentiality

Participation in this survey is *voluntary*. You can decline to answer any part of the survey and may withdraw from the survey at any time. All information you provide will be *confidential*. However anonymous quotations may be used in Chris Lemieux's PhD thesis, and associated reports and publications.

The time needed to complete the *first round* survey is about 45 minutes but will ultimately depend upon the amount of information you wish to provide. The *second round* and possible *third round* questionnaires will likely require about 20 minutes to complete.

As with all University of Waterloo projects involving human participants, this research has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at (519) 888-4567 ext. 3600.

Survey Overview: Answering the Questions

The *first round* of the survey is largely open-ended and is designed to identify adaptation ideas. The *second round* of the survey will synthesize and arrange the varied ideas and will allow you evaluate the importance and feasibility of the adaptation ideas. A possible *third round* of the survey will present respondents with a summary of results from the second round and provide respondents with the opportunity to evaluate suggestions made by other panelists. It is possible that some degree of consensus on suggested climate change adaptation options for Ontario's protected areas may be obtained.

Returning the Survey

Survey responses would be appreciated by:

October 20, 2006

A) For surveys being completed via <u>E-Mail or Fax</u>:

Please save the survey documents to your hard drive. The survey can be completed at your convenience in more than one sitting by simply saving the document to your hard drive when necessary. Please also print and mail (in the self-addressed envelope provided) or fax the Consent Form with *attention* to **"Daniel Scott": (519) 746-0658.**

When your survey is complete, please forward it to:

Christopher Lemieux
cjlemieu@fes.uwaterloo.ca

B) For <u>hard-copy</u> surveys being returned via <u>Regular Mail:</u>

Please complete the attached survey and Consent Form and return them as soon as possible in the enclosed self-addressed stamped envelope.

If you are unable to complete the survey, we would appreciate it if you would complete the consent form and return it via regular mail in the envelope provided or fax.

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Please save your survey to your hard drive before closing it.
Thank-you for taking the time to complete the survey!

Section 1: Respondent Information

1. Name:

2. Your position title:

3. Years with your current organization:

4. Educational background:

☐ Earth Sciences (e.g., Geology, Soil Science, Limnology, Geography, etc.)
Please specify:

☐ Life Sciences (e.g., Biology, Ecology, Zoology, Forestry, etc.)
Please specify:

☐ Social Sciences (e.g., Economics, Political Science, Sociology, Planning, Resource Management, Geography, etc.)
Please specify:

☐ Other (e.g., Business, Engineering, Communications, Education, etc.)
Please specify:

5. At what geographical *and* protected areas *scale* is your knowledge and/or experience concentrated (you may select more than one option)?

☐ International	☐ System-scale (e.g., national parks system of another country) ☐ Regional-scale (e.g., within a particular natural/eco/bio-region or delineated management unit of another country) ☐ Local-scale (e.g., within a single or a few protected areas)
☐ National	☐ System-scale (e.g., Canadian national parks system) ☐ Regional-scale (e.g., within a particular natural/eco/bio-region or delineated management unit in Canada) ☐ Local-scale (e.g., within a single or a few protected areas)
☐ Provincial	☐ System-scale (e.g., Ontario provincial parks system) ☐ Regional-scale (e.g., within a particular natural/eco/bio-region or delineated management unit – e.g., Great Lakes bioregion) ☐ Local-scale (e.g., within a single or a few protected areas)

☐ Regional

☐ System-scale (e.g., Carolinian Canada system of protected areas)
☐ Regional-scale (e.g., within a particular ecodistrict)
☐ Local-scale (e.g., within a single or a few protected areas)

☐ Other

Please identify:

6. Based on the following ecozone map of Ontario, where would you geographically identify your area(s) of knowledge and/or experience (you may select more than one option)?

☐ Hudson Bay Lowlands/James Bay
☐ Ontario Shield
☐ Mixedwood Plains
☐ Great Lakes
☐ Other (e.g., other provinces/territories, Canada in general)

Please identify:

7. How would you rank your level of knowledge (LoK) and years of experience with regards to climate change?

Rating System for LoK:

☐ Expert, High Level of Knowledge, Much Experience
☐ Knowledgeable, Above Average Experience
☐ Somewhat Knowledgeable, Limited Experience
☐ Non-Expert, No Experience

Years:

Section 2: Climate Change Adaptation Options for Ontario's Protected Areas

**** Persons completing the survey electronically please note that the text boxes will expand to accommodate text as you key it in – there are no restrictions in terms of space.**

2(A). POLICY, PLANNING AND LEGISLATION

Issues Raised by Climate Change: Policy, legislation and planning are used to guide the selection and management of a system of provincial parks and conservation reserves that represent Ontario's natural features, species and ecosystems, to protect provincially significant elements of Ontario's natural and cultural heritage, to maintain biodiversity, and to provide opportunities for recreation. However, ecological features and species represented in today's protected areas may prove to be under-represented, over-represented, or not represented at all in these protected areas in the future (Scott *et al.,* 2002; Scott and Lemieux, 2005). Moreover, 'ecological integrity', which has been adopted as a guiding management concept by both Ontario Parks and Parks Canada focuses on the maintenance of 'native ecosystems' within 'acceptable limits' of ecological change.

Ontario Parks Legislation and Policy (web links):
http://www.ontla.on.ca/documents/Bills/38_Parliament/session2/b011_e.htm
http://www.ontarioparks.com/english/bldg.html

Canada National Parks Act (web link):
http://lois.justice.gc.ca/en/N-14.01/19110.html

1. **What aspects of protected area *policies* (e.g., *Ontario Provincial Parks Planning and Management Policies*) may be need to be modified to address the impacts of climate change?**

2. **Given that protected areas *legislation* such as the *Provincial Parks and Conservation Reserves Act (2006)* and *the Canada National Parks Act (2000)* recognize ecological integrity as a guiding concept, how could climate change be integrated into their implementation?**

3. **What considerations could be factored into protected areas *system planning* with regard to climate change (i.e., what protected area selection and design principles could be incorporated into system planning to account for ecological change)?**

2(B). MANAGEMENT DIRECTION

Issues Raised by Climate Change: Protected area management plans and other resource management plans (e.g., vegetation management plans and prescribed burn plans) describe protection objectives and work program priorities. The impacts of climate change may need to be addressed in these management plans. For example, protected area objectives, forest fire management strategies, vegetation or wildlife management plans, contingencies for species at risk, invasive species management programs, and species reintroduction programs will be impacted by a changed climate. In some cases, Scott *et al.* (2002) and Lemieux and Scott (2005) suggest that existing plans will require a complete reassessment.

1. What are some specific considerations with regard to climate change that should be taken in account when preparing management direction for Ontario's protected areas (e.g., how would you integrate climate change into individual protected area management plans, and resource management plans such as forest fire management, prescribed burning, vegetation management, invasive species, species at risk, environmental assessment, protected area operations, visitor management, etc.)?

2(C). OPERATIONS AND DEVELOPMENT

Issues Raised by Climate Change: In the context of this survey, operations and development refers to the construction and management of property, campgrounds, visitor centres, office buildings, access, and road maintenance. In support of energy conservation initiatives to reduce emissions and enhance Ontario's air quality, there are a number of behavioural and technological innovations that can be employed to address climate change.

1. What would you suggest protected area agencies and organizations do 'in-house' to reduce greenhouse gas emissions (e.g., within buildings and offices, alternative vehicle solutions, energy conservation initiatives, etc.).

2. Given that lower water levels in the Great Lakes will likely result from climate change, what adaptations to operations and development would you suggest to address lower water levels in protected areas?

3. Given that climate change will likely increase the rates at which invasive species spread into Ontario's protected areas, what adaptations to operations and development would you suggest to help manage the impacts of new invasive species which migrate into protected area boundaries?

4. Given that climate change will likely change the habitat ranges of fish species, what adaptations to operations and development would you suggest to address changes in fish species distribution (e.g., the migration of warm water species into traditionally cool water species territory)?

5. Given that climate change is projected to expand warm-weather recreation seasons and threaten winter-recreation, what adaptations to visitor infrastructure and services would you suggest to reduce risks and take advantage of new opportunities?

2(D). RESEARCH, MONITORING, AND REPORTING

Issues Raised by Climate Change: Research and monitoring programs are currently supported in a number of protected areas. Some research and monitoring will help determine the impacts of climate change on protected area ecosystems and on protected area infrastructure. Reporting can help to communicate the results of monitoring and research and to assess progress.

3. What are the research and monitoring priorities with respect to climate change that could be integrated into current programs at the protected area level and the system level?

4. What indicators should be monitored and reported upon in relation to climate change in protected areas?

2(E). CORPORATE CULTURE AND FUNCTION

Issues Raised by Climate Change: Protected area agencies and organizations, such as Ontario Parks and Parks Canada, support a diversified staff with various educational and professional backgrounds. In the future, protected area agencies and organizations will need to ensure that staff have an adequate level of understanding of the tools and the capacity to respond to climate change impacts as they emerge.

1. Can you describe (a) the contents of an education program and (b) an approach for training that ensures climate change issues are addressed by people working in protected areas?

3(F). EDUCATION, INTERPRETATION, AND OUTREACH

Issues Raised by Climate Change: Many protected area organizations help educate the public about many issues related to protected areas and make natural heritage interpretation information available to visitors. These organizations may be interested in better incorporating climate change into interpretation and outreach programs.

1. How could public interpretation, outreach, and education be enhanced with regard to climate change impacts and initiatives by protected areas agencies in Ontario?

2. How could <u>conservation 'partner' awareness</u> related to climate change impacts and adaptations be enhanced, and their cooperation and participation in climate change initiatives be fostered?

Section 3: Other

Are there additional adaptation ideas or suggestions you wish to convey?

Consent Form

In the space provide below, please indicate your permissions related to this survey.

1. I agree that the data I provide in this questionnaire can be used in aggregate form, which means in combination with others, so that I may remain anonymous. I am aware that I may withdraw my consent at any time by advising the researcher.

2. I have read the information presented in the covering pages to the questionnaire about the survey conducted by Chris Lemieux of the Department of Geography at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I am aware that I may withdraw from the study without penalty at any time by advising the researchers of this decision.

3. I was informed that I may contact Dr. Susan Sykes, Director, Office of Research Ethics, at (519) 888-4567 ext. 6005 if I have any concerns or comments resulting from my participation in this study.

4. I agree that written excerpts from the questionnaire may be included in the thesis and/or publications that may result from this research, with the understanding that the quotations will be *confidential*.

5. Would you be interested in being contacted for a follow-up, in-person interview?

   ☐ YES, I would be interested.

   ☐ NO, I would like to decline.

6. With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

   ☐ YES, I will participate.

☐ NO, I would like to decline.

Participant Name (please print):
Organization/Institution (please print):
Participant Signature: ______________________________
Date:

<u>Mail:</u> Please use self-addressed stamped envelope provided.
<u>Fax:</u> Please make *attention* to **"Daniel Scott": (519) 746-0658.**

Appendix 2.6.
First Round Survey Reminder Letter

September 27, 2006

Re. "An Invitation to a Pioneering Dialogue on Climate Change and Protected Areas"

Dear [Name of Participant],

Recently you should have received an email and hard-copy package from me containing a letter requesting your participation in a Delphi survey entitled *Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas.*

We are writing you now to remind you that survey responses would be greatly appreciated by **October 20, 2006**. We would like to stress again that your input is important because it represents one of several positions which must be considered in designing such a strategy. *Participation in this project is limited and you have been selected by the advisory team to participate in the survey based on your expertise and/or experiences with protected areas policy, planning, management and research.* Accordingly, we feel that your views on the subject of climate change and protected areas are important.

If you would like your position to be represented in this project, then please complete and return the questionnaire and response form either via email or the self-addressed stamped envelope included in the hard-copy survey package. If you have responded recently, or you are in the process of responding, then accept our sincere thanks for your participation.

As with all University of Waterloo projects involving human participants, this research has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at (519) 888-4567 ext. 36005. If you have any questions or concerns, please contact me at either the phone number or email address listed at the bottom of the page.

Thank you for your time and input,

Christopher Lemieux (survey coordinator)
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on behalf of

Dr. Daniel Scott (project advisor)
Department of Geography, University of Waterloo

Rob Davis and Paul Gray (project advisors)
Ontario Parks and Ontario Ministry of Natural Resources (OMNR)

Appendix 2.7.
First Round Survey Thank-you Letter

October 20, 2006

Re. "An Invitation to a Pioneering Dialogue on Climate Change and Protected Areas"

Dear [Name of Participant],

We would like to *thank* you for your participation in the survey entitled *Towards a Climate Change Strategy for Ontario's Protected Areas*. As a reminder, the purpose of the multi-round survey is to mobilize the conservation community to help identify and evaluate climate change adaptation options for Ontario's system of protected areas. The eventual outcome of the exercise will be to develop a proactive strategy for the integration of climate change into Ontario's existing protected areas policy, planning, and management frameworks.

As we stated in our original cover letter, without your input, this project would not be possible. Once we receive the remaining response and synthesized the information therin, we will mail ou the second round survey to you. The purpose of of the second round survey is to have respondents evaluated the recommended adaptation options for desirability, feasibility and time-frame of implementation.

Please remember that any information pertaining to you as an individual participant will be kept *confidential*. Once all of the information are collected and analyzed for this exercise, the information will be shared with the conservation community through seminars, conferences, presentations and journal articles. If you are interested in receiving more information regarding the results of this project, or if you have any questions or concerns, please contact me at either the phone number or email address listed at the bottom of the page.

As with all University of Waterloo projects involving human participants, this research has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at (519) 888-4567 ext. 36005.

Best Regards,

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
Tel: (519) 888-4567 ext. 35783 | E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of

Dr. Daniel Scott (project advisor)
Department of Geography, University of Waterloo

Rob Davis and Paul Gray (project advisors)
Ontario Parks and Ontario Ministry of Natural Resources (OMNR)

Appendix 2.8.
Second Round Survey Cover Letter

January 25, 2007

Re. "Towards a Climate Change Adaptation Strategy for Ontario's Parks and Protected Areas: Second Round Delphi Survey"

Dear [Name of Participant],

Thank-you for participating in the first round of the Delphi survey called *Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas*. Approximately 50 responses were received representing a response rate of 70%. The research team has analyzed and collated the recommendations provided by respondents in the first round. This second and final round of the Delphi study is based on those recommendations. The objective of this second round is to **evaluate** the recommended adaptation options provided by respondents in the first round. This exercise provides you with the opportunity to evaluate adaptation options provided by other respondents, and to re-evaluate your own initial position. It also allows the research team to measure whether the respondent group generally supports, opposes, or is ambivalent towards a recommended adaptation option.

We ask that you evaluate the adaptation options in terms of three assessment indicators: (i) **desirability**; (ii) **feasibility**; and, (iii) **time-frame** for implementation. You can find an explanation of each assessment indicator on p. 1 of the survey. Please select ONE option from each category using the drop-down menus. In some instances, you may feel that a recommended adaptation option is desirable (beneficial) and feasible (workable, can be implemented); and in others, you may feel that a recommended adaptation is desirable but not feasible (cannot be implemented). If you are unsure of your position on a recommended adaptation option, a "not sure" option is provided in the drop-down menu. While we do not ask you to substantiate each one of your responses, we do provide **extra space** at the end of each section should you like to provide an opinion, extra reasoning, or any other relevant information concerning a recommended adaptation option. Please remember that all information you provide in this survey will be **confidential**. The time needed to complete the second round survey is estimated at two to three hours.

This second round is the final round in this Delphi survey; thus, your participation is imperative to provide a cross-section of expert opinions on climate change adaptation. We may follow up with you afterwards to obtain feedback on the Delphi survey process, or conduct smaller focus groups to further develop aspects of the climate change adaptation strategy. The final aggregated results of this exercise will be shared with the conservation community through seminars, conferences, presentations and journal articles. If you are interested in receiving more information regarding the results of this project, or if you have any questions or concerns, please contact Chris Lemieux using the email address listed at the bottom of the page.

A response by **February 9, 2007** would be greatly appreciated. Thank you once again for your time and we look forward to your second round Delphi response.

All the best in 2007,

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo | E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of:

Dr. Daniel Scott
University of Waterloo

Rob Davis and Paul Gray
Ontario Ministry of Natural Resources

Appendix 2.9.
Second Round Survey

Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas ~Second Iteration~

Rating Scales: Overview

Desirability (Effectiveness or Benefits)	**Very Desirable** Will have a positive effect and little or no negative effect Extremely beneficial Justifiable on its own merit	**Desirable** Will have a positive effect and little or no negative effect Beneficial Justifiable as a by-product or in conjunction with other items	**Undesirable** Will have a negative effect Harmful May be justified only as a by -product of a very desirable item, not justified as a by-product of a desirable item	**Very Undesirable** Will have a major negative effect Extremely harmful Not justifiable
Feasibility (Practicality)	**Definitely Feasible** No hindrance to implementation No R&D required No political roadblocks/barriers Acceptable to the public	**Possibly Feasible** Some indication this is implementable Some R&D still required Further consideration or preparation to be given to political or public reaction	**Possibly Unfeasible** Some indication this is unworkable Significant unanswered questions/barriers	**Definitely Unfeasible** All indications are negative Unworkable Cannot be implemented
Implementation Time Frame (Priority or Relevance)	**Short Term (0-10 years)** A most relevant point First-order priority Must be resolved, dealt with, or treated immediately	**Medium Term (10-20 years)** Is relevant to the issue Second-order priority Significant impact but response should be deferred until other items are treated Does not have to be fully resolved	**Long Term (20+ years)** Insignificantly relevant Third-order priority Has little importance Not a determining factor to major issue	**'Wait and See' (Reactive)** Not a priority now Should be dropped as an item to consider for now Respond as impact(s)/issue(s) emerge 'on the ground'

Section 1: Respondent Information

Please provide your name:

Please check your affiliation (check one option only):

☐ Ontario Provincial Government (e.g., OMNR, Ontario Ministry of the Environment)
☐ Canadian Federal Government (e.g., Parks Canada, Environment Canada)
☐ Academia (i.e., University)
☐ Non-governmental Organization (NGO)

☐ Other (e.g., Consulting); Please specify:

Section 2: Prioritizing Program Areas

Considering resources (i.e., staff and available funding) and other considerations (e.g., state of knowledge and science on climate change, uncertainty in climate change projections, etc.), please rank the following protected areas program areas with regards to overall response priority (i.e., where you feel climate change adaptations should occur/focus on first/highest priority to last/least priority).

Policy, Planning and Legislation	Please Rank: ☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6
Management Direction	Please Rank: ☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6
Operations and Development	Please Rank: ☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6
Research, Monitoring and Reporting	Please Rank: ☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6
Corporate Culture and Function	Please Rank: ☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6
Education, Interpretation and Outreach	Please Rank: ☐1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

*please only check <u>one</u> ranking for each category and ensure each ranking number is represented (i.e., only one ranking of "1", only one ranking of "2", etc.) – please do not indicate a tie.

Section 3: Climate Change Adaptation Options for Ontario's Protected Areas

Please only select <u>one</u> option from each evaluation category using the drop-down menus (highlighted by "Please Select"). Space is provided at the end of each section should you wish to provide explanation or any other relevant information related to a recommended adaptation option

PLEASE REMEMBER TO FREQUENTLY SAVE YOUR SURVEY TO YOUR HARD DRIVE

2(A). POLICY AND LEGISLATION

4. What aspects of protected area *policies* (e.g., *Ontario Provincial Parks Planning and Management Policies*) may need to be modified to address the impacts of climate change?

Adaptation Options:

1. Protected area policies <u>should not</u> be modified to address the impacts and implications of climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. A strategic and corporate policy on climate change and protected areas is needed to provide sufficient direction for planning and management.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. Ontario Parks should consult with protected area organizations in adjacent provinces and states to help anticipate, plan, and synergize cross-jurisdictional objectives to anticipate the "loss and gain" of species, communities and processes.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. A national protected areas strategy should be developed to ensure that protected areas systems are integrated into a plan to achieve broad goals of biodiversity conservation and ecosystem health.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. Policies for provincial parks and conservation reserves should embrace a science-based adaptive management approach to better deal with potential climate change impacts (i.e., acknowledgement of the dynamic nature of ecosystems and increased flexibility to better manage uncertainty).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. Policy and regulations should ensure that land uses adjacent to protected areas do not compromise integrity and connectivity functions, and take into account the possible movement of species due to climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

7. Climate change should be addressed in a review of policies for provincial parks and conservation reserves to ensure they consider climate change, biodiversity conservation, and ecological integrity goals.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

8. Policies on modifying protected area boundaries should include climate change considerations in designing ecologically appropriate boundaries.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

9. Some of the broad guiding principles incorporated into Ontario Parks policy, such as representation and permanence, should be re-evaluated in light of climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

10. Policies and targets should not only address elements of biodiversity pattern, but should also include the spatial and temporal aspects of natural processes, including population sizes, movements, metapopulation dynamics, disturbance regimes, ecological refugia, and adjustments to climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

11. There is an increasing need to take a precautionary approach to park management as uncertainty increases with climate change. This is particularly true in the context of cumulative impacts. As such, the precautionary approach should be explicitly built into policy, planning and management.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

12. It is necessary to develop a more explicit mandate and policies for protected areas system design to enable better connectivity among protected areas through the protection of corridors, linkages, and functional ecology.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

13. Newly exposed shorefront lands should be secured under public protection and managed for the new biological communities that will evolve there, possibly combined with public access to the waterbodies for recreational purposes.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

14. Future policy reviews should consider redefining the concept of ecological integrity. "Acceptable rates of change" and defining what exactly constitutes species "characteristic" of a natural region should be more explicitly defined with climate change considerations in future policy.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. Given that protected areas *legislation* such as the *Provincial Parks and Conservation Reserves Act (2006)* and *the Canada National Parks Act (2000)* recognize ecological integrity as a guiding concept, how could climate change be integrated into their implementation?

Adaptation Options:

15. Climate change <u>should not</u> be considered in any future legislative reviews.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

16. Climate change <u>should not</u> be integrated into planning and management decisions that affect ecological integrity.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

17. Each protected areas management plan should specifically address how climate change is likely to affect ecological integrity and provide management direction to help address the issues.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

18. The concept of ecological integrity should be re-defined with climate change considerations.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

19. Many of the initiatives needed to enhance ecological integrity under the existing climate regime are the same as those under future climate scenarios. As such, climate change should be used to help rationalize and compel the implementation of ecological integrity objectives.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Short Term (0-10 years)

3. What considerations could be factored into protected areas system planning with regard to climate change (i.e. what protected area selection and design principles could be incorporated into system planning to account for ecological change)?

