ENHANCING RESEARCH UTILIZATION FOR SUSTAINABLE FOREST MANAGEMENT: THE ROLE OF MODEL FORESTS

by

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Submitted in partial fulfilment of the requirements
for the degree of Master of Environmental Studies

at

Dalhousie University
Halifax, Nova Scotia
January 2012

DALHOUSIE UNIVERSITY

SCHOOL FOR RESOURCE AND ENVIRONMENTAL STUDIES

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Dated: 17 January 2012

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DALHOUSIE UNIVERSITY

DATE: 17 January 2012

AUTHOR: Brian Bonnell

TITLE: ENHANCING RESEARCH UTILIZATION FOR SUSTAINABLE FOREST MANAGEMENT: THE ROLE OF MODEL FORESTS

DEPARTMENT OR SCHOOL: School for Resource and Environmental Studies

DEGREE: MES CONVOCATION: May YEAR: 2012

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ABSTRACT

Model Forests were developed to bridge the gap between the emerging policy and the practice of sustainable forest management (SFM) in the early 1990s and, as such, to facilitate uptake of research findings into practice. The purpose of this study was to explore mechanisms that may explain why some research results are used in the policy and practice of SFM and others are not. Based on interviews in three Model Forests in Canada, the most prominent factors influencing research utilization identified were (1) *relevance of the research findings to users' needs,* (2) *effective research design and scientific credibility,* and (3) *user involvement in the research process*. However, it was evident that there is no one factor that influences uptake, but rather a combination dependent upon the circumstances of each situation. This study also deepens understanding of the science–practice/policy interface by exploring the notion of Model Forests as boundary organizations.

LIST OF ABBREVIATIONS USED

C&I	Criteria and indicators
CCFM	Canadian Council of Forest Ministers
CIHR	Canadian Institutes of Health Research
CMFP	Canada's Model Forest Program
FCP	Forest Communities Program
FRAC	Forest Research Advisory Committee
GIS	Geographic Information System
IFPRI	International Food Policy Research Institute
IMFN	International Model Forest Network
IUFRO	International Union of Forestry Research Organizations
MFNL	Model Forest of Newfoundland & Labrador
NRCan	Natural Resources Canada
PNSTs	Post-normal sustainability strategies
SFM	Sustainable forest management

ACKNOWLEDGEMENTS

I would like to thank the researchers, Model Forest staff and partner representatives who participated in the interviews. This work could only have been completed through the sharing of their thoughts, knowledge and experiences.

My supervisor, Dr. Peter Duinker, and committee member, Dr. Heather Castleden, have provided invaluable guidance throughout the project. I enjoyed the discussions and debate while sipping single malts or sampling the latest beers at the local pubs. While Peter and I have been sharing our views on Model Forests and sustainable forest management since at least 2000, my return to study under his supervision got its start with a discussion in a taxi in Ottawa in the fall of 2005. Reaching this point of completion has been a somewhat slow journey but one I am grateful for undertaking. I am looking forward to more debates, beers and laughs in the years ahead.

Through facilitating class discussions on the concepts, frameworks and underlying principles of science and the socio-political dimensions of resource management, Heather helped me achieve some of my goals for returning to university—to more fully understand and appreciate the research process and have my perspectives challenged, debated and sometimes confirmed.

I would also like to thank Dr. Stephen Wyatt for being the external examiner and challenging me during my final stages of writing. Your questions have strengthened the thesis.

I have been fortunate to have been involved with Model Forests since 1991 both within Canada and throughout the International Model Forest Network. The many, many people I have worked with, talked to, discussed Model Forest principles with

and who have taken the time to show me what they are doing within their Model Forest, I send you my deepest thanks. Your interest and enthusiasm has made my work enjoyable and fulfilling, and has enriched me as a person.

Finally, I would like to thank Marie-Annick who provided ongoing encouragement, support and patience especially through the final stages of my project.

CHAPTER ONE
INTRODUCTION

Science has been increasingly finding its way into public decision-making (Ozawa, 1991) and it is assumed that scientists should provide objective scientific information to policy-makers to facilitate resolution of environmental decisions (Mazur, 1981). However, Formaini (1990, p. 1, Emphasis in original) concluded that "scientifically-based (i.e., *justified*) public policy…is a myth, a theoretical illusion". At the same time, while demand for evidence-based policy continues to grow (Head, 2010; Nutley, Walter, & Davies, 2009), it is often unclear which findings should influence policy when there are conflicting results (Francis, Whittaker, Shandas, Mills, & Graybill, 2005) or even what *science-based* means (Mills & Clark, 2001). Additionally, a gap exists between the knowledge produced by science and the application of that knowledge by decision-makers (Tribbia & Moser, 2008).

The policy-making process is complex and many studies have been designed to enhance our understanding of the role of science in policy formulation, including within the environment and forest sectors (e.g., Buttoud, 2000; Cortner, 2000; Evans, 2006; Innes, 2003; Likens, 2010; Mills & Clark, 2001; Norse & Tschirley, 2000; Spilsbury & Nasi, 2006). The concept of research utilization is prevalent in the literature, particularly in the health sector (see, for example: CIHR, 2005; Estabrooks, 1999; Funk, Tornquist, & Champagne, 1995; Lacey, 1994; Peterson, Rogers, Cunningham-Sabo, & Davis, 2007; Schmitt, 1999), and refers to the overall process where findings from research, or knowledge production, is transferred to practice, or the implementation of research-based knowledge in practice (Sunesson & Nilsson, 1988). This study takes a broad view of research utilization in line with Weiss and Bucuvalas (1980, p. 312) who wrote that

> [o]ur understanding of research utilization has to go beyond the explicit adoption of research conclusions in discrete decisions to encompass the assimilation of social science information, generalizations, and ideas into agency perspectives as a basis for making sense of problems and

pondering strategies of action.

In other words, research utilization does not only mean having a direct impact on decision-making, but can also include awareness raising, changing or challenging attitudes and beliefs, and increasing knowledge and understanding (Walter, Nutley, Percy-Smith, McNeish, & Frost, 2004).

In explorations of the science–policy interface and the use of science in policy, numerous studies have focused on predicting how the knowledge produced by science would be used in decision-making (Dilling & Lemos, 2011; Holmes & Clark, 2008; Klenk & Hickey, 2011; Landry, Amara, & Lamari, 2001; Landry, Lamari, & Amara, 2003). Other studies focused on identifying the many factors that could impede the use of research results in decision-making (Adato & Menzien-Dick, 2002; Barratt, 2003; Dobbins, Ciliska, Cockerill, Barnsley, & DiCenso, 2002; Hemsley-Brown, 2004; Holzer, Lewig, Arney, & Bromfield, 2007; IFPRI, 2002; Van Damme, Duinker, & Quintilio, 2008).

A review of the literature identified a range of potential factors that could influence the uptake of research results, including (Adato & Menzien-Dick, 2002; Barratt, 2003; Cohen & Levinthal, 1990; Dobbins, Ciliska, Cockerill, Barnsley, & DiCenso, 2002; Hanney, Gonzales-Block, Buxton, & Kogan, 2002; Hemsley-Brown, 2004; IFPRI, 2002; Van Damme, Duinker, & Quintilio, 2008; Walt, 1994). Using the framework of Holzer, Lewig, Arney, & Bromfield (2007), these can be summarized as:

- *Pragmatics:* factors over which practitioners, policy makers, and their organisations have little influence including resources, organizational structure and external influences
- *Organizational culture:* organizational support for use of research results, supportive management and colleagues, workload, incentives, leadership
- *Nature of the evidence:* relevance and applicability, presentation of research findings, volume of research, accessibility of research

- *Individual factors:* values, beliefs, assumptions, motivation, receptivity
- *Purveyors of information:* trust and credibility
- *Linkage and exchange mechanisms:* gap between researchers and users, collaboration, partnerships, links, communication networks, communities of practice
- *Other factors:* understanding of policy processes, absorptive capacity

Researchers have also developed various frameworks for examining the impact of research to assist in navigating the complexity inherent in the policy-making process. Several of these focus on the interfaces between researchers and the users of research (Buxton & Hanney, 1996; Chunharas, 2000; Frenk, 1992; Hanney, Packwood, & Buxton, 2000; Weiss, 1977, 1979) such as the model for assessing payback from health research (Buxton & Hanney 1998). Other models and frameworks include: Bozeman and Kingsley's (1997) Research and Development (R&D) Value Mapping which tracks the flows of knowledge and possible outcomes of research and development projects; and a simpler model by Duryea, Hochman, & Parfitt (2007) within which four levels of research impact scope are identified: 1) research outputs (publications, patents, etc.), 2) research transfer (engagement with end users), 3) research outcomes (new or improved products, services or processes), and 4) research impact (value-added, improvements achieved).

In their study of the use of social science research in Canada, Landry, Amara, & Lamari (2001) identified four broad categories of independent explanatory variables used in prior studies of research utilization: 1) science push variables by looking at types of research outputs and the researchers' context, 2) demand pull variables by exploring users' needs and the users' context, 3) dissemination variables by examining adaptation of products and efforts made in dissemination, and 4) interaction variables by looking at the linkages between researchers and users. These four categories have also been described as four explanatory models of research utilization (Landry, Lamari, & Amara, 2003): engineering, organizational, cultural and interaction.

Focusing on the interaction explanation of research utilization, boundary organizations are one mechanism that has been increasingly used to bridge the gap between research and practice, scientists and practitioners, and science and policy-making (Cash, 2001; Clark et al., 2010; Guston, 2001; Tribbia & Moser, 2008). Boundary organizations are "institutions that straddle the shifting divide between politics and science" (Guston et al., 2000, p. 1) by facilitating collaboration among all sides of the science–policy interface (Guston, 1999, 2001). While there have been concerns about science–policy links in forestry (Guldin, 2003; Innes, 2003; Janse, 2008; Joyce, 2003; Kimmins et al., 2005; Klenk & Hickey, 2011; Spilsbury & Nasi, 2006), there has not been an examination of boundary organization theory as a possible mechanism to overcome these concerns and challenges.

1. RATIONALE, PURPOSE AND OBJECTIVES OF THIS STUDY

The Government of Canada developed the Model Forest Program to bring together diverse organizations and people to develop innovative local approaches to integrating sustainable forest management (SFM) policy and on-the-ground implementation supported by science (Hall & Bonnell, 2004). One of the concept's fundamental principles is a "commitment to generate and share knowledge through research, innovation and collaboration" (International Model Forest Network, 2009). In working towards this goal, significant funding has been expended on research activities in Model Forests in Canada (Natural Resources Canada, 2006b).

During the study period, fifteen Model Forests existed in Canada (Figure 1.1) representing the diversity of Canada's forest regions, land tenures, and socio-economic and cultural conditions (Canadian Model Forest Network, 2011). The Model Forests are linked together through the Canadian Model Forest Network, developed to provide an avenue for the individual sites to share knowledge and experiences, and cooperate on projects of strategic importance to Canada's forest sector that would be beyond the purview of a single Model Forest.

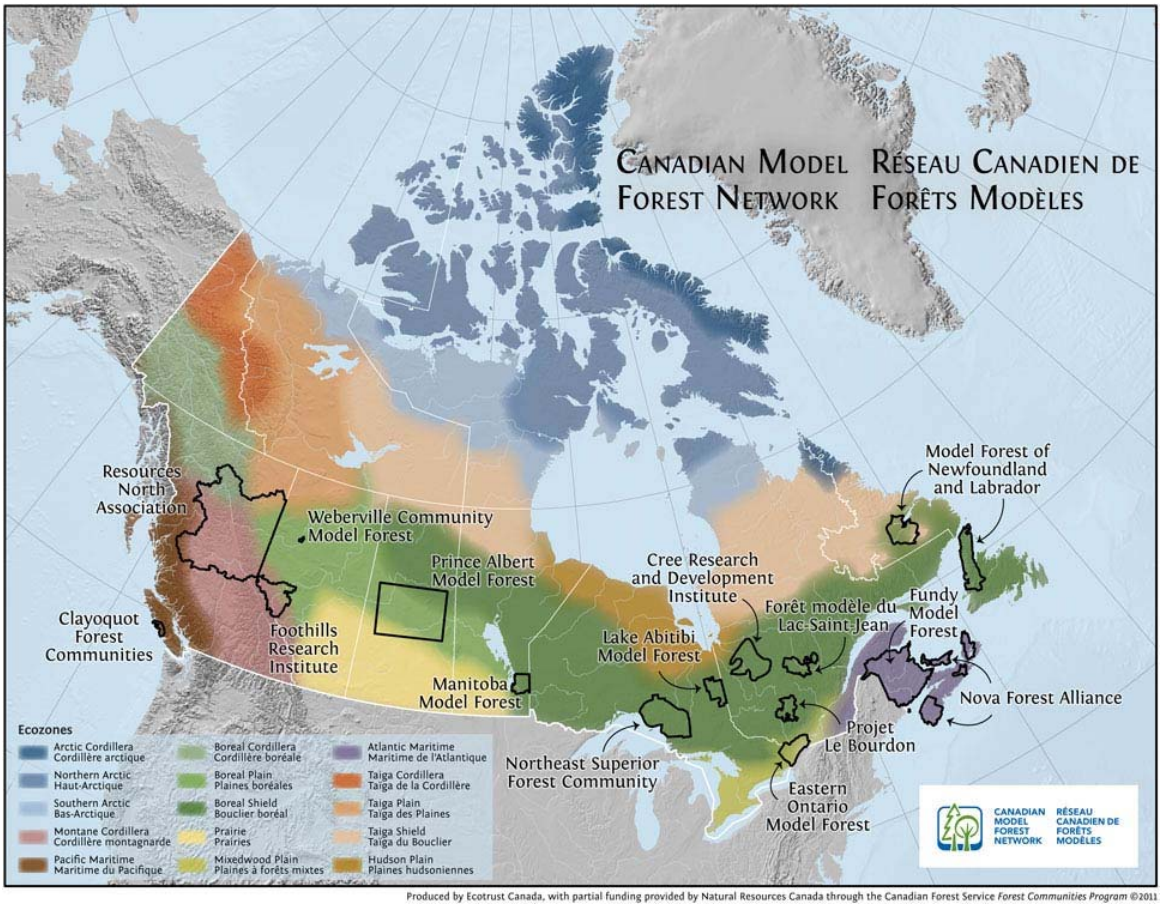

Figure 1.1: Canadian Model Forest Network

The role of research and the extent of the impact of Model Forest research have not been examined in any significant manner as highlighted in the 2002 evaluation of Canada's Model Forest Program which states: "There is a lack of understanding within the administration of the [Program] of the overall content, impact and opportunity of research activities within the Model Forests" (Natural Resources Canada, 2002). This conclusion was reiterated in the 2006 program evaluation (Natural Resources Canada, 2006b).

It is just as important to examine how the uptake of research results can be facilitated or enhanced and the factors that might also impede such uptake as it is to examine the impact of research, and how to measure that impact effectively. The purpose of this study is to explore the mechanisms that may explain why some of

the results of Model Forest-supported research are used in the policy and practice of SFM and others are not.

OBJECTIVES OF THE STUDY

To fulfill the purpose of the study, four objectives were set:

1) To review the use of research results by Model Forests, Model Forest stakeholders and others in advancing SFM;
2) To identify factors that contribute to or impede the uptake of research results of Model Forest-supported research activities;
3) To examine the role Model Forests play in bridging the science–practice and science–policy interface in SFM in Canada; and
4) To provide recommendations on how research activities in Model Forests and other organizations could be better supported to increase impact and uptake of research results within the natural resource management sector.

2. ORGANIZATION OF THE THESIS

The thesis is presented in five chapters. The research methods are outlined in chapter 2. Chapters 3 and 4 are two independent manuscripts intended for publication. As such, each contains separate abstracts, introductions, literature reviews, methods, findings, discussions, conclusions and reference lists. Chapter 3 highlights the facilitating and limiting factors, and the role of Model Forests, in enhancing research utilization in SFM. Chapter 4 focuses on the science–practice and science–policy interface by exploring the notion of Model Forests as boundary organizations, institutions that bridge the divide between science and policy. The final chapter presents an overall summary and conclusion, general reflections, recommendations on the role of Model Forests in enhancing research utilization, and suggestions for future research.

CHAPTER TWO
RESEARCH METHODS

The purpose of this study is to explore the mechanisms that may explain why some of the results of Model Forest-supported research are used in the policy and practice of SFM and others are not. This study, in attempting to identify factors that may contribute to or impede the uptake of research results, was exploratory in nature and, as such, lent itself to a qualitative approach (Marshall & Rossman, 1989). Semi-structured interviews of key informants were undertaken to probe how research results were used and to assist in identifying factors that contributed to or hindered the uptake up research results. Interviewees were selected to allow for the gathering of a breadth and depth of viewpoints greater than which could have been achieved through surveys.

1. NUMBER OF PARTICIPANTS AND SELECTION OF CASES

Several elements were considered in identifying participants for this study, including: number and location of Model Forests to use as cases, number of participants per Model Forest, and who to include within the sample for each Model Forest. A range of Model Forest-sponsored research projects—including both those that possess clearly identified impacts and others that do not—as well as various contexts in terms of Model Forests and research topics (e.g., wildlife habitat and population dynamics, socio-economic analysis, ecosystem dynamics, forest management, etc.) were identified for this study. The following criteria were used to assist in identifying Model Forests and specific research projects to examine:

1) *Level of research activity within the Model Forest*. The level of research activity within the Model Forests was identified through my own experiential knowledge, a review of Model Forest project reports available on web sites, and a review of peer-reviewed journal articles based on research supported by a Model Forest. Model Forests where a high level of research activity was

supported were sought as these sites were expected to have the greatest diversity of experiences in the uptake of research results.

2) *Perceived level of uptake of Model Forest research activity.* Numerous Model Forest General Managers, Canadian Forest Service staff, natural resource managers, and academics were contacted with a request to provide insights into the perceived level of uptake of the outputs of research activities supported through the Model Forests.
3) *The time window of research activity*. A compromise had to be made between the selection of research projects where sufficient time had passed for their results to be made known and used, and the quality of records as well as participants' ability to recall their activities (Bozeman & Kingsley, 1997). Research undertaken over the past few years would have had little time to make an impact either in the literature or in practice. At the same time, finding researchers who implemented their studies at the beginning of Canada's Model Forest Program—during the early to middle 1990s—may have been difficult. The primary time window examined focused on the period 1997–2007.
4) *Socio-political and economic contexts*. A diversity of contexts within which research took place was sought. This included selecting Model Forests located within different provinces, and with varying budgets and funding sources.

Several additional aspects were considered to finalize the selection of Model Forests to study. First, the study was limited to the Model Forests within the Canadian Model Forest Network due to time constraints and language issues outside Canada. The newest Model Forests in the Network (those that joined in 2008) were not examined. As well, both the Bas-Saint-Laurent and Long Beach Model Forests are no longer operating so were also excluded as possible cases as there would have been challenges in locating those involved in the Model Forest as staff, researchers or stakeholders.

After a review of the 17 current and former Model Forests in Canada, three were

selected—Foothills Research Institute (Alberta), Fundy Model Forest (New Brunswick), and Model Forest of Newfoundland & Labrador[1]. Three Model Forests were deemed sufficient to provide a diversity of opinions based on various stakeholder groups engaged, research activities implemented, and socio-political and economic contexts. Fewer than three might have resulted in a focus only on factors specific to one site.

One of the first questions asked by many when a study is to be conducted is: how large must the sample be? (Neuman, 2000). Sample size is affected by the extent to which the population is homogeneous, the kind of sampling procedure being used, the amount of time, money and personnel available, and the number of categories by which the collected data are to be analyzed (Backstrom & Hursh, 1963; Neuman, 2000; Oppenheim, 1992). The sample pool in each Model Forest was quite large. While there were only nine staff members (i.e., General Managers) in the three Model Forests since 1992, on the researcher side, over 600 individual authors of journal articles based on Model Forest-supported research were identified. As well, over 20 stakeholder groups were involved in each Model Forest with most representing potential users of research results and, within each of those organizations, there were numerous individual staff members either involved in Model Forest activities or were potential users of research findings.

In this study, purposive sampling was used to identify participants from a range of sectors, disciplines and organizations. The sample pool included professional foresters, academics, mining company representatives, government officials, representatives of environmental groups or non-governmental organizations, and other interested community members. As well, based on preliminary discussions with Model Forest General Managers and Canadian Forest Service staff, an attempt was made to obtain a sample that focused on Model Forest-supported research

[1] During 1992–2007, the Foothills Research Institute was known as the Foothills Model Forest and the Model Forest of Newfoundland & Labrador was the Western Newfoundland Model Forest. Their current names will be used.

activities whose results have clearly been used by a stakeholder group, and from those projects whose results have had limited or no demonstrated uptake of results by stakeholder groups. This was done to obtain a variety of perspectives and possible explanations as to the role of Model Forests in bridging the science–practice/policy interface. Of the 40 individuals invited to participate, only one person approached explicitly declined an interview. Three other identified key informants, particularly in the Model Forest of Newfoundland & Labrador, did not respond to my call to participate during the research period.

As purposive sampling involves "selecting elements for the sample that the researcher's judgment and prior knowledge suggests will best serve the purposes of the study and provide the best information" (Sullivan, 2001, p. 209), 35 participants were interviewed from the following key groups of individuals (Table 2.1):

- Researchers whose research was supported by one of the three Model Forests (3-6 per Model Forest)
- Staff of the identified Model Forests (2 per Model Forest)
- Model Forest stakeholder groups that represent users (4-5 per Model Forest) that would be expected to have an interest in the research activities of the Model Forests.

