Maple Sugar Bush Management and Biodiversity Conservation in Eastern Ontario, Canada

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Abstract

This thesis examines the extent to which sugar bush management in Eastern Ontario might contribute to biodiversity maintenance and conservation and therefore be promoted as a form of rural sustainable development. Ontario government policy seeks to actively promote actions that strengthen the province's rural communities and protect biodiversity. Therefore sustainable development is an important concept to encourage in rural areas. The production of maple syrup on sugar bushes has already been demonstrated to be economically, socially, and in some aspects ecologically sustainable. This study seeks to determine how the operation of sugar bushes might also contribute to ecological sustainability through the maintenance and conservation of forest biodiversity.

I identified three documents published by the Eastern Ontario Model Forest (EOMF): a set of management principles for conserving biodiversity on private woodlots, a list of biodiversity indicators, and a manual for monitoring them. I monitored three of the biodiversity indicators (spring ephemerals, birds, and frogs) on three of the larger sugar bushes in the Eastern Ontario and established that the EOMF biodiversity monitoring practices and guidelines were suitable for working sugar bushes. Using the management principles for biodiversity conservation developed by the EOMF, I interviewed 22 sugar bush operators in Eastern Ontario. With these interviews I addressed two objectives:

1. To generate empirical information regarding the management practices of maple sugar bush operators in Eastern Ontario and to compare these with established management principles for forest biodiversity conservation in the region

2. To generate suggestions for woodlot operators and government policymakers alike about future opportunities for research and management decision-making.

The results of the study show that although most operators do not have a formal management plan for their sugar bush, many of their management practices are consistent with prescribed biodiversity conservation principles. Sugar bush operators are receptive to conserving biodiversity on their properties. The findings suggest that through sound management and planning, small-scale commercial sugar bush operations generally can be made environmentally sustainable, and become important components in broader rural development strategies.

This study provides new insights into how small-scale sugar bush management, when practiced well, is consistent with conservation principles and with sustainable development principles more generally. It shows how sugar bush operators in Eastern Ontario can help the province reach its goals of biodiversity conservation and rural development set out in Ontario's Biodiversity Strategy (2005) and Ontario's Rural Plan (2004).

Résumé

Cette thèse examine la mesure dans laquelle la gestion de l'industrie acéricole de l'Est ontarien pourrait contribuer au maintien et à la conservation de la biodiversité, et de ce fait être promue comme étant une forme de développement rural et durable. Le gouvernement ontarien cherche activement à promouvoir les programmes qui renforcent les collectivités rurales de la province, ainsi qu'à protéger leur biodiversité. Le développement durable est donc un concept qui doit être encouragé dans les zones rurales. La production acéricole est déjà reconnue comme étant économiquement, socialement et, sous certains aspects, écologiquement durable. La présente étude cherche à déterminer comment le fonctionnement des érablières pourrait contribuer à la durabilité écologique par le maintien et la conservation de la biodiversité forestière.

On utilisant trois documents publiés par la Forêt modèle de l'Est de l'Ontario (FMEO): un ensemble de principes de gestion servant à préserver la biodiversité dans les boisés privés, une liste d'indicateurs de biodiversité et un manuel de contrôle pour ceux-ci, j'ai suivi trois des indicateurs de biodiversité (plantes éphémères, oiseaux et grenouilles) sur trois des plus grandes érablières dans la zone d'étude. Les pratiques et directives de surveillance de la biodiversité FMEO sont aptes à être appliqués aux érablières fonctionnelles. En utilisant les principes de gestion de la conservation de la biodiversité développés par la FMEO, j'ai interviewé 22 opérateurs d'érablières dans l'Est ontarien. ont été interviewé ou j'ai adressé deux objectifs spécifiques:

1. Générer des informations empiriques sur les pratiques de gestion des opérateurs d'érablières dans l'Est ontarien et comparer celles-ci avec les

principes de gestion préalablement établis pour la conservation de la biodiversité des forêts de la region

2. Générer des suggestions portant sur les possibilités de recherche future, ainsi que la prise de décisions au niveau de la gestion, pour les exploitants de boisés et les décideurs politiques

Les résultats de l'étude démontrent que bien que la plupart des opérateurs d'érablière ne possèdent pas de plan de gestion officiel, plusieurs de leurs pratiques de gestion sont conformes aux principes de conservation de la biodiversité prescrits par la FMEO. Les opérateurs d'érablières désirent préserver la biodiversité sur leurs propriétés. Les résultats suggèrent que par une saine gestion et planification, les érablières à petite échelle commerciale peuvent généralement être écologiquement viables, et deviennent un élément important en terme de stratégies de développement rural.

