THE INFLUENCE OF SCIENCE ON CONSERVATION PLANNING IN THE LONG POINT REGION: HOW CHARACTERIZATIONS OF SCIENCE AFFECT CONSERVATION APPLICATIONS

by

Sarah Ellen Ramey

A thesis submitted to the School of Urban and Regional Planning

in conformity with the requirements for

the degree of Master of Urban and Regional Planning

Queen's University

Kingston, Ontario, Canada

(June, 2010)

Abstract

This research explored the role of science and civil society environmental organizations in conservation planning, using a case study of Ontario's Long Point region. Science is a dynamic field that is constantly adapting and evolving (Bocking 2001; Kohler 2006; Loo 2007), and is increasingly relied on as a basis for decision-making in conservation planning, policy and management (Bocking 2001; Loo 2006; Theberge & Theberge 2009). The role of civil society in conservation planning has also grown and organizations that operate outside of government now play an important role in acquiring land, conducting monitoring activities, and promoting local stewardship (Merenlender et al. 2004; Whitelaw 2005; Reed 2007; Conrad & Daoust 2008; Dempsey & Dearden 2009). Considering the activities of these organizations, and the underlying science that informs them, is essential given the increasing prevalence of this type of work and the increasing ability of civil society organizations to affect conservation planning outcomes.

Through a literature review, document analysis, and semi-structured interviews, this research considered how characterizations of science, applications of science, and recent trends in science have influenced conservation plans, policies, and actions in the Long Point region. The results illustrate how different forms of information were considered and applied when prioritizing, justifying, and implementing conservation

projects and provide a location-specific example of how the modern features of conservation planning and management are influencing environmental outcomes. Specifically, the results suggest how place-based knowledge can potentially be disseminated through policy and planning initiatives and also suggest how different forms of information may interact to influence overall project credibility. These findings have implications for both planning theory and practice by contributing to our understanding of the role of science in shaping conservation practices, the role of civil society in driving conservation innovation, and the importance of local knowledge in supporting effective conservation actions.

Acknowledgements

I would like to thank everyone who contributed – in any way – to the shaping and production of this thesis. Firstly, thank you to everyone I was involved with in the Long Point region - your passion for the area and the conservation work you do is wonderful. I appreciate the time you took to assist me in various ways with this study, and without you this research could never have happened.

Thank you also to all the SURP faculty (and Jo-Anne!) who have contributed to my planning education here at Queen's, particularly Graham Whitelaw who offered me the opportunity to pursue this research and provided guidance, advice, and opinions along the way. Additionally, I would like to thank the CIP for believing in this research and recognizing it through a scholarship, and similarly thank the SSHRC for their recognition and financial support.

Finally, I would like to thank my parents, Bill and Bev, who not only proofread the full thesis, but also offered invaluable moral support throughout my planning education. Thank you also to all my friends – SURPers or otherwise – who made the last two years relaxed, fun, and enjoyable!

Table of Contents

List of Tables

List of Figures

List of Acronyms

ALUS	Alternative Land Use Services Program
ANSI	Area of Natural and Scientific Interest
CA	Conservation Authority
CC	Carolinian Canada
CO	Conservation Ontario
EIS	Ecological Information Systems
EMAN	Ecological Monitoring and Assessment Network
GIS	Geographic Information Systems
LEI	Local Ecological Information
LEK	Local Ecological Knowledge
LPBLT	Long Point Basin Land Trust
LPRCA	Long Point Region Conservation Authority
LPWBRF	Long Point World Biosphere Reserve Foundation
NCC	Nature Conservancy of Canada
NFA	Norfolk Federation of Agriculture
NFN	Norfolk Field Naturalists
NHIC	Natural Heritage Information Centre
NLSC	Norfolk Land Stewardship Council
NWOA	Norfolk Woodlot Owners Association
OHT	Ontario Heritage Trust
OLTA	Ontario Land Trust Alliance
OMOE	Ontario Ministry of Environment
OMNR	Ontario Ministry of Natural Resources
ON	Ontario
OWA	Ontario Woodlot Association
SAR	Species at Risk
SEI	Scientific Ecological Information
SNO	Stewardship Network of Ontario
TEK	Traditional Ecological Knowledge
UNESCO	United Nations Educational, Scientific and Cultural Organization

Chapter 1: Introduction

1.1 CONTEXT

The interactions between science, society, and stewardship activities have changed through time, as have their influence on conservation planning. Although science was once used unquestioningly, new concerns and activities have drawn attention to the values that shape science and the interactions between science and society that produce knowledge (Bocking 2007; Skogstad & Hartley 2007). This has resulted in the identification of alternate forms of knowledge and a recent understanding of how different types of information may interact to influence conservation planning and management (Callon 1999; Berkes et al. 2000; Olsson & Folke 2001; Yil-Pelkonen & Kohl 2005; Fazey et al. 2006).

Recently a new paradigm of conservation planning and management has emerged, which embeds the principles of sustainability, collaboration, and science to pursue conservation objectives (Phillips 2003; Francis 2008). The role of civil society in conservation planning has also grown and organizations that operate outside of government now play an important role in acquiring land, conducting monitoring activities, and promoting local stewardship (Merenlender et al. 2004; Whitelaw 2005; Reed 2007; Conrad & Daoust 2008; Dempsey & Dearden 2009).

This research considers these conservation planning activities (particularly land acquisition, habitat restoration, and monitoring projects) from a collaborative planning perspective, and specifically examines how civil society environmental organizations use science to prioritize, justify, and implement projects and initiatives. Considering these conservation activities, and their underlying science, is essential given the increasing prevalence of this type of work and the increasing ability of civil society organizations to shape the current and future conservation landscape.

1.2 OBJECTIVES

This research was based on the ideas of modern conservation planning (Phillips 2003; Francis 2008) and collaborative planning theory (Healey 1998) and asked the question "*How are modern trends in stewardship science influencing the conservation planning and management activities of civil society environmental organizations?*" Conceptually, it was guided by the idea that landscapes, culture, technology, economics and politics shape the creation of science and subsequently affect its application (Callon 1999; Bocking 2007). To explore these interactions within modern conservation planning, I investigated the following three areas:

- *Characterizations of science* : what types of science were being used;
- *Applications of science* : how, why, and where science was used;
- *Trends in science* : how the use of science has changed and evolved.

Specifically, I illustrate how recent trends in stewardship science have been applied in a specific geographic setting, explore the interactions between scientific and other forms of information in the decision-making process, and examine the dissemination of knowledge through planning. This study supports collaborative planning theory by suggesting how local knowledge can be integrated in decision-making (Healey 1998) and by demonstrating the role of civil society in promoting conservation innovation (Whitelaw 2005).

1.3 METHODS

The research was conducted using a case study of seven civil society environmental organizations that operate in the Long Point region, which is located in southern Ontario on the north shore of Lake Erie (see figure 1.1). This region is considered one of the best examples of Canada's remaining Carolinian forest (Craig et al. 2003) and has Canada's highest number of endangered and threatened species (Craig et al. 2003; McCarthy et al. 2006). It is also home to a wide variety of local, regional, and national environmental organizations and agencies.

Within the case study, I used a triangulated research method consisting of a literature review, document analysis, and semi-structured interviews. During the research each environmental organization was assessed independently for diverging patterns but the

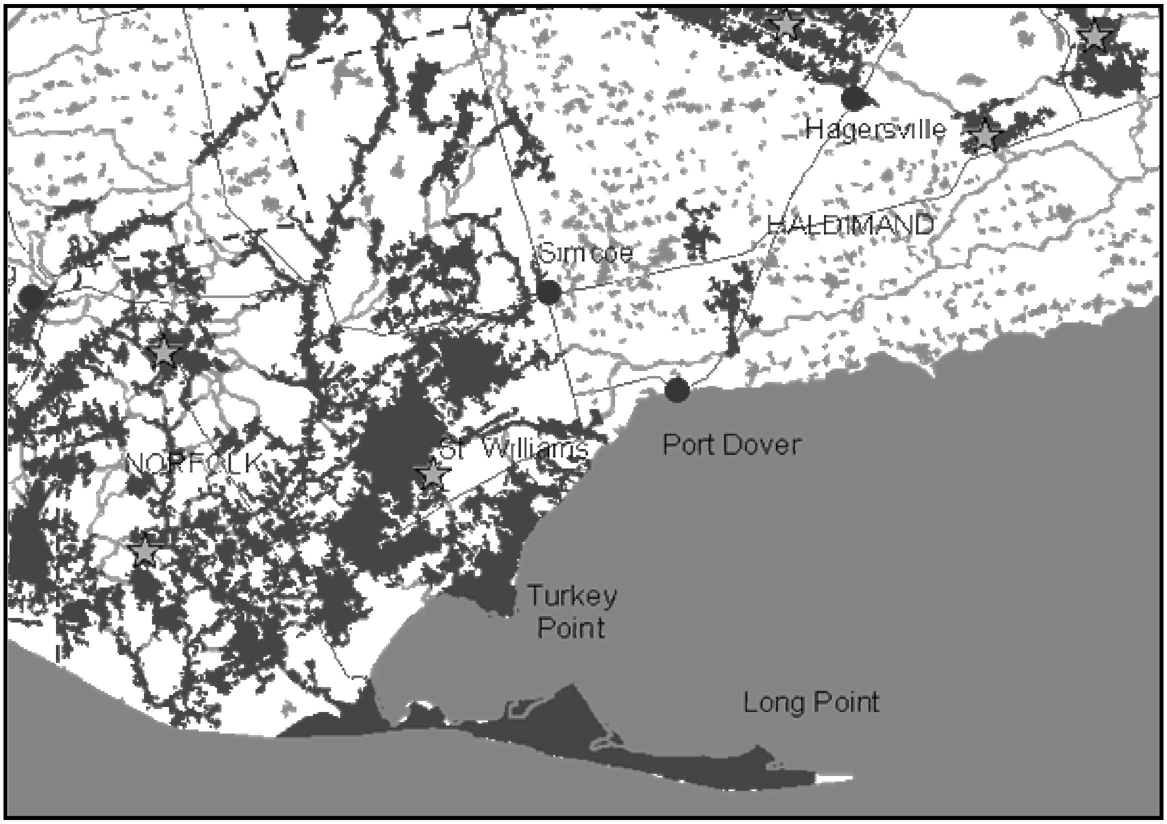


Figure 1.1 The Long Point region; shaded areas represent protected natural areas (from Carolinian Canada 2004).

individual findings were integrated during the results and analysis (Berg 2007). Methods are discussed in greater detail in Chapter 2.

1.4 STRUCTURE

This report is divided into seven chapters. Chapter 2 describes the research approach and methods in further detail and also provides background information on the Long Point region and the environmental organizations studied. Chapter 3 consists of a literature review that illustrates the characteristics of different forms of stewardship science, summarizes the history of interaction between science and planning in

Canada, and describes how these interactions have produced certain trends in modern conservation planning. Chapter 3 also contains a conceptual framework based on these ideas that guided the remainder of the research and analysis.

Chapter 4 presents the results of the interviews and document analysis, and describes how Long Point environmental organizations characterized and applied stewardship science. It also describes modern trends in stewardship science that were expressed by the respondents and revealed in the reviewed documents. Chapter 5 builds on Chapter 4 by tying the results to the conceptual framework outlined in Chapter 3, while discussing the broader implications of the research with respect to collaborative and conservation planning theory and practice.

Chapter 6 concludes with a summary of the contributions of this research and suggests areas for further study. Ultimately, I hope that my examination of the role of science in planning will help planners to effectively incorporate stewardship knowledge into planning decisions and to apply science to achieve conservation goals. Additionally, I believe that considering the role of civil society environmental organizations in these activities will help to illustrate their contributions to conservation planning and allow them to better engage in planning and policy discussions.

Chapter 2: Methodology

2.1 RESEARCH APPROACH

My research used a case study of the Long Point region to explore how stewardship science has been incorporated into conservation planning by seven local, regional, and national-level environmental organizations within civil society. A case study approach was chosen because of the exploratory detail it could provide. Yin (2009) describes how a "case study method allows investigators to retain the holistic and meaningful characteristics of real-life events" (p.4) and examine contemporary situations within their own context.

To maintain rigour and avoid researcher bias, Yin (2009) recommends a systematic approach to case study research that is guided by theoretical propositions and relies on multiple sources of data and converging evidence. As a result, I based my research in existing theory and used multiple methods to collect my data. I also approached this project by considering my own perspectives on the subject. My undergraduate degree was in environmental science, and I have been employed by several conservation organizations on a variety of projects. As a result, this is a subject that interests me, but also a subject where I potentially arrive with pre-conceived ideas. Throughout this research, I strove to acknowledge and address my own biases.

Additionally, I collaborated with members from different Long Point environmental organizations on the research design. The initial framing of the research questions was done with assistance from Long Point respondents to help ensure their relevancy to the region's conservation work (Baskerville 1999). Interview respondents were also asked to review my preliminary results and provide feedback on their validity; their responses have been incorporated in the final results as a form of "respondent validation" (Merriam 2009). This addressed some of the limitations of myself as a researcher, and allowed my conclusions to be considered from alternate perspectives for cross-validation of my findings (Berg 2007). The final results of the research will also be made available to all the Long Point organizations that were involved.

2.2 METHODS

Within the case study, I used a triangulated research method to increase the validity of the individual findings, mitigate the weaknesses of each individual method, and increase the reliability of the results as a whole (Yin 2009). The triangulated methods consisted of a:

1) Literature review
2) Document analysis of relevant planning, policy, communications, and scientific documents
3) Semi-structured interviews with leaders from seven Long Point environmental organizations

Each of these approaches were analyzed separately to locate divergences, but then later assessed together in an integrated presentation of the research findings (see chapters 4 and 5) (Berg 2007). Appendix I describes my research protocol.

2.2.1 Literature Review

I began my research with a literature review of theories on the interactions between conservation planning and stewardship science (see chapter 3). This research led to a working definition of stewardship science, informed the topics and areas I covered during the document analysis and interviews, and helped guide my discussion of the results.

To further guide my data collection and analysis, I synthesized this research into a conceptual framework of how knowledge is shaped (Bocking 2007), and how this process subsequently affects its application (Callon 1999). Comparing the results of my research to this framework tied them to existing theory and strengthens the external validity of the research (Yin 2009).

2.2.2 Document Analysis

After the literature review, and concurrent with the interviews, I conducted a document analysis related to the conservation activities of the Long Point environmental organizations. A formal analysis forced me to be "methodologically explicit" (p.61, Rose 2007), which enhances the validity and replicability of the approach, and ensures that a future researcher would reach similar conclusions.

Documents were chosen based on the recent trends in science identified during the literature review and through recommendations from interview participants. The documents included guidelines, scientific studies, funding proposals, and public communications relating to land acquisitions, restoration and stewardship projects, and monitoring programs in the Long Point area. A full list and description of the documents is located in Appendix II. The documents were assessed using a meta-analysis approach, where the content of each document was analyzed separately and the overall results were later compared. This allowed for a more comprehensive study, and the identification of divergent and convergent patterns in the findings (Gaber & Gaber 2005). This approach was also used for a series of documents, such as Conservation Ontario's and the Norfolk Land Stewardship Council's annual reports, where each report was individually assessed along with the series as a whole.

For each document, I performed three types of analysis: a manifest content analysis, a latent content analysis, and an image analysis. The manifest analysis used themes and characters within the document, such as researcher and topic, as units of analysis. The latent analysis considered the broader themes of how science was emphasized and portrayed within the document. Finally, I also assessed the use and context of images within the document as a unique analysis. This seemed relevant, since images are a separate type of communication, and can interpret, amplify, or modify a message (Frank 2003). For all analyses, I used a "grounded category" approach to identify my categories, so although they were initially based on the literature review and interviews they were further refined through the research process itself (Gaber & Gaber 2005). Appendix III presents the final categories.

Although collaboration with the organizations helped me access most documents, the sensitive or transient nature of certain reports made some unavailable. Reviewing documents also limited me to analyzing events without their full context, and in some cases the documents may not accurately reflect what actually occurred (Berg 2007). To address these limitations, during the interviews I attempted to explore in detail any content relating to unavailable documents, and the context surrounding the production of analyzed documents (Palys 2003). Additionally, I also found that some types of communication, such as workshops or personal observations, were not recorded. This has, however, been noted in the results, since the absence of documentation can indicate equally important trends (Merriam 2009).

2.2.3 Semi-structured Interviews

Concurrent with the document analysis I conducted a series of thirteen semi-structured interviews with key members of civil society environmental organizations who were actively involved with the conservation work their organization was pursuing in the Long Point area. Respondents were chosen based on my initial research of the area's conservation work, and additional respondents were interviewed based on recommendations from people working in the area. Most respondents were consistently suggested by representatives from different organizations. Nine of the interviews were conducted in person, while four were conducted over the telephone based on respondent preference and geographic constraints. Additionally, I also began my research by conducting three informal interviews that helped shape my research questions, and later provided all interested interview respondents with a draft of my preliminary analysis to review for feedback.

A semi-structured approach was chosen for the interviews so that each interview could cover similar lines of inquiry, while still keeping the questions fluid and conversational (Yin 2009). A set of predetermined topics were covered (see Appendix IV), although the order or phrasing of the questions was changed as needed, and responses were probed beyond the answers given (Berg 2007). Generally, the interviews were used to assess respondents' perceptions regarding how and why their organization used different types of science, and which types of science they have found to be the most relevant in achieving their conservation objectives. Since the quality of the interview data depended heavily on the relevancy of the questions posed and the atmosphere that I created (Palys 2003), I pilot tested both my questions and my performance as an interviewer before beginning. Results from the interviews were also compared against the reviewed documents to verify responses and identify deviations (Berg 2007).

The results from the interviews were analyzed using the "inductive and comparative analysis strategy" suggested by Merriam (2009). This approach treats analysis as an ongoing and iterative process that is integrated with other forms of data collection and assessment (Merriam 2009). To conduct this form of analysis, I first assessed patterns in the interviews through "open coding," where I recorded any potentially relevant patterns and comments. These initial codes were later grouped into categories, which led to "analytical codes" that included broader interpretations and reflection on meanings (Merriam 2009). I then re-assessed my initial findings by reviewing all the interviews within the context of the analytical codes, and re-sorted my results into these categories (Merriam 2009). A list of the final analytical codes is located in Appendix V.

During the interview analysis, respondents were separated into three categories based on their role within an organization. The first group consisted of people who held permanent positions; this group is indicated by "PER" for permanent. The second group consisted of people who held volunteer positions; this group is indicated by "VOL" for volunteer. The final group consisted of people who held temporary positions based on available grant funding; this group is referred to as "TEM" for temporary. Table 2.1 describes how these categories roughly correspond with organizational governance, the respondents' accountability, and the respondents' history of involvement with the organization. However, some organizations were represented by respondents who held different categories of position.

Table 2.1 Broad differences between the permanent (PER), volunteer (VOL), and temporary (TEM) interview respondents based on their organization's governance structure, their accountability within their organization, and their history of involvement with the organization.

	Permanent (PER)	Volunteer (VOL)	Temporary (TEM)
Organization's Governance	*Most hierarchical*	*Least hierarchical*	*Varied*
Accountability	*Accountability to employer*	*Limited accountability*	*Accountability to funders*
History with Organization	*Tended to be longer and more continuous*	*Tended to be less continuous*	*Tended to be shorter*

My research was approved by the Queen's General Research Ethics Board. Written permission was granted for in-person interviews, and verbal consent was provided for all telephone interviews.

2.2.4 Analysis

During the integrated analysis, the patterns that emerged from the document analysis and interviews were analyzed using the "constant comparative" method to locate similarities and differences between data themes (Merriam 2009), and later tied to the conceptual framework developed during the literature review. Generally, converging findings were presented if respondents or documents from at least three different organizations referred to similar themes; where possible, this information was presented using quotes or document statements from all organizations or respondent categories that referred to the theme (Berg 2007). Although not all respondents or documents touched on all themes, specific divergences from common patterns were noted (Merriam 2009). In these cases, the diverging statements or documents were described in the results. All respondents and all documents provided information that was used in the analysis.

2.3 LIMITATIONS

Ultimately, this research considered the activities of seven organizations located within Long Point, and the specific findings should not be generalized beyond the area or organizations that this research considered (Yin 2009). However, although the results of the case study cannot be generalized, the depth of detail provided should allow for the transferability of the ideas to similar situations and issues (Merriam 2009). Comparing the results to the conceptual framework developed from the literature review also fits the findings within a broader theoretical context (Palys 2003), and allows for analytic generalization by demonstrating how the results fit within, and deviate from, current theory (Yin 2009).

Additional limitations of this research include the potential bias in the organizations researched, the people interviewed, and the documents selected. Although all attempts were made to identify and include all relevant organizations, people, and documents, it is possible that some may have been inadvertently excluded. Subsequently, the results are best seen as a reflection of the seven organizations that were studied, the specific documents that were reviewed, and the type of category of respondents that were interviewed.

There is also the potential for bias during the analysis process. Although patterns were supported by the largest number of respondent categories and organizations possible, and divergences were noted where present, it is possible that some organizations, documents, or respondents may have been over-represented. This issue has been noted by qualitative researchers, with the suggestion that additional quantitative methods could determine the extent that certain phenomenon may be over-emphasized (McCracken 1988). However, this scale of meta-analysis was beyond the scope of this thesis.

2.4 LONG POINT REGION CASE STUDY

2.4.1 Area Overview

The Long Point region is situated in Norfolk County, formerly the Regional Municipality of Haldiman-Norfolk, on the north shore of Lake Erie. It has a diverse mix of sand bars, beaches, dunes, forests, scrub, bays, and open lake, and also includes a 32 kilometre erosion-deposited sand spit that projects into Lake Erie (Nelson & Wilcox 1996). The region is representative of the Great Lakes Coastal Ecosystem, has the most undeveloped wildlands of any shoreline in the Lower Great Lakes (Nelson & Wilcox 1996), and is considered one of the best examples of Canada's remaining Carolinian forest (Craig et al. 2003). Its wetlands have been internationally recognized by the Ramsar Convention on Wetlands (Nelson & Wilcox 1996) and it is also considered an internationally "Important Bird Area" by Bird Life International (Wren & Couturier 2009).

Additionally, the Long Point region is home to Canada's highest number of endangered and threatened species (Craig et al. 2003; McCarthy et al. 2006). Twenty distinct biotic communities and 700 species of vascular plants have been recorded in the area (Nelson & Wilcox 1996). Of these, 90 are considered rare in Ontario, and four are found nowhere else (Nelson & Wilcox 1996). The region is also home to ten species of reptiles including five that are listed as either endangered or rare (Ashley et al. 2007), and over 260 species of birds have been identified by the Long Point Bird Observatory (Nelson & Wilcox 1996). General ecological concerns for the area include forest fragmentation, habitat loss, invasive species, shoreline alterations, nutrient loading, and impacts from recreation (Whitelaw et al. 2004)

The Long Point region is relatively rural, with a 2003 regional population of approximately 61,000 people (McCarthy et al. 2006; Edge & McAllister 2009). Early settlements were founded based on its timber and agriculture potential and the area remains predominately agricultural (Nelson & Wilcox 1996). However, the formerly large tobacco industry is in decline and recently experienced a federal buyout (Ottawa Citizen 2008), which has raised concerns over the loss of local agriculture and rural character (McCarthy et al. 2006). Resource extraction for natural gas and lumber, and the establishment of a commercial and recreational fishery, are newer but important economic activities (Nelson & Wilcox 1996).

The recreational and aesthetic qualities of the area were also recognized early and are now a major economic driver (Nelson & Wilcox 1996). In 1921 the province passed the *Long Point Act* designating the area as a park (Killan 1993) and in 1928 a causeway was built to link the point to the mainland (Nelson & Wilcox 1996). Nature-based tourism annually contributes nearly two million dollars to the local economy, and in 2003 there were a total of 130,000 visitors (Edge & McAllister 2009). There has also been a recent increase in retirees choosing to settle in the area (Edge & McAllister 2009; McCarthy et al. 2006). However, although the recreational and aesthetic qualities of the region are recognized, a 2001 government restructuring and amalgamation has decreased the government funding available for local conservation initiatives (Edge & McAllister 2009).

2.4.2 Environmental Organizations

Conservation planning and management in the Long Point region is provided by a variety of national, provincial, and regional organizations and agencies (Nelson & Wilcox 1996). This includes governments, civil society environmental organizations, and private groups. For instance, a large portion of the Point is owned by the Long Point Company, which is a private organization of recreational hunters that prohibit public access to their lands (Killan 1993). Other large protected areas include the Long Point and Big Creek National Wildlife Areas, which are administered by the Canadian Wildlife Service; Long Point Provincial Park and Crown Marsh, which are administered by the province; and a variety of regional protected areas which are administered by Norfolk County (Edge & McAllister 2009). Combined, there are 19 government agencies administrating over 22 plans and policies and an additional 30 stakeholder groups who play a role in the region's conservation initiatives (Craig et al. 2003).

Although a wide variety of environmental organizations and agencies operate in the Long Point region, this research was limited to the seven civil society environmental organizations that are described in table 2.2. Some of these groups were initially identified based on preliminary research of the area, while others were suggested by interview respondents as influencing the conservation initiatives in the area. Combined, they represent a mix of organizations that pursue different activities, have

Table 2.2 Characteristics of seven civil society-based environmental organizations operating within the Long Point region as described by mandate, activities, staffing, funding, and governance

Organization	Mandate/Goal	Activities	Staff/Funds	Governance
Long Point Basin Land Trust (LPBLT)	*Direct land preservation through acquisition and linking people with nature*	*Land Acquisition, Restoration, Monitoring, Education*	*Part-time Coordinator (Grant funded) + Volunteers*	*Board of Directors (volunteers)*
Norfolk Woodlot Owners Association (NWOA)	*Promote wise use and stewardship of Norfolk's woodlots*	*Restoration, Education*	*Coordinator (County funded) + Volunteers*	*Board of Directors (volunteer woodlot owners)*
Norfolk Land Stewardship Council (NLSC)	*Bring community-based stakeholders together to improve local stewardship and provide conservation tools*	*Coordinates and funds a variety of all types of stewardship projects*	*Coordinator (Gov't funded) + Volunteers*	*Stewardship Council (volunteers)*
Alternative Land Use Services Program (ALUS)	*Conserve and restore environmental benefits while respecting and rewarding farmers*	*Restoration, Education*	*Coordinator (Grant funded) + Volunteers*	*Partnership Advisory Committee/ Farmers*
Long Point World Biosphere Reserve Foundation (LPWBRF)	*Support biodiversity, conservation and sustainable communities in the Biosphere Reserve*	*Restoration, Monitoring, Education*	*Coordinator (Grant funded) + Volunteers*	*Board of Directors (volunteers)*
Long Point Region Conservation Authority (LPRCA)	*Provide for the conservation, restoration, development, and responsible management of water, land and natural habitats*	*Land Acquisition, Restoration, Monitoring, Education*	*Staff (Gov't + Internally funded)*	*Board of Directors (municipally appointed)*
Nature Conservancy of Canada (NCC)	*Direct protection of Canada's biodiversity through the acquisition of ecologically significant lands*	*Land Acquisition, Restoration, Monitoring, Education*	*Staff (Grant + Internally funded)*	*National and Regional level Board of Directors (paid staff)*

different forms of funding and governance, and operate at different scales. Although some of these organizations receive government funding, or have the support of government staff, all the organizations also source some funding elsewhere and operate outside a traditional government hierarchy by relying on either community volunteers or other civil society-based governance structures to make decisions. For these reasons, they are considered in this research as civil society environmental organizations. These organizations are described in greater detail in Appendix VI.

Although the majority of the decision-making and planning of these environmental organizations was locally autonomous, many of the organizations did have links to broader umbrella associations that provided some guidance and direction on broader policy. For instance, the Ontario Land Trust Alliance, the Ontario Woodlot Association, the Stewardship Network of Ontario, the UNESCO World Biosphere Program, and Conservation Ontario were associated with the Long Point Basin Land Trust, Norfolk Woodlot Owners Association, Norfolk Land Stewardship Council, Long Point World Biosphere Reserve Foundation, and Long Point Region Conservation Authority respectively. Where respondents referred to documents produced by these groups the documents were considered; however, the broader operations of these umbrella groups were outside the scope of the case study.

Similarly, respondents occasionally referred to documents published by the provincial or federal government; in these cases the documents were reviewed specifically because of their use by a civil society organization. Additionally, the Norfolk Field Naturalists were also referred to, but not included in this study since their interests and membership tended to overlap with the Long Point Basin Land Trust, with the Land Trust taking the more active role in conducting conservation activities. However, this overlap resulted in some documents published by the Naturalists being reviewed, since they were either used or produced by members of the Land Trust.

Chapter 3: Literature Review

The following literature review describes the characteristics of different forms of scientific knowledge, summarizes the history of interaction between stewardship science and conservation planning in Canada, and suggests how these interactions have produced certain trends in modern conservation planning and management. This research is synthesized in the final section to produce a conceptual framework that describes the processes that create scientific knowledge and its subsequent application to planning and management. The ideas presented here helped guide the research process and the analysis of the results (see chapters 2 and 5).

3.1 THE NATURE OF SCIENCE

The Merriam-Webster Dictionary describes science as "knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method" (2010). This definition includes two contentious, yet traditionally defining, aspects of science: the idea of truth and the idea of the scientific method. These ideas form the basis of a "social contract" where science is trusted as a means of generating reliable knowledge that will lead to societal benefits (Bocking 2004).

However, alternate considerations of science and a questioning of its underlying values have led to an examination of science's position within society, its inherent values, and how it relates to broader societal beliefs (Feyerbend 1978; Ackermann 1985; Boghossian 1996; Harding 1998; White 1999; Weber & Word 2001; Bäckstrand 2004; Larson 2005; Bocking 2005; Duncan 2006; Bocking 2007). This has resulted in greater acknowledgement of the social factors involved in producing and using scientific knowledge, and contested the idea of an absolute truth. It has also resulted in the identification of other forms of information such as traditional or locally-based ecological knowledge (Berkes et al. 2000; Huntington 2000; Olsson & Folke 2001; Yli-Pelkonen & Kohl 2005; Fazey et al. 2006).

The following section describes research-based "scientific knowledge" and locally-based "ecological knowledge," and considers how they interact to produce stewardship science (Yli-Pelkonen & Kohl 2005; Duncan 2006; Fazey et al. 2006). These characterizations and their interactions are used to develop a broader understanding and definition of the nature of stewardship science in modern society.

3.1.1 Characterizing "Scientific Knowledge"

Traditionally, science has been defined by the idea of a scientific method and the idea of truth. Combined, these ideas form a powerful ideology and have provided a rationale for the role of science in guiding societal actions (Weber & Word 2001;

Bocking 2004). When applied to conservation planning and management, this form of knowledge has been referred to as “ecological research information” (Yli-Pelkonen & Kohl 2005), “scientific knowledge” (Fazey et al. 2006), “scientific ecology” (Berkes et al. 2000), or “technoscience” (Callon 1999).

The scientific method consists of a set of approaches and values that are shared and agreed upon by scientists and are the foundation of scientific inquiry. Robert Merton provided an early description of these values and although they have since been summarized and debated by later authors they are still referred to as “Mertonian norms” (see Ackermann 1985; Bocking 2004; McOuat 2007). Generally, these norms centre on the shared values of universalism, communism of knowledge, disinterestedness, and skepticism (as described by McOuat 2007). Although these norms can be considered values unto themselves, they also create a distinct type of value. Lacey (1999) describes them as “cognitive values,” and argues that since they are based on worth and merit they still allow the impartiality, neutrality, and autonomy necessary to pursue scientific inquiry within the scientific method.