Table 2.1: Classification of interviewees in each of the three Model Forests

Model Forest (number of interviews)	**Category[2]**			**Years involved in the Model Forest**			
	Researcher	**User**	**Staff**	**1-5**	**6-10**	**11-15**	**15+**
Foothills (n=13)	6	5	2	2	4	3	4
Fundy (n=13)	6	5	2	1	4	4	4
Newfoundland & Labrador (n=9)	3	4	2	1	2	2	4
Total	**15**	**14**	**6**	**4**	**10**	**9**	**12**

[2] Staff refers to Model Forest General Managers and former General Managers. In the case of the Foothills Research Institute, several researchers were employed directly by the Institute but have been classified as "researchers" for this study. Researchers and users can also be more broadly described as knowledge producers and knowledge consumers (Bogenschneider & Corbett, 2010) based on their respective roles in the production and use of research findings and other information.

2. DATA COLLECTION

RECRUITMENT

Study participants were recruited for interviews by emails, phone calls, and face-to-face invitations. The contact information for potential participants was obtained from three sources: the Model Forests, the Canadian Model Forest Network, and the International Model Forest Network (IMFN) Secretariat. Given my professional affiliation to the International Model Forest Network and my familiarity to the Model Forest General Managers, there was no need to have someone make an initial contact on my behalf. However, I requested that the General Manager introduce me to Model Forest staff, researchers and stakeholders as a graduate student working on the project, indicating that I had extensive experience and involvement with Model Forests in Canada and internationally, and that I would follow up with them directly to request their participation. I sent an email message to each potential participant explaining the study and the commitment involved in participating. I then telephoned participants within a week to answer questions and set up an interview time if informed consent was given to participate in the study.

INTERVIEW SCHEDULES AND INTERVIEWS

Three semi-structured interview schedules were developed to gather viewpoints from the three interviewee groups (see Appendices 1, 2, 3). While there were variations in the questions asked to each group, there was also a set of common questions in each interview schedule. Questions focused on involvement in Model Forests, the role of Model Forests in research, research activities that had been supported by a Model Forest, and the perceived facilitating factors or barriers to the uptake of research results. Interviews were conducted between April and November 2010 in person (n=31) or by telephone (n=4). Each lasted between 15 and 120 minutes, with the average interview being 48 minutes; all interviews were digitally recorded. One interview was with two persons from the same organization, both classified as “users”.

DOCUMENT COLLECTION AND REVIEW

A wide range of documentation was reviewed for this study to undertake a preliminary assessment of the key characteristics of Model Forests and the level of research activity that had been conducted through support provided by the Model Forests, and to become familiar with the activities of the Model Forests. At the site level, Model Forest strategic plans[3] and annual reports (Table 2.2) from 1992 to 2010 were collected and reviewed. Web sites for each Model Forest, the Canadian Model Forest Network, the International Model Forest Network, and Natural Resources Canada were examined to find relevant documentation. The web sites were valuable in providing information on governance structures and current partners of the Model Forests. Early documentation on Canada's Model Forest Program (e.g., Canadian Forest Service, 1995, 1996; Forestry Canada, 1991, 1992) provided a foundation for the history of Model Forests in Canada.

International Model Forest Network Secretariat documents were also collected and reviewed to identify the key attributes of Model Forests. These included the Model Forest Development Guide (IMFN Secretariat, 2008b), Guide to Model Forest Governance (IMFN Secretariat, 2008a), Framework of Model Forest Principles and Attributes (IMFN Secretariat, 2008b), workshop proceedings (e.g., IMFN Secretariat, 1998a, 1998b, 1999a, 1999b), among others. Other documents scrutinized included journal articles on the Model Forests in Canada (e.g., Ayling & Kelly, 1997; Beyers, 2003; Brand, Bouman, Bouthillier, Kessler, & LaPierre, 1996; Brand, Roberts, & Kemp, 1993; Hall, 1997; Sinclair & Lobe, 2005; Sinclair & Smith, 1999), professional articles (e.g., Besseau, Dansou, & Johnson, 2002; Besseau & Mooney, 2004; Bonnell, 1995a, 1995b; Brand & LeClaire, 1994; Carrow, 1999; Giannace, 2006; Hardy, 1994; LaPierre, 2002; Tomsons, 2000), graduate student theses[4] (e.g., Beyers, 1998;

[3] Each Model Forest prepared a 5-year strategic plan for each phase of Canada's Model Forest Program (1992–97, 1997–02, 2002–07). For those sites that received funding through the Forest Communities Program (FCP), a 5-year strategic plan was also developed for 2007–12.

[4] There have been more than 115 graduate students in Canada whose research was supported by a Model Forest or who have focused their research on Model Forests. The full list was reviewed to assist in identifying key themes and the level of research activity within individual Model Forests. Theses based on research examining key aspects of Model Forests, particularly partnership and

Bidinosti, 1998; den Otter, 1999; Gibson, 2009; Gilbert, 2007; McGurk, 2003; Palen, 2003; Pettitt, 1997; Sawatzky, 2006), evaluation reports (e.g., Natural Resources Canada, 2002, 2006a), and other reports and papers (e.g., Brand, 1995; Hall, 1996; Nantel, 2001) to determine what other studies concluded about Model Forests and to compare to my own results.

Table 2.2: Availability of Model Forest Annual Reports[5]

Model Forest	Year																	
	2209-10	2008-09	2007-08	2006-07	2005-06	2004-05	2003-04	2002-03	2001-02	2000-01	1999-00	1998-99	1997-98	1996-97	1995-96	1994-95	1993-94	1992-93
Bas-Saint-Laurent Model Forest				•	•	•					•		•			•		
Canadian Model Forest Network	•	•														•	•	•
Eastern Ontario Model Forest	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Foothills Model Forest / FRI	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•
Fundy Model Forest	•	•	•		•	•	•	•	•		•	•	•		•	•	•	•
Lake Abitibi Model Forest				•	•	•	•	•	•	•	•	•	•	•	•	•		
Long Beach Model Forest											•		•	•	•			
Manitoba Model Forest	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•		•
McGregor Model Forest / Resources North Association	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Nova Forest Alliance			•	•	•	•	•	•	•		•							
Prince Albert Model Forest	•		•	•	•	•	•	•				•	•	•	•	•	•	•
Waswanipi Cree Model Forest																		
MF of Newfoundland & Labrador	•	•	•	•		•	•	•	•	•	•	•	•				•	

As part of the joint Dalhousie University–University of Manitoba Partnership Synergy Project sponsored by the Canadian Model Forest Network, partnership histories of ten Model Forests were completed in 2006 (Palen, Gilbert, & Duinker, 2006a, 2006b, 2006c, 2006d, 2006e, 2006f, 2006g, 2006h, 2006i; Sawatzky, Sinclair, Gilbert, & Duinker, 2006). Additionally, over 380 journal articles (Table 2.3) based

governance, were reviewed in more depth as part of the assessment of Model Forests as boundary organizations.

[5] The Long Beach Model Forest ceased operations in 2000 and Bas-Saint-Laurent Model Forest after 2006–07. The Canadian Model Forest Network was incorporated as a NGO in 2007; the annual reports from 1992–93 to 1994–95 were prepared by the Canadian Forest Service which acted as the Canadian Model Forest Network Secretariat prior to 2007. The Waswanipi Cree Model Forest officially started its operations in 1997 and the Nova Forest Alliance in 1998.

on Model Forest-supported research projects were reviewed to assist in identifying research themes (Figure 2.1) and researchers in the Model Forests which was used to help identify participants from a range of disciplines and organizations.

Table 2.3: Number of journal articles produced based on research activities supported by Model Forests, 1993–2010

Model Forest	Total	Years			
		93-97	98-02	03-07	08-10
Foothills Research Institute	107	2	22	44	39
Fundy Model Forest	49	4	22	21	2
Lake Abitibi Model Forest	47	1	7	35	4
Prince Albert Model Forest	44	10	28	5	1
Model Forest of Newfoundland & Labrador	39	8	13	16	2
Canadian Model Forest Network (or more than one Model Forest)	31	7	9	13	2
Eastern Ontario Model Forest	19	4	5	9	1
McGregor Model Forest	13	0	5	8	0
Bas-Saint-Laurent Model Forest	12	1	5	6	0
Manitoba Model Forest	8	1	1	5	1
Waswanipi Cree Model Forest	6	0	0	4	2
Long Beach Model Forest	4	1	1	2	0
Nova Forest Alliance	3	0	1	0	2
PEI Model Forest Partnership Network	2	0	0	0	2
TOTAL	**384**	**39**	**119**	**168**	**58**

3. DATA ANALYSIS

The interviews were transcribed and analyzed soon after their completion. Preliminary data analysis was done without the aid of computer software, leading to a preliminary coding scheme. NVivo 8 software (QSR International Pty Ltd., 2008) was then used to manage the data and facilitate the coding process of comparing, conceptualizing and categorizing data (Bryman & Teevan, 2005), and to identify emergent concepts, patterns and themes in the data, and salient quotations from individuals.

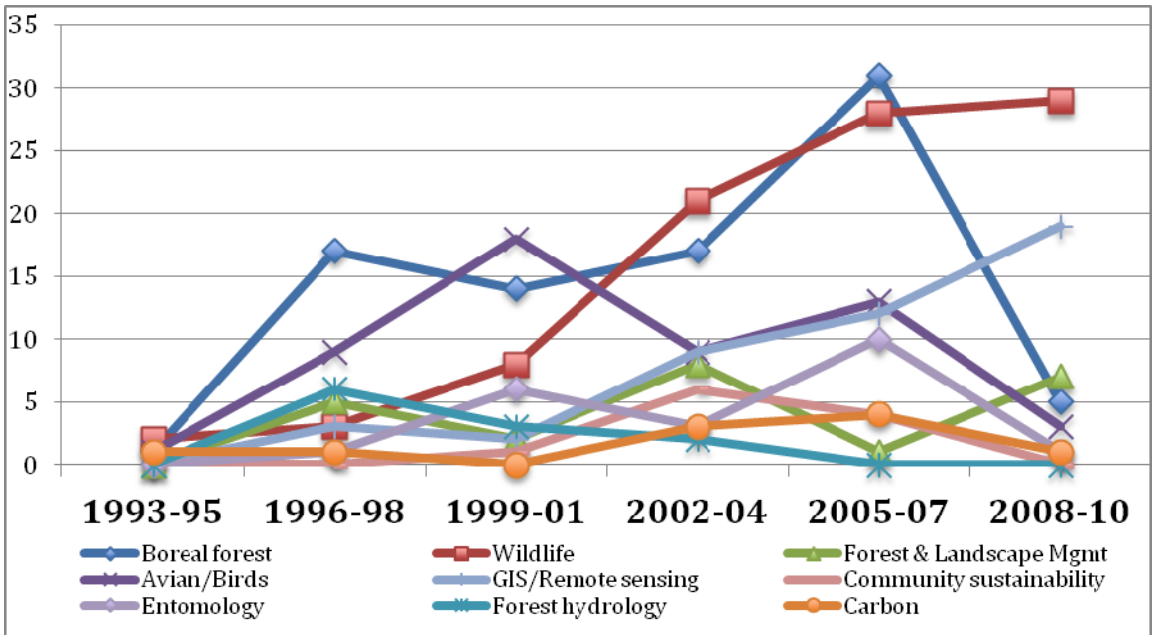

Figure 2.1: Canadian Model Forest Network research trends based on number of journal articles produced[6]

Initial coding focused on several primary categories with free coding within each, including facilitating factors, barriers, the role of Model Forests in research activities, stakeholder activities, research activities, and what could have been done better by each group of interviewees (i.e., Model Forests, users, researchers). Each node was then reviewed to identify duplicate nodes or those that were similar enough to be combined to reduce the overall number of nodes. Finally, the interviews were grouped into sets to allow for further analysis and comparison, including interviewee category, time involved in a Model Forest, and Model Forest. Processing the data into categories based on the interview questions, and then mapping and charting them, facilitated a systematic approach to extracting meaning and drawing out common themes and comparisons among interviewees' accounts (Bryman & Teevan, 2005).

4. INSIDER RESEARCH

A key issue in undertaking this research was the close relationship I have had with

[6] Over 380 journal articles based on Model Forest-supported research activities were classified into one or more of 45 themes. Figure 2.1 highlights the trends of nine of those themes.

the Model Forests in Canada since 1991. I approached this study from an *emic perspective*; that is, from a subjective, informed and influential standpoint in contrast to an objective, distant, logical and removed, or *etic perspective* (Headland, Pike, & Harris, 1990). Researchers who belong to the setting being studied can often have views about the setting, and the findings obtained can be quite different from those an outside researcher might reveal (Bartunek & Louis, 1996). Such "insider research", where the researcher "conducts studies with populations, communities, and identity groups of which they are also members" (Kanuha, 2000, p. 439), can help build research–participant relationships but also presents numerous unique challenges (Asselin, 2003), including assumptions of the culture being studied, objectivity, participant perceptions and expectations, role confusion, and the effect of the researcher on participants especially in cases where there is researcher power over participants (this was not the case here). For example, the potential existed that interviewee responses might have been biased (Tilley & Chambers, 1996) particularly from those whom I know personally or professionally. In addition, there was a risk that interviewees might have responded positively during the interviews knowing of my involvement as a staff member of the International Model Forest Network Secretariat.

ASSUMPTIONS ABOUT THE CULTURE BEING STUDIED

There is a tendency for the researcher working within a peer group to believe he or she knows the culture of that peer group. Such assumptions could limit the researcher's ability to probe for deeper understandings in the observations. It is important for a researcher to assume a complete lack of knowledge of what is being studied and be conscious of clues such as "you know how it is" in participant responses (Asselin, 2003, p. 100).

OBJECTIVITY

With insider research, a researcher's past experiences, beliefs and expectations may prevent the detachment from the setting necessary to objectively analyze the data.

However, Aguilar (1981) suggested that such biases or predispositions "might very well be sources of insight as well as error" (p. 26). A continual process of self-reflection (Tilley & Chambers, 1996) has been recommended to address this challenge.

PARTICIPANT PERCEPTIONS AND EXPECTATIONS

In some instances, participants may have expectations of the researcher that could affect their participation and the information shared (Asselin, 2003). For example, participants might expect the researcher to act as an advocate—in my particular case, for renewal of funding under a program, which is due to expire in 2012[7]. When the researcher is known to participants, trust between the two could be present which could encourage the participants in being more candid and open in their responses.

ROLE CONFUSION

An insider researcher also has to consider the possibility of role confusion during the interview process. Role confusion occurs when the researcher begins to analyze data from the perspective of their substantive position rather than that of a researcher, or when the researcher is drawn into participating in the study rather than focusing on collecting data and observing (Asselin, 2003).

OVERCOMING THE CHALLENGES OF INSIDER RESEARCH

Asselin (2003) suggested that the challenges posed by insider research could be overcome by building compensatory techniques into the study design and analysis. In particular, a continual process of self-reflection (Tilley & Chambers, 1996) and Lawson's (1985) position of critical suspicion or reflexivity are viewed as important in addressing many of these challenges.

[7] The Forest Communities Program, through which two of the Model Forests in this study received funding, is scheduled to end in March 2012. Additionally, I was an employee of the Canadian Forest Service (CFS) that hosted both the Forest Communities Program and the International Model Forest Network Secretariat although the two initiatives were located in different branches of the CFS.

For this study, I worked with my committee members[8] to deconstruct any assumptions and values I might have had about the Model Forest concept. This involved continual self-reflection, discussing the findings with them and others who may be objective, constantly questioning the data and what was seen, and ensuring the confidentiality of the participants' identities and views.

There were several times during the interviews when I noticed that I was beginning to be drawn into the participant's discussions and to empathize with their views. At those times, it was important for me to pull back from the discussion, re-focus on the questions at hand, and take a more critical look at the responses and discussion.

During the recruitment and data collection phases I clearly identified myself as a researcher while also explaining that my substantive role was as a staff member of the International Model Forest Network Secretariat with a long history of involvement with the Canadian Model Forest Network. Participants understood that the three Model Forests included in this study would be identified but they were assured of the confidentiality of the individual information gathered. Specifically, the use of direct quotations where any information that could identify an individual would be removed. As well, participants were informed of how data were going to be used and shared. Indeed, most participants specifically commented that the study results should be provided to the Model Forests once completed.

[8] As my supervisor was also heavily involved with Model Forests, I particularly relied on my committee member to question any potential assumptions I might make with respect to Model Forests. In addition, an external examiner was selected that had not been involved in Model Forest activities in any significant manner.

CHAPTER THREE

ENHANCING THE UPTAKE OF RESEARCH RESULTS IN SUSTAINABLE FOREST MANAGEMENT: FACILITATING AND LIMITING FACTORS AND THE ROLE OF MODEL FORESTS

Brian Bonnell was responsible for the research and writing of this manuscript. Peter Duinker was the thesis supervisor and Heather Castleden was a thesis committee member. Both provided guidance, revision, and feedback. When submitted to a journal for publication, this paper will have the following authors: Bonnell, B., Duinker, P., & Castleden, H.

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ABSTRACT

Model Forests were developed, in part, to bridge the gap between the emerging policy and the practice of sustainable development in forestry in the early 1990s and, as such, to facilitate the uptake of research findings into practice. Four explanatory models of research utilization—engineering, organizational, cultural and interaction—were used as a framework for assessing perceptions of factors affecting the uptake of research findings in three Model Forests in Canada. Based on a series of interviews with research participants associated with the Model Forests, the most prominent factors influencing research utilization identified were (1) *relevance of the research and research findings to users' needs,* (2) *effective research design and scientific credibility,* and (3) *user involvement in the research process*. However, it was evident that there is, in effect, no one factor that influences uptake or the creation of usable science, but rather a combination of factors that are dependent upon the particular circumstances of each situation. The findings also demonstrated that each of the three Model Forests examined—Foothills, Fundy, and Newfoundland & Labrador—played a role in facilitating the use of research findings. Several practical measures are identified to enhance the probability that research findings will be used.

KEYWORDS: Model Forests, research utilization, knowledge translation

1. INTRODUCTION

During the seventeenth century, western science started to become a source and

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standard of legitimacy (Greenfled, 1987) and the "cloak of scientific respectability" (Majone, 1984, p. 15) has been used by regulators to gain legitimacy for decisions. Science has maintained its place on this pedestal for over four hundred years. Beginning in the 1980s, science has increasingly found its way into public decision-making (Ozawa, 1991) although Formaini (1990, p. 1, emphasis in original) concluded that "scientifically-based (i.e., *justified*) public policy…is a myth, a theoretical illusion". However, the demand for evidence-based policy continues to grow (Head, 2010; Nutley, Walter, & Davies, 2009) as it is believed that important policy decisions are better with stronger information (Szaro et al., 1998).

Despite the desire to use scientific information and results, "a disconnect remains at the intersection between science and decision-making, i.e., between the information and knowledge produced by scientists and the information and knowledge applied by decision-makers" (Tribbia & Moser, 2008, p. 316). Scientists have long believed that the results of their research, while making an important contribution, are seriously underutilized in policy formulation. Conversely, policy-makers feel that those same results are unintelligible, not relevant to the immediate issue in question and not sensitive to the pressures for the immediate action required (Oh, 1997). Indeed, ignoring research findings appears to be a common practice (Weiss, 2009).

The policy-making process is complex and includes many factors that could impede the uptake of research results (Hanney, Gonzales-Block, Buxton, & Kogan, 2003). In health research, studies suggest that it takes an average of 17 years to move from new scientific discoveries to practice (Westfall, Mold, & Fagnan, 2007). Ellefson (2000, p. 93) highlighted the significant challenges in linking science and policy because of "the complex nature of policy issues, disciplinary orientation of the scientific community, dilemmas of diverging scientific conclusions, overzealous certainty allied with some scientific approaches, dangers of narrowly focused scientific advocacy, and the enigma of agreement as the universal criteria for choice in a policy selection". In an extensive review of the literature, McNie (2007) identified several additional challenges, including a lack of understanding of how

decisions are made, and temporal, spatial, political, scientific and cultural contexts related to knowledge generation and political processes.

Many studies have been designed to enhance our understanding of the role of science in policy formulation, including within the environment and forest sectors (e.g., Buttoud, 2000; Cortner, 2000; Evans, 2006; Innes, 2003; Likens, 2010; Mills & Clark, 2001; Norse & Tschirley, 2000; Spilsbury & Nasi, 2006). Several have focused on predicting how knowledge produced by science would be used in decision-making (Dilling & Lemos, 2011; Holmes & Clark, 2008; Klenk & Hickey, 2011; Landry, Amara, & Lamari, 2001; Landry, Lamari, & Amara, 2003).

Model Forests were developed, in part, to bridge the gap between emerging policy and the practice of sustainable development in forestry (Forestry Canada, 1991). To facilitate this, a fundamental principle of a Model Forest was a "commitment to generate and share knowledge through research, innovation and collaboration" (International Model Forest Network, 2010). Indeed, during 1992–1997, research activities accounted for 60% of the Model Forests' programming (Natural Resources Canada, 2006). However, the factors influencing uptake of the results of Model Forest-supported research have not been examined nor has the role of Model Forests in facilitating the use of research results despite the focus on research by the Model Forests.

By investigating three (of 15) Model Forests in Canada, this study deepens the understanding of how science and practice are linked. In particular, this paper focused on two primary questions: (1) what are the facilitating and limiting factors affecting use of the findings of research supported by Model Forests, and (2) what was the role of the Model Forest in facilitating uptake of research findings. The paper provides recommendations that could enhance the probability of research findings being used in management and policy decision-making.