Adaptation Options:

20. Protected areas system planning and reserve design should not specifically incorporate climate change considerations.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

21. A multi-disciplinary team should be developed to examine the ecological representation criterion for selecting and designing protected areas, evaluate whether this approach is viable in protecting biodiversity under a changing climate, and examine alterative approaches to protected area systems planning.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

22. Ecological representation should no longer be used as one of the five criteria (the others being condition, diversity, ecological functions, and special features) for selecting and designing protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

23. Representation should continue to be used as a tool for protected areas system planning as a wider variety (diversity) of landform/vegetation associations being protected may increase the likelihood that different species and habitats will remain protected under climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

24. Protected areas system design should focus on the continued representation of species but should more effectively incorporate persistence parameters to ensure "perpetual representation" (i.e., representation through time).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

25. Because natural regions such as ecoregions and ecodistricts may shift as a result of climate change, they should be used primarily as administrative policy units and should no longer be used for protected areas system planning (e.g., park class targets, representation requirements).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

26. Increasing park class targets for waterway and aquatic class parks could be helpful to mandate the creation of additional riparian corridors to help with aquatic impact mitigation and plant, animal and community movements induced by climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

27. Increasing size criteria for specific park classes could help in alleviating the ecological impacts of local perturbations and cross-boundary stressors related to climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

28. Policies on modifying protected area boundaries should include climate change considerations in designing ecologically appropriate boundaries.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

29. Land use activities adjacent to protected areas should allow for movement of wildlife and plants and help to "feather" protected areas into the working landscape.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

30. Protected areas system planning should incorporate 'redundancy' into representation requirements to offset potential species losses resulting from climatic and ecological change (giving high priority to species at risk and highly threatened species).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

31. Protected areas organizations should use the climate change issue as a catalyst to accelerate the process of establishing additional protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

32. De-regulating parks should be explored as an option should a protected area no longer achieve its original protection mandate.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

33. "Floating protected areas", "temporal reserves" and protected areas "swapping" approaches (i.e., strategic de-regulation and establishment) should be explored as a planning option in order facilitate the movement of non-migratory species and increase the overall resiliency of the protected areas system to climate change related impacts.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

34. Park class targets and feature representation requirements should be modified to include the impacts and implications of climate change on ecological processes (e.g., composition, structure and function).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

35. Minimum size guidelines for establishing protected areas should be developed with climatic and ecological change considerations and should consider varying degrees of uncertainty.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

36. The establishment of new protected area "classes" should be considered. "Evolutionary baseline" class parks, for example, could allow for natural evolution and be used to research, monitor and demonstrate ecosystem changes.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

37. Future protected area establishment should focus on species at the northern limits of their range as these may be the best adapted to adjust to changing climatic conditions.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

38. System planning should focus more on inherent capability (e.g., soils, water, productivity) and less on the current occupancy of flora and fauna (i.e., permanent features vs. impermanent ones). As such, Ontario Parks should "accept" whatever ends up thriving on these different landforms.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

39. Highly vulnerable, disjunct/relict, and outlier species should receive higher protection priority in system planning.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

40. Highly vulnerable systems should not be protected – limited resources should focus on areas with a reasonable chance of longer term resilience.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

41. Spatial considerations related to disturbance regimes and faunal movements should be more adequately addressed in protected area system design principles. Incorporating guidance on the application of these concepts in the design of new protected areas, particularly in the north, where wide-ranging mammals and large-patch disturbance regimes exist, should provide spatial insurance for ecosystems and the components being protected.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

42. Ontario Parks' protected area selection criterion of "ecological functions" (i.e., processes) should receive greater emphasis in protected areas system design in order for protected areas to be sufficiently designed to better withstand increased natural disturbances and to help facilitate the movement of species in response to climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

43. Ontario Parks should examine the possibility of supplementing "fixed" protected areas with "dynamic reserves" that protect early successional ecosystems, perhaps managed to re-set them back from time-to-time.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

44. Ontario Parks should anticipate locations that could serve as refugia for certain kinds of ecosystems and work to protect these sites in advance.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

Section Comments

Question #	Comment

2(B). MANAGEMENT DIRECTION

1. For the purposes of this survey, "management direction" can include management plans, management statements (e.g., IMS, SCI), environmental assessments, and resource management plans such as forest fire management, prescribed burning, vegetation management, invasive species, species at risk, park operations, and/or visitor management. What are some specific considerations with regard to climate change that should be taken in account when preparing management direction for Ontario's protected areas?

Adaptation Options:

1. Climate change should not be incorporated into Ontario Parks' management direction.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. A corporate statement/position on climate change should be developed in order to help provide staff with direction and guidance on climate change-related planning and management issues.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. The role of each protected area in contributing to "ecological representation requirements" should be incorporated as part of the protected area planning process and should be reassessed at decadal intervals (i.e., the overall landscape of Ontario will be changing, and so must the role of each location).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. Protected areas zoning with climate change considerations should be incorporated as part of the protected area planning process and should be made more adaptable and flexible as the location of natural values shift (i.e., recognize that park zones may need to shift across the landscape to protect certain features as current values move, are lost, and new ones appear).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. Park classifications should be reviewed as part of the planning process, and changed if necessary to accommodate changing protection values. For example, some protected areas originally established for recreation purposes may emerge to be more valuable for the protection of natural assets, such as species at risk.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. Management plans should incorporate a long-term trends analysis to help guide longer-term actions and priorities.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

7. Management direction should become more flexible to enable adaptation to the impacts of climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

8. "Clustered" management plans that would provide a generic management prescription for a series of protected areas having similar ecological management should be used to provide the flexibility needed to incorporate climate change considerations at local and regional levels for protected areas having similar environmental conditions.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

9. Adaptive management should be explicitly incorporated into management direction in order to anticipate the uncertainties associated with climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

10. Ontario Parks, and the MNR as a whole, should reconsider the basic definitions of non-native and invasive species. Future definitions should include climate change considerations.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

11. Management plans should acknowledge climate change as an ecological driver and should no longer focus on maintaining the "status quo" of flora and faunal composition.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

12. Species translocation should be considered as an active management option when species are unable to migrate to suitable habitat naturally.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

13. Species at risk planning should include protection provisions for the range expansions and contractions of species.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

14. Vegetation management plans should include species lists of native plants and communities that could migrate into/out of protected area boundaries and include provisions and guidance to adapt accordingly.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

15. Invasive species management direction should be "fluid" and include new and upcoming invasives that could expand their range and affect ecological integrity because of climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

16. Protected area management direction should determine long-term goals with some targets for species and ecosystems that consider the impacts of climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

17. Management direction should explicitly identify species, habitats, and ecosystems at risk due to possible climate change impacts.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

18. The principles of "adaptive management" and the "ecosystem approach" should be incorporated into all management (e.g., preparing and implementing resource management plans and their subset of interventions) and planning (strategic/corporate, systems planning, site level management plans) directions of Ontario Parks.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

19. Management plans should be reviewed once specific thresholds related to climate change are exceeded (e.g., changes in species populations or temperature regimes).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

20. Management direction for fisheries should place more emphasis on maintaining cold-water aquatic ecosystems and the species that depend on them. Areas adjacent to cold-water streams and lakes should generally not be developed, and natural vegetative cover should be maintained.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

21. Class Environmental Assessments should incorporate climate change considerations.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

22. Climate change adaptation indicators need to be identified, defined and used to assess the successes and challenges of specific management plans.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

Section Comments

Question #	**Comment**

2(C). OPERATIONS AND DEVELOPMENT

1. What would you suggest protected area organizations do 'in house' to reduce greenhouse gas emissions (e.g., within buildings and offices, alternative vehicle solutions, energy conservation initiatives, etc.).

Adaptation Options:

1. Reductions in greenhouse gas emissions should not be incorporated into park operations and development.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. The parks and protected areas sector should be a national and provincial leader and a showcase (i.e., lead by example and develop demonstration sites for alternative energy solutions) for curbing all emissions under its control.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. The parks and protected areas sector should play an advocacy role in garnering widespread pubic support for greenhouse gas reductions and should encourage other sectors to do likewise.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. Ontario Parks should develop a greenhouse gas emissions reduction strategy for its buildings and fleet. Ontario Parks should include explicit goals for greenhouse gas emissions reductions in their management plans that push the envelope in terms of best management practices. Any infrastructure development or refurbishing should then take a best practices approach to energy and emissions. Vehicle fleets should reflect the best possible energy efficiency standards. This could serve as a public education tool, to show that emissions reductions are possible both at an individual and institutional level, and help build political support for real action to reduce emissions across society.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. Ontario Parks should explore opportunities for greenhouse gas reductions, including alternative vehicle solutions (e.g., increased use of bicycles, 4-cycle engines for boat motors, lawn mowers, snow blowers, opportunities for commuting, purchasing hybrid vehicles), energy efficient lighting options, and waste reduction strategies.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. Service-oriented protected areas should be better designed to reduce the need for vehicle use (e.g., campgrounds should be designed in a way that reduces vehicle use by visitors and park staff).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

7. Incentives and dis-incentives should be used to change park staff and visitor attitudes and behaviours with regards to energy use and conservation.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

8. Park staff should make greater use of alternative modes of transportation, including bicycles, golf carts, and foot patrols rather than mechanized modes such as trucks.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. Given that water levels will likely fall in the Great Lakes and will likely fluctuate more severely elsewhere as a result of climate change, what adaptation to operations and development would you suggest to address changing water levels in protected areas?

Adaptation Options:

9. No adaptations to operations and development should be considered to address changing water levels in protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

10. Permanent docks should be replaced by floating docks to facilitate annual relocations subject to water levels and to reduce impacts on aquatic habitats.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

11. Ontario Parks should seek opportunities to re-design access and pedestrian traffic controls with greater environmental and climate change considerations where marked beach regression is occurring.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

12. Ontario Parks should rely less on built structures such as docks and boathouse which will be left hanging high and dry when water levels change. Lake-level dependent developments should be avoided.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

13. Adaptation to operations and development should be idiosyncratic in nature and will need to be evaluated on a park by park, or even site by site, basis because many other variables will also need to be evaluated (e.g., water control structures, cost-benefit analysis, risk analysis).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

14. Protected area managers should not be required to "fix" water levels – water levels should not be altered to maintain artificially high water levels.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

15. Recreational uses (e.g., swimming, walking, day-use, mechanized travel, etc.) could be altered (i.e., decreased, stopped) to protect newly exposed shorelines and allow for stabilization through natural succession to occur. Vulnerable coastal ecosystems and facilities should be inventoried and monitored - inventory and monitoring could lead to decisions about possible closures of some areas to public use.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. Given that climate change will likely increase the rates at which invasive species spread into Ontario's protected areas, what adaptations to operations and development would you suggest to help manage the impacts of new invasive species which migrate into protected area boundaries?

16. Ontario Parks <u>should not</u> adapt operations and development initiatives to help manage the impacts of new invasive species which migrate into protected area boundaries.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

17. Live bait should be severely restricted, perhaps even regulated against, in order to avoid the spread of invasive species.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

18. A total ban on campers bringing personal firewood into parks should be implemented to avoid the spread of invasive and disturbance species.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

19. A staff and public education program with standardized messaging should be implemented to help recognize, monitor and report on invasive species occurrences in protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

20. The role of visitors and volunteers in preventing, monitoring, and managing invasive species should be addressed in management planning.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

21. Ecological integrity should be maintained or restored wherever possible as intact ecosystems are more likely to naturally resist invasive species.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

22. Ontario Parks should establish a "warning system" for visitors through the Ontario Parks website, campsite reservation site, and reservation confirmation letters about the imminent spread of invasive species and how to report and who to report occurrences to.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

23. Restoration and re-vegetation activities should use native species and grasses only (e.g., no ornamental, non-native plants).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

24. Minimizing disturbance (e.g., new roads, infrastructure, etc.) should be an approach used to offset possible invasive species response.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

25. There should be an increased effort of using natural ecological processes (e.g., fire, prescribed burns) to control invasives.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

26. Mandatory check-points and cleaning stations to ensure boats are clean of non-native/invasive species prior to their launch in a protected area should be installed.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

27. Rules for acceptance of non-native species as part of the ecosystem need to be developed.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

28. A contingency budget should be established by Ontario Parks and the broader MNR to consider/manage invasives early.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. Given that climate change will likely change the habitat ranges of fish species, what adaptations to operations and development would you suggest to address changes in fish species distribution (e.g., the migration of warm water species into traditionally cool water species territory)?

Adaptation Options:

29. No adaptations to operations and development should be considered to address changes in fish species distribution.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

30. Populations and species associations should be allowed to equilibrate (migrate to suitable water habitats) as ecosystems change, unless the changes are due to over-exploitation or other artificial stresses.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

31. In the event that climate change increases to a point that certain fish species are no longer able to survive without translocation, selected lakes should be stocked and managed to provide habitat for species and angling opportunities.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

32. Native populations of fish species that can adapt to warmer water temperatures should be translocated where natural migration is not possible.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

33. Streambank erosion restoration (e.g., enhancing vegetation cover) should be used to enhance and prolong cool water species habitats.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

34. Anthropogenic lakes and ponds which connect to cool water streams and have a warming influence should be reduced or eliminated.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

35. Anthropogenic lakes and ponds should be disconnected and restored to their proper bathymetry to the river to reduce water temperature and restore freshwater and groundwater influxes.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. Given that climate change is projected to expand warm weather recreation seasons and threaten winter recreation, what adaptations to visitor infrastructure and services would you suggest to reduce risks and take advantage of new opportunities?

Adaptation Options:

36. No adaptations to visitor infrastructure and service should be considered to reduce risks and take advantage of new opportunities resulting from climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

37. More funding should be directed to fix roof accommodations such as yurts and cabins to capture the opportunities associated with an extended spring and fall camping season.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

38. Ontario Parks should more aggressively monitor lake ice conditions and perhaps restrict access and travel in the shoulder seasons to ensure visitor safety.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

39. Ontario Parks should put into place caps on usage of facilities such as trails to proactively ensure that excessive and extended use in the future does not create additional stresses on these ecosystems.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

40. Ontario Parks should identify and close facilities that may no longer be viable under changing climatic conditions (e.g., no longer maintain ski, skate or ice fishing facilities).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

41. Ontario Parks should invest fewer resources into winter programs due to the anticipated reduction in seasonal use and invest more in warm-weather recreation options.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

42. Sole-use winter trails should be converted to multi-use/multi-season trails as conditions change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

43. Camping seasons should be extended in selected provincial parks to take advantage of the potential increase in visitor use.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

44. Ontario Parks should identify staffing needs and challenges due to the possibility an extended warm-season (e.g., the availability of students during non-peak season, increased visitation during warm-weather seasons).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

45. Efforts should focus on reducing, not increasing, the ecological footprint of human activities. As such, efforts should focus on new forms of recreation that are proactive and environmentally responsible.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

Section Comments

Question #	Comment

2(D). RESEARCH, MONITORING AND REPORTING

5. What are the research and monitoring priorities with respect to climate change that could be integrated into current programs at the protected area level and the system level?

Adaptation Options:

1. Climate change <u>should not</u> be integrated into protected areas research, monitoring, and reporting activities.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. A specific monitoring strategy should be developed related to climate change to detect and monitor trends and impacts.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. An integrated and cooperative monitoring strategy related to climate change to detect and monitor trends and impacts, especially for regionally threatened species, extinction prone species, and management target species, should be established and should be implemented at the ecoregional/system level. Such a monitoring program should also be used to document and assess the success/failure of remedial actions.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. Natural Heritage staff and "volunteer" monitoring programs (e.g., NGOs, "Friends Of" groups, local schools, park users, etc.) to detect and monitor climate change impacts should be established by Ontario Parks, regional offices, and individual protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. Ontario Parks should establish long-term research and monitoring sites against which to quantitatively measure climate change impacts.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. Weather stations should be established and strategically located in protected areas to improve the grid of climate data in Ontario and to provide long-term climate information specifically relevant to protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

7. Ontario Parks should increase climate change trend modelling studies (e.g., with regards to species composition, water quality and quantity, invasive species, pests and diseases, local and regional climate, species species at risk, threatened species, etc.) to assess potential future impacts on protected areas assets.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

8. A comprehensive research strategy and monitoring framework with a defined set of measures (with sufficient spatial and temporal considerations) pertaining to climate change should be established (e.g., incorporated into Ontario Parks Comprehensive Monitoring Framework) at both the system and park level to track climate change and its effects and for comparative reporting.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

9. Climate change impacts and actions should be explicitly recognized as an ecosystem management issue in state of the protected areas and ecological integrity reporting.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

10. A research strategy should be developed on the role of protected areas and climate change (e.g., What are the looming questions needing answers necessary to address critical policy, planning, management and operation needs in protected areas? More broadly, what service roles can protected areas play as platforms for long-term time-trend research on climate change issues that transcend protected areas?).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

11. Ontario Parks should develop specific thresholds related to climate change that trigger management actions if the state of ecological integrity is assessed to be declining.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

12. Ontario Parks should monitor long-term changes in species composition using permanent sample/systematic plots located at ecotones (species at the northern limits of their range).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

13. Monitoring sites should be established in the least disturbed protected areas in each ecodistrict to act as control sites for projects investigating the effects of climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

14. Regional climate models should be used to predict current protected areas whose ecosystems will be most susceptible to alteration.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

15. Ontario Parks should assess major species, habitats, physical features, processes and other important ecosystem resources that are most likely to be impacted by climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

16. Research strategies should be reviewed to include the ability of species to recover from climate change disturbances and repeated disturbances (i.e., resiliency).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

17. Ontario Parks should maintain up-to-date distribution maps of species and communities.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

18. Demonstration monitoring should be employed to illustrate to protected area visitors some of the environmental changes caused by climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

19. Monitoring efforts should be coordinated across jurisdictions and with other organizations and partners (i.e., standardize indicators, protocols, etc. to enable seamless roll-ups, assessment, and reporting of time-trend data).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

20. Ontario Parks should regularly report on climate change monitoring results and adaptation activities via scientific literature, grey literature, and the popular literature to inform clients and help garner support for funding and staffing.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

21. The role of protected areas in sequestering carbon needs to be explored in more detail and ensure that ecological integrity and biodiversity goals are not compromised by carbon sequestration goals.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

22. The assessment of ecological integrity should be made relative the prevailing climate at the time of assessment and not a historical benchmark that no longer exists.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. What indicators should be monitored and reported upon in relation to climate change in protected areas?

Adaptation Options:

23. Specific climate change indicators of climate change should not be developed.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

24. Climate change indicators should be built into existing monitoring programs and ecological integrity monitoring frameworks.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

25. Specific climate change indicators should be developed for each Ontario ecoregion (i.e., Hudson Bay Lowlands, Ontario Shield; Mixedwood Plains).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

26. There needs to be a balance between climate (driver) and feature/species (responder) indicators, and a clear distinction between regions and parks.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

Section Comments

Question #	**Comment**

2(E). CORPORATE CULTURE AND FUNCTION

1. Can you describe (a) the contents of a staff education program and (b) an approach for training that ensures climate change issues are addressed by people working in protected areas?

Adaptation Options:

1. Climate change <u>should not</u> be integrated into Ontario Parks staff education programs and training initiatives.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. Ontario Parks should ensure that all staff have a level of understanding of, and capacity to respond to, climate change impacts and adaptation appropriate to their mission.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. The Ontario Parks "Planning and Research Team" should develop a training session to address climate change and related topics for all levels of park staff.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. Staff orientation and training should be geared to occupation (e.g., biologists, planners, mid and upper management, interpreters, etc.) to ensure each understands the science of climate change, impacts, and potential adaptations. As such, training needs to be targeted, concise and directly relevant so employees so they can use it in their daily work.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. A system-wide "culture of conservation" needs to be cultivated in order to address activities which can reduce the effects of climate change. Ontario Parks should become a model of "low impact" and positive action.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. The contents of an education program could focus on: 1) current science; 2) potential impacts; 3) potential adaptations and limitations to response; 4) "the plan" on moving ahead; and, 5) the role of employees in implementing "the plan".

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

7. A standardized educational package at the provincial level should be developed with regional specialists disseminating information and training staff at the park level.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

8. Climate change adaptation workshops should be developed for specific ecoregions or greater park ecosystems.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

9. All new staff should attend a climate change orientation program.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

10. Ontario Parks should ensure that educational materials related to ecological integrity address climate change as one of the threats.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

11. A parks certificate course should be re-instated and the curriculum should include basic information and training on climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

12. There should be more opportunities for staff to participate in climate change workshops and engage with experts in the field to keep abreast of new climate change related developments.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

13. Climate change should be a mandatory topic for parks superintendents to report on in annual reports on park planning, managing and operating parks.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

Section Comments

Question #	**Comment**

2(F). EDUCATION, INTERPRETATION AND OUTREACH

2. How could public interpretation, outreach and education be enhanced with regard to climate change impacts and initiatives by protected areas organizations in Ontario?

Adaptation Options:

1. Climate change <u>should not</u> be incorporated into public interpretation, outreach and education initiatives/activities.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. Ontario's protected areas organizations should provide input into the development of primary and secondary school curriculum on protected areas and climate change (e.g., develop lesson plans that teachers could use in the classroom). The contents of a climate change curriculum could include: 1) an overview of climate change impacts and supporting evidence; 2) a brief overview of potential implications; 3) introduction to the concept of ecological integrity; 4) methods for minimizing local contributions to climate change and ways to mitigate and adapt; 5) methods for minimizing other stresses; and, 6) ways to monitor for key ecological changes within protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

3. Ontario Parks should be leading by example in public interpretation and education activities. Protected areas should be used to educate the public (e.g., through interpretation activities) about climate change impacts and the implications of these impacts for park features (e.g., species, habitats, ecoregions, physiography, etc.) and to build public support on climate change initiatives. Parks should be used to inform the public about climate change efforts to mitigate and adapt to it.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

4. Ontario Parks should provide visitors with climate change ideas and conservation-oriented activities that they can act on themselves. As such, interpretation and outreach should play a role in encouraging personal responsibility in reducing emissions and making a difference.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

5. Climate change issues awareness messages should be incorporated into virtually every public communication tool available to protected areas (e.g., interpretive packages, publications such as fact sheets, tabloids and parks guides, websites, DVDs, etc.).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

6. Interpretive programs should incorporate climate change and energy conservation measures to inform the public of the ways to reduce climate change impacts (mitigate), conserve energy and reduce waste at home and at the park.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

7. Interactive, hands-on displays, demonstration monitoring (demonstration sites, such as lake retreat), and mitigative/adaptive actions and techniques (e.g., ways to reduce emissions and conserve energy) should be used in protected areas to educate the public and engage multiple partners in climate change education and outreach.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

8. Protected areas organizations should participate in broader landscape initiatives related to climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

9. Protected areas organizations should work in cooperation with other organizations outside of protected area boundaries to help reduce the impacts of climate change through approaches such as protected area system design, ecological restoration, and compatible land uses adjacent to protected areas.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

2. How could conservation 'partner' awareness related to climate change impacts and adaptations be enhanced, and their cooperation and participation in climate change initiatives be fostered?

Adaptation Options:

10. Ontario protected areas organizations <u>should not</u> be involved in conservation 'partner' awareness initiatives.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

11. A national climate change working group with provincial/territorial representation should be established to address climate change and protected areas issues including adaptation.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

12. A "Partner Program" with government, NGOs, and other relevant organizations and individuals should be developed to address climate change and protected areas issues. Examples include: partners to reduce climate change (mitigation measures); partners to educate visitors; and, partner to educate staff.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

13. A conference or series of workshops across the country to bring together partners involved in conservation to discuss and learn from leading edge researchers and practitioners who have been considering climate change and how to integrate it into protected areas planning and management should be developed.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

14. Ontario Parks should explore opportunities to educate visitors about climate change related issues with program sponsors (e.g., Canadian Tire, Pepsi, etc.).