Weber and Word (2001) believe that the perceived impartiality of science’s underlying values creates a frame of reference that supports a broader authority for scientific, research-based knowledge. These values establish the credibility of science by supporting the belief that it can provide truthful, objective, and trustworthy knowledge (Bocking 2004). Bocking suggests that this perception is further enhanced by scientific communications that favour representations of Mertonian norms, such as universalism, objectivity and unanimity (Bocking 2004). As a result, scientific statements tend to focus on quantitative "hard facts" where consensus can be achieved rather than the implications of the results, and will also refer to previously established information and ideas to gain credibility (Bocking 2004). For example, when the study of "systems ecology" originated in the 1950s it gained authority by referring to "energy flows" and "budgets" within natural systems, which implicitly linked it to the established disciplines of physics and economics (Loo 2006).

Bocking (2004) further suggests that administrative agencies support this projection of science because it enhances their own power by privileging a certain type of knowledge. By defining an issue in terms of scientific knowledge while simultaneously controlling funding and access to scientific expertise, agencies can increase their own authority and power while maintaining the appearance of neutrality (Bocking 2004; Porter & Phillips 2007). This works to narrow any debate to purely scientific terms, masking any political, social or economic issues and implications (Bocking 2005; Skogstad & Hartley 2007). It also directs attention to specific areas; for example, the use of a term focuses debate onto issues that fit within that term, while the study of a specific species or ecosystem will draw attention to that species or system (Bocking 2004).

Philosophical approaches to science have also considered the scientific method and the internal processes that lead to the creation of scientific knowledge. Kuhn (1970) examined this process and drew attention to the concept of "paradigms," which are internal constraints on how science is performed based on the accumulation of past discoveries and practices. Kuhn (1970) argued that paradigms produce a type of "normal science" by defining the methods used, the standards of practice, and the questions a scientist asks. During normal science, scientists work as "puzzle solvers," by sorting the "puzzle pieces" of experiments and observations into paradigm-defined boxes (Kuhn 1970). Castel and Sismondo (2003) describe this world, and suggest how it plays a significant factor in shaping what topics are prioritized and the types of knowledge that are produced. For example, scientists may choose and evaluate their own research through discussion with colleagues, by imagining other scientists' critiques, and by considering responses from anonymous reviewers (Castel & Sismondo 2003). As a result, scientists are indoctrinated into a scientific community and the paradigm it uses; in this situation, changes to the dominant paradigm require alternate theories and only occur through revolutions (Kuhn 1970).

Mertonian norms and Kuhn's paradigms are both internal features of scientific practice that are based on the rationalist idea of an absolute truth (Marcum 2005). Although a scientist's own "cognitive limitations" may prevent him from achieving this truth, under this rationalist perspective absolute truth is still achievable and good science can discover it by using the scientific method (Kitcher 1993). However, this idea of absolute truth has been challenged by a variety of alternate approaches to science, which have brought greater attention to how external factors such as politics, economics, technology, and culture can influence the production and application of science (Feyerbend 1978; Ackermann 1985; Boghossian 1996, Harding 1998; Bocking 2007).

For instance, Feyerabend (1978) argues that "the history of science, after all, does not just consist of facts and conclusions drawn from facts. It also contains ideas, interpretation of facts, problems created by conflicting interpretations, mistakes, and so on" (p.229). This constructivist approach to science recognizes the role that external forces, such as socialization, cultural norms, and economic development can have, and argues that the test of science is not external truth, but internal consistency with its own theories (Bloor 1976). Ackermann (1985) similarly contested Kuhn's presentation of normal science, suggesting that it oversimplified the interaction of scientists and technology in creating science. He explained that "normal science as puzzle solving suggests wrongly that the pieces are given in advance" (p.30, Ackermann 1985), and proposed instead that theory comes from "data domains" that are defined technologically by instruments (Ackermann 1985).

Similarly, postmodern approaches to scientific processes have also dismissed the idea of an external pure truth in favour of a plurality of perspectives. They acknowledge other ways of knowing and consider each of these internally valid and consistent with the surrounding world (Boghossian 1996). For example, postmodern science embraces local observations and feminist and indigenous knowledge perspectives, with the belief that approaching a scientific problem from different angles will result in a different truth and express a different external world (Harding 1998).

3.1.2 Characterizing "Local Ecological Knowledge"

A "post-normal" science has begun to emerge in reaction to the increased understanding of the internal and external values of science, and the complexities of modern environmental issues (Bäckstrand 2004). Bäckstrand (2004) suggests that "problems such as climate change, [genetically modified organisms] or biodiversity, which are fraught with uncertainties, cannot be adequately resolved by resorting to the puzzle-solving exercise of Kuhnian normal science" (p.32). Instead, post-normal science draws on constructionist views to evaluate scientific findings within a world characterized by high decision stakes, large uncertainties, and intense value disputes (Bäckstrand 2004). As a result, the social world that science operates in has become fundamental to understanding its applications, as scientists seek to substantiate their claims and citizens question the relevancy of the scientists' work (Callon 1999; Bocking 2005; Bocking 2007).

This social environment has helped to legitimize other forms of information, as environmental practitioners seek to find the best available knowledge to address value-laden, complex, and uncertain environmental issues (Olsson & Folke 2001; Bäckstrand 2004; Yli-Pelkonen & Kohl 2005; Fazey et al. 2006). One example of this is a broader acceptance of information based on a person's or community's own experiences and observations (Callon 1999; Olsson & Folke 2001; Bäckstrand 2004; Yli-Pelkonen & Kohl 2005; Fazey et al. 2006). This type of knowledge is referred to as "local ecological knowledge" (Yli-Pelkonen & Kohl 2005), "lay knowledge" (Callon 1999), or "experiential knowledge" (Fazey et al. 2006), and is also sometimes associated with the idea of "traditional ecological knowledge" (Berkes et al. 2000; Huntington 2000).

Traditional ecological knowledge is generally connected with indigenous communities and refers to "a cumulative body of knowledge, practice, and belief, evolve[ed] by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (p.1252, Berkes et al. 2000). This form of knowledge is commonly recognized in international conservation management, but some of its principles are beginning to be applied in western societies (Huntington 2000; Olsson & Folke 2001; Yli-Pelkonen & Kohl 2005). In these situations, this form of experiential knowledge is described as "local ecological knowledge" and describes spatial, temporal, and situation-specific information collected over an individual's lifespan; as a result, it does not have the historical or cultural continuity of traditional ecological knowledge (Olsson & Folke 2001; Fazey et al. 2006). Generally, local ecological knowledge has been described as a way to supplement gaps in scientific knowledge, provide alternative interpretations of scientific data, improve management practices, and promote societal change through positive collaborations (Huntington 2000; Olsson & Folke 2001; Fazey et al. 2006; Duncan 2006).

Fazey et al. examined the nature of local ecological knowledge, and identified three internal subsets within it: explicit, implicit, and tacit knowledge (Fazey et al. 2006). "Explicit" knowledge is information that is articulated both quantitatively and qualitatively, although Fazey et al. (2006) suggest that it is often most valuable when described qualitatively because of its associated context. "Implicit" ecological knowledge refers to information that is not articulated, although it can be if necessary (Fazey et al. 2006). Finally, Fazey et al. (2006) describe a third type of "tacit" knowledge, which cannot be articulated but can still influence decision-making.

Combined, explicit, implicit, and tacit knowledge interact to produce "mental models" that individuals use to recognize emergent properties in an environmental system or make predications (Fazey et al. 2006). Berkes et al. (2000) compared this process to adaptive management, suggesting how qualitative observation-based feedback can be used to adapt to complex and dynamic changes. A study of Swedish fishermen supported this comparison by demonstrating how local management practices could increase resiliency by directing decisions in periods of crisis or change (Olsson & Folke 2001). Similarly, Fazey et al. (2006) suggest that examining the creation of local ecological knowledge increases our ability to understand complex environmental systems.

Although the perceived legitimacy of local ecological knowledge in management has increased, there are limitations in its use (Huntington 2000; Yli-Pelkonen & Kohl 2005; Fazey et al. 2006). For instance, a variety of abilities within local knowledge can exist, and not all local knowledge may be accurate (Huntington 2000; Yli-Pelkonen and Kohl 2005). Similarly, Fazey et al. (2006) suggest that developing a place-based "expert knowledge" generally takes at least ten years. Additionally, although local ecological knowledge can be effectively applied to management, it also has the potential to be intensely emotional and value-laden (Yli-Pelkonen & Kohl 2005), and since it is context-dependent its value can be significantly decreased if it becomes isolated (Fazey et al. 2006).

3.1.3 The Production and Application of Knowledge

Although there are unique features to both scientific information and local ecological information, the boundary between the two has been criticized as an artificial construct (Callon 1999), since a variety of personal and community values and factors interact when knowledge is applied (White 1999; Weber & Word 2001; Larson 2005; Bocking 2005; Yli-Pelkonen & Kohl 2005; Duncan 2006; Fazey et al. 2006; Bocking 2007).

For instance, the application of any form of knowledge depends heavily on communication, which is shaped by an individual's personal judgments of usefulness, credibility, and interest (Weber & Word 2001). As a result, the scale, language, and imagery used to describe an issue reflect certain values, and can therefore affect the way a problem is perceived and the solutions that are applied (White 1999; Larson 2005; Duncan 2006). For example, an exploration of how science was used to describe potential development on the Oak Ridges Moraine demonstrated how a variety of scientific experts were used by different interest groups, and suggested that each group's expert shaped the issue, and the science, to emphasize certain values and opinions (Bocking 2005). Similarly, a study of the American-Canadian "salmon wars" dispute indicated how describing the system at varying scales presented different stories of the fish, fisherman, and surrounding players, and therefore focused attention on different aspects of the issue (White 1999).

Bocking (2007) describes the interactions within and surrounding science as a "disciplinary space," and suggests that this space produces certain methods and concepts that are inherently tied to the environment that shapes them. Landscapes, he suggests, can attract certain types of researchers, with certain research questions, and also provide unique social, political, and economic barriers and opportunities (Bocking 2007). Consequently, within the disciplinary space, scientific and local information interact with cognitive and social factors to create knowledge (Bocking 2007). Bocking examined two examples of northern research to support this idea, demonstrating how shifts in the perception of the environment, changing economic bases, technological improvements, and evolving scientific methods all impacted the design and outcomes of scientific studies (Bocking 2007).

Scientific and local ecological information can also directly interact. Yli-Pelkonen and Kohl propose (2005) that in westernized societies scientific knowledge is so pervasive that any form of local ecological knowledge invariably reflects some scientific information (see also Olsson & Folke 2001). Consequently, they suggest that in western societies, local ecological knowledge is better considered as a blend of a person's general scientific knowledge combined with local observations and experiences (Yli-Pelkonen & Kohl 2005). Fazey et al. (2006) similarly argue that scientific research is just another form of experience that contributes to an individual's knowledge, and expanded their definition of local ecological knowledge accordingly to suggest that it is "derived from a mixture of research, work, educational, and personal experience" (p.8). They further contend that implicit and tacit ecological knowledge play an important role in guiding scientific research and practice by identifying problems, shaping how they are understood, and determining actions (Fazey et al. 2006).

As a result, although they have distinct features, the interactions between scientific and local ecological information used in conservation planning and management may be better understood as an ongoing construction of a "stewardship science," which integrates information based on its credibility and usefulness. Callon (1999) suggests three models of how these two forms of information may interact to create credible and applicable knowledge. Figure 3.1 illustrates these models and applies them to a conservation planning context by indicating the relative importance of local ecological information and scientific information in producing stewardship science.

In the “Public Education” (M1) model scientists teach the public and effective communication of science is necessary for credible decisions (Callon 1999). In the “Public Debate” (M2) model, community knowledge is shared in a public arena and can be used to enhance incomplete scientific knowledge; in this model credibility is achieved through full representation and expression in the participation process (Callon 1999). Both the M1 and M2 models clearly demarcate a difference between scientific and local ecological knowledge (Callon 1999). In the final “Co-Production of Knowledge” (M3) model this boundary is blurred as communities become actively involved in the production of knowledge; in this model credibility is inherently achieved through the collaboration process (Callon 1999). Subsequently, the M3 model has the largest potential to incorporate local ecological knowledge in decision-making while the M1 model has the least.

Callon (1999) suggests that although all three models can operate in a situation, the third model, M3, has the most potential to achieve credible decisions. As such, he indicates that it is important to understand its functions and conditions of diffusion

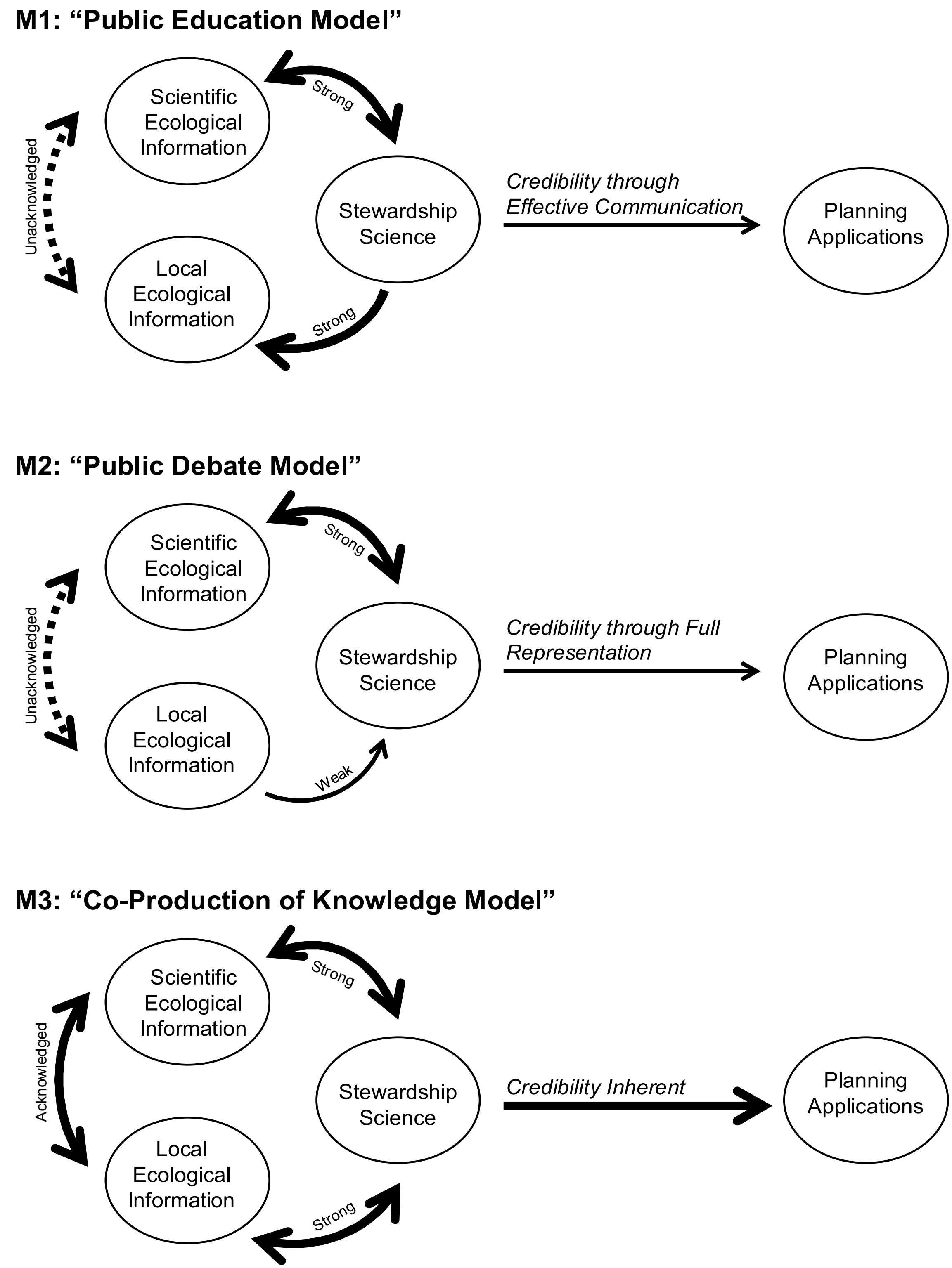


Figure 3.1 Three models of knowledge production and dissemination (based on Callon 1999 and Yli-Pelkonen & Kohl 2005). The M1 model indicates a reliance on education to promote the credibility of scientific information; M2 indicates the potential role of local information in supplementing scientific information; and M3 describes how local and scientific information can interact to produce inherently credible science.

(Callon 1999). Yli-Pelkonen and Kohl (2005) applied these models to local environmental planning processes in Helsinki, and suggested that local ecological knowledge had the strongest influence on decisions, and the M3 model was most present, in situations where scientific knowledge was scarce or lacking.

3.2 SCIENCE AND CONSERVATION PLANNING IN CANADA

The interactions between science, society, and stewardship activities have changed through time, as have their influence on conservation planning. Initially, stewardship science and conservation initiatives were locally-driven, but the government now plays a much larger role in setting policy and conducting science (Bocking 2001; Loo 2006). Science today is used for a variety of purposes including research, monitoring and assessment, indicator development, and reporting (Doern 2000). Loo (2006) suggests that the "growth of government conservation over the twentieth century and the hegemony of scientific management" (p.6) is the defining trend in Canadian conservation, with "ecosystems thinking" and new ideas from ecology providing a basis for most of the latter half of the century's environmental practices.

The influence of science has changed, however, as public perceptions of science have changed. Although science was once seen as an authoritative source of knowledge, mistrust over the privatization of government science, increasing recognition of the limitations of science, and concern over its institutionalized function in creating policy have led to a stronger public role in the shaping of science and debates over its place in policy formation (Bocking 2004; Bäckstrand 2004; Skogstad & Hartley 2007). Public interest in conservation has also grown over this period, as people have become more concerned about environmental issues and the associated planning and policy, with a resulting increase in civil society-based environmental organizations and a similar increase in their influence on conservation planning (Bocking 2001; Whitelaw 2005; Conrad & Daoust 2008; Dempsey & Dearden 2009).

The following section describes different eras in the history of stewardship science and conservation planning, explores the growth of civil society-based environmental activities, and suggests some emerging conservation issues and trends.

3.2.1 Eras of Canadian Conservation Planning

The following section briefly describes five eras of Canadian conservation planning with an emphasis on Ontario, and suggests how stewardship science has interacted with protected area management and other stewardship initiatives to shape conservation planning. This section concludes with a timeline that outlines key events within each era (see figure 3.2, at the end of this section). Additional descriptions of each of the early eras are located in Appendix VII.

The first "Parks and Resources" era took place from the late nineteenth to early twentieth century and was characterized by a strong lead from civil society, the creation of parks, and an emphasis on resource management. Citizen naturalists, hunters, and trappers were a driving factor behind stewardship science and many resource management activities during this period (Bocking 2001; Loo 2007). For instance, naturalists and other citizen scientists were involved in collecting, categorizing, and identifying species and subspecies (Kohler 2006) while Ducks Unlimited was established by recreational hunters to restore and manage waterfowl breeding grounds (Loo 2007). Additionally, increasing industrial and urban development had triggered declines in fish and wildlife populations, and public demand to protect these species led to Ontario's provincial government passing its first *Provincial Parks Act* in 1913 to protect natural areas (Killan 1993).

At the end of the Second World War the federal and provincial governments began to play an increasing role in stewardship science and conservation planning, with a new focus on using research to manage systems for productivity and profit (Bocking 1997; Loo 2007; Daniels 2009). This led to a new era of "Scientization and Economic Productivity." For example, in 1945 the federal government began a commercial bison cull in national parks using ecology-based theories of game management (Loo 2007). Similarly, Ontario's Conservation Authorities were created to mitigate flood risks to protect floodplain resources and implicitly promote economic development (Shrubsole 1996). This period was also characterized by a new public interest in outdoor recreation. A wildlife ethic was popularized and both national and provincial park visitation saw substantial increases (Loo 2007). To meet provincial demand, Ontario passed a new *Provincial Parks Act* that focused on creating more parks, providing better amenities, and promoting tourism, while the Conservation Authorities broadened their mandate to explicitly include planning for recreation (Killan 1993).

Public interest continued into the 1960s, with an era of “Protection and Regulation” that was characterized by both a strong public interest and a strong government role. This period saw an increased public understanding and awareness of ecological principles and the interconnectedness of natural systems (Bocking 2004; Loo 2007). Consequently, conservation and stewardship initiatives shifted from utilitarian arguments and began to value “wilderness for its own sake” (Warecki 2000), with a new interest in “non-profitable” species and landscapes, such as wetlands, deserts, macro-predators, and songbirds (Killan 1993; Bocking 2001; Bocking 2004). For instance, Ontario’s provincial parks planning moved to a new classification system that completely protected certain “wilderness areas” (Killan 1993; Warecki 2000). This period also saw the emergence of larger civil society based environmental organizations. For instance, the Canadian Parks and Wilderness Society, World Wildlife Fund Canada, and the Nature Conservancy of Canada were all founded to represent the public’s new environmental interests (Bocking 2001).

During the 1970's, conservation through ecological management remained a public priority, although concerns about pollution shifted the focus from the health of the natural environment to human health (Bocking 1997). This began a period of institutionalized government regulation and a hierarchical "command-and-control" style of conservation planning (Bocking 2001; Daniels 2009). For example, the *Marine Mammal Protection Act*, *Canada Wildlife Act*, and *Endangered Species Act* all lent protection to Canada's wildlife (Bocking 2001), while Ontario's *Niagara Escarpment Planning and Development Act* was passed to protect landscape features (Hodge & Gordon 2008). Environment Canada was formed in 1971, and Ontario's Ministry of Environment was formed in 1972 (Bocking 2001; OMOE 2007). Additionally, concern over the environmental consequences of development projects led to a federal "Environmental Assessment Review Process" Guidelines Order and in 1975 Ontario passed its own *Environmental Assessment Act* (Noble 2010).

The 1980s and 1990s launched a new era of "Global Environmentalism," that began with a backlash against the "command and control" style of top-down government regulation and a corresponding decrease in government-mandated controls (Daniels 2009). An educated public increasingly questioned government science, and there were substantial cuts to government science funding (Doern 2000). This decrease led to greater citizen involvement in conservation initiatives as civil society environmental organizations emerged to fill the void left by diminished government involvement (Bocking 2002; Whitelaw et al. 2003; Skogstad & Hartley 2007; Daniels

2009; Edge & McAllister 2009). Additionally, the introduction of the concepts of sustainability and biodiversity brought a resurgence of public interest in habitat and ecosystem protection, and recognition of the global implications of environmental practices (Hanna et al. 2008; Bocking 2001). In response to this lobby, the number of federal and provincial protected areas significantly increased during the 1990s (Killan 1993; Dearden & Dempsey 2004).

Many of the recent trends in science and conservation remain current today, and Phillips (2003) suggests that they form the basis for a "Modern Paradigm" of conservation planning. This paradigm embeds science-based management, but is also influenced by a strong public role, and the principles of sustainability (Phillips 2003; Francis 2008). This paradigm will be explored in detail in the following section as its characteristics are most relevant to current conservation planning.

Parks and Resources

Park Creation, Resource Management, Industry & Individuals Lead

Event	Year	Decade	Year	Event
		1800s	1885	Banff National Park established
			1909	Canadian Commission of Conservation established
			1909	Game wardens hired for national parks
Migratory Birds Convention Act passed (Canada/USA)	1916	1910s	1913	*Provincial Parks Act* passed (ON)
		1920s	1921	Canadian Commission of Conservation disbanded
Canadian government standardizes bird banding	1922		1921	Long Pont Provincial Park established
			1927	Charles Elton publishes *Animal Ecology*
Ducks Unlimited established	1938	1930s	1933	HBC establishes The Rupert House Beaver Preserve

Scientization and Economic Productivity

Scientization of Government, Managing for Productivity, Increasing Park Visitation

Event	Year	Decade	Year	Event
National Park attendance 500,000 people	1940	1940s	1941	Guelph Conference
Conservation Authorities Act passed (ON)	1946		1945	Federal Government begins commercial bison cull in national parks
			1947	Dominion Wildlife Service (CWS) formed
National Park attendance 2 million people	1950	1950s	1959	Provincial Park classification scheme created
Provincial Parks Act (ON) revised	1954		1959	*Wilderness Areas Act* passed (ON)

Protection and Regulation

Public Interest in Ecology, Creation of NGOs, Strong Government Role, Strong Regulations

Event	Year	Decade	Year	Event
National Park attendance 5.5 million people	1960	1960s	1961	"Resources for Tomorrow" Conference
			1961	35 "Wilderness Areas" created in Ontario
Rachel Carson publishes *Silent Spring*	1962		1963	Canadian Parks and Wilderness Society founded
			1965	Classification/Zoning policies introduced to Ontario parks
Science Council of Canada created	1966		1965	Canada Land Inventory established
			1967	World Wildlife Fund-Canada founded
CWS begins first national "songbird" survey	1968		1969	Ian McHarg publishes *Design with Nature*
Marine Mammal Protection Act passed (federal)	1972	1970s	1973	*Canadian Wildlife Act* passed (federal)
Ministry of Environment created (ON)	1972		1973	*Endangered Species Act* passed (federal)
			1973	*Niagara Escarpment Planning and Development Act* passed (ON)
Federation of ON Naturalists grows to 42 member groups	1976		1973	"Environmental Assessment Review Process" Guidelines Order (federal)
National Wildlife Research Centre established	1976		1975	*Environmental Assessment Act* passed (ON)
ON Parks Planning and Management Policies manual (ON)	1978		1977	COSEWIC created

Global Environmentalism

Anti-Government Backlash, Global Issues, Civic Science, Private Initiatives

Event	Year	Decade	Year	Event
Michael Hough publishes *City Form and Natural Process*	1984	1980s	1987	Brundtland Commission publishes *Our Common Future*
National Forum on Biodiversity (USA)	1986		1987	Federation of ON Naturalists releases first Breeding Bird Atlas
			1989	Bringing Back the Don citizen task group formed
Rio Earth Summit	1992	1990s	1993	Canadian Biodiversity Strategy (federal)
Environment Canada establishes EMAN	1994		1995	*Canadian Environmental Assessment Act* passed (federal)
Ottawa Greenbelt Plan	1996		1995	National Parks Policy revised to focus on ecological integrity

The Modern Paradigm

Science-based Management, Collaboration, Integration

Event	Year	Decade	Year	Event
National Parks corporate restructuring	2000	2000s	2001	Federation of ON Naturalists starts second Breeding Bird Atlas
Canada ratifies the Kyoto Protocol	2002		2003	*Species At Risk Act* passed (federal)
			2007	*Endangered Species Act* passed (ON)

Figure 2.2 Conceptual timeline of the eras of interaction between stewardship science and conservation planning in Canada with an emphasis on Ontario (based on ideas from Bocking 2001; Loo 2006; Kohler 2006; Doern & Kinder 2007; Skogstad & Hartley 2007; Hodge & Gordon 2008; Francis 2008; Daniels 2009).

3.2.2 The Influence of Civil Society Environmental Organizations

In this research, civil society-based environmental organizations refer to organizations that lack the "authority of the state…[and are] motivated by objectives other than profit making" (p.4-5, Swift 1999). These organizations "operate under the environmental banner, and work toward societal change through influencing government, business and cultural values" (p.33, Whitelaw 2005).

In Canada, many civil society environmental organizations emerged in the 1960s in response to public environmental interest (Bocking 2001), and again expanded in the 1990s due to the resurging interest in global environmental concerns and the diminished role of government-led conservation activities (Whitelaw et al. 2003; Conrad & Daoust 2008). During this period, some of the larger organizations began to link with corporations, foundations, and national agencies to increase their political power to affect national and international policy domains (Bocking 2004; Dempsey & Dearden 2009). There was also a parallel increase in smaller organizations that maintained their community ties and focused solely on local and regional concerns (Bocking 2004). Today, civil society environmental organizations include a wide range of "voluntary associations, non-government organizations, student activists, scientists, researchers, professionals, and citizens' committees" (p.30, Ahmed 1999).

The increasing prevalence and influence of civil society environmental organizations is a major development in modern conservation activities, and Dempsey and Dearden propose that it reflects a broader neo-liberal trend within government, which emphasizes voluntary, self-regulating approaches and private initiatives (2009). Whitelaw (2005), based on Simmons (1998), suggests that these organizations influence planning activities by setting conservation agendas, negotiating actions, conferring legitimacy, and implementing solutions. Three specific activities that civil society organizations are engaged in that are shaping current conservation planning are the establishment of community-based environmental monitoring programs, the formation of civil society-based land trusts that can acquire property, and the promotion of stewardship and habitat restoration programs.

During the 1990s, community-based environmental monitoring programs emerged to fill the void left by decreased government-led monitoring (Whitelaw et al. 2003; Conrad & Daoust 2008). For instance, the Ecological Monitoring and Assessment Network (EMAN) was created in 1994 by Environment Canada to facilitate multi-party collaboration on long-term ecological monitoring (Environment Canada 2009), while Ontario's "Citizens Environment Watch" linked community monitoring programs with universities that could provide technical assistance such as training and equipment (Conrad 2006). Involving communities in monitoring programs became a popular way to meet the increasing demands for science-based information, engage an environmentally interested public, and include stakeholders in management decisions (Whitelaw et al. 2003; Conrad & Daoust 2008; Dempsey & Dearden 2009). By employing their own scientists and conducting their own studies, citizen organizations also began to build their own knowledge and increase their capacity to engage in science debates (see Bocking 2005 for an example of how citizen organizations were able to contest industry science).

The 1990s also saw the formation of civil society-based "land trusts" that independently purchased or negotiated measures for private land protection (Merenlender et al. 2004). Land trust protection takes the form of legal agreements, direct acquisitions, or pre-acquisitions that are subsequently passed on to another agency to manage (Merenlender et al. 2004). In Ontario, the number of land trusts grew from 13 to 36 in the last decade, and there are now over 200 operating in Canada (Dempsey & Dearden 2009). Their popularity is partly attributed to their flexibility and emphasis on direct action, since they can target the areas they deem most valuable to produce tangible, place-based outcomes in the communities where they work (Brewer 2003; Merenlender et al. 2004). In some cases, land trust purchases are supported by government funding (Dempsey & Dearden 2009). However, many land trusts are also forced to operate opportunistically, purchasing properties based on financial realities and availability rather than scientific principles (Newburn et al. 2005). This has raised concerns over the aggregated nature of land trust management and the lack of systematic purchasing (Brewer 2003; Merenlender et al. 2004; Murphy & Noon 2007). There are also concerns over the social equity of their purchases, since decisions can be made without public accountability or community participation (Fairfax et al. 2005; Reed 2007; Dempsey & Dearden 2009).

A final trend in civil society conservation activities are community stewardship and habitat restoration programs (Wilcove & Lee 2003; Merenlender et al. 2004; Dempsey & Dearden 2009). These programs tend to target private landowners, and provide technical assistance, recognition, or incentives to assist an individual's environmental efforts (Dempsey & Dearden 2009). In Canada, a variety of programs from many different agencies have emerged to promote these activities. For example, farming and conservation agencies are pilot-testing the Alternative Land Use Services program, which provides incentives to farmers who provide ecological services, while a range of programs exist to support reforestation by landowners (see Appendix VI for more information on how these programs operate in the Long Point region).

3.2.3 Emerging Issues

Recently emerging issues and trends are also shaping modern stewardship activities and have the potential to affect future conservation planning. For instance, species at risk and climate change have both emerged as major federal and international issues that are addressed through global, national, and provincial agreements and legislation (Kerr & Cihlar 2004; Venter et al. 2006; Theberge & Theberge 2009; Wiens & Bachelet 2010), while advancements in technology are providing tools that assist conservation planning and knowledge sharing (Quinn & Alexander 2008; Daniels 2009).