Cette étude fournit un nouvel aperçu quant à la gestion d'érablières à l'échelle locale. Les principes qui guident cette gestion, lorsque pratiqués sous les consignes de la FMEO, la rendent généralement conforme aux principes de conservation et de développement durable. L'étude démontre comment les opérateurs d'érablières dans l'Est ontarien peuvent faciliter les efforts de la province en ce qui a trait à l'atteinte de ses objectifs de conservation de la biodiversité et de développement rural durable, établis sous l'ombrelle de la Stratégie de la biodiversité de l'Ontario (2005) et le Plan rural de l'Ontario (2004).

Preface

This thesis follows the article format and consists of an introductory chapter, a second chapter consisting of an article that has been submitted to and accepted for publication by the peer-reviewed scholarly journal *Small-scale Forestry*, and a concluding chapter. The candidate is the first author of the article, and had primary responsibility for the conceptualization of the research project, the design and execution of the empirical research, and led the writing of the journal article. The second author, Dr. Robert McLeman, provided conceptual guidance and direction of research, was responsible for obtaining and directing project funding, establishing initial contacts in the study community, and providing editorial assistance in the crafting of the journal article. The introductory chapter includes the objectives of the study, the context of the research, a literature review, and the development of methods. The final chapter summarizes the main results and findings of the study. It discusses the major contributions of the study, outlines its limitations, and suggests areas for future research. Additional information, including the interview guide used and some of the results that were not included in the text of the article, is provided in appendices.

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Many thanks to biodiversity specialist Erin Neave who took the time to meet with me and provided me with valuable advice on what to include in my interviews and how best to word them. Erin also gave me several good information resources on private woodlots and sugar bushes in Ontario.

I would also like to thank Mark Richardson of the Eastern Ontario Model Forest who spoke with me about monitoring biodiversity indicators and whose advice helped set me on the right track for how to conduct my research.

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Chapter 1

1.1 Introduction and Objectives

A current global priority is the need to move toward sustainable development and its three pillars of environmental, social, and economic responsibility (IISD 2010). As ecosystem services and natural resources are depleted at increasing rates, it is becoming increasingly apparent that this unsustainable approach deteriorates communities and economies. For rural communities especially, where livelihoods and household incomes depend directly and indirectly upon natural resources, there is a need for sustainable development options that will improve their societies, support their economies, preserve biodiversity and improve the natural environment (FAO 2007). Ontario's Rural Plan (OMMAH 2004) suggests that the province's natural resource base creates potential for rural communities to establish livelihoods based on rural sustainable development principles.

In rural Eastern Ontario, maple sugar/syrup production is a longstanding household livelihood practice that is becoming gradually more commercialized. Sugar bushes have a long history in North America and have demonstrated both economic and cultural sustainability (Whitney & Upmeyer 2004). If it can be safely assumed that sugar bush operations also support the environmental pillar of sustainable development, through such benefits as the maintenance of biodiversity, they may be seen as a good candidate for active promotion through rural sustainable development initiatives. While sugar bush owners and their local governments have occasionally put forward the idea that sugar bushes are working forests that support high levels of biodiversity, there is little scientific literature investigating whether this is true. The purpose of this research is to examine whether the

evidence supports this claim, and to situate the maple syrup industry within the framework of biodiversity conservation and sustainable development promoted by Ontario's Biodiversity Strategy (2005) and Rural Plan (2004). Specifically, I did this by assessing the potential for maple syrup production in Eastern Ontario to contribute to the maintenance of biodiversity. If it does help maintain biodiversity, it might be encouraged as a potential contributor to sustainable development in rural Ontario. I set out to:

1. Generate empirical information regarding the management practices of maple sugar bush operators in Eastern Ontario and to compare these with established management principles for forest biodiversity conservation in the region

2. Generate suggestions for woodlot operators and government policymakers alike about future opportunities for research and management decision-making.