2. THEORETICAL FRAMEWORK

DEFINITIONS

As an examination of research utilization will inevitably focus on the science–policy interface, it is important first to define the meaning of policy. For this study, I define **policy** as "the development, enactment, and implementation of a plan or course of action carried out through a law, rule, code, or other mechanism in the public or private sector" (Bogenschneider, 2006, p. 16). This definition goes beyond the political process to include any unwritten standard by any organization.

In an examination of the issue of science in policy-making, a distinction is generally made between usable science and research utilization. **Usable science** refers to knowledge that meets the needs of users, including being available when and where needed, accessible to the user community, and understandable to the users (Lemos & Morehouse, 2005). I take a broad view of **research utilization** in line with the definition of policy above and Weiss and Bucuvalas (1980, p. 312) who wrote that

> [o]ur understanding of research utilization has to go beyond the explicit adoption of research conclusions in discrete decisions to encompass the assimilation of social science information, generalizations, and ideas into agency perspectives as a basis for making sense of problems and pondering strategies of action.

Weiss (1980, p. 381) referred to this as "knowledge creep". Although science is the process of generating knowledge (Conway, Waage, & Delaney, 2010) while research is one of the first steps in that process, throughout this paper the terms of science and research will be used interchangeably as both will be referring to the generation of knowledge and information.

For the most part, I will refer to researchers and users or researchers and practitioners throughout the paper. These groups can also be more broadly described as **knowledge producers** and **knowledge consumers** (Bogenschneider & Corbett, 2010) based on their respective roles in the production and use of

research findings and other information.

MODES OF SCIENCE PRODUCTION AND EXPLANATORY MODELS OF RESEARCH UTILIZATION

Three main approaches to science production, particularly with respect to science–policy integration, have been identified. The first mode is characterized by the pursuit of knowledge and is generally referred to as the "science push" or linear model (Stokes, 1997). Topics are chosen and the research is driven by researchers while users are simply the receptacles of the results. However, key criticisms of this mode focus on (1) no one has responsibility for the transfer of knowledge to users, and (2) raw research information is generally not usable knowledge and needs to be transformed (Lomas, 1990).

While also following a linear approach, in the "demand pull" model it is the users who commission the research and thus identify the ideas or themes of research (Weiss, 1978, 1979; Yin & Moore, 1988). Within this model, a more direct "customer–contractor relationship" (Landry et al., 2001, p. 335) develops. The key drawback of this mode is that the information or knowledge demanded may not be feasible to produce or be scientifically robust (Sarewitz & Piekle, 2007). However, as the information is requested, there is a greater chance of uptake.
The third approach combines both the science push and demand pull modes into a "co-production" or interaction model (Yin & Moore, 1988). Here, the research agenda is developed through ongoing interaction between knowledge producers and users (Lemos & Morehouse, 2005). Through this mode, knowledge is co-produced between the researchers and users and greater attention is also given to the relationships between the two groups throughout the entire process of knowledge production, dissemination, and use (Landry et al., 2001).

However, while the modes of science production offer an explanation of the ways in which science might be used, the issue of why some results are used while others are not is seldom addressed. In a systematic empirical study on the determinants of

the use of university research in government agencies, Landry et al. (2003) identified four explanatory models of research utilization: engineering, organizational, cultural and interaction; each of these is described below.

Engineering explanations

Within the engineering explanation, uptake of research results follows a linear sequence from the supply of knowledge to its use by practitioners and decision-makers (Landry et al., 2001). In a review of previous studies, Amara, Ouimet, and Landry (2004) highlight characteristics of research findings and type of research as two key components of the engineering model that affect use. These characteristics or context attributes include (Dearing & Meyer, 1994; Dearing, Meyer, & Kazmierczak, 1994; Weiss & Bucuvalas, 1980): compatibility, complexity, observability, trialability, validity, reliability and applicability. Type of research has also been identified as a determining factor. Types include basic/theoretical/applied science, quantitative/qualitative, general/abstract (Machlup, 1980), social/physical science (Yinger & Cutler, 1978), and the research discipline (Landry et al., 2001). Essentially, this explanation posits that the more research findings are compatible with the decision to be made, the more likely they will be used. The two main critiques of this model are: (1) the transfer of new knowledge is not automatic if no one is assuming responsibility for the transfer (Landry et al., 2001), and (2) raw research information must be transformed before it can be used (Lomas, 1990).

Organizational explanations

The organizational explanation assumes that the characteristics of the recipient organization influence use of research results. This includes such factors as the size of an agency, organizational structure and processes, types of policy domains, needs and interests, and the position of personnel within the organization (Amara et al., 2004). Greater use of research results is expected if the research focuses on the needs of users rather than solely on advancing scholarly knowledge, if users

consider research to be pertinent and valuable, and if results are available when needed (Landry et al., 2001, 2003). Another factor is absorptive capacity, that is, an organization's capacity to evaluate, use and exploit knowledge acquired from external sources (Cohen & Levinthal, 1990). This latter factor could also be extended to include whether an organization has the material means to use information or implement alternatives (Lemos, Finan, Fox, Nelson, & Tucker, 2002).

Dilling & Lemos (2011) further subdivide the organizational or institutional context affecting uptake into formal and informal barriers. Formal barriers include inflexible institutional decision rules whereas a preference for established and tested practices rather than new ideas (i.e., related to how risk-averse an organization might be) is a form of informal institutional barrier.

Cultural explanations

A persistent explanation in the literature assumes that scientists and users belong to two distinct cultures, or communities, with differing values, ideologies, and languages that may impede the uptake of research results (Caplan, 1979; Oh, 1997; Small, 2005; Weber, 1987). This third explanation has been described as the "two-communities" model (Amara et al., 2004; Landry et al., 2003), the "community dissonance theory" (Bogenschneider & Corbett, 2010), and more poetically as "[r]esearchers are from Mars; policymakers are from Venus" (Feldman, Nadash, & Gursen, 2001, p. 312). The model postulates that a low level of knowledge uptake occurs because of a lack of understanding between the two communities as a result of each community working within distinct professional and institutional cultures. Both the adaptation of research results into a language the user understands (Caplan, 1979; Weber, 1987) and focusing on acquisition efforts such as engaging researchers in discussions to enhance understanding of the results (Amara et al., 2004) are highlighted as factors that may reduce the gap between the communities.

Interaction explanations

Criticisms of the various explanations of research utilization outlined above led to the development of the "interaction" model (Landry et al., 2001). The model focuses on the social links or relationships between knowledge producers and knowledge consumers and holds that the interaction between these groups is the most important determinant of research utilization (Landry et al., 2001, 2003; Oh, 1997; Oh & Rich, 1996; Yin & Moore, 1988). Interaction explanations postulate that the "more sustained and intense the interaction between researchers and users, the more likely utilization will occur" (Landry et al., 2003, p. 195). In effect, this model builds on the earlier explanations and integrates the factors previously identified as influencing research utilization. The "linkage mechanism" has been identified as a variable within this model (Landry et al., 2001, 2003) and encompasses such things as meetings, symposia and seminars, committees and working groups, and email.

Other explanations

The four explanations outlined above—engineering, organizational, cultural, and interaction—are the main models of research utilization evident in the literature. Several other models have been developed to identify and explain factors that might influence the uptake of research results. However, most of these are the same as those above but with different names and many of the factors identified are evident within the explanations above. These other models of research utilization in policy-making include (Booth, 1988; Bozeman & Kingsley, 1997; Buxton & Hanney, 1996; Landry et al., 2001; Thomas, 1985; Walt, 1994): the classic/purist/knowledge-driven model, problem-solving/policy-driven model, enlightenment/percolation/limestone model, political model, tactical model, dissemination model, research payback model, and the research-and-development value-mapping model.

These explanatory models will form the framework for assessing the perceptions of factors affecting research uptake in three Model Forests in Canada.

3. MODEL FORESTS

Starting in the late 1980s and leading into the early 1990s, there was a paradigm shift in Canadian forestry away from sustained yield management, focused on maintaining a continuous supply of timber, towards sustainable forest management (SFM) and a more social approach to resource management (Kimmins, 1995). The Government of Canada developed the Model Forest Program in response to the changes taking place in the forest sector. The Program was designed to bring together diverse organizations and people to develop innovative local approaches to integrating SFM policy and on-the-ground implementation supported by science (Hall & Bonnell, 2004). Model Forests were to act as "large-scale, living laboratories where people with an interest in the forest could participate in decisions about how the forest could be sustainably managed" (LaPierre, 2003, p. 796).

A Model Forest is both a large geographical area (generally exceeding 100,000 hectares) representing a diversity of land uses, ecosystems and administrative units, and a very broad group of stakeholders who collaborate to develop and work towards a common vision for the sustainable management of that landscape (Hall & Bonnell, 2004). Typically, Model Forest participants include: land users, owners, and managers; forest-based and other industries; community, non-governmental environmental, and forestry groups; federal, provincial, and municipal government agencies; academic and research institutions; managers of conservation areas; Aboriginal groups and communities; and others (IMFN Secretariat, 2008).

During the study period, fifteen Model Forests existed in Canada (Figure 3.1) representing the diversity of Canada's forest regions, land tenures, and socio-economic and cultural conditions (Canadian Model Forest Network, 2011). The Model Forests are linked together through the Canadian Model Forest Network, developed to provide an avenue for the individual sites to share knowledge and experiences, and cooperate on projects of strategic importance to Canada's forest sector that would be beyond the purview of a single Model Forest.

4. RESEARCH METHODS

To identify factors that influence research utilization, this study was exploratory in nature and thus lent itself to a qualitative approach (Marshall & Rossman, 1989). Semi-structured interviews of key informants (researchers, staff, users) were undertaken to probe how the results of research supported by three Model Forests in Canada have been used and to assist in identifying factors that may have contributed to or hindered the uptake of those research results.

The Model Forests selected for this study—Foothills Research Institute (Alberta), Fundy Model Forest (New Brunswick), Newfoundland & Labrador[9]—were identified based on four factors:

1) *Level of research activity within the Model Forest*. The level of research activity within the Model Forests was identified through my own knowledge, a review of Model Forest project reports available on web sites, and a review of peer-reviewed journal articles based on research supported by a Model Forest. Model Forests where a high level of research activity was supported were being sought as these sites were expected to have the greatest diversity of experiences in the level of uptake of research results.
2) *Perceived level of uptake of Model Forest research activity.* Numerous Model Forest General Managers, Canadian Forest Service staff, natural resource managers, and academics were contacted with a request to provide insights into the perceived level of uptake of the outputs of research activities supported through the Model Forests.
3) *The time window of research activity*. A compromise had to be made between the selection of research projects where sufficient time had passed for their results to be made known and used, and the quality of records as well as participants' ability to recall their activities (Bozeman & Kingsley, 1997).

[9] During 1992–2007, the Foothills Research Institute was known as the Foothills Model Forest and the Model Forest of Newfoundland & Labrador was the Western Newfoundland Model Forest. Their current names will be used.

Research undertaken over the past few years would have had little time to make an impact either in the literature or in practice. At the same time, finding researchers who implemented their studies at the beginning of Canada's Model Forest Program—during the early to middle 1990s—may have been difficult. The primary time window examined focused on the period 1997–2007.

4) *Socio-political and economic contexts*. A diversity of contexts within which research took place was sought. This included selecting Model Forests located within different provinces, and with varying budgets and funding sources.

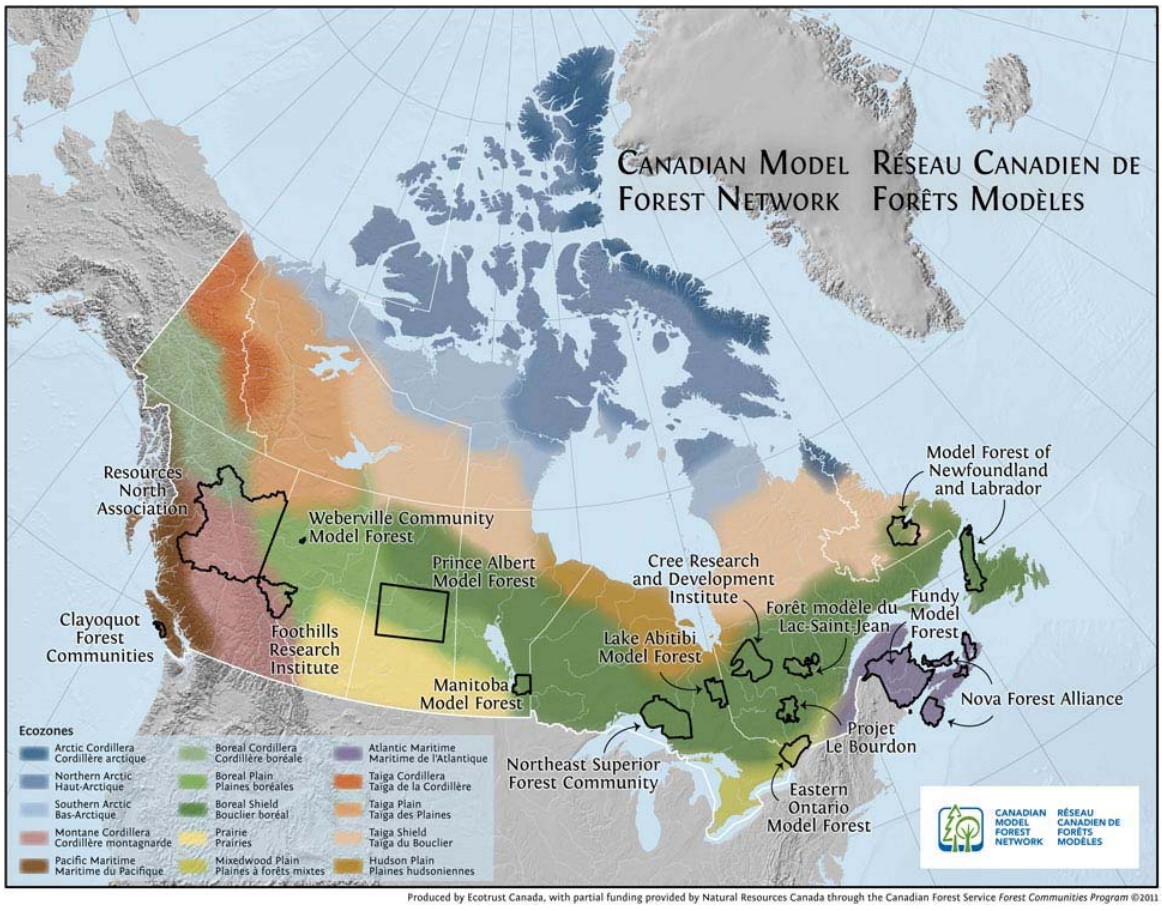

Figure 3.1: Model Forest locations in Canada

Three Model Forests were deemed sufficient to provide a diversity of opinions based on various stakeholder groups engaged, research activities implemented, and

socio-political, economic and ecological contexts. Fewer might have focused too much on factors specific to one site and more than that also presented challenges with respect to conducting interviews in the additional sites within a limited time frame and budget. The study population included researchers whose research was supported by one of the three Model Forests (3-6 per Model Forest), staff of the identified Model Forests (2 per Model Forest), and Model Forest stakeholder groups that represent users (4-5 per Model Forest) that would be expected to have an interest in the research activities of the Model Forest in which they participated (Table 3.1). The sample pool in each Model Forest was quite large. While there were only nine General Managers in the three Model Forests since 1992, on the researcher side, over 600 individual authors of journal articles based on Model Forest-supported research were identified. As well, over 20 stakeholder groups were involved in each Model Forest with most representing potential users of research results and, within each of those organizations, there were numerous individual staff members who were either involved in Model Forest activities or potential users of research findings.

Table 3.1: Classification of interviewees in each of the three Model Forests

Model Forest (number of interviews)	**Category**[10]			**Years involved in the Model Forest**			
	Researcher	**User**	**Staff**	**1-5**	**6-10**	**11-15**	**15+**
Foothills (n=13)	6	5	2	2	4	3	4
Fundy (n=13)	6	5	2	1	4	4	4
Newfoundland & Labrador (n=9)	3	4	2	1	2	2	4
Total	**15**	**14**	**6**	**4**	**10**	**9**	**12**

Purposive sampling was used to identify participants from a range of sectors, disciplines and organizations. The sample pool included professional foresters,

[10] Staff refers to Model Forest General Managers and former General Managers. In the case of the Foothills Research Institute, several researchers were employed directly by FRI but have been classified as "researchers" for this study.

academics, mining company representatives, government officials, representatives of environmental groups or other non-governmental organizations, and other interested community members. As well, an attempt was made to obtain a sample that focused on Model Forest-supported research activities whose results have clearly been used by a stakeholder group, and from those projects whose results have had limited or no demonstrated uptake of results by stakeholder groups. This was done to obtain a variety of perspectives and possible explanations as to the role of Model Forests in bridging the science–practice/policy interface. Only one person approached declined to provide an interview. Several other identified key informants, particularly in the Model Forest of Newfoundland & Labrador, could not be contacted during the research period.

Three semi-structured interview schedules were developed to gather viewpoints from the three interviewee groups. Questions focused on involvement in Model Forests, the role of Model Forests in research, research activities that had been supported by a Model Forest, and the perceived facilitating factors or barriers to the uptake of research results. Interviews were conducted between April and November 2010 in person (n=31) or by telephone (n=4). Each lasted between 15 and 120 minutes, with the average interview being 48 minutes in length. All interviews were digitally recorded. One interview was with two persons from the same organization, both classified as “users”.

The interviews were transcribed and analyzed immediately following data collection. Preliminary data analysis was done without the aid of computer software, leading to a preliminary coding scheme. NVivo 8 software (QSR International Pty Ltd., 2008) was then used to manage the data and facilitate the coding process of comparing, conceptualizing, and categorizing data (Bryman & Teevan, 2005), identify emergent concepts, patterns and themes in the data, and identify salient quotations from individuals.

A key issue for me in undertaking this research was the close relationship I have had

with the Model Forests in Canada since 1991. Such "insider research" where the researcher "conducts studies with populations, communities, and identity groups of which they are also members" (Kanuha, 2000, p. 439), can help build research–participant relationships (Asselin, 2003) but also presents numerous unique challenges. For example, the potential existed that interviewee responses might be biased (Tilley & Chambers, 1996) particularly from those whom I knew personally. In addition, there was a risk that interviewees might have responded positively in interviews if they knew of my involvement as a staff member of the International Model Forest Network Secretariat. At the same time, this was expected to be balanced by my level of knowledge of various activities through which I could potentially identify when there might be issues. As well, interviewees might have been more candid with me because of my long history of engagement. The challenges can be overcome by building techniques into the study design and analysis (Asselin, 2003), particularly by working on deconstructing any assumptions and values I might have about the Model Forest Concept and adopting Lawson's (1985) position of critical suspicion or reflexivity.

5. Findings

Engineering explanations influencing the usability of Model Forest-supported research

Interviewees in all three Model Forests identified several characteristics of research findings they felt affected the usability of research results. These have been grouped into: effective research design; perception of attributes of research findings; and the type of research undertaken.

Effective research design and sound science

Approximately a quarter of the interviewees indicated that effective research design, or the more general idea of "sound science" (mf2u8[11]), was an important factor in research utilization. A factor highlighted by all three groups of interviewees

[11] Interviewees are identified by code where mf# refers to the 1st, 2nd or 3rd Model Forest, r = researcher, u = user and s = Model Forest staff. The second number refers to the nth interviewee in that category.

and in all three Model Forests While validity and reliability were not specifically mentioned by interviewees, several talked about the importance of the independence of the scientific process and of ensuring the research was peer-reviewed. When asked about their views on factors that might facilitate the uptake of research results, almost one-third of interviewees highlighted some aspect of scientific credibility in their responses. For the most part, though, credibility was linked to peer-reviewed research in all Model Forests and to the notion that a well-designed and credible research project producing a peer-reviewed paper would support future decisions more fully than project reports or general communications products. At the same time, several interviewees in the Model Forest of Newfoundland & Labrador felt that there was less a need for peer-reviewed materials than there was a more direct engagement by users in the research process. However, the need for sound science was pervasive.

Attributes of research findings

The attributes of research findings that may facilitate or hinder use can be summarized from the literature on the diffusion of innovations and include compatibility, complexity, observability, trialability and applicability (Dearing et al., 1994; Rogers, 1995). Several of the attributes were mentioned during the interviews but not by large numbers of interviewees. For example, the concept of *compatibility*—the degree to which the data and findings conform to existing ideas, norms, practices, and values—was mentioned by only two interviewees while trialability, or the degree to which users could experiment with the results, was mentioned only once. Both *complexity* and *applicability* were the most-mentioned attributes although they, as well, were not mentioned often by interviewees. Several interviewees felt the research results had to be "very easy to use" (mf1r14) and "user friendly" (mf3u7) or the research "wasn't practical to begin with" (mf1s3). Finally, the applicability of findings to the local context was identified by a couple of interviewees. For example, one researcher said:

> even though in some cases there may have been similar kinds of studies elsewhere, we had data from [here] that people could be convinced that

these results really related to what was going on in [their area]. (mf2r4)

Type of research undertaken

The final engineering explanation component that can influence use of research findings focuses on the type of research undertaken in terms of basic versus applied, quantitative versus qualitative, or general versus abstract. Although undertaking or facilitating applied research was identified as one of the roles of a Model Forest by approximately half of the interviewees, the nature of research was not mentioned specifically as a factor for utilization of findings. However, one researcher felt that the difference between the social and physical sciences was a factor in the uptake of their research results:

> we're always swimming upstream in the sense of sort of the legitimacy of social science endeavour and its utility and so forth. It's not hard science. It's got all this baggage with it. (mf1r2)

Organizational explanations influencing the usability of Model Forest-supported research

While the engineering explanations focused on the characteristics of the research findings, organizational explanations highlight characteristics of the user as a factor in research utilization. Under this explanation, use of research results is expected to increase if (1) the research is relevant to users, (2) users value research, and (3) information is available when needed by users (Landry et al., 2003). Four key themes related to organizational factors were identified in the data: needs of the users; availability of information; research receptor capacity; and formal and informal institutional barriers. These themes are elaborated on below.