Although species-at-risk have been recognized since the 1973 *Endangered Species Act*, they have recently gained increased legal backing and government protection through the 2003 federal *Species at Risk Act*, and Ontario's 2007 *Endangered Species Act*. Habitat loss is considered one of the biggest threats to these species (Venter et al. 2006), and scientists are drawing attention to the need to build stronger and larger networks of protected areas to assist in their protection and recovery (Kerr & Cihlar 2004). As a result, there is increasing attention on integrating species-at-risk science with protected area design and management, and in finding alternative forms of protection that may operate outside of designated protected areas (Deguise & Kerr 2006). Government interest has contributed funding to these initiatives; for example, Ontario pledged $18 million, over four years, for species-at-risk stewardship projects that support the *Endangered Species Act* (OMNR 2008).

Climate change is another nationally important environmental issue supported by international agreements such as the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Copenhagen Accord. As a result, there are increasing efforts to consider the potential management implications of different climate regimes, and the need to plan for dynamic vegetation models (Hanna et al. 2002; Lemieux & Scott 2005). However, much of the current research focuses on broad scale atmospheric and vegetative trends, since influences from local land cover and topography are difficult to accurately model (Wiens & Bachelet 2010). As a result, although there is discussion and research, this is not yet translating into management actions (Theberge & Theberge 2009). Subsequently, there is interest in developing ways to effectively downscale climate models so they can influence local-level conservation planning (Wiens & Bachelet 2010). One example of this may be the Canadian Biosphere Reserves Association's "Climate Change Initiative," which provides local climate data to Biosphere Reserve communities to allow them to better understand and adapt to potential changes (Hamilton et al. 2001).

Advancements in technology are also influencing modern conservation by providing increasingly accessible tools that can integrate a variety of concerns at a variety of scales, and facilitate the exchange of information (Drummond & French 2008; Quinn & Alexander 2008; Daniels 2009). For instance, technology-based mapping, which includes mapping through satellite imagery, geographic information systems (GIS), and environmental information systems (EIS), allows users to synthesize information at multiple scales, rapidly assess species and habitat associations, and create predictive models to aid management (Quinn & Alexander 2008). This provides a method of referencing locally important sites within a broader context, which bridges the gap between protected area design theory and land use planning practices, and facilitates a systems approach to planning that includes adaptive and dynamic processes (Quinn & Alexander 2008). For example, the Nature Conservancy of Canada has recently implemented a GIS mapping-based approach to prioritize land acquisitions and management objectives that uses both coarse and fine scale data (NCC 2009a).

Technology-based mapping is also a popular way of integrating local ecological knowledge to support complex community decision-making (Bojórquez-Tapia et al. 2001) and empower citizens and communities (Ceccato & Snickars 2000; Duncan 2006). Other technological advancements have facilitated this trend in knowledge sharing and collaboration. For example, online distributed platforms such as Google Earth, Wikimaps, or the new Google Wave, allow data collaboration from different locations, and have the ability for a variety of dispersed users to simultaneously upload, access, and edit shared information. Similarly, Ontario's Centre for Community Mapping is another recently developed web-based collaboration tool that supports partnerships between geographic and virtual communities (COMAP 2010). In 2007 they launched a Stewardship Tracking System, and are also involved with environmental projects that link to climate change and sustainable development, such as ecosystem restoration, biodiversity monitoring, and ecosystem goods and services accounting (COMAP 2010).

3.3 A MODERN PARADIGM OF CONSERVATION PLANNING AND MANAGEMENT

The history of stewardship science and conservation planning has undergone shifts in who conducted the science, the role of government, and the role of citizens. Science-based management is now widely accepted and the ideas of sustainability and community participation have integrated social and economic needs with environmental protection in conservation planning (Phillips 2003; Hodge & Gordon 2008; Francis 2008; Theberge & Theberge 2009). Theberge and Theberge (2009) suggest that "today's park biologists and managers need not only be fluent in the application of ecological theory to park management, but also must be comfortable in the art of collaboration, negotiation, and communication with other agencies and stakeholders in the region" (p.105).

Combined, these ideas form the basis of a "modern paradigm" of conservation planning and management (Phillips 2003; Francis 2008). Although this paradigm was initially described in the context of protected area planning (see Phillips 2003), its emphasis on community integration and collaboration make it equally applicable to the broader ideas of conservation planning, which also encompass stewardship activities such as restoration and monitoring. The following table (table 3.1) outlines its features with respect to protected area planning, while the following sections describe its broader applicability and principles, specifically its emphasis on science-based management, collaboration, and social and economic integration.

Table 3.1 Characteristics of the "Modern Paradigm" of conservation planning with respect to protected area management (adapted from p.6, Phillips 2003).

Characteristics	New Paradigm	Old Paradigm
Objectives	*Often set up for scientific, economic, cultural reasons* *Tourism a means to help local economies* *Valued for the cultural importance of so-called "wilderness"* *About protection, restoration and rehabilitation* *Conservation, social and economic objectives*	*Established mainly for spectacular wildlife and scenic protection* *Managed mainly for visitors and tourists* *Valued as wilderness* *About protection* *Conservation objectives*
Wider Context	*Planned as part of a national, regional and international system* *Managed as "networks" (strictly protected cores, buffered and linked by green corridors)*	*Developed in isolation* *Managed as "islands"*
Governance	*Run by many partners* *Draws on local knowledge* *Planned and managed with, for, and/or by local people* *Managed by multi-skilled individuals*	*Run by central government* *Expert-led* *Planned and managed without local people* *Managed by scientists and natural resource experts*
Management Techniques	*Politically sensitive decisions* *Managed to meet the needs of local people* *Managed adaptively*	*Technocratic decisions* *Managed without regard to local opinions* *Managed reactively within short timescales*
Perceptions	*Viewed as a community and national asset* *Viewed as an international and national concern*	*Viewed primarily as a government asset* *Viewed only as a government concern*
Finance	*Paid for from many sources*	*Paid for by taxpayer*

3.3.1 Science-based Management

Measures to protect and enhance biodiversity are now considered a fundamental aspect of modern conservation planning, and rely on a variety of principles derived from ecological theory such as systems thinking, conservation biology, and landscape ecology (Phillips 2003; Francis 2008; Slocombe & Dearden 2009). Two concepts employed in Canada that represent this approach are ecosystem-based management and the concept of ecological integrity, which are both considered key to the effective protection of the natural environment (Theberge & Theberge 2009).

Ecosystem-based management is a form of management that arose through recognition of "the need for a more regional, multi-stakeholder, science-based, and collaborative approach" (p.342, Slocombe & Dearden 2009), and Whitelaw (2005) suggests that it represents a conceptual shift within conservation planning. Although ecosystem-based management is commonly linked with protected area management, in Ontario it has also been used to develop a regional natural heritage system through a privately-owned landscape (Whitelaw & Eagles 2007). Overall, the model is seen as a way to create transparent decisions that are both scientifically and politically defensible (Slocombe & Dearden 2009). It is a fundamental feature of the modern paradigm of conservation planning, and can be considered as a convergence of multiple-use management, integrated resource management, watershed management, and comprehensive regional land-use planning (Slocombe & Dearden 2009). Its principles include the use of:

- biophysical boundaries
- science as a basis for management
- collaborative and participatory processes
- explicit management goals such as ecological integrity, biodiversity maintenance, and system sustainability (Slocombe & Dearden 2009)

Ecological integrity is fundamentally linked with ecosystem-based management, and signifies a shift from the protectionist “fortress conservation” of the 1980s to a model that encourages active management to meet science-based conservation goals (Hanna et al. 2008; Clark et al. 2008; Slocombe & Dearden 2009; Woodley 2009). Managing for ecological integrity draws heavily on ecosystem science by recognizing systems as dynamic and considers the processes, species composition, community structure, resistance to disturbance, and system resiliency of an area (Woodley 2009). Generally, it seeks to maintain and restore ecological functions, integrity, and system sustainability (Woodley 2009). In Canada, management for ecological integrity has attempted to address issues such as hyper-abundant populations, alien and exotic species, fire, and habitat degradation (Woodley 2009).

Ecological integrity is also commonly linked with restoration ecology, as both attempt to actively address system functioning, and are derived from similar ecological ideas such as landscape ecology, population dynamics, and alternate system states (Burke &

Mitchell 2007; Woodley 2009). Other scientific approaches now commonly employed in conservation planning include the representation of native ecosystem types, maintenance of viable populations, maintenance of ecological and evolutionary processes, and the importance of unique or rare species (Theberge & Theberge 2009). Regional context, scale, and landscape connectivity are similarly considered, and are assisted by landscape mapping and GIS modeling tools (Quinn & Alexander 2008; Theberg & Theberge 2009). Additionally, recognition of the uncertainty within science has led to a subsequent emphasis on catastrophe theory and resiliency, adaptive management, and mitigating and adapting to environmental variations such as climate change (Quinn & Alexander 2008; Theberge & Theberge 2009).

3.3.2 Collaboration

Partnerships between governments, industry, private organizations and agencies, and communities are another aspect of the new paradigm of conservation planning and management (Phillips 2003; Francis 2008), and correspond with the shift in planning towards more collaborative approaches. Generally, collaborations in conservation planning are a way for stakeholders to empower themselves in the decision-making process, and in some cases are also a reaction to perceived deficiencies in government-led approaches (Bocking 2002; Brewer 2003; Whitelaw et al. 2003; Bäckstrand 2004; Conrad & Daoust 2008; Skogstad & Hartley 2007; Dempsey & Dearden 2009).

Collaborative planning is a process that diffuses power and responsibility among different stakeholder groups through partnerships that mutually define problems, set agendas, and implement actions (Margerum 2002). Collaboration is seen as a way to resolve conflicts and improve stakeholder capacity (Frame et al. 2004). It can also produce acceptable actions that are easier to implement since stakeholders have developed a "shared intellectual capital including agreement on data or analysis, definitions of a problem or objective, and mutual understanding of each other's interests" (p.60, Frame et al. 2004). Healey (1998) suggests five key elements to collaborative planning:

1) Integrative place making that breaks down silos
2) Collaboration in policy making by different stakeholders
3) Inclusive stakeholder involvement leading to mutual learning and consensus building
4) Use of local or practical knowledge
5) Building relational resources that facilitate shared communication

Additionally, Whitelaw (2005) further suggests a sixth element of how collaborative partnerships with civil society environmental organizations create flexibility that can drive change and innovation (p.173).

In Canada, conservation planning collaborations with civil society have taken the form of civic science initiatives (Whitelaw et al. 2003; Bäckstrand 2004; Bocking 2005; Doern & Kinder 2007; Conrad & Daoust 2008; Skogstad & Hartley 2007), and land acquisition and stewardship programs (Reed 2007; Dempsey & Dearden 2009).

Civic science, which includes community-based monitoring, is based in collaboration and knowledge sharing between citizens and scientists (Bäckstrand 2004). For example, the National Wildlife Research Centre routinely uses surveys collected by volunteer birders as a basis for management recommendations (Doern & Kinder 2007). Doern and Kinder (2007) suggest that these types of partnerships can be mutually beneficial since community organizations are able to solicit funding and donations for "interesting" projects, while government agencies are able to contribute support to "less-interesting" long-term projects and provide technical support for data management and analysis. They also allow communities to draw attention to locally important issues through data collection (Conrad & Daoust 2008). However, there is often still a gap in the application of civic science data, and in many cases community-based monitoring programs have difficulty finding the appropriate channels to influence broader policies (Whitelaw et al. 2003; Danielsen et al. 2005; Milne et al. 2006; Conrad & Daoust 2008).

Land acquisition and stewardship programs are another collaborative approach to conservation planning. Their emergence is partly attributed to an increasing awareness that existing protected areas may not be enough to preserve biodiversity, and that collaborations are necessary to promote protection throughout the landscape (Wilcove & Lee 2003; Merenlender et al. 2004; Deguise & Kerr 2006; Dempsey & Dearden 2009). For instance, Ontario's government has funded a network of "Land Stewardship Councils" that support local, community-based stewardship initiatives

(OMNR 2007). Civil society-led land trust acquisitions also tend to involve creative partnerships with governments, communities, and other agencies (Dempsey & Dearden 2009) and Fairfax et al. (2005) suggest that these types of projects blur the line between public and private management. For instance, the Ontario government provides money to the Nature Conservancy of Canada to acquire lands for conservation, but these acquisitions happen outside the official provincial parks and protected areas system (Dempsey & Dearden 2009).

3.3.3 Integration

Finally, the concept of integrating social, economic, and environmental issues remains an important trend in modern conservation planning and is tied to both the ideas of science-based management and collaboration (Francis 2008). Although this concept was first popularized internationally, through the promotion of sustainability by the Brundtland Commission, it has gained recognition at local and regional levels as a comprehensive way to address a variety of concerns within a locally-adaptive framework (Bäckstrand 2004). An integrated approach provides a way to reconcile conservation objectives with the needs of people living in, or beside, protected areas (Francis 2008), and can also be used to promote other stewardship activities.

For example, UNESCO's Biosphere Reserve program is underscored by environmental protection but also encourages sustainable economic and community development in the adjacent region (UNESCO 2009). Economic and social integration are also an important aspect of many stewardship programs. For instance, the Alternative Land Use Services program pays farmers to provide ecological services (Reid & Bailey 2004), while the Conservation Land Tax Incentive Program provides tax breaks to landowners who protect eligible natural areas of their properties (OMNR 2009). Both these programs support existing community practices while simultaneously strengthening local economies and environmental conservation. Similarly, "ecological restoration," can be applied to both protected and productive landscapes to enhance ecological values, restore degraded sites, and improve productivity (Hobbs & Norton 1996; Burke & Mitchell 2007). Its popularity as a local conservation response is attributed to this practical ability to integrate productivity with ecological aims, which produce both social and economic benefits (Hobbs & Norton 1996).

3.4 CONCEPTUAL FRAMEWORK FOR RESEARCH

The interactions between stewardship science and conservation planning have changed through time, and affect the types of activities that are done; the role of communities, governments, and other agencies in conservation; and the relative influence of local and research-based knowledge on decision-making. Currently, they are interacting to produce a paradigm of protected area planning that embeds science-based management, collaboration, and social and economic integration (Phillips 2003; Francis 2008). This paradigm is broadly applied to this research to cover a range of stewardship activities within conservation planning, and is used to guide the questions and processes it considers.

Within this paradigm, I developed an additional framework to further guide the research (see figure 3.3). This framework extends Bocking's (2007) description of factors that interact to shape science, to include Callon's (1999) models of knowledge dissemination, and therefore facilitates an understanding of how different factors interact to create stewardship science, and how these interactions influence its subsequent dissemination and application to conservation planning.

In this conceptual framework, landscapes, economics, politics, culture, technology, and scientific and local information interact to produce a location-specific stewardship science (Bocking 2007). These interactions renegotiate the relative influence of scientific and local information, which subsequently affect the perceived legitimacy and credibility of the stewardship science, and influence its application to conservation planning and management initiatives (Callon 1999; Yli-Pelkonen & Kohl 2005). Concurrently, conservation planning is being influenced by the modern trends of science-based management, collaboration, and integration, which affect its acceptance of stewardship science (Phillips 2003; Francis 2008).

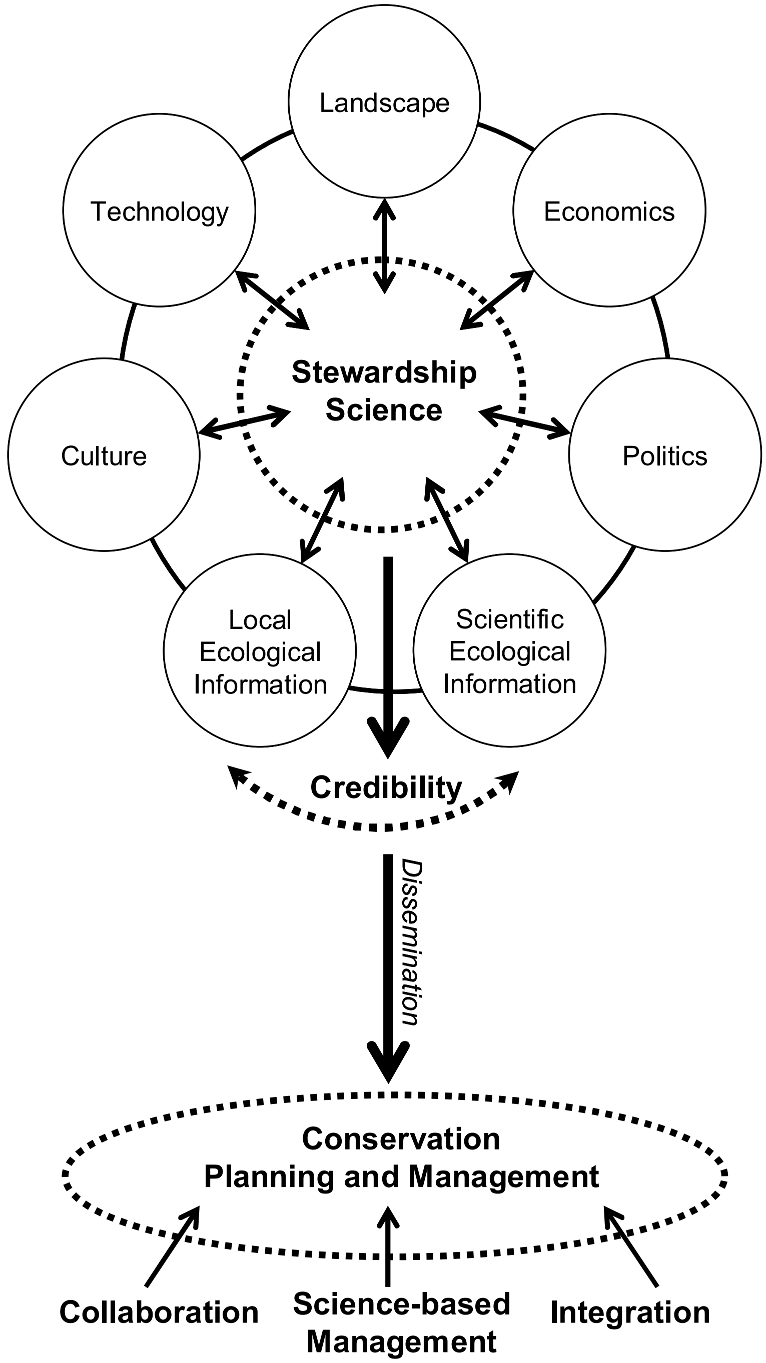


Figure 3.3 Conceptual research framework suggesting how different factors interact to create stewardship science within a disciplinary space (Bocking 2007) and how these interactions affect its credibility and subsequent application (Callon 1999) to modern conservation planning and management (based on Phillips 2003 and Francis 2008).

Chapter 4: Results

This chapter is broken into three sections that describe the data collected during the document analysis and interviews. The first section outlines how stewardship science has been characterized in the Long Point region in terms of the types of information that are being documented and applied. The second section describes how this knowledge is used by organizations when internally prioritizing, externally justifying, and implementing land acquisition, restoration, and monitoring projects. The final section outlines some of the major trends happening in stewardship science and how they have influenced conservation planning activities in the Long Point region. In these results, respondents have been classified into three groups based on their position within an organization: "PER" for permanently-funded positions, "VOL" for volunteer positions, and "TEM" for positions funded through temporary grants. For more information on these divisions please refer to Chapter 3. Information on the document analysis process is also located in Chapter 3, and descriptions of each reviewed document are located in Appendix II.

4.1 CHARACTERIZATIONS OF SCIENCE

Stewardship science is influencing a variety of initiatives in the Long Point region. These initiatives include landscape-level mapping projects, such as the Nature

Conservancy of Canada's "Great Lakes Conservation Blueprints" (NCC 2005) and Carolinian Canada's "Big Picture" (2004), which both employ conservation biology principles based on core habitats and corridors (PER1, PER2, PER3, VOL1, VOL2, VOL4, TEM1, TEM3). There is also a variety of species-specific monitoring and inventory work (PER2, PER4, VOL1, VOL2, VOL3, TEM1), such as the Norfolk Field Naturalist's "Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk" (Gartshore et al. 1987) and the Long Point World Biosphere Foundation's "Long Point Environmental Folio" (Nelson & Wilcox 1996). In addition, many agencies are using restoration ecology science to manage and maintain private and public properties (PER1, PER4, VOL1, VOL2, VOL4, TEM3) along with principles based on ecological goods and services accounting (PER6, TEM3).

However, the knowledge base used to pursue these initiatives was perceived and discussed by respondents in substantially different ways. These perceptions can be divided into three characterizations of information based on Fazey et al.'s (2006) classifications of local ecological knowledge (see section 3.1.2) and on the responses given during the interviews (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3):

1) *Scientific Knowledge* : scientific principles explicitly recognized and referred to as "true" or "hard science"

2) *Local Ecological Knowledge* : personal and local observations explicitly referred to as "soft science" or "knowledge" rather than science

3) *Embedded Knowledge* : scientific principles referred to as fact that were rarely explicitly acknowledged as science

The way these types of knowledge were perceived as science affected the way they were applied, documented, and discussed. These differences are further explored in the following sections.

4.1.1 Scientific Knowledge

"Scientific knowledge" was a type of knowledge that respondents explicitly referred to as science. This type of knowledge was linked to the ideas of hypothesis testing (PER1, PER3, PER6, VOL1), experiments (PER2, VOL2, TEM3), and the scientific method (PER6). For example, when asked about their definitions of science, respondents offered the following descriptions:

> "Science is the result of finding out how things work, facts about life… finding out what you know and what you don't know…I think that there's a scientific method in how you do that, you propose a hypothesis, and you test the hypothesis, and you publish the results and the results should be reproducible by anyone else, and ideally it should be peer reviewed" (PER6)

> "I guess it's setting out to prove a specific hypothesis or thesis; essentially you identify an area with a lack of information, and you want to fill that gap by studying it" (TEM3)

Scientific knowledge was used to specifically describe certain types of studies and information. Respondents suggested that it could be used for documenting information on species such as occurrences, population sizes, population viabilities, habitat needs, and life cycle characteristics (PER1, PER4, PER5, PER6, VOL1, VOL2, TEM1, TEM2); for informing the best ways to conduct restoration projects based on biotic and abiotic characteristics (PER2, PER3, TEM1, TEM3); and to systematically monitor the outcomes and effectiveness of projects (PER2, PER3, PER4, PER5, VOL4, TEM1, TEM3).

The generation of scientific knowledge was associated with a separate scientific community (PER5, PER6, VOL2, VOL3). For example, PER5 differentiated between the "science folks" and the community, VOL3 described how "science is done by scientists, and has to be published in adjudicated journals," VOL2 referred to lectures from "a real scientist," and PER6 suggested that a degree in science was not enough, and that you needed to be part of a practicing group to be considered a scientist. Many documents also referred to specific individuals or groups who were entrusted with making science-based decisions. For example, the "Great Lakes Conservation Blueprints" used a "Core Science Team" (p.96, Henson et al. 2005), the "NCC Stewardship Manual" refers to "a group of scientists, naturalists, biologists and others who collectively act as a Science Advisory Network" (p.30, NCC 2004), and the "Long Point Causeway Improvement Plan" describes how "the LPWBRF has retained a team of ecologists, environmental planners, water resources and civil engineers" to guide the study and make recommendations (p.4, Ecoplans 2008a).

Scientific knowledge was also associated with published documents and designations. For example, the Norfolk Field Naturalist's "Natural Areas Inventory of the Regional

Municipality of Haldimand-Norfolk" (Gartshore et al. 1987) was often mentioned as a scientific document (PER1, PER4, VOL3, VOL4, TEM2), as was Carolinian Canada's "Big Picture" map (2004) (PER4, VOL1, VOL3, TEM2), and Environment Canada's "How Much Habitat is Enough" manual (Bryan 2004) (PER6, TEM3). Many respondents also referred to areas with provincial natural heritage values, such as Areas of Natural and Scientific Interest (ANSIs), Provincially Significant Woodlands, and Provincially Significant Wetlands as having science-based designations (see OMNR 1999 for information on these designations) (PER1, PER4, PER5, VOL3, VOL4, TEM2, TEM3). Finally, management plans and studies (PER1, PER2, PER3, TEM1 VOL3) and GIS maps (PER1, PER2, PER3, PER4, VOL1, VOL3, TEM2) were also given as examples of documented scientific knowledge.

Documents that were mentioned as scientific tended to conform to scientific standards. For example, the "Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk" (Gartshore et al. 1987) was written in a scientific style, with latin names, citations, an abstract and a methods section. Within the document, there were descriptions of how potentially significant natural areas were chosen based on "consultation with experts, museum and herbarium collections and the literature" (p.6, Gartshore et al. 1987). The Big Picture project was similarly described as a systematic process, which "generate[d] replicable, rule-based mapping of a landscape-scale natural heritage system for southern Ontario" (LPWBRF 2002). The "How Much Habitat is Enough" report also stressed how its "guidelines are based on scientific literature and field studies concerning the amount of habitat required to provide for the ecological needs of fish and wildlife in wetlands, riparian areas and forested areas" (p.2), and referred to specific academic studies throughout the document (Bryan 2004).

Comparatively, the "Long Point Environmental Folio" (Nelson & Wilcox 1996) and "Great Lakes Conservation Blueprints" (NCC 2005) were less frequently mentioned as scientific documents. The "Great Lakes Conservation Blueprints" (NCC 2005) are written in a scientific style, but were only referred to as an example of documented scientific knowledge by individuals involved in their creation. When prompted, one respondent seemed hesitant about how it would affect their decision-making (VOL3); this may be either a reflection on its recent publication or on the quality of the Blueprint itself. Alternatively, the "Long Point Environmental Folio" specifically avoided a scientific style, explaining how scientific literature is "often written in ways not readily accessible and understandable to people" (introduction [online], Nelson & Wilcox 1996). Instead, it attempted "to minimize the technical language in the Folio and to use as many maps, graphs and illustrations as possible in the belief that this would make the Folio easier to understand and use in decision-making" (introduction [online], Nelson & Wilcox 1996). However, despite its emphasis on accessibility, the Folio was only mentioned by the individuals involved with its creation as a factor in decision-making. When prompted, one respondent commented that they preferred to use the original supporting documents rather than the synthesized information within the Folio (VOL4).

Published academic literature was also referred to by some respondents as examples of recorded scientific knowledge, although this tended to be in a broader sense of general studies that influenced their work rather than specific examples (PER2, PER4, PER5, PER6, VOL4, TEM3). Two exceptions were VOL1 and VOL4 who referred specifically to Karin Beazley's paper on forest fragmentation in the "Long Point Environmental Folio" (see Beazley & Nelson 1993) as leading to the initiation of the "Forest Corridor-Carbon Sequestration" reforestation program, and VOL2 who discussed Paul Ashley's studies of roadkill on the Long Point causeway as the basis for the Long Point Causeway Improvement Project (see Ashley & Robinson 1996). This study was also used, and prominently placed, in the first public presentation relating to the project (Ashley 2007).

Most of the documents and maps that were referred to as scientific documents were widely available. The only exceptions were information relating to parcel-level purchases (PER1, PER2, PER3, VOL3) and the locations of species-at-risk occurrences (PER2, PER3, VOL4, TEM1).

4.1.2 Local Ecological Knowledge

Another type of information used by respondents to describe their conservation work can be described as "local ecological knowledge." This category parallels Fazey et al.'s (2006) description of "explicit knowledge" since they are both formally articulated. This form of knowledge was based on personal observations and locally collected information, and was not recognized by respondents as science. In some cases, it was deliberately separated from scientific knowledge, and described instead as "soft science" (VOL4, TEM2), "field smarts" (PER5), or simply as "knowledge" (PER3, PER4).

For example, after finishing describing how property management plans were created by setting restoration goals and strategies based on site observation, one respondent ended with "I don't think anything I've talked about is science," suggesting that the plans were not scientific because they did not rely on experimentally collected data (PER2). Another respondent stated that "although we use the word 'science' a lot, I'm not sure what we're doing is pure science," explaining how the organization used "good knowledge" but not hypothesis testing (PER3). Similarly, when describing a local network that reported reptile sightings, one respondent stated that the locally-based observational data was "not really monitoring, it's documenting species," although they also noted that "soft data is better than no data" (VOL4). The "Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk" (Gartshore et al. 1987) made a similar distinction, explaining how “time and manpower constraints did not allow us to quantitatively measure plant communities, and as such, much of our information remains qualitative” (p.2, Norfolk Field Naturalist 1987).

Local ecological knowledge was often used to describe the same types of information as were described for scientific knowledge, such as documenting species information or conducting and assessing restoration projects, but tended to be associated with local management or monitoring applications rather than with published information (PER1, VOL1, VOL2, PER4, PER6, VOL3, TEM2, VOL4, PER5, TEM3). For example, the “Baseline Documentation Report” (OLTA & OHT 2006) standards used by the Long Point Basin Land Trust make a specific distinction between baseline documentation that needs to be collected for management and baseline documentation for scientific monitoring, which must use “science-based methodologies,” “resource inventory standards,” and be prepared for scrutiny from the “scientific community” (p.10, OLTA & OHT 2006).

The distinction between local ecological knowledge and scrutinized and published “proof” was also made by respondents. For example, when I asked TEM3 what types of scientific studies needed to be done, the reply was:

> “You know, we’re not really huge into trying to prove things through science…The stand that we take is that there’s already a lot of science out there that informs individuals and informs on the value of ecosystems” (TEM3)

When I later re-phrased the question to ask if more knowledge was needed, TEM3 suggested that it would help to quantitatively measure the outcomes of restoration projects. In this case, science was narrowly associated with experiments and published proof – which TEM3 did not need more of – while "knowledge" related to applied information that the organization could use. Another respondent described how their organization's local ecological knowledge would only become recognized as "science" after being published:

> "Many of our - what I would call scientists - are not publishers, or don't get published because they're not in that stream…we're doing the work before it gets published, and then scientists come along and review our work and publish it and then it becomes science" (VOL3)

Similarly, VOL4 commented on how ecological knowledge that was developed through local applications is now being recognized in academic literature:

> "Through practicing, we have come to some of these conclusions…Well suddenly, this year, it's in scientific literature" (VOL4)

The role of individuals featured prominently in local ecological knowledge, and an individual's personal knowledge or common sense observations were often referred to rather than specific principles when respondents described how local ecological knowledge was applied to conservation activities (PER1, PER5, VOL1, VOL4, TEM2). For example, PER1 described how their organization would rely on local descriptions of sites when making conservation decisions, such as a naturalist stating "I know that such and such an area is good for x or y species" (PER1), and both VOL3 and VOL4 described how the Long Point region had attracted many scientists who have subsequently stayed in the area. Certain people were also singled out, and individuals and organizations would refer to how they or other agencies would rely on a practitioner's personal knowledge (PER1, PER5, VOL1, TEM2, TEM3). For example,

> "A lot of this is in the science, but it's not, there's more in this head than there is in the book; maybe the data's in here, but the data's useless unless someone looks at it in certain ways" (TEM2)

> "He is one of the best restoration ecologists in the area;" "He knows what he wants to do;" "She is one of the best restoration ecologists in the area" (VOL1)

> "There is a recognition by the ministry that they a) can't do all the work down here and b) that there is a lot of competence in the area" (PER5)

The role of local ecological knowledge in environmental management was also referred to by some documents, particularly those that linked to stewardship. For example, the Norfolk Land Stewardship Council uses "A Guide to Stewardship Planning for Natural Areas" (OMNR 2006a) that describes how:

> "A landowner's knowledge about the wildlife in a woodlot normally comes from years of observation…A few observation visits can tell you a lot if the visits are over the course of several seasons and you make use of some good field guides." (p.29, OMNR 2006a).

Similarly, the "Caring for Nature in Norfolk" (Carolinian Canada 2008) brochure explains how:

> "The American Badger Recovery Team works with rural communities to raise awareness and collect new and historical reports of the animal. As a result, landowners have significantly enhanced our understanding of this disappearing species." (p.7, Carolinian Canada 2008).