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

15. In order to avoid duplication of effort and maximize efficiencies, protected areas jurisdictions should seek out partnership opportunities (e.g., with protected area research groups such as the Canadian Council on Ecological Areas (CCEA), Science and the Management of Protected Areas Association (SAMPAA), the World Commission on Protected Areas (WCPA), the Parks Research Forum of Ontario (PRFO), etc.) to stage workshops and develop guidelines, strategies, etc. to help management organizations cope with climate change.

Desirability	Feasibility	Implementation Time Frame
Please Select	Please Select	Please Select

Section Comments

Question #	Comment

Appendix 2.10.
Second Round Survey Reminder Letter

February 5, 2007

Re. "Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas" Second Round Delphi Survey"

Dear [Name of Participant],

Recently you should have received an e-mail package from me requesting your participation in the second round Delphi survey entitled *Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas*. As noted in this e-mail, the purpose of the second round Delphi is to *evaluate* the adaptation options identified by respondents in the first round of the survey.

This is the final round in this Delphi survey; thus, your participation is imperative to provide a cross-section of expert opinions on climate change and protected areas adaptation. A completed survey would be appreciated by February 9th, 2007. E-Mail responses can be forwarded to cjlemieu@fes.uwaterloo.ca.

I have attached another copy of the survey (MS Word form), in case you did not receive it or have accidentally deleted the original email. There were a few minor issues with form fields in the survey forwarded to you over a week ago; however, all issues have been resolved in the attached survey.

If you have any questions or concerns, please feel free to contact me.

Thank-you in advance for your time. We look forward to your input on this important issue.

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of::

Dr. Daniel Scott
Department of Geography, University of Waterloo

and

Rob Davis and Paul Gray
Ontario Parks and Ontario Ministry of Natural Resources

Appendix 2.11.
Second Round Survey Final Call Letter

February 20, 2007

Re. "Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas"

Dear [Name of Participant],

In the process of checking the Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas second round survey responses, we find that we do not have a completed questionnaire from you.

So far, the response to the survey has been very positive and we are looking forward to a very good return of completed surveys. We very much hope that you will be able to provide a survey response. Remember, you have been selected by the advisory team to participate in the first round of this survey based on your expertise and/or experiences with protected areas policy, planning, management and research. Your participation and input is important not only to the success of this project but also to the development of an effective climate change adaptation strategy for Ontario's system of protected areas.

We would appreciate a short reply confirming receipt of this email as well as a short note on your intents with regards to the survey, as it is important for us to have an accurate count on confirmed survey contacts.

Since some respondents have requested additional time to complete the survey, we have extended the deadline to receive completed questionnaires to February 26, 2007. I have attached a copy of the survey (MS Word form-fillable format) to this email should you have accidentally deleted the original email. Given the interest and importance of your work on protected areas and other conservation lands, we do hope that you can take some time to complete the survey.

We look forward to receiving a completed questionnaire for you.

Thank you for participating in the Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas survey.

Best Regards,

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
E-Mail: cjlemieu@fes.uwaterloo.ca

in collaboration with project advisors:

Dr. Daniel Scott (project advisor)
University of Waterloo

Rob Davis and Paul Gray (project advisors)
Ontario Ministry of Natural Resources (OMNR)

Appendix 2.12.
Second Round Survey Thank-you Letter

September 12, 2007

Re. "Towards a Climate Change Adaptation Strategy for Ontario's Protected Areas"

Dear [Name of Participant],

We would like to *thank you* for your participation in the survey entitled *Towards a Climate Change Strategy for Ontario's Protected Areas*. As we stated in our original cover letter, without your input, this project would not be possible.

The adaptation options that were identified in the first round survey and subsequently assessed in the second round survey will be further reviewed by several focus groups in the New Year. The eventual outcome of this work will help develop a proactive strategy for the integration of climate change into Ontario's existing protected areas policy, planning, and management frameworks.

Please remember that any information pertaining to you as an individual participant will be kept *confidential*. Once the information is analyzed for this exercise, the results will be shared with the conservation community through seminars, conferences, presentations, and journal articles. Preliminary results of the project and other relevant information will be posted on my website in late fall/early winter, 2007:

http://www.fes.uwaterloo.ca/u/cjlemieux/climatechange.htm

I will notify you via email when results are available. I may also post a survey evaluation form on the website to obtain your feedback on the Delphi survey process. If you have any questions or concerns, please feel free to contact me at the e-mail address noted at the bottom of the page.

Thanks again for your participation,

Christopher Lemieux (survey coordinator)
Department of Geography, University of Waterloo
E-Mail: cjlemieu@fes.uwaterloo.ca

on behalf of

Dr. Daniel Scott (project advisor)
Department of Geography, University of Waterloo`

Rob Davis and Paul Gray (project advisors)
Ontario Parks and Ontario Ministry of Natural Resources (OMNR)

Appendix 3

Recommended Climate Change Adaptation Options by Ontario Parks Program Area

Materials:

3.1. Policy, System Planning & Management (PSPL)
3.2. Management Direction (MD)
3.3. Operations & Development (OD)
3.4 Research, Monitoring & Reporting (RMR)
3.5 Corporate Culture & Function (CCF)
3.6 Education, Interpretation & Outreach (EIO)

Appendix 3.1.
Policy, System Planning & Legislation (PSPL)

Recommendation
PSPL.1: Protected area policies <u>should not</u> be modified to address the impacts and implications of climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	1	0	14	15	3	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	3.3%	0.0%	46.7%	50.0%	9.1%		
% like categories	3.3%		96.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	7	7	4	5	**N/A**	**N/A**
% with opinion	35.7%	25.0%	25.0%	14.3%	15.2%		
% like categories	60.7%		39.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	2	2	6	7	**N/A**	**N/A**
% with opinion	60.0%	8.0%	8.0%	24.0%	21.9%		
% like categories	68.0%		32.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.2: A strategic and corporate policy on climate change and protected areas is needed to provide sufficient direction for planning and management.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	25	6	0	1	2		
% with opinion	78.1%	18.8%	0.0%	3.1%	5.9%	**HIGH**	**Very Desirable**
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	19	13	1	0	1		
% with opinion	57.6%	39.4%	3.0%	0.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	97.0%		3.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	32	1	0	0	1		
% with opinion	97.0%	3.0%	0.0%	0.0%	2.9%	**HIGH**	**Short-term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

PSPL.3: Ontario Parks should consult with protected area organizations in adjacent provinces and states to help anticipate, plan, and synergize cross-jurisdictional objectives to anticipate the loss and gain of species, communities and processes.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	26	7	0	0	1		
% with opinion	78.8%	21.2%	0.0%	0.0%	2.9%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	17	15	2	0	0		
% with opinion	50.0%	44.1%	5.9%	0.0%	0.0%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	94.1%		5.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	5	0	3	0		
% with opinion	76.5%	14.7%	0.0%	8.8%	0.0%	**HIGH**	**Short-term**
% like categories	91.2%		8.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Climate change and biodiversity management issues are matters much bigger than parks and protected areas. Ontario Parks should position itself based in what it can contribute to the broader agenda… not just with other protection organizations.
- Need for consultation among organizations within Ontario too. Could be on an ecodistrict basis for issues that are best handled within that scale.

Recommendation
PSPL.4: A national protected areas strategy should be developed to ensure that protected areas systems are integrated into a plan to achieve broad goals of biodiversity conservation and ecosystem health.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	10	1	0	5	**HIGH**	**Very Desirable to Desirable**
% with opinion	60.7%	35.7%	3.6%	0.0%	15.2%		
% like categories	96.4%		3.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	15	11	6	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	46.9%	34.4%	18.8%	0.0%	3.0%		
% like categories	81.3%		18.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	18	10	0	0	5	**HIGH**	**Short to Medium-Term**
% with opinion	64.3%	35.7%	0.0%	0.0%	15.2%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Federal-provincial consultative mechanisms are in place. *Biodiversity Convention* would require such strategies at national level.

Recommendation

PSPL.5: Policies for provincial parks and conservation reserves should embrace a science-based adaptive management approach to better deal with potential climate change impacts (i.e., acknowledgement of the dynamic nature of ecosystems and increased flexibility to better manage uncertainty).

Desirability							
	VD	**D**	**U**	**VU**	**Not Sure**	**CONSENSUS**	**DESIRABILITY**
responses	29	3	0	0	2		
% with opinion	90.6%	9.4%	0.0%	0.0%	5.9%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility							
	DF	**PF**	**PU**	**DU**	**Not Sure**	**CONSENSUS**	**FEASIBILITY**
responses	14	17	1	0	2		
% with opinion	43.8%	53.1%	3.1%	0.0%	5.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	96.9%		3.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame							
	S	**M**	**L**	**W&S**	**Not Sure**	**CONSENSUS**	**TIME FRAME**
responses	22	10	0	0	2		
% with opinion	68.8%	31.3%	0.0%	0.0%	5.9%	**HIGH**	**Short to Medium-Term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.6: Policy and regulations should ensure that land uses adjacent to protected areas do not compromise integrity and connectivity functions, and take into account the possible movement of species due to climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	21	10	1	2	0	HIGH	Very Desirable to Desirable
% with opinion	61.8%	29.4%	2.9%	5.9%	0.0%		
% like categories	91.2%		8.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	18	12	0	1	LOW	Definitely Feasible to Possibly Feasible
% with opinion	9.1%	54.5%	36.4%	0.0%	2.9%		
% like categories	63.6%		36.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	13	1	1	2	HIGH	Short to Medium-Term
% with opinion	53.1%	40.6%	3.1%	3.1%	5.9%		
% like categories	93.8%		6.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

PSPL.7: Climate change should be addressed in a review of policies for provincial parks and conservation reserves to ensure they consider climate change, biodiversity conservation, and ecological integrity goals.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	9	1	0	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	69.7%	27.3%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	20	10	2	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	62.5%	31.3%	6.3%	0.0%	5.9%		
% like categories	93.8%		6.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	39	4	0	0	1	**HIGH**	**Short-term**
% with opinion	90.7%	9.3%	0.0%	0.0%	2.3%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Do it now while writing the regs for S.O. 2006, c. 12.

Recommendation
PSPL.8: Policies on modifying protected area boundaries should include climate change considerations in designing ecologically appropriate boundaries.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	12	1	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	56.7%	40.0%	3.3%	0.0%	9.1%		
% like categories	96.7%		3.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	14	10	0	2	**LOW**	**Definitely Feasible to Possibly Feasible**
% with opinion	22.6%	45.2%	32.3%	0.0%	6.1%		
% like categories	67.7%		32.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	11	4	3	1	**MEDIUM**	**Short to Medium-Term**
% with opinion	43.8%	34.4%	12.5%	9.4%	3.0%		
% like categories	78.1%		21.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.9: Some of the broad guiding principles incorporated into Ontario Parks' policy, such as representation and permanence, should be re-evaluated in light of climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	15	3	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	43.8%	46.9%	9.4%	0.0%	5.9%		
% like categories	90.6%		9.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	18	2	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	39.4%	54.5%	6.1%	0.0%	2.9%		
% like categories	93.9%		6.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	9	4	1	1	**HIGH**	**Short to Medium-Term**
% with opinion	57.6%	27.3%	12.1%	3.0%	2.9%		
% like categories	84.8%		15.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- By 're-evaluate', I am not assuming that they will be changed, or should be changed.

Recommendation

PSPL.10: Policies and targets should not only address elements of biodiversity pattern, but should also include the spatial and temporal aspects of natural processes, including population sizes, movements, metapopulation dynamics, disturbance regimes, ecological refugia, and adjustments to climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	21	10	0	0	3	HIGH	Very Desirable to Desirable
% with opinion	67.7%	32.3%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	21	7	0	2	MEDIUM	Definitely Feasible to Possibly Feasible
% with opinion	12.5%	65.6%	21.9%	0.0%	5.9%		
% like categories	78.1%		21.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	12	13	4	2	3	HIGH	Short to Medium-Term
% with opinion	38.7%	41.9%	12.9%	6.5%	8.8%		
% like categories	80.6%		19.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Conceptually desirable but operationally challenging.

Recommendation

PSPL11: There is an increasing need to take a precautionary approach to park management as uncertainty increases with climate change. This is particularly true in the context of cumulative impacts. As such, the precautionary approach should be explicitly built into policy, planning and management.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	11	3	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	54.8%	35.5%	9.7%	0.0%	8.8%		
% like categories	90.3%		9.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	13	6	0	5	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	34.5%	44.8%	20.7%	0.0%	14.7%		
% like categories	79.3%		20.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	8	1	1	5	**HIGH**	**Short to Medium-Term**
% with opinion	65.5%	27.6%	3.4%	3.4%	14.7%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I think there are a great number of uncertainties in protected areas management--this certainly includes climate change. Adopting a precautioary approach is advisable even for more stable systems. Given that we do not really know the range, rate or degree of changes, it behooves us to follow a precautionary approach. I agree it should be built into all levels: policy, planning and management.

Recommendation

PSPL.12: It is necessary to develop a more explicit mandate and policies for protected areas system design to enable better connectivity among protected areas through the protection of corridors, linkages, and functional ecology.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	8	1	0	2		
% with opinion	71.9%	25.0%	3.1%	0.0%	5.9%	**HIGH**	**Very Desirable**
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	19	9	0	2		
% with opinion	12.5%	59.4%	28.1%	0.0%	5.9%	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% like categories	71.9%		28.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	12	3	3	1		
% with opinion	45.5%	36.4%	9.1%	9.1%	2.9%	**HIGH**	**Short to Medium-Term**
% like categories	81.8%		18.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Answer is more 'it depends.' In my opinion, connectivity is a bigger concern in highly developed landscape (housing, highways, etc) of southern Ontario but of lesser concern with disturbed (wildfire, logging, etc.) natural landscapes in northern Ontario.
- Particularly in the south it may not be feasible.

Recommendation
PSPL.13: Newly exposed shorefront lands should be secured under public protection and managed for the new biological communities that will evolve there, possibly combined with public access to the waterbodies for recreational purposes.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	8	3	0	6	HIGH	Very Desirable to Desirable
% with opinion	60.7%	28.6%	10.7%	0.0%	17.6%		
% like categories	89.3%		10.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	15	12	0	3	LOW	Definitely Feasible to Possibly Feasible
% with opinion	12.9%	48.4%	38.7%	0.0%	8.8%		
% like categories	61.3%		38.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	7	8	3	5	LOW	Short to Medium-Term
% with opinion	37.9%	24.1%	27.6%	10.3%	14.7%		
% like categories	62.1%		37.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Newly exposed shoreline may not be desireable for protection at all, depending on where it is -- in southern Ontario, particularly along the Great Lakes and other developed lakes, these communities may consist largely of invasive aliens.
- Depends on title to lands adjacent to newly exposed shoreline.

Recommendation
PSPL.14: Future policy reviews should consider redefining the concept of ecological integrity. Acceptable rates of change and defining what exactly constitutes species characteristic of a natural region should be more explicitly defined with climate change considerations in future policy.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	17	2	0	4	HIGH	Very Desirable to Desirable
% with opinion	36.7%	56.7%	6.7%	0.0%	11.8%		
% like categories	93.3%		6.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	18	5	0	4	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	23.3%	60.0%	16.7%	0.0%	11.8%		
% like categories	83.3%		16.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	9	4	2	4	HIGH	Short to Medium-Term
% with opinion	50.0%	30.0%	13.3%	6.7%	11.8%		
% like categories	80.0%		20.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- The concept of ecological integrity is so flexible that any changing rates in the future, or characteristic features, can be taken in the current (at the time) context; it is unclear to me that there is a need to define a temporal context for the concept; I suspect that we will not be able to predict rates of change, especially under a scenario where organisms are always trying to 'catch up' to the new and changing conditions.
- Raises interesting perception and judgemental issues. Is Ontario Parks to judge all this on their own?

Recommendation
PSPL.15: A Climate change <u>should not</u> be considered in any future legislative reviews.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	2	9	20	0	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	6.1%	6.1%	27.3%	60.6%	0.0%		
% like categories	12.1%		87.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	4	8	8	5	**N/A**	**N/A**
% with opinion	25.9%	14.8%	29.6%	29.6%	15.6%		
% like categories	40.7%		59.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	4	1	1	9	**N/A**	**N/A**
% with opinion	71.4%	19.0%	4.8%	4.8%	30.0%		
% like categories	90.5%		9.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I am not sure what parks/conservation reserve legislation would enunciate on climate change. Climate change may be the kind of issue that gets dealt with in broader omnibus legislation, at some point.

Recommendation

PSPL.16: Climate change should not be integrated into planning and management decisions that affect ecological integrity.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	1	1	16	15	0	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	3.0%	3.0%	48.5%	45.5%	0.0%		
% like categories	6.1%		93.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	5	9	10	4	**N/A**	**N/A**
% with opinion	17.2%	17.2%	31.0%	34.5%	12.1%		
% like categories	34.5%		65.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	16	5	0	2	8	**N/A**	**N/A**
% with opinion	69.6%	21.7%	0.0%	8.7%	25.8%		
% like categories	91.3%		8.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.17: Each protected areas management plan should specifically address how climate change is likely to affect ecological integrity and provide management direction to help address the issues.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	15	2	2	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	42.4%	45.5%	6.1%	6.1%	2.9%		
% like categories	87.9%		12.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	14	8	2	1	**LOW**	**Definitely Feasible to Possibly Feasible**
% with opinion	27.3%	42.4%	24.2%	6.1%	2.9%		
% like categories	69.7%		30.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	10	3	3	3	**HIGH**	**Short to Medium-Term**
% with opinion	48.4%	32.3%	9.7%	9.7%	8.8%		
% like categories	80.6%		19.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.18: The concept of ecological integrity should be re-defined with climate change considerations.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	13	4	2	6	**MEDIUM**	**Very Desirable to Desirable**
% with opinion	32.1%	46.4%	14.3%	7.1%	17.6%		
% like categories	78.6%		21.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	15	2	0	5	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	41.4%	51.7%	6.9%	0.0%	14.7%		
% like categories	93.1%		6.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	18	6	3	0	7	**HIGH**	**Short to Medium-Term**
% with opinion	66.7%	22.2%	11.1%	0.0%	20.6%		
% like categories	88.9%		11.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- As an organization, we talk about ecological integrity but I am not convinced that everyone is on the same page in terms of definition or implications. This would be an ideal time to consider climate change within a redefinition of ecological integrity.
- It will be driven by climate change so it is a question of how sensible the policy decisions would be.

Recommendation
PSPL.19: Many of the initiatives needed to enhance ecological integrity under the existing climate regime are the same as those under future climate scenarios. As such, climate change should be used to help rationalize and compel the implementation of ecological integrity objectives.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	7	20	1	0	6		
% with opinion	25.0%	71.4%	3.6%	0.0%	17.6%	**HIGH**	**Desirable**
% like categories	96.4%		3.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	17	2	0	6		
% with opinion	32.1%	60.7%	7.1%	0.0%	17.6%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	92.9%		7.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	6	2	1	6		
% with opinion	67.9%	21.4%	7.1%	3.6%	17.6%	**HIGH**	**Short to Medium-Term**
% like categories	89.3%		10.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Same as PSPL. 18: It will be driven by climate change so it is a question of how sensible the policy decisions would be.

Recommendation

PSPL.20: Protected areas system planning and reserve design <u>should not</u> specifically incorporate climate change considerations.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	1	15	15	2	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	0.0%	3.2%	48.4%	48.4%	6.1%		
% like categories	3.2%		96.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	3	9	7	7	**N/A**	**N/A**
% with opinion	24.0%	12.0%	36.0%	28.0%	21.9%		
% like categories	36.0%		64.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	5	1	2	10	**N/A**	**N/A**
% with opinion	57.9%	26.3%	5.3%	10.5%	34.5%		
% like categories	84.2%		15.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

PSPL.21: A multi-disciplinary team should be developed to examine the ecological representation criterion for selecting and designing protected areas, evaluate whether this approach is viable in protecting biodiversity under a changing climate, and examine alternative approaches to protected areas systems planning.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	20	1	0	2	HIGH	Very Desirable to Desirable
% with opinion	34.4%	62.5%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	17	2	0	1	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	42.4%	51.5%	6.1%	0.0%	2.9%		
% like categories	93.9%		6.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	21	9	0	1	3	HIGH	Short to Medium-Term
% with opinion	67.7%	29.0%	0.0%	3.2%	8.8%		
% like categories	96.8%		3.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I think we need to have a real think tank on how climate change will change our thoughts on ecological representation and protecting biodiversity. From this, we may likely have to take a multi-faceted approach that goes well beyond the current notion of protected area boundaries. We will have to explore a great many of the options which hare suggested in this section.

Recommendation

PSPL.22: Ecological representation should <u>no longer</u> be used as one of the five criteria (the others being condition, diversity, ecological functions, and special features) for selecting and designing protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	1	3	13	9	8	HIGH	Undesirable to Very Undesirable
% with opinion	3.8%	11.5%	50.0%	34.6%	23.5%		
% like categories	15.4%		84.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	5	10	4	11	N/A	N/A
% with opinion	17.4%	21.7%	43.5%	17.4%	32.4%		
% like categories	39.1%		60.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	3	2	3	11	N/A	N/A
% with opinion	63.6%	13.6%	9.1%	13.6%	33.3%		
% like categories	77.3%		22.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Representation should always be a component of protected area selection, although the emphasis on it, or the approach used to measure it, could change.
- Representation principle is not undesireable, but it partly depends on how 'representative' is defined.
- Prejudice toward 'ecological representation' applies to all five criteria to some extent.

Recommendation

PSPL.23: Representation should continue to be used as a tool for protected areas system planning as a wider variety (diversity) of landform/vegetation associations being protected may increase the likelihood that different species and habitats will remain protected under climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	14	2	0	7	**HIGH**	**Very Desirable to Desirable**
% with opinion	40.7%	51.9%	7.4%	0.0%	20.6%		
% like categories	92.6%		7.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	18	6	1	0	8	**HIGH**	**Definitely Feasible**
% with opinion	72.0%	24.0%	4.0%	0.0%	24.2%		
% like categories	96.0%		4.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	21	4	0	1	7	**HIGH**	**Short-term**
% with opinion	80.8%	15.4%	0.0%	3.8%	21.2%		
% like categories	96.2%		3.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Whatever thrives in a protected area is representative by definition.
- Retention of 'representation' as a core system design construct will guarantee that a representative physiographic (landform, topography, ecological sites, etc.) base will always be housed in the system irrespective of shifts in the biotic realm--this is an important construct in the 'baseline' value of protected areas.

Recommendation
PSPL.24: Protected areas system design should focus on the continued representation of species but should more effectively incorporate persistence parameters to ensure perpetual representation (i.e., representation through time).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	11	2	0	10	HIGH	Very Desirable to Desirable
% with opinion	45.8%	45.8%	8.3%	0.0%	29.4%		
% like categories	91.7%		8.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	15	2	0	9	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	29.2%	62.5%	8.3%	0.0%	27.3%		
% like categories	91.7%		8.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	13	2	2	7	HIGH	Short to Medium-Term
% with opinion	32.0%	52.0%	8.0%	8.0%	21.9%		
% like categories	84.0%		16.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.25: Because natural regions such as ecoregions and ecodistricts may shift as a result of climate change, they should be used primarily as administrative policy units and should no longer be used for protected areas system planning (e.g., park class targets, representation requirements).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	3	12	6	11	MEDIUM	Undesirable to Very Undesirable
% with opinion	8.7%	13.0%	52.2%	26.1%	32.4%		
% like categories	21.7%		78.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	7	9	2	10	N/A	N/A
% with opinion	25.0%	29.2%	37.5%	8.3%	29.4%		
% like categories	54.2%		45.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	9	5	3	7	10	N/A	N/A
% with opinion	37.5%	20.8%	12.5%	29.2%	29.4%		
% like categories	58.3%		41.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- We already use other (non-ecological) boundaries for administrative units. We may need to redefine ecoregions/districts over time as a result of climate change.
- If shifting natural regions are a serious problem, regions could be re-defined solely on stable landform units independent of climate, such as Chapman and Putnam's physiographic units in the south and Bostock in the north.