Needs of the users

Relevance of the research to users was the single largest factor identified among all explanations with more than 50% of interviewees mentioning some aspect of relevance in their responses. For example, in talking about a particular issue they were facing, one industry representative said: "[the issue] really impacted our operations because we couldn't harvest our fibre the way we used to so, you know,

the research…had a direct impact on us"(mf3u7).

Availability of information

There was evidence that availability of information (research findings) was a factor in uptake of the results of Model Forest-supported research. This included the "timeliness of delivery" (mf2r12) and, in some cases, the unavailability of information from results not being written up or no communications product being generated at the end of the research. Some interviewees acknowledged that "the need for a decision is often faster than the ability of research to catch up" (mf2u4). For example, one researcher described the building of an economic impact model and, because of the difficulty in obtaining data, by the time the model was completed, the time period users were looking for a forecast had passed although the model ended up being used in different ways than originally envisioned.

Research receptor capacity

An important organizational characteristic highlighted in the literature on research utilization is absorptive capacity. Although this study did not directly assess the absorptive capacity of organizations participating in the Model Forests, several factors of research utilization were identified by interviewees that can be linked to the concept. As one interviewee stated:

> Model Forests should be innovative in research and producing modeling tools, *et cetera*…whether at the time when they're finished doing the prototype if the partner is ready for it is another thing. (mf3s2)

Both researchers and users who participated in the study highlighted ideas related "research receptor capacity" (mf1r10) that influenced the use of research findings, including: receptivity of the management structure; staff willingness to look at new ideas; availability of time to review research; and degree of understanding of research processes and the value of research.

A *receptive management structure* was identified by some interviewees as an important facilitating factor, particularly "in the organization that's sponsoring the research" (mf1r2). One stakeholder highlighted an example where job descriptions were changed specifically to try to enhance the "research receptor capacity within the company" (mf1r10). While a lack of organizational support at a senior level was also highlighted as a barrier, some interviewees focused on *staff willingness to look at new ideas* as a barrier. As one interviewee stated,

> After 30 or 40 years in any job you get pretty used to what you're doing and accustomed to that and, boy, to start something new…that late in your career is a tough sell and some people just really don't like change that much. (mf3u15)

Consistent with the literature (Barwick et al., 2008; Boström, Kajermo, Nordstrøom, & Wallin, 2008; Burch, 2010), a *lack of time* to be engaged in research uptake activities was cited by many interviewees, particularly users. Comments such as "being swamped with administrative tasks" (mf1u3), "everybody's busy" (mf3u5), "I just don't have the time" (mf1u9) and "just been absolutely swamped…I think workload is an impediment" (mf3u15) were common. One person commented that organizations have downsized but there is still the same amount or more work to do so, in effect, there is less time to look at the results of new studies to see how they could be used. Another interviewee recommended requiring key employees to embed keeping abreast of research for their specific duties within their work plans and performance reporting.

Formal and informal institutional barriers

Discussion of the inflexibility of institutional decision rules primarily focused on the regulatory process. In the few instances where institutional barriers were raised, interviewees talked about some organizations using existing regulations as a mechanism for not changing practices regardless of what the research findings were or that the government agency itself prevented change. One researcher said, "you may come with a great idea that, hey, that this would work or something but it's

outside the rules" (mf2r15) so changes were not made despite the evidence.

Traditional management and decision-making processes were also identified as a possible barrier. With some of the research, findings raised new ideas and concepts representing a threat to the status quo and possibly to the "professional credibility" (mf1r3) of forest managers as the new information could change the way decisions were being made on forest management. The apparent incompatibility with traditional management approaches within the context of more recent changes in the nature of resource management and stakeholder engagement was also raised:

> None of us have been classically trained in other than command-and-control implementation. Those methods of implementation are inefficient at times and not practical or reasonable to multi-agency, landscape issues. (mf2u13)

There was, however, more discussion on informal institutional barriers such as a preference for established practices rather than new ideas. In particular, some interviewees felt that a key barrier was a cultural resistance among some professionals or the difficulty in tearing down older paradigms that people may have on some key issues. In describing this attitude, one researcher said: "[w]e've always done it this way so why can't we continue to do the same in the future" (mf3r11).

CULTURAL EXPLANATIONS INFLUENCING THE USABILITY OF MODEL FOREST-SUPPORTED RESEARCH

The idea that a lack of understanding between scientists and practitioners exists has been used by numerous authors to explain low levels of uptake of research results (Caplan, 1979; Feldman et al., 2001; Oh, 1997; Small, 2005; Weber, 1987). Many of the interviewees in this study highlighted several factors consistent with the "two communities" model of research utilization. As one interviewee stated:

> It is very simple for a researcher to answer a research or scientific question given enough resources and time. It's more difficult to have those findings taken up by managers for management purposes because the language is different, the understandings are different, the

> implications are different, and the risks are different. (mf1u6)

Interviewees identified a lack of understanding on both sides as factors. Thus, on the one side, managers did not understand the research process and, on the other, many researchers did not understand resource management so were unable to provide information that could facilitate resource management decision-making.

The following paragraphs consider interviewee views on: user involvement in the development of research questions; translation of research findings into user-relevant language; and the role of Model Forests, researchers and users in enhancing understanding of the results.

User involvement in research design

Almost half of the interviewees felt that user involvement in the identification of research questions or the initial research design would have helped facilitate uptake of research findings. Such involvement was raised by both users and researchers. In particular, some researchers indicated that the more they became involved in a Model Forest, the more they came to appreciate the need for user engagement in the development of research questions. In that way, the users would be "interested in the answer and have an idea of how it's going to be used before you ever start. That's the most important thing. That it's not just our brainchild but it comes from them" (mf2r15). Conversely, a lack of user engagement in the research design process was viewed as a significant barrier to the use of results. In describing one project with a lack of researcher–user engagement in research design, one interviewee said:

> Here was a case of somebody that just…wasn't interested in partnering and he wanted the money…and he wasn't interested in having any input from us who wanted the answers to the questions that he was going to be working on. At the end of it, it was just a disaster and none of what he did ever got applied, it's just on a shelf somewhere. (mf1s4)

Engagement in research design was also closely linked to *user ownership* of the

process and the information being generated, with one-third of interviewees mentioning user ownership in a research project as being important for facilitating use. For example, one staff member said, "[i]f they [a user] were going to suggest it and put their money on the table, that builds into it some level of ownership in the final product or the output of that particular level of research" (mf3s2).

Translation of research findings into user-relevant language

A number of interviewees stressed the need for translation of research findings into a language or tool that directly related to users' needs, or as one interviewee described, "there needs to be a connection between the finding and its implementation" (mf1r10). Interviewees also felt that technical, field and regular project reports were insufficient or at times incomprehensible to many managers; findings should directly relate to users if they are going to be utilized and "the further away it is from their world, the more communication and connections you have to make" (mf2r1). At the same time, some interviewees felt there was a need for more technical and peer-reviewed publications to ensure credibility of the research, an aspect discussed earlier. A balance needs to be sought between the two. As one interviewee said, "[w]e have to have both. If we don't have both, we're not firing on all cylinders" (mf2u4).

A key challenge raised by some interviewees was the difficulty many researchers had in trying to translate their findings into a language that users could readily understand. For example, one interviewee said,

> There is a role and responsibility of the scientific community to see the limitations of their own capacity to share their information with the audience and the target audience intended…That's been my only concern with regards to our researchers is they speak a foreign language and sometimes they're unwilling to speak any other language so it's incumbent upon them to, you know, use organizations like the Model Forest or whomever to be the animator of their research with communities or with industry or with the public. (mf3s2)

Role of Model Forests, researchers and users

The engagement of researchers in discussions on the results was a factor raised by several interviewees. Such activities provided a common framework for understanding the outputs of models and other tools developed from the research. In addition to researchers undertaking activities to assist in the translation of research results, Model Forests were also identified as having a significant role to play in bringing researchers and practitioners together, developing a common language and acting as an interface between science and policy. A huge benefit of the Model Forest was felt to be that "everyone was sitting at the table" (mf3r5) which facilitated user engagement in research design and the translation of research results into user-relevant language. Several additional activities of Model Forests, researchers and users in facilitating the use of research results were identified (Table 3.2). While many interviewees highlighted the important role of the Model Forests in the translation and communication of research results, they also felt that both themselves and the Model Forests always could have done more. In particular, several researchers felt they could have worked harder to build more direct links or relationships with potential users.

Interaction explanations influencing the usability of Model Forest-supported research

During the study, interviewees were asked to identify the roles they felt the Model Forest had in research and research-related activities. Many interviewees described the role of Model Forests as being the interface between the science and on-the-ground management. One interviewee indicated that the Model Forest "brings those two groups [researchers and users] together. Puts them at the same table and does it often enough that you get to know each other…" (mf1u11). This idea was reinforced by almost half of the interviewees across the three Model Forests.

Interviewee perceptions on the importance of the interaction between researchers and users in research utilization and the role of Model Forests in facilitating the interaction are reviewed below.

Table 3.2: Activities of Model Forests, researchers and users in facilitating use of research results

Group	Roles
Model Forests	• Brought people together, particularly researchers and practitioners • Supported communications • Supported technical training, workshops and capacity-building • Worked directly with users • Summarized the research that was supported by the Model Forest
Researchers	• Produced publications, made presentations, and undertook communications in general • Built relationships with users • Demonstrated relevance and translated research results • Presented workshops and developed manuals and tools
Users	• Promoted research results or lobbied within their organization • Encouraged staff to get involved in the Model Forest • Undertook informal communications and direct contact with researchers

Ongoing interaction between researchers and users

The concept of continuous researcher–user interaction throughout the research process was the third most-cited facilitating factor overall in the use of research results behind relevance to the stakeholder and user involvement in research design. Some interviewees even went further to say that the interaction had to extend beyond a particular project timeframe to allow personal relationships to develop.

Several interviewees felt that the ongoing interaction of researchers and users increased support for the research activity and "if you were able to do that you wouldn't see barriers forming" (mf2u12). This increased buy-in to the research and the results—"it becomes partially the practitioner's project" (mf1r10)—enhances the possibility that the findings would be used in the end. As one researcher stated,

> the more interaction that there is, the more buy-in there is to the project and then the more likely that whatever we find out will be actually used.

> That's the big thing is to get that buy-in and participation from the end user throughout the course of the project. (mf2r12)

LINKAGE MECHANISMS

Linkage mechanisms such as meetings, symposia and seminars, committees and working groups were identified by most interviewees. However, many also felt that more, particularly seminars and workshops, could have been done.
Described as a place for "one-stop shopping" (mf3s6) and as a "venue for researchers to interact with practitioners and other interested groups [that] is pretty unique" (mf1r10), the Model Forests themselves were identified as the main linkage mechanism. "The Model Forest provided an opportunity for the education institutions, the environmental organizations, the different levels of government to deal directly with researchers in understanding what the research objectives, scope and methodologies were and the intended outcome of research" (mf3s2). Indeed, approximately 80% of those interviewed felt that the main role of the Model Forest was as a facilitator to bring researchers and users together. The value of the Model Forest as a vehicle for facilitating this interaction was highlighted by both researchers and users:

> There have been a number of connections with industry players and recreational groups and so forth that I probably wouldn't have made if it hadn't been for the [Model Forest]. (mf2r4)

> What the Model Forest has really allowed for me is some contact with folks who have the ability to answer questions that I have. I mean, face it, I'm a forester. I spend a lot of my time out in the woods, talking to the client and things like that. I don't…wouldn't have a lot of direct time with someone who is a forest vegetation researcher or a forest wildlife researcher but when I'm there [at the Model Forest table] they're right there and I know them and they know me. I can just ask them a question and they might just be able to answer it or they might say, I don't know either but maybe that's something we should look into. (mf1u11)

In addition to being a facilitator to bring the stakeholders together, several interviewees highlighted the value of the long-term relationships that were built

through the Model Forest; "I mean we've been at the table with some of these people or organizations now for 17 years" (mf3u2). Getting to "understand other values and other people's needs" (mf3u7) and developing a "social consensus" (mf1r6) were mentioned as benefits of being involved in a Model Forest, particularly for an extended period.

OTHER FACTORS INFLUENCING THE USABILITY OF MODEL FOREST-SUPPORTED RESEARCH

During the interviews, participants identified several additional facilitators and barriers to the uptake of research results. Other identified barriers included circumstances and priorities, lack of information dissemination, and findings not practical for implementation, while good communications and extension was another facilitating factor highlighted. Another factor that could be viewed as both a facilitator and barrier was the nature of the small professional community within which many Model Forests operate:

> We're the only game in town is the problem. Ok, so, the uptake of the results…I think it encourages from one aspect because there's nothing that we do that isn't known by every level of every department. [Being small] favours us with regards to who knows about it and who can get involved with it, who can ask questions. Also being familiar with our science community and our forest managers…On the other side, if you piss anyone off you can't go to the next person in line because, you know, you have to make sure that the Model Forest stays this neutral entity that's sometimes fairly benign and be skirting around heavy issues because we don't want to have that level of confrontation and have to work where we sometimes poo…so there's good and bad with being small. (mf3s2)

Several additional factors influencing the usability of Model Forest-supported science were also identified (Table 3.3). While many barriers were identified—close to 60 distinct codes were developed for the data—over half were mentioned only once.

6. DISCUSSION

Overall, the results of this study are in line with the findings of other studies on the determinants of research utilization. The discussion will focus on facilitating factors,

Table 3.3: Additional factors affecting the utilization of research results

Factor classification	Factor description
Barriers	• *Changes in circumstances and priorities:* "because of the change in focus…I guess the wood supply all eased up and there wasn't quite the crunch so we can make more accommodations for those issues that [others] might bring to the table" (mf3u5). • *Suspicion of others:* "There was always a degree of suspicion of why people, why different organizations, different sectors were supporting different aspects of the Model Forest" (mf1s3) • *Competing values:* "Our challenge is that we usually end up colliding with a number of values so then how do you model that risk and make appropriate decisions" (mf2u8). "It's hard to accommodate the realities of economics and social values and the ecology…and how much is needed for other things. So we produce a document and then it gets accepted or not based upon economic rationale. Wouldn't it be nice to actually have the two run together in concert from the beginning but I haven't seen anybody do it" (mf1r6). • *Lack of acceptance of results:* "A lot of good work but nobody accepted the results" (mf3u5) • *Volume of research available:* "there's so much research out there" (mf2s1) and information produced by the Model Forest could get lost in what is available overall. • *Not practical or too expensive to implement:* "when research wasn't being accepted it was for either one of two reasons: it either wasn't practical to begin with, or it translated into too great a cost to implement for the operators" (mf1s3).
Facilitators	• *Good communications and extension:* "dissemination of the information. Getting it out to the people that are making the decisions on-the-ground" (mf3u15). "Effective communication in the right forms for the right target audiences" (mf1r10). "[T]he Model Forest was a good place to disseminate the results of research" (mf1r3). While communications was identified as an important role of Model Forests by one-third of interviewees, about 20% also indicated that the Model Forest could have done more. However, as one interviewee said, "Communications. Never ever can you do too much" (mf2r1). • *Part of a wave of ideas:* **"**I think they were used because we were part of a building wave of momentum of, you know, ideas behind some of these things" (mf1r3). • *Provided a unique solution:* "Providing solutions that no one else has…to be honest, we're in such new territory that it's not a matter of partners having an option of well I could go with [that] program or I could go with this. There is nothing else" (mf2r1).

barriers to research utilization, and the role of Model Forests in bringing people together.

FACILITATING FACTORS

The most prominent individual factor identified in the study was *relevance of the research and research findings to users' needs*. Numerous studies have shown that relevance is positively related to use (Beyer & Trice, 1982; Feldman et al., 2001; Greenberg & Mandell, 1991; Rogers, 1995; Weiss & Bucuvalas 1980). In simple terms, if the research results meet the needs of a user, they will be more likely to use them. Cited by more than 50% of interviewees, relevance was the main facilitating factor identified in both the Fundy and Newfoundland & Labrador Model Forests. This factor was less prominent in Foothills, coming behind scientific credibility and user involvement in research design.

One of the original intents of the Model Forest Program was to generate new knowledge to bridge the gap between the theory and practice of SFM (Forestry Canada, 1991; Hall & Bonnell, 2004). Making substantive changes to on-the-ground management would necessitate addressing the needs of users with respect to new information on appropriate practices. Research supported by Model Forests had to therefore be relevant to user needs to meet the mandate of the Program.

Of the three groups of interviewees, relevance was mainly cited as a factor by the researchers, whereas identification of relevance as a key factor by users was expected. When combined with interviewee responses on the role and benefits of being involved in a Model Forest, a potential explanation is identified. A key role of Model Forests identified by all categories of interviewees was providing funding and other support to research activities. As such, any researcher seeking funding support from a Model Forest for his or her research would necessarily have to ensure that the research was relevant to the Model Forest and constituent stakeholders.

Effective research design and scientific credibility were other prominent factors identified. Both effective research design and scientific credibility were raised mainly by researchers and staff with very few users mentioning these factors. There were also large differences among the three Model Forests. For example, while more than 60% of interviewees from Foothills mentioned some aspect of scientific credibility as a factor, only one interviewee in Fundy and two in Newfoundland & Labrador mentioned this factor. This is consistent with the current visions of each of the Model Forests (Table 3.4). Since 2007, the Foothills Research Institute has placed an increasing emphasis on research while both Fundy and Newfoundland & Labrador have focused on community sustainability and have moved away from research activities since the advent of the Forest Communities Program[12]. Foothills does not receive funding from the Forest Communities Program and, as such, has followed a different course with enhanced focus on research in support of the needs of its partner organizations which provide financial support to the Institute (Foothills Research Institute, 2001a).

While *user involvement in the research process* was the third most-cited factor in the study, there was a pronounced difference in the rate of response by researchers and users. Although 60% of researchers interviewed identified user engagement as important, less than 30% of users felt their direct involvement in research was a factor influencing uptake. With respect to Model Forest staff, one-third of those interviewed identified user engagement in the research process as a factor. All groups felt that a key role of Model Forests was to bring different stakeholders together. However, the majority of researchers (93% versus 67% of staff and 71% of users) also more specifically identified the bringing of researchers and users together as an important function. There was a similar rate of identification of this factor across the three Model Forests.

[12] In 2007, Canada's Model Forest Program ended and Natural Resources Canada–Canadian Forest Service implemented the Forest Communities Program which focused more on economic development opportunities for local enterprises and communities than SFM (Natural Resources Canada, 2011).

Table 3.4: Vision statements for the three Model Forests, 2002-07 and 2007-12

Model Forest	2002-07 Vision Statement	2007-12 Vision Statement
Foothills	To play a key role in establishing Alberta and Canada's reputation as a world leader in sustainable forest management. (Foothills Model Forest, 2003)	The Institute is a leader in developing innovative science and knowledge for integrated resource management on the forest landscape through diverse and actively engaged partnerships. (Foothills Research Institute, 2011a)
Fundy	To achieve, enhance, restore and sustain a healthy Acadian Forest Ecosystem by building capacity for sustainable forest management and conservation of natural diversity. (Fundy Model Forest, 2002)	Healthy communities within a working Acadian Forest managed using the principles of sustainable forest management. (Fundy Model Forest, 2007)
Newfoundland & Labrador	The partnership of the Western Newfoundland Model Forest is implementing innovative SFM systems and tools; adapting their management practices and philosophies; exchanging knowledge locally, provincially and nationally; and balancing our social, economic, and ecological values. (Western Newfoundland Model Forest, 2002)	Resource-based rural communities are equipped and empowered to be innovative in meeting opportunities and challenges of a healthy and changing forest sector. (MFNL, 2007)

Consistent with the literature (Landry et al., 2001, 2003; Oh, 1997; Oh & Rich, 1996; Yin & Moore, 1988), the ongoing interaction between the researchers and practitioners throughout the entire research project was also deemed to be an important factor. In an extensive literature review on the supply and demand of scientific information, McNie (2007, p. 31) concluded "that the production of useful scientific information is about process, and not just product". She emphasized the need for fostering "social capital" and "mutually respectful relationships" between knowledge producers and consumers (researchers and users) as critically important for generating usable science. Numerous responses point to the importance of the Model Forest as a forum for bringing people together and building relationships. When the length of time interviewees were involved in a Model Forest

was examined, the results also seem to indicate that the longer someone was involved, the more he/she would identify relationship building and interaction as factors.

The governance structures of each Model Forest differed from each other but all were developed to facilitate interaction among different stakeholders (IMFN Secretariat, 2008). Both the Model Forest of Newfoundland & Labrador and the Fundy Model Forest created working groups on various themes to facilitate project development and monitoring (Fundy Model Forest, 2007; MFNL, 2007). The Activity Teams developed by the Foothills Research Institute for each major programming area (Foothills Research Institute, 2011b) were probably the most developed working group structure of the three Model Forests. The Activity Teams include researchers, users, members of the Board of Directors of the Model Forest, and others interested in the theme or topic that a particular Activity Team focused on. Long-term involvement in such structures through the Model Forest would facilitate the development of McNie's (2007) social capital. Although not examined directly, the relationships developed through the Model Forest could be expected to be capable of examining a range of issues and not just the one for which a particular groups of organizations came together.

BARRIERS TO RESEARCH UTILIZATION

Although asked about barriers, most interviewees focused primarily on the factors that may facilitate the use of research findings. The order questions were asked, with interviewees being requested to identify potential facilitating factors before barriers, might have played a role in the focus on facilitating factors. In many instances, the opposite of an identified facilitating factor could also be a barrier or vice-versa, a comment made by several interviewees.