However, although some documents referenced the role of this type of information in management, there were few instances of explicitly recorded, and easily accessible, accounts of local ecological knowledge. Two respondents specifically mentioned this gap, and a desire for better communication and documentation of information on local conservation approaches:

> "There's so much work going on, on the ground… and there isn't a lot of sharing, of the information [it would be beneficial to know] what worked and what didn't work so that people don't need to reinvent the wheel" (TEM3)

> "So many organizations are doing work here… [but there] seems to be a lack of knowing what each other are doing" (TEM1)

When specifically asked how local ecological knowledge was communicated, respondents commonly referenced person to person communication (PER5, VOL1, VOL3, VOL4, TEM1, TEM3), internal sharing within their organization (PER3, PER4, VOL3, TEM2), and local meetings and workshops (PER4, PER6, TEM1). For example, the Norfolk Woodlot Owner's Association provides a series of workshops, lectures, and outings to communicate information to its members. Recent events listed on their website have included a "Forest Health Symposium," "Fall Walk in the Woods and Mushroom ID," and "Bald Eagle Workshop." The "Bald Eagle Workshop" event posting specified how there would be "discussion and distribution of information on Raptor (Hawk & Owl) Nests - otherwise known as Stick Nests - for landowners to use as a tool to identify nests in their own woodlots" (online, NWOA 2010).

Similarly, VOL4 told an anecdote of how after telling a friend that there were badgers in the area, the friend noticed and reported a badger roadkill the very same day, while a presentation on the "Forest Corridor-Carbon Sequestration" reforestation program described how site plans were prepared by "[consulting] with the local and regional restoration experts/advisory committee" (LPWBRF 2007). Additionally, "ALUS: The Farmer's Conservation Plan" indicated through footnotes how some information was obtained through personal communication rather than formally documented sources (Reid & Bailey 2004).

When local ecological knowledge was communicated more broadly, it tended to be in collaboration with other agencies. For example, PER3 described how observational data on invasive species removal was collected through interviews and presented by the Ontario Invasive Species Council, and PER4 described how case study information from a restoration site was incorporated into a research paper in collaboration with the Trees Ontario Foundation. Respondents also referred to the role of university and government agencies in assisting with the compilation and analysis of observations (PER4, VOL1, VOL2, VOL4, TEM2). For example, the monitoring data collected for EMAN by the Long Point World Biosphere Reserve Foundation was analyzed by government staff to produce the "Long Point Monitoring Program Status Report 2003," and presented scientifically with academic language, citations, graphs, and charts (see Parker 2003). One respondent described this process of using outside agencies to analyze locally collected data as an "interesting use of soft data to generate hard science"(TEM2).

4.1.3 Embedded Knowledge

A final way that stewardship information was treated was as "embedded knowledge." This form of knowledge was rarely referred to, but instead formed an implicit operational framework for the respondents. This form of knowledge combines Fazey et al.'s (2006) "implicit" and "tacit" categories of non-articulated knowledge into a single functional category based on respondent response.

Embedded knowledge generally stemmed from principles that are broadly accepted by the scientific community and by stewardship organizations, but were not explicitly referred to as "science" by the respondents. Instead, embedded knowledge was referred to as "fact" (PER4) or "truth" (PER6, TEM3). These references tended to occur when people discussed the broader principles of landscape ecology and conservation biology such as habitat corridors, connectivity, patch dynamics, and buffers (PER3, PER4, PER6, VOL1, VOL3, TEM3).

If embedded science was explicitly referred to, it tended to be treated as an aside, and discussed under the assumption that its principles were good, obvious, and correct (PER4, PER6, TEM3). For example, when discussing natural succession, one respondent stated "[we] play around with that theory a lot, well it's not a theory, it's fact" (PER4). Another respondent described how they relied on existing science, such as a recommended minimum percent of stream buffering, explaining how it allowed them to move forward with implementation since "all of these things have already been *proven*" [emphasis added] (TEM3). Buffers were similarly discussed by PER6, who described how "some things are intuitive" and that you already knew their value for filtration and habitat creation (PER6). Interestingly, both these respondents also mentioned how they used the document "How Much Habitat is Enough" to provide guidelines for restoration (PER6, TEM3); however, the document itself recognizes its statements as theoretical, explaining how the first 1998 edition was revised and changed "to ensure that the guidelines are based upon the most current science" (p.1, Bryan 2004).

Only two respondents referred to the underlying assumptions within conservation science, and where those assumptions stemmed from. One respondent described how their organization was "working under the *hypothesis* that creating connections and maintaining properties will ultimately protect biodiversity" [emphasis added] (PER3). Similarly, VOL1 began by stating that for some projects no science was needed, but ended with acknowledging that this was likely because existing research already provided support.

Since embedded knowledge describes information the respondents took as truth, there were few specific references to how this information was documented or communicated. Instead, respondents generally referenced broader policy or communication documents that influenced their work, which in turn described the scientific rationale behind conservation projects. For example, the "Forest Corridor-Carbon Sequestration" reforestation program was justified based on a mix of principles from landscape ecology, conservation biology, and climate change science (Hounsell 2007); the "Ontario Stewardship Guidelines" similarly relied on principles from landscape ecology (OMNR 2007); and the "Conservation Blueprints" used landscape ecology mixed with systems theory (NCC 2005):

> [Forest Corridor-Carbon Sequestration program description] "…our plantings are targeted to expand key 'core' forested areas and connect woodland patches to help promote the recovery of wildlife that are at risk because of the loss and fragmentation of habitat. Enhancing 'connectivity' on the landscape is a key goal, hence the need for natural heritage modeling and planning at a hierarchy of scales…An interconnected system of habitat cores and habitat corridors, facilitating the dispersal of plants and animals to more favourable habitats, is an important management strategy to help conserve biodiversity in the face of rapidly changing climatic regimes." (p.2, Hounsell 2007)

> [Stewardship Guidelines] "A Natural Heritage Systems approach or a landscape level strategy is encouraged in order to provide the context for stewardship projects and help set priorities among competing opportunities." (p.4, OMNR 2007)

> [Conservation Blueprints] "The Great Lakes Conservation Blueprint portfolio provides a rule based approach to establishing a network of conservation lands and protected areas that would secure the survival of existing native species, ecological systems and processes that are essential to the biodiversity of the Great Lakes ecoregion… Future management within the ecoregion needs to maintain landscape scale ecological functions and services, and restore and rehabilitate degraded systems." (x, Henson et al. 2005).

Similarly, the Long Point Region Conservation Authority documents frequently referred to an "ecosystem approach to watershed planning" (for example, LPRCA

2002; Conservation Ontario 2003-2008a); the Alternative Land Use Services program documents often mentioned ecological goods and services accounting (for example, Reid & Bailey 2004; Bailey 2005); and a variety of documents discussed species at risk and biodiversity (for example, LPBLT 2008a/2008b/2009/2010c; NHIC & NCC 2002; Ecoplans 2008a; Ecoplans 2008b). In these documents, these principles were treated as a foundation for the work the organization pursued, and their underlying science was not specifically questioned.

4.2 APPLICATIONS OF SCIENCE

Although I had initially expected operating scale (local, regional, or national) to be a major determinant in an organization's application of stewardship science, after analyzing the data I found that it played a minor role compared to other factors. This was potentially because of the large degree of collaboration among organizations of different scales. For example, the national-scale Nature Conservancy of Canada partnered with the locally-based Long Point Basin Land Trust on the purchase and management of the Konrad Reserve (LPBLT 2010c). Similarly, the Long Point Biosphere Reserve Foundation's "Periodic Review Report" explains how "people associated with governmental authorities or other community groups have served on the executive committee for the biosphere reserve, or have otherwise been involved in voluntary activities fostered by the biosphere reserve" (p.9-10, Francis & Whitelaw 2001). As a result, through different collaborations and the movement of individuals between agencies, most organizations operating in the Long Point region had access to both national-scale policy and guideline information and local expertise.

Instead, the major differences in how stewardship science was applied seemed to reflect what the organization was attempting to do, rather than the organization's structure. During their work, respondents described how they internally prioritized or selected conservation projects, externally justified the project to potential funders or the public, and then finally implemented the project (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3). Although these stages have some degree of overlap, respondents described their decision-making processes for these stages in different ways and indicated variations in how knowledge was applied (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3). These differences are described in the following sections. Where they exist, variations based on an organization's scale are noted.

4.2.1 Prioritizing Projects

Since there are an extensive variety of potential conservation activities to pursue, each organization must in some way internally prioritize their actions based on their available resources and choose a particular site to acquire, property to restore, feature to monitor, or type of project to initiate. This prioritization appears to be based on a blend of an organization's mandate, opportunity, specific project "champions," and different forms of knowledge (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3).

The organization's mandate and philosophy often directed the general type of project that a group was interested in and the relative amount that they engaged in acquisitions, restoration, monitoring and other stewardship activities (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3). For example, members of the Nature Conservancy of Canada discussed their broad goals of acquiring properties and managing for biodiversity while the Long Point World Biosphere Reserve Foundation members referred to the biosphere's mission of conservation, sustainable development, and research.

For some organizations, science played a role in their mandate and was emphasized in the documents they produced. For example, the Nature Conservancy of Canada's "Conservation Policy Framework" stressed the organization's "science-based conservation planning," specified that Conservation Plans must have a "science foundation or ecological case for conservation," and described the new approach of Conservation Blueprints as "science-based conservation planning to guide on-the-ground activities" (NCC 2006). Even a description of how the NCC used "non-scientific" information for decision-making was justified through the use of scientists; for example:

> “The overall methodology for the project was developed with the direction, support and consensus of the Core Science Team and other experts. The Team also took responsibility for decision-making on issues not based directly on scientific information (for example, setting conservation goals).” (p.96, Henson et al.2005)

Documents from Conservation Ontario also stressed the use of science by Conservation Authorities, describing how they “use a watershed-based approach that relies on science to help to build resiliency in Ontario watersheds” (CO 2009a) and similarly emphasized the use of science in their Annual Reports. For example, the 2003 Report described how their “technical expertise and scientific models provide the information required to make the right decisions in terms of current and future water resources,” the 2005 report included a pull-out box titled “Research,” 2007 used the byline “Applying the Science,” and 2008 included a section called “Investing in Science” (CO 2003/5/7/8a).

Comparatively, the mandates of other organizations did not consistently refer to the use of scientific principles in decision-making, and some specifically highlighted other approaches. For example, the Alternative Land Use Services program focused on their farmer-driven approach to conservation (Reid & Bailey 2004), while the Norfolk Land Stewardship Council’s guidelines stated that potential stewardship projects must “not be considered to be research work” (p.10, OMNR 2007).

Within their organization's mandate, opportunity played a major factor for many organizations (PER3, PER6, VOL1, VOL3, TEM2). In some cases, opportunity described the availability of a particular piece of land to purchase:

> "Do we have the money to do it, and is anyone interested in it; you can usually find money, it's the interest to sell that's hard to find" (VOL3)

Opportunity could also refer to available funding or the ability to capitalize on existing programs, grants, or legal protection (PER2, PER4, PER6, VOL1, VOL2, VOL3, TEM1, TEM2):

> "What happens with smaller groups, is that you end up doing the conservation that you can get the dollars for … [we have recently] been doing work on reptiles, and it's because we can get money through [the habitat stewardship program] and [species at risk] to do reptile work" (TEM2)

> "Like most non-governmental organizations it is very opportunistic with respect to funding and the expertise and interests of the Board of Directors" (VOL1)

> "We're following endangered species around… when this eagle moved over [to an adjacent woodlot], we started looking to buy that property because of the new endangered species act" (VOL3)

Similarly, many documents also linked conservation activities to recent policy and events, to capitalize on existing attention. For example, the Long Point Basin Land Trust's newsletter promoted their reptile monitoring program and linked it with 2010 being the International Year of Biodiversity (LPBLT 2010c); the Conservation Ontario Annual Reports stressed their role in watershed monitoring and maintaining watershed health in relation to Ontario's new *Clean Water Act* (CO 2005/2006); and the Alternative Land Use Service program recently held a meeting to discuss "the role of ALUS in the new world of climate change and carbon markets" (ALUS 2010b).

Opportunity was also commonly used to describe a unique area of conservation or community need that was not being pursued by other organizations (PER3, VOL1, VOL2, PER6, VOL3, TEM2). For example:

> "The last thing we want to do is overlap with other organizations" (PER3)
>
> "That's what really piqued my interest… we were looking for a project to do, and no one else was doing it in the Long Point area, so let's carve out a bit of a niche and get started" (VOL1)
>
> "Let's not waste our effort where everyone else is looking…so we started looking at river valleys…nobody had been looking at the north-south connections because it was all privately held" (VOL3)
>
> "We're looking at the broader landscape…we're not going to compete…there's not as many players down the road here" (TEM2)

Individual people or project "champions" also played an important role in directing an organization's activities. This could take the form of either an individual actively pursuing a project of personal interest (PER6, VOL2, VOL3, VOL4, TEM2, TEM3), or an individual indirectly influencing a type of project by providing personal expertise that increased their organization's capacity in a certain area (VOL1, VOL2, TEM1). For example, an individual's experience and expertise in monitoring was described as facilitating the Long Point World Biosphere Reserve Foundation's involvement in EMAN's forest biodiversity monitoring program (VOL2). The following examples demonstrate how respondents described an individual's influence on conservation projects:

> "A new council member comes on board and they've got a pet peeve or a pet interest and they want to chase it" (PER6)
>
> "[It's] less because of the mandate, and more because you have a sparkplug, a person who takes the lead and makes things happen" (TEM2)
>
> "[He was] pounding the pavement for 7 years to make it work" (TEM3)

Some of the reviewed documents also indicated the role an individual may have in championing certain projects. For instance, the Norfolk Land Stewardship Council's Annual Reports each have a "Chairman's Message," which highlights some of the larger projects the organization engaged in, but also appeared to reflect the Chairman's own interests. For instance, the 2004/05 message mentions work by the Long Point Bay Anglers' Association and includes a picture of the chairman sport fishing (NLSC 2004/5). Other chairmen have highlighted ALUS, reforestation projects, and "no-till" agriculture with corresponding photographs of themselves in an agricultural field (2007/8, 2008/9), in hunting gear (2005/6), and with a large "no-till" sign (2003/4).

In some cases, respondent's linked an individual's interest to local ecological knowledge, suggesting that a person's own observations and experiences would lead them to champion an issue (PER6, VOL3, TEM2). For example, TEM2 described how word of mouth reports on properties and property availability drew attention to certain areas, and VOL3 similarly described how an individual's observation of a particular property led to its recognition as a significant area (VOL3). Additionally, PER6 described how a mix of literature (scientific knowledge) and long-term personal observations (local ecological knowledge) led to their interest in a project:

> "As a biologist, I'm reading about it in the scientific literature and I'm driving the same route…and I'm seeing, I'm noticing… good things happening on the landscape that you could physically see…and it wasn't just demonstration sites it was a landscape impact, and that really interested me" (PER6)

Finally, many organizations also based their decisions to pursue certain projects directly on different forms of conservation science. Scientific knowledge was often used to assess potential projects, and many organizations used scientific information to develop criteria to rank potential projects or purchases (PER1, PER2, PER4, PER6, VOL3, TEM2, TEM3). Similarly, the "Natural Areas Inventory of Haldimand-Norfolk" used specifically defined criteria to identify potentially significant natural areas (Gartshore et al. 1987). These criteria stemmed from both the organization's goals, and from other recognized policies and guidelines. For example, one respondent described how, when assessing a potential restoration site, a property is rated higher if it falls within Carolinian Canada's "Big Picture" (PER4). The existence of ANSIs, Provincially Significant Wetlands, and Provincially Significant Woodlands were also used by organizations to prioritize areas for conservation (PER1, PER4, VOL3). This type of criteria was described by one respondent as "high level stuff" based on literature and the "basic principles of conservation biology" (PER3).

Similarly, the Nature Conservancy of Canada, the Long Point Basin Land Trust, and the Long Point Region Conservation Authority also used GIS mapping to help prioritize specific properties for protection. For all three organizations, the maps consisted of different layers indicating significant natural heritage features, such as woodlands, wetlands, and species occurrences, and were also used to assess broader landscape patterns. No supporting descriptive documents were available for the mapping projects developed and used by the Conservation Authority or the Land Trust. However, supporting documents for the "Great Lakes Conservation Blueprints" maps developed by the Nature Conservancy specifically stress their systematic, science-based approach:

> "The Geographic Information Systems (GIS)-based analysis of representation and gaps in existing protected areas provides a transparent, rule-based methodology that has used the best-available data and the scientific consensus of a team of core scientists to provide a basis for setting conservation priorities within a natural ecoregion. The analysis also sets the stage for subsequent reanalysis, update and measure of conservation achievements over time." (p.viii, Henson et al. 2005)

Local ecological knowledge also played a role in pursuing projects, and in some cases was used to supplement or circumvent established criteria or rankings (PER1, VOL3, VOL4, TEM2). For example, VOL3 explained that although GIS maps were used when making decisions, it was "more the on-the-ground knowledge," and that interpretations of the maps were strongly influenced by personal experiences with the landscape. Regarding mapping, TEM2 suggested:

> "I guess that's hard science – it's made from legitimate data layers, which have been generated from alternate sources; how you interpret them, maybe that's soft science" (TEM2)

Similarly, PER1 and TEM2 both described an example of how local naturalist observations drew attention to a site that was otherwise missed by science-derived criteria. However, TEM2 noted the difficulty in operating outside the criteria to protect the site as a "hard sell," and how ultimately "the justification for purchasing it was not on anything on-site, it was everything that was roadkilled around it."

Local ecological knowledge, combined with embedded knowledge, also seemed to play a role in assessing the general worth of a project. For example, PER4 described how different types of tree-planting programs worked in tandem, with a project arriving and then being slotted into a specific program based on its eligibility. However, although criteria were used to establish which program a project fell under, the general assessment that all tree planting projects should be pursued was an underlying assumption, "ideally, you don't want to turn anyone down from planting trees" (PER4). PER5 and TEM3 similarly talked about adapting restoration projects based on a landowner's need, under the same assumption that any restoration actions would be an improvement.

Generally, local ecological knowledge tended to be used more often by the less-formally structured organizations, with opportunity and individual champions also playing a larger role (PER6, VOL1, VOL2, VOL3, TEM2). This is potentially reflective of the structure of the smaller organizations, which often had a rotating board of directors and a large volunteer component with a corresponding flexibility in decision-making. Conversely, scientific knowledge and established criteria seemed to be used most often by the formally structured organizations and permanent staff when they were prioritizing projects (PER1, PER2, PER4) and was also more likely to be formally described in documents as the basis for decision-making.

4.2.2 Justifying Projects

While prioritizing projects is an internal decision, all respondents referred to how they were also required to externally justify their conservation initiatives to potential project funders or the community (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3). Generally, the process of justifying projects tended to rely much more heavily on scientific knowledge and its corresponding documentation.

Scientific knowledge was used by some organizations to specifically measure and report project outcomes (PER2, PER4, PER6, VOL4). This was often linked to the criteria involved in prioritizing projects, since project choice could then be externally rationalized by stating how it fit within pre-established targets. For example, the "Forest Corridor-Carbon Sequestration" reforestation program targets restoration sites that "are strategically chosen based upon 'Big Picture' regional conservation needs" (Hounsell 2007). Similarly, the Nature Conservancy of Canada justifies their stewardship activities based on "the biodiversity targets identified in conservation blueprints or comparable landscape-scale or jurisdictional conservation planning" (p.18, NCC 2004).

The use of baseline documentation, and subsequent change, was also used as a way to report project success. For example, the Ontario Land Trust Alliance's "Baseline Documentation Report" (2006), which is used by the Long Point Basin Land Trust, outlines replicable procedures to monitor change, while the Alternative Land Use Services program conducted a benchmark survey of public opinion with the aim of later repeating the survey to quantitatively determine how the project has affected the community (Bailey & Greenslade 2006):

> "The primary purpose was to establish benchmarks of public opinion for the three target groups on the status of the environment, economy and quality of life in the county, in advance of the implementation of the ALUS pilot project….and to quantify views among target groups on a range of environmental and farming issues, concerns and opportunities arising during ALUS discussions in Norfolk County over the past three years." (p.10, Bailey & Greenslade 2006)

Additionally, many organizations felt they would benefit from being able to offer stronger quantitative descriptions to defend the success of conservation projects (PER3, PER4, PER5, PER6, VOL1, VOL2, TEM1, TEM3). For example, PER3 thought that stronger quantitative descriptions of the outcomes of conservation activities would help with fundraising; PER4 wanted to map water quality trends across the landscape to assess conservation efforts; and PER6 explained how ecological health indicators would ideally be used to assess project benefits. However, respondents also noted the difficulties in quantitatively describing the benefits of projects, including how hard it was to measure complex ecological outcomes (PER6, VOL1, VOL4), the long timeframe necessary to successfully judge a project's outcomes (PER4, VOL2), and balancing the resources needed to implement an experimental monitoring program against directly pursuing corrective action (PER6, VOL2, VOL4). For example, respondents noted:

> "It's tough, when you get into population ecology, you can't get definite numbers" (VOL1)
>
> "[You would] never have enough money to monitor all the sites if you have to do it every year" (PER4)
>
> "It's really tough to show cause and effect…If you had to prove the benefits, you would be spending so much time in research that you wouldn't be getting things done on the landscape" (PER6)
>
> "It's just that it takes so long, eh? …And by the time you get the data everyone's lost interest, like the volunteer people who push the projects forward" (VOL2)
>
> "...you don't wait until you have the data" (VOL4)

In the case of the Alternative Land Use Services program, respondents indicated that they were obliged to change their initial environmental monitoring indicators, such as water chemistry, turbidity, and nutrient loading, because they proved too difficult to measure (see p.46, Reid & Bailey 2004 for the full list of intended indicators). Consequently, the program is now being evaluated through changes in public opinion as measured through a public opinion questionnaire (see Bailey & Greenslade 2006). Somewhat similarly, the Norfolk Land Stewardship Council does not report on the specific conservation outcomes of its projects, but instead illustrates its progress towards its mission by describing the diversity of types of projects and the number of partners it involves (see Annual Reports, NLSC 1996-2009).

The use of scientific knowledge and corresponding documentation was generally seen as a way to enhance an organization's credibility. For example, VOL2 described how a "Science Committee" was created for the Long Point Causeway Improvement Project because people "really doubted the science behind it," and how using science "makes us believable as an organization." Similarly, TEM1 stated that "to do any conservation project, there needs to be some scientific backing to show it's beneficial," while TEM3 explained that "people want to know more of the hard science." PER5 described how the organization worked with external data analyzers to gain credibility, explaining how "at the local level there's some skeptics who say, 'well it's local staff making that stuff up.'"

Similarly, the "How Much Habitat is Enough" manual specifically describes how it can promote credible decision-making through the use of science (Bryan 2004):

> "The Framework can be applied in land-use planning to address specific issues and needs from a scientific basis. Use of the science based guidelines to formulate planning and policy decisions can make such decisions more defensible and provide a rationale for directly protecting habitat or initiating restoration projects." (p.10, Bryan 2004)

Some respondents also spoke about how scientific knowledge and its perceived credibility were specifically used to justify projects that were prioritized based on local ecological knowledge (PER6, VOL1, VOL3, TEM2). For example:

> "Intuitively, the scientists, conservation biologists, species-at-risk people know that traffic's increasing… they know that you're going to lose your species, they're getting run over… [but we are told] 'give us the numbers'" (VOL1)

> "If you look at the Big Picture there's a lot of corridors, which were generated by computer… we don't need the Big Picture, the only reason to go back to the Big Picture is to legitimize the purchase to a funding agency - we don't need that legitimacy for our own purposes, we're looking at the landscape itself" (VOL3)

> "The information that's been pieced together from all these different undertakings, these documents, over the years, is used as a justification when you're looking for funding" (TEM2)

Interestingly, although organizations relied heavily on documentation for externally justifying their work, many respondents explained how specific documents were rarely used otherwise (VOL1, VOL3, VOL4, TEM2). For example, one respondent stated "oh, people don't use documents, they put them on a shelf and never look at them again," but suggested that if you wanted to gain funding you would look to see whether there were any provincially significant woodlands or wetlands, the presence of species at risk, or whether it fit within existing guidelines such as the "Big Picture" (VOL4). VOL2 similarly described how finding a species at risk made it "sort of like a shoe-in." In these descriptions, the documents and policies were described only as a way to externally secure funding and recognition, rather than as a rationale to initially pursue the project. This was described by VOL3, who explained how "to be successful we must address our funders in a language that they understand and accept, science."

This may, in part, be a reflection on the documents themselves. Since they are locally and regionally based, many of the current environmental practitioners in the area were involved in their production. For example, VOL1 described how the "Big Picture" was produced by the "best ecologists in Ontario" which included representatives and agencies associated with the Nature Conservancy of Canada, the Long Point Basin Land Trust, the Norfolk Land Stewardship Council, and the Long Point World Biosphere Reserve Foundation. As a result, the documents tend to be a record of information compiled from existing expertise, so consulting them may not be necessary for the local practitioners. VOL3 explained this as "it's not that we're following the 'Big Picture' as much as that the 'Big Picture' came out of the experience here."

4.2.3 Implementing Projects

Once a project was selected, different factors influenced its on-ground implementation. Implementing a project generally involved either networking to attract participants and gain support or physically conducting restoration work. Different forms of knowledge played a role in both these types of projects, with local ecological knowledge having a prominent role in outreach, and a mix of all forms of knowledge supporting restoration activities (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3).

Most respondents discussed the importance of communication and relationship-building when implementing their projects, particularly those that involved recruiting new participants or outreach to landowners (PER3, PER5, PER6, VOL3, TEM2, TEM3). For example, PER3 described how "the one thing I learned being involved in conservation is that there's species, and ecosystems, but it's really about the people and the interactions." PER5 described how poor communication could impact a stewardship project "and if you can't communicate with people… it creates friction." Similarly, both VOL3 and TEM2 described how relationship-building helped them build contacts and gain information:

> "Again, we are using science to, soft science, to do contact" (TEM2)
>
> "What we're looking to do next is buy these fields and create a buffer, so every time we get a property the idea is to get the next properties around it and start buffering the property, so we're trying to make relations with each one of these neighbours so when they're interested in selling they think of us as a buyer" (VOL3)

Communication was often linked with local ecological knowledge, with many organizations describing either the value of local knowledge of an area (PER3, PER5, PER6, VOL2, VOL3, TEM2, TEM3) or the benefits of person-to-person communication of an individual's experiences with a program (PER5, PER6, TEM3).

Respondents that discussed local landscape knowledge described its benefits in knowing places, knowing how local systems operated, and creating connections:

> "Almost everything we do, there's some sort of partnership involved…local partners are much better in land owner relation…and knowing places" (PER3)
>
> "You can be book smart, but if you're not field smart it's going to backfire on you" (PER5)
>
> "Farmers understand agriculture, they're your neighbour, they've been living in this community, they can connect better" (TEM3)

Some organizations actively used local people to communicate their message, and stressed the success of person-to-person communication in recruiting program participants (PER5, PER6, TEM3). For example, PER6 provided an example of how a person-to-person approach resulted in nearly full subscription to a stream buffering program; PER5 described how hiring a local farmer to operate restoration equipment made it "his baby now, it's his equipment, he's trying to figure out the best way it will work;" and TEM3 described how their organization relied on spokespeople who would "use [their] experiences and … stories to communicate the effectiveness of [the program]" to the community.

In these cases, communication relied heavily on local ecological knowledge that came from either experience with the landscape or experience with a certain type of project. The only respondents who expressed a need to communicate scientific knowledge to gain support were those involved with the Long Point Causeway Improvement Project. One respondent described skepticism over the project's rationale amongst both their internal staff and community members, explaining "there's a need for…evaluating…population viability…it's a thing we need to prove to the naysayers and for us too" (VOL2).

Documentation, particularly publicity documentation to recruit participants, also tended to take a locally-based approach to describing conservation initiatives. For example, the "Caring for Nature in Norfolk" brochure gave four examples of stewardship projects, explaining how:

> "…these folks and other neighbours too numerous to mention are quietly helping to restore our landscape, to protect rare wildlife, and to make your home a safer place to live by keeping the air and water clean. You can help too, in many ways." (p.5, Carolinian Canada 2008).

Similarly, the Long Point Region Conservation Authority's "Break Wind, Make Money" brochure provided two first person accounts from farmers who have successfully planted windbreaks and offered to "put you in touch with other farmers who have completed similar projects" (CO 2010b). The Ontario Woodlot Association's newsletter, which is distributed to members of the Norfolk Woodlot Owner's Association, also promotes stewardship and similarly relies on a person's own experiences rather than scientific literature to build interest. For example, a feature article on bats began with:

> "Let's talk about bats—not the ones used by baseball players—the nocturnal flying mammals that inhabit rural and urban areas. We have all encountered bats at one time or another, but have you ever given any thought about how your woodlot activities may affect their habitat?" ("S & W Report," OWA 2006)

When respondents discussed how they implemented and monitored restoration projects, they tended to refer to a blend of both scientific and local ecological knowledge (PER4, PER6, VOL1, VOL3, VOL4, TEM2). For example, one respondent described how:

> "You look at all the available data, you look at what species require, you look at species compatibility, and you look at the historic landscape - and that's using science to get the job done, or get the project implemented; and then, you basically have to watch it and see how it works - see if the [species at risk] are using it, see if your species composition is just as diverse as when you planted it, see if you're losing species out of the mix" (PER4)

Another respondent commented on PER4's approach to using scientific knowledge in conjunction with personal observations, adding how PER4 would be "monitoring every time [PER4] drives down the road, every time [PER4] passes a site [they're] always looking at it, seeing what works, which trees have died, which ones are doing well" (VOL1).

Other respondents similarly described the use of local ecological knowledge in conducting and monitoring restoration projects. For example:

> "We've also based our approach on observation of natural processes… you think, it's not one oak tree there, it's not one species of oak, there's three species" (TEM2)
>
> "It's always a combination of practice and reading" (VOL4)
>
> "When we go out to a farm, usually the farmer already has, in their mind, what they want to do on the land, and it's because they've already identified a problem" (TEM3)
>
> "It's basic science in terms of this is what we did, this is what we're seeing, but in terms of restoration you learn as you go" (PER4)

Generally, the type of scientific information that was used when conducting restoration work was related to existing management plans and maps (PER1, PER2, PER3, VOL3, TEM2), although respondents that referred to this information tended to represent organizations that were larger and more structured. However, many respondents also explained how they were required to adapt these documents to local conditions (PER2, PER4, PER5, PER6, TEM3). For example, although the "Great Lakes Conservation Blueprints" (NCC 2005) and the "Big Picture" (Carolinian Canada 2004) define conservation priorities, these are often at a broad level. As a result, organizations may be forced to adjust priorities at a local level; this process is described in relation to the "Forest Corridor-Carbon Sequestration" reforestation program:

> "In the case of southwestern Ontario, Carolinian Canada's 'Big Picture' conservation plan is used as a macro-screen for the selection of candidate restoration sites (i.e. cores and corridors). The site selection process is further honed at finer scales within the broader cores and corridors by more detailed natural heritage plans that better identify 'on-the-ground' restoration opportunities. In the specific case of the LPWBRF, the finer scale resolution was defined through their Forest Corridor and Restoration Project. The process is managed and informed by a multi-stakeholder site selection team who screen sites against well established criteria." (p.2, Hounsell 2007).