Recommendation
PSPL.26: Increasing park class targets for waterway and aquatic class parks could be helpful to mandate the creation of additional riparian corridors to help with aquatic impact mitigation and plant, animal and community movements induced by climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	15	16	2	0	4		
% with opinion	45.5%	48.5%	6.1%	0.0%	10.8%	**HIGH**	**Very Desirable to Desirable**
% like categories	93.9%		6.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	15	3	0	5		
% with opinion	37.9%	51.7%	10.3%	0.0%	14.7%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	89.7%		10.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	13	2	4	4		
% with opinion	36.7%	43.3%	6.7%	13.3%	11.8%	**HIGH**	**Short to Medium-Term**
% like categories	80.0%		20.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I have been somewhat pessimistic on timelines for policy changes on park class target sizes, because of the highly contentious nature of planning processes such as Lands for Life, where changes in targets and considerations for boundary changes probably cannot be achieved any time soon.

Recommendation

PSPL.27: Increasing size criteria for specific park classes could help in alleviating the ecological impacts of local perturbations and cross-boundary stressors related to climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	13	3	0	7	HIGH	Very Desirable to Desirable
% with opinion	40.7%	48.1%	11.1%	0.0%	20.6%		
% like categories	88.9%		11.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	2	17	9	1	4	LOW	Definitely Feasible to Possibly Feasible
% with opinion	6.9%	58.6%	31.0%	3.4%	12.1%		
% like categories	65.5%		34.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	14	3	4	4	MEDIUM	Short to Medium-Term
% with opinion	27.6%	48.3%	10.3%	13.8%	12.1%		
% like categories	75.9%		24.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Seems to address bureaucratic practices for classification versus anything on the ground.

Recommendation

PSPL.28: Policies on modifying protected area boundaries should include climate change considerations in designing ecologically appropriate boundaries.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	19	1	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	37.5%	59.4%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	13	6	0	4	**HIGH**	**Short to Medium-Term**
% with opinion	36.7%	43.3%	20.0%	0.0%	11.8%		
% like categories	80.0%		20.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	10	1	3	3	**HIGH**	**Short to Medium-Term**
% with opinion	54.8%	32.3%	3.2%	9.7%	8.8%		
% like categories	87.1%		12.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This may work only with a fundamental shift in thinking by many constituents. At present, much public opposition to further park creep; hopefully through further understanding of climate change and all too harsh realities of changing ecological integrity, this may turn around.
- Would need better scenarios at site levels.
- Not sure how this consideration may apply to local scale. May require case-by-case consideration.

Recommendation

PSPL.29: Land use activities adjacent to protected areas should allow for movement of wildlife and plants and help to feather protected areas into the working landscape.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	20	12	1	0	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	60.6%	36.4%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	20	7	0	2	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	15.6%	62.5%	21.9%	0.0%	5.9%		
% like categories	78.1%		21.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	13	4	1	2	**HIGH**	**Short to Medium-Term**
% with opinion	43.8%	40.6%	12.5%	3.1%	5.9%		
% like categories	84.4%		15.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- It will be important to address climate change and changing ecological representation/protection needs on non-park lands. Climate change is a much bigger issue than simply parks--need to address on a more holistic level.
- Again, little we can do in the south.
- 'Modified management areas' around/adjacent to many provincial parks and conservation reserves already demonstrate this principle.

Recommendation
PSPL.30: Protected areas system planning should incorporate 'redundancy' into representation requirements to offset potential species losses resulting from climatic and ecological change (giving high priority to species at risk and highly threatened species).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	12	0	0	6	**HIGH**	**Very Desirable to Desirable**
% with opinion	57.1%	42.9%	0.0%	0.0%	17.6%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	15	10	0	5	**LOW**	**Definitely Feasible to Possibly Feasible**
% with opinion	13.8%	51.7%	34.5%	0.0%	14.7%		
% like categories	65.5%		34.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	9	9	1	7	**LOW**	**Short to Medium-Term**
% with opinion	29.6%	33.3%	33.3%	3.7%	20.6%		
% like categories	63.0%		37.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Redundancy is just a good precautionary principle, irrespective of climate change, so climate change fortifys the notion.

Recommendation

PSPL.31: Protected areas organizations should use the climate change issue as a catalyst to accelerate the process of establishing additional protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	15	13	2	1	3	HIGH	Very Desirable to Desirable
% with opinion	48.4%	41.9%	6.5%	3.2%	8.8%		
% like categories	90.3%		9.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	15	4	1	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	35.5%	48.4%	12.9%	3.2%	6.1%		
% like categories	83.9%		16.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	22	3	3	3	2	HIGH	Short-Term
% with opinion	71.0%	9.7%	9.7%	9.7%	6.1%		
% like categories	80.6%		19.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- May need considerably more public support to see this through. At present, many would see this as a land grab. Need a major paradigm shift in public thinking about climate change.
- This might better apply on a case-by-case basis. Legitiamte, where rationalized by protected areas and climate change policy.

Recommendation
PSPL32: De-regulating parks should be explored as an option should a protected area no longer achieve its original protection mandate.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	8	14	8	2	**LOW**	**Undesirable to Very Undesirable**
% with opinion	6.3%	25.0%	43.8%	25.0%	5.9%		
% like categories	31.3%		68.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	9	12	3	4	**N/A**	**N/A**
% with opinion	14.3%	32.1%	42.9%	10.7%	12.5%		
% like categories	46.4%		53.6%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	4	5	5	9	9	**N/A**	**N/A**
% with opinion	17.4%	21.7%	21.7%	39.1%	28.1%		
% like categories	39.1%		60.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Or redefine the mandate, or reclassify the park, or do an off-set somewhere else?
- Because my conception of parks includes the protection of values independent of the biotic realm and climate perturbation, e.g., landform, I do not subscribe to this idea.

Recommendation

PSPL.33: Floating protected areas, temporal reserves and protected areas swapping approaches (i.e., strategic de-regulation and establishment) should be explored as a planning option in order facilitate the movement of non-migratory species and increase the overall resiliency of the protected areas system to climate change related impacts.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	11	4	4	12		
% with opinion	13.6%	50.0%	18.2%	18.2%	35.3%	**N/A**	**NOT SURE**
% like categories	63.6%		36.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	1	13	8	4	7		
% with opinion	3.8%	50.0%	30.8%	15.4%	21.2%	**LOW**	**Possibly Feasible**
% like categories	53.8%		46.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	4	8	6	5	10		
% with opinion	17.4%	34.8%	26.1%	21.7%	30.3%	**N/A**	**NONE**
% like categories	52.2%		47.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I am adamantly opposed to the floating reserve concept. A protected area that was originally established to represent one feature may well represent others in the future. The floating reserve idea is a concept that has been used in the past to argue that no permanent protected areas are needed, and that all areas can be used for extractive purposes of one sort or another, and the residual then handed over for temporary 'protection' (of what, I'm not sure).
- Need a major shift in thinking about protected areas as areas etched in stone, permanent, etc. May be seen negatively by some, used for counterproductive purposes such as mining potential.
- Conceptually a good idea, but needs to have a firm set of core areas as safeguards. Extractive industries would love it without the latter.
- Question is problematic in offering tenets for which one response may not apply, i.e., the idea of 'floating reserves' does not require de-regulating existing areas, whereas 'swapping' areas definitely does. There is a very sensitive history around the notion of floating reserves arising from efforts of the mining constituency in the 1990s promoting this idea to re-cycle lands (basically, the old 'multiple use' paradigm where you strip and area, than make it a park. The notion received a bit of a political hearing, but was severly chastised by environmental groups. Many protected areas practitioners just shudder when the idea is raised.

Recommendation
PSPL.34: Park class targets and feature representation requirements should be modified to include the impacts and implications of climate change on ecological processes (e.g., composition, structure and function).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	15	1	1	7	**HIGH**	**Very Desirable to Desirable**
% with opinion	34.6%	57.7%	3.8%	3.8%	21.2%		
% like categories	92.3%		7.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	16	6	0	7	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	15.4%	61.5%	23.1%	0.0%	21.2%		
% like categories	76.9%		23.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	11	4	2	8	**MEDIUM**	**Short to Medium-Term**
% with opinion	32.0%	44.0%	16.0%	8.0%	24.2%		
% like categories	76.0%		24.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.35: Size guidelines for establishing protected areas should be developed with climatic and ecological change considerations and should consider varying degrees of uncertainty.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	16	3	0	6	**HIGH**	**Very Desirable to Desirable**
% with opinion	32.1%	57.1%	10.7%	0.0%	17.6%		
% like categories	89.3%		10.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	18	7	0	6	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	10.7%	64.3%	25.0%	0.0%	17.6%		
% like categories	75.0%		25.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	8	4	2	7	**MEDIUM**	**Short to Medium-Term**
% with opinion	48.1%	29.6%	14.8%	7.4%	20.6%		
% like categories	77.8%		22.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Need landscape-scale analyses.
- Size guidelines for wilderness parks and zones, natural environment parks and zones and waterway parks already provide a precedent to build upon. The area prescribed just needs to be bigger!

Recommendation

PSPL.36: The establishment of new protected area classes should be considered. Evolutionary baseline class parks, for example, could allow for natural evolution and be used to research, monitor and demonstrate ecosystem changes.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	10	7	8	0	9	LOW	Very Desirable to Desirable
% with opinion	40.0%	28.0%	32.0%	0.0%	26.5%		
% like categories	68.0%		32.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	13	8	0	7	MEDIUM	Definitely Feasible to Possibly Feasible
% with opinion	22.2%	48.1%	29.6%	0.0%	20.6%		
% like categories	70.4%		29.6%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	7	7	2	7	LOW	Short to Medium-Term
% with opinion	40.7%	25.9%	25.9%	7.4%	20.6%		
% like categories	66.7%		33.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Need more information/discussion on implications, e.g. permitted uses, etc. What would this form of protection mean in practical terms?
- I have mixed feelings about the need for a new class to serve as a baseline. I believe that existing classes can serve this role -- e.g., Nature Reserve, Wilderness, perhaps even Natural Environment, depending on zoning and use.
- Evolutionary baseline parks are essentially wilderness parks (where nature is allowed to function freely as per the Blue Book definition).
- While it may be feasible to establish new classes, I do not believe that they are needed. Wilderness and nature reserve classes already have the capacity to fulfill 'evolutionary' and 'baseline' constructs. That said, I was a 'lone wolf' advocate for 'Ecological Reserves' legislation apart from the Provincial Parks Act while in the public service to specifically highlight the research, monitoring, science angle to frame a subset of the most significant protected areas in Ontario.

Recommendation

PSPL.37: Future protected area establishment should focus on species at the northern limits of their range as these may be the best adapted to adjust to changing climatic conditions.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	7	5	6	0	16		
% with opinion	38.9%	27.8%	33.3%	0.0%	47.1%	**N/A**	**NOT SURE**
% like categories	66.7%		33.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	14	3	0	11		**Definitely**
% with opinion	26.1%	60.9%	13.0%	0.0%	32.4%	**HIGH**	**Feasible to**
% like categories	87.0%		13.0%				**Possibly Feasible**

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	6	6	5	9		
% with opinion	32.0%	24.0%	24.0%	20.0%	26.5%	**N/A**	**NONE**
% like categories	56.0%		44.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- They may also be remenant, less stable populations. Protection of core may be best. Would depend on the status of the species.
- The focus should NOT be strictly on species at the northern limits of their range. We should not pretend that we can predict how all species will shift, nor how ecosystems will re-assemble. What about species at the eastern limits? If drying occurs, then some species may move from west to east. What about species in the middle of large ranges? These have the potential of being represented within the system for a long time before sufficient change occurs to cause them to shift their range elsewhere. - etc.
- Some species have a southern limit rather than northern.
- Maybe species on their southern limit are of equal value for their resilience to climate change. The, western affinities, Atlantic coastal plain species.

Recommendation

PSPL.38: System planning should focus more on inherent capability (e.g., soils, water, productivity) and less on the current occupancy of flora and fauna (i.e., permanent features vs. impermanent ones). As such, Ontario Parks should accept whatever ends up thriving on these different landforms.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	4	16	6	0	8	**MEDIUM**	**Very Desirable to Desirable**
% with opinion	15.4%	61.5%	23.1%	0.0%	23.5%		
% like categories	76.9%		23.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	18	2	0	3	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	33.3%	60.0%	6.7%	0.0%	9.1%		
% like categories	93.3%		6.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	7	6	5	4	**LOW**	**Short to Medium-Term**
% with opinion	37.9%	24.1%	20.7%	17.2%	12.1%		
% like categories	62.1%		37.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Why assume that soils and productivity will remain constant? These are subject to change just as much as the vegetatiion -- productivity is a function of vegetation and climate, and soils are formed by a combination of these interacting with parent material.
- Agree that should focus on soil/site more but I not necessarily agree with just accept what grows back.
- Agreed with first sentence, not second. We don't accept any species.
- This is largely the current bias in the system, and advocating that it remain a core design construct adds some certainty without denying options to build upon and enhance design measures for climate change, such as increasing area size, increasing number of sites, adding corridors, etc.

Recommendation

PSPL.39: Highly vulnerable, disjunct/relict, and outlier species should receive higher protection priority in system planning.

Desirability							
	VD	**D**	**U**	**VU**	**Not Sure**	**CONSENSUS**	**DESIRABILITY**
responses	1	13	6	0	14		
% with opinion	5.0%	65.0%	30.0%	0.0%	41.2%	**N/A**	**NOT SURE**
% like categories	70.0%		30.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility							
	DF	**PF**	**PU**	**DU**	**Not Sure**	**CONSENSUS**	**FEASIBILITY**
responses	4	14	6	0	10		
% with opinion	16.7%	58.3%	25.0%	0.0%	29.4%	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% like categories	75.0%		25.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame							
	S	**M**	**L**	**W&S**	**Not Sure**	**CONSENSUS**	**TIME FRAME**
responses	7	8	4	5	10		
% with opinion	29.2%	33.3%	16.7%	20.8%	29.4%	**LOW**	**Short to Medium-Term**
% like categories	62.5%		37.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Need some viable population analyses for target species.
- These questions are really about values. While I think that rare/relict species have intrinsic value and deserve attention and funding, I do not believe that a largely disproportionate amount of funding should be directed toward them to the detriment of species which hold more promise for persistence.
- Disjuncts, relicts, outliers, etc. can remain one of several attributes considered in selection and design of protected areas, since they constitute a component of the biodiversity of the province, and may constitute important genetic variation. Such features have not been the primary focus of selection in the past several decades, in any case, but they are supportive natural heritage features when combined with the other selection criteria. It should also be made clear that representation in Ontario's system is based on ecosystems or their surrogates, not species (since we don't have adequate species-level information for most of the province).
- This question, like many others, begs the need for park system planning to embrace a comprehensive approach that considers roles for the many other categories of protected areas in Ontario.

Recommendation
PSPL.40: Highly vulnerable systems should not be protected – limited resources should focus on areas with a reasonable chance of longer term resilience.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	8	14	4	6	LOW	Undesirable to Very Undesirable
% with opinion	7.1%	28.6%	50.0%	14.3%	17.6%		
% like categories	35.7%		64.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	10	8	1	9	N/A	N/A
% with opinion	20.8%	41.7%	33.3%	4.2%	27.3%		
% like categories	62.5%		37.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	9	9	4	4	6	N/A	N/A
% with opinion	34.6%	34.6%	15.4%	15.4%	18.8%		
% like categories	69.2%		30.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Same as PSPL.39: These questions are really about values. While I think that rare/relict species have intrinsic value and deserve attention and funding, I do not believe that a largely disproportionate amount of funding should be directed toward them to the detriment of species which hold more promise for persistence.
- Same as PSPL.39: Disjuncts, relicts, outliers, etc. can remain one of several attributes considered in selection and design of protected areas, since they constitute a component of the biodiversity of the province, and may constitute important genetic variation. Such features have not been the primary focus of selection in the past several decades, in any case, but they are supportive natural heritage features when combined with the other selection criteria. It should also be made clear that representation in Ontario's system is based on ecosystems or their surrogates, not species (since we don't have adequate species-level information for most of the province).
- Could become the argument for collapsing the park system.
- Same as PSPL.39: This question, like many others, begs the need for park system planning to embrace a comprehensive approach that considers roles for the many other categories of protected areas in Ontario.

Recommendation

PSPL.41: Spatial considerations related to disturbance regimes and faunal movements should be more adequately addressed in protected area system design principles. Incorporating guidance on the application of these concepts in the design of new protected areas, particularly in the north, where wide-ranging mammals and large-patch disturbance regimes exist, should provide spatial insurance for ecosystems and the components being protected.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	15	0	2	3	HIGH	Very Desirable to Desirable
% with opinion	45.2%	48.4%	0.0%	6.5%	8.8%		
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	2	26	1	0	5	HIGH	Possibly Feasible
% with opinion	6.9%	89.7%	3.4%	0.0%	14.7%		
% like categories	83.3%		16.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	18	7	5	0	4	HIGH	Short to Medium-Term
% with opinion	60.0%	23.3%	16.7%	0.0%	11.8%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Construct also applies in the south.

Recommendation

PSPL.42: Ontario Parks' protected area selection criterion of ecological functions (i.e., processes) should receive greater emphasis in protected areas system design in order for protected areas to be sufficiently designed to better withstand increased natural disturbances and to help facilitate the movement of species in response to climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	16	0	0	2	HIGH	Very Desirable
% with opinion	50.0%	50.0%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	18	2	0	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	37.5%	56.3%	6.3%	0.0%	5.9%		
% like categories	93.8%		6.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	7	4	1	5	HIGH	Short to Medium-Term
% with opinion	58.6%	24.1%	13.8%	3.4%	14.7%		
% like categories	82.8%		17.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
PSPL.43: Ontario Parks should examine the possibility of supplementing fixed protected areas with dynamic reserves that protect early successional ecosystems, perhaps managed to re-set them back from time-to-time.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	7	14	3	1	9	**HIGH**	**Very Desirable to Desirable**
% with opinion	28.0%	56.0%	12.0%	4.0%	26.5%		
% like categories	84.0%		16.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	13	7	0	7	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	25.9%	48.1%	25.9%	0.0%	20.6%		
% like categories	74.1%		25.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	5	10	9	1	9	**LOW**	**Short to Medium-Term**
% with opinion	20.0%	40.0%	36.0%	4.0%	26.5%		
% like categories	60.0%		40.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- The key word in this question is 'supplemented'. See comment on 'floating reserves' above.
- Current management policies for nature reserves, that distinguish 'era' and 'evolutionary' management regimes, coupled with fire management policies (especially for wilderness parks, but other classes), already provide for this to some degree.

Recommendation
PSPL.44: Ontario Parks should anticipate locations that could serve as refugia for certain kinds of ecosystems and work to protect these sites in advance.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	23	0	0	3		
% with opinion	25.8%	74.2%	0.0%	0.0%	8.8%	HIGH	Desirable
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	23	6	0	2		
% with opinion	9.4%	71.9%	18.8%	0.0%	5.9%	HIGH	Possibly Feasible
% like categories	81.3%		18.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	7	12	8	2	5		
% with opinion	24.1%	41.4%	27.6%	6.9%	14.7%	LOW	Short to Medium-Term
% like categories	65.5%		34.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Appendix 3.2.
Management Direction (MD)

Recommendation
MD.1: Climate change <u>should not</u> be incorporated into Ontario Parks' management direction.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	13	19	1	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	0.0%	0.0%	40.6%	59.4%	3.0%		
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	3	8	5	5	**N/A**	**N/A**
% with opinion	36.0%	12.0%	32.0%	20.0%	16.7%		
% like categories	48.0%		52.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	3	2	1	9	**N/A**	**N/A**
% with opinion	68.4%	15.8%	10.5%	5.3%	32.1%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

MD.2: A corporate statement/position on climate change should be developed in order to help provide staff with direction and guidance on climate change-related planning and management issues.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	8	0	1	2		
% with opinion	71.9%	25.0%	0.0%	3.1%	5.9%	**HIGH**	**Very Desirable**
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	23	9	0	0	2		
% with opinion	71.9%	28.1%	0.0%	0.0%	5.9%	**HIGH**	**Definitely Feasible**
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	30	1	0	0	3		
% with opinion	96.8%	3.2%	0.0%	0.0%	8.8%	**HIGH**	**Short-Term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

MD.3: The role of each protected area in contributing to ecological representation requirements should be incorporated as part of the protected area planning process and should be reassessed at decadal intervals (i.e., the overall landscape of Ontario will be changing, and so must the role of each location).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	15	2	0	4	**HIGH**	**Very Desirable to Desirable**
% with opinion	43.3%	50.0%	6.7%	0.0%	11.8%		
% like categories	93.3%		6.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	19	3	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	31.3%	59.4%	9.4%	0.0%	5.9%		
% like categories	90.6%		9.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	12	6	0	2	**HIGH**	**Short to Medium-Term**
% with opinion	41.9%	38.7%	19.4%	0.0%	6.1%		
% like categories	80.6%		19.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Not sure this would be appropriate very every protected area. Incorporate for the largets parks (Wilderness) and Natura Environment and Watershed class parks, critical Nature Reserves, etc.).
- Don't know how feasible/applicable to many smaller, less representative Recreation class parks and Conservation Reserves, for example.

Recommendation

MD.4: Protected areas zoning with climate change considerations should be incorporated as part of the protected area planning process and should be made more adaptable and flexible as the location of natural values shift (i.e., recognize that park zones may need to shift across the landscape to protect certain features as current values move, are lost, and new ones appear).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	13	2	0	8		
% with opinion	42.3%	50.0%	7.7%	0.0%	23.5%	**HIGH**	**Very Desirable to Desirable**
% like categories	92.3%		7.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	22	5	0	4		
% with opinion	10.0%	73.3%	16.7%	0.0%	11.8%	**HIGH**	**Possibly Feasible**
% like categories	83.3%		16.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	9	5	5	4		
% with opinion	36.7%	30.0%	16.7%	16.7%	11.8%	**LOW**	**Short to Medium-Term**
% like categories	66.7%		33.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Re. Protected areas zoning -- while it would be good to move zones -In Algonquin we have to provide a certain amount of 'Recreation/Utlization' zone which is subject to forest management. I would not want to 'give up' a protected Nature Reserve zone (and allow it to be harvested) in order to 'add' a Recreation/Utlization zone to the protected area. Although climate change might cause a Nature Reserve to lose some of the values for which it was created (eg. vegetation communities) the value of that site is still very, very high simply because it is an area without roads etc. Adding new Nature Reserve zones would be great, but not at the expense of 'losing' areas with high protection.
- Not sure change will be detected at that scale.
- 'Floating' zones' are akin to 'floating reserves', but at a finer scale. The principle might apply in some instances for zones in some parks where the geometry/scale enables such shifts, but in many cases it may not be feasible.