The key barriers identified focused on elements from the organizational explanation of research utilization, including a lack of time to review research findings, lack of

information availability (particularly when needed), and the lack of research receptor capacity. The lack of time to review information or to become involved in research activities was, by far, the most common barrier identified by the users interviewed (50%) and is consistent with organizational barriers identified in the literature (Barwick et al., 2008; Boström et al., 2008; Burch, 2010). Increasing volumes of information, increased workloads, and reduced staffing tend to exacerbate this barrier. Enhancing access to information through presentations, publications and summaries and, as one interviewee recommended, embedding reviewing relevant research into work plans and performance reporting could help address this barrier. While the latter falls under the purview of a user's host organization, the Model Forest has played and can play an increasing role in the former set of activities. Indeed, users felt that the Model Forest could do more in overall communications, particularly with respect to demonstrating applicability of research findings and translating research results into user-friendly language. Researchers, on the other hand, indicated that the Model Forest could hire more people to assist in communications and research-translation activities possibly in recognition of the difficulty researchers generally have in communicating results to a non-scientific audience.

For staff, a lack of information dissemination was seen as the primary barrier preventing the effective uptake of research findings within the Model Forest. At the same time, more than 50% of staff identified providing communications support as one of the primary activities of Model Forests in facilitating research utilization. At first, staff views of barriers and the role of Model Forests appear to be in conflict especially as staff would be responsible for ensuring the communications function of a Model Forest is undertaken. However, staff would also be more aware of budget and financial constraints and the challenge of funding knowledge generation versus dissemination.

FACILITATION ROLE OF MODEL FORESTS

Participants in the work of Holmes and Clark (2008, p. 707) highlighted the "important role played by interpreters in the interface between science and policy" with three key roles identified: describing the implications of research results; facilitating development of relevant research questions and communicating those to researchers; and synthesizing research information and uncertainties with respect to an issue.

Other authors have identified similar interpretation roles, including "science arbiter" Pielke (2007, p. 16) and "knowledge broker" (Campbell, Benita, Coates, Davies, & Penn, 2007, p. 28). The concept of boundary organizations is also being increasingly explored as a mechanism to bridge the gap between research and practice, scientists and practitioners, and science and policy-making (Cash, 2001; Clark et al., 2010; Guston, 2001; Tribbia & Moser, 2008). Such organizations

> provide an institutionalized space in which long-term relationships can develop and evolve, two-way communication is fostered, tools for management (such as models) are developed and utilized, and the boundary of the issue itself is negotiated. (Cash, 2001, p. 450)

All but one researcher talked about the role of the Model Forest in bringing people together. While users and staff highlighted this facilitation role less often than did researchers, it was still identified by approximately 70% of each group. Additionally, 60% of researchers and 50% of staff also specifically mentioned the Model Forests as having a role in bringing researchers and practitioners together, something mentioned by only a few users. This role was most strongly identified in the Model Forest of Newfoundland & Labrador where all interviewees discussed it.

While the concept and construct of the Model Forest playing a role in facilitating the use of research findings was clear, whether this was a unique role was not clear as there are other fora facilitating interaction between researchers and practitioners. For example, one forest industry established a Forest Research Advisory Committee

(FRAC) to bring together forest managers and researchers to assist the company in focusing on key research questions and gathering the information required to make decisions on its operations. The advantage of the Model Forest approach, however, might be in the diversity of stakeholders and the longevity of the relationships that develop. A study by Sinclair and Lobe (2005) found that the relationships fostered through involvement in a Model Forest provided the foundation for broader, productive partnerships outside the Model Forest structure. A comparison of Model Forests, FRACs and other similar researcher–practitioner fora would be an interesting future study.

Communications and information dissemination were expected to be key factors and a lack of information dissemination was one of the most commonly identified barriers to uptake. Additionally, providing support to communications activities was the highest-cited activity of the Model Forests in facilitating use, although it was also the most common item identified that Model Forests could do better on.

7. Conclusion and recommendations

The four explanatory models of research utilization—engineering, organizational, cultural, and interaction—identified by Landry et al. (2003) were used as a framework for assessing interviewee perceptions of factors affecting the uptake of research findings. This provided a useful framework for examining the data, but recognizing that each subsequent explanation builds on the previous ones is also critical. For example, the interaction explanation also encompasses all of the components of the engineering, organizational and cultural explanations.

The results of the study suggest that ongoing interaction between researchers and users is an important factor in facilitating research utilization. The results also support the notion that user involvement in initial research design, while important, may be insufficient in and of itself to enhance research utilization. However, there is, in effect, no one factor that influences uptake or the creation of usable science, but rather a combination of factors that are dependent upon the particular

circumstances of each situation. Although focused on one model or explanation of research utilization, Oh and Rich's (1996) comment can be applied to all the explanatory models of research utilization:

> It seems clear that the two-communities metaphor has been overrated as an influence on information processing in policymaking, mainly because other important variables have been ignored (p. 30).

What was not examined in this study was the extent to which each factor actually affected use. As such, which of the factors might be good predictors of research utilization cannot be identified, only which ones the interviewees perceived to influence use.

The results of the study point to several practical measures that can be taken to enhance the probability that research findings will be used:

1) Focus on the needs of users. Research that is focused on meeting the needs of users has a greater chance of being used. Relevance refers to the timeliness, salience and actionability of the results (Beyer & Trice, 1982; McNie, 2007) and one of the best ways to ensure that the research being undertaken is relevant is to involve both users and researchers in the research process.

2) Engage in collaborative research. The co-production of knowledge fosters the bi-directional flow of information between the researchers and users facilitating both relevance and scientific credibility. Essentially, while users need to be involved in identifying questions to enhance relevance, scientists should be involved in formulating the questions to ensure scientific credibility.

3) Ensure scientific credibility. While not forgetting the translation of research results into a format that users can both understand and readily use, ensuring scientific credibility of the work is also important. Having trust in the results produced is important in their use, especially in decision-making processes. Two

key components in building such credibility are creating an effective research design and a peer-review process for the findings.

4) Facilitate ongoing communications, dissemination and translation of research findings. An important element in the research utilization process is adaptation of results into a language the user understands (Caplan, 1979; Weber, 1987). While important for ensuring scientific credibility,

> [s]cientific writing, as exemplified in technical journals, offers some appalling examples of almost dead-level abstracting, which is the reason so much of it is hard to read…They go on indefinitely, reciting insignificant facts, never able to pull them together to frame a generalization that would give a meaning to the facts. (Hayakawa & Hayakawa, 1990, p. 95)

A balance needs to be sought between maintaining scientific credibility through the production of peer-reviewed publications and the development of user-friendly materials. Knowledge translation is about closing the gap between research and practice, and "promoting the rapid uptake of evidence-based knowledge by multiple users" (Davis et al., 2003, p. 35). In addition to translating research results, the communications and dissemination of that information need to be ongoing and targeted towards relevant users.

5) Develop organizational capacity and culture. The use of research results is generally more heavily dependent on both behavioural factors and users' context than the attributes of the research or research products (Landry et al., 2001). Investments in capacity-building within both researcher and user institutions can affect all these areas, generating an environment more conducive to uptake of knowledge. Such capacities include: approaches to promoting the co-production of knowledge; knowledge within the research community of the resource management and policy-making processes; abilities to translate and communicate research findings to better target users; and the research receptor capacity within user institutions.

6) Focus on a variety of elements and not just one or two to impact research utilization. The use of research findings is complex and predicated on much more than one or two factors (Landry et al., 2001). While each of the three main factors identified in this study are important, addressing only one of those factors will not be sufficient to enhance uptake of research results. Of the four explanations—engineering, organizational, cultural, and interaction—the interaction model appears to hold the most promise for enhancing the creation of usable science and its use in practice. Important, however, is recognizing that the interaction explanation and its factors are built on the earlier models. As such, to enhance the use of research findings, factors highlighted in *all* explanations must be examined and considered, although this does not necessarily guarantee uptake of research findings. Rather, only the likelihood of use is enhanced.

As a final note, while science is important in providing critical information and knowledge, it does not actually deliver decisions (Cortner, 2000; Gregory, Failing, Ohlson, & McDaniels, 2006) nor is it a panacea for our challenges. Resource management decisions are, in effect, value judgments and not resolvable solely by science (Healey, 1997). A variety of social, economic and cultural considerations must be incorporated into the decision-making process through deliberative and often political processes (Gregory et al., 2006). Science and the research process can help provide clarity into those processes but cannot replace them.

Model Forests have played a role in influencing research utilization by supporting user involvement in the research process, promoting effective research design and scientific credibility, and putting in place processes which encouraged the research to be relevant to users' needs. As such, Model Forests offer an opportunity to bridge the science–practice–policy interface, and take a leadership role in facilitating research utilization for advancing SFM in Canada and on the international scene.

ACKNOWLEDGEMENTS

I would like to thank the researchers, Model Forest staff and partner representatives who participated in the interviews. This work could only have been completed through the sharing of their thoughts, knowledge and experiences. My supervisor, Dr. Peter Duinker, and committee member, Dr. Heather Castleden, have provided invaluable guidance throughout the project.

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CHAPTER FOUR

STRATEGIC BRIDGE-BUILDING FOR SUSTAINABLE FOREST MANAGEMENT: MODEL FORESTS AS BOUNDARY ORGANIZATIONS

Brian Bonnell was responsible for the research and writing of this manuscript. Peter Duinker was the thesis supervisor and Heather Castleden was a thesis committee member. Both provided guidance, revision, and feedback. When submitted for publication to *The Forestry Chronicle*, this paper will have the following authors: Bonnell, B., Duinker, P., & Castleden, H.

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ABSTRACT

Model Forests were first developed in Canada in the early 1990s at a time of increasing public demand for more say in environmental decision-making. The concept brought together diverse organizations to develop innovative local approaches to sustainable forest management in an effort to link policy with on-the-ground actions supported by science. This study deepens the understanding of the science–policy / science–practice interface by exploring the notion of Model Forests as boundary organizations—institutions that bridge the divide between science and policy—based on three key criteria. First, Model Forests facilitate the participation of diverse stakeholders from all sides of the science–policy / science–practice interface. Second, the governance structure of a Model Forest encourages accountability to the different social worlds involved. Finally, Model Forests use boundary objects that provide links to and stability among the stakeholders and their worldviews.

KEYWORDS: Model Forests, boundary organizations, sustainable forest management, wicked problems, science–policy interface

1. INTRODUCTION

The complexity of contemporary forest management is well documented in the literature. Bunnell (1999) notes that "forestry isn't rocket science–it's much more complex" and forest management has been frequently used as an example to

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portray the complexity of trying to manage ecosystems (Hauhs, Lange, & Kastner-Maresch, 2001; Levin, 2003; Wu & David, 2002). In a comparison to conventional forest management, Wang (2004) describes sustainable forest management (SFM) as being "interdisciplinary, heterogeneous, less hierarchical, and more socially accountable" (p. 205). SFM includes technical, ecological, social, cultural, political, economic and institutional dimensions (Galloway, 2006) across multiple spatial and temporal scales (Lennart, Ljungman, Martin, & Whiteman, 1999) with each component and its interactions with others adding additional levels of complexity. These components and the ongoing changes in both forest ecosystems and societal values add to the notion of SFM as a "wicked problem"[1], a concept proposed by Rittel and Webber (1973) in relation to social planning. The nature of wicked problems, with their complexity, high uncertainty and a range of values and interests, requires not just good science but also meaningful engagement of a broad range of stakeholders in decision-making (Baite, 2008).

Model Forests were designed to bring together diverse organizations and people to develop innovative local approaches to integrating SFM policy and on-the-ground implementation supported by science (Hall & Bonnell, 2004). Despite the level of research activity supported by Model Forests, the role of research and researchers and the extent of the impact of Model Forest research have not been examined in any significant manner. The 2002 evaluation of Canada's Model Forest Program noted that "[t]here is a lack of understanding within the administration of the [Model Forest Program] of the overall content, impact and opportunity of research activities within the Model Forests" (Natural Resources Canada, 2002), which was reiterated in the 2006 program evaluation (Natural Resources Canada, 2006b). This paper reports the results of a study that seeks to explore the role Model Forests play in bridging the science–practice and science–policy interface in Canada to address the wicked issues inherent in SFM.

[1] The idea of forestry and SFM as a "wicked problem" is expanded upon by Allen and Gould (1986), Kimmins et al. (2005), Ludwig (2001), Shindler and Cramer (1999), and Wang (2002).

I begin by providing an overview of the Model Forest concept. A conceptual framework related to boundary organizations is provided in section 3 and the research methods used are outlined in section 4. Section 5 presents evidence of how Model Forests relate to various aspects of boundary organization theory, section 6 provides a discussion, and section 7 the conclusion.

2. Model Forests

Overview

Starting in the late 1980s, there was a paradigm shift in Canadian forestry away from sustained yield management, which focused on maintaining a continuous supply of timber, towards SFM and a more socially responsible approach to resource management (Kimmins, 1995). Model Forests were developed in the early 1990s to bridge the gap between theory and practice of sustainable development in forestry (Forestry Canada, 1991). During the study period, fifteen Model Forests existed in Canada (Figure 4.1) representing the diversity of Canada's forest regions, land tenures, and socio-economic and cultural conditions (Canadian Model Forest Network, 2011). The Model Forests are linked together through the Canadian Model Forest Network, developed to provide an avenue for the individual sites to share knowledge and experiences, and cooperate on projects of strategic importance to Canada's forest sector that would be beyond the purview of a single Model Forest.

Each Model Forest is incorporated as a not-for-profit organization for administration of programming and without creating a new resource management structure. In theory, this allowed the Model Forests, as organizations representing constituent stakeholders, to act as neutral forums that were neither threatening to those with management authority nor intimidating to those without (Besseau, Dansou, & Johnson, 2002). Additionally, all Model Forests are defined and guided by the *Framework of Principles and Attribute of Model Forests* which identifies six key principles (IMFN Secretariat, 2008a): (1) partnership of diverse stakeholders, (2) large landscape representing a broad range of values and uses, (3) commitment to

sustainability, (4) representative, participative and accountable governance structure, (5) program of activities reflective of stakeholders needs, and (6) commitment to engage in knowledge sharing, capacity building and networking.

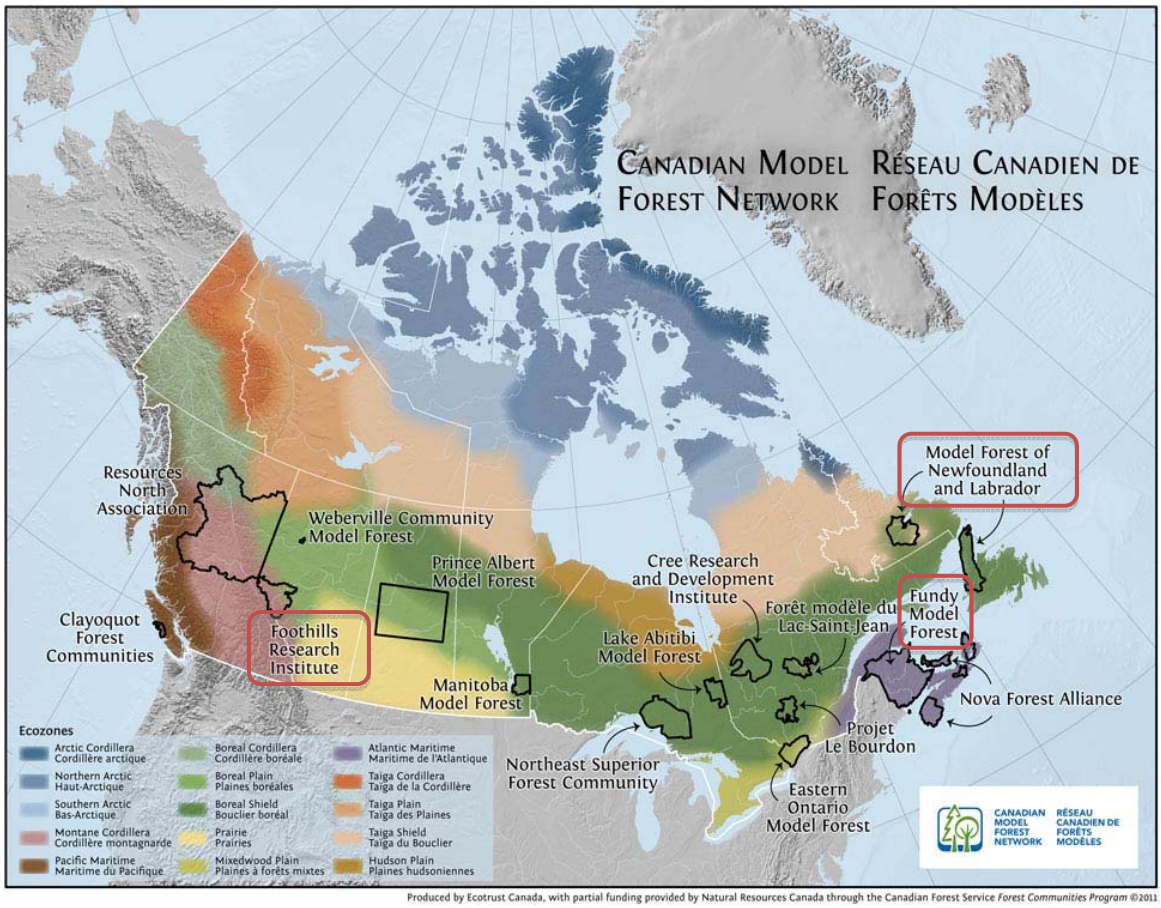

Figure 4.1: Model Forests identified for the study and the Canadian Model Forest Network

The Model Forests selected for this study—Foothills Research Institute (Alberta), Fundy (New Brunswick), Newfoundland & Labrador—were identified based on four factors:

1) *Level of research activity within the Model Forest*. The level of research activity within the Model Forests was identified through my own experiential knowledge, a review of Model Forest project reports available on web sites, and a review of peer-reviewed journal articles based on research supported

by a Model Forest. Model Forests where a high level of research activity was supported were sought as these sites were expected to have the greatest diversity of experiences in the uptake of research results.

2) *Perceived level of uptake of Model Forest research activity.* Numerous Model Forest General Managers, Canadian Forest Service staff, natural resource managers, and academics were contacted with a request to provide insights into the perceived level of uptake of the outputs of research activities supported through the Model Forests.
3) *The time window of research activity*. A compromise had to be made between the selection of research projects where sufficient time had passed for their results to be made known and used, and the quality of records as well as participants' ability to recall their activities (Bozeman & Kingsley, 1997). Research undertaken over the past few years would have had little time to make an impact either in the literature or in practice. At the same time, finding researchers who implemented their studies at the beginning of Canada's Model Forest Program—during the early to middle 1990s—may have been difficult. The primary time window examined focused on the period 1997–2007.
4) *Socio-political and economic contexts*. A diversity of contexts within which research took place was sought. This included selecting Model Forests located within different provinces, and with varying budgets and funding sources.

Each of the three selected Model Forests are highlighted below.

FOOTHILLS RESEARCH INSTITUTE

The Foothills Research Institute[2] covers a core study area of 2.75 million hectares in west-central Alberta which includes Jasper National Park of Canada, the Willmore Wilderness Park, W.A. Switzer Provincial Park, Whitehorse Wildland Park and the Forest Management Area of Hinton Wood Products, a division of West Fraser Mills

[2] The Foothills Research Institute was initially called the Foothills Model Forest. Further information can be found at: http://foothillsresearchinstitute.ca

Ltd. Timber, petroleum and coal extraction, tourism and recreation are undertaken within the study area which covers three main forest types—boreal, montane and sub-alpine. The Institute has over a hundred partners, including forest companies, all levels of government, oil and gas companies, Aboriginal communities, universities, environmental groups, and not-for-profit organizations. The Institute has supported research activities on grizzly bears and other wildlife species, forest growth and yield, forest fires and natural disturbance, Mountain Pine Beetle, biodiversity, fish and watershed management, and social aspects of SFM. There has been a strong emphasis, especially over the past ten years, on the publication of research results in peer-reviewed journals (Table 4.1).

Table 4.1: Publication of research results in peer-reviewed journals, 1993–2010

Model Forest	Number of peer-reviewed journal articles				
	1993–1997	1998–2002	2003–2007	2008–2010	TOTAL
Foothills Research Institute	2	22	44	39	**107**
Fundy Model Forest	4	22	21	2	**49**
Model Forest of Newfoundland & Labrador	8	13	16	2	**39**
TOTAL	**14**	**57**	**81**	**43**	**195**

FUNDY MODEL FOREST

The Fundy Model Forest[3] currently includes the entire Province of New Brunswick as its programming area. This study focused on the period 1997–2007 when the site covered 420,000 hectares of the Acadian Forest Region in southern New Brunswick surrounding and including Fundy National Park of Canada. Currently numbering over 35, partners in the Model Forest include the forest industry, three levels of government, Aboriginal groups, non-government organizations, universities, schools, and community development groups. Most of its research activities during its first 15 years focused on examining criteria and indicators of SFM and the themes arising from that framework (Fundy Model Forest, 2007a). This included

[3] Further information can be found at: http://www.fundymodelforest.net

riparian and buffer zone studies, remote sensing for landscape change detection, ecological land classification, wildlife and bird habitat, best practices for SFM, biodiversity assessment and impacts of forest harvesting.