Environment Canada's "How Much Habitat is Enough" (Bryan 2004) guidelines, which were referred to by respondents from the Alternative Land Use Services program and the Norfolk Land Stewardship Council, similarly recognize the need to adapt to past conditions, special species, and the surrounding landscape, stating how:

> "The *Framework* is meant to guide, not dictate, local decisions. It provides planners and rehabilitation teams with the best available science to enable them to make their own

> decisions on how much habitat is required to rehabilitate local watersheds and landscapes. The *Framework* is intended to be adaptable." (p.2, Bryan 2004)

The influence of past practices on the landscape, and their role in influencing local conservation was similarly mentioned by some respondents (PER4, PER5, VOL3). For instance, PER5 described how historic agricultural practices have enhanced local badger habitat, while VOL3 explained how hidden woodlot tobacco plots created micro-openings that now benefit animals such as the Prothonotary Warbler. PER5 explained the need to adapt guidelines to fit this historic landscape, stating:

> "That's the sad thing when it comes to natural resource management, while there's guidelines… each [property] has been influenced by past practices, which [are] unique" (PER5)

Respondents also discussed the importance of socially adapting a project to local interests (PER6, VOL2) or landowner needs (PER4, PER5, PER6, TEM3). For example, the Long Point Causeway Improvement Project broadened its scope to appeal to the broader community (PER6, VOL2). Although the first project presentation emphasized scientific knowledge and the need to reduce wildlife mortality, later presentations balanced environmental and social benefits and included community considerations such as overall road safety and aesthetics (compare Ashley 2007 to Ecoplans 2008b). The Alternative Land Use Services program was similarly described as an adaptable program that worked with a farmer to meet their needs through mutual consensus on the type of restoration project to implement (PER6). Another respondent provided an example of how restoration projects needed to fit with a landowner's individual needs and abilities:

> "Well, the practicality of that, is that some 80 year old farmer is not going to go out on his hands and knees in the middle of summer; and, number one, he's not going to know what species he should or shouldn't be cutting; number two, he's not going to do it in the first place" (PER5)

In these cases, although broad management practices are defined and documented as scientific knowledge they were only used as a framework while the actual operational practices were adapted based on local ecological knowledge and experiences. However, this adaptation of knowledge seemed less likely to be recorded. Three exceptions to this are the Long Point Region Conservation Authority, which keeps records on tree survival at individual project sites; the Long Point World Biosphere Reserve Foundation, which documented the outcomes of a specific habitat restoration project (LPWBRF 2000); and the Norfolk Land Stewardship Council which initiated a catalogue of land stewardship demonstrations (NLSC 1996/97). Aside from these instances there appears to be no other easily accessible records of individual site practices; TEM3 noted this lack of documentation, explaining how:

> "We're trying to document now a little bit better on our planting sites exactly what was done and what the site conditions were, and things like that, to better inform ourselves down the road doing project types" (TEM3)

Similarly, the Norfolk Land Stewardship Council has recently applied for grant funding to increase the accessibility of their catalogue by switching to a digital database that would document both pre-treatment conditions and project implementation details (Emery 2010). This was described as a way to provide a "standard reporting tool to assess why projects succeeded, [and] for others, why they didn't" (p.2, Emery 2010).

To compensate for the lack of recorded information, person-to-person localized and regionalized knowledge-sharing plays an important role in implementing projects (VOL1, VOL3, TEM3). For example, VOL3 described a particular restoration technique, and how knowledge of it originated with people involved with the Biosphere Reserve, spread to the Long Point Basin Land Trust, and was then taken up by the Conservation Authority:

> "It's called pit and mound ecology, and it dries out from the top down so you end up with orchids and things like this near the top; and down below it's wet, that becomes a vernal pond in the spring. So [the Long Point Basin Land Trust took] this model and now the CA, Conservation Authority, on marginal lands are using bulldozers to create pit and mound…so that's where it was modeled from…I first heard about it about 5 years ago, [through] the Biosphere Reserve - it was the latest thing" (VOL3)

Similarly, TEM3 described how they were introduced to restoration practices through instruction by a local restoration expert, commenting on how "it's really, very much, a vocal sharing of knowledge."

4.3 TRENDS IN SCIENCE

Many of the features of the "modern paradigm" of conservation planning (Phillips 2003; Francis 2008) appear to be present in the Long Point region. These results also contribute to an understanding of how emerging issues in stewardship science, such as species at risk, climate change, and technology developments, are shaping conservation initiatives in the Long Point region.

4.3.1 Modern Paradigm of Conservation Planning

The features of the modern paradigm of conservation planning, such as science-based management, an emphasis on collaboration, and social and economic integration (Phillips 2003; Francis 2008) appear to be present in the Long Point region.

For example, most respondents referred to broad ecological principles, such as patch dynamics, corridors, and buffers, when describing their conservation projects (PER3, VOL1, PER4, PER6, VOL3, TEM3). These concepts implicitly and explicitly informed many of the conservation initiatives in the area and were the basis of embedded knowledge and environmental thought. For example, the "Forest Corridor-Carbon Sequestration" reforestation program and other tree planting programs aimed to enhance existing habitat fragments and connect them through corridors (for instance, Hounsell 2007); organizations used property acquisition frameworks that delineated regional-level connections such as Carolinian Canada's

“Big Picture” (Carolinian Canada 2004); and restoration projects such as the Alternative Land Use Service program sought to increase habitat variety within the landscape (Reid & Bailey 2004).

Collaboration was another prominent trend in the area, with almost all projects being a partnership of some form and all respondents provided examples of how they worked with other organizations to achieve conservation goals (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3). For example:

> “Almost everything we do, there’s some sort of partnership involved” (PER1)
>
> “Many hands are stronger than one” (TEM1)
>
> “I think partnerships are key” (PER4)
>
> “That’s how we do things, through partnerships and collaboration” (PER6)
>
> “I think that conservation delivered by a multitude of agencies is giving the general public options” (TEM2)

The reviewed documents supported this trend, with a variety of documents also emphasizing the importance of partnering:

> [NCC’s Southern Norfolk Sand Plain Natural Area Conservation Plan] “NCC will work in partnership with Tallgrass Ontario, the Ontario Invasive Plant Council, Long Point Region Conservation Authority and other partners to achieve community outreach, landowner contact, field research, and conservation education and training, and to develop plans to sustain conservation and restoration activities over the long term.” (p.1, NCC 2009b)
>
> [NLSC Terms of Reference] “The Council will partner with those private landowners, community groups, and resource agencies that respect private land ownership, to advance and implement practical and sustainable resource management.” (p.i, NLSC 2005)

> [LPBLT Newsletter] "As a young charitable, non-governmental organization, LPBLT knows how important it is to build partnerships with other conservation groups, landowners and the public." (p.4, LPBLT 2009)

> [LPWBRF Newsletter] "In the year ahead, the LPWBRF will continue working with the 16 other organizations and local community members involved on the LPCIP Steering Committee, to move this project forward." (p.4, LPWBRF 2010)

> [CO Brochure] "The battle for biodiversity will be won or lost in backyards, on farms and in Ontario's green spaces by people, agencies and government teaming up to give habitat a hand." (CO 2010c)

Although organizations would actively assist other agencies when similar interests existed (PER2, PER4, PER6, VOL1, TEM1, TEM3), niche differentiation also seemed to play an important role with many organizations intentionally pursuing unique projects to avoid overlap (PER3, PER6, VOL1, VOL2, VOL3, TEM2). For instance, project funding guidelines from the Norfolk Land Stewardship Council specifically state how "co-operation is sought to provide complimentary services and support to landowners while avoiding duplication of efforts" (p.1, NLSC 2010b). Differentiation also appeared to occur within collaborations, with each participating organization bringing different strengths to the project, such as fundraising ability (PER3, PER4, PER6, VOL1, VOL2, VOL3, TEM1, TEM2, TEM3), credibility (PER3, PER6, TEM2), or expertise (PER2, PER3, PER4, PER5, VOL1, VOL2, VOL3, TEM2, TEM3).

For example, the Nature Conservancy of Canada was frequently mentioned as an example of an organization that could provide funding (PER3, PER6, VOL2, TEM2), with a common example given of how they offered $10,000 in matching funds towards a feasibility study for the Long Point Causeway Improvement Project. Non-profit organizations, such as the Long Point World Biosphere Reserve Foundation or the Long Point Basin Land Trust, were also identified as organizations that could assist with fundraising since some funds are only available to charitable organizations (VOL1, VOL2) or because some grant applications are more successful when fronted by a non-profit organization (TEM1). Credibility was also mentioned as a factor in involving certain organizations; this tended to be related to either their profile (PER3) or to their perceived neutrality (PER6, TEM2).

Expertise was a final reason for collaboration. This could refer to expertise in local conditions or communication (PER2, PER3, PER5, TEM3); in specific skills such as land procurement or plant identification (PER3, PER5); or in technical delivery capabilities (PER4, VOL1, VOL2, VOL3). For example, VOL2 described how they "used other organizations for their expertise in those areas they focus in;" and PER6 explained how a program operated "as a delivery mechanism that fits with other existing conservation programs." For instance, Conservation Authorities were described as providing expertise as an agency that "[brought] science and knowledge to the table" (CO 2003). Similarly, a presentation on the "Forest Corridor-Carbon Sequestration" program described how the Biosphere Reserve Foundation relied on expertise from other organizations when choosing planting sites:

> "With LPWBRF leading the project, the Long Point Region Conservation Authority partnered with the Foundation to help locate appropriate sites and provide tree planting advice and services. The Long Point Basin Land Trust also assisted with the location of appropriate planting sites." (LPWBRF 2000)

Although most local and regional government and non-governmental organizations involved in stewardship were referred to by respondents as assisting with local conservation efforts, one notable exception was an identified lack of support from federal and provincial government agencies (PER5, VOL1, VOL4). For example, VOL1 described how the Canadian Wildlife Service avoided a project they deemed too political; VOL4 stated "forget government, government doesn't lead;" and PER5 explained that "the province of Ontario no longer has the capacity to do field work." Similarly, Conservation Authorities are now responsible for collecting water quality samples rather than the government, although the government still provides data analysis and management (p.46, LPRCA 2008).

Finally, integrating social and economic viability into conservation work was also a noticeable trend in the Long Point region. For example, the Long Point World Biosphere Reserve Foundation has recently begun pursuing eco-tourism initiatives to capitalize on the economic possibilities of nature-based tourism (LPWBRF 2010). Similarly, the Alternative Land Use Services program is based on the idea that farmers should receive incentives for providing ecological services, explaining that "Canadians in cities and towns must recognize that a healthy environment is linked to socio-economic prosperity in rural landscapes" (p.2, Reid & Bailey 2004). The Norfolk Land Stewardship Council also emphasizes an economic rationale to conservation, and one of their focuses includes "[involving] landowners so they understand [the] financial benefits of stewardship" (p.2, NLSC 2010a).

When asked about the future of conservation in the region, many respondents specifically referred to the ALUS program as an innovative and positive approach (PER3, PER6, VOL1, TEM1, TEM3). VOL1 specifically commented on how ALUS was "opening up a whole new… it's opening up more restoration in the county... in areas we wouldn't normally get." Additionally, one respondent suggested that the conservation work in the area helped to attract high-paying jobs that could act as "an incubator for a broader knowledge industry" (VOL3).

4.3.2 Emerging Issues

Although some principles from conservation science, such as landscape ecology and conservation biology, were treated implicitly as embedded knowledge, other topics within conservation science, especially those explicitly identified as "scientific knowledge" tended to elicit more hesitation from respondents. For instance, restoration ecology and species-at-risk science were frequently identified as scientific knowledge, but respondents also suggested that these were areas that could benefit from further research (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL4, TEM1, TEM3).

Species at risk were frequently mentioned by respondents (PER1, PER2, PER4, PER5, PER6, VOL1, VOL2, VOL3, TEM1, TEM2) and in the reviewed documents. For example, one of the criteria used by the "The Natural Areas Inventory of the Regional

Municipality of Haldimand-Norfolk" report to determine significant natural areas and sites was the presence of rare species (Gartshore et al. 1987), and the newsletters published by the Ontario Woodlot Association, the Long Point Basin Land Trust, and the Long Point World Biosphere Reserve Foundation all contained articles on specific at-risk species (see OWA 2010; LPBLT 2008b/09/10c; LPWBRF 2010). Similarly, one respondent referred to a recently initiated study to identify and define areas with threatened species, explaining how "it's just something we do internally to keep ahead of the game, we recognize we have a lot of species at risk" (PER4). Some of this attention is potentially a response to Ontario's new *Endangered Species Act* (2007). One respondent called the issue a "hot potato" (PER5), and two respondents specifically mentioned how the legal backing strengthens funding applications (VOL2, VOL3).

Interestingly, although respondents mentioned how they were required to restrict data on species-at-risk locations to protect specific occurrences (PER2, VOL4, TEM2), no respondents specifically referred to these restrictions as a barrier. This may indicate knowledge sharing networks, or potentially reflect a general awareness among practitioners of where species occur so that documents are not needed. However, many respondents mentioned a need for collecting current information on population viabilities and best management practices to support sensitive species (PER1, PER4, PER5, PER6, VOL1, VOL2, VL4, TEM1). One respondent suggested that the lack of information, combined with legal regulations, put an unfair management burden on landowners and stated that “the science behind that, to me, needs to be re-looked at in reality, in regards to how much we can do and how much we should spend” (PER5).

The reviewed documents also recognized the need for updated species information. For example, “The Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk” described how “the lack of complete coverage and a paucity of substantiated records makes it difficult to develop a complete picture of the region's butterflies”(p.1 of Butterflies, Vol II) and also drew attention to the need for more information on other invertebrates, fish, and non-vascular plants (Gartshore et al. 1987). The “Great Lakes Conservation Blueprints” similarly expressed a need for more information, including conducting inventories on and monitoring existing protected areas; updating natural heritage survey data; collecting more information on species-at-risk needs; and integrating data collected from private lands, municipal and county natural areas, and private land trusts (Henson et al. 2005).

Restoration science was also commonly identified as an area that could use more research, as practitioners sought the most effective ways to restore different landscapes (PER1, PER2, PER3, PER4, VOL4, TEM1, TEM3). For example, the restoration guidelines provided in “How Much Habitat is Enough” note the lack of baseline literature on grasslands and lake habitats and suggest these as areas that “warrant further investigation as the state of ecological knowledge develops” (p.2, Bryan 2004). Similarly, one conservation action listed in the "Southern Norfolk Sand Plain Natural Area Conservation Plan" is to "facilitate the formation of a working group to research and develop 'best practices' guidelines and strategies for Common Reed management in the [Natural Area]" (Conservation Action 2.2.1, NCC 2009b).

Additionally, restoration work is changing the conservation landscape, and respondents noted the need for operating information to keep pace with these changes (PER4, VOL1, VOL4, TEM1, TEM2). For instance, PER4 explained the problem, indicating how the species lists used to create restoration plans were often outdated:

> "But a lot of your list of species isn't up to date, some of it is what we have here, but a lot of it is what we had that no longer exists, and you need to take that into consideration too" (PER4)

In the Long Point region, the most recent systematic surveying work appears to be the "Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk" (Gartshore et al. 1987), which is now over twenty years old. Both VOL1 and TEM1 suggested that this document needed to be updated to include recent changes to the landscape, while VOL4 noted how the local areas of natural and scientific interest that were designated based on this document should also be reassessed.

Outdated or inaccurate maps were also a concern that was described in some documents and by two respondents (VOL4, TEM2). For example, the "Big Picture" was described as a project with “accurate mapping of features (1:10 000) but limited by availability of local data” (NHIC & NCC, 2002). The “Great Lakes Conservation Blueprints” (NCC 2005) similarly expressed the need for current information, explaining how:

> “Although Ontario excels in digital landscape data compared to other jurisdictions, current digital data for natural heritage analysis is out-of-date or lacking altogether in some areas of the province.” (p.61, Wichert et al. 2005)

Additionally, TEM2 described how map boundaries that did not accurately reflect conservation values could impede conservation:

> “You are always forced to identify boundaries on something, and recently we’ve been involved in some conservation actions where these boundaries have become an inhibition to doing conservation… [when they don’t] reflect the particular habitat type you're trying to protect” (TEM2)

Similarly, VOL4 suggested how an area that was not originally documented as an ecological priority could now be seen as valuable if reassessed at a landscape level:

> “It wouldn’t show itself as being an area that should be protected in itself, but you kind of stack up all the relationships that that bit has with the rest of the landscape and you can justify it” (VOL4)

Restoration work is potentially accelerating the need to update these documents, since restored areas are transforming the landscape through linkages and enhancements. For example, areas of natural and scientific interest (ANSIs) which were designated based on inventory work done in the 1980s do not include any of the new restoration projects (VOL4, TEM2). VOL4 described them as being "implemented then frozen." TEM2 gave an example of this issue, describing how a site that was restored in the 1990s is now considered one of the best examples of tall grass prairie in the region; however, it is not designated as an ANSI and therefore does not have the protection that an ANSI provides (TEM2).

Interestingly, although I had expected climate change to be described by respondents as a conservation issue, only three respondents mentioned it without prompting and it was generally referred to only in passing (PER4, VOL1, TEM3). For example, two respondents included carbon sequestration when listing the benefits of restoration work (VOL1, TEM3), and one respondent similarly listed climate stability among other reasons for diversifying tree plantings (PER4).

Conversely, climate change was frequently mentioned in the reviewed documents. For example, the Ontario Woodlot Association prepared feature articles on the Kyoto Protocol and Climate Change (OWA 2010); the Long Point World Biosphere Reserve Foundation's brochure described how their monitoring work "allows scientists to monitor landscape response to climate changes and other environmental stresses" (LPWBRF 2009); and Conservation Ontario's Annual Reports frequently referred to their work in the context of climate change. For example, the 2007 Report had a pull-out box called "Creating a Climate for Change" (CO 2007) and the 2008 report described the importance of creating climate change adaptation strategies (CO 2008a). Similarly, the "Forest Corridor-Carbon Sequestration" reforestation program's role in climate change adaptation and mitigation is heavily promoted by Ontario Power Generation:

> "In addition to the sequestering of greenhouse gases, this effort is an important adaptation strategy for reducing the adverse effects of climate change on southern Ontario's forest wildlife. An interconnected system of habitat cores and habitat corridors, facilitating the dispersal of plants and animals to more favourable habitats, is an important management strategy to help conserve biodiversity in the face of rapidly changing climatic regimes." (p.2, Hounsell 2007)

Comparatively, when respondents discussed this project, they referred to it in terms of landscape connectivity and restoration, without linking it to potential climate change adaptation strategies (PER4, VOL1, VOL2).

The academic literature suggests that climate change modeling data is difficult to apply locally and regionally (Wiens & Bachelet 2010); this difficulty may partly address the divide between respondents and documents. However, when asked about studies that would help conservation in the area, no respondents referred to localized climate models. Additionally, one of the few academic examples of downscaled climate modeling used the Long Point area as a case study, linking local and regional data on temperature and precipitation (see Hamilton et al. 2001). When specifically asked about climate change science studies, only one respondent noted that the science surrounding carbon sequestration could be improved, as it was difficult to justify purchases based on sequestration potential and they were not aware of any existing funding programs they could use (VOL3).

An alternate explanation to the divide between respondents and documents may be that compared to other factors, respondents viewed climatic changes as a relatively small influence on conservation initiatives. For instance, when prompted about climate change, one respondent suggested that biotic rebound could be more important:

> "I'm not sure we're actually dealing with climate change as much as biotic rebound from glaciation, so we do take it into account but we're not planning for dramatic change yet…I guess the bottom line is that we're always dealing with climate change, but we don't exactly know what the climate is here" (VOL3)

Similarly, other respondents indicated their belief that the increasing use of biofuels would be the dominant factor in influencing future landscape changes, and play a major role in future conservation efforts (VOL1, TEM1, TEM3). Another respondent stated their belief that climate variation was a natural part of the area's ecosystem, and that they did not "believe in all the hoopla about catastrophic anthropogenic global warming" (PER6).

A final reason, suggested by VOL3, is that much of the work being done in the area is to protect Carolinian ecosystems and species; however, these species are at the northern limit of their range. Subsequently, emphasizing climate change has the potential to diminish the success of the area's conservation efforts, as species expansions could be credited to broader climatic trends rather than local actions (VOL3). Similarly, although northern boreal species may be negatively affected by climate change, VOL3 explained that "there is no advantage to focus on boreal species, it puts us into funding competitions with 80% of Canada and what is becoming rare and endangered here is common and prolific elsewhere."

Finally, advancements in technology also appear to be shaping the way some organizations are using and sharing knowledge in the Long Point region, particularly through GIS mapping (PER1, PER2, PER3, VOL3, TEM2) and digital photography (VOL4, TEM2). For example, one respondent described how their organization used mapping to prioritize purchases:

> "We have used a mapping approach to identify the significant parcels; we looked at size, we looked at connectivity, we used all these parameters, and of course, the mapping allows you to do that easily" (TEM2)

Another respondent discussed how maps allowed them to notice new connections and patterns in the landscape, such as the prevalence of prairie remnants along railway tracks (VOL3). Similarly, "The Great Lakes Conservation Blueprint Terrestrial" specifically states how:

> "With the recent innovation of being able to analyze multiple data layers in a GIS environment, it becomes possible for prioritization models to be more replicable and less prone to subjective bias." (p.18, Henson et al. 2005)

GIS mapping was also used in the development of the "Big Picture" (Carolinian Canada 2004), in the Long Point Region Conservation Authority's "Long Point Region Source Water Assessment Report" (LPRCA 2008), and was a suggested tool in a "How

Much Habitat is Enough" case study (Bryan 2004). Additionally, Conservation Ontario's Annual Reports refer to the Ontario Geospatial Data Exchange and their online, interactive GIS mapping program "CAMap" (CO 2003/2004; CO 2006), and the Norfolk Land Stewardship Council has initiated a project that would attach GIS mapping to a digital database of stewardship projects (Emery 2010).

To date, no organizations appear to use collaborative geomatics (for example, COMAP 2010), although this may partly be indicative of the recent emergence of this technology. When specifically asked, one respondent suggested that it could be a useful tool, but raised concerns about accessibility, particularly amongst volunteer members who had limited internet connections or less familiarity with technology (VOL3). There were also concerns about the possible implications of sharing sensitive data on potential property purchases (VOL3).

Similar accessibility problems were noted on the use of GIS maps, and although they were considered valuable, one respondent described how "discussions grind to a halt as the data specialist tries to find the right level and scale to project" (VOL3). "The Great Lakes Conservation Blueprint Terrestrial" specifically states how:

> "Future ecoregional planners should have adequate GIS expertise to manage large-scale GIS-based projects such as this." (p.98, Henson et al. 2005)

Another different technology-based trend is the increasing prevalence of portable, high quality, image capture devices such as digital cameras and mobile phones. Although only two respondents referred to these devices (TEM2, VOL4), and no documents mentioned them, they may prove to be an important tool for categorizing and legitimizing citizen observations. For example, VOL4 described how an individual documented a dead badger in an unexpected area by photographing it and emailing the image to an expert for verification.

4.4 SUMMARY

The results of the interviews and document analysis indicated how science is being characterized and applied in the Long Point region, and suggested how recent trends in the communication and use of stewardship science may be influencing local and regional conservation initiatives.

Specifically, the results indicated a difference in how conservation information is perceived, with respondents treating science-based knowledge separately from locally-based ecological knowledge. Scientific knowledge tended to be associated with a separate scientific community, and linked with the ideas of hypothesis testing, experiments, and formally published documents. Comparatively, local ecological knowledge was described as an individual's experiences and field observations, and was often shared through oral communication rather than being formally recorded.

Additionally, there was a third type of knowledge, referred to here as "embedded knowledge," that was implicitly used by respondents and indicated a general acceptance of certain ecological principles as fact. These differences are presented in the following table, table 4.1.

Table 4.1 Differences between scientific knowledge, local ecological knowledge, and embedded knowledge as described by interview respondents (PER1, PER2, PER3, PER4, PER5, PER6, VOL1, VOL2, VOL3, VOL4, TEM1, TEM2, TEM3).

	Scientific Knowledge	Local Ecological Knowledge	Embedded Knowledge
Description	*"Hard Science"* *"Real Science"* *"Book Smarts"*	*"Soft Science"* *"Observation"* *"Field Smarts"*	*"Fact"* *"Obvious"* *"Everyone Knows"*
Features	*Experiments* *Hypothesis Testing* *Scientific Method* *Peer Review/Publishing*	*Observations* *Experience-based* *Individuals Prominent*	*Implicit*
Producer	*Scientist* *Professional Researcher*	*Individual* *Local Community*	*Accepted by most Stewardship Organizations*
Examples	*GIS Maps* *Restoration experiments* *Research on population dynamics of species* *ANSI designations*	*SAR occurrences* *Individual site plans* *Restoration techniques* *Restoration successes*	*Ecological goods & services* *Cores/Corridors* *Buffers* *Reforestation*
Documentation/ Communication	*Academic Literature* *GIS Maps* *Big Picture, Blueprint*	*Person-to-person* *Collaborative papers* *Workshops*	*Government Policies* *Guidelines* *Mandate*

These characterizations of knowledge played an important role in how organizations prioritized, justified, and implemented conservation projects. When internally prioritizing projects a mix of all forms of knowledge appeared to be present, with an organization's mandate, different types of opportunities, and project champions also contributing to decision-making. However, scientific knowledge was almost exclusively used, or desired, by organizations when externally justifying projects to potential funders or the community. Finally, a mix of types of knowledge was used when organizations implemented projects. Local ecological knowledge seemed to be preferred for outreach activities, while scientific knowledge was used to guide restoration projects. However, local ecological knowledge also played an important role in adapting restoration activities to the local ecological and social environment, although these adaptations were much less likely to be formally recorded.

Finally, recent trends in stewardship science and conservation planning and management were influencing the Long Point region. All respondents spoke of collaboration among organizations, and there appeared to be a reliance on scientific principles when conducting conservation activities, along with an integration of social and economic considerations. Although many scientific principles were commonly used, respondents did note a need for more information, and updated information, on local species-at-risk occurrences and applied restoration practices, particularly in the context of the changing conservation landscape. Interestingly, no respondents directly mentioned climate change as a consideration for their work; however, this was frequently referred to in the reviewed documents. Additionally, GIS maps appear to play an increasing role in many organization's conservation decisions, while the prevalence of digital image capture devices may have the potential to affect future monitoring and documentation programs.

These findings will be explored in the following chapter, with an emphasis on how the results fit within the conceptual framework and existing academic literature, and the subsequent implications for collaborative and conservation planning.

Chapter 5: Discussion and Recommendations

My research explored the role of stewardship science in the Long Point region and considered how characterizations of science, applications of science, and recent trends in science are influencing the conservation planning activities of civil society environmental organizations. To guide this research I developed a conceptual framework that suggested how landscapes, economics, politics, culture, technology, and scientific and local ecological information interact to produce stewardship science, and how these interactions affect its credibility and application to modern conservation planning (based on Callon 1999; Phillips 2003; Bocking 2007; Francis 2008).

Within this framework, my results illustrated how different forms of information were considered and applied when prioritizing, justifying, and implementing conservation activities such as land acquisition, habitat restoration, and community-based monitoring projects. Additionally, the case study provided a location-specific example of how science-based management, collaboration, and integration are currently influencing these projects (see section 4.3). This demonstrated, as suggested in the conceptual framework (see section 3.4), how these principles could be applied beyond protected area management (Phillips 2003; Francis 2008) to cover a broader range of activities within conservation planning. The following discussion examines the implications of these conservation activities and paradigm with respect to collaborative planning theory and conservation planning and management.

5.1 DISCUSSION

5.1.1 The Role of Science in Conservation Planning

Bocking (2007) suggests that landscapes can play an important role in influencing the development of science within a disciplinary space. Science, in turn, can influence planning and management practices (Callon 1999; Phillips 2003; Yli-Pelkonen & Kohl 2005; Loo 2006; Doern & Kinder 2007; Francis 2008; Theberge & Theberge 2009). As a result, landscapes, science, and conservation planning are potentially interrelated. However, stewardship science is a dynamic field that is constantly adapting and evolving (Bocking 2001; Loo 2006; Kohler 2006), which may change the basis of past planning decisions. For instance, Whitelaw (2005) considered how science influenced the development of two conservation plans developed a decade and a half apart. He suggested that although both plans used the best available science of the time changes within science resulted in the plans taking different approaches to conservation, which provided differing forms of protection, and have now shaped the landscape in different ways (Whitelaw 2005).

Science-based management is a key feature of the modern paradigm of conservation planning and appeared to play an important role in directing conservation activities in the Long Point region. For instance, many of the conservation activities described by respondents are based on a stewardship science that values landscape-level connections. Subsequently, current projects in the region are creating and acquiring permanent corridors and linkages between protected areas (for instance, NCC 2005; Hounsell 2007; Ecoplans 2008). Similarly, science-based restoration and monitoring programs are building local ecological knowledge that may provide a foundation for later landscape changes (Olsson & Folke 2001). For example, one respondent spoke of how farmers who were already familiar with growing local prairie grasses may be more likely to choose native vegetation for biofuel production (TEM3). If many farmers made this choice it could produce significant habitat changes and re-shape the landscape based on the current use of stewardship science.

Ultimately, the values that inform conservation planning decisions potentially place a certain form of stewardship science on a landscape. This situation is currently creating challenges for many aspects of conservation planning and management as modern science draws attention to new issues (Hamilton et al. 2001; Merenlender et al. 2004; Deguise & Kerr 2006; Wiens & Bachelet 2010). For example, Lemieux and Scott (2005) stress how many of Canada's national parks were protected on the scientific assumption of climate stability, while other authors have suggested that isolated protected areas are not adequately supporting species at risk (Kerr & Cihlar

2004; Deguise & Kerr 2006). Accordingly, the interest in creating corridors by Long Point environmental organizations can be seen as an adaptation to past practices, as agencies attempt to connect isolated protected areas to promote the current scientific value of landscape connectivity.

Similar challenges occur when using outdated scientific information. In the Long Point region, respondents suggested how the lack of current scientific information was a hurdle to conducting conservation work (PER4, VOL1, VOL4, TEM1, TEM2). However, respondents also indicated how local ecological information could be used in situations where scientific information was scarce or lacking (PER2, PER4, PER5, PER6, VOL2, TEM3), or outdated (VOL4, TEM2). Consequently, the use of alternative forms of information did not necessarily undermine science-based management but instead complemented it (Berkes et al. 2000; Huntington 2000; Olsson & Folke 2001; Fazey et al. 2006; Duncan 2006), by assimilating locally-relevant and current information into conservation planning and management.

Accordingly, the challenge to successfully incorporating science in conservation planning is to recognize the scientific values that informed past decisions, assess this foundation against modern theory, and adapt prior stewardship activities to ensure they remain effective. To do this requires not only an understanding of current stewardship science, but also an understanding of its limitations and the potential role of local ecological knowledge in addressing these limitations.

5.1.2 The Role of Civil Society in Conservation Planning

Whitelaw (2005) suggests that "initiative, vision, and innovation from civil society" are an emerging element in collaborative planning approaches (p.173). This trend was present in the Long Point region, both through the prominent involvement of civil society environmental organizations, and through their collaborative interactions that promoted conservation innovation.

The majority of current conservation activities in the Long Point region appeared to be done by civil society organizations and agencies. Some respondents suggested that this was due to a lack of leadership by government (PER5, VOL1, VOL4), which is consistent with other findings that alternative management approaches can arise out of perceived deficiencies in government initiatives (Bocking 2002; Brewer 2003; Whitelaw et al. 2003; Bäckstrand 2004; Skogstad & Hartley 2007; Conrad & Daoust 2008; Dempsey & Dearden 2009). This pattern further supports the identified trend of a decreasing role of government in conservation management (Bocking 2002; Whitelaw et al. 2003; Skogstad & Hartley 2007; Daniels 2009; Edge & McAllister 2009) and an increasing prevalence of civil society-based leadership (Whitelaw 2005; Dempsey & Dearden 2009).

Although there are concerns over the broader implications of increased conservation management by civil society and the potential for protected-area fragmentation

(Merenlender et al. 2004; Fairfax et al. 2005; Reed 2007; Murphy & Noon 2007; Dearden & Dempsey 2009; see also section 3.2.2), in the Long Point region, collaboration seemed to address this concern through knowledge-sharing and niche differentiation. Through niche differentiation, respondents actively sought out unique projects to separate themselves from other organizations (PER3, PER6, VOL1, VOL2, VOL3, TEM2) that ultimately strengthened region-wide conservation efforts, while broader umbrella groups, such as Conservation Ontario or the Stewardship Network of Ontario, helped integrate local and regional efforts.