This research is timely for several reasons: the maple syrup industry in Ontario is flourishing and is expected to grow (Chapeskie 2009); many communities in rural Eastern Ontario are struggling and in need of economic and livelihood diversification (OMAFRA 2010; McLeman 2010; Sander-Regier et al 2009; Eastern Ontario CDFC Network Inc 2007; OMMAH 2004), and Ontario's biodiversity is generally believed to be threatened and in need of protection (OMNR 2005).

1.2 Literature Review

This section reviews the literature in the three key components of this project (rural sustainable development, biodiversity, and the maple syrup industry) with the purpose of establishing linkages between them.

1.2.1 Sustainable Development

The most widely used definition of sustainable development comes from the 1987 WCED report *Our Common Future* (WCED 1987). In that document, sustainable development is defined as meeting "the needs of today without compromising the ability of future generations to meet their own needs"(p.43). Since the publication of *Our Common Future*, the concept of sustainable development has been incorporated into plans, policies, and practices around the world, from the international scale to the local scale. Kates et al (2004) analysed the ongoing dialogue concerning the definition, goals, indicators, and values associated with sustainable development and how they have changed since the publication of *Our Common Future*. They note that while the ambiguity of the WCED report's definition has been discussed and debated at length, it has allowed the general concept to be applied in diverse settings. "[T]he concept of sustainability has been adapted to address very different challenges, ranging from the planning of sustainable cities to sustainable livelihoods, sustainable agriculture to sustainable fishing, and the efforts to develop common corporate standards in the UN Global Compact and in the World Business Council for Sustainable Development" (Kates et al 2004 p.20).

Sustainable development incorporates three "pillars": economy, society, and environment (Kates et al 2004). For development to be considered sustainable, it must be good for society, good for the economy, and not harmful to the environment. The 2002 *Johannesburg*

Declaration on Sustainable Development called for "a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development – economic development, social development, and environmental protection – at the local, national, regional, and global scales" (WSSD 2002 5).

1.2.2 Rural Sustainable Development

In his appraisal of rural Canada, Troughton (1995) describes the decline of rural Canada in recent decades, a trend that continues to this date (McLeman et al in press). Troughton notes that by the 1990s, all sectors of rural resource economy were declining, from farming to forestry to mining. Associated with this deterioration was the weakening of rural communities that depended on those resources, and as these communities collapsed, urban centres and the corporate control of natural resource economy began to grow. Troughton (1995) argues that the decline of rural Canada diminishes the potential for sustainable development in Canada as a whole. This is because "the most likely settings in which to achieve sustainable development consistent with ecological goals, are rural countrysides where, by definition, physical processes support human activity and lifestyle based on extensive renewable natural resources" (Troughton 1995 p.291). Rurally sustainable livelihoods, of which sugar bushes may be an example, will help geographers working to stop the decline of rural communities and livelihoods. If a livelihood is beneficial to a rural community's society, economy, and environment, it will help that community flourish.

Smit and Brklacich (1989) also suggest that sustainable development be used as a key theme when analysing rural systems, since the concept applies to all the important factors of rural systems and helps researchers promote the welfare of rural communities. Nelson (2003)

argues that avoiding negative outcomes for rural people (and therefore promoting their welfare) is what rural sustainable development is all about. He states that there is increasing pressure on Canada's rural areas to adopt an industrial and corporate model, choosing to specialize and lower costs. However, this leads to many unsustainable outcomes such as "population migration to urban areas; decline of small villages and towns; more intensive use of land; drainage and reclamation of wetlands; cutting of woods and forests; loss of natural areas; and the breakdown of traditional ways of life" (Nelson 2003 p.74). Rural sustainable development attempts to avoid these problems. It is clear from all of these researchers that rural Canada needs sustainable development options, and that any analysis of rural systems should bear this in mind.