MODEL FOREST OF NEWFOUNDLAND & LABRADOR

The Model Forest of Newfoundland & Labrador[4] is located within the boreal forest and currently covers over four million hectares in the Province of Newfoundland & Labrador on both the island and mainland sections of the province. During the timeframe primarily examined as part of this study (1997–2007), the Model Forest's study area was 923,000 hectares on the west coast of the island of Newfoundland. The Model Forest started with seven partners including two major pulp-and-paper companies, a municipal government, two provincial government departments (forestry and wildlife), an educational institution, and a local environmental group. Currently, there are over 20 participating organizations. Since its inception, the Model Forest of Newfoundland & Labrador has undertaken research activities on a wide range of topics, including numerous wildlife species with a particular emphasis on the endangered Newfoundland marten (*Martes americana atrata*), natural disturbance, biodiversity assessment, riparian area management and buffer zones, water quality, socio-economics, non-timber forest values, and forest pests (MFNL, 2011). There has been less of an emphasis on peer-reviewed article publication for research results than the other two Model Forests (Table 4.1).

RESEARCH IN MODEL FORESTS

One of the fundamental principles of a Model Forest is a "commitment to generate and share knowledge through research, innovation and collaboration" (International Model Forest Network, 2010), a principle that has been in place since the development of the Model Forest approach in the early 1990s (Forestry Canada, 1991). To achieve this principle, the Model Forests engaged in research and undertook activities to ensure that new ideas and knowledge were made available

[4] This site was originally known as the Western Newfoundland Model Forest. Further information can be found at: http://www.wnmf.com

to decision-makers.

Scientists, from a range of academic and other research institutions, have been involved in all Model Forests in some way since their inception—e.g., on boards of directors, working groups, and advisory committees, or through supporting graduate students (Natural Resources Canada, 2002; Nantel, 2001; Sinclair & Duinker, 2008). In 2006, there were 87 education and research organizations directly involved in Canadian Model Forests representing 16.5% of Model Forest partners, the second largest category after non-governmental organizations (Natural Resources Canada, 2006b). In addition, significant funding has been expended on research activities within the Canadian Model Forest Network (Natural Resources Canada, 2006a). For example, during 1992–1997, research activities accounted for 60% of the Model Forests' programming (Natural Resources Canada 2006b). The strong emphasis on research continued until 2007 in most Model Forests. At that time, a key federal government source of funding changed its emphasis to local economic development for resource-based communities[5].

3. BOUNDARY ORGANIZATIONS

Throughout the twentieth century, research has generally followed a linear model of science that implied distinct boundaries between science and application (Widmalm, 2007) such as the concept of "normal science" (Kuhn, 1962) that sought "universal, objective and context-free knowledge" (Haag & Kaupenjohann, 2001, p. 53). This type of science, however, is generally unable to engage with such complex issues as are common in contemporary resource management (Haag & Kaupenjohann, 2001; Widmalm, 2007). As well, the linear approach of science providing information to decision-makers once the science is "right" (Tribbia & Moser, 2008, p. 317) is

[5] In 2007, Canada's Model Forest Program, implemented in three 5-year phases starting in 1992, ended and the Forest Communities Programs (FCP) was initiated by Natural Resources Canada–Canadian Forest Service. The main objective of FCP is "to help forest-based communities develop and share the tools, approaches, and strategies needed to meet the challenges of a changing forest sector" (Natural Resources Canada, 2011a). Most of the existing Model Forests became funding recipients under FCP that shifted the primary focus of many of the activities from SFM to local economic development.

increasingly seen to be ineffective (Cash, Borch, & Patt, 2006).

The notion of breaking down the strict barriers of "normal science" has been explored for several decades, particularly in the context of addressing wicked problems. Early in this process, Weinberg (1972) identified "trans-science" as a zone between science and policy where both interact. More recently, several collaborative approaches have emerged that focus on extending the science–policy / science–practice interface to incorporate greater stakeholder engagement. These include 'Mode 2' science (Gibbons, 2000), post-normal science (Ravetz, 2006), socially robust knowledge (Nowotny, Scott, & Gibbons, 2003) and co-production (Jasanoff, 2004). Such approaches provide opportunities for knowledge producers together with knowledge users to frame research questions. Additionally, in all of these approaches, "knowledge-making is incorporated into governance, and governance influences the making and use of knowledge" (Chilvers & Evans, 2009, p. 256).

However, most environmental governance literature focuses on "the balancing of competing interests" and "largely ignore[s] the role of science" (Chilvers & Evans, 2009, p. 355) in the policy process. Boundary organization theory is being increasingly used to explore this knowledge–governance interface in terms of how to bridge the gap between research and practice, scientists and practitioners, and science and policy-making (Cash, 2001; Clark et al., 2010; Guston, 2001; Tribbia & Moser, 2008). Boundary organizations are "institutions that straddle the shifting divide between politics and science" (Guston et al., 2000, p. 1) by simultaneously maintaining the boundaries between science and policy, and facilitating collaboration among all sides (Guston, 1999, 2001) of the science–policy interface.

The concept of boundary organizations has been applied to environmental cooperatives (Franks, 2010) and policy (Guston, 2001), agriculture (Carr & Wilkinson, 2005; Goldberger, 2008), climate policy (Lövbrand, 2007; Miller, 2001), extension services (Breuer, Fraisse, & Cabrera, 2010), water management (White, Corley, & White, 2008), organizational studies (Sapseed & Salter, 2004; Zeiss &

Groenewegen, 2009), bioethics (Leinhos, 2005), healthcare (Allen, 2009), and juvenile justice (Schneider, 2009). Interestingly, while there have been concerns about science–policy links in forestry (Guldin, 2003; Innes, 2003; Janse, 2008; Joyce, 2003; Kimmins et al., 2005; Klenk & Hickey, 2011; Spilsbury & Nasi, 2006), there has not been an examination of boundary organization theory as a possible mechanism to overcome these concerns and challenges.

Boundary organizations, first named by Guston (1999), builds on the earlier concepts of boundary work used to demarcate "science" from "non-science" to establish distinctiveness and legitimacy (Gieryn, 1983), "boundary objects" (Star & Griesemer, 1989) and "bridging organizations" (Brown, 1991). Boundary organizations facilitate cooperation across the science–policy and science–practice interface and assist in improving the end-to-end process of knowledge production and application by bringing both researchers and practitioners together. They transcend the divide between research and practice while also protecting the divisions, or boundaries, between the two worldviews[6]; they provide "protection from the politicization of science, transcending for improved information flow" (Tribbia & Moser, 2008, p. 317). Such organizations:

> provide an institutionalized space in which long-term relationships can develop and evolve, two-way communication is fostered, tools for management (such as models) are developed and utilized, and the boundary of the issue itself is negotiated (Cash, 2001, p. 450).

Based on the work of Guston (1999, 2001), three key attributes, or criteria, of successful boundary organizations have been identified (Clark et al., 2010):

- **Participation of stakeholders:** Boundary organizations "involve the participation of actors from both sides of the boundary, as well as professionals who serve a mediating role in the co-production of knowledge that can be used

[6] A worldview is a socially constructed, interconnected system of beliefs (DeWitt, 2004) or pre-suppositions that we hold about the world (Sire, 2004) through which we interpret facts (Bertrand, 2007). Indeed, some of these "assumptions appear so obvious that people do not know what they are assuming because no other way of putting things has ever occurred to them" (Whitehead, 1926, p. 61).

by multiple audiences" (Guston, 2001, p. 401)—Criterion 1;

- **Governance:** These organizations have distinct lines of accountability to the different social worlds involved—Criterion 2;
- **Use of boundary objects:** They create and use boundary objects and standardized packages, such as maps, models, reports and policies, adaptable to different viewpoints while being able to maintain their identify—Criterion 3.

Stakeholder participation: Boundary organizations mediate between different communities and worldviews, and facilitate mutual understanding of the perspectives of everyone involved to achieve a shared goal or, as Guston (2001, p. 405) writes, the "co-production of mutual interests". Such organizations can be viewed as a forum where multiple perspectives and knowledge systems converge (Miller, 2001). It is through the bringing together of different values and perspectives that the utility of boundary organizations can be found.

Governance: A successful boundary organization also maintains distinct lines of accountability and responsibility to each actor and worldview (Guston, 1999). It is the duality of accountability required that provides stability to a boundary organization (Guston, 2001) and various institutional arrangements are required to accomplish this task.

Use of boundary objects: Boundary objects are a key component of boundary organizations and enhance the ability of ideas, theories and practices to translate across boundaries and might even reduce conflict and "dissensus" (Fox, 2011). These objects facilitate connections between different perspectives and viewpoints (Harvey, 1997) serving as interfaces between different worldviews (Goldberger, 2008) by providing the foundation for knowledge exchange and negotiation (Sapsed & Salter, 2004). They can be maps, models, reports, policies or any other object that can be used by different groups while also structuring relations among them:

> Boundary objects are objects which are both plastic enough to adapt to

> local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identify across sites (Star & Griesemer, 1989, p. 393).

An effective boundary object transmits meanings among groups, "establishes a shared language for representing knowledge, provides a concrete method for learning about differences and dependencies, and facilitates a process for transforming knowledge" (Carlile & Rebentisch, 2004, p. 1191). This common lexicon facilitates both collaboration and knowledge-sharing. Fujimura (1992) goes so far as to say that boundary objects can "facilitate the translation of one group's interests into interests of other groups" (p. 192). While many artefacts can be described as boundary objects and may have many of its intrinsic properties, it only "*becomes* a boundary object if it works like one" (Zeiss & Groenewegen, 2009, p. 93, emphasis in the original).

4. RESEARCH METHODS

The exploration of the role Model Forests play in bridging the science–policy / science–practice interface in Canada was exploratory in nature and thus lent itself to a qualitative approach (Marshall & Rossman, 1989). Semi-structured interviews of key informants (researchers, staff, users) were undertaken to probe how Model Forests bridged the divide between the science and practice of SFM in Canada.

Data were gathered through an extensive documentation review and semi-structured interviews of key informants. The key informant study population included researchers whose research was supported by one of the three Model Forests (3-6 per Model Forest), staff of the identified Model Forests (2 per Model Forest), and Model Forest stakeholder groups that represent users (4-5 per Model Forest) that would be expected to have an interest in the research of the Model Forest they participate in (Table 4.2). The sample pool in each Model Forest was quite large. While there were only nine staff members (i.e., General Managers) in the three Model Forests since 1992, on the researcher side, over 600 individual authors

of journal articles based on Model Forest-supported were identified. As well, there were over 20 stakeholder groups involved in each Model Forest with most representing potential users of research results and within each of those organizations, there were numerous individual staff members who were either involved in Model Forest activities or were potential users of research findings.

Table 4.2: Classification of interviewees in each of the three Model Forests

Model Forest (number of interviews)	**Category of interviewees[7]**			**Years involved in the Model Forest**			
	Researcher	**User**	**Staff**	**1-5**	**6-10**	**11-15**	**15+**
Foothills (n=13)	6	5	2	2	4	3	4
Fundy (n=13)	6	5	2	1	4	4	4
Newfoundland & Labrador (n=9)	3	4	2	1	2	2	4
Total	**15**	**14**	**6**	**4**	**10**	**9**	**12**

Purposive sampling was also used to identify participants from a range of sectors, disciplines and organizations. The sample pool included professional foresters, academics, mining company representatives, government officials, representatives of environmental groups or non-governmental organizations, and other interested community members. As well, an attempt was made to obtain a sample that focused on Model Forest-supported research projects whose results have clearly been utilized by a stakeholder group, and from those projects whose results have had limited or no demonstrated uptake of results by stakeholder groups. This was done to obtain a variety of perspectives and possible explanations as to the role of Model Forests in bridging the science–policy / science–policy interface. Only one person approached refused to provide an interview. Several other identified key informants, particularly in the Model Forest of Newfoundland & Labrador, could not

[7] Staff refers to Model Forest General Managers and former General Managers. In the case of the Foothills Research Institute, several researchers are employed directly by the Institute but have been classified as "researchers" for this study.

be contacted during the research period.

Three semi-structured interview guides were developed to gather breadth and depth of viewpoints from researchers, potential users of research results, and Model Forest staff. Questions focused on participant involvement in Model Forests, research activities that had been supported by a Model Forest, and the role of Model Forests in research and the uptake of research results.

In addition, a comprehensive review of the literature on boundary organizations was undertaken along with an examination of Model Forest program and site-level documentation to compare Model Forests with the characteristics of boundary organizations. Such documentation included the Model Forest strategic and annual work plans, annual reports and web sites as well as journal articles based on research supported by the Model Forests. Model Forest documents were reviewed to identify governance or other mechanisms used or developed by Model Forests that either supported or contradicted the information collected from the key informants.

The interviews were transcribed and analyzed throughout the data collection process. Preliminary data analysis was done without the aid of computer software, leading to a preliminary coding scheme. NVivo 8 software (QSR International, 2008) was then used to manage the data and facilitate the coding process of comparing, conceptualizing and categorizing data (Bryman & Teevan, 2005), in identifying emergent concepts, patterns and themes in the data as well as in identifying salient quotations from individuals.

5. Application of boundary organization criteria to Model Forests

Using interview data and information gathered through the document analysis, the Model Forests examined in this study are analyzed using the three criteria of boundary organizations identified by Clark et al. (2010): i) participation of

stakeholders from both sides of the science–policy / science–practice interface, ii) distinct lines of accountability to the different social worlds involved, and iii) the use of boundary objects.

CRITERION 1: STAKEHOLDER PARTICIPATION IN MODEL FORESTS

Typically, Model Forest participants include land users, owners and managers; forest-based and other industries; community, environmental and forestry non-governmental groups; federal, provincial and municipal government agencies; academic and research institutions; conservation areas; Aboriginal groups and communities; and others (Hall & Bonnell, 2004). An examination of stakeholder involvement in the Model Forests clearly illustrates the diversity of sectors involved in each site[8]. The interview data suggest that this engagement is seen as an important Model Forest principle with the majority (71%) of interviewees in all three sites identifying one of the key roles of a Model Forest as being a facilitator to bring people together. The facilitator role was reiterated by both researchers and users where 93% of the researchers interviewed and 71% of users identified it as a key role. As two interviewees stated,

> [The Model Forest was] able to bring different players together so it's almost like providing a common ground if you will or a safe haven for people to come around the one table. (mf3r11[9])

> Basically, [the Model Forest] brings those two groups [researchers and practitioners] together, puts them at the same table and does it often enough that you get to know each other. (mf1u11)

Many interviewees talked about Model Forests as "being that interface between the science and on-the-ground management" (mf2r9), incorporating both sides of the researcher–practitioner boundary, highlighting the differences between the groups:

[8] A list of stakeholders involved in each Model Forest can be found on the respective web sites.
[9] Interviewees are identified by code where mf# refers to the 1st, 2nd or 3rd Model Forest, r = researcher, u = user and s = Model Forest staff. The second number refers to the nth interviewee in that category.

> It is very simple for a researcher to answer a research or scientific question given enough resources and time. It's more difficult to have those findings taken up by managers for management purposes because the language is different, the understandings are different, the implications are different and the risks are different. (mf1u6)

Model Forests also provide the framework for meaningful participation by interested stakeholders from all sides of the boundary in issue identification, priority setting and knowledge generation. Several interviewees highlighted participation of stakeholders in issue identification as an important aspect of the Model Forest they were involved in. For example,

> From the very beginning…the users were at the table and so you had the users actively involved and the landowners actively involved in trying to figure out what the problems were and what the questions are and so the strength of the Model Forest I think has been the partnership clearly identifying what the real issues are. (mf1s4)

> A huge benefit of the Model Forest was that everyone was sitting at the table. So we said, these are the questions, right? Everybody agree? Yes, ok, so this is how we're going to do it, right? And so when you come out at the end with it, it's like, ok, everybody agreed. (mf3r5)

The Model Forest role in facilitating meaningful stakeholder participation is also clearly identified within the International Model Forest Network *Framework of Principles and Attributes of Model Forests* (IMFN Secretariat, 2008a). Indeed, Model Forests are described as a "neutral forum" within the framework and elsewhere (Besseau, Dansou, and Johnson, 2002; LaPierre, 2003; Natural Resources Canada, 2002). The facilitator role is also outlined in the governance mechanisms of each Model Forest (Foothills Research Institute, 2011; Fundy Model Forest, 2007b; Western Newfoundland Model Forest, 2007).

However, several study participants thought researchers could do more to build direct links with stakeholders while stakeholders could get more directly involved in research and projects, and the Model Forest could have done better in engaging

stakeholders in projects and enhancing science–policy / science–practice links. Additionally, one participant felt that the move away from research under the Model Forest Program towards focusing on community economic development under the Forest Communities Program resulted in losing the interaction between researchers and users:

> There is a trend right now of going backwards with the research community by not having the Model Forest focused on research as much. I think the Model Forest provided an opportunity for the education institutions, the environmental organizations, the different levels of government to deal directly with researchers in understanding what the research objectives, scope and methodologies were and the intended outcome of research. I don't believe that exists any more. It's my personal thought that because the Model Forest has changed direction with regards to its emphasis and concentration on community…we've taken out two-thirds of the equation with regards to the social and the economic side and basically we've created silos now. Our research community no longer talks to aspects of our academic community or the environmental organizations or whatever so we've kind of gone backwards. (mf3s2)

CRITERION 2: MODEL FORESTS AND GOVERNANCE

Three main mechanisms were identified through which accountability is maintained in a Model Forest. The first mechanism is through formal governance. Each of the Model Forests in this study has a governance structure that helps bridge the tripartite interface between science, policy and practice[10], while maintaining appropriate and distinct lines of accountability. At one level, this is accomplished by having each participating stakeholder represented in the Model Forest governance structure either on a Board of Directors, partnership committee or working group. For example, in addition to a Board of Directors, the Foothills Research Institute has an Activity Team for each of its major program areas. Each Activity Team is "supposed to be a microcosm of a cross-section of the partnership" (mf2u12). One of

[10] Policy and practice could also be grouped together as knowledge consumers. However, they are kept separate in this section as each group has different needs and thus lines of accountability and responsibility that have to be maintained within the Model Forest.

the Activity Teams has "representatives from the forest industry, the energy industry, from the provincial government and then also academia…and then there's also representation from the Board on each team" (mf2r12).

Secondly, the governance structures assisted not just in bringing various stakeholders together but also for both sides of the boundary to work together to identify key research questions in a manner that met the needs for both researchers and practitioners. As two interviewees expressed:

> I really appreciated [the Model Forests] were able to bring so many different so-called stakeholders around the table and to try and, from that, well what are some research questions or needs whether the biological sciences or social-economic that we need to address. (mf3r11)

> What the Model Forest allowed was to get everyone at the table to discuss the issues. The benefit of it to me came in bringing the partners together that could identify real issues that they need answers to. (mf3r8)

Within this operating environment, users or practitioners were able to identify their questions, issues and needs. The scientists, on the other hand, were able to formulate the questions in a manner that would allow for scientific credibility:

> You know, the traditional model of a researcher thinking of questions and then trying to find someone that might be interested in them, we flipped that around. It's the other way around. People have questions and the researcher says, "well, how about if I convert that into this science question and would that answer your question" and if that's done and done correctly and on a timely basis, it's much more powerful than the other way around. (mf2u4)

This engagement of both researchers and practitioners in identifying issues and questions helped ensure that the needs of both groups were met. It also appeared that the Model Forests were able to allow individuals and individual organizations to retain their independence within the governance structure:

> These are questions they asked us to answer and they didn't tell us what

> they wanted the answer to be or if they did we didn't pay any attention to that because we were going to give them the truth and that sort of thing. And that's another thing too, asking the questions and allowing, you know, staying hands off enough to allow us to actually ask the question in a valid way. That was a major thing. (mf1r7)

Third, the lack of jurisdictional authority over the land base by the Model Forest (Ayling, 2001) assists in highlighting the Model Forest as an independent organization and to maintain the lines of accountability to various stakeholders, particularly to those responsible for land management and to those funding the activities. This feature promotes dialogue among the partners as "[e]ach [Model Forest] relies on its partners, especially government and industry, to take up the good ideas from the discussions and studies undertaken since provincial governments and forest industry maintain forest management authority" (Sinclair & Smith, 1999, p. 125). In other words, the Model Forest cannot supersede the rights and obligations of any of the stakeholders and must work closely with those organizations to make changes in management practices and processes. As one interviewee stated,

> [The Model Forest is] not a land manager and it doesn't have the authority to manage but it has some kind of moral suasion especially if you can develop a consensus amongst thirty or more different partner agencies to try some new things. (mf1r10)

CRITERION 3: MODEL FORESTS AND USE OF BOUNDARY OBJECTS

Model Forests employ boundary objects to facilitate dialogue between stakeholders and the different worldviews they represent. In this study, one researcher described Model Forests as "a place where the scientists and the foresters are forced to speak a common language at a level that each other can understand" (mf1r7). To facilitate this dialogue, Model Forests generate and use a range of boundary objects. However, despite the use of a range of boundary objects, a number of study participants felt that Model Forests could do more in the translation of research results from academic jargon to user-friendly material (19%) and communications (19%). As one study participant said,

> I believe it was the Model Forest's job to be more of a communicator and package research. Both work with the scientists and then work with the forest manager to ensure that there was a common currency of knowledge and understanding, you know and commitment to the methodologies employed. (mf3s2)

Examples of boundary objects used by Model Forests include criteria and indicator frameworks, wildlife habitat and other models, ground rules and GIS maps (Table 4.3). Each of these artefacts is used by different organizations, which assist in facilitating conversation and collaboration among stakeholders from all sides of the boundary. However, the most common boundary object in use by Model Forests is probably the strategic plan and vision statement developed for each site.