Similarly, respondents described local collaborations on issues of mutual interest (PER2, PER4, PER6, VOL1, TEM1, TEM3), which provided a venue for knowledge sharing and integration of efforts to minimize fragmentation. For instance, the national-scale Nature Conservancy of Canada partnered with the locally-based Long Point Basin Land Trust on the purchase and management of the Konrad Reserve (LPBLT 2010c). However, although they were not identified as barriers by respondents, some individuals noted the new restraints on sharing species-at-risk data (PER2, PER3, VOL4, TEM1) and expressed a desire to keep parcel-level acquisition information confidential (PER1, PER2, PER3, VOL3). These may pose future barriers to knowledge integration through collaboration.

Additionally, these collaborative processes appeared to provide a venue that drove local conservation innovation. This process fits within the conceptual framework developed for this research and acknowledges the role of landscapes in fostering place-based knowledge (Bocking 2007). However, the Long Point case study results also suggest how the model could be extended by demonstrating how place-based knowledge can be disseminated beyond the landscape that generates it through broader policy and planning initiatives and attention.

The Long Point landscape has long been recognized for its environmental value, with an early establishment of a provincial park, the creation of the Long Point Bird Observatory, and international recognition through UNESCO's World Biosphere Reserve program, Ramsar designation, and an International Bird Area designation (Killan 1993; Nelson & Wilcox 1996). Two respondents suggested that these characteristics have helped attract scientific expertise to the area, which has spurred local conservation awareness and initiatives (VOL3, VOL4), and has resulted in a large variety of environmental organizations that now operate in the area (Craig et al. 2003). This density, in turn, appeared to drive conservation innovation through collaboration and niche differentiation.

In the Long Point region, collaboration played an important role in developing a place-based knowledge as organizations and individuals shared information on locally applicable conservation practices to implement different projects (PER2, PER3, PER4, PER5, VOL1, VOL2, VOL3, TEM3). For example, one respondent described how a "pit and mound" restoration technique originated with one organization and subsequently spread to other local organizations (VOL3), while another respondent described how they learned restoration methods through local experts (TEM3). Through collaboration, organizations were therefore able to learn from the successes of other agencies and use this as a foundation for their own practices. Then, by attempting to differentiate themselves from the work of other organizations, they extended this foundation by experimenting in innovative ways. For instance, respondents described how the Long Point World Biosphere Reserve Foundation began a landscape-level reforestation project because they felt it was an unexplored area of conservation work, while the Long Point Basin Land Trust began looking at north-south corridor connections to separate themselves from the east-west corridor work of other organizations (VOL1, VOL3).

In the Long Point region this place-based knowledge also appeared to extend beyond the landscape where it was produced. For instance, broader initiatives have emerged, with Long Point representatives collaborating on Carolinian Canada's "Big Picture" project (CC 2004) and the Nature Conservancy of Canada's "Great Lakes Conservation Blueprints" (NCC 2005). This broader collaboration creates the potential for further dissemination of Long Point-developed place-based knowledge as the people involved in local practices use their knowledge and experience to influence broader initiatives. Additionally, some respondents mentioned how their restoration practices have been studied by scientists and published in academic literature (PER3, PER4, VOL1, VOL3, VOL4), which provides a further channel for locally-created knowledge to influence projects beyond its origin. These processes are illustrated below in figure 5.1.

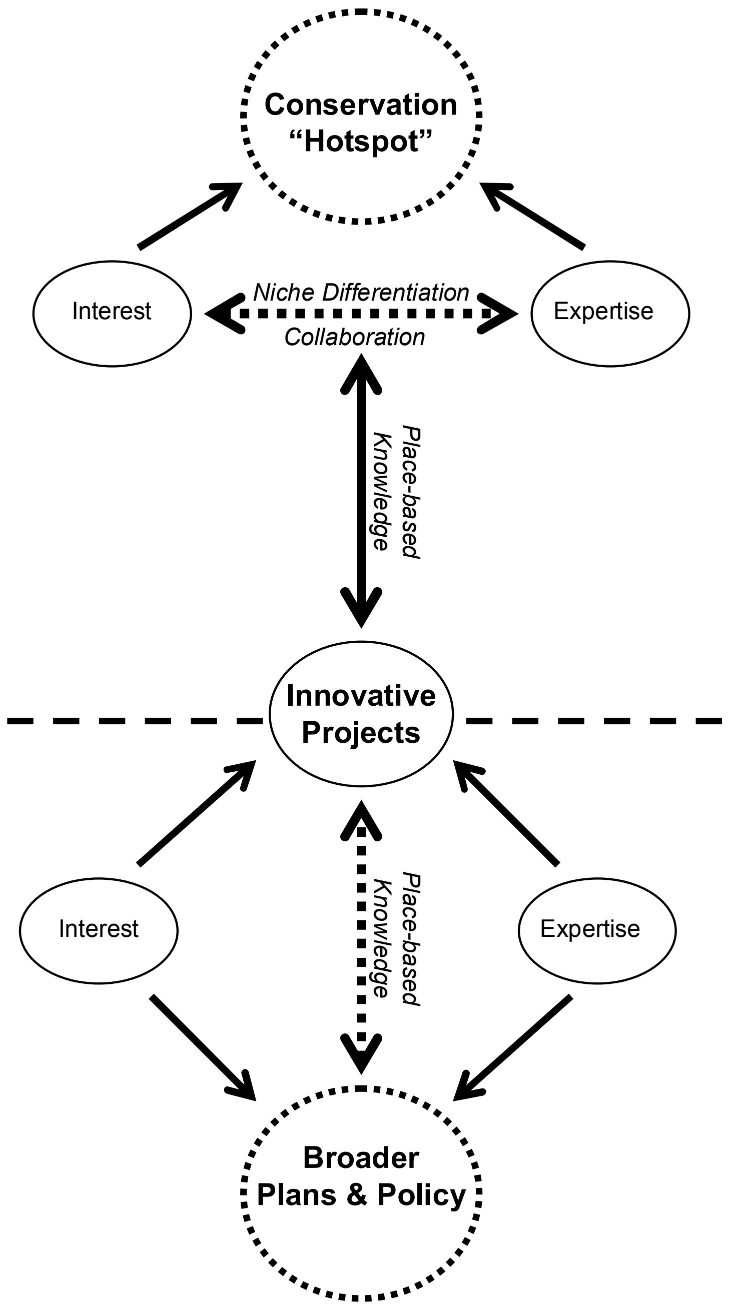


Figure 5.1 Dissemination of landscape influenced place-based knowledge through planning and policy. The process begins with a conservation "hotspot" attracting attention and expertise that interact through collaboration and differentiation to produce innovative projects. These projects attract broader attention and can then influence plans and policies that disseminate the place-based knowledge beyond its landscape of origin.

To summarize, this process of dissemination begins with an environmental "hotspot" attracting interest and expertise to a particular landscape. This fosters locally innovative conservation actions and thought, as organizations share knowledge through collaboration, but then use this place-based knowledge as a foundation to experiment with other techniques and projects to differentiate their own stewardship and conservation planning efforts. However, these innovative projects, combined with the area's environmental prominence, attract wider attention that provides a channel to integrate place-based knowledge into broader planning, policy, and management applications. This process consequently extends the use and application of place-based knowledge beyond the landscape that created it.

5.1.3 Integrating Local Knowledge into Conservation Planning

The previous discussions of the Long Point case study have highlighted the role of local ecological knowledge in supplementing the region's use of scientific knowledge and in contributing to a place-based knowledge that drives civil society-based innovation. Local ecological knowledge is also an important aspect of collaborative planning approaches, and Healey's (1998) fourth element of collaborative planning is the "use of local or practical knowledge." The results from Long Point indicate that local ecological knowledge was used differently when prioritizing, justifying, and implementing projects. Examining these differences through the conceptual framework and Callon's (1999) models of knowledge interaction (see section 3.1.3 and figure 3.1) suggests how local ecological information may be integrated with scientific information to potentially support collaborative approaches to conservation planning and achieve positive conservation outcomes.

In the Long Point region, it appears that a M1 model of knowledge integration (see figure 3.1) was most prevalent when externally justifying projects. This is consistent with the literature, which suggests that institutions may prefer science-based justifications to rationalize decision-making (Bocking 2004; Porter & Phillips 2007). Conversely, a M3 model (see figure 3.1) was most present in the implementation of stewardship projects, where site-specific scientific information was often limited (PER2, PER4, PER5, PER6, TEM3). This is also consistent with the literature, and parallels Yli-Pelkonen and Kohl's (2005) findings that the model is strongest when scientific knowledge is lacking and Callon's (1999) description of how a M3 model can adapt standardized scientific knowledge to specific situations.

Interestingly, a variety of factors, including an emphasis on local experience and observation, appeared to be present when internally prioritizing projects (see section 4.2.1), which is not consistent with any of the three models suggested by Callon (1999). This potentially indicates the existence of a fourth "M4" model (see figure 5.2), which emphasizes local ecological information. In this model, scientific information can influence local knowledge and experience, but credibility is achieved through place-based understanding and observation. This model was most present in situations where decisions were mainly internally or locally accountable (PER6, VOL1, VOL2, VOL3, TEM2), which potentially provides a greater amount of flexibility. This may play an important role in driving innovation, since the prioritization stage is when organizations seek out and choose unique projects, and the responsiveness provided by the use of local ecological information may promote experimentation in conservation activities.

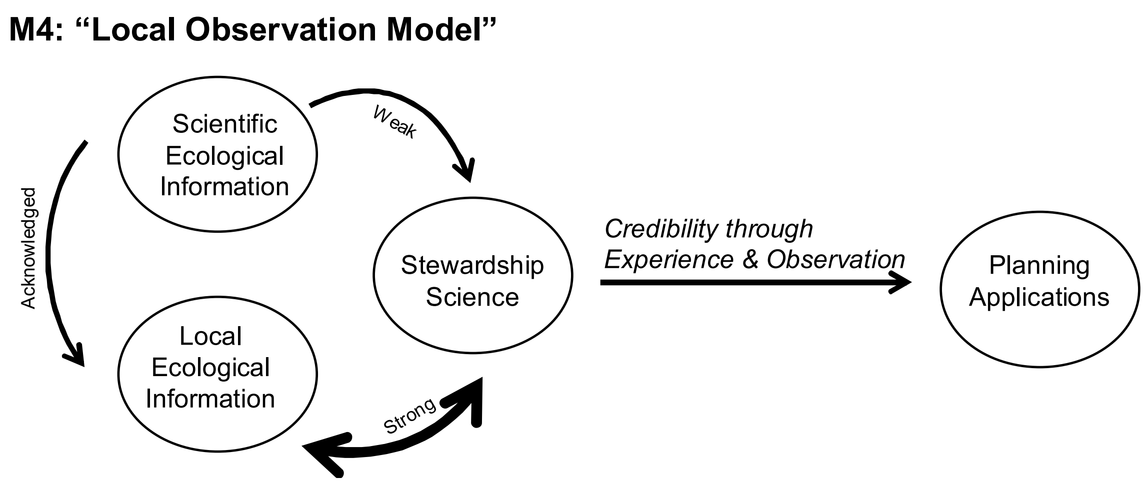


Figure 5.2 A "Local Observation" (M4) model for the integration and application of information for decision-making, where credibility is achieved through experience and observation. Extended from models presented by Callon (1999) and based on results from the Long Point case study.

Despite the presence of different models, it is also important to recognize the broader interactions between the prioritization, justification, and implementation stages of a stewardship project, and the corresponding interactions between these models and their use of local ecological information. For instance, although a project may be prioritized by an organization using a M4 model, it may not be implemented without the support gained through justification with a M1 model. Accordingly, although a

M4 model may exist, it still requires the support of other forms of knowledge and the other models. As a result, the balance between the different models may affect overall project credibility and conservation outcomes as the benefits, or weaknesses, of different models permeate a project.

For instance, skepticism over the scientific information gathered for the Long Point Causeway Improvement project appears to have slowed the project, as discussions focus on the scientific credibility of the justification (PER6, VOL1, VOL2), rather than other project aspects that may be achieved through implementation. This demonstrates how unsuccessful communication of scientific information, which is a risk of a M1 model (Callon 1999), can impact credibility and subsequently permeate a project. This example also parallels the literature, which suggests how emphasizing scientific information may mask social, political, or economic considerations in decision-making (Bocking 2004; Porter & Phillips 2007).

Conversely, the "Forest Corridor-Carbon Sequestration" reforestation program was externally justified using climate change science (see Hounsell 2007), an issue that appeared insignificant to respondents who discussed the project (PER4, VOL1, VOL2). However, respondents did describe the value of this initiative in ways that were achieved through implementation, such as choosing corridors that created landscape connectivity (VOL1). Therefore, the credibility achieved through actual implementation was able to permeate the overall project to create legitimacy, despite skepticism over its external justification. This suggests how the inherent credibility of a M3 model may lead to overall project credibility, even when other models are present at different stages. Accordingly, by enhancing a M3 model's presence, and the corresponding use of local ecological information, planners may be able to promote project legitimacy and collaborative planning approaches despite institutional pressure for scientific justifications.

5.2 RECOMMENDATIONS

5.2.1 For Conservation Planning Practice

These findings indicate the importance of both science and civil society to modern conservation planning. Key recommendations for planners include the need to:

- Recognize the variability within science and the need to re-evaluate, and potentially adapt, past conservation activities to maintain their effectiveness.
- Acknowledge and respect the role of local ecological knowledge in conservation activities, particularly its ability to supplement outdated or lacking scientific knowledge and its ability to promote innovation.
- Concurrently understand the potential limitations of local ecological knowledge and evaluate its use with respect to its value-laden nature (Yli-Pelkonen & Kohl 2005), potential for inaccuracies (Huntington 2000; Yli-Pelkonen and Kohl 2005), and situational dependency (Fazey et al. 2006).
- Develop mechanisms that enhance the integration of local ecological knowledge in decision-making to promote overall project credibility. For instance, technology-based mapping, collaborative geomatics, and community monitoring programs provide potential venues for the co-creation of

> knowledge (Ceccato & Snickars 2000; Bojórquez-Tapia et al. 2001; Whitelaw et al. 2003; Duncan 2006; Conrad & Daoust 2008; Dempsey & Dearden 2009; COMAP 2010).

Additionally, this research has illustrated the prominent role of civil society-based environmental organizations in the Long Point region, a pattern that is potentially present in other areas. Subsequently, conservation planning must recognize the contributions of these organizations, along with more formalized approaches to planning, to best promote comprehensive conservation efforts.

5.2.2 For Civil Society Based Environmental Organizations

Many of the recommendations for planning practice also apply to the work of civil society environmental organizations as they are also engaging in conservation planning. For instance, environmental organizations would also benefit by recognizing the variability within science and the need to re-evaluate, and potentially adapt, past conservation activities to maintain their effectiveness. This, in turn, involves remain abreast of current scientific developments.

Similarly, many of the Long Point environmental organizations indicated their use of local ecological knowledge, but a preference for scientific information when justifying projects. Consequently, these organizations could seek to validate their use of local ecological knowledge through parallel scientific processes. This would provide a means to internally evaluate the accuracy of their own knowledge-base, while creating a framework that could promote it. Considering how scientific processes could be implemented at the initiation of a project may also help reduce their potential burden by integrating them with other project aspects, and provide a mechanism to judge subsequent project performance. Potential partnerships with academic researchers could also be investigated and actively pursued, and may provide an additional means of reducing the possible burdens of the research commitment.

Additionally, initiating parallel scentific processes could help integrate organizations into the production of knowledge, and potentially enhance the integration of local ecological knowledge in decision-making to promote overall project credibility. This could be particularly relevant to Long Point organizations involved with the Long Point Causeway Improvement project, where providing a venue for the co-production of knowledge may enhance credibility and help diffuse tension. Potential tools to support the legitimacy of local ecological knowledge may involve the use of collaborative geomatics that build on existing stewardship tracking programs, and a formalized integration of cell-phone and digital camera use into citizen monitoring programs.

Finally, climate change mitigation and adaptation appears to be an untapped area of conservation within the Long Point region. Work by the Canadian Biosphere

Reserves Association Climate Change Initiative (see Hamilton et al. 2001) has potentially provided a foundation to support future projects through downscaling data, and this foundation could be capitalized on by an interested organization.

Chapter 6: Conclusion

6.1 CONTRIBUTIONS

By examining how civil society environmental organizations have used science to achieve their conservation objectives, my research has expanded the understanding of both the role of science and the role of civil society in conservation planning and collaborative planning theory. Specifically, this research:

- Presented a definition of conservation planning, and illustrated how the principles of modern protected area planning and management (Phillips 2003; Francis 2008) could be further extended to include broader stewardship activities such as restoration and monitoring.

- Suggested how place-based knowledge could be disseminated beyond the landscape that generates it through policy and planning initiatives, which potentially extends Bocking's (2007) model of knowledge creation.

- Examined the role of civil society within collaborative planning processes, to support Whitelaw's (2005) suggestion that civil society can provide initiative, vision, and innovation.

- Applied Callon's (1999) models of knowledge formation and dissemination to conservation planning to suggest processes that support the use of local information in collaborative planning (Healey 1998).

- Proposed a fourth, M4 model, of knowledge integration, which expands Callon's (1999) processes of knowledge dissemination to include a situation where local experiences and observations drive credibility.

These findings can potentially assist both environmental organizations and planners in effectively communicating and applying science to better achieve their conservation goals and objectives.

6.2 DIRECTIONS FOR FUTURE RESEARCH

This research identified important trends and processes in how conservation planning uses and considers science. However, it explored these ideas through a single case study, and the transferability of the findings would be strengthened by examining these concepts in other locations. Specifically, further studies could explore:

- The broader application of place-based knowledge and the role "conservation hotspots" may play as "innovation hotspots" for conservation planning and management by attracting support and building capacity. This could be explored through additional case studies, or through the use of quantitative approaches such as using census data characteristics to help identify hotspots or quantify conservation project descriptions and their outcomes.

- Limitations in the use of local ecological knowledge when applied to broader planning and policy initiatives, specifically its value and accuracy when removed from its local context.

- The existence of a M4 model of local ecological knowledge integration, the factors that promote it, and how it may interact with other models of knowledge dissemination.

- The interactions between civil society organizations and government within the modern paradigm of conservation planning.

- The interactions between civil society organizations and academic researchers within the modern paradigm of conservation planning, specifically how researchers become attracted to certain areas and how civil society organizations can best communicate their research needs.

- Potential techniques to re-adapt past landscapes to current standards of stewardship science.

- The role of modern technology, such as cell-phones and digital cameras, in legitimizing citizen monitoring data.

- The use of climate change science and the factors that promote or diminish local mitigation and adaptation strategies.

6.3 FINAL THOUGHTS

Scientific knowledge is manifesting itself on the landscape in permanent ways, but science itself is malleable. Over time, stewardship science has shifted from a species-specific and resource-oriented focus to a systems-driven landscape level analysis. As planners, we must recognize the variability and uncertainty within science and the role of "best available data" in decision-making. In some cases, this may include recognition of alternative forms of information, such as local ecological knowledge, which may be more reflective of local realities, particularly in recently emerging scientific areas. Ultimately, it is important to maintain flexibility both in considering forms of knowledge, and when designing management plans and policies within a shifting geographic and cognitive landscape.

References

Ackermann, R.J. 1985. *Data, Instruments, and Theory: a Dialectic Approach to Understanding Science*. New Jersey: Princeton University Press.

Ahmed, F. 1999. "A Shared Environmental Challenge." In A. Van Rooy (ed) *Civil Society and Global Change: Canadian Development Report*. 1999. Ottawa: The North South Institute.

Alternative Land Use Services. 2010a. "Norfolk ALUS Pilot Project." Online at: www.norfolkalus.com. Accessed on February 25, 2010.

Alternative Land Use Services. 2010b. "ALUS and Ontario's Climate Change Policy: Where does ALUS fit, and why?" Meeting Invitation.

Artibise, A. and G. Stelter. 1981. "Conservation Planning and Urban Planning: The Canadian Commission of Conservation in Historical Perspective." In C. Gaffield and P. Gaffield (eds) *Consuming Canada: Readings in Environmental History*. 1981. Toronto: Copp Clark Ltd. Pp. 152-169.

Ashley, P. 2007. "Long Point Causeway Improvement Project." Powerpoint.

Ashley, P. and J. Robinson. 1996. "Road Mortality of Amphibians, Reptiles, and Other Wildlife on the Long Point Causeway, Lake Erie, Ontario." *The Canadian Field Naturalist*. Vol 110: 403 - 412.

Ashley, P., A. Kosloski, and S. Petrie. 2007. "Incidence of Intentional Vehicle-Reptile Collisions." *Human Dimensions of Wildlife*. Vol 12 (3): 137 – 143.

Bäckstrand, K. 2004. "Civic Science for Sustainability: reframing the role of experts, policy-makers and citizens in environmental governance." *Global Environmental Politics*. Vol 3 (4): 24 - 41.

Bailey, R. 2005. "ALUS: An Opportunity for Agriculture to Lead in Conservation." Powerpoint.

Bailey, R. and L. Greenslade. 2006. "ALUS: A benchmark survey of public opinion on the environment in relation to farming and the quality of life in Norfolk County."

Beazley K. and J. Nelson. 1993. "Forests of the Long Point Area: Landscape History and Strategic Planning." Long Point Environmental Folio Series, Technical Paper #3. Heritage Resources Centre, University of Waterloo, Waterloo, Ontario

Berg, B. 2007. *Qualitative Research Methods for the Social Sciences, 6th Edition*. Long Beach: California State University.

Berkes, F., J. Colding, and C. Folke. 2000. "Rediscovery of Traditional Ecological Knowledge as Adaptive Management." *Ecological Applications*. Vol 10 (5): 1251-1262.

Bloor, D. 1976. "The Strong Programme in the Sociology of Science," from *Knowledge and Social Imagery*. In R. Klee (ed) *Scientific Inquiry: Readings in the Philosophy of Science.* 1999. Oxford: Oxford University Press. Pp. 241 – 250.

Bocking, S. 1997. *Ecologists and Environmental Politics: A History of Contemporary Ecology*. New Haven: Yale University Press.

Bocking, S. 2001. "The Politics of Endangered Species: A Historical Perspective." In K. Beazley and R. Boardman (eds) *The Politics of the Wild: Canada and Endangered Species*. 2001. Toronto: Oxford University Press. Pp. 119-136.

Bocking, S. 2002. "Agendas, Interests and Authority: Science and Politics in Canada," *Journal of Canadian Studies*. Vol 37(3): 5-13.

Bocking, S. 2004. *Nature's Experts: Science, Politics, and the Environment*. New Brunswick, NJ: Rutgers University Press.

Bocking, S. 2005. "Protecting the Rain Barrel: Discourses and the Roles of Science in a Suburban Environmental Controversy." *Environmental Politics*. Vol 14(5): 611-628.

Bocking, S. 2007. "Science and Spaces in the Northern Environment." *Environmental History*. Vol 12: 868-895.

Boghossian, P. 1996. "The Sokal Hoax." In R. Klee (ed) *Scientific Inquiry: Readings in the Philosophy of Science.* 1999. Oxford: Oxford University Press. Pp. 265 – 273.

Bojórquez-Tapia, L., S. Díaz-Mondragón, and E. Ezcurra. 2001. "GIS-based approach for participatory decision making and land suitability assessment. *International Journal of Geographical Information Science*. Vol 15 (2): 129-151.

Brewer, R. 2003. *Conservancy: The Land Trust Movement in America*. London: University Press of New England.

Bryan, G. 2004. "Great Lakes Fact Sheet: How Much Habitat is Enough. 2nd Edition." Environment Canada.

Burke, S. M. and N. Mitchell. 2007. "People as Ecological Participants in Ecological Restoration." *Restoration Ecology*. Vol 15 (2): 348-350.

Callon, M. 1999. "The Role of Lay People in the Production and Dissemination of Scientific Knowledge." *Science, Technology, and Society*. Vol 4 (1): 81 – 94.

Canada Wildlife Act, S.C. 1973.

Canadian Environmental Assessment Act, S.C. 1995.

Carolinian Canada. 2004. "The Big Picture." Online at: www.carolinian.org/BigPictureMap_Norfolk.htm. Accessed on February 25, 2010.

Carolinian Canada. 2008. "Caring for Nature in Norfolk." Brochure.

Carson, R. 1962. *Silent Spring*. Boston: Houghton Mifflin.

Castel, B. and S. Sismondo. 2003. *The Art of Science*. Mississauga: Broadview Press.

Ceccato, V. and F. Snickars. 2000. "Adapting GIS technology to the needs of local planning." *Environment and Planning B: Planning and Design*. Vol 27: 923-937.

Centre for Community Mapping. 2010. "Centre for Community Mapping." Online at: www.comap.ca. Accessed on April 9, 2010.

Clark, D., S. Fluker, and L. Risby. 2008. "Deconstructing Ecological Integrity Policy in Canadian National Parks." In K. Hanna, D. Clark and D. Scott Slocombe (eds) *Transforming Parks and Protected Areas: Policy and Governance in a Changing World.* 2008. New York: Routledge. Pp.154-168.

Conrad, C. 2006. "The Community-Based Environmental Monitoring Network." *Living Knowledge: International Journal of Community Based Research*. Vol 7: 5-7.

Conrad, C. and T. Daoust. 2008. "Community-Based Monitoring Frameworks: Increasing the Effectiveness of Environmental Stewardship." *Environmental Management*. Vol 41(3): 358-388.

Conservation Authorities Act, S.O. 1946.
Conservation Authorities Act, R.S.O. 1990, c. C.27.
Conservation Ontario. 2003. "Conservation Ontario Annual Report."
Conservation Ontario. 2004. "Conservation Ontario Annual Report."
Conservation Ontario. 2005. "Conservation Ontario Annual Report."
Conservation Ontario. 2006. "Conservation Ontario Annual Report."
Conservation Ontario. 2007. "Conservation Ontario Annual Report."
Conservation Ontario. 2008a. "Conservation Ontario Annual Report."
Conservation Ontario. 2008b. "Adapting to Climate Change: Conservation Authorities on the Front Line." Powerpoint.
Conservation Ontario. 2009a. "Conservation Authorities of Ontario Mandate." Online at: www.conservation-ontario.on.ca/about/mandate.html. Accessed on February 23, 2010.
Conservation Ontario. 2009b. "Climate Change. Media Release."
Conservation Ontario. 2010a. "Fact Sheet." Online at: http://www.conservation-ontario.on.ca/resources/Fact_sheets/CO_Fact_Sheet_Feb_2010.pdf. Accessed on April 3, 2010.
Conservation Ontario. 2010b. "Break Wind, Make Money." Brochure.
Conservation Ontario. 2010c. "Stewardship Partners Working Together to Recover Species at Risk." Brochure.
Craig, B., G. Whitelaw, J. Robinson, and P. Jongerden. 2003. "Community Based Ecosystem Monitoring: A Tool for Developing and Promoting Ecosystem-Based Management and Decision Making in the Long Point World Biosphere Reserve." Proceedings of the Fifth Science and Management of Protected Areas Association Conference. Victoria, BC. Available at: http://www.sampaa.org/PDF/ch4/4.4.pdf. Accessed on August 2, 2009
Daniels, T. 2009. "A Trail Across Time: American Environmental Planning from City Beautiful to Sustainability." *Journal of the American Planning Association*. Vol 17 (2): 178 – 192.
Danielsen, F., N. . Burgess, and A. Balmford. 2005. "Monitoring Matters: Examining the Potential of Locally-Based Approaches." *Biodiversity and Conservation*. Vol 14: 2507-2542.
Dearden, P. and Dempsey, J. 2004. "Protected Areas in Canada: Decade of Change." *Canadian Geographer*. Vol 48(2): 225-39.
Deguise, I. and J. Kerr. 2006. "Protected Areas and Prospects for Endangered Species Conservation in Canada." *Conservation Biology*. Vol 20 (1): 48 – 55.
Delta Waterfowl. 2010. "Alternative Land Use Services." Online at: www.deltawaterfowl.org. Accessed on February 25, 2010.
Dempsey, J. and P. Dearden. 2009. "Stewardship: Expanding Ecosystem Protection." In P. Dearden and R. Rollins (eds) *Parks and Protected Areas in Canada: Planning and Management. 3rd Edition*. 2009. Toronto: Oxford University Press. Pp. 432 - 454.
Doern, G.B. and T. Reed. 2000. "Canada's Changing Science-Based Policy and Regulatory Regime: Issues and Framework." In G.B Doern and T. Reed (eds) *Risky Business. Canada's Changing Science-Based Policy and Regulatory Regime*. 2000. Toronto: University of Toronto Press. Pp.3 - 28.

Doern, G.B and J.S. Kinder. 2007. *Strategic Science in the Public Interest: Canada's Government Laboratories and Science-Based Agencies*. Toronto: University of Toronto Press.

Drummond, W. and S. French. 2008. "The Future of GIS in Planning: converging technologies and diverging interests." *Journal of the American Planning Association*. Vol 74 (2): 161-174.

Duncan, S. L. 2006. "Mapping Whose Reality? Geographic Information Systems (GIS) and 'Wild Science.'" *Public Understanding of Science*. Vol 15: 411-434.

Ecoplans. 2008a. "Long Point Causeway Improvement Plan."

Ecoplans. 2008b. "Long Point Causeway Improvement Plan." Powerpoint.

Edge, S. and McAllister, M.L. 2009. "Place-based Local Governance and Sustainable Communities: lessons from Canadian biosphere reserves." *Journal of Environmental Planning and Management*. Vol 52 (3): 1-18.

Emery, M. 2010. "Stewardship Council Project Data Base Tracking and Reporting System Funding Application."

Endangered Species Act, S.C. 1973.

Endangered Species Act, S.O. 2007.

Environment Canada. 2009. "All About EMAN." Online at: www.eman-rese.ca/eman/program/about.html. Accessed on April 9, 2010.

Environmental Assessment Act, S.O. 1975.

Fairfax, S., L. Gwin, M. A. King, L. Raymond, and L. Watt. 2005. *Buying Nature: The Limits of Land Acquisition as a Conservation Strategy, 1780-2004.*. Cambridge: The MIT Press.

Fazey, J., A. Fazey, A. Salisbury, D. Lindenmayer, and S. Dovers. 2006. "The nature and role of experiential knowledge for environmental conservation." *Environmental Conservation*. Vol 33(1): 1-10.

Feyerabend, P. 1978. "An Argument Against Method." In R. Klee (ed) *Scientific Inquiry: Readings in the Philosophy of Science*. 1999. Oxford: Oxford University Press. Pp. 228 – 236.

Frame, T.M., T. Gunton, and J.C. Day. 2004. "The Role of Collaboration in Environmental Management: An Evaluation of Land and Resource Planning in BC." *Environmental Planning and Management*. Vol 47(1): 59-82.

Francis, G. 2008. "Evolution of Contexts for Protected Areas Governance." In K. Hanna, D. Clark and D. Scott Slocombe (eds). *Transforming Parks and Protected Areas: Policy and Governance in a Changing World*. 2008. New York: Routledge. Pp.15 - 38.

Francis, G. and G. Whitelaw. 2001. "Long Point Biosphere Reserve, Periodic Review Report: 2001."

Frank, A. 2003. "Graphic Communication." In H. Dandekar (ed) *The Planner's Use of Information*. 2003. Chicago: Planner's Press. Pp. 293-339.

Gaber, J. and S. Gaber. 2005. *Qualitative Analysis for Planning and Policy: Beyond the Numbers*. Chicago: Planners Press.