Recommendation

MD.5: Park classifications should be reviewed as part of the planning process, and changed if necessary to accommodate changing protection values. For example, some protected areas originally established for recreation purposes may emerge to be more valuable for the protection of natural assets, such as species at risk.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	14	1	1	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	50.0%	43.8%	3.1%	3.1%	5.9%		
% like categories	93.8%		6.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	14	5	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	42.4%	42.4%	15.2%	0.0%	2.9%		
% like categories	84.8%		15.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	9	6	3	1	**MEDIUM**	**Short to Medium-Term**
% with opinion	45.5%	27.3%	18.2%	9.1%	2.9%		
% like categories	72.7%		27.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

MD.6: Management plans should incorporate a long-term trends analysis to help guide longer-term actions and priorities.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	15	15	0	0	4	**HIGH**	**Very Desirable to Desirable**
% with opinion	50.0%	50.0%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	8	18	3	1	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	26.7%	60.0%	10.0%	3.3%	11.8%		
% like categories	86.7%		13.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	11	5	1	3	**HIGH**	**Short to Medium-Term**
% with opinion	45.2%	35.5%	16.1%	3.2%	8.8%		
% like categories	80.6%		19.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Individual management plans should reference the broader direction/corporate guidance; this in turn should incorporate the longer-term trend analysis.

Recommendation
MD.7: Management direction should become more flexible to enable adaptation to the impacts of climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	18	2	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	37.5%	56.3%	6.3%	0.0%	5.9%		
% like categories	93.8%		6.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	16	3	0	5	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	34.5%	55.2%	10.3%	0.0%	14.7%		
% like categories	89.7%		10.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	9	2	2	4	**HIGH**	**Short to Medium-Term**
% with opinion	56.7%	30.0%	6.7%	6.7%	11.8%		
% like categories	86.7%		13.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Management direction is reviewed every 10-20 years so not necessary.

Recommendation
MD.8: Clustered management plans that would provide a generic management prescription for a series of protected areas having similar ecological management should be used to provide the flexibility needed to incorporate climate change considerations at local and regional levels for protected areas having similar environmental conditions.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	4	23	1	0	6		
% with opinion	14.3%	82.1%	3.6%	0.0%	17.6%	HIGH	Desirable
% like categories	96.4%		3.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	23	1	0	5		
% with opinion	17.2%	79.3%	3.4%	0.0%	14.7%	HIGH	Possibly Feasible
% like categories	96.6%		3.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	11	3	1	2		
% with opinion	53.1%	34.4%	9.4%	3.1%	5.9%	HIGH	Short to Medium-Term
% like categories	87.5%		12.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Not clear how this would work.

Recommendation

MD.9: Adaptive management should be explicitly incorporated into management direction in order to anticipate the uncertainties associated with climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	18	14	1	1	0	**HIGH**	**Very Desirable to Desirable**
% with opinion	52.9%	41.2%	2.9%	2.9%	0.0%		
% like categories	94.1%		5.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	17	0	0	3	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	45.2%	54.8%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	4	3	0	2	**HIGH**	**Short-Term**
% with opinion	78.1%	12.5%	9.4%	0.0%	5.9%		
% like categories	90.6%		9.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Desireable -- but I do not see how this can be incorporated without a change in workload or staffing.
- Need benchmarks for comparisons?

Recommendation

MD.10: Ontario Parks, and the MNR as a whole, should reconsider the basic definitions of non-native and invasive species. Future definitions should include climate change considerations.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	7	16	3	0	8		
% with opinion	26.9%	61.5%	11.5%	0.0%	23.5%	**HIGH**	**Very Desirable to Desirable**
% like categories	88.5%		11.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	17	4	0	3		
% with opinion	32.3%	54.8%	12.9%	0.0%	8.8%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.1%		12.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	11	2	2	6		
% with opinion	46.4%	39.3%	7.1%	7.1%	17.6%	**HIGH**	**Short to Medium-Term**
% like categories	85.7%		14.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Some invasive species are native plants, e.g., milkweed.
- Species' plasticity and adaptability to climate change may vary.

Recommendation

MD11: Management plans should acknowledge climate change as an ecological driver and should no longer focus on maintaining the status quo of flora and faunal composition.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	18	1	0	3	HIGH	Very Desirable to Desirable
% with opinion	38.7%	58.1%	3.2%	0.0%	8.8%		
% like categories	96.8%		3.2%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	16	3	0	4	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	36.7%	53.3%	10.0%	0.0%	11.8%		
% like categories	90.0%		10.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	12	3	1	4	HIGH	Short to Medium-Term
% with opinion	46.7%	40.0%	10.0%	3.3%	11.8%		
% like categories	86.7%		13.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Depends on the value being protected – e.g., if this means throwing open the gates to warm and coolwater fish species in Algonquin it would mean the loss of the worlds largest complex of nNaturally Sustaining Brook Trout lakes. Considering this species survives in the Great Smokies (in small creeks) as well as Algonquin, climactic considerations shouldn't automatically result in us giving up on our attempts to 'preserve' intact ecosystems.
- Again, management plans should be reviewed every 10-20 years so should be evaluated then.
- Consideration contingent on over-riding management philosophy, i.e., 'era' vs. 'evolutionary' management--it may be desireable to maintain both across the system through classification, zoning and management. Current management policy and many management plans already subscribe to evolutionary management goals--will depend on the goal for an area, its always been a changing world, and some parks, such as wilderness parks are simply managed as such, which adds to their value as pure baselines for any environmental change including that induced by climate change.

Recommendation

MD.12: Species translocation should be considered as an active management option when species are unable to migrate to suitable habitat naturally.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	11	6	0	14		
% with opinion	15.0%	55.0%	30.0%	0.0%	41.2%	**N/A**	**NOT SURE**
% like categories	70.0%		30.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	12	8	0	8		
% with opinion	23.1%	46.2%	30.8%	0.0%	23.5%	**LOW**	**Definitely Feasible to Possibly Feasible**
% like categories	69.2%		30.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	4	9	7	4	10		
% with opinion	16.7%	37.5%	29.2%	16.7%	29.4%	**NONE**	**NONE**
% like categories	54.2%		45.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Species translocation should always be a 'last resort', and even then, it may not be justifiable. This has to be dealt with on a case-by-case basis. Too often, we delude ourselves into thinking that we know how ecosystems work and what will be the impacts of translocations/introductions. We should not pretend that we are ecosystem engineers.
- Consider for species-at-risk species first if identified in approved recovery strategies and for other species providing proper environmental assessment screening, disease screening (eg. rabies, mange, ranavirus, VHS, etc.).
- Species translocations are most often a colossal waste of money and trying to play God. Most single-species management is inefficient.
- We usually don't know enough about their biology to do this successfully.
- Dependent on species and distance for translocation.
- We cannot start compensating for climate change--it will never end.
- Examples include past re-introductions of caribou and elk.

Recommendation

MD.13: Species at risk planning should include protection provisions for the range expansions and contractions of species.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	15	0	0	6	HIGH	Very Desirable to Desirable
% with opinion	46.4%	53.6%	0.0%	0.0%	17.6%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	22	4	0	5	HIGH	Possibly Feasible
% with opinion	10.3%	75.9%	13.8%	0.0%	14.7%		
% like categories	86.2%		13.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	12	11	3	2	6	HIGH	Short to Medium-Term
% with opinion	42.9%	39.3%	10.7%	7.1%	17.6%		
% like categories	82.1%		17.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Desirable -- but species-at-risk planning should not 'rely' on protected area populations as some protected area species-at-risk populations are subject to higher mortality than unprotected area populations due to increased human traffic (e.g., Long Point causeway).
- In the south, climate trends may favour habitat expansion/maintenance for some species and some communities, specifically those on the dry end of the moisture regime--i.e., some prairies, savannahs, Great Lakes shorelines, etc.

Recommendation
MD.14: Vegetation management plans should include species lists of native plants and communities that could migrate into/out of protected area boundaries and include provisions and guidance to adapt accordingly.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	5	19	2	0	8		
% with opinion	19.2%	73.1%	7.7%	0.0%	23.5%	**HIGH**	**Desirable**
% like categories	92.3%		7.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	19	3	1	6		
% with opinion	17.9%	67.9%	10.7%	3.6%	17.6%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	85.7%		14.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	11	4	1	5		
% with opinion	44.8%	37.9%	13.8%	3.4%	14.7%	**HIGH**	**Short to Medium-Term**
% like categories	82.8%		17.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Normally assumed to be ok if native. Only a concern if a native can be invasive. Meaning of this is not very clear.
- This may be practical/applicable in some situations, but not system wide, at least not early on. And it may not be easy to predict the response, trajectory of some/many species depending on their plasticity/adaptive response.

Recommendation
MD.15: Invasive species management direction should be fluid and include new and upcoming invasives that could expand their range and affect ecological integrity because of climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	15	0	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	51.6%	48.4%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	18	2	1	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	30.0%	60.0%	6.7%	3.3%	11.8%		
% like categories	90.0%		10.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	20	5	3	0	6	**HIGH**	**Short-term**
% with opinion	71.4%	17.9%	10.7%	0.0%	17.6%		
% like categories	89.3%		10.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement (shaded)

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Can't really predict.
- Current management policies provide for such considerations, although not prescribed in a climate change context at present.

Recommendation

MD.16: Protected area management direction should determine long-term goals with some targets for species and ecosystems that consider the impacts of climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	21	1	1	3		
% with opinion	25.8%	67.7%	3.2%	3.2%	8.8%	HIGH	Very Desirable to Desirable
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	20	2	1	6		
% with opinion	17.9%	71.4%	7.1%	3.6%	17.6%	HIGH	Possibly Feasible
% like categories	89.3%		10.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	9	11	7	1	6		
% with opinion	32.1%	39.3%	25.0%	3.6%	17.6%	MEDIUM	Short to Medium-Term
% like categories	71.4%		28.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Probably practical only for designated species, e.g. species-at-risk.

Recommendation

MD.17: Management direction should explicitly identify species, habitats and ecosystems at risk due to possible climate change impacts.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	17	0	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	45.2%	54.8%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	16	4	0	3	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	35.5%	51.6%	12.9%	0.0%	8.8%		
% like categories	87.1%		12.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	20	7	1	1	5	**HIGH**	**Short to Medium-Term**
% with opinion	69.0%	24.1%	3.4%	3.4%	14.7%		
% like categories	93.1%		6.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

MD.18: Principles of adaptive management and the ecosystem approach should be incorporated into all management (e.g., preparing and implementing resource management plans and their subset of interventions) and planning (strategic/corporate, systems planning, site level management plans) directions of Ontario Parks.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	20	12	0	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	62.5%	37.5%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	20	1	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	34.4%	62.5%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	22	6	2	1	3	**HIGH**	**Short-Term**
% with opinion	71.0%	19.4%	6.5%	3.2%	8.8%		
% like categories	90.3%		9.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Desireable -- unsure as to whether it is feasible given the current resources.
- I am not convinced that an adaptive management approach will be effective in adapting to climate change. The reason is that forests are long-lived and reflect past climatic conditions, while we want to be able to predict the future performance of forests under a future climate.
- To be prescribed in the context of 'evolutionary' and 'era' framework, which recognizes that the inherent value of true long-term baselines in the system, where hands-off' intervention is the goal, are a desireable asset and a major component of the system.

Recommendation

MD.19: Management plans should be reviewed once specific thresholds related to climate change are exceeded (e.g., changes in species populations or temperature regimes).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	17	4	0	5	**HIGH**	**Very Desirable to Desirable**
% with opinion	27.6%	58.6%	13.8%	0.0%	14.7%		
% like categories	86.2%		13.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	17	6	0	6	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	17.9%	60.7%	21.4%	0.0%	17.6%		
% like categories	78.6%		21.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	3	10	8	5	8	**NONE**	**NONE**
% with opinion	11.5%	38.5%	30.8%	19.2%	23.5%		
% like categories	50.0%		50.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- We need to be careful here that we are not attributing population change to climate change arbitrarily. There could be many reasons why a population fluctuates.
- Implementation plans (e.g., vegetation management plans), as opposed to management plans, should be reviewed (less constrained approach).
- Under new *Provincial Parks and Conservation Reserves Act*, management plans are to be reviewed every decade. If the rate of change is much more rapid than this, it will be very difficult to manage no matter what we do. Suggest there is direction given on dealing with climate change in management plans and in management plan review, but not to solely act as the trigger.
- Will this happen in less time than a plan is to be in effect?
- I think that the current regime for park management plan review sets a review interval already calibrated sufficiently fine to accommodate such considerations/needs.

Recommendation

MD.20: Management direction for fisheries should place more emphasis on maintaining cold-water aquatic ecosystems and the species that depend on them. Areas adjacent to cold-water streams and lakes should generally not be developed, and natural vegetative cover should be maintained.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	11	1	0	8	HIGH	Very Desirable to Desirable
% with opinion	53.8%	42.3%	3.8%	0.0%	23.5%		
% like categories	96.2%		3.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	18	5	0	6	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	17.9%	64.3%	17.9%	0.0%	17.6%		
% like categories	82.1%		17.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	4	6	1	9	MEDIUM	Short to Medium-Term
% with opinion	56.0%	16.0%	24.0%	4.0%	26.5%		
% like categories	72.0%		28.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Emphasis should also be placed on improving warm water fisheries and degraded streams.

Recommendation

MD.21: Environmental assessments should incorporate climate change considerations.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	20	1	1	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	29.0%	64.5%	3.2%	3.2%	8.8%		
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	22	2	0	4	**HIGH**	**Possibly Feasible**
% with opinion	20.0%	73.3%	6.7%	0.0%	11.8%		
% like categories	93.3%		6.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	11	2	1	7	**HIGH**	**Short to Medium-Term**
% with opinion	48.1%	40.7%	7.4%	3.7%	20.6%		
% like categories	88.9%		11.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
MD.22: Climate change adaptation indicators need to be identified, defined and used to assess the successes and challenges of specific management plans.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	18	1	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	40.6%	56.3%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	21	3	0	5	**HIGH**	**Possibly Feasible**
% with opinion	17.2%	72.4%	10.3%	0.0%	14.7%		
% like categories	89.7%		10.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	16	11	3	1	3	**HIGH**	**Short to Medium-Term**
% with opinion	51.6%	35.5%	9.7%	3.2%	8.8%		
% like categories	87.1%		12.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Management goals should be what mgt plans are evaluated against.

Appendix 3.3.
Operations & Development (OD)

Recommendation
OD.1: Reductions in greenhouse gas emissions <u>should not</u> be incorporated into park operations and development.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	4	28	0		
% with opinion	0.0%	0.0%	12.5%	87.5%	0.0%	**HIGH**	**Very Undesirable**
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	3	5	8	5		
% with opinion	38.5%	11.5%	19.2%	30.8%	16.1%	**N/A**	**N/A**
% like categories	50.0%		50.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	18	0	1	0	9		
% with opinion	94.7%	0.0%	5.3%	0.0%	32.1%	**N/A**	**N/A**
% like categories	94.7%		5.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
OD.2: The parks and protected areas sector should be a national and provincial leader and a showcase (i.e., lead by example and develop demonstration sites for alternative energy solutions) for curbing all emissions under its control.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	24	7	0	1	2		
% with opinion	75.0%	21.9%	0.0%	3.1%	5.9%	**HIGH**	**Very Desirable**
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	20	11	3	0	0		
% with opinion	58.8%	32.4%	8.8%	0.0%	0.0%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	91.2%		8.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	27	4	1	0	2		
% with opinion	84.4%	12.5%	3.1%	0.0%	5.9%	**HIGH**	**Short-term**
% like categories	96.9%		3.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Could cost too much.
- Doubtful they will have the budget to be a leader.

Recommendation

OD.3: The parks and protected areas sector should play an advocacy role in garnering widespread public support for greenhouse gas reductions and should encourage other sectors to do likewise.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	18	9	3	2	2		
% with opinion	56.3%	28.1%	9.4%	6.3%	5.9%	**HIGH**	**Very Desirable to Desirable**
% like categories	84.4%		15.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	18	10	4	1	1		
% with opinion	54.5%	30.3%	12.1%	3.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	84.8%		15.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	23	3	3	2	3		
% with opinion	74.2%	9.7%	9.7%	6.5%	8.8%	**HIGH**	**Short-term**
% like categories	83.9%		16.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Ontario Parks Natural Heritage Education program is already position to contact hundreds of thousands of people yearly through interpretive programs.
- May not have the budget.
- Advocacy best done by others -- being a good example is OK.

Recommendation

OD.4: Ontario Parks should develop a greenhouse gas emissions reduction strategy for its buildings and fleet. Ontario Parks should include explicit goals for greenhouse gas emissions reductions in their management plans that push the envelope in terms of best management practices. Any infrastructure development or refurbishing should then take a best practices approach to energy and emissions. Vehicle fleets should reflect the best possible energy efficiency standards. This could serve as a public education tool, to show that emissions reductions are possible both at an individual and institutional level, and help build political support for real action to reduce emissions across society.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	7	1	1	2		
% with opinion	71.9%	21.9%	3.1%	3.1%	5.9%	**HIGH**	**Very Desirable**
% like categories	93.8%		6.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	18	13	2	0	1		
% with opinion	54.5%	39.4%	6.1%	0.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	93.9%		6.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	28	3	2	0	1		
% with opinion	84.8%	9.1%	6.1%	0.0%	2.9%	**HIGH**	**Short-term**
% like categories	93.9%		6.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Agree with statement except that direction should not be in park management plans.

Recommendation
OD.5: Ontario Parks should explore opportunities for greenhouse gas reductions, including alternative vehicle solutions (e.g., increased use of bicycles, 4-cycle engines for boat motors, lawn mowers, snow blowers, opportunities for commuting, purchasing hybrid vehicles), energy efficient lighting options, and waste reduction strategies.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	31	3	0	0	0		
% with opinion	91.2%	8.8%	0.0%	0.0%	0.0%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	25	7	2	0	0		
% with opinion	73.5%	20.6%	5.9%	0.0%	0.0%	**HIGH**	**Definitely Feasible**
% like categories	94.1%		5.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	32	1	1	0	0		
% with opinion	94.1%	2.9%	2.9%	0.0%	0.0%	**HIGH**	**Short-term**
% like categories	97.1%		2.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- These will require a large culture shift unless large energy inefficient vehciles are no longer available to staff. Enforcement staff view large vehicles as a symbol of power and superiority and few choose bicycles if the large trucks are also available.
- May not have the budget.

Recommendation

OD.6: Service-oriented protected areas should be better designed to reduce the need for vehicle use (e.g., campgrounds should be designed in a way that reduces vehicle use by visitors and park staff).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	10	0	0	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	69.7%	30.3%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	19	14	0	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	57.6%	42.4%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	6	2	0	0	**HIGH**	**Short-term**
% with opinion	76.5%	17.6%	5.9%	0.0%	0.0%		
% like categories	94.1%		5.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Park once programs already in existence in some parks.

Recommendation

OD.7: Incentives and dis-incentives should be used to change park staff and visitor attitudes and behaviours with regards to energy use and conservation.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	19	11	1	1	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	59.4%	34.4%	3.1%	3.1%	5.9%		
% like categories	93.8%		6.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	17	12	2	1	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	53.1%	37.5%	6.3%	3.1%	5.9%		
% like categories	90.6%		9.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	28	2	1	1	1	**HIGH**	**Short-term**
% with opinion	87.5%	6.3%	3.1%	3.1%	3.0%		
% like categories	93.8%		6.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Can't/shouldn't be done at this level - general policy issue.

Recommendation

OD.8: Park staff should make greater use of alternative modes of transportation, including bicycles, golf carts, and foot patrols rather than mechanized modes such as trucks.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	22	12	0	0	0		
% with opinion	64.7%	35.3%	0.0%	0.0%	0.0%	**HIGH**	**Very Desirable to Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	22	7	4	0	1		
% with opinion	66.7%	21.2%	12.1%	0.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.9%		12.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	31	2	1	0	0		
% with opinion	91.2%	5.9%	2.9%	0.0%	0.0%	**HIGH**	**Short-term**
% like categories	97.1%		2.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- These will require a large culture shift unless large energy inefficient vehciles are no longer available to staff. Enforcement staff view large vehicles as a symbol of power and superiority and few choose bicycles if the large trucks are available.
- Desireable where safety is not an issue – i.e., golf carts on roads etc.
- May not have the budget and logisitics in large parks.

Recommendation
OD.9: **<u>No</u> adaptations to operations and development should be considered to address changing water levels in protected areas.**

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	18	16	0	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	0.0%	0.0%	52.9%	47.1%	0.0%		
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	7	10	6	5	**N/A**	**N/A**
% with opinion	14.8%	25.9%	37.0%	22.2%	15.6%		
% like categories	40.7%		59.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	2	3	3	9	**N/A**	**N/A**
% with opinion	61.9%	9.5%	14.3%	14.3%	30.0%		
% like categories	71.4%		28.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
OD.10: Permanent docks should be replaced by floating docks to facilitate annual relocations subject to water levels and to reduce impacts on aquatic habitats.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	6	20	0	0	8		
% with opinion	23.1%	76.9%	0.0%	0.0%	23.5%	**HIGH**	**Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	19	1	0	4		
% with opinion	31.0%	65.5%	3.4%	0.0%	12.1%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	96.6%		3.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	9	3	3	3		
% with opinion	50.0%	30.0%	10.0%	10.0%	9.1%	**HIGH**	**Short to Medium-Term**
% like categories	80.0%		20.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.11: Ontario Parks should seek opportunities to re-design access and pedestrian traffic controls with greater environmental and climate change considerations where marked beach regression is occurring.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	16	1	0	4		
% with opinion	43.3%	53.3%	3.3%	0.0%	11.8%	HIGH	Very Desirable to Desirable
% like categories	96.7%		3.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	17	1	0	4		
% with opinion	40.0%	56.7%	3.3%	0.0%	11.8%	HIGH	Definitely Feasible to Possibly Feasible
% like categories	96.7%		3.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	12	9	1	6	6		
% with opinion	42.9%	32.1%	3.6%	21.4%	17.6%	MEDIUM	Short to Medium-Term
% like categories	75.0%		25.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
OD.12: Ontario Parks should rely less on built structures such as docks and boathouses which will be left hanging high and dry when water levels change. Lake-level dependent developments should be avoided.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	v	10	1	0	8		
% with opinion	57.7%	38.5%	3.8%	0.0%	23.5%	**HIGH**	**Very Desirable**
% like categories	96.2%		3.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	18	2	0	4		
% with opinion	33.3%	60.0%	6.7%	0.0%	11.8%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	93.3%		6.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	12	12	3	3	4		
% with opinion	40.0%	40.0%	10.0%	10.0%	11.8%	**HIGH**	**Short to Medium-Term**
% like categories	80.0%		20.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.13: Adaptation to operations and development should be idiosyncratic in nature and will need to be evaluated on a park by park, or even site by site, basis because many other variables will also need to be evaluated (e.g., water control structures, cost-benefit analysis, risk analysis).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	10	19	2	1	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	31.3%	59.4%	6.3%	3.1%	5.9%		
% like categories	90.6%		9.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	15	1	0	6	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	42.9%	53.6%	3.6%	0.0%	17.6%		
% like categories	96.4%		3.6%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	8	2	3	6	**HIGH**	**Short to Medium-Term**
% with opinion	51.9%	29.6%	7.4%	11.1%	18.2%		
% like categories	81.5%		18.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.14: Protected area managers should not be required to fix water levels – water levels should not be altered to maintain artificially high water levels.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	9	0	1	12		
% with opinion	54.5%	40.9%	0.0%	4.5%	35.3%	N/A	NOT SURE
% like categories	95.5%		4.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	14	5	0	8		
% with opinion	24.0%	56.0%	20.0%	0.0%	24.2%	HIGH	Definitely Feasible to Possibly Feasible
% like categories	80.0%		20.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	6	2	2	9		
% with opinion	56.5%	26.1%	8.7%	8.7%	28.1%	HIGH	Short to Medium-Term
% like categories	82.6%		17.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Not sure -- depends on values being protected – i.e., if maintaining an artificially high water level retains the biodiversity of a marsh, critical fish spawning areask, recreation, etc. thorough examination of benefits/repercussions need to be examined. Almost all major watersheds in Algonquin Park are maintained at artificially high levels to provide recreational opportunities and manage water for hydroelectric facilities downstream. removal of these structures now would reduce aquatic habitat, fish spawning areas, drain a Nature Reserve zone created to protect a bog complex partially dependent on current water levels, and allow for invasive species to infiltrate waterways (through removal of dams - fish barriers).