Model Forest vision statements and strategic plans as boundary objects

All participating stakeholders are generally engaged in the development of a strategic plan for their Model Forest that outlines a vision for sustainably managing the identified landscape, governance structure, and program of work (IMFN Secretariat, 2008b). In the process of developing a Model Forest, "[s]takeholders must meet, understand each other and seek consensus on the broad vision for the landscape, the mutual values they hold and the actions required to sustain those values" (IMFN Secretariat, 2008b, p. 19). These items are outlined in a strategic plan that is designed not just to provide direction but also to develop a sense of shared ownership among stakeholders (IMFN Secretariat, 2008b). As such, they act as boundary objects creating a foundation for building connections among the different perspectives involved. As one interviewee stated, a Model Forest's "strength comes from getting those people together and developing a collective vision of what you want to build" (mf2r12).

Criteria and indicator frameworks as boundary objects

During 1997–2002, each Model Forest in Canada was required to develop a criteria and indicators (C&I) framework based on the national Canadian Council of Forest Ministers (CCFM) criteria, with indicators defined collaboratively by the

Table 4.3: Examples of boundary objects developed or in use by the three Model Forests

Boundary Object	Description	Boundary Object Characteristics	References
Model Forest of Newfoundland & Labrador			
Stream Crossing Inventory	GIS database of stream crossings (culverts, bridges, etc.) on forest access roads. Information provided to various stakeholders to be incorporated into their own databases.	Information could be used by forest industry for certification and road maintenance; provincial forest service for road maintenance and forest fire management; fisheries for habitat assessment.	Centre for Forest & Environmental Studies (2000)
Ground Rules	Operating procedures developed by the partnership committee that defined key governance concepts, roles and responsibilities, and mechanisms for consensus-based governance.	The Ground Rules were developed by all stakeholders and are regularly reviewed. They assist in mediating between different actors and provide a common lexicon.	Cormick, Dale, Edmond, Sigurdson, & Stuart, (1996); MFNL (2007)
Fundy Model Forest			
Stand Density Management Diagram	A simple biological model for spruce-balsam fir mixtures in New Brunswick which relates forest yield to forest density for all stages of the stand type's development.	The information could be used to make management decisions on thinning and other prescriptions by industry and government agencies.	Penner, Swift, Gagnon, & Brissette (2006); Swift, Penner, Gagnon, & Knox (2007)
Foothills Research Institute			
GIS maps	Various habitat and land use maps overlaid with grizzly bear location and other data. Also reach-scale maps produced to identify areas of low, medium and high probability of occurrence of several fish species and which could be used in conservation and research planning.	Maps could be used by different stakeholders in resource management planning (mining, oil & gas, and forest sectors), conservation planning, etc.	Graham, Boulanger, Duval, & Stenhouse (2010); Linke, Franklin, Huettmann, & Stenhouse (2005); McCleary & Hassan (2008); Nielsen, McDermid, Stenhouse, & Boyce (2010): Roever, Boyce, & Stenhouse (2008)
Grizzly Bear	A large and diverse research program has been developed based on the grizzly bear as a species at risk.	The focus on a large carnivore allows examination of landscape-level issues necessitating interaction and cooperation between a wide range of stakeholders.	Clark & Slocombe (2011)

stakeholders (von Mirbach, 2000). Model Forests have facilitated indicator use in management planning, scenario planning, setting targets and measurable goals, forest certification, and state of the forest reporting (von Mirbach, 2000). For example, within the Fundy Model Forest, C&I provided the foundation for programming and activity development (Fundy Model Forest, 2007a) serving as an interface facilitating interactions and cooperative work. Joint development of the indicators allowed for increased understanding and communication among stakeholders and facilitated connections among different perspectives and values. At the same time, the indicators were used by various stakeholders either individually or jointly:

> The work around criteria and indicators very much set the stage for planning for both the [provincial government] and certainly within [the forest company] today. That kind of thing couldn't have happened unless the Model Forest had been there. (mf3s9)

COMPUTER MODELS AS BOUNDARY OBJECTS

A well-developed computer model provides a mechanism to engage stakeholders in the model's development and assessment which can lead to shared understandings. Various models were developed and used in all three Model Forests, including marten population dynamics (Schneider & Yodzis, 1994) and habitat (Natural Resources Canada, 2009) in the Model Forest of Newfoundland & Labrador, Spruce Budworm Decision Support System (MacLean, Porter, MacKinnon, & Beaton, 2000) in the Fundy Model Forest, and an economic impact model (Alavalapati, White, Wellstead, & Patriquin, 1998) in the Foothills Research Institute. The marten habitat model in Newfoundland & Labrador, in particular, facilitated communication among stakeholders by providing a shared language. As one interviewee indicated,

> [For] the modeling work, [the researcher] would come and give presentations on what he had done so that everybody had a common framework for how the maps were being generated…That was probably one of the biggest challenges, making sure everybody was using the same variable [and running the model] with the standardized one. (mf3r5)

In this case, while the model was developed independently by a researcher, its

development also involved stakeholders from many sides of the science–policy/science–practice interface, including the forest industry, provincial biologists as the wildlife population and species-at-risk managers and researchers, and provincial foresters as the primary forest (i.e., habitat) manager. In short, development and use of the model required participation by all sides for it to be accepted. To illustrate this, one interviewee talked about how the work of one Model Forest stakeholder was rejected by the entire group due to the lack of engagement with others at the table:

> [They] spent a huge amount of time and went on an outside contract and developed their own marten model and they presented the big binder to [another stakeholder] and said, here, there's no issue with habitat and it was like, sorry, we don't know what you did, how you did it. We're not buying that. (mf3r5)

The same basic conclusion, that habitat was not the limiting factor, was reached by the later marten model developed through a project that engaged all interested stakeholders in the process. The model's development process allowed for researcher independence (and thus scientific credibility). It was transparent so everyone understood and could determine personally whether to accept its findings and limitations, and it used the provincial forest inventory database, a common data currency among government and industrial forest managers.

6. Discussion

In addition to a wide range of ecological conditions, the SFM domain tends to engage many actors, each with its own characteristics, perspectives and values. This illustrates the heterogeneity of the SFM operating environment involving different social, ecological, economic and cultural worlds that interact and sometimes collide. Within such a wicked problem system, while each actor engages in activities within a certain boundary, the same actor also needs to work collaboratively with others both within the community and beyond. Each of the three Model Forests provided an institutional framework that allowed different stakeholders to interact. As

boundary organizations, they served as an interface among different worldviews that often collided in the process of bringing together diverse stakeholders with conflicting values, goals, languages and operating processes. Such interaction has been identified by Weichselgartner and Kasperson (2010), and illustrated by Van Damme, Duinker and Quintillio (2008) in SFM, as an important element in generating mutual understanding among stakeholders involved allowing decisions to be "negotiated in good faith" (Ravetz, 2006, p. 278).

Ayling (2001, p. 159) writes, "One of the advantages to including such a broad range of stakeholders [in a Model Forest] is that it enables a discussion of the complex relationships and values found across the landscape". However, because of the diversity of values involved, SFM can mean something different to each stakeholder. Some scholars such as Berry (2000) contend that for conversations among diverse organizations to take place, "a common purpose, a common standard, and a common language" (p. 60) are required. Others suggest that conversational spaces that do not restrict the types of conversations would lead to greater and more diverse interaction (Carr & Wilkinson, 2005). Many boundary objects were either created or used by each Model Forest, facilitating communications among stakeholders, thus promoting an understanding of each other's perspectives and values. This, in turn, also built trust and enhanced the ability of the stakeholders to interact and work cooperatively. However, more could have been done by the Model Forests, researchers and users in translating research findings into user-friendly language and tools.

LONGEVITY OF ROLE AS BOUNDARY ORGANIZATIONS

As a result of the governance structures, operating procedures for identifying issues and key questions for research, and the lack of jurisdictional or management authority, Model Forests were seen by interviewees to be generally effective in facilitating the participation of groups representing different sides of the science–policy / science–practice interface without directing their involvement or actions. However, despite the strong identification by many interviewees of the role and

value of Model Forests in bringing different groups together, there have also been challenges. In her research on public participation in the Fundy Model Forest, 48% of Palen's (2003) respondents felt inequality existed within the partnership with landowner interests perceived as dominating the process. A similar focus was found in Foothills where activities were seen as being driven by practitioners and resource management agencies with challenges experienced in engaging "activist-oriented" organizations (Palen, Gilbert, & Duinker, 2006a). The Model Forest of Newfoundland & Labrador was not immune to partnership challenges and in 1996 one of its original partners, the Humber Environment Action Group, withdrew because of conflicts with other partners (Palen, Gilbert, & Duinker, 2006b).

Such partnership challenges appear to have been exacerbated after 2007 with the advent of the Forest Communities Program, a key funding source for many Model Forests. An evaluation of Natural Resources Canada's forest-based communities activities found that several Model Forests experienced weakened partnerships through the loss of some traditional stakeholders (e.g., forest industry, provincial forest agencies, and research groups) as a result of a shift away from SFM to economic development (Natural Resources Canada, 2011b). This suggests that a change in priorities resulting from a change in funding could affect the ability of the Model Forests to operate as boundary organizations. It also raises questions regarding the longevity of the role of Model Forests in helping to bridge the science–policy / science–practice interface. Although not considered as part of this study, it will be important to consider how (or, indeed, if) the core precepts of boundary organizations can be promoted and maintained without a separate, officially constituted institution such as a Model Forest.

ADDRESSING COMPLEX ISSUES THROUGH "CLUMSY" SOLUTIONS

Frame and Brown (2008) discussed the role of post-normal sustainability technologies (PNSTs) in addressing wicked problems. PNSTs, in their view, "work with the complexity and uncertainty by enlisting stakeholders with diverse perspectives and multiple capacities in the coproduction of sustainability know-

how" (Frame & Brown, 2008, p. 226). Boundary organizations are one type of PNST (Frame & Brown, 2006; Lorenzoni, Jones, & Turnpenny, 2007). Such multi-stakeholder processes have also been described as "messy governance" (Strand & Cañellas-Boltà, 2006) and "clumsy" solutions in which "all the ' voices ' [are] heard, and responded to by the others" (Verweij et al., 2006, p. 822).

Providing mechanisms to facilitate participation, and allowing voices to be heard, in the exploration of SFM was and continues to be a central feature of Model Forests. Successive evaluations of both Canada's Model Forest Program and the International Model Forest Network have noted that the creation and maintenance of the partnerships was a major accomplishment of Model Forests (Gardner Pinfold Consulting Economists Limited, 1996; Natural Resources Canada, 2002; Food and Agriculture Organization of the United Nations, 2004). For example, the independent evaluators for the 2002 evaluation of Canada's Model Forest Program noted:

> Through the struggles of establishing trust, the partnership-based operating mechanism provided the means to tackle issues which, in the absence of the Model Forest, would have been addressed in confrontational or less co-operative means, with resolutions likely less satisfactory. It is through the direct involvement of a broad cross-section of people in the governance and management of Model Forests that capacity is being built that allows participation in sustainable forest management. (Natural Resources Canada, 2002)

Participation is not, however, about just attending a meeting, receiving an information sheet or being asked your opinion. The potential range of opportunities for, ideas related to and objectives for participation in resource management means that it is often unclear what is meant by having an opportunity to participate in the decision-making process. For example, it "could mean to take part in the final *determination*, to have a chance to *express*…views and opinion, or to participate in *establishing a procedure* for decision-making" (Oughton, 2008, p. 487, emphasis in original). For many years after being first introduced more than 40 years ago,

Arnstein's (1969) "A Ladder of Citizen Participation" formed the foundation for policy-makers and practitioners promoting public participation in planning processes. A key feature of Arnstein's model is that it made a clear distinction between participation and consultation (Petts, 1999) which is very much related to participant's power or influence in the decision-making process.

Model Forests were, in part, designed to advocate governance systems "that encompasses the entire range of management issues and empowers the participants to work together toward mutually acceptable solutions to problems" (Brand, Bouman, Bouthillier, Kessler, & LaPierre, 1996, p. 87). However, planning and resource management generally take place within a formal system of bureaucratic management where power is "omnipresent" (Pløger, 2001, p. 231). As such, many participatory processes could be viewed as part of a system of "domination" (p. 95) and "subjectivisation" (p. 139) as described by Foucault (1972). Through Model Forests, a delicate balance was sought between moving along Arnstein's continuum while trying to remove imbalances in the power dynamic inherent in planning processes.

Indeed, while each Model Forest establishes a governance structure to facilitate the implementation of activities and administration of funding, the Model Forest, as an institution, does not have any resource or land management responsibilities. Importantly, the creation of a Model Forest does not supersede the rights, management responsibilities or jurisdictional authorities of individual land owners and managers (Ayling, 2001). As Sinclair & Smith (1999) write,

> …the [Model Forests] themselves have no decision-making authority regarding the use of forest resources. MFs are not new legal entities with jurisdiction over forest management issues; rather, they are organizations that seek to identify a common set of forest management objectives that can be implemented by policymakers. Each MF, therefore, relies on its partners, especially government and industry, to take up and implement the good ideas that result from the studies undertaken in each MF. (p. 125)

In effect, the Model Forest becomes a "neutral" forum within which issues can be discussed and ideas developed without the usual power struggles taking place (Besseau, Dansou, and Johnson, 2002; LaPierre, 2003). While this may limit the ability for the ideas, tools and knowledge developed through the Model Forest to be implemented, it can also facilitate dialogue as it removes much of the power imbalance that could exist if the Model Forest exercised management authority. A boundary organization must be equally accessible by the organizations representing different worldviews without them losing their identity at the same time (Forsyth, 2003), something the Model Forests appeared to have accomplished.

7. CONCLUSION

Addressing wicked problems requires the generation and use of credible knowledge and information that informs policy-making and on-the-ground implementation of best practices, thus effectively creating an interface between science and policy / science and practice. Each side of these divisions, or boundaries, has its own worldview, language and mode of operation, often resulting in conflict when two or more sides of the boundary attempt to cooperate or communicate. A boundary organization has the potential and necessary characteristics to bridge these divisions. Although the important function they can fulfill is clear, Frame and Brown (2008, p. 237) conclude that "[t]here are, at present, insufficient boundary organisations to provide the sorts of facilitators or negotiators needed to broker relations between diverse stakeholders and promote open dialogue" for effective implementation of sustainability.

Using the basic criteria of participation, accountability, and use of boundary objects, this paper reported on a study that explored whether Model Forests are effective boundary organizations in terms of bridging the science–practice and science–policy interface for SFM in Canada. It can be concluded that the three Model Forests in this study—Foothills, Fundy, and Newfoundland & Labrador—conform to the key

characteristics of successful boundary organizations and can, therefore, be seen as boundary organizations.

It was evident that Model Forests had credibility on both sides of the boundary. Model Forests served knowledge producers through promoting scientific credibility by allowing the researchers to maintain their independence and develop valid (but also relevant) questions. As a Model Forest has no jurisdictional authority (Ayling, 2001), land owners and managers needed to be engaged but were also free to take up or reject results of the work undertaken by the Model Forest. Finally, on the policy side, the Model Forest facilitated involvement of a wide range of stakeholders, thus enhancing the legitimacy of decisions and reducing potential conflict among stakeholders. In sum, the Model Forests served an intermediary role, or as boundary organizations, at the science–policy / science–practice interface; they were able to:

- facilitate the scientific process by engaging users in the identification of research areas while ensuring the maintenance of scientific credibility;
- influence on-the-ground practices by taking scientific knowledge and translating it into languages and forms appropriate for users/practitioners; and
- provide opportunities for and facilitate both scientific information and on-the-ground experience input into the policy process.

The Model Forests are boundary organizations linking knowledge producers (researchers) with knowledge consumers including both practitioners and policy-makers. Through the Model Forest approach and the governance mechanisms employed by the three cases, stakeholders representing all sides of the science–policy / science–practice interface were engaged, able to maintain their independence and develop tools that served as interfaces among them. This enhanced the ability for participating organizations to effectively engage in addressing the wicked issues underlying the concept of SFM. Considering that all Model Forests are based on six common principles that effectively encompass the criteria of boundary organizations, all Model Forests within the International Model

Forest Network as a whole have the potential to be viewed as effective boundary organizations. However, further research would be needed to confirm this claim.

As boundary organizations, Model Forests represent an important interface in the forest sector, building bridges among the science, practice and policy stakeholders that are critical if the challenges of SFM are to be successfully addressed. As such, they, or the principles embedded within them, need to be maintained. The original concept was for Model Forests to act as pilot sites with the ideas, processes and tools developed becoming the normal operating procedure across the landscape and among the stakeholders without the need for a separate entity in the long term (Forestry Canada, 1991). The ongoing existence of Model Forests and continued expansion of the concept in numerous countries throughout the world provides encouragement that this transformation is underway. However, it will take time to determine whether the principles can become embedded throughout the forest sector (and beyond) or if an independent structure or organization such as a Model Forest will continue to be required. It would be interesting to determine if the Model Forest concept has been or could be used to address other landscape and natural resource-based wicked issues (e.g., climate change, biodiversity conservation) and sectors such as marine and fisheries management, agriculture, natural hazards and land degradation.

ACKNOWLEDGEMENTS

I have been fortunate to be involved with the Model Forest concept since 1991 both within Canada and throughout the International Model Forest Network. I would like to thank the researchers, Model Forest staff and partner representatives who participated in the interviews for this study. It is only through the sharing of their thoughts, knowledge and experiences that this work could have been completed. My supervisor, Dr. Peter Duinker, and committee member, Dr. Heather Castleden, have provided invaluable guidance throughout the project.

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CHAPTER FIVE
RECOMMENDATIONS AND CONCLUSIONS

1. STUDY SUMMARY

In this study, I examined the use of research results by Model Forest stakeholders in advancing SFM. Specifically, the two-fold purpose of the study was to identify potential factors that contribute to and impede the uptake of the results of research and to examine the role Model Forests played in bridging the science–practice and science–policy interface in SFM.

Interviews were conducted in three Model Forests in Canada with researchers whose work was supported by a Model Forest, with Model Forest staff, and with Model Forest stakeholder groups that would be expected to have an interest in the research activities of the Model Forests. Three Model Forests were selected to be the focus of the study—Foothills Research Institute (Alberta), Fundy Model Forest (New Brunswick), and Newfoundland & Labrador. Three Model Forests were deemed sufficient to provide a diversity of perspectives based on various stakeholder groups engaged, research activities implemented, and socio-political, economic and ecological contexts. Fewer than three study sites might have focused too much on factors specific to one site.

A review of Model Forest research activities and governance mechanisms was undertaken based on examination of Model Forest web sites, project reports, annual work plans and reports, and journal articles published based on research and other activities supported by a Model Forest. This information was used to help identify which Model Forests to use as case studies, identify potential interviewees, and to examine the outputs and possible impact of Model Forest-supported research. Details concerning the methodological approach are provided in Chapter 2. The interviews primarily focused on identifying factors that may have either facilitated or impeded the uptake of research results within the Model Forests, the results of

which are outlined in Chapter 3. Finally, the role of Model Forests in enhancing research utilization for SFM, particularly as a possible boundary organization, was examined and is the focus of Chapter 4.

Information from a review of Model Forest literature was used in several ways: 1) to help identify which Model Forests to focus on, 2) to gain a broader understanding and familiarization of the research activities of the Model Forests particularly for the three Model Forests selected, 3) to assist in identifying how Model Forests link to boundary organizations, and 4) to show consistency in other studies with the findings of this study.

2. LIMITATIONS OF THE STUDY

The extent to which each factor actually affected the uptake of research findings was not examined in this study and represents the study's primary limitation. As such, which of the factors might be good predictors of research utilization cannot be identified, only those factors that the interviewees perceived to be a positive influence are articulated in the thesis.

A secondary limitation was the lack of comparison to other natural resource sector organizations or fora that facilitate interaction between researchers and practitioners (i.e., that could potentially be identified as boundary organizations). Such a comparison would assist in more clearly defining the role of Model Forests in research utilization, and more specifically, identifying the extent to which Model Forests play a unique role.

Finally, while three Model Forests were deemed sufficient to provide a diversity of perspectives, an examination of more Model Forests may have provided additional insight into the factors related to, and role of Model Forests in, research utilization. The use of interviews, while providing detailed information, limited the number of sites that could be included in the study. The use of a survey in addition to the

interviews would have allowed for collecting data from a larger group of people from both within the three Model Forests and from other Model Forests.

3. IMPLICATIONS OF THE STUDY

This study identified actions Model Forests could undertake to enhance research utilization. The analysis of the views and perspectives of participants regarding research utilization highlights aspects of the research process that can affect uptake of research findings. From the analysis, implications are drawn which may apply to the three Model Forests studied as well as to other Model Forests and other organizations supporting research in the natural resource sector. Implications of the study are highlighted below and focus on facilitating factors and barriers, boundary organizations, and the role of the Model Forests in research utilization.

FACILITATING FACTORS AND BARRIERS

The findings of this study highlight some factors that can explain why a gap exists between the knowledge produced by science and the application of that knowledge by decision-makers. Supported is the notion that user involvement in initial research design, while important, may be insufficient in and of itself to enhance research utilization. Instead, no one factor appears to influence research utilization, but rather a combination of factors that are dependent upon the particular circumstances of each situation. At the same time, factors focusing on the nature of the evidence and exchange mechanisms were deemed the most prominent to interviewees while organizational culture was considered a key barrier. More specifically, the three most commonly identified individual factors positively influencing research utilization identified were (1) *relevance of the research and research findings to users' needs,* (2) *effective research design and scientific credibility,* and (3) *user involvement in the research process*. Results of the study also suggest that the research community found being able to engage with users more valuable than the reverse. Worth noting, there were also differences among the three Model Forests. For example, relevance was more important in the Newfoundland &

Labrador and Fundy Model Forests, while scientific credibility was the most prominent factor in Foothills.