Gartshore, M., D. Sutherland, and J. McCracken. 1987. *The Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk*. Norfolk Field Naturalists.

Hamilton, J., Whitelaw, G. and A. French. 2001. "Mean Annual Temperature and Total Annual Precipitation Trends at Canadian Biosphere Reserves." *Environmental Monitoring and Assessment*. Vol 67 (1-2): 239 - 275.

Hanna, L., G. F. Midgley, T. Lovejoy, W. J. Bond, M. Bush, J. C. Lovett, D. Scott, and F. I. Woodward. 2002. "Conservation of Biodiversity in a Changing Climate." *Conservation Biology*. Vol 16 (1): 264 – 268.

Hanna, K., D. Clark, and D. S. Slocombe. 2008. "Introduction: protected areas in a changing world." In K. Hanna, D. Clark and D. Scott Slocombe (eds). *Transforming Parks and Protected Areas: Policy and Governance in a Changing World*. 2008. New York: Routledge. Pp.1-12.

Harding, S. 1998. *Is Science Multicultural? Postcolonialisms, Feminisms, and Epistemologies*. Indianapolis: Indiana University Press.

Healey, P. 1998. "Building Institutional Capacity Through Collaborative Approaches to Urban Planning." *Environment and Planning A*. Vol 30: 1531-1546.

Henson, B. and K. Brodribb. 2005. "Great Lakes Conservation Blueprint Terrestrial. Volume II."

Henson, B., K. Brodribb, and J. Riley. 2005. "Great Lakes Conservation Blueprint Terrestrial. Volume I."

Hobbs, R. J., and D. A. Norton. 1996. "Towards a Conceptual Framework for Restoration Ecology." *Restoration Ecology*. Vol 4 (2): 93-110.

Hodge, G. & D. Gordon. 2008. *Planning Canadian Communities: 5th ed*. Toronto: Nelson.

Hounsell, S. 2007. "Biodiversity Programs at Ontario Power Generation."

Huntington, H. 2000. "Using Traditional Ecological Knowledge in Science: Methods and Applications." *Ecological Applications*. Vol 10 (5): 1270-1274.

Kerr, J. and J. Cihlar. 2004. "Patterns and Causes of Species Endangerment in Canada." *Ecological Applications*. Vol 14 (3): 743 - 753.

Killan, G. 1993. *Protected Places: A History of Ontario's Provincial Park System*. Toronto: Dundurn Press.

Kitcher, P. 1993. "Realism and Scientific Progress." In R. Klee (ed) *Scientific Inquiry: Readings in the Philosophy of Science*. 1999. Oxford: Oxford University Press. Pp. 330 – 337.

Kohler, R. E. 2006. *All Creatures: Naturalists, Collectors, and Biodiversity, 1850-1950*. Princeton: Princeton University Press.

Kuhn, T. 1970. *The Structure of Scientific Revolution, Second Edition*. Chicago: University of Chicago Press.

Lacey, H. 1999. *Is Science Value Free? Values and Scientific Understanding*. New York: Routledge.

Larson, B. M. H. 2005. "The war of the roses: Demilitarizing invasion biology." *Frontiers in Ecology and the Environment*. Vol 3(9): 495-500.

Leopold, A. 1948. *Sand County Almanac*. New York: Oxford University Press.

Lemieux, C. J., and Scott, D. J. 2005. "Climate Change, Biodiversity Conservation and Protected Area Planning in Canada." *Canadian Geographer*. Vol 49(4): 384-99.

Long Point Act, S.O. 1921.

Long Point Basin Land Trust. 2008a. "Conserving Carolinian Reptiles." Project Outline.

Long Point Basin Land Trust. 2008b. "LPBLT Newsletter: Summer 2008."
Long Point Basin Land Trust. 2009. "LPBLT Newsletter: Spring 2009."
Long Point Basin Land Trust. 2010a. "Long Point Basin Land Trust." Online at: www.lpblt.on.ca/. Accessed on February 25, 2010.
Long Point Basin Land Trust. 2010b. "Long Point Basin Land Trust." Brochure.
Long Point Basin Land Trust. 2010c. "LPBLT Newsletter: Winter 2010."
Long Point Biosphere. 2010. "Long Point World Biosphere." Online at: www.longpointbiosphere.org. Accessed on February 23, 2010.
Long Point Region Conservation Authority. 2002. *Watershed Strategies*.
Long Point Region Conservation Authority. 2008. "Long Point Region Source Water Assessment Report."
Long Point Region Conservation Authority. 2009. "Long Point Region Conservation Authority." Online at: www.lprca.on.ca. Accessed on February 23, 2010.
Long Point World Biosphere Reserve Foundation. 2000. "Long Point World Biosphere Reserve Foundation Habitat Restoration Project." Online at: <http://longpointbiosphere.com/Publications/Habitat%20Restoration/content.htm> Accessed on March 14, 2010.
Long Point World Biosphere Reserve Foundation. 2007. "Long Point World Biosphere Reserve Foundation Forest Corridor Project." Powerpoint.
Long Point World Biosphere Reserve Foundation. 2010. "Biosphere Matters Newsletter." Vol 1 (1).
Loo, T. 2006. *States of Nature: Conserving Canada's Wildlife in the Twentieth Century*. Vancouver: University of British Columbia Press.
Marcum, J.A. 2005. *Thomas Kuhn's Revolution.* New York: Continuum.
Margerum, R. D. 2002. "Collaborative Planning: Building Consensus and Building a Distinct Model for Practice." *Planning Education and Research*. Vol 21: 237-253.
Marine Mammal Protection Act, S.C. 1972.
McCarthy, D., G. Whitelaw, P. Jongerden, and B. Craig. 2006. "Contributions of four Long Point sustainability workshops to community social learning and the logistics function of the biosphere reserve." *Environments: A Journal of Interdisciplinary Studies*. Vol 34(2): 79-91.
McCracken, G. 1988. "The Long Interview: Qualitative Research Methods." *Qualitative Research Methods 13*. Thousand Oaks: Sage Publications.
McHarg, Ian. 1969. *Design with Nature*. New York: Wiley.
McOuat, G. 2007. "Science Studies Encounter with Public Science: Mertonian Norms, the Local Life of Science, and the Long Duré." In J. Porter & P. Phillips (eds) *Public Science in Liberal Democracy*. 2007. Toronto: University of Toronto Press. Pp.121 – 134.
Merenlender, A.M., L. Huntsinger, G. Guthey, and S.K. Fairfax. 2004. "Land Trusts and Conservation Easements: who is conserving what for whom?." *Conservation Biology*. Vol 18(1): 65-75.
Merriam, S. B. 2009. *Qualitative Research: A Guide to Design and Implementation*. USA: Jossey-Bass (Wiley).
Merriam-Webster. 2010. "Science." *Merriam-Webster Online Dictionary*. Online at: <www.merriam-webster.com/dictionary/Science>. Accessed on January 11, 2010

Milne, R., G. Rosolen, G. Whitelaw, and L. Bennett. 2006. "Multi-Party Monitoring in Ontario: Challenges and Emerging Solutions." *Environments: A Journal of Interdisciplinary Studies*. Vol 34(1): 11-23.

Murphy, D. and B. Noon. 2007. "The Role of Scientists in Conservation Planning on Private Lands." *Conservation Biology*. Vol 21(1): 25-28.

Natural Heritage Information Centre and Nature Conservancy of Canada. 2002. "Big Picture." Powerpoint.

Nature Conservancy of Canada. 2000. "NCC Stewardship Manual 2000."

Nature Conservancy of Canada. 2004. "NCC Stewardship Manual 2004."

Nature Conservancy of Canada. 2005. "Great Lakes Conservation Blueprints."

Nature Conservancy of Canada. 2006. "NCC Conservation Policy Framework."

Nature Conservancy of Canada. 2009a. "Nature Conservancy of Canada." Online at: www.natureconservancy.ca. Accessed on February 23, 2010.

Nature Conservancy of Canada. 2009b. "Southern Norfolk Sand Plain Natural Area Conservation Plan, 2009-2013: Overview."

Nelson, J. and K. Wilcox. 1996. *Long Point Environmental Folio*. Heritage Resource Centre. University of Waterloo. Waterloo, Ontario

Newburn, D., S. Reed, P. Berck, and A. Merenlender. 2005. "Economics and Land-Use Change in Prioritizing Private Land Conservation." *Conservation Biology*. Vol 19(5): 1411- 1420.

Noble, B. 2010. *Introduction to Environmental Impact Assessment: A guide to principles and practices. 2nd Edition*. Don Mills: Oxford University Press.

Norfolk Federation of Agriculture. 2010. "Growing a Better Environment in Norfolk County with Alternative Land Use Services (ALUS)." Brochure.

Norfolk Land Stewardship Council. 1997. "Norfolk Land Stewardship Council Annual Report: 1996-1997."

Norfolk Land Stewardship Council. 1998. "Norfolk Land Stewardship Council Annual Report: 1997-1998."

Norfolk Land Stewardship Council. 1999. "Norfolk Land Stewardship Council Annual Report: 1998-1999."

Norfolk Land Stewardship Council. 2000. "Norfolk Land Stewardship Council Annual Report: 1999-2000."

Norfolk Land Stewardship Council. 2001. "Norfolk Land Stewardship Council Annual Report: 2000-2001."

Norfolk Land Stewardship Council. 2002. "Norfolk Land Stewardship Council Annual Report: 2001-2002."

Norfolk Land Stewardship Council. 2003. "Norfolk Land Stewardship Council Annual Report: 2002-2003."

Norfolk Land Stewardship Council. 2004. "Norfolk Land Stewardship Council Annual Report: 2003-2004."

Norfolk Land Stewardship Council. 2005. "Norfolk Land Stewardship Council Terms of Reference."

Norfolk Land Stewardship Council. 2005. "Norfolk Land Stewardship Council Annual Report: 2004-2005."

Norfolk Land Stewardship Council. 2006. "Norfolk Land Stewardship Council Annual Report: 2005-2006."

Norfolk Land Stewardship Council. 2007. "Norfolk Land Stewardship Council Annual Report: 2006-2007."

Norfolk Land Stewardship Council. 2008. "Norfolk Land Stewardship Council Annual Report: 2007-2008."

Norfolk Land Stewardship Council. 2009. "Norfolk Land Stewardship Council Annual Report: 2008-2009."

Norfolk Land Stewardship Council. 2010a. "NLSC 2010-2013 Profile."

Norfolk Land Stewardship Council. 2010b. "NLSC Guidelines for Project Eligibility and Funding."

Norfolk Woodlot Owners Association. 2005. "Norfolk Woodlot Owners Association." Online at: http://www.norfolkwoodlots.com. Accessed on February 25, 2010.

Norfolk Woodlot Owners Association. 2007. "News Online." Online at: <www.norfolkwoodlots.com/pages/news.htm > Accessed on March 14, 2010.

Olsson, P. and C. Folke. 2001. "Local Ecological Knowledge and Institutional Dynamics for Ecosystem Management: A Study of Lake Racken Watershed, Sweden." *Ecosystems*. Vol 4 (2): 85-104.

Ontario Land Trust Alliance and Ontario Heritage Trust. 2006. "Baseline Documentation Report."

Ontario Land Trust Alliance. 2010 "Members Page." Online at: www.olta.ca/members.aspx?page_name=Members_Map/Members/long_point_basin_land_trust&restricted=no. Accessed on February 25, 2010.

Ontario Ministry of Environment. 2007. "History of the Ministry from 1972 to 1997." Online at: www.ene.gov.on.ca/en/about/org/moehistory.php. Accessed on April 8, 2010.

Ontario Ministry of Natural Resources. 1999. "Natural Heritage Reference Manual." OMNR.

Ontario Ministry of Natural Resources. 2006a. "A Guide to Stewardship Planning for Natural Areas."

Ontario Ministry of Natural Resources. 2006b. "Land Stewardship Programs." Online at: www.mnr.gov.on.ca/en/Newsroom/LatestNews/MNR_E004009.html/. Accessed on February 25, 2010.

Ontario Ministry of Natural Resources. 2007. "Ontario Stewardship Guidelines."

Ontario Ministry of Natural Resources. 2008. "Species at Risk Stewardship Fund." Online at: www.mnr.gov.on.ca/en/Newsroom/LatestNews/247268.html. Accessed on February 12, 2010.

Ontario Ministry of Natural Resources. 2009. "Conservation Land Tax Incentive Program." Online at: www.mnr.gov.on.ca/en/Business/CLTIP/index.html. Accessed on February 12, 2010.

Ontario Woodlot Association. 2006. "Bats – Ontario's Flying Mammals." *The S & W Report*. 45 (Fall/Winter).

Ontario Woodlot Association. 2010. "Extension Notes." Landowner Resource Centre and OMNR. Online at: < www.ont-woodlot-assoc.org/info_pub_ext.html > Accessed on March 14, 2010.

Ontario Woodlot Association. 2010. "The S & W Report: Feature Articles." Online at: < http://www.ont-woodlot-assoc.org/info_pub_swlibmain.html> Accessed on March 14, 2010.

Ottawa Citizen. 2008. "Farmers to get $300 million to quit growing tobacco." CanWest MediaWorks Publications Inc. > Posted August 2, 2008. Online at: <www.canada.com/ottawacitizen/news/story.html?id=3cee32c9-7819-4322-881f-19fc6a162b41> Accessed on May 15, 2010.

Palys, T. 2003. *Research Decisions: Quantitative and Qualitative Perspectives, 3rd Edition*. Nelson: Simon Fraser University.

Parker, B. H. 2003. *Long Point World Biosphere Reserve Monitoring Program Status Report*. Port Rowan, Ontario: Long Point World Biosphere Reserve Foundation.

Phair, C., B. Henson, and K. Brodribb. 2005. "Great Lakes Conservation Blueprint Aquatic. Volume II."

Phillips, A. 2003. "A Modern Paradigm: World Parks Congress." *World Conservation*. IUCN Bulletin. Vol 2: 6-7.

Provincial Parks Act, S.O. 1913

Provincial Parks Act, R.S.O. 1954

Porter, J. and P. Phillips. 2007. "Introduction: The History, Philosophy, and Practice of Public Science." In J. Porter and P. Phillips (eds) *Public Science in Liberal Democracy*. 2007. Toronto: University of Toronto Press. Pp. 3 – 19.

Quinn, M. and S. Alexander. 2008. "Information Technology and the Protection of Biodiversity in Protected Areas." In K. Hanna, D. Clark and D. Scott Slocombe (eds) *Transforming Parks and Protected Areas: Policy and Governance in a Changing World*. 2008. New York: Routledge. Pp. 62-84.

Reed, M. 2007. "Uneven Environmental Management: A Canadian Comparative Political Ecology." *Environment and Planning A*. Vol 39: 320 – 338.

Reid, D. and R. Bailey. 2004. "ALUS: The Farmer's Conservation Plan."

Rose, G. 2007. *Visual Methodologies: an introduction to the interpretation of visual materials. 2nd Edition*. London: Sage.

Shrubsole, D. 1996. "Ontario Conservation Authorities: Principles, Practice and Challenges 50 Years Later." *Applied Geography*. Vol 16 (4): 319-335.

Skogstad, G. and S. Hartley. 2007. "Science and Policymaking: The Legitimation Conundrum." In J. Porter & P. Phillips (eds) *Public Science in Liberal Democracy*. 2007. Toronto: University of Toronto Press. Pp. 215 – 238.

Slocombe, D. S. and P. Dearden. 2009. "Protected Areas and Ecosystem-based Management." In P Dearden and R. Rollins (eds) *Parks and Protected Areas in Canada: Planning and Management. 3rd Edition*. 2009. Toronto: Oxford University Press. Pp. 342 - 370.

Solymar, B. and LPWBRF. 2009. "Long Point World Biosphere Reserve." Brochure.

Species at Risk Act, S.C. 2002.

Stewardship Network of Ontario. 2010. "Norfolk Land Stewardship Council" Online at: www.ontariostewardship.org/councils/norfolk/index.php/program_overview/. Accessed on February 25, 2010.

Swift, J. 1999. *Civil Society in Question*. Toronto: Between the Lines.

The Niagara Escarpment Planning and Development Act, S.O. 1973.

Theberge, J. and J. Theberge. 2009. "Application of Ecological Concepts to the Management of Protected Areas." In P Dearden and R. Rollins (eds) *Parks and Protected Areas in Canada: Planning and Management. 3rd Edition*. 2009. Toronto: Oxford University Press. Pp. 84 - 109.

United Nations Educational, Scientific, and Cultural Organization. 2009. "Frequently Asked Questions." Man and Biosphere Programme (World Network of Biosphere Reserves). Online at: <www.unesco.org/mab/nutshell.htm.> Accessed August 6, 2009.

Venter, O., N. Brodeur, L. Nemiroff, B. Belland, I. Dolinsek, and J. Grant. 2006. "Threats to Endangered Species in Canada." *BioScience*. Vol 56 (11): 903-910.

Warecki, G. M. 2000. *Protecting Ontario's Wilderness: A History of Changing Ideas and Preservation Politics, 1927-1973*. New York: Peter Lang.

White, R. 1999. "The Nationalization of Nature." *Journal of American History*. Vol 86 (3): 976-986.

Whitelaw, G. 2005. *The Role of Environmental Movement Organizations in Land Use Planning: Case Studies of the Niagara Escarpment and Oak Ridges Moraine Processes*. Phd Thesis. Waterloo, Ontario: University of Waterloo.

Whitelaw, G., H. Vaughan, B. Craig, and D. Atkinson. 2003. "Establishing the Canadian Community Monitoring Network." *Environmental Monitoring and Assessment*. Vol 88(1): 409-418.

Whitelaw, G., B. Craig, G. Jamieson, and B. Hamel. 2004. "Research, monitoring and education: Exploring the 'logistics function' of four Canadian biosphere reserves." *Environments*. Vol 32(3): 61-78.

Whitelaw, G. and P. Eagles. 2007. "Planning for Long, Wide Conservation Corridors on Private Lands in the Oak Ridges Moraine, Ontario, Canada." *Conservation Biology*. Vol 21(3): 675- 83.

Wichert, G., K. Brodribb, B. Henson, and C. Phair. 2005. "Great Lakes Conservation Blueprint Aquatic. Volume I."

Wiens, J. and D. Bachelet. 2010. "Matching the Multiple Scales Conservation with the Multiple Scale of Climate Change." *Conservation Biology*. Vol 24 (1): 51-62.

Wilcove, D. and J. Lee. 2003. "Using Economic and Regulatory Incentives to Restore Endangered Species: lessons learned from three new programs." *Conservation Biology*. Vol 18 (3): 639 – 645.

Woodley, S. 2009. "Planning and Managing for Ecological Integrity in Canada's National Parks." In P. Dearden and R. Rollins (eds) *Parks and Protected Areas in Canada: Planning and Management. 3rd Edition*. 2009. Toronto: Oxford University Press. Pp. 111 - 132.

World Commission on Environment and Development. 1987. *Our Common Future*. Oxford: Oxford University Press

Wren, L. S. and A.R. Couturier. 2009. "Canada." In C. Devenish, D. Díaz Fernández, R. Clay, I. Davidson and I. Yépez Zabala (eds) *Important Bird Areas Americas: Priority Sites for Biodiversity Conservation*. 2009. Quito: BirdLife International. Pp. 113 – 124.

Yin, R. 2009. *Case Study Research Design and Methods. 4th Edition*. Thousand Oaks: Sage.

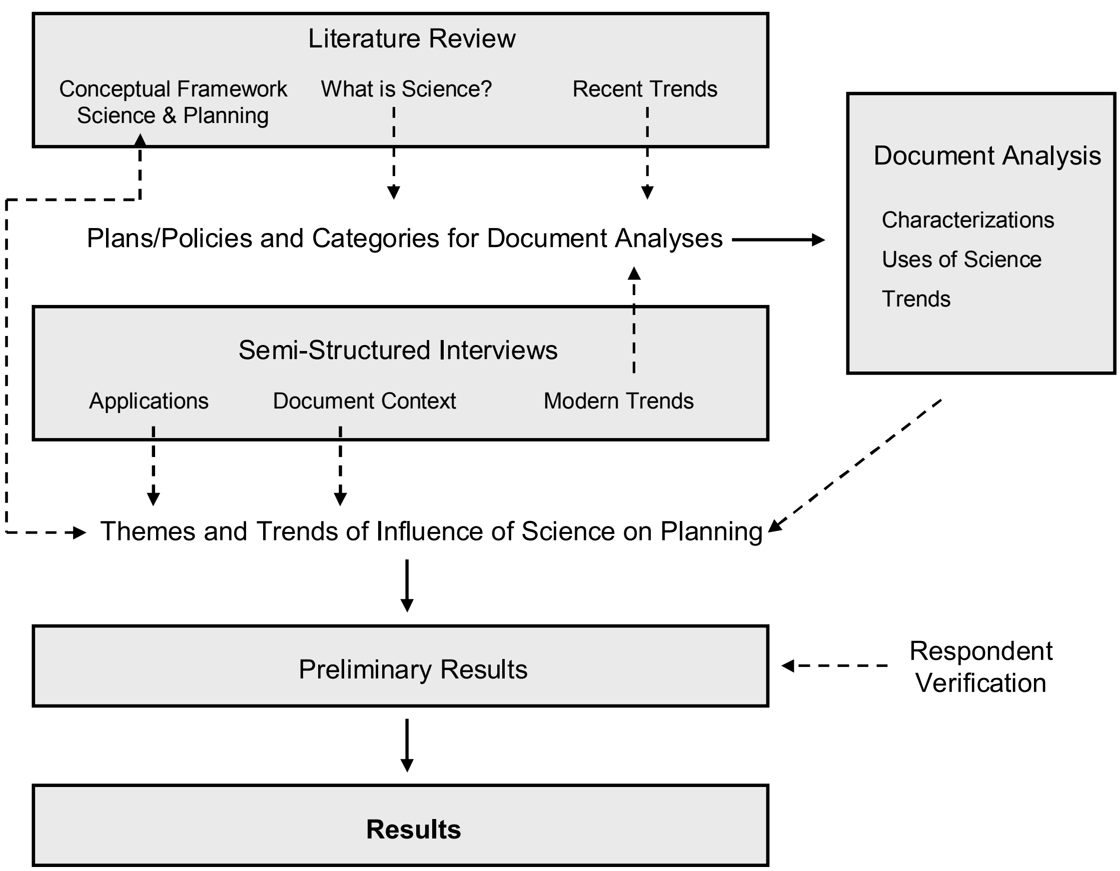
Yli-Pelkonen, V. and J. Kohl. 2005. "The role of local ecological knowledge in sustainable urban planning: perspectives from Finland." *Sustainability: Science, Practice, & Policy*. Vol 1(1):3-14.

Appendix I: Research Protocol

My research protocol provides a rough guide to the procedures I used during my data collection and how the collected data related to my research questions. Following the protocol helped increase the construct validity and reliability of the final results.

The following diagram illustrates how each research method contributed to answering the research questions and how they relate. The literature review was the first step of my research, and helped shape the categories used in the document analysis and identify interview questions. The document analyses and semi-structured interviews evaluated specific uses of science at Long Point, and provided insight into how science has been applied. These results were then compared to the conceptual framework developed during the literature review, and the preliminary results were presented back to interview respondents for feedback and verification. Their changes were incorporated in the final results.

Research Protocol



Appendix II: Analyzed Documents

The following documents were assessed during the document analysis.

Title	Associated LP Org.	Author	Date	Type of Document & Focus
NCC Stewardship Manual 2000	NCC	NCC	2000	Manual: Procedures to conduct restoration
NCC Stewardship Manual 2004	NCC	NCC	2004	Manual: Procedures to conduct restoration
Great Lakes Conservation Blueprint Aquatic, Vol 1	NCC	G.A. Wichert, K.E. Brodribb, B.L. Henson and C. Phair	2005	Manual: Identifies/ revalidates best areas for land acquisition
Great Lakes Conservation Blueprint Aquatic, Vol 2	NCC	C. Phair, B.L. Henson and K.E. Brodribb	2005	Manual: Identifies/ revalidates best areas for land acquisition
Great Lakes Conservation Blueprint Terrestrial, Vol 1	NCC	B.L. Henson, K.E. Brodribb, and J.L. Riley	2005	Manual: Identifies/ revalidates best areas for land acquisition
Great Lakes Conservation Blueprint Terrestrial Vol 2	NCC	B.L. Henson and K.E. Brodribb	2005	Manual: Identifies/ revalidates best areas for land acquisition
Great Lakes Conservation Blueprint Terrestrial LP Ecodistrict	NCC	B.L. Henson and K.E. Brodribb	2005	Manual: Identifies/ revalidates best areas for land acquisition
NCC Conservation Policy Framework	NCC	NCC	2006	Policy: Emphasis on science-based conservation planning
Southern Norfolk Sand Plain Natural Area Conservation Plan, 2009-2013 Overview	NCC	NCC	2009b	Conservation Plan: Detailed property management goals and activities including restoration, monitoring, and education activities
Watershed Strategies	LPRCA	LPRCA	2002	Report: Strategies and business plans outlining acquisition, restoration, monitoring, and education goals
Long Point Region Source Water Assessment Report	LPRCA	LPRCA	2008	Report: Describes physical and social watershed conditions and identifies potential threats
Adapting to Climate Change: Conservation Authorities on the Front Line	LPRCA	Conservation Ontario	2008b	Powerpoint: Describes potential watershed impacts of climate change and suggests restoration and monitoring activities to help mitigate
Break Wind, Make Money Brochure	LPRCA	Conservation Ontario	Current (2010b)	Brochure: Promotes wind break tree planting restoration program to landowners

Title	Associated LP Org.	Author	Date	Type of Document & Focus
Stewardship Partners Working Together to Recover SAR	LPRCA	Conservation Ontario	Current (2010c)	Brochure: Promotes value of SAR and encourages habitat enhancement restoration projects to landowners
Conservation Ontario Annual Report	LPRCA	Conservation Ontario	2003-2008a	Annual Reports: Identifies major achievements and influences on the acquisition, restoration, monitoring, and education work of CAs
Media Release: Climate Change	LPRCA	Conservation Ontario	2009b	Media Release: Promotes CA role in mitigating climate change through restoration and monitoring
ALUS: The Farmer's Conservation Plan	ALUS	Dave Reid & Robert Bailey	2004	Proposal: Outlines rationale for ALUS restoration program
ALUS: An Opportunity for Agriculture to Lead in Conservation	ALUS	Robert Bailey (Delta Waterfowl)	2005	Powerpoint (presentation to AIC): Explains and promotes ALUS restoration program
ALUS: A benchmark survey of public opinion on the environment in relation to farming and the quality of life in Norfolk County	ALUS	Robert Bailey & Loreley Greenslade	2006	Report: Presents data gathered in a benchmark survey on environmental perceptions before the implementation of the ALUS restoration program
ALUS and Ontario's Climate Change Policy: Where does ALUS fit, and why?"	ALUS	ALUS	2010b Mar.26	Meeting Invitation: Focuses on how ALUS restoration program can link with climate change mitigation and adaptation programs
Growing a Better Environment in Norfolk County with Alterantive Land Use Services (ALUS) - Brochure	ALUS	Norfolk Federation of Agriculture	Current (2010)	Brochure: Promotes ALUS restoration program to landowners and to potential funders
Great Lakes Fact Sheet: How Much Habitat is Enough 2nd Edition	NLSC	Envm Canada; Graham Bryan	2004	Manual: Provides science-based guidelines for conducting habitat restoration
NLSC Terms of Reference	NLSC	NLSC	2005	Terms of Reference: Describes operating guidelines of NLSC
A Guide to Stewardship Planning for Natural Areas	NLSC	OMNR	2006	Manual: Explains basic restoration and monitoring activities an interested landowner can engage in
Ontario Stewardship Guidelines	NLSC	OMNR	2007	Guidelines: Describes operating guidelines and procedures for all Land Stewardship Councils
Caring for Nature in Norfolk	NLSC	Carolinian Canada	2008	Brochure: Promotes restoration activities to landowners
NLSC Annual Report, 1996-2009	NLSC	NLSC	1996-2009	Annual Reports: Identifies key achievements and lists all projects and partners

Title	Associated LP Org.	Author	Date	Type of Document & Focus
NLSC 2010-2013 Profile	NLSC	NLSC	2010a	Organization Profile: Describes mission and focus of NLSC
NLSC Guidelines for Project Eligibility and Funding	NLSC	NLSC	2010b	Guidelines: Describes criteria for project funding and eligibility
Stewardship Council Project Data Base Tracking and Reporting System	NLSC	Mark Emery	2010	Funding Application: Describes potential electronic stewardship project database
The Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk	LPBLT	Norfolk Field Naturalists (M. Gartshore, D. Sutherland, J. McCracken)	1987	Natural Heritage Inventory: Detailed descriptions of key areas of natural and scientific interest
Baseline Documentation Report	LPBLT	Ontario Land Trust Alliance & Ontario Heritage Trust	2006	Manual: Procedures for monitoring acquired properties
Conserving Carolinian Reptiles	LPBLT	LPBLT	2008a	Project Outline: Describes SAR community monitoring project
LPBLT Newsletter Summer 2008	LPBLT	LPBLT	2008b	Newsletter: Describes recent work and promotes opportunities for community members to support monitoring, restoration, and acquisition projects
LPBLT Newsletter Spring 2009	LPBLT	LPBLT	2009	Newsletter: Describes recent work and promotes opportunities for community members to support monitoring, restoration, and acquisition projects
LPBLT Newsletter Winter 2010	LPBLT	LPBLT	2010c	Newsletter: Describes recent work and promotes opportunities for community members to support monitoring, restoration, and acquisition projects
Long Point Basin Land Trust Brochure	LPBLT	LPBLT	Current (2010b)	Brochure: Promotes work of LPBLT and provides a donation slip
Long Point Environmental Folio	Biosphere	J.G. Nelson and K. L. Wilcox (but individual chapters have different authors)	1996	Report: Amalgamation of scientific and other information on Long Point
LPWBR Habitat Restoration Project	Biosphere	LPWBRF	2000	Report: Describes a local restoration project and presents monitoring data
Long Point Biosphere Reserve, Periodic Review Report	Biosphere	George Francis & Graham Whitelaw	2001	Report: Periodic review of the work and activities of the LPBR
Big Picture, 2002	Biosphere	NHIC/NCC	2002	Powerpoint: Describes rationale and suggested land acquisition framework
LPWBR Monitoring Program Status Report 2003	Biosphere	Brent Parker	2003	Status Report: Collection and analysis of data from LP forest monitoring plots

Title	Associated LP Org.	Author	Date	Type of Document & Focus
LPWBR Forest Corridor Project	Biosphere	LPWBRF	2007	Powerpoint: Describes rationale and restoration techniques of forest corridor tree planting program
Long Point Causeway Improvement Project	Biosphere	Paul Ashley	2007	Powerpoint: Describes rationale for causeway improvement restoration project
Biodiversity Programs at OPG	Biosphere	Steve Hounsell	2007	Report: Describes for LPWBR forest corridor tree planting program
Long Point Causeway Improvement Plan	Biosphere	Ecoplans	2008a	Report: Describes rationale and potential plan to enhance ecological functioning of LP causeway
Long Point Causeway Improvement Plan	Biosphere	Ecoplans	2008b	Powerpoint: Describes rationale and potential plan to enhance ecological functioning of LP causeway
LPWBR Brochure	Biosphere	Bernie Solymar/ LPWBR	2009	Brochure: Describes/promotes restoration, monitoring, and education work of LPWBRF
Biosphere Matters Newsletter (v.1:1)	Biosphere	LPWBRF	2010	Newsletter: Promotes recent restoration and education programs
The "S & W Report" - Feature Articles	NWOA	Ontario Woodlot Association	Varied	Newsletter: Articles educating and promoting landowner involvement in restoration and monitoring activities
Extension Notes	NWOA	Ontario Woodlot Association (by Land Owner Resource Centre & MNR)	Varied	"Fact Sheets:" Promotes best practice land management techniques to landowners
News Online - ON Woodlot Association	NWOA	NWOA	2003-2007	Event postings: Describes education extension activities of NWOA

Appendix III: Document Analysis Categories

The following categories were developed to assess the manifest and latent themes within the document, along with any associated images. The three broad headings relate to the research questions, while the individual subjects were chosen based on common patterns:

1) Characterizations
Types of Science
Emphasis on Science
Images
Language
Citations/References
"Personal" Accounts
Who Researches?
Types of Projects

2) Applications
Goal/Purpose (prioritize, operational, justify)
Techniques
Audience

3) Trends
Types of Studies that Need to be Done
Collaboration/Partnerships
Changes to Science

Appendix IV: Interview Guide

The following questions are general topics that I covered during the interviews, but the actual questions were flexible, and depended on the focus of the organization and the individual's role within it. Questions were often probed further for examples, clarification, and additional context.