In Ontario, 15% of the population lives in rural areas (Statistics Canada 2009). While most of the population growth in Ontario since 2001 took place in urban areas, rural populations have also been growing and accounted for 11.6 % of the province's growth between 2001 and 2006 (OMF 2010). In 2004 the Ontario Ministry of Municipal Affairs and Housing developed a rural plan to ensure that rural Ontario prospers. As stated in the plan, "Rural Ontario is key to the health and vitality of our province. Our rural communities contribute to a high quality of life for all of us. And the success Ontario enjoys today as the economic engine of the country owes much to the strengths of our rich agriculture, forestry, mining, and manufacturing sectors" (OMMAH 2004, p.5). The Rural Plan recognizes the importance of a healthy natural environment for human health, economic prosperity, and environmental sustainability, incorporating the principles of sustainable development. Part of the Plan which supports the environmental pillar of sustainable development is to "protect the natural environment and ensure that natural resources are used in a sustainable way" (OMMAH

2004 p.11) which is consistent with Ontario's Biodiversity Strategy, where "[h]ealthy, evolving ecosystems and the maintenance of natural processes are prerequisites for the *in-situ* conservation of biodiversity and the sustainable use of biological resources" (OMNR 2005 p.11).

1.2.3 Biodiversity

Biodiversity is "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems" (UNEP 1992 Article 2). Biodiversity maintains the environmental services that allow humans and the rest of life on Earth to flourish (Brooks et al 2006; Balvanera et al 2006). These services include, but are not limited to, soil formation, food production, water purification, waste decomposition, and the maintenance of atmospheric composition (Spray & McGlothlin 2003). Biodiversity preserves these and many other environmental services from collapsing. (Balvanera et al 2006).

It is believed that because of the actions of humans, biodiversity is declining around the world (UNEP 1992; Chapin et al 2000). Humans have altered the composition of the atmosphere, introduced changes into biogeochemical cycles, over-exploited natural resources, and transported organisms around the world, all to the detriment of biodiversity (Chapin et al 2000). The 2005 *Millennium Ecosystem Assessment* reports that rates of species extinction are up to 1000 times higher than they were in pre-human history (MEA 2005). The societal consequences of biodiversity loss are numerous, as biodiversity is linked to economies and cultural, intellectual, aesthetic, and spiritual values. Chapin et al

(2000) provide several examples where loss of species richness has depleted ecosystem services and led to negative societal outcomes.

In 1992, the United Nations Convention on Biological Diversity recognized that biodiversity loss was happening at a global scale. 168 countries signed this convention and adopted its goals of:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources (UNEP1992)

Canada was one of the countries to sign the convention. As a result, it created the Canadian Biodiversity Strategy (1995). Responding to this, Ontario's Ministry of Natural Resources created its provincial biodiversity strategy in 2005. *Ontario's Biodiversity Strategy: Protecting What Sustains Us* outlines the threats to Ontario's biodiversity and identifies opportunities and steps that can be taken to conserve the province's biodiversity. Ontario's Biodiversity Strategy has two general goals:

1. Protect the genetic, species, and ecosystem diversity of Ontario
2. Use and develop the biological assets of Ontario sustainably, and capture benefits from such use for Ontarians (OMNR 2005)

The main threats to Ontario's biodiversity include the loss, alteration, and fragmentation of habitats, urbanization, agricultural intensification, and natural resource extraction (OMNR 2005). Human population growth emphasizes each of these threats since more people use more space and more resources (OMNR 2011a). Forests are an important habitat for many species and cover approximately two thirds of Ontario (OMNR 2005). In Eastern Ontario, over three-quarters of the land in the region is privately owned, and 35% of this land is forested (Bland et al 2006). Consequently, these rural woodlot owners may be seen as *de facto* stewards of the biodiversity in their forests. Their use and management of forest lands has significant influence on forest biodiversity and habitat availability.

1.2.4 The Maple Syrup Industry

Maple syrup production is a rural industry and forest use that has been seen as socially, economically, and in some ways ecologically sustainable (Whitney & Upmeyer 2004). Since it relies on a productive forest with intact and mature trees, it is a land-use that is seen as being less invasive than many other rural land-uses such as timber extraction, agriculture, and mining.