Recommendation

OD.15: Recreational uses (e.g., swimming, walking, day-use, mechanized travel, etc.) could be altered (i.e., decreased, stopped) to protect newly exposed shorelines and allow for stabilization through natural succession to occur. Vulnerable coastal ecosystems and facilities should be inventoried and monitored - inventory and monitoring could lead to decisions about possible closures of some areas to public use.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	18	0	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	41.9%	58.1%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	17	8	0	2	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	21.9%	53.1%	25.0%	0.0%	5.9%		
% like categories	75.0%		25.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	12	11	1	7	3	**MEDIUM**	**Short to Medium-Term**
% with opinion	38.7%	35.5%	3.2%	22.6%	8.8%		
% like categories	74.2%		25.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.16: Ontario Parks should not adapt operations and development initiatives to help manage the impacts of new invasive species which migrate into protected area boundaries.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	1	8	21	1	HIGH	Undesirable to Very Undesirable
% with opinion	6.3%	3.1%	25.0%	65.6%	3.0%		
% like categories	9.4%		90.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	4	9	7	5	N/A	N/A
% with opinion	25.9%	14.8%	33.3%	25.9%	15.6%		
% like categories	40.7%		59.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	12	3	3	4	7	N/A	N/A
% with opinion	54.5%	13.6%	13.6%	18.2%	24.1%		
% like categories	68.2%		31.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Should be done on a specie by species basis: some changes may be successional.

Recommendation

OD.17: Live bait should be severely restricted, perhaps even regulated against, in order to avoid the spread of invasive species.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	25	7	0	0	2		
% with opinion	78.1%	21.9%	0.0%	0.0%	5.9%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	13	3	1	3		
% with opinion	45.2%	41.9%	9.7%	3.2%	8.8%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.1%		12.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	7	0	0	3		
% with opinion	77.4%	22.6%	0.0%	0.0%	8.8%	**HIGH**	**Short-term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Definitly possible - Algonquin has had a live bait ban for 20 years to prevent the introduction of non-native fish species. banning organic bait should also be considered as diseases (VHF) may still be transferable via dead bait. Use of earthworms (another invasive species) should be reviewed in protected areas as well.

Recommendation

OD.18: A total ban on campers bringing personal firewood into parks should be implemented to avoid the spread of invasive and disturbance species.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	15	15	2	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	46.9%	46.9%	6.3%	0.0%	5.9%		
% like categories	93.8%		6.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	16	4	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	37.5%	50.0%	12.5%	0.0%	5.9%		
% like categories	87.5%		12.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	23	6	0	3	2	**HIGH**	**Short-term**
% with opinion	71.9%	18.8%	0.0%	9.4%	5.9%		
% like categories	90.6%		9.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- If personal fire wood is to be banned, I think that the park should look into providing one free bag per site. We want parks to remain economically accessible to everyone and the campfire experience should not be available only to those who can afford Ontario Parks' wood.

Recommendation
OD.19: A staff and public education program with standardized messaging should be implemented to help recognize, monitor and report on invasive species occurrences in protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	18	16	0	0	0		
% with opinion	52.9%	47.1%	0.0%	0.0%	0.0%	HIGH	Very Desirable to Desirable
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	19	14	0	0	1		
% with opinion	57.6%	42.4%	0.0%	0.0%	2.9%	HIGH	Definitely Feasible to Possibly Feasible
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	29	3	0	1	1		
% with opinion	87.9%	9.1%	0.0%	3.0%	2.9%	HIGH	Short-term
% like categories	97.0%		3.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Canadian Forestry Service issues bulletins on invasive forest species which could be better distributed to parks staff/visitors.

Recommendation
OD.20: The role of visitors and volunteers in preventing, monitoring, and managing invasive species should be addressed in management planning.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	14	2	0	2	HIGH	Very Desirable to Desirable
% with opinion	50.0%	43.8%	6.3%	0.0%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	18	1	0	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	40.6%	56.3%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	22	7	0	0	5	HIGH	Short-term
% with opinion	75.9%	24.1%	0.0%	0.0%	14.7%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.21: Ecological integrity should be maintained or restored wherever possible as intact ecosystems are more likely to naturally resist invasive species.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	20	8	0	0	6		
% with opinion	71.4%	28.6%	0.0%	0.0%	17.6%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	19	3	1	6		
% with opinion	17.9%	67.9%	10.7%	3.6%	17.6%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	85.7%		14.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	8	4	1	6		
% with opinion	53.6%	28.6%	14.3%	3.6%	17.6%	**HIGH**	**Short to Medium-Term**
% like categories	82.1%		17.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.22: Ontario Parks should establish a warning system for visitors through the Ontario Parks website, campsite reservation site and reservation confirmation letters about the imminent spread of invasive species and how to report and who to report occurrences to.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	12	2	0	3	HIGH	Very Desirable to Desirable
% with opinion	54.8%	38.7%	6.5%	0.0%	8.8%		
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	18	12	2	0	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	56.3%	37.5%	6.3%	0.0%	5.9%		
% like categories	93.8%		6.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	2	1	4	3	HIGH	Short-term
% with opinion	77.4%	6.5%	3.2%	12.9%	8.8%		
% like categories	83.9%		16.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- There are benefits and drawbacks to doing this (similar to disclosing the presence of/state of threatened and endangered species). Some people looking to cause trouble may exacerbate the situation when given the details.

Recommendation

OD.23: Restoration and re-vegetation activities should use native species and grasses only (e.g., no ornamental, non-native plants).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	29	3	0	0	2		
% with opinion	90.6%	9.4%	0.0%	0.0%	5.9%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	24	6	3	0	1		
% with opinion	72.7%	18.2%	9.1%	0.0%	2.9%	**HIGH**	**Definitely Feasible**
% like categories	90.9%		9.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	29	2	1	1	1		
% with opinion	87.9%	6.1%	3.0%	3.0%	2.9%	**HIGH**	**Short-term**
% like categories	93.9%		6.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Need to coordinate this with the Ministry of Transportation (MTO). MTO seed mixes used on road right-of-way's (including those in protected areas) are all non native (some invasive) plant species.

Recommendation
OD.24: Minimizing disturbance (e.g., new roads, infrastructure, etc.) should be an approach used to offset possible invasive species response.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	26	4	1	0	3		
% with opinion	83.9%	12.9%	3.2%	0.0%	8.8%	**HIGH**	**Very Desirable**
% like categories	96.8%		3.2%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	12	3	1	2		
% with opinion	50.0%	37.5%	9.4%	3.1%	5.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.5%		12.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	3	1	1	4		
% with opinion	83.3%	10.0%	3.3%	3.3%	11.8%	**HIGH**	**Short-term**
% like categories	93.3%		6.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.25: There should be an increased effort of using natural ecological processes (e.g., fire, prescribed burns) to control invasives.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	21	8	0	0	5		
% with opinion	72.4%	27.6%	0.0%	0.0%	14.7%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	20	2	0	3		
% with opinion	29.0%	64.5%	6.5%	0.0%	8.8%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	93.5%		6.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	22	5	1	2	4		
% with opinion	73.3%	16.7%	3.3%	6.7%	11.8%	**HIGH**	**Short-term**
% like categories	90.0%		10.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- There is one necessary caveat to my answer on this one. Improper use of fire actually can exacerbate the invasive problem.
- Need legislation making this a requirement -- otherwise costs of planning and executing a prescribed burn may hinder their use in protected areas.

Recommendation

OD.26: Mandatory check-points and cleaning stations to ensure boats are clean of non-native/invasive species prior to their launch in a protected area should be installed.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	15	14	2	1	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	46.9%	43.8%	6.3%	3.1%	5.9%		
% like categories	90.6%		9.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	17	8	1	2	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	18.8%	53.1%	25.0%	3.1%	5.9%		
% like categories	71.9%		28.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	8	2	1	4	**HIGH**	**Short to Medium-Term**
% with opinion	63.3%	26.7%	6.7%	3.3%	11.8%		
% like categories	90.0%		10.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Boats should remain in the protected area.
- No boats should enter a protected area -- that's protection.

Recommendation

OD.27: Rules for acceptance of non-native species as part of the ecosystem need to be developed.

Desirability							
	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	14	2	0	10	HIGH	Very Desirable to Desirable
% with opinion	33.3%	58.3%	8.3%	0.0%	29.4%		
% like categories	91.7%		8.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility							
	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	14	1	1	9	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	36.0%	56.0%	4.0%	4.0%	26.5%		
% like categories	92.0%		8.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame							
	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	6	3	3	9	MEDIUM	Short to Medium-Term
% with opinion	52.0%	24.0%	12.0%	12.0%	26.5%		
% like categories	76.0%		24.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This depends on the definition of 'non-native' Species from other continents should never be 'accepted'. Species native to adjacent areas might be treated differently.
- The introduction of non-native species to control invaasive species ahs created problems in the past and must be severly linmited if used at all
- Don't understand the question--does this relate to invasuves that cannot be controlled; does it relate to use of cultivars for landscaping?

Recommendation
OD.28: A contingency budget should be established by Ontario Parks and the broader MNR to consider/manage invasives early.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	15	0	1	5	**HIGH**	**Very Desirable to Desirable**
% with opinion	44.8%	51.7%	0.0%	3.4%	14.7%		
% like categories	96.6%		3.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	15	4	2	6	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	25.0%	53.6%	14.3%	7.1%	17.6%		
% like categories	78.6%		21.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	5	1	1	7	**HIGH**	**Short-term**
% with opinion	73.1%	19.2%	3.8%	3.8%	21.2%		
% like categories	92.3%		7.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.29: <u>No</u> adaptations to operations and development should be considered to address changes in fish species distribution.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	14	13	6	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	0.0%	0.0%	51.9%	48.1%	18.2%		
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	8	4	8	3	9	**N/A**	**N/A**
% with opinion	34.8%	17.4%	34.8%	13.0%	28.1%		
% like categories	52.2%		47.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	2	2	4	11	**N/A**	**N/A**
% with opinion	57.9%	10.5%	10.5%	21.1%	36.7%		
% like categories	68.4%		31.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.30: Populations and species associations should be allowed to equilibrate (migrate to suitable water habitats) as ecosystems change, unless the changes are due to over-exploitation or other artificial stresses.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	5	20	0	0	9		
% with opinion	20.0%	80.0%	0.0%	0.0%	26.5%	**HIGH**	**Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	10	14	1	0	9		
% with opinion	40.0%	56.0%	4.0%	0.0%	26.5%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	96.0%		4.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	9	7	6	4	8		
% with opinion	34.6%	26.9%	23.1%	15.4%	23.5%	**LOW**	**Short to Medium-Term**
% like categories	61.5%		38.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Depends on the value - many fish species have not migrated into areas b/c of fish barriers - not because current water temps (eg. pike can be found north of Thunder Bay, but not in many small watersheds in Algonquin) - need increased education and enforcement to combat the 'bucket brigade' of people who deliberately and illegally move fish species into new areas.
- Need legislation banning the movement of live fish in Ontario.
- Other considerations may be required.

Recommendation

OD.31: In the event that climate change increases to a point that certain fish species are no longer able to survive without translocation, selected lakes should be stocked and managed to provide habitat for species and angling opportunities.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	9	8	1	13	**N/A**	**NOT SURE**
% with opinion	14.3%	42.9%	38.1%	4.8%	38.2%		
% like categories	57.1%		42.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	13	7	1	9	**LOW**	**Definitely Feasible to Possibly Feasible**
% with opinion	12.5%	54.2%	29.2%	4.2%	27.3%		
% like categories	66.7%		33.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	5	4	8	5	10	**NONE**	**N/A**
% with opinion	22.7%	18.2%	36.4%	22.7%	31.3%		
% like categories	40.9%		59.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I can justify manipulation to preserve a species, less enthusiastic about manipulation to provide angling opportunities--go to a fish farm.
- I would rarely advocate 'stocking' anywhere. This is analogous to introduction/translocation (see above). I would have to think very carefully about the sort of situation where I would think this would be a legitimate activity.

Recommendation

OD32: Native populations of fish species that can adapt to warmer water temperatures should be translocated where natural migration is not possible.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	6	9	1	18		
% with opinion	0.0%	37.5%	56.3%	6.3%	52.9%	N/A	NOT SURE
% like categories	37.5%		62.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	13	5	0	12		
% with opinion	14.3%	61.9%	23.8%	0.0%	36.4%	N/A	NOT SURE
% like categories	76.2%		23.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	3	4	7	6	13		
% with opinion	15.0%	20.0%	35.0%	30.0%	39.4%	N/A	NOT SURE
% like categories	35.0%		65.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I would have to think very carefully about the sort of situation where I would think this would be a legitimate activity.
- Only if they are within the same natural watersheds - isolated fish populations can evolve into new species and this process should not be hindered or altered by human movement of fish species.
- Depends how rare the species/stock is.

Recommendation

OD.33: Streambank erosion restoration (e.g., enhancing vegetation cover) should be used to enhance and prolong cool water species habitats.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	25	6	0	1	2	HIGH	Very Desirable
% with opinion	78.1%	18.8%	0.0%	3.1%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	18	1	0	3	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	38.7%	58.1%	3.2%	0.0%	8.8%		
% like categories	96.8%		3.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	9	2	3	5	HIGH	Short to Medium-Term
% with opinion	51.7%	31.0%	6.9%	10.3%	14.7%		
% like categories	82.8%		17.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Case-by-case consideration needed viz natural processes vs. human induced erosion and the impact of same on the riparian system.

Recommendation
OD.34: Anthropogenic lakes and ponds which connect to cool water streams and have a warming influence should be reduced or eliminated.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	16	0	1	8	HIGH	Very Desirable to Desirable
% with opinion	34.6%	61.5%	0.0%	3.8%	23.5%		
% like categories	96.2%		3.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	15	4	0	9	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	24.0%	60.0%	16.0%	0.0%	26.5%		
% like categories	84.0%		16.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	10	6	1	9	MEDIUM	Short to Medium-Term
% with opinion	32.0%	40.0%	24.0%	4.0%	26.5%		
% like categories	72.0%		28.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
OD.35: Anthropogenic lakes and ponds should be disconnected and restored to their proper bathymetry to the river to reduce water temperature and restore freshwater and groundwater influxes.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	14	0	0	12		
% with opinion	36.4%	63.6%	0.0%	0.0%	35.3%	**N/A**	**NOT SURE**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	13	5	1	11		
% with opinion	17.4%	56.5%	21.7%	4.3%	32.4%	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% like categories	73.9%		26.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	5	11	4	1	13		
% with opinion	23.8%	52.4%	19.0%	4.8%	38.2%	**N/A**	**NOT SURE**
% like categories	76.2%		23.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Generally, I support the removal of dams and other artificial impediments to hydrological processes, regardless of the potential effects of climate change.
- Case-by-case consideration may be necessary, at least in some situations.

Recommendation
OD.36: <u>No</u> adaptations to visitor infrastructure and service should be considered to reduce risks and take advantage of new opportunities resulting from climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	16	14	3	**HIGH**	**Undesirable to Very Undesirable**
% with opinion	0.0%	0.0%	53.3%	46.7%	9.1%		
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	7	6	6	6	**N/A**	**N/A**
% with opinion	26.9%	26.9%	23.1%	23.1%	18.8%		
% like categories	53.8%		46.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	7	2	3	9	**N/A**	**N/A**
% with opinion	40.0%	35.0%	10.0%	15.0%	31.0%		
% like categories	75.0%		25.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

OD.37: More funding should be directed to fix roof accommodations such as yurts and cabins to capture the opportunities associated with an extended spring and fall camping season.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	12	8	0	11	**LOW**	**Very Desirable to Desirable**
% with opinion	13.0%	52.2%	34.8%	0.0%	32.4%		
% like categories	65.2%		34.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	19	1	0	5	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	31.0%	65.5%	3.4%	0.0%	14.7%		
% like categories	96.6%		3.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	8	13	2	3	8	**HIGH**	**Short to Medium-Term**
% with opinion	30.8%	50.0%	7.7%	11.5%	23.5%		
% like categories	80.8%		19.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Will depend on the park. Some parks may already be at their maxiumum stress absorbing capacity and increasing visitation may put some natural values at risk. Just because people are willing to spend more time in the parks doesn't mean we should necessarily accommodate it. Will depend on the park/system.
- This is contrary to earlier discussions about reducing infrastructure. Suggest we put prioroity on funds within parks elsewhere (rehab, education, etc.). We will require more energy to operate/heat yurts and other structures.
- I am getting old -- I like yurts and cabins (actually, they should really fix them irrespective of climate change.

Recommendation
OD.38: Ontario Parks should more aggressively monitor lake ice conditions and perhaps restrict access and travel in the shoulder seasons to ensure visitor safety.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	11	1	0	9	**HIGH**	**Very Desirable to Desirable**
% with opinion	52.0%	44.0%	4.0%	0.0%	26.5%		
% like categories	96.0%		4.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	11	2	0	5	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	55.2%	37.9%	6.9%	0.0%	14.7%		
% like categories	93.1%		6.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	7	0	3	5	**HIGH**	**Short to Medium-Term**
% with opinion	65.5%	24.1%	0.0%	10.3%	14.7%		
% like categories	89.7%		10.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- If parks are liable, that's one thing. But I don't think parks can get into the habit of babysitting visitors. There are lots of threats out there and we should not assume responsibility for them. Educational materials should be made available but it is primarily up to the visitor to monitor their own safety in a natural setting full of risks (e.g. Lightning, some animals, poisonous berries, slippery rocks, traffic, etc)
- There are reason to monitor these things that are better than visitor safety.
- This becomes a visitor safety issue.
- Supportive of this without knowing the current policy and practices--possible liability issue.

Recommendation

OD.39: Ontario Parks should put into place caps on usage of facilities such as trails to proactively ensure that excessive and extended use in the future does not create additional stresses on these ecosystems.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	15	3	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	43.8%	46.9%	9.4%	0.0%	5.9%		
% like categories	90.6%		9.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	16	8	0	1	**MEDIUM**	**Definitely Feasible to Possibly Feasible**
% with opinion	27.3%	48.5%	24.2%	0.0%	2.9%		
% like categories	75.8%		24.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	20	5	1	4	4	**HIGH**	**Short to Medium-Term**
% with opinion	66.7%	16.7%	3.3%	13.3%	11.8%		
% like categories	83.3%		16.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- We should do this now--close sensitive hiking trails durin spring melt to minimize erosion, for example.
- Case-by-case assessment needed--should happen irrespective of climate change.

Recommendation

OD.40: Ontario Parks should identify and close facilities that may no longer be viable under changing climatic conditions (e.g., no longer maintain ski, skate or ice fishing facilities).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	17	3	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	35.5%	54.8%	9.7%	0.0%	8.8%		
% like categories	90.3%		9.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	18	1	0	3	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	36.7%	60.0%	3.3%	0.0%	9.1%		
% like categories	96.7%		3.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	9	11	3	10	0	**LOW**	**Short to Medium-Term**
% with opinion	27.3%	33.3%	9.1%	30.3%	0.0%		
% like categories	60.6%		39.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Whose facilities? If Ontario Parks, then OK

Recommendation

OD.41: Ontario Parks should invest fewer resources into winter programs due to the anticipated reduction in seasonal use and invest more in warm-weather recreation options.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	8	8	0	16		
% with opinion	11.1%	44.4%	44.4%	0.0%	47.1%	**N/A**	**NOT SURE**
% like categories	55.6%		44.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	13	3	0	10		
% with opinion	30.4%	56.5%	13.0%	0.0%	30.3%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.0%		13.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	6	8	3	11	5		
% with opinion	21.4%	28.6%	10.7%	39.3%	15.2%	**NONE**	**N/A**
% like categories	50.0%		50.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- There are two points made in this question. I agree with closure of winter facilities when no longer viable, but I do not agree with the development of additional or new warm-weather facilities to compensate for the winter closures. This gets to the point of reducing the 'footprint' in protected areas (OD.45).

Recommendation
OD.42: Sole-use winter trails should be converted to multi-use/multi-season trails as conditions change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	2	8	5	0	19		
% with opinion	13.3%	53.3%	33.3%	0.0%	55.9%	**N/A**	**NOT SURE**
% like categories	66.7%		33.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	14	3	0	10		
% with opinion	26.1%	60.9%	13.0%	0.0%	30.3%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.0%		13.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	7	5	3	11	7		
% with opinion	26.9%	19.2%	11.5%	42.3%	21.2%	**NONE**	**N/A**
% like categories	46.2%		53.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Will depend on the conditions. Some trails may be acceptable only in the winter and may cause damage if used in the summer. We may not mind providing access to some areas during certain seasons but it may not be appropriate in other seasons.
- Closure is the preferred option. Multi-use trails create conflicts and ecosystem degradation.
- There are a variety of issues/impacts associated with multiple use of trails.
- Case-by-case assessment may be needed.

Recommendation

OD.43: Camping seasons should be extended in selected provincial parks to take advantage of the potential increase in visitor use.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	6	15	0	0	13		
% with opinion	28.6%	71.4%	0.0%	0.0%	38.2%	**N/A**	**NOT SURE**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	16	1	0	6		
% with opinion	39.3%	57.1%	3.6%	0.0%	17.6%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	96.4%		3.6%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	10	10	3	7	4		
% with opinion	33.3%	33.3%	10.0%	23.3%	11.8%	**LOW**	**Short to Medium-Term**
% like categories	66.7%		33.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This will also depend on how much pressure the natural features can endure.
- Depends on how long extended season would be -- need to allow sites to rehabilitate between camping seasons.

Recommendation

OD.44: Ontario Parks should identify staffing needs and challenges due to the possibility an extended warm-season (e.g., the availability of students during non-peak season, increased visitation during warm-weather seasons).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	22	0	0	4	HIGH	Desirable
% with opinion	26.7%	73.3%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	17	2	0	2	HIGH	Short to Medium-Term
% with opinion	40.6%	53.1%	6.3%	0.0%	5.9%		
% like categories	93.8%		6.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	11	1	2	5	HIGH	Short to Medium-Term
% with opinion	50.0%	39.3%	3.6%	7.1%	15.2%		
% like categories	89.3%		10.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Lack of funding for low use shoulder seasons.