NATURE OF THE EVIDENCE

The most prominent individual factor identified was *relevance of the research and research findings to users' needs* which has also been observed in social science and health studies (Beyer & Trice, 1982; Feldman, Nadash, & Gursen, 2001; Greenberg & Mandell, 1991; Rogers, 1995, Weiss & Bucuvalas, 1980). In other words, research results that meet the needs of users are generally more likely to be used than results that are not in line with users' needs.

Availability and accessibility of information was another factor identified that potentially influenced the uptake of the results of Model Forest-supported research. This included reports not being prepared or distributed, results not available when needed, and results not available in a form or language directly related to users' needs. Ongoing communications, dissemination and translation of research findings were viewed as critical to the process of research utilization.

The maintenance of *scientific credibility* was also identified as critical for research utilization. Having trust in the results is important for many people and organizations, particularly when those results are being used in decision-making processes. As Booth, Colomb, & Williams (2008) write, "Without trustworthy *published* research, we all would be locked in the options of the moment, prisoners of what we alone experience or dupes to whatever we're told" (p. 10, emphasis in original).

EXCHANGE MECHANISMS

Co-production or collaboration between scientists and users in the research process was viewed as promoting both relevance of the results and scientific credibility. Almost half of the interviewees felt that user involvement in the identification of research questions or the initial research design would help facilitate uptake of

research findings. Conversely, a lack of user engagement in the research design process was viewed as a significant barrier to the use of results. More importantly, the concept of *continuous researcher–user interaction* throughout the research process was the third most-cited factor in the study, a factor more prominently identified by researchers than the two other categories of participants in this study.

ORGANIZATIONAL CULTURE

Several factors relating to organizational culture were identified in the study. These included *a receptive management structure*, *staff willingness to look at new ideas*, and *a lack of time* to examine results, all consistent with the literature (Barratt, 2003; Barwick, Boydell, Stasiulis, Gerguson, Blasé, & Fixsen, 2008; Boström, Kajermo, Nordstrøom, & Wallin, 2008; Burch, 2010; Landry, Lamari, & Amara, 2003).

The apparent incompatibility with traditional management approaches, such as the command-and-control model (Knight & Meffe, 1997; Meffe, Nielsen, Knight, & Schenborh, 2002), within the context of more recent changes in the nature of resource management and stakeholder engagement was also raised. There was, however, more discussion on informal institutional barriers such as a preference for established practices rather than new ideas. In particular, some interviewees felt that a key barrier was a cultural resistance among some professionals or the difficulty in tearing down older paradigms that people may embrace concerning certain key issues.

BOUNDARY ORGANIZATIONS

Using the basic criteria of participation, stakeholders, and use of boundary objects (Clark et al., 2010), it can be concluded that the three Model Forests in this study are appropriately viewed as boundary organizations. First, the Model Forests facilitated the participation of diverse stakeholders from all sides of the science–policy and science–practice interface. Second, the governance structure of the three Model Forests encouraged accountability to the different social worlds involved. Finally,

the Model Forests used boundary objects (e.g., vision statements and strategic plans, criteria and indicator frameworks, computer models) that provided links to and stability among the stakeholders and their worldviews. As boundary organizations, Model Forests represent an important interface in the forest sector, building bridges among science, practice and policy stakeholders that are critical if the challenges of SFM are to be addressed.

Role of the Model Forests

Participants in this study identified several key roles of Model Forests, which were in line with the roles of "interpreters in the interface between science and policy" highlighted by Holmes and Clark (2008, p. 707): describing the implications of research results; facilitating development of relevant research questions and communicating those to researchers; and synthesizing research information and uncertainties with respect to an issue. The key role identified for Model Forests was the linking of researchers (knowledge producers) with users (knowledge consumers), including both practitioners and policy-makers. As well, interviewees felt that this facilitation role assisted in the development of long-term relationships providing the foundation for broader, more productive partnerships outside the Model Forest structure, as confirmed by Sinclair and Lobe (2005). In effect, Model Forests were viewed as serving an intermediary role, as boundary organizations, at the science–practice and science–policy interface as they were able to:

- facilitate the scientific process by engaging users in the identification of research areas while ensuring the maintenance of scientific credibility;
- influence on-the-ground practices by taking scientific knowledge and translating it into languages and forms appropriate for users/practitioners; and
- provide opportunities for and facilitate input of both scientific information and on-the-ground experience into the policy process.

IMPLICATIONS FOR MODEL FORESTS

The study findings suggest that Model Forests should continue in their role of linking of researchers with users. However, there is also a need for Model Forests to focus more on communications and dissemination of information, particularly the translation of research results into a language or tool that directly relates to users' needs. A lack of information dissemination was one of the most commonly identified barriers to uptake. Additionally, providing support to communications activities was the highest-cited activity of the Model Forests in facilitating use, although it was also the most common item identified that Model Forests could improve. Enhancement of their role as boundary organizations through continued stakeholder engagement and the use of boundary objects could help bridge the gap between research and practice, scientists and practitioners, and science and policy-making for SFM.

POLICY IMPLICATIONS

The four explanatory models of research utilization—engineering, organizational, cultural, and interaction—identified by Landry, Lamari, and Amara (2003) were used in this study as a framework for assessing interviewee perceptions of factors affecting the uptake of research findings. While this provided a useful framework for examining the data, it is important to recognize that each subsequent explanation builds on the previous ones. For example, the interaction explanation also encompasses all of the components of the engineering, organizational and cultural explanations.

The key policy lesson that can be derived is that the creation of incentives for research utilization should focus on increasing the ongoing interaction between knowledge producers and knowledge consumers, enhancing scientific credibility, and facilitating effective communications including translation of research findings into more user-friendly products and messages. While focusing research on the needs of users was perceived as an important factor in enhancing research utilization, other research suggests that this factor does not explain increased research utilization (Landry, Amara, & Lamari, 2001) and thus should not be a

primary focus of intervention. Rather, facilitating ongoing interaction between researchers and users would increase the likelihood that the research will focus on users' needs.

4. Recommendations regarding Model Forests in enhancing research utilization

Although interviewees clearly felt that each of the three Model Forests played a role in facilitating the use of research findings, a number of actions can be taken by the Model Forests, and other similar organizations, to further enhance the probability that research findings will be used.

- *Facilitate the early and* ongoing *interaction between researchers and users in the research process, from identification of questions to dissemination of results.*

  Research that is relevant and focused on meeting the needs of users has a greater chance of being used. Not all research needs to focus on the needs of users because, as Nobel laureate (physics) Dr. George Smoot said, "People cannot foresee the future well enough to predict what's going to develop from basic research. If we only did applied research, we would still be making better spears" (Lawrence Berkeley National Laboratory, 2011). However, if the goal of the research is to investigate improvements on a particular practice or policy, then not focusing on users' needs will reduce the likelihood that the findings will have an impact. One of the best ways to ensure that the research being undertaken is relevant is to involve both users and researchers in the research design and process.

  Through the study, it was clear that while user involvement in the identification of research questions or the initial research design would help facilitate uptake of research findings, the idea of regular researcher–user interaction throughout the entire research process was more critical. Such co-production of knowledge fosters the bi-directional flow of information between the researchers and users,

facilitating both relevance and scientific credibility. Essentially, it is the role of the researcher to assure scientific credibility while the engagement of users in the research process assists in enhancing relevance.

- *Ensure scientific credibility through effective research design and encouraging the peer-review of findings.*

  While not forgetting the translation of research results into a format that users can both understand and readily use, ensuring scientific credibility of the work is also important in enhancing research utilization. Having trust in the results produced is important in their use, especially in decision-making processes. Two key components in building such credibility are creating an effective research design and a peer-review process for the findings.

- *Facilitate ongoing communications, dissemination and translation of research findings into a language users understand and a format they can use.*

  An important element in the research utilization process is the adaptation of results into a language the user understands (Caplan, 1979; Weber, 1987). At the same time, a balance needs to be sought between maintaining scientific credibility through the production of peer-reviewed publications and the development of user-friendly materials. In addition to translating research results, the communications and dissemination of that information need to be ongoing and targeted towards relevant users. More specific actions for Model Forests, researchers and users to implement to enhance research utilization include:

  1) Enhance documentation of research activities and findings either as published articles in journals or in project reports and ensure those project reports are accessible to users.
  2) Track and document the use of the results of Model Forest-supported

research.

- *Generate an environment more conducive to uptake of knowledge by strengthening organizational capacity and culture.*

The use of research results is generally more heavily dependent on both behavioural factors and users' context than the attributes of the research or research products (Landry et al., 2001). Investments in capacity-building within both researcher and user institutions can affect all these areas. Such capacities include: approaches to promoting the co-production of knowledge; knowledge within the research community of the resource management and policy-making processes; abilities to translate and communicate research findings to better target users; and the research receptor capacity within user institutions. Also important is increasing the understanding of the value of research and the research process so that individuals can judge the research of others and see more easily how it could be used. Modifying an existing organizational culture or creating a new one can be quite difficult. An effective boundary organization, which facilitates ongoing interaction between researchers and users, could play an important role in nurturing such change.

- *Focus on all elements or factors that influence research utilization.*

As the use of research findings is complex and predicated on much more than one or two factors (Landry et al., 2001), addressing only one of those factors will not be sufficient to enhance uptake of research results. To enhance the use of research findings, factors highlighted in *all* utilization explanations—engineering, organizational, cultural, and interaction—must be examined and considered, although this does not necessarily guarantee uptake of research findings. Rather, only the likelihood of use is enhanced.

- *Support the emergence and maintenance of boundary organizations to assist in bridging the gap between science and policy in SFM.*

  Governments and other organizations involved in research at the science–policy/science–practice interface should support boundary organizations, such as Model Forests, as they play an important role in enhancing research utilization. Supporting the emergence and maintenance of such institutions can facilitate bridging the gap between science and policy and advance SFM. In times of fiscal constraint, such support can be difficult as the provision of an external organization becomes an easy target for budget cuts. However, if research is to continue, then an investment in boundary organizations, can make good fiscal sense as it can enhance the probability that the research investment will pay off through increased impact. Additionally, it may be sufficient to incorporate the principles of a boundary organization—participation of stakeholders in the research process, maintenance of accountability, and use of boundary objects—into the policies and normal operating procedures of current research and user institutions rather than creating a separate entity.

Some of the above recommendations are more easily adoptable than others. For example, focusing research on the needs of users is probably easier to achieve than changing the culture of an organization.

5. AREAS FOR FURTHER STUDY

Throughout the course of the research, several potential additional research streams were identified which could further knowledge on the tripartite interface between science, policy and practice, particularly for SFM:

- *To what extent were the findings of Model Forest-supported research actually used by different stakeholders.*

While interviewees were asked to provide examples of uptake of results of Model Forest-supported research, there was no attempt to analyse or verify the extent of that uptake. Instead, the study focused on the perceived factors that may have either facilitated or hindered the uptake of the research results. Refinement of the extent to which research results were used would provide the basis for looking more closely at factors of research utilization, especially with respect to examining why there was little or no uptake of some results. Additional information on the uptake of research findings, including how they were used and by whom, could be used to further assess the importance of individual factors and assist in identify the determinants of research utilization.

- *What are the determinants of research utilization? That is, which factors are intricately linked to research utilization rather than perceived to be important?*

  This study identified the perceived factors affecting research utilization. A focus on *determinants* would identify those factors that actually influence uptake and the extent to which uptake is influenced. Additionally, the results of this study could be used to form the foundation for building an assessment scale based on perceived barriers or determinants. In 1987, Funk, Champagne, Tornquist & Wise (1991) developed the "BARRIERS to Research Utilization Scale" to assess nursing clinicians', administrators' and academicians' perceptions of barriers to the utilization of research findings in practice. Their scale contains 29 items divided among four factors: characteristics of the potential adopter, characteristics of the organization in which the research will be used, characteristics of the innovation or research, and characteristics of the communication of the findings. The BARRIERS scale was not adapted for use in this study as I wanted to take an exploratory approach to the topic and be able to probe interviewees' perspectives on how and why Model Forest-supported research results have been used. However, development of such a scale or tool for the natural resource management sector could assist organizations and individuals in identifying the areas that should be focused on to enhance the uptake of their research findings.

- *Is there a difference in the uptake of social science versus biophysical or natural science?*

  In this study, an attempt was made to include researchers from diverse backgrounds, including both the natural and social sciences. However, no attempt was made to determine if there was a difference in the level of uptake of results between social and natural science research, or whether different factors were more or less important depending on the type of research or nature of the information being generated. Such an exploration could build on the work of Landry et al. (2001, 2003) that focused on the social sciences.

- *To what extent is the role of Model Forests in research utilization unique or do/can other fora such as Forest Research Advisory Committees play a similar role?*

  While many interviewees highlighted the uniqueness, in their opinion, of the Model Forest concept in bringing researchers and practitioners together, some mentioned other researcher–user forums such as Forest Research Advisory Committees. A comparison with other such fora could highlight additional factors, more clearly identify the role of Model Forests in research utilization, and identify the key mechanisms influencing the identified factors.

6. SIGNIFICANCE OF THE RESEARCH AND CONCLUDING REMARKS

With respect to SFM, research is used to increase our understanding of the ecological, economics and social dimensions of forests as well as expand the potential range of alternatives available to inform management actions and policy decisions. However, research findings that "sit on a shelf" are, in all practical senses, equivalent to research not done at all. Additionally, although government funding for public sector research had been increasing between 1981 and 2002 (Maass, 2003), recent Canadian federal government budgets have seen reduced funding to the three government-sponsored research councils that provide grants to scientists

(Kondro, 2009). At the same time, accountability and value received for the use of funding, particularly public funds, are becoming increasingly important (Mitchell, 2006; OECD, 2003). As such, it is important to be able to demonstrate utility of research activities.

This research addresses questions around the science–policy interface with a focus on the factors affecting uptake or use of research findings. The key policy lesson that can be derived from this study is that the creation of incentives for research utilization should focus on increasing the ongoing interaction between researchers and users, enhancing scientific credibility, and facilitating effective communications including translation of research findings into more user-friendly products and messages. The creation and maintenance of boundary organizations, such as Model Forests, is one way of achieving this.

While science is important in providing critical information and knowledge, it does not actually deliver decisions (Cortner, 2000; Gregory, Failing, Ohlson, & McDaniels, 2006) nor is it a panacea for our challenges. Resource management decisions are, in effect, based on value judgements and not resolvable solely by science (Healey, 1997). The role of research is to provide good information to decision-makers that they can use in the decision-making process. Additionally, the results of research are not the only information considered in the decision-making process. A range of social, economic and cultural considerations also influence decision-making through deliberative and often political processes (Gregory et al., 2006). Science and the research process can help provide clarity into those processes but cannot replace them and an effective boundary organization can be an important arbiter in this process.

Model Forests have played a role in influencing research utilization by supporting user involvement in the research process, promoting effective research design and scientific credibility, and putting in place processes which encouraged the research to be relevant to users' needs. As boundary organizations, Model Forests represent

one, and possibly a unique, institution that offers an opportunity to bridge the science–practice–policy interface, and take a leadership role in facilitating research utilization for advancing SFM in Canada and on the international scene.

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APPENDIX ONE
INTERVIEW SCHEDULE (RESEARCHERS / KNOWLEDGE PRODUCERS)

These questions were written to be appropriate for the semi-structured interviews with researchers whose research activities have received support from a Model Forest.

I will go over the consent form and have them sign it before I begin.

Thank you for agreeing to participate in my study. Before we begin, let me explain the purpose of my research. I am studying the factors that may facilitate or hinder the uptake of the results of research that has been supported by a Model Forest. The purpose of this study is to gain insight into the mechanisms that may explain the degree to which results of Model Forest-supported research activities are used by stakeholders in the policy and practice of sustainable forest management.

Before I begin, do you have any questions or need clarification on any aspects of my research project or your participation?

Questions:

- To begin, could you tell me a little about your involvement in Model Forests?
- In your opinion, what roles does the Model Forest have in research and associated activities?
- Which Model Forest-supported research activity(ies) were you involved in and how did you become involved in that activity (those activities)?
- Why were you involved in that (those) Model Forest-supported research activity(ies)?
- What benefits do you see to being involved in Model Forest-supported research activities?
- In what way has involvement in the Model Forest affected your perspective on research and the utilization of research results?
- Have the results of your Model Forest-supported research been utilized by any

organization? If yes, could you briefly describe how they have been utilized?

- Why do you think the results of your Model Forest-supported research have been utilized (or not)?

- Thinking specifically about your research activities that have been supported by a Model Forest, what have you done to facilitate the uptake or utilization of the results of that research by Model Forest or other stakeholders? What else do you think you could have done to facilitate the utilization of your research results?

- What did the Model Forest do, if anything, to facilitate the utilization of your research results? What else do you feel the Model Forest could do (or could have done better) to facilitate the utilization of research results?

- When designing the research project, did you think about how the results of your research could be used by others either during or after research project completion? If so, what elements did you try to incorporate into your overall research project design?
- What do you think are the most important factors in facilitating the uptake or utilization of the results of your Model Forest-supported research?

- What, if any, barriers do you see to the utilization of the results of your Model Forest-supported research?

I am now finished with my questions for you. Do you have anything else you would like to say?

To conclude, thank you again for participating in my study, and for sharing your time and your answers with me. Your responses are valuable to my research. Do you have any questions? If you have any questions about your participation in my study—at any time in the future—do not hesitate to contact me by phone or email (contact information is on the consent form).

APPENDIX TWO
INTERVIEW SCHEDULE (USERS / KNOWLEDGE COMSUMERS)

These questions were written to be appropriate for semi-structured interviews with representatives of Model Forest stakeholders or partner organizations that have an interest in Model Forest research activities.

I will go over the consent form and have them sign it before I begin.

Thank you for agreeing to participate in my study. Before we begin, let me explain the purpose of my research. I am studying the factors that may facilitate or hinder the uptake of the results of research that has been supported by a Model Forest. The purpose of this study is to gain insight into the mechanisms that may explain the degree to which results of Model Forest-supported research activities are used by stakeholders in the policy and practice of sustainable forest management.

Before I begin, do you have any questions or need clarification on anything?

Questions:

- To begin, could you tell me a little about your involvement in Model Forests?
- In your opinion, what role does the Model Forest have in research and associated activities?
- To what extent have you been involved in Model Forest-supported research activities? …other research activities? What has been the nature of that involvement?
- In what ways does your organization support Model Forest research activities (financially or in-kind)? If in-kind, what is the nature of the support? How does your organization decide which research activities to support?
- How has your organization used the results of Model Forest-supported research? Has your organization changed its practices on the basis of the results of Model Forest-supported research? If so, how?
- What, in your opinion, facilitated the use of those results? In your opinion, what could have been done better? Could anything else have been done to facilitate utilization by i) the researcher, ii) the Model Forest, or ii) your organization?

- In your opinion, what could the Model Forest do to facilitate the utilization, by your organization, of the results of research supported by the Model Forest?

- Have the results of Model Forest-supported research influenced decisions in your own work? How? What role do research and research results play in your day-to-day work? How do you view the role of research in your work?

- To what extent do you try to keep up-to-date on Model Forest-support research activities? How do you do so?

- To what extent do you review research (from any source) for relevancy to your work? What factors facilitate the use of such research? What may hinder you from using research results?

- How important is it to design research projects that are closely aligned with needs identified by stakeholder organizations (i.e., the users of research results)?

- In your opinion, what are the barriers to the utilization of the results of Model Forest-supported research?

- What would you do to increase the potential for the results of research you get involved in to be taken up by your organization?

I am now finished with my questions for you. Do you have anything else you would like to say?

To conclude, thank you again for participating in my study, and for sharing your time and your answers with me. Your responses are valuable to my research. Do you have any questions? If you have any questions about your participation in my study—at any time in the future—do not hesitate to contact me by phone or email (contact information is on the consent form).

APPENDIX THREE
INTERVIEW SCHEDULE (MODEL FOREST STAFF)

These questions were written to be appropriate for the semi-structured interviews with Model Forest General Managers or other staff.

I will go over the consent form and have them sign it before I begin.

Thank you for agreeing to participate in my study. Before we begin, let me explain the purpose of my research. I am studying the factors that may facilitate or hinder the uptake of the results of research that has been supported by a Model Forest. The purpose of this study is to gain insight into the mechanisms that may explain the degree to which results of Model Forest-supported research activities are used by stakeholders in the policy and practice of sustainable forest management.

Before I begin, do you have any questions or need clarification on anything?

Questions:

- To begin, could you tell me a little about your involvement in Model Forests?
- In your opinion, what role does the Model Forest have in research and associated activities?
- Why does the Model Forest support research? What types of research does your Model Forest support?
- How does your Model Forest support research activities? Besides funding of activities directly, what other role(s) does the Model Forest play in research?
- How does the Model Forest choose which research activities to support?
- How have the results of Model Forest-supported research been utilized by your partners and stakeholders? Could you provide some examples?
- What, in your opinion, facilitated the uptake of those results by those organizations? What did the Model Forest do? In your opinion, was there anything the Model Forest could have done (or done better) to increase the utilization of the results by others?
- What does the Model Forest do to facilitate / encourage the uptake of Model

Forest-supported research results by its partner organizations or others?

- What do you see as some of the barriers to the utilization of the results of Model Forest-supported research?

- What role do you see for the researchers in facilitating the uptake of the results of their work?

I am now finished with my questions for you. Do you have anything else you would like to say?

To conclude, thank you again for participating in my study, and for sharing your time and your answers with me. Your responses are valuable to my research. Do you have any questions? If you have any questions about your participation in my study—at any time in the future—do not hesitate to contact me by phone or email (contact information is on the consent form).