Maple sugar and syrup have a long history in Ontario. When Europeans arrived in North America, Native Americans were already tapping trees and producing maple sugar – the first sugar produced in North America (Chapeskie 2009). As Europeans began to clear land and farm in Ontario, maple stands were often left on the farms to provide the families with maple sugar to use throughout the year. With the industrial revolution, on-farm maple sugar production declined as farms became more specialized. Cane sugar also became more readily available in North America so that farmers relied less on on-farm maple stands for

their sugar. However, by the 1970s, farmers realized the need to diversify, and turned back to their sugar bushes as a source of revenue (Chapeskie 2009).

Since the 1950s, considerable research and development has gone into the maple industry. New sap collection and processing methods, woodlot management, and quality standards have been developed. These advances have allowed some sugar bush operators to specialize in maple syrup as their main source of income (Chapeskie 2009). Currently in Ontario there are approximately 2,600 maple syrup producers whose industry contributed $11.2 million to the province's economy in 2009 (Leuty 2009). Ontario's Ministry of Agriculture, Food and Rural Affairs (OMAFRA) notes that there is a healthy domestic market and growing export market for maple products (Chapeskie 2009; Leuty 2009).

Since its beginnings in Native American societies, the management of maple trees for sap extraction has undergone many changes (Chapeskie 2009). The original method developed by Native Americans was to cut a V-shaped gash in the trunk of a maple tree and collect the sap that dripped from it in a trough on the ground. This method often killed the trees, and the Native Americans would move on to another set of trees the next year. European settlers eventually developed the bucket and spile method where a hole was bored into the trunk of the tree, a spile inserted, and a bucket positioned underneath to collect the sap (see Figure 1, below). This method caused less damage to the trees, but other aspects of the early sugar bush management were detrimental to the forest ecosystem. For example, sugar bushes on farms were often used throughout the year as grazing areas for livestock which limited the development of any undergrowth. This made it easier for people to access the trees to collect

sap, but also meant that instead of a thriving forest, the sugar bush was simply a stand of sugar maples with little else growing between (Chapeskie 2009).

Present day commercial sugar bush operators use a system of plastic tubing to collect sap (see Figure 1, below), which reduces the need for a woodlot free of undergrowth. The plastic tubing is attached to the spile on the tree, and channels the sap by gravity or with the aid of a vacuum pump to the building where it will be evaporated to produce syrup. With this system, there is no need to visit each tree daily to collect the sap from a bucket. As opposed to sugar maple monocultures, sugar bush operators are encouraged by government bodies and forestry organizations to retain other tree species in their woodlots to reduce the risk of harmful insect outbreaks and to provide habitat for wildlife. The use of reverse osmosis in sap processing greatly reduces the amount of time and fuel required to evaporate water from the sap (Chapeskie 2009).

Image 1: Bucket and spile sap collection (left), plastic tubing sap collection (right)
(Sources: http://www.mainewindjammerblog.com; http://www.hilljacksugarshack.com)

Whitney and Upmeyer (2004) conducted an extensive literature review on the maple syrup industry in North America to analyze its sustainability. In terms of economic sustainability, they conclude that there will likely always be a market for local retail sales of maple syrup and that most investigators believe there is room for an increase in supply of maple products. However, improved sap extraction and processing technology has led to lower bulk prices. Socially, Whitney and Upmeyer (2004) found that syrup production has long been associated with celebration and interaction among people and families. Many sugar bushes are family operations that provide an opportunity for rural and urban family members to reunite during the tapping season. It is a livelihood that connects sugar bush owners with their heritage and their land. As a part of North America's history, identity and culture, the industry should be preserved for future generations.

Concerning the ecological sustainability of maple syrup production, Whitney and Upmeyer (2004) focused on the ability of sugar maples to persist throughout years of sap extraction. They found that from the beginning of maple sugar and syrup production in North America "as a species, sugar maple has held its own or even increased somewhat" (p.328). Sugar bush owners naturally favour sugar maples over other trees, and have allowed them to flourish. The authors of the study note that sugar maple monocultures and global warming are detrimental to the sustainability of sugar maples and sugar bushes. Monocultures of sugar maple make it easier for diseases and insect defoliators to spread throughout the stand, and do not provide an adequate quality of nutrients to the soil. Some global warming models show the range of sugar maple decreasing as higher winter temperatures prevent buds from breaking dormancy.