Recommendation
OD.45: Efforts should focus on reducing, not increasing, the ecological footprint of human activities. As such, efforts should focus on new forms of recreation that are proactive and environmentally responsible.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	9	0	0	2		
% with opinion	71.9%	28.1%	0.0%	0.0%	5.9%	HIGH	Very Desirable
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	17	2	0	1		
% with opinion	42.4%	51.5%	6.1%	0.0%	2.9%	HIGH	Definitely Feasible to Possibly Feasible
% like categories	93.9%		6.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	20	8	2	2	2		
% with opinion	62.5%	25.0%	6.3%	6.3%	5.9%	HIGH	Short to Medium-Term
% like categories	87.5%		12.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none.

Appendix 3.4.
Research, Monitoring & Reporting (RMR)

Recommendation

RMR.1: Climate change <u>should not</u> be integrated into protected areas research, monitoring and reporting activities.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	0	6	23	1		
% with opinion	9.4%	0.0%	18.8%	71.9%	3.0%	**HIGH**	**Very Undesirable**
% like categories	9.4%		90.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	4	8	7	6		
% with opinion	26.9%	15.4%	30.8%	26.9%	18.8%	**N/A**	**N/A**
% like categories	42.3%		57.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	1	1	1	13		
% with opinion	81.3%	6.3%	6.3%	6.3%	44.8%	**N/A**	**N/A**
% like categories	87.5%		12.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

RMR.2: A specific monitoring strategy should be developed related to climate change to detect and monitor trends and impacts.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	12	2	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	54.8%	38.7%	6.5%	0.0%	8.8%		
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	16	2	0	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	40.0%	53.3%	6.7%	0.0%	11.8%		
% like categories	93.3%		6.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	6	0	1	3	**HIGH**	**Short-term**
% with opinion	77.4%	19.4%	0.0%	3.2%	8.8%		
% like categories	96.8%		3.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Need to have a specific climate change monitoring and then tie in with the broader management of protected areas.

Recommendation

RMR.3: An integrated and cooperative monitoring strategy related to climate change to detect and monitor trends and impacts, especially for regionally threatened species, extinction prone species, and management target species, should be established and implemented at the ecoregional/system level. Such a monitoring program should also be used to document and assess the success/failure of remedial actions.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	19	13	0	0	2	HIGH	Very Desirable to Desirable
% with opinion	59.4%	40.6%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	9	20	2	0	3	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	29.0%	64.5%	6.5%	0.0%	8.8%		
% like categories	93.5%		6.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	7	0	1	2	HIGH	Short-term
% with opinion	75.0%	21.9%	0.0%	3.1%	5.9%		
% like categories	96.9%		3.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Same as RMRR.2: need to have a specific climate change monitoring strategy and then tie in with the broader management of protected areas.
- I do not know the state of natural history record-keeping system wide. Years back, some parks/some naturalists used to keep various records such as first bird arrivals/departures, phenological records like first-flowering and first-leaving dates, species occurrence records, anecdotal weather records, etc.

Recommendation

RMR.4: Natural Heritage staff and volunteer monitoring programs (e.g., NGOs, 'Friends Of' groups, local schools, park users, etc.) to detect and monitor climate change impacts should be established by Ontario Parks, regional offices, and individual protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	13	0	0	4	**HIGH**	**Very Desirable to Desirable**
% with opinion	56.7%	43.3%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	19	1	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	39.4%	57.6%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	5	1	0	4	**HIGH**	**Short-term**
% with opinion	80.0%	16.7%	3.3%	0.0%	11.8%		
% like categories	96.7%		3.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Adequate training would be necessary to ensure consistency in data collection but assuming adequate training, volunteers could enable us to collect data we otherwise wouldn't get to. In return for their time and effort, it will be important to show them how we use the data.
- Need some sort of quality assurance - often 'managing' volunteers takes as long as doing the work yourself.
- I am in the proces of trying this exact thing and am finding the value of having volunteers do work that a trained professional should be doing is limited; Ontario Parks needs to do this work internally by qualified and trained staff.
- We need to have our own programs up and running before we involve external groups. Training, consistency in reporting etc. are key issues. We typically have much well-intentioned interest that needs to be utilized appropriately, not just a bunch of feel-good stuff done that may actually reduce our limited resources. Use them but cautiously.
- Provided well trained.
- I do not know the state of natural history record-keeping system wide. Years back, some parks/some naturalists used to keep various records such as first bird arrivals/departures, phenological records like first-flowering and first-leaving dates, species occurrence records, anecdotal weather records, etc.

Recommendation

RMR.5: Ontario Parks should establish long-term research and monitoring sites against which to quantitatively measure climate change impacts.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	23	8	0	0	3		
% with opinion	74.2%	25.8%	0.0%	0.0%	8.8%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	16	0	0	2		
% with opinion	50.0%	50.0%	0.0%	0.0%	5.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	5	0	0	3		
% with opinion	83.9%	16.1%	0.0%	0.0%	8.8%	**HIGH**	**Short-term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- These sites would not be isolated from the effects of climate change -- wouldn't it be with which to monitor the impacts of climate change?
- Much of this is already being done and new initiatives need to be fully scoped prior to their implementation to avoid repetition.
- May well be difficult to idntify data that can be clearly related to climate change and nothing else in the ecosystems.
- Sites should be established for more comprehensive monitoring to include climate change indicators and consderations -- it would be ideal if this could be standardized nation-wide sensu an EMAN approach. I am really not up to speed on current Ontario Parks policy/practices.

Recommendation
RMR.6: Weather stations should be established and strategically located in protected areas to improve the grid of climate data in Ontario and to provide long-term climate information specifically relevant to protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	15	0	1	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	50.0%	46.9%	0.0%	3.1%	5.9%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	19	0	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	40.6%	59.4%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	3	1	1	3	**HIGH**	**Short-term**
% with opinion	83.9%	9.7%	3.2%	3.2%	8.8%		
% like categories	93.5%		6.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- If done, it should be carefully integrated with existing programs.
- Build on existing weather stations.
- Ensure linkage and compatibility to national weather network.
- Environment Canada's abandonment of weather stations is scandalous in the light of the crisis that we face, and their superior knowledge of it! (Can the closure of stations be reversed? I don't know).
- Could be an important educational initiative for park visitors, as well as collecting/callibrating info for park management.

Recommendation

RMR.7: Ontario Parks should increase climate change trend modelling studies (e.g., with regards to species composition, water quality and quantity, invasive species, pests and diseases, local and regional climate, species species at risk, threatened species, etc.) to assess potential future impacts on protected areas assets.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	17	2	0	4		
% with opinion	36.7%	56.7%	6.7%	0.0%	11.8%	**HIGH**	**Very Desirable to Desirable**
% like categories	93.3%		6.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	8	21	1	0	4		
% with opinion	26.7%	70.0%	3.3%	0.0%	11.8%	**HIGH**	**Possibly Feasible**
% like categories	96.7%		3.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	9	0	1	7		
% with opinion	63.0%	33.3%	0.0%	3.7%	20.6%	**HIGH**	**Short to Medium-Term**
% like categories	96.3%		3.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Through partnerships with universities, perhaps.
- Not sure this has to be in house, but it's a desirable option.
- Need to explore options/opportunities with other partners to build parks' needs into already existing modelling initiatives.

Recommendation
RMR.8: A comprehensive research strategy and monitoring framework with a defined set of measures (with sufficient spatial and temporal considerations) pertaining to climate change should be established (e.g., incorporated into Ontario Parks Comprehensive Monitoring Framework) at both the system and park level to track climate change and its effects and for comparative reporting.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	17	0	1	0	**HIGH**	**Very Desirable to Desirable**
% with opinion	47.1%	50.0%	0.0%	2.9%	0.0%		
% like categories	97.1%		2.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	17	2	1	3	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	35.5%	54.8%	6.5%	3.2%	8.8%		
% like categories	90.3%		9.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	5	0	0	4	**HIGH**	**Short-term**
% with opinion	83.3%	16.7%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Some park zones already have monitoring strategies that could simply be updated and modified to answer specific climate change monitoring questions.
- Engage outside parties/partners already involved in comprehensive efforts.

Recommendation

RMR.9: Climate change impacts and actions should be explicitly recognized as an ecosystem management issue in state of the protected areas and ecological integrity reporting.

Desirability							
	VD	**D**	**U**	**VU**	**Not Sure**	**CONSENSUS**	**DESIRABILITY**
responses	21	10	0	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	67.7%	32.3%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility							
	DF	**PF**	**PU**	**DU**	**Not Sure**	**CONSENSUS**	**FEASIBILITY**
responses	19	14	0	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	57.6%	42.4%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame							
	S	**M**	**L**	**W&S**	**Not Sure**	**CONSENSUS**	**TIME FRAME**
responses	26	6	0	0	2	**HIGH**	**Short-term**
% with opinion	81.3%	18.8%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- May well be difficult to identify data that can be clearly related to climate change and nothing else in the ecosystems.
- Could be shaped as part of an ecological integrity strategy

Recommendation

RMR.10: A research strategy should be developed on the role of protected areas and climate change (e.g., What are the looming questions needing answers necessary to address critical policy, planning, management and operation needs in protected areas? More broadly, what service roles can protected areas play as platforms for long-term time-trend research on climate change issues that transcend protected areas?).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	16	1	0	4		
% with opinion	41.4%	55.2%	3.4%	0.0%	12.1%	**HIGH**	**Very Desirable to Desirable**
% like categories	96.6%		3.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	18	0	0	4		
% with opinion	37.9%	62.1%	0.0%	0.0%	12.1%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	2	0	0	6		
% with opinion	92.6%	7.4%	0.0%	0.0%	18.2%	**HIGH**	**Short-term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Could be shaped as part of an ecological integrity strategy.

Recommendation

RMR.11: Ontario Parks should develop specific thresholds related to climate change that trigger management actions if the state of ecological integrity is assessed to be declining.

Desirability							
	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	17	2	0	6	HIGH	Very Desirable to Desirable
% with opinion	32.1%	60.7%	7.1%	0.0%	17.6%		
% like categories	92.9%		7.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility							
	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	14	7	0	9	MEDIUM	Definitely Feasible to Possibly Feasible
% with opinion	16.0%	56.0%	28.0%	0.0%	26.5%		
% like categories	72.0%		28.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame							
	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	11	10	3	4	6	MEDIUM	Short to Medium-Term
% with opinion	39.3%	35.7%	10.7%	14.3%	17.6%		
% like categories	75.0%		25.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- In general, predefined definite thresholds for action are problematic, especially given the level of uncertainty involved.
- Not sure how/if this would work. Much of our management is not active ie. emphasis is given more to minimizing impacts/minimizing footprint. Triggering management actions suggests that there is a very active form of mgmt for our broad, varied land base.

Recommendation

RMR.12: Ontario Parks should monitor long-term changes in species composition using permanent sample/systematic plots located at ecotones (species at the northern limits of their range).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	17	1	0	4		
% with opinion	40.0%	56.7%	3.3%	0.0%	11.8%	**HIGH**	**Very Desirable to Desirable**
% like categories	96.7%		3.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	16	2	0	3		
% with opinion	41.9%	51.6%	6.5%	0.0%	8.8%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	93.5%		6.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	7	0	0	12		
% with opinion	66.7%	33.3%	0.0%	0.0%	36.4%	**N/A**	**NOT SURE**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Medium-term; not sure why ecotone is equated to northern limits of species; is it assumed we have nothing at southern limits? This isn't true for Polar Bear Provincial Park where many species probably reach their southern limits and loss of arctic derived species is a real expectation.
- Again, relate this to ecological integrity, and don't restrict to 'northern species' bias.

Recommendation
RMR.13: Monitoring sites should be established in the least disturbed protected areas in each ecodistrict to act as control sites for projects investigating the effects of climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	15	0	1	4	**HIGH**	**Very Desirable to Desirable**
% with opinion	46.7%	50.0%	0.0%	3.3%	11.8%		
% like categories	96.7%		3.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	14	0	0	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	53.3%	46.7%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	4	0	1	5	**HIGH**	**Short-Term**
% with opinion	82.8%	13.8%	0.0%	3.4%	14.7%		
% like categories	96.6%		3.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Our least disturbed protected areas are often our least accessible ones; establishing sites here may lead to accelerated degradation of the site itself.
- Annual reporting seems unrealistic and may be unneccessary (reduce frequency); likely not required on a per park basis
- The site then becomes disturbed.
- May well be difficult to idntify data that can be clearly related to climate change and nothing else in the ecosystems.

Recommendation

RMR.14: Regional climate models should be used to predict current protected areas whose ecosystems will be most susceptible to alteration.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	19	0	0	6		
% with opinion	32.1%	67.9%	0.0%	0.0%	17.6%	HIGH	Very Desirable to Desirable
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	20	1	0	6		
% with opinion	25.0%	71.4%	3.6%	0.0%	17.6%	HIGH	Possibly Feasible
% like categories	96.4%		3.6%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	10	0	1	6		
% with opinion	60.7%	35.7%	0.0%	3.6%	17.6%	HIGH	Short to Medium-Term
% like categories	96.4%		3.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Doubt that one can predict at site levels from regional models.

Recommendation
RMR.15: Ontario Parks should assess major species, habitats, physical features, processes and other important ecosystem resources that are most likely to be impacted by climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	17	0	0	1	HIGH	Very Desirable to Desirable
% with opinion	48.5%	51.5%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	20	0	0	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	37.5%	62.5%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	5	1	0	2	HIGH	Short-term
% with opinion	81.3%	15.6%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Is this better accomplished by the federal government, e.g., Environment Canada, Natural Resources Canada? Much of this would transcend provincial boundaries and would have a greater economy of scale. We should certainly use the info. Do not have this capability within Ontario Parks.
- Really is MNR's role not just Ontario Parks'.

Recommendation
RMR.16: Research strategies should be reviewed to include the ability of species to recover from climate change disturbances and repeated disturbances (i.e., resiliency).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	18	2	0	5		
% with opinion	31.0%	62.1%	6.9%	0.0%	14.7%	**HIGH**	**Very Desirable to Desirable**
% like categories	93.1%		6.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	4	23	1	0	6		
% with opinion	14.3%	82.1%	3.6%	0.0%	17.6%	**HIGH**	**Possibly Feasible**
% like categories	96.4%		3.6%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	10	1	3	7		
% with opinion	48.1%	37.0%	3.7%	11.1%	20.6%	**HIGH**	**Short to Medium-Term**
% like categories	85.2%		14.8%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

RMR.17: Ontario Parks should maintain up-to-date distribution maps of species and communities.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	17	3	0	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	39.4%	51.5%	9.1%	0.0%	2.9%		
% like categories	90.9%		9.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	18	6	0	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	20.0%	60.0%	20.0%	0.0%	11.8%		
% like categories	80.0%		20.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	16	13	2	0	3	**HIGH**	**Short to Medium-Term**
% with opinion	51.6%	41.9%	6.5%	0.0%	8.8%		
% like categories	93.5%		6.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This is the role of the Natural Heritage Information Centre (NHIC). Ontario Parks should contribute to NHIC and use their data, but likely should not be in the business of generating and maintaining distribution maps.
- Again, I don't believe this is Ontario Parks' responsibility alone or per se, better expressed as Ontario Parks with MNR and others.
- Feasibility varies with species and even guild.
- This could/should be a function of NHIC/wider MNR efforts on biodiversity conservation.

Recommendation
RMR.18: Demonstration monitoring should be employed to illustrate to protected area visitors some of the environmental changes caused by climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	16	1	1	2	HIGH	Very Desirable to Desirable
% with opinion	43.8%	50.0%	3.1%	3.1%	5.9%		
% like categories	93.8%		6.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	17	0	0	1	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	48.5%	51.5%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	20	9	2	0	3	HIGH	Short to Medium-Term
% with opinion	64.5%	29.0%	6.5%	0.0%	8.8%		
% like categories	93.5%		6.5%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This kind of initiative should be used to demonstrate broader monitoring functions--past examples of this include deer exclosures in Rondeau Park which were used to demonstrate the impact of deer over-browsing on Carolinian species.

Recommendation
RMR.19: Monitoring efforts should be coordinated across jurisdictions and with other organizations and partners (i.e., standardize indicators, protocols, etc. to enable seamless roll-ups, assessment, and reporting of time-trend data).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	24	10	0	0	0		
% with opinion	70.6%	29.4%	0.0%	0.0%	0.0%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	18	2	0	1		
% with opinion	39.4%	54.5%	6.1%	0.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	93.9%		6.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	7	1	0	1		
% with opinion	75.8%	21.2%	3.0%	0.0%	2.9%	**HIGH**	**Short-term**
% like categories	97.0%		3.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
RMR.20: Ontario Parks should regularly report on climate change monitoring results and adaptation activities via scientific literature, grey literature, and the popular literature to inform clients and help garner support for funding and staffing.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	15	16	2	0	1		
% with opinion	45.5%	48.5%	6.1%	0.0%	2.9%	**HIGH**	**Very Desirable to Desirable**
% like categories	93.9%		6.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	14	4	0	2		
% with opinion	43.8%	43.8%	12.5%	0.0%	5.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	87.5%		12.5%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	21	7	1	0	5		
% with opinion	72.4%	24.1%	3.4%	0.0%	14.7%	**HIGH**	**Short-term**
% like categories	96.6%		3.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This ties in with comment above (RMR.15). Need to work with other agencies as we do not have full resources to put an emphasis on climate change. We can help showcase climate change but need to coordinate as suggested in RMR.19.
- Annual reporting seems unrealistic and may be unneccessary (reduce frequency); likely not required on a per park basis.
- Really is MNR's role not just Ontario Parks'.
- This process requires transparency, information sharring and accountability. It also requires an ability to publish. All of these are endangered or threatened capacities in MNR.

Recommendation
RMR.21: The role of protected areas in sequestering carbon needs to be explored in more detail and ensure that ecological integrity and biodiversity goals are not compromised by carbon sequestration goals.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	10	13	1	1	9	**HIGH**	**Very Desirable to Desirable**
% with opinion	40.0%	52.0%	4.0%	4.0%	26.5%		
% like categories	92.0%		8.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	15	0	0	12	**N/A**	**NOT SURE**
% with opinion	31.8%	68.2%	0.0%	0.0%	35.3%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	9	1	0	11	**HIGH**	**Short to Medium-Term**
% with opinion	56.5%	39.1%	4.3%	0.0%	32.4%		
% like categories	95.7%		4.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Effect would be negligible considering the total area of protected areas.

Recommendation

RMR.22: The assessment of ecological integrity should be made relative the prevailing climate at the time of assessment and not a historical benchmark that no longer exists.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	6	11	1	0	16		
% with opinion	33.3%	61.1%	5.6%	0.0%	47.1%	**N/A**	**NOT SURE**
% like categories	94.4%		5.6%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	10	1	0	17		
% with opinion	35.3%	58.8%	5.9%	0.0%	50.0%	**N/A**	**NOT SURE**
% like categories	94.1%		5.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	7	7	1	2	17		
% with opinion	41.2%	41.2%	5.9%	11.8%	50.0%	**N/A**	**NOT SURE**
% like categories	82.4%		17.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I think that in practice these benchmarks will be very difficult to establish.
- That question needs a great deal of discussion around protected areas goals.

Recommendation

RMR.23: Specific climate change indicators of climate change should not be developed.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	0	15	16	0		
% with opinion	8.8%	0.0%	44.1%	47.1%	0.0%	**HIGH**	**Undesirable to Very Undesirable**
% like categories	8.8%		91.2%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	8	5	4	8	8		
% with opinion	32.0%	20.0%	16.0%	32.0%	24.2%	**N/A**	**N/A**
% like categories	52.0%		48.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	13	3	1	1	12		
% with opinion	72.2%	16.7%	5.6%	5.6%	40.0%	**N/A**	**N/A**
% like categories	88.9%		11.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- The need for climate change indicators contingent on ecological integrity indicators.

Recommendation

RMR.24: Climate change indicators should be built into existing monitoring programs and ecological integrity monitoring frameworks.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	20	13	0	0	1		
% with opinion	60.6%	39.4%	0.0%	0.0%	2.9%	**HIGH**	**Very Desirable to Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	16	0	0	2		
% with opinion	50.0%	50.0%	0.0%	0.0%	5.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	4	1	0	3		
% with opinion	83.9%	12.9%	3.2%	0.0%	8.8%	**HIGH**	**Short-term**
% like categories	96.8%		3.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

RMR.25: Specific climate change indicators should be developed for each Ontario ecoregion (i.e., Hudson Bay Lowlands, Ontario Shield; Mixedwood Plains).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	15	1	0	4	**HIGH**	**Very Desirable to Desirable**
% with opinion	46.7%	50.0%	3.3%	0.0%	11.8%		
% like categories	96.7%		3.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	15	2	0	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	43.3%	50.0%	6.7%	0.0%	11.8%		
% like categories	93.3%		6.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	4	0	0	5	**HIGH**	**Short-term**
% with opinion	86.2%	13.8%	0.0%	0.0%	14.7%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- May be desirable to have a consistent suite of core indicators plus some region-specific ones.

Recommendation
RMR.26: There needs to be a balance between climate (driver) and feature/species (responder) indicators, and a clear distinction between regions and parks.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	5	18	0	0	11		
% with opinion	21.7%	78.3%	0.0%	0.0%	32.4%	**HIGH**	**Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	3	17	1	0	13		
% with opinion	14.3%	81.0%	4.8%	0.0%	38.2%	**HIGH**	**Possibly Feasible**
% like categories	95.2%		4.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	5	1	2	11		
% with opinion	63.6%	22.7%	4.5%	9.1%	33.3%	**N/A**	**NOT SURE**
% like categories	86.4%		13.6%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- This is the stress-response paradigm.

Appendix 3.5.
Corporate Culture & Function (CCF)

Recommendation

CCF.1: Climate change <u>should not</u> be integrated into Ontario Parks staff education programs and training initiatives.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	1	10	22	0		
% with opinion	0.0%	3.0%	30.3%	66.7%	0.0%	**HIGH**	**Undesirable to Very Undesirable**
% like categories	3.0%		97.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	7	6	8	4		
% with opinion	22.2%	25.9%	22.2%	29.6%	12.9%	**N/A**	**N/A**
% like categories	48.1%		51.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	1	1	1	10		
% with opinion	83.3%	5.6%	5.6%	5.6%	35.7%	**N/A**	**N/A**
% like categories	88.9%		11.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
CCF.2: Ontario Parks should ensure that all staff have a level of understanding of, and capacity to respond to, climate change impacts and adaptation appropriate to their mission.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	22	7	2	0	3		
% with opinion	71.0%	22.6%	6.5%	0.0%	8.8%	**HIGH**	**Very Desirable**
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	17	11	4	1	1		
% with opinion	51.5%	33.3%	12.1%	3.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	84.8%		15.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	5	0	0	4		
% with opinion	83.3%	16.7%	0.0%	0.0%	11.8%	**HIGH**	**Short-Term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Not all staff need to have this understanding.