1) Can you tell me a little bit about your organization and the role it plays in conservation in Long Point?

2) What are some of the conservation activities your organization engages in?
   - How do scientific studies support these activities?
   - Where do you receive the scientific information from?
   - How do you communicate the scientific information that you use?

3) How do you choose between the activities your organization engages in?
   - What role does science play in prioritizing?
   - Where do you receive the scientific information from?
   - How do you communicate the scientific information that you use?

4) How does the work your organization engages in compare to the work done by other organizations? Differences? Overlap?

5) What types of studies are needed to support conservation in the Long Point Region?

6) Where do you think conservation science is going? What has happened recently?

7) Finally, what comes to mind when you think of science? What do you consider "scientific"?

8) [Is there anything else you'd like to add? Do you have any questions for me?]

Appendix V: Interview Analysis Categories

The following categories were developed based on the initial development of "open codes" and the subsequent grouping and re-assessment of themes into analytical categories. The three broad headings relate to the research questions, while the individual subjects were chosen based on common patterns.

1) Characterizations
Definitions of Science
Types of Projects
Communicating Science

2) Applications
Choosing/Prioritizing Projects - Mandate, Opportunities, Champions, Science
Implementing Projects
Justifying Success of Projects

3) Trends
Types of Studies that Need to be Done
Collaboration/Partnerships
Changes to Science
Limitations
Opportunities

Appendix VI: Long Point Environmental Organizations

1) Long Point Basin Land Trust (LPBLT)

The Long Point Basin Land Trust (LPBLT) was formed in 1996 as a non-advocacy, non-profit, charitable organization to preserve sensitive Long Point habitats through land acquisition and stewardship (Ontario Land Trust Alliance 2010; Long Point Basin Land Trust 2010a). It operates within the area outlined in figure I. The Land Trust is a locally-based volunteer organization with approximately 125 members and one part-time grant-funded staff member (OLTA 2010). It is governed by a volunteer Board of Directors, and is a founding member of the Ontario Land Trust Alliance, an umbrella organization that provides some assistance and management guidelines to Land Trusts (OLTA 2010). The LPBLT is formally listed as partnering with the Nature Conservancy of Canada, a national-level land acquisition organization, and with the locally-based Norfolk Field Naturalists (OLTA 2010). Personal communications indicate that the Land Trust also partners with other Long Point environmental organizations where appropriate.

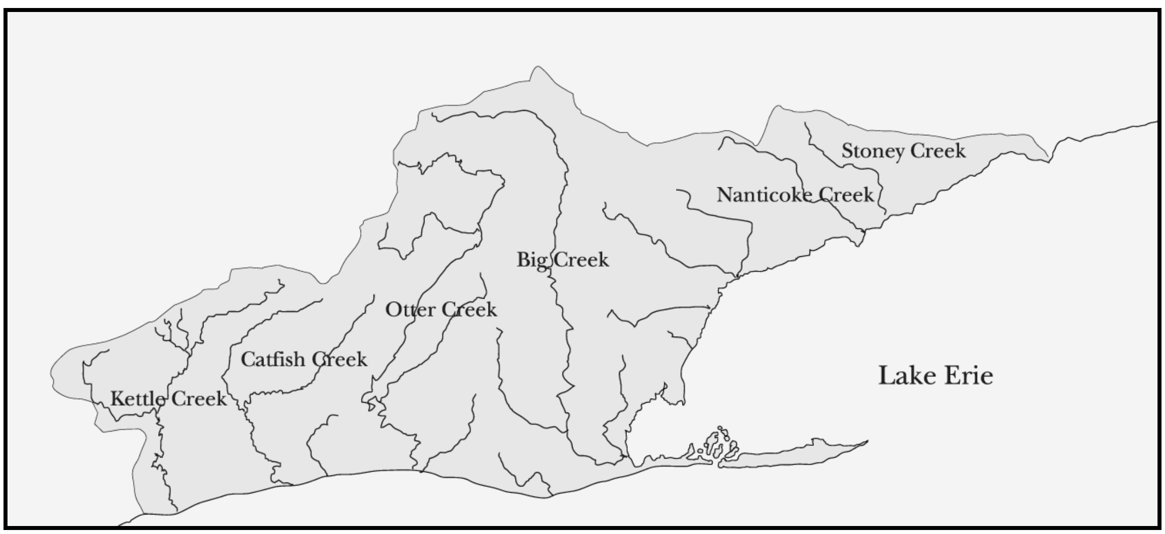


Figure I Long Point Basin Land Trust operating area (from LPBLT 2010a).

The mandate of the Long Point Basin Land Trust is to protect and restore habitats to increase their biodiversity and ecological integrity for future generations (LPBLT 2010a). It also promotes opportunities for people to become involved in conservation initiatives, particularly through their "Conserving Carolinian Reptiles" program, which works with the community to document reptile populations and identify and restore key habitats (LPBLT 2010a). The Land Trust is also involved in land conservation through property purchases and property donations (LPBLT 2010a). In total, the Land Trust owns 83 hectares of property, including the Jackson Gunn Old Growth Forest and the Langford Property (LPBLT 2010a). It contributed funds towards the Nature Conservancy of Canada's purchase of the Konrad Reserve, and is now actively involved in restoring the property; the Land Trust also assists with research at the Turkey Point Picetum (LPBLT 2010a). Currently, the Land Trust has not been involved with legal measures of land protection such as easements; however, this form of protection is currently being discussed by members.

2) Norfolk Woodlot Owners Association (NWOA)

The Norfolk Woodlot Owners Association (NWOA) is a locally-based organization operating in Norfolk County and the surrounding area. It is a member of the larger umbrella organization, the Ontario Woodlot Association. The NWOA is a non-profit group that aims to "…assist all members in their understanding of how to manage and conserve their woodlots" (NWOA 2005). Decisions are made by a volunteer Board of Directors, made up of woodlot owners, while most of the coordination for the program is provided by a staff member from Norfolk County's Forestry Conservation Service. The NWOA was initiated, in part, through funding provided by the Norfolk Land Stewardship Council in 1996.

The organization is involved in a variety of activities, including marketing products, lobbying for regulatory and legal issues, conducting research, collecting and distributing information, and providing technical advice to their membership (NWOA 2005). Part of these activities involves promoting land stewardship, including the preservation and enhancement of forest habitats and the protection of sensitive species (NWOA 2005).

3) Norfolk Land Stewardship Council (NLSC)

The Norfolk Land Stewardship Council (NLSC) is one of 46 community-level councils created by the Ontario Ministry of Natural Resources (OMNR) and managed under the Ontario Stewardship umbrella (Stewardship Network of Ontario 2010). The NLSC was formed in 1995, and employs one full-time OMNR government staff member who coordinates the program (SNO 2010). The remainder of the Council is composed of volunteers, with a mandatory majority of rural land owners, and additional mandatory representation from naturalists, fish and game clubs, rural non-farm owners, the education community, and business owners (SNO 2010).

The stewardship council program is a relatively new government approach that incorporates interested stakeholders in resource management through partnerships, coordination, and the provision of logistical support to help local communities access funding and other forms of support (SNO 2010). The program focuses on private land stewardship, on properties otherwise outside of government protection, and aims to produce tangible and local benefits (OMNR 2006b). In the Long Point region, the Council is involved in a variety of projects including research, youth stewardship programs, education, and restoration work (SNO 2010). It has also provided funding and support to the Long Point Causeway Improvement Project, the Alternative Land Use Services program, the Norfolk Woodlot Owners Association, the 'Trees for Roads' reforestation program, and the 'Wetland Drain' restoration project (NLSC Annual Reports, 1996-2009).

4) Alternative Land Use Services (ALUS) Program

The Alternative Land Use Services (ALUS) program was adopted in 2008 as a pilot project for Norfolk County (ALUS 2010a), although it has been operating since 2005 on a "pre-pilot" basis. The program seeks to conserve and restore ecological values to the farming landscape, while acknowledging and rewarding farmers' roles in environmental management through incentives (ALUS 2010a). It takes a "fee-for-service" approach, where farmers receive funds and other extension services to help them enhance and preserve natural features of their properties (ALUS 2010a). The program is modeled after a Manitoba initiative and is also supported by the American hunting association Delta Waterfowl. It is currently being implemented in different pilot forms in many Canadian provinces, and Prince Edward Island has adopted some of its principles as provincial farm policy (Delta Waterfowl 2010).

ALUS is governed by a Partnership Advisory Committee, with representatives from Delta Waterfowl, Norfolk County, Long Point Region Conservation Authority, provincial ministries, farmers' organizations and local farmers (ALUS 2010a). It also has one full-time coordinator, who is funded through grant money. Although the partnership advisory committee is involved with broad decisions regarding the program, individual project decisions are made in collaboration with the farmer who owns the land.

Since it was initiated, ALUS has registered 182 hectares of farming land for ecological value (ALUS 2010a). Conservation projects have included planting native vegetation, the creation and enhancement of wetlands, the establishment of riparian buffers, reforestation, and the creation of waterfowl nesting structures (ALUS 2010a). ALUS promotes its work through tours, workshops, and demonstration farm projects (ALUS

2010a). It has also conducted a baseline survey of public opinion on farming and the state of the environment in Norfolk County (see Bailey & Greenslade 2006).

5) Long Point World Biosphere Reserve Foundation (LPWBRF)

The Long Point World Biosphere was created in 1986, and is part of a larger, international network of biospheres. Like all biospheres, the Long Point World Biosphere Reserve's goal is to balance conservation and sustainable use by protecting lands for conservation and by encouraging sustainable economic and community development (UNESCO 2009). To support this goal it also facilitates research, monitoring, education, and information exchange (UNESCO 2009); this function is fundamental to the biosphere, since it contributes to the other functions and drives sustainable development forward (Whitelaw et al. 2004). The Biosphere itself consists of a "core" area directly around Long Point (outlined in figure II), and the surrounding buffer "area of cooperation" (Long Point Biosphere 2010).

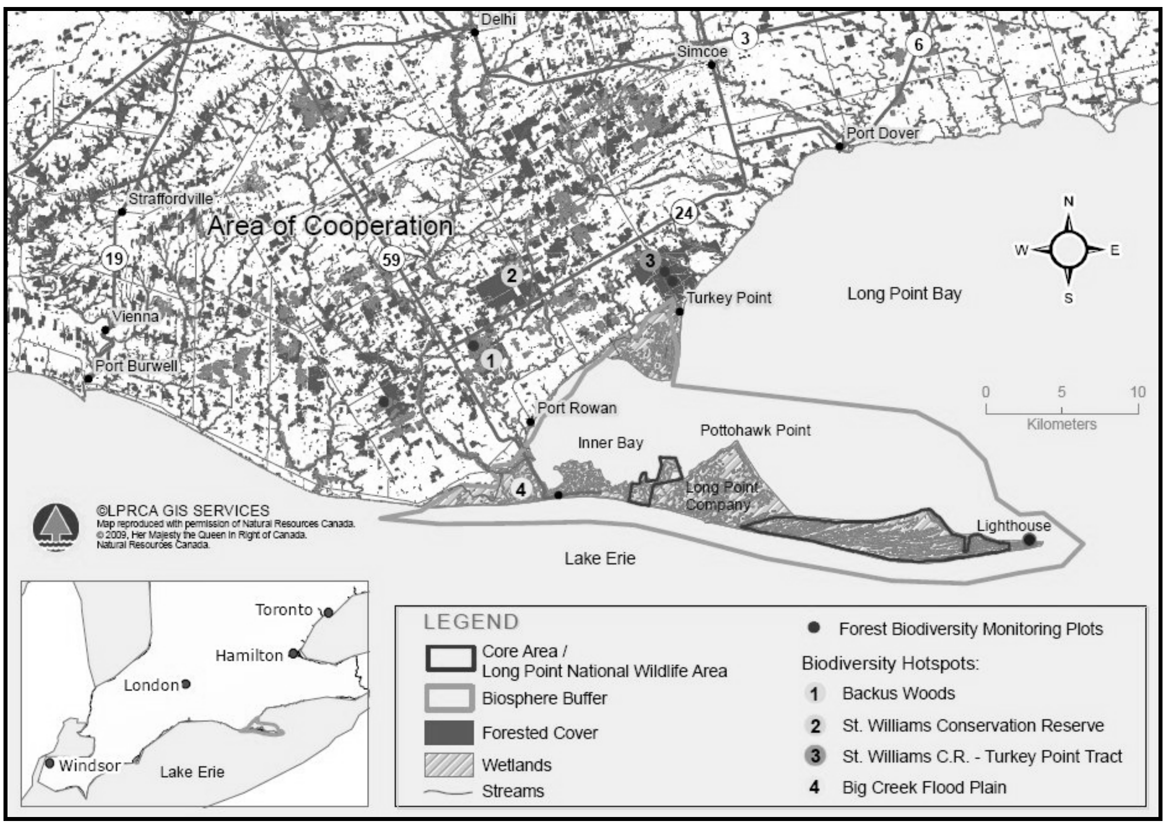


Figure II Long Point World Biosphere Reserve operating area (from LPB 2010). The "core" area is outlined around the point, while the surrounding area is designated an "area of cooperation."

The Long Point World Biosphere is directly administered by the Long Point World Biosphere Reserve Foundation (LPWBRF), a non-profit organization established in

1990. Membership is open to the public, and the LPWBRF is led by a volunteer, 15 member board of directors, who each sit for a once-renewable, three year term (Craig et al. 2003; Edge & McAllister 2009). Grant money has recently provided for three years of funding to hire a Biosphere Coordinator, who now plays a role in coordinating activities but still takes direction from the Board of Directors.

The LPWBRF is involved with a variety of conservation initiatives in the Long Point area, and often collaborates with other organizations to promote stewardship (LPB 2010). Larger projects it has been involved with include the "Biosphere Reserve Cooperation Plan" which links together over 55 different monitoring programs to supplement existing information (Whitelaw et al. 2005; Edge & McAllister 2009); EMAN's forest biodiversity monitoring plots, "Ontario Power Generation's Forest Corridor-Carbon Sequestration" reforestation program, the production of the "Long Point Environmental Folio" which documents available scientific information on the area, and a range of community education programs such as "Kids for Turtles" (LPB 2010). The LPWBRF has also recently begun to coordinate the Long Point Causeway Improvement Project, and is also exploring local opportunities for eco-tourism (Long Point World Biosphere Reserve Foundation 2010).

6) Long Point Region Conservation Authority (LPRCA)

The Long Point Region Conservation Authority (LPRCA) is one of thirty-six legally-mandated Conservation Authorities in Ontario, and part of the "Conservation Ontario" Conservation Authority network that provides watershed-based planning (Conservation Ontario 2009a). The LPRCA receives its power from the *Conservation Authorities Act*; under the act, a Conservation Authority is to "establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources" (20.1, R.S.O. 1990). As such, the LPRCA describes its mandate as "[working] with our local communities, and our many other partners, to achieve the conservation, restoration, development and responsible management of our water, land and natural habitats through programs that balance human, environmental and economic needs" (LPRCA 2002). The LPRCA is based in five counties; figure III outlines the extent of its operating area.

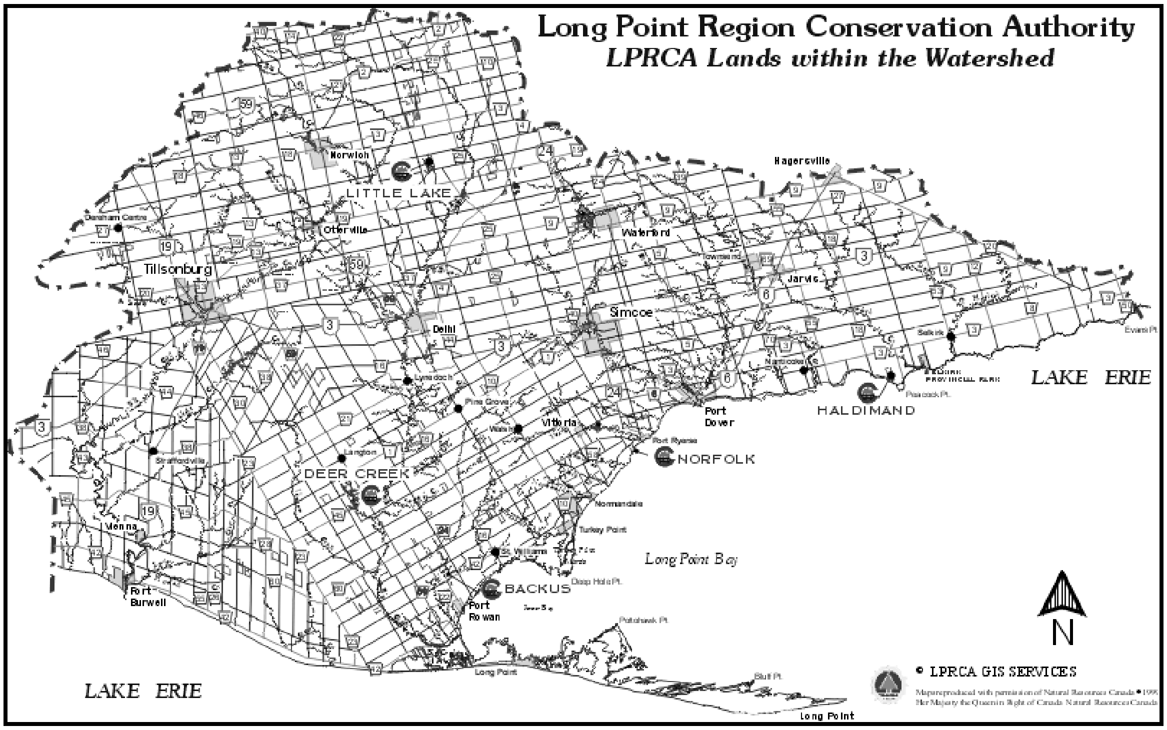


Figure III Long Point Region Conservation Authority operating area (from LPRCA 2009).

The LPRCA receives approximately one third of its funding through municipal levies; another third of its funding though provincial, federal, and municipal project grants; and the remaining third is self-generated (CO 2010a). It is governed by a Board of Directors made up of municipally appointed representatives from the counties it covers and also employs a full-time and permanent scientific and administrative staff that assist in carrying out its mandate (LPRCA 2009). In total, the LPRCA manages seven conservation areas with a combined size of 4700 hectares; of these, 782 hectares are managed as “natural heritage woodlands” (LPRCA 2009). The LPRCA is also actively involved in a variety of conservation projects including restoration projects, reforestation, water quality monitoring, and species-at-risk inventories (personal communication).

7) The Nature Conservancy of Canada (NCC)

The Nature Conservancy of Canada (NCC) first formed in 1962 in southern Ontario, but has since spread throughout Canada (NCC 2009a). The NCC describes itself as “Canada’s leading national land conservation organization,” and conducts its activities in areas of national or international environmental significance (NCC 2009a). It is a private, non-profit, non-advocacy organization that focuses on preserving biodiversity through direct purchase, land donation, and conservation agreements (NCC 2009a). It has a large paid staff, and is governed by a national board of directors who are supported by seven regional-level boards, for a total of over 120 representatives who are involved in governance (NCC 2009a). The NCC has also recently instituted a volunteer program, which provides assistance in monitoring, surveying and restoration work on its properties (NCC 2009a).

Once acquired, the NCC manages properties for natural values through conservation science (NCC 2009a). Landscape-level ecological planning is an important aspect of their purchases, and "landscape ecological assessment, or ecoregional planning, is a central element in NCC's commitment to a science-based conservation program" (NCC 2009a). At Long Point, the NCC is involved with a variety of initiatives, including the purchase of the 40 hectare Konrad Property, which it now jointly manages with the Norfolk Field Naturalists and the Long Point Basin Land Trust. It has also partnered with the provincial government to create a "Conservation Blueprint" to prioritize areas for conservation efforts, and is a member of Carolinian Canada which produced a similar ecological ranking project called the "Big Picture" (NCC 2009a). Additionally, the NCC has provided financial assistance towards the feasibility study for the Long Point Causeway Improvement Project.

Appendix VII: Early Eras of Canadian Conservation Planning

1) Parks and Resources: 1890s –1930s

Conservation science during the late nineteenth and early twentieth century primarily focused on research surrounding resource management (Loo 2007), while early environmental planning centered on the creation of protected areas and open space for recreation and conservation (Hodge & Gordon 2008). Although a conservation ethic had emerged, these protectionist values were relatively marginalized from the aesthetic and economic approaches popular in both planning and natural resource management (Bocking 2004).

Science during this period was mostly limited to waterfowl and game animals and a variety of projects tracked their abundance and fluctuations (Bocking 2001). Although naturalists and other citizen scientists were involved in collecting, categorizing, and identifying species and subspecies, the majority of research was typically driven by recreational hunters and trappers and economic interests (Bocking 2001; Kohler 2006). For instance, the Hudson's Bay Company sponsored arctic research, with the hope that it would lead to more accurate predictions for fur-animal harvesting, while Ducks Unlimited was established by recreational hunters to restore and manage waterfowl breeding grounds (Loo 2007). Similarly, the Commission for the Conservation of Natural Resources was established in 1909 to provide advice on optimal resource use (Artibise & Stelter 1981). During their twelve year span they published nearly 200 papers and studies and were an important link between science and planning (Artibise & Stelter 1981; Hodge & Gordon 2008).

Most of the early environmental planning during this period focused on the creation of protected areas and open spaces to provide recreational opportunities and beautify the city (Hodge & Gordon 2008). Increasing industrial and urban development had led to declines in fish and wildlife populations and there was a subsequent demand to create provincial and federal parks to protect these species (Killan 1993). Lobbying from this "parks movement" led to the establishment of Canada's first national park, Banff National Park, in 1885 (Dearden & Dempsey 2004). In Ontario, the provincial government passed the first *Provincial Parks Act* in 1913, and established Algonquin (1893), Rondeau (1894), Quetico (1913), Long Point (1921), and Presqu'ile (1922) Provincial Parks (Killan 1993). However, planning for these early parks was a piecemeal process, with each park created "…in response to unique combinations of social, economic, and political pressures" (p.1, Killan 1993). Momentum to protect natural areas continued into the early 1920s, when changes to the fish and game laws defused many of the early concerns over resource depletion and dissipated the parks movement lobbyists (Killan 1993).

2) Scientization and Economic Productivity: 1940s-1950s

At the end of the Second World War the federal and provincial governments began to play an increasing role in conservation science and protected area planning, with a new focus on research and science-based management. Charles Elton and other scientists had been promoting the ideas of production and consumption within ecological communities and the government began using these ideas to manage systems for productivity and profit (Bocking 1997; Loo 2007; Daniels 2009). For example, in 1945 the federal government began a commercial bison cull in national parks using ecology-based theories of game management (Loo 2007).

Part of the shift towards science-based management began with an overhaul of the existing federal park warden system that significantly increased government scientific personnel and placed a new emphasis on research (Loo 2007). Specific agencies were also created to oversee environmental planning concerns (Loo 2007; Hodge & Gordon 2008). For example, the Dominion Wildlife Service (soon to be renamed the Canadian Wildlife Service) was created to contribute scientific knowledge to government wildlife policies (Loo 2007), and regional agencies such as the Prairie Farm Rehabilitation Administration and the Maritime Marshland Rehabilitation Administration were formed to address the economically damaging environmental problems of soil degradation and salt water intrusions (Hodge & Gordon 2008).

Similarly, concern over the degradation of natural resources led to the 1941 "Guelph Conference," which was attended by conservation organizations throughout Ontario and resulted in attendees lobbying for a program that would both protect and restore natural resources (Shrubsole 1996). The Ontario government used these ideas to establish a provincial network of watershed-based "Conservation Authorities" through the 1946 *Conservation Authorities Act* (Shrubsole 1996). Shrubsole (1996) suggests that the formation of these agencies was initially based on the implicit idea that protecting Ontario's resources and mitigating flood damage would contribute to economic development; however, their broad mandate has given them flexibility and they now form the foundation of Ontario's ecosystem-based planning (Shrubsole 1996; Hodge & Gordon 2008).

The end of the Second World War also led to a new public interest in outdoor recreation. Urban populations were increasingly affluent and mobile and began to seek out nature experiences (Killan 1993). A wildlife ethic was popularized and both national and provincial park visitation saw substantial increases (Loo 2007). For instance, the number of national park visitors grew from 500,000 in 1940, to 2 million in 1950, and 5.5 million in 1960 (Loo 2007). To meet provincial demand, Ontario passed a new *Provincial Parks Act* in 1954 that focused on creating more parks, providing better amenities, and promoting tourism (Killan 1993). In response, the number of provincial parks increased by over ten-fold between 1954 and 1967 (Killan 1993). During this period, the Conservation Authorities similarly broadened their mandate to explicitly include planning for recreation (Killan 1993).

3) Protection and Regulation: 1960s- 1970s

The 1960s saw an increased public understanding and awareness of ecological principles, where science was accepted as a solid basis to decision-making. Aldo Leopold's the *Sand County Almanac* popularized ecological principles and Rachel Carson's *Silent Spring* drew attention to the interconnectedness of natural systems (Bocking 2004; Loo 2007). This generated new popular interest in "non-profitable" species and landscapes, such as wetlands, deserts, macro-predators, and songbirds (Killan 1993; Bocking 2001; Bocking 2004). In response, national and international non-governmental environmental organizations, including the Canadian Parks and Wilderness Society, World Wildlife Fund Canada, and the Nature Conservancy of Canada, were founded to represent the public's new environmental interests (Bocking 2001).

Spurred by this lobby, environmental protection shifted from utilitarian arguments and began to value "wilderness for its own sake" based on scientific principles (Warecki 2000). For instance, in Ontario, provincial parks planning shifted to a new classification system that completely protected certain "wilderness areas" (Killan 1993; Warecki 2000). This shift eventually led to the 1978 publication of a parks planning manual that outlined systematic guidelines for the classification and acquisition of new protected areas (Killan 1993). Similarly, during the 1961 federal-provincial "Resources for Tomorrow" conference, biologists advocated for a park zoning system to protect ecological values, which led to new parks policies and a shift from the previous recreation and resource-oriented management approaches (Warecki 2000).

Additional tools were also developed and implemented to help systematically analyze and protect land. For example, the federal Canada Land Inventory was created as an "authoritative source for decision making on land use, a tool employed by state wildlife workers to designate areas – particularly wetlands – as protected habitats" (p.183, Loo 2007). Similarly, Ian McHarg's *Design with Nature* established a systematic method of incorporating ecological principles into environmental planning by mapping landscapes to identify environmental constraints (Hodge & Gordon 2008).

During the 1970's, conservation remained a public priority, although concerns about pollution shifted the focus from the health of the natural environment to human health (Bocking 1997). This began a period of institutionalized government regulation and a hierarchical "command-and-control" style of environmental planning (Bocking 2001; Daniels 2009). For example, Environment Canada was formed in 1971, and the *Marine Mammal Protection Act*, *Canada Wildlife Act*, and *Endangered Species Act* all lent protection to Canada's wildlife (Bocking 2001). Similarly, British Columbia and Quebec passed legislature to protect agricultural areas from development, and Ontario passed the *Niagara Escarpment Planning and Development Act* to protect landscape features (Hodge & Gordon 2008). Provincial ministries of environment were also created; in Ontario a Ministry of Environment was formed in 1972 by merging the Department of the Environment with the Ontario Water Resources Commission (OMOE 2007).

Additionally, concern over the potential environmental consequences of development projects led to the development of an environmental impact assessment process in the United States, and in 1973 Canada followed this lead by creating a federal "Environmental Assessment Review Process" Guidelines Order (Noble 2010). This process was not legally-binding at the federal level, and was initially intended to be a voluntary approach to consider and mitigate potential harm (Noble 2010). However, many provinces took a regulatory approach; for example, Ontario passed its *Environmental Assessment Act* in 1975 (Noble 2010). Environmental impact assessment has since become instituted in federal law with the passing of the *Canadian Environmental Assessment Act* in 1995, and is arguably a stronger environmental management tool that is increasingly comprehensive and inclusionary (Noble 2010).

4) Global Environmentalism: 1980s-mid 1990s

The 1980s and 1990s began with a backlash against the "command and control" style of top-down government regulation and a corresponding decrease in government-mandated controls (Daniels 2009). Government science was increasingly questioned, and resulting decreases in funding led to greater citizen involvement in conservation management (Bocking 2002; Whitelaw et al. 2003; Skogstad & Hartley 2007; Daniels 2009; Edge & McAllister 2009). The introduction of the concepts of biodiversity and sustainability also brought a resurgence of public interest in habitat and ecosystem protection, and recognition of the global implications of environmental practices (Hanna et al. 2008; Bocking 2001).

In 1987 the World Commission on Environment and Development produced *Our Common Future*, which introduced the concept of sustainability, and the term "biodiversity" was also popularized. This followed a growing trend in recognizing environmental problems as global issues, and as a result, the international community has become increasingly important in driving federal policy creation and lobbying for protected area creation (Bocking 2004; Wiens & Bachelet 2010). Partly in response to this lobby, the number of federal and provincial protected areas significantly increased during the 1990s (Killan 1993; Dearden & Dempsey 2004). Additionally, many of the larger, mainstream environmental organizations began to link with corporations, foundations, and national agencies to increase their political power to affect national and international policy domains (Bocking 2004). Conversely, renewed interest in local and regional conservation initiatives led to a parallel increase in smaller organizations that maintained their community ties and focused solely on local and regional concerns (Bocking 2004).

However, although conservation awareness rose in the 1990s, this was not paired with a similar increase in conservation funding (Doern 2000). Doern (2000) explains that "we observe the paradox that all the while that biodiversity was gaining ground as a political priority, wildlife science was being cut" (p.301). Between 1992 and 2000, Environment Canada had its budget cut by 31% and its staff cut by 23% (Doern 2000). This resulted in a loss of in-house science capacity (Skogstad & Hartley 2007), and a further blurring of public and private knowledge as government science sought partnerships elsewhere through privatization and collaboration with industry on commercially viable products (Doern & Kinder 2007).

To bridge the funding and science shortfalls, governments began to encourage greater citizen involvement in science and management initiatives. For example, fiscal restraints led to Ontario's park staff creating volunteer programs that involved the public in protected area management (Killan 1993). Similarly, community-based environmental monitoring programs emerged to fill the void left by decreased government-led monitoring (Whitelaw et al. 2003; Conrad & Daoust 2008). For instance, the Ecological Monitoring and Assessment Network (EMAN) was created in 1994 by Environment Canada to facilitate multi-party collaboration on long-term ecological monitoring (Environment Canada 2009). Involving communities in monitoring programs became a popular way to meet the increasing demands for science-based information, engage an environmentally interested public, and include stakeholders in management decisions (Whitelaw et al. 2003; Conrad & Daoust 2008;

Dempsey & Dearden 2009). Dempsey and Dearden (2009) also suggest that the popularity of community-based involvement reflects a broader neo-liberal trend within government, which emphasizes voluntary, self-regulating approaches and private initiatives.