Tree health and species composition are only two elements of environmental sustainability. The Whitney and Upmeyer (2004) study did not address the broader relationship between maple syrup production and forest biodiversity, a relationship worth investigating further since biodiversity is an important aspect of environmental and ecological system integrity and therefore sustainable development. Before commercial maple syrup production can be recommended as contributing to sustainable development, it is worth gauging the potential impacts of sugar bush management on biodiversity. I found only one study that addressed this topic, one in which Leniere and Houle (2006) studied the undergrowth in 30 sugar bushes in Quebec under varying levels of management. They concluded that traditional sugar bush management that selectively cuts trees other than sugar maple results in less species richness in the undergrowth. However, maple syrup operations are heterogeneous in nature, and selective cutting is only one possible feature of sugar bush management. As Whitney and Upmeyer (2004) note, "prevailing opinion has shifted to encourage a more biologically diverse stand of trees in the sugar bush"(p.325). With maple monocultures, there can be an increased incidence and spread of pests and disease and a decrease in the supply of leaf litter and food for the earthworms that develop the soil characteristics of productive sugar bushes (Whitney & Upmeyer 2004).

Although I was able to find a large quantity of literature on the operational methods, maintenance, and technology associated with sugar bushes, there is limited information on how these operations affect the wildlife that uses the sugar bush as a habitat. My research aims to respond to this gap in the literature. There are various ways of managing a woodlot, and some of these may be more consistent with maintaining and promoting biodiversity than others. Several researchers, both in forestry and academic fields, have developed suggested

guidelines for managing forests so as to promote biodiversity (Lindenmayer 2006; McEvoy 2004; Bland et al 2006).

The Eastern Ontario Model Forest (EOMF) is an organization that works to develop and promote new ways to manage and sustain forests in Eastern Ontario. As part of the Canadian Model Forest Network, they work with private landowners, government, industry, and First Nations to achieve their goals. Their slogan, "forests for seven generations" indicates their commitment to protecting natural resources for future generations, a key goal of sustainable development. The EOMF has developed many tools and resources for private woodlot owners to help them manage their forests sustainably. They provide forest certification, workshops and seminars, publications and reports and much more for woodlot owners. One of the EOMF initiatives is to promote forest biodiversity. They have developed a list of biodiversity indicators for woodlot owners and a manual for monitoring them. They also have a set of woodlot management guidelines that promote biodiversity, and an observer network to collect biodiversity information. Given its specific design by a local forestry organization for use in Eastern Ontario, it may be assumed that of all possible established guidelines the EOMF's would likely be among the best known in the study area, and therefore most likely to have been influential if not explicitly implemented. My research consequently assesses whether sugar bush owners in Eastern Ontario are following these or similar management guidelines to foster biodiversity implicitly or explicitly in their ongoing management practices.

1.3 Methods

I conducted my research primarily in Lanark County, Ontario. Lanark County covers approximately 2979 square kilometres to the west of Ottawa. With a population of 63,785 (Statistics Canada 2010), Lanark County is known as the "Maple Syrup Capital of Ontario" and has the highest number of sugar bush operators of any county in Eastern Ontario (EOMF 2006), making it an ideal location to conduct my research. I also conducted interviews in the neighbouring counties of Leeds & Grenville and Frontenac. I chose these three counties as my study area since they fit under a larger long-term research project about rural sustainability in Eastern Ontario and there were pre-existing research contacts in the area.

My research sought to understand sugar bush owners' concepts and ideas of biodiversity, how these may or may not be incorporated into their sugar bush management practices, and the extent to which these practices are consistent with prescribed biodiversity conservation practices for private woodlot managers. These objectives meant that systematic qualitative data collection techniques, through direct interaction with sugar bush owner-operators, would be my primary empirical method (Palys 1992). The collected data would then be analyzed and compared against the EOMF's established biodiversity management standards specific to the forest ecosystems of the study region. Prior to collecting this information, I wished to familiarize myself with sugar bush dynamics, get a general idea of biodiversity on sugar bushes, and learn biodiversity indicator survey methods.