Recommendation

CCF.3: The Ontario Parks Planning and Research Team should develop a training session to address climate change and related topics for all levels of park staff.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	19	10	2	0	3	HIGH	Very Desirable to Desirable
% with opinion	61.3%	32.3%	6.5%	0.0%	8.8%		
% like categories	93.5%		6.5%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	16	14	1	1	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	50.0%	43.8%	3.1%	3.1%	5.9%		
% like categories	93.8%		6.3%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	29	0	0	0	5	HIGH	Short-Term
% with opinion	100.0%	0.0%	0.0%	0.0%	14.7%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Coordinate with the Natural Heritaage Education (NHE) team for delivery. They are the expert communicators in Ontario Parks.

Recommendation

CCF.4: Staff orientation and training should be geared to occupation (e.g., biologists, planners, mid and upper management, interpreters, etc.) to ensure each understands the science of climate change, impacts, and potential adaptations. As such, training needs to be targeted, concise and directly relevant so employees so they can use it in their daily work.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	18	16	0	0	0	**HIGH**	**Very Desirable to Desirable**
% with opinion	52.9%	47.1%	0.0%	0.0%	0.0%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	17	15	1	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	51.5%	45.5%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	31	2	0	0	1	**HIGH**	**Short-Term**
% with opinion	93.9%	6.1%	0.0%	0.0%	2.9%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
CCF.5 A system-wide culture of conservation needs to be cultivated in order to address activities which can reduce the effects of climate change. Ontario Parks should become a model of low impact and positive action.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	27	7	0	0	0		
% with opinion	79.4%	20.6%	0.0%	0.0%	0.0%	**HIGH**	**Very Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	17	14	2	0	1		
% with opinion	51.5%	42.4%	6.1%	0.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	93.9%		6.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	28	6	0	0	0		
% with opinion	82.4%	17.6%	0.0%	0.0%	0.0%	**HIGH**	**Short-Term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- One would expect this culture to be already in place!

Recommendation
CCF.6: The contents of an education program could focus on: 1) current science; 2) potential impacts; 3) potential adaptations and limitations to response; 4) the plan on moving ahead; and, 5) the role of employees in implementing the plan.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	19	0	0	3	**HIGH**	**Very Desirable to Desirable**
% with opinion	38.7%	61.3%	0.0%	0.0%	8.8%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	17	0	0	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	43.3%	56.7%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	28	2	0	0	4	**HIGH**	**Short-Term**
% with opinion	93.3%	6.7%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
CCF.7: A standardized educational package at the provincial level should be developed with regional specialists disseminating information and training staff at the park level.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	16	1	0	9		
% with opinion	32.0%	64.0%	4.0%	0.0%	26.5%	**HIGH**	**Very Desirable to Desirable**
% like categories	96.0%		4.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	13	1	0	8		
% with opinion	46.2%	50.0%	3.8%	0.0%	23.5%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	96.2%		3.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	22	3	0	0	9		
% with opinion	88.0%	12.0%	0.0%	0.0%	26.5%	**HIGH**	**Short-Term**
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
CCF.8: Climate change adaptation workshops should be developed for specific ecoregions or greater park ecosystems.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	14	1	0	7		
% with opinion	44.4%	51.9%	3.7%	0.0%	20.6%	**HIGH**	**Very Desirable to Desirable**
% like categories	96.3%		3.7%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	14	4	0	5		
% with opinion	37.9%	48.3%	13.8%	0.0%	14.7%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	86.2%		13.8%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	22	4	0	1	7		
% with opinion	81.5%	14.8%	0.0%	3.7%	20.6%	**HIGH**	**Short-Term**
% like categories	96.3%		3.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
CCF.9: All new staff should attend a climate change orientation program.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	10	7	0	4		
% with opinion	43.3%	33.3%	23.3%	0.0%	11.8%	**MEDIUM**	**Very Desirable to Desirable**
% like categories	76.7%		23.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	15	12	6	0	1		
% with opinion	45.5%	36.4%	18.2%	0.0%	2.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	81.8%		18.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	23	1	1	2	7		
% with opinion	85.2%	3.7%	3.7%	7.4%	20.6%	**HIGH**	**Short-Term**
% like categories	88.9%		11.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Perhaps new long-term seasonal staff or permanent staff -- but the backbone of Ontario Parks are students -- and already it is a challenge to ensure they get enough training. Important, but a challenge
- Suggest this should be for all staff, not limited to new staff.
- Should be part of their training before they join.

Recommendation

CCF.10: Ontario Parks should ensure that educational materials related to ecological integrity address climate change as one of the threats.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	21	10	2	0	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	63.6%	30.3%	6.1%	0.0%	2.9%		
% like categories	93.9%		6.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	23	9	1	0	1	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	69.7%	27.3%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	28	2	0	0	4	**HIGH**	**Short-Term**
% with opinion	93.3%	6.7%	0.0%	0.0%	11.8%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I agree this is appropriate however we have seen little about ecological integrity in our Natural Heritage Education (NHE) programs. Note that these programs have been cut in the past year. Think that while it is good to be part of the program, suggest that much of this can be accomplished in the broader educational system, the media etc. Too much to implement on an already declining NHE program.

Recommendation

CCF.11: A parks certificate course should be re-instated and the curriculum should include basic information and training on climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	14	8	2	0	9		
% with opinion	58.3%	33.3%	8.3%	0.0%	27.3%	**HIGH**	**Very Desirable to Desirable**
% like categories	91.7%		8.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	14	2	0	8		
% with opinion	40.7%	51.9%	7.4%	0.0%	22.9%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	92.6%		7.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	0	0	1	9		
% with opinion	96.0%	0.0%	0.0%	4.0%	26.5%	**HIGH**	**Short-Term**
% like categories	96.0%		4.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I've heard people mention this certificate program before, but I don't know what it was like.
- Climate change or not, it is important to re-instate this course, as well as other training opportunities.

Recommendation

CCF.12: There should be more opportunities for staff to participate in climate change workshops and engage with experts in the field to keep abreast of new climate change related developments.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	14	0	1	3	HIGH	Very Desirable to Desirable
% with opinion	51.6%	45.2%	0.0%	3.2%	8.8%		
% like categories	96.9%		3.1%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	11	17	2	0	4	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	36.7%	56.7%	6.7%	0.0%	11.8%		
% like categories	93.3%		6.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	25	3	1	0	4	HIGH	Short-Term
% with opinion	86.2%	10.3%	3.4%	0.0%	12.1%		
% like categories	96.6%		3.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

CCF.13: Climate change should be a mandatory topic for parks superintendents to report on in annual reports on park planning, managing and operating parks.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	8	15	4	1	5	**HIGH**	**Very Desirable to Desirable**
% with opinion	28.6%	53.6%	14.3%	3.6%	15.2%		
% like categories	82.1%		17.9%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	19	4	1	3	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	22.6%	61.3%	12.9%	3.2%	8.8%		
% like categories	83.9%		16.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	8	0	2	5	**HIGH**	**Short to Medium-Term**
% with opinion	65.5%	27.6%	0.0%	6.9%	14.7%		
% like categories	93.1%		6.9%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Not sure if the superintendent is the right person to address this -- maybe in consultation with the zone ecologist. The super should report on what steps have been taken at the park level to address climate change issues (e.g., energy efficient light bulbs, 'park once' programs, etc.).
- While a great thought, do our supers have enough training or time to provide insights regarding climate change in their parks? Should this be left to staff with more expertise (ie. ecologists?). Would annual reports be meaningful? Report to the superintendent on an as needed basis by experts.
- This is the role of an ecologist, not a superintendent. They do not have those skills.
- Question if they get reliable data, but can no doubt make general comments.

Appendix 3.6.
Education, Interpretation & Outreach (EIO)

Recommendation
EIO.1: Climate change <u>should not</u> be incorporated into public interpretation, outreach and education initiatives/activities.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	9	24	0		
% with opinion	0.0%	0.0%	27.3%	72.7%	0.0%	**HIGH**	**Very Undesirable**
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	6	6	7	6		
% with opinion	24.0%	24.0%	24.0%	28.0%	19.4%	**N/A**	**N/A**
% like categories	48.0%		52.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	14	0	1	0	13		
% with opinion	93.3%	0.0%	6.7%	0.0%	46.4%	**N/A**	**N/A**
% like categories	93.3%		6.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

EIO.2: Ontario's protected areas organizations should provide input into the development of primary and secondary school curriculum on protected areas and climate change (e.g., develop lesson plans that teachers could use in the classroom). The contents of a climate change curriculum could include: 1) an overview of climate change impacts and supporting evidence; 2) a brief overview of potential implications; 3) introduction to the concept of ecological integrity; 4) methods for minimizing local contributions to climate change and ways to mitigate and adapt; 5) methods for minimizing other stresses; and, 6) ways to monitor for key ecological changes within protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	14	2	2	7	HIGH	Very Desirable to Desirable
% with opinion	33.3%	51.9%	7.4%	7.4%	20.6%		
% like categories	85.2%		14.8%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	14	4	1	8	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	26.9%	53.8%	15.4%	3.8%	23.5%		
% like categories	80.8%		19.2%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	15	8	0	1	8	HIGH	Short to Medium-Term
% with opinion	62.5%	33.3%	0.0%	4.2%	25.0%		
% like categories	95.8%		4.2%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I like the idea but don't' know if it's the role of Ontario Parks.
- Need to coordinate with Ministry of Education to make this stuff mandatory -- otherwise it might not be used in the classroom.
- Curriculum idea is good, but not sure what role Ontario Parks should have.
- This would be an excellent contribution, but there has always been a challenge in linking to curriculum with our parks programs (again, climate change or not). Emphasis should be placed on other agencies to educate climate change on the broader environment--it is not only protected areas that play a role in climate change. Suggest that Ministry of the Environment work directly with Ministry of Education.
- It is not Ontario Parks role to provide curriculum for schools. We have attempted this in the past (providing curriculum based information on our parks) and have had to decrease or terminate due to funding constraints and lack of staffing and to a degree, a lack of interest from schools. Climate change should be in the school curriculum by all means, but Ontario Parks should not be the group to develop

it. Ontario Parks should limit eduction to park visitors.

- Partnership with Canadian Wildlife Federation is essential here.
- Education systems best ones ot do this -- if open this to protected areas organizations, then climate change deniers would want equal billing.

Recommendation

EIO.3: Ontario Parks should be leading by example in public interpretation and education activities. Protected areas should be used to educate the public (e.g., through interpretation activities) about climate change impacts and the implications of these impacts for park features (e.g., species, habitats, ecoregions, physiography, etc.) and to build public support on climate change initiatives. Parks should be used to inform the public about climate change efforts to mitigate and adapt to it.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	19	15	0	0	0		
% with opinion	55.9%	44.1%	0.0%	0.0%	0.0%	HIGH	Very Desirable to Desirable
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	20	13	1	0	0		
% with opinion	58.8%	38.2%	2.9%	0.0%	0.0%	HIGH	Definitely Feasible to Possibly Feasible
% like categories	97.1%		2.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	30	3	0	0	1		
% with opinion	90.9%	9.1%	0.0%	0.0%	2.9%	HIGH	Short-Term
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Climate change is important -- but should be incorporated into interpretation about park themes – e.g., how can climate change affect this rare vegetation community for which the park was created.
- Strongly agree that we should lead by example and that we can showcase much in our protected areas.
- Not a specific role for parks -- idea is to get them up to speed to carry out their own responsibilities -- alot of info out there for the general public already, and lots more likely on the way now that climate change is topping the polls.

Recommendation

EIO.4: Ontario Parks should provide visitors with climate change ideas and conservation-oriented activities that they can act on themselves. As such, interpretation and outreach should play a role in encouraging personal responsibility in reducing emissions and making a difference.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	20	9	1	0	3	HIGH	Very Desirable to Desirable
% with opinion	66.7%	30.0%	3.3%	0.0%	9.1%		
% like categories	96.7%		3.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	19	10	3	0	1	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	59.4%	31.3%	9.4%	0.0%	3.0%		
% like categories	90.6%		9.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	24	4	1	0	3	HIGH	Short-Term
% with opinion	82.8%	13.8%	3.4%	0.0%	9.4%		
% like categories	96.6%		3.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Same as EIO.3: Not a specific role for parks -- idea is to get them up to speed to carry out their own responsibilities -- alot of info out there for the general public already, and lots more likely on the way now that climate change is topping the polls.
- I think this might fall outside the scope of our mandate. This is a huge overwhelming issue -- one of many we face in parks. We can't take them all on in our education programs. We don't educate users on urbanization, even though it affects our parks.
- I think this is way too much emphasis on protected areas intrerpretation programs. This should be done at home as part of school curriculm, other educational/volunteer groups such as Scouts etc., plus the media. Realize that many people come to parks to get away from the day-to-day worries--it would be inappropriate and counterproductive to saturate them with climate change messages through all Natural Heritage Education (NHE) programing. Not doubt there would be some tie-in--it is impossible to discuss local flora, fauna, ecology without context of climate change but leave the conservation message to the greater masses who do not use our parks. Also, disagree with statement in EIO.5 about incorporating in virtually every public communication tool…. This is not Ministry of Climate Change; there are other messages as well. Statement is worded much too strongly.

Recommendation

EIO5: Climate change issues awareness messages should be incorporated into virtually every public communication tool available to protected areas (e.g., interpretive packages, publications such as fact sheets, tabloids and parks guides, websites, DVDs, etc.).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	11	11	7	0	4	**MEDIUM**	**Very Desirable to Desirable**
% with opinion	37.9%	37.9%	24.1%	0.0%	12.1%		
% like categories	85.7%		14.3%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	11	3	1	4	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	46.4%	39.3%	10.7%	3.6%	12.5%		
% like categories	97.0%		3.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	18	4	3	1	6	**HIGH**	**Short to Medium-Term**
% with opinion	69.2%	15.4%	11.5%	3.8%	18.8%		
% like categories	84.6%		15.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Climate change should be incorporated into overall Natural Heritage Education (NHE) plans, but not forced into every educational activity – e.g., may not be appropriate to incorporate a climate change message into a historical program on a Mica mine.
- Climate change is no the only issue facing parks. We cannot make climate change the top issue in our communications. Other risks far outweigh climate change (i.e., habitat loss in the south).
- Same as other recommendations: not a specific role for parks - idea is to get them up to speed to carry out their own responsibilities -- alot of info out there for the general public already, and lots more likely on the way now that climate change is topping the polls.
- Same as other recommendations: I think this might fall outside the scope of our mandate. This is a huge overwhelming issue -- one of many we face in parks. We can't take them all on in our education programs. We don't educate users on urbanization, even though it affects our parks.
- Same as other recommendations: I think this is way too much emphasis on protected areas intrerpretation programs. This should be done at home as part of school curiculm, other educational/volunteer groups such as Scouts etc., plus the media. Realize that many people come to parks to get away from the day-to-day worries--it would be inappropriate and counterproductive to

	saturate them with climate change messages through all Natural Heritage Education (NHE) programing. Not doubt there would be some tie-in--it is impossible to discuss local flora, fauna, ecology without context of climate change but leave the conservation message to the greater masses who do not use our parks. Also, disagree with statement in EIO.5 about incorporating in virtually every public communication tool…. This is not Ministry of Climate Change; there are other messages as well. Statement is worded much too strongly.

Recommendation

EIO.7: Interactive, hands-on displays, demonstration monitoring (demonstration sites, such as lake retreat), and mitigative/adaptive actions and techniques (e.g., ways to reduce emissions and conserve energy) should be used in protected areas to educate the public and engage multiple partners in climate change education and outreach.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	9	21	0	0	3		
% with opinion	30.0%	70.0%	0.0%	0.0%	9.1%	**HIGH**	**Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	14	16	0	0	3		
% with opinion	46.7%	53.3%	0.0%	0.0%	9.1%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	9	1	1	3		
% with opinion	63.3%	30.0%	3.3%	3.3%	9.1%	**HIGH**	**Short to Medium-Term**
% like categories	93.3%		6.7%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Same as other recommendations.

Recommendation

EIO.8: Protected areas organizations should participate in broader landscape initiatives related to climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	16	16	0	0	2	**HIGH**	**Very Desirable to Desirable**
% with opinion	50.0%	50.0%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	15	16	1	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	46.9%	50.0%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	23	7	1	1	2	**HIGH**	**Short-Term**
% with opinion	71.9%	21.9%	3.1%	3.1%	5.9%		
% like categories	93.8%		6.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
EIO.9: Protected areas organizations should work in cooperation with other organizations outside of protected area boundaries to help reduce the impacts of climate change through approaches such as protected area system design, ecological restoration and compatible land uses adjacent to protected areas.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	22	10	0	0	2		
% with opinion	68.8%	31.3%	0.0%	0.0%	5.9%	**HIGH**	**Very Desirable to Desirable**
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	12	20	2	0	0		
% with opinion	35.3%	58.8%	5.9%	0.0%	0.0%	**HIGH**	**Definitely Feasible to Possibly Feasible**
% like categories	94.1%		5.9%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	23	6	2	1	2		
% with opinion	71.9%	18.8%	6.3%	3.1%	5.9%	**HIGH**	**Short-Term**
% like categories	90.6%		9.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation
EIO.10: Ontario protected areas organizations should not be involved in conservation 'partner' awareness initiatives.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	0	0	19	11	3	HIGH	Undesirable to Very Undesirable
% with opinion	0.0%	0.0%	63.3%	36.7%	9.1%		
% like categories	0.0%		100.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	5	4	6	6	10	N/A	N/A
% with opinion	23.8%	19.0%	28.6%	28.6%	32.3%		
% like categories	42.9%		57.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	9	2	1	3	14	N/A	N/A
% with opinion	60.0%	13.3%	6.7%	20.0%	48.3%		
% like categories	100.0%		0.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- none

Recommendation

EIO.11: A national climate change working group with provincial/territorial representation should be established to address climate change and protected areas issues including adaptation.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	12	16	0	0	6	**HIGH**	**Very Desirable to Desirable**
% with opinion	42.9%	57.1%	0.0%	0.0%	17.6%		
% like categories	100%		0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	16	0	0	5	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	44.8%	55.2%	0.0%	0.0%	14.7%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	23	5	0	1	5	**HIGH**	**Short-Term**
% with opinion	79.3%	17.2%	0.0%	3.4%	14.7%		
% like categories	96.6%		3.4%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Can't believe there isn't already such a group, what role would Ontario Parks have? Seems a higher level issue.
- Not sure about this question. How does the broader climate change working group (i.e., on the broader landscape and greater society) tie in with protected areas issues?
- CCEA could play a prominent role here.

Recommendation

EIO.12: A partner program with government, NGOs and other relevant organizations and individuals should be developed to address climate change and protected areas issues. Examples include: partners to reduce climate change (mitigation measures); partners to educate visitors; and, partner to educate staff.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	5	20	2	0	6		
% with opinion	18.5%	74.1%	7.4%	0.0%	18.2%	**HIGH**	**Desirable**
% like categories	92.6%		7.4%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	7	21	1	0	4		
% with opinion	24.1%	72.4%	3.4%	0.0%	12.1%	**HIGH**	**Possibly Feasible**
% like categories	96.6%		3.4%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	19	7	1	1	5		
% with opinion	67.9%	25.0%	3.6%	3.6%	15.2%	**HIGH**	**Short to Medium-Term**
% like categories	92.9%		7.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- I have reservations about this. The program coud be hijacked by special interest groups (e.g., oil industry).

Recommendation

EIO.13: A conference or series of workshops across the country to bring together partners involved in conservation to discuss and learn from leading edge researchers and practitioners who have been considering climate change and how to integrate it into protected areas planning and management should be developed.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	13	16	0	0	5	HIGH	Very Desirable to Desirable
% with opinion	44.8%	55.2%	0.0%	0.0%	14.7%		
% like categories	100.0%		0.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	13	18	1	0	2	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	40.6%	56.3%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	26	3	0	1	4	HIGH	Short-Term
% with opinion	86.7%	10.0%	0.0%	3.3%	11.8%		
% like categories	96.7%		3.3%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Does this not contribute to climate change (all that travel)?
- Again, a role for CCEA.

Recommendation

EIO.14: Ontario Parks should explore opportunities to educate visitors about climate change related issues with program sponsors (e.g., Canadian Tire, Pepsi, etc.).

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	3	15	5	2	9	MEDIUM	Very Desirable to Desirable
% with opinion	12.0%	60.0%	20.0%	8.0%	26.5%		
% like categories	72.0%		28.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	6	15	1	1	11	HIGH	Definitely Feasible to Possibly Feasible
% with opinion	26.1%	65.2%	4.3%	4.3%	32.4%		
% like categories	91.3%		8.7%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	17	2	1	0	13	HIGH	Short-Term
% with opinion	85.0%	10.0%	5.0%	0.0%	39.4%		
% like categories	95.0%		5.0%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Unless the program sponsor organizations (Canadian Tire, Pepsi) are themselves implementing climate change mitigation measures, this could be viewed as hypocritical.
- All science-based issues and those affecting ecological integrity in parks and the related messages need to be completely independent of corporate sponsors in order to maintain our integrity.
- Concern with corporate partnerships in a philosophical sense since they are inherently part of the problem, not the solution. This runs contrary to earlier questions re green operations and minimizing footprint in parks--what message does this send to our clients when we are in bed with CTC re. climate change when they whole heartedly promote ATVs, non-refillable propane cylinders and a generally consumptive lifestyle.
- May not be appropriate to use some sponsors (may lead to opportunities for obtaining new sponsors).
- Choice of sponsers would need to be reletively green industries or industries with commitments to becoming more green.

Recommendation

EIO.15: In order to avoid duplication of effort and maximize efficiencies, protected areas jurisdictions should seek out partnership opportunities [e.g., with protected area research groups such as the Canadian Council on Ecological Areas (CCEA), Science and the Management of Protected Areas Association (SAMPAA), the World Commission on Protected Areas (WCPA), the Parks Research Forum of Ontario (PRFO), etc.] to stage workshops and develop guidelines, strategies, etc. to help management organizations cope with climate change.

Desirability

	VD	D	U	VU	Not Sure	CONSENSUS	DESIRABILITY
responses	17	15	1	0	1	**HIGH**	**Very Desirable to Desirable**
% with opinion	51.5%	45.5%	3.0%	0.0%	2.9%		
% like categories	97.0%		3.0%				

VD=Very Desirable; D=Desirable; U=Undesirable; VU=Very Undesirable

Feasibility

	DF	PF	PU	DU	Not Sure	CONSENSUS	FEASIBILITY
responses	15	17	0	0	2	**HIGH**	**Definitely Feasible to Possibly Feasible**
% with opinion	46.9%	53.1%	0.0%	0.0%	5.9%		
% like categories	100.0%		0.0%				

DF=Definitely Feasible; PF=Possibly Feasible; PU= Possibly Unfeasible; DU= Definitely Unfeasible

Implementation Time Frame

	S	M	L	W&S	Not Sure	CONSENSUS	TIME FRAME
responses	27	4	1	0	2	**HIGH**	**Short-Term**
% with opinion	84.4%	12.5%	3.1%	0.0%	5.9%		
% like categories	96.9%		3.1%				

S=Short-Term; M=Medium-Term; L=Long-Term; W&S=Wait & See (Reactive); N/A=Not Applicable

= point of agreement

Notes (i.e., arguments for-or-against, justifications, rationale, etc.)

- Instead of doing a new conference adapt the topic into the Latornell or PRFO or some other already existing confernece -- many staff do not have the budget or time to attend multiple conferences every year.
- I would also add the Ministries of Environment at the provincial and federal levels and the Ministries responsibnle for energy.

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