I started with some background research to identify what kinds of biodiversity conservation guidelines are available to private woodlot owners. I discovered that the EOMF had published a set of guidelines that are specific to most of my study area as well as a list of biodiversity indicators and a manual for measuring them. As a preliminary step, I conducted some simple field surveys of three EOMF biodiversity indicators on three of the larger sugar bushes in my study area. I found that the EOMF's indicators and monitoring methods were relatively easy to learn and appropriate for sugar bushes. A detailed description of the specific measurement techniques and the results from using them can be found in Appendix A.

Once I was sufficiently familiar with biodiversity monitoring techniques such as those encouraged by EOMF and had familiarized myself with maple sugar bush dynamics, I began to collect data from sugar bush owners concerning their woodlot management practices. Palys (1992) outlines several ways for gathering data using contact and response methods. Since I wished to develop a convivial rapport with sugar bush owners and learn from them their forest management practices and their attitudes toward biodiversity, I used a direct contact and response method. The type of information that I required did not lend itself to the simplified, easily structured questions of a questionnaire and since I hoped to enter into a dialogue with sugar bush owners, I opted to conduct interviews. I used a semi-standardized structure for my interviews. I had a set of questions that I asked at each interview, but since some sugar bush owners had thoughts on biodiversity or woodlot management that were not incorporated in my questions, I adapted the interview to allow myself to learn as much as possible from each sugar bush owner.

I derived my interview questions from the EOMF's Information Report No 60.c, *Biodiversity on Your Eastern Ontario Woodlot*. This report outlines the importance of maintaining biodiversity on private woodlots in Eastern Ontario and provides woodlot management guidelines for doing so. Since the EOMF guidelines are applicable to more than one forest use and mainly geared toward timber extraction, I reviewed the interviews with a biodiversity specialist who is familiar with sugar bush operations to ensure that they were appropriate and applicable to my research. Once I had done this and refined my interview questions accordingly, I interviewed twenty-two sugar bush operators in my study area.

I used the advice of Palys (1992) and Berg (2001) as well as the advice of an EOMF biodiversity specialist on how to word, order, and communicate my interview questions, how to develop rapport with interviewees, and how to make the interview flow smoothly. The interview guide I used is given in Appendix B. The next step was to introduce myself and become acquainted with sugar bush operators in the study area. I sought introductions from the operators I already knew and used the Ontario Maple Syrup Producers Association's (OMSPA) website to find others. I also gained contact information snowball-style from the sugar bush owners that I found through the OMSPA. As well as this, I took note of any signs for sugar bushes that I saw as I drove around the region doing my interviews.

At the beginning of each interview, I explained the purpose of my research to the sugar bush owner(s), allowed them to ask questions, guaranteed their anonymity, and assured them that

all of my findings would be available to them. I took notes throughout the interviews, and entered them into an excel spreadsheet soon afterward.

1.4 Data Analysis

I entered all of the information from the interviews into one master spreadsheet first, and then categorized it into separate spreadsheets to make it more manageable. I made one spreadsheet for all of the background questions about sugar bush characteristics, one for all questions based on management principles, one for information about operators' values and opinions, one organizing the information about the important habitats found on each sugar bush, and another one for all of the leftover information.

The background questions about sugar bush characteristics lent themselves to straightforward analysis. I determined the range in size of operations by number of taps and by number of hectares, the number of operations open to tourism, the number of family operations, and how long each operation had been owned by the same family.

The majority of the interview questions were about management practices and were all based on the EOMF management principles for conserving biodiversity. I assessed the range of management practices surrounding each biodiversity principle, and determined how many operators employed each management practice. I assessed the similarities and differences between the practices reported by operators and those recommended by the EOMF.

The information about important habitats was simply counted to determine how many operators had each type of habitat. Values and opinions were grouped into emergent themes, for example those who encourage vs. those who discourage wildlife, those who manage for

long term sustainability vs. those who manage for short term gain, so that I could see general patterns. Any additional information provided by operators was used to help provide context for their other answers. I compared the conclusions drawn from analyzing the interviews with the goals and actions outlined in Ontario's biodiversity strategy and rural plan to assess whether sugar bush operators might be able to participate in achieving them.

The findings from my own surveys of EOMF biodiversity indicators on three sugar bushes served as a type of triangulation that guided me in my interpretations of the data, and enabled me to gauge with some confidence any relationships between sugar bush practices and biodiversity that emerged from the data, regardless of whether or not the biodiversity outcomes were an intentional part of the sugar bush owner's management plan.

1.5 Challenges and Limitations

My positionality may have affected the outcomes of my research. Since I am not from a rural background, and have limited familiarity with sugar bushes, biodiversity measuring/monitoring and woodlot management, I approached this research topic with relatively little experience. To address this challenge I gained knowledge in these areas through literature review, speaking with sugar bush owners and visiting their properties, and monitoring biodiversity indicators on three properties. Although my initial lack of experience with my research area and topic may have been a limitation, it allowed me to assess the influence of sugar bushes on biodiversity with fewer preconceived notions.

The results of my research are specific in their particular details to sugar bush operators in three counties in Eastern Ontario. Sugar bush operators in other regions of Ontario and in

other provinces and states may employ management practices or hold attitudes toward biodiversity conservation that are different from those in my study area. The scale of sugar bush operations in Ontario is relatively small compared with large commercial operations in Quebec, although comparable with those in Canada's other syrup-producing provinces and the US. Because of this, I may not be able to generalize all my results outside of Eastern Ontario, but this still leaves me with a large geographical area across which the findings will be relevant.

As well, neither the bioindicator studies completed nor the interviews were comprehensive. For the indicator surveys, only those indicators that were easily measured were chosen, and these only represented certain aspects of woodlot biodiversity. Other indicator species exist that indicate other aspects of biodiversity. The interviews only addressed a specific selection the EOMF's management principles for biodiversity conservation that were determined to be most relevant to sugar bush operators. The EOMF has other management principles (including those for near waterbodies and watercourses) which might be applicable to some sugar bush operators.

Chapter 2

Maple sugar bush management and forest biodiversity conservation in Eastern Ontario, Canada

By Kristin Clark and Dr. Robert McLeman

Abstract

As in many parts of the world, rural and forest-dependent communities in Ontario are struggling with a variety of economic and demographic challenges. Ontario government ministries are seeking to enhance rural sustainable development while at the same time maintaining forest habitat and preventing forest biodiversity decline. Commercial maple sugar bushes, which in Eastern Ontario are typically family owned and operated, have the potential to play an important role in biodiversity conservation and habitat protection, while at the same time contributing to sustainable development. Existing research has shown the social and economic benefits of small scale maple sugar bushes, but room remains for greater study of the environmental impacts, particularly in terms of forest biodiversity. In this study, woodlot management practices on twenty-two sugar bushes in Eastern Ontario were compared against established forest biodiversity conservation guidelines, using information obtained through detailed interviews with operators. Sugar bush operators reported the presence of many important habitats on their properties. The interview results show that many standard sugar bush management practices are consistent with biodiversity conservation principles. Operators were found to be receptive to biodiversity conservation ideals, and could enhance their contribution to the provincial government's official biodiversity strategy with additional guidance, incentives, and formal planning. The findings suggest that through sound management and planning, small scale commercial sugar bush operations generally can be made environmentally sustainable, and become important components in broader rural development strategies.

Keywords: Sugar bush – Maple syrup – Biodiversity conservation – Woodlot management – Eastern Ontario

1.0 Introduction

In recent decades, social and economic well-being in Canada's rural and forest-dependent communities has been declining, necessitating greater attention to rural sustainable development (Smit & Brklacich 1989; Troughton 1995; Bryant and Joseph 2001; Nelson 2003). In Ontario, Canada's most populous province, the share of the population living in rural areas has been falling steadily, now to only fifteen percent (Statistics Canada, 2009). Ongoing challenges faced by Ontario's remaining rural population include shortfalls in financial and human capital, declining profitability of agriculture and resource-extraction activities, and decreasing competitiveness due to rising energy costs and currency exchange rates (ORRSC 2007). Many of these stresses are similar to those in other rural areas as well. Under the 2004 *Ontario Rural Plan* the provincial government has sought to strengthen rural communities through economic, social and environmentally sustainable development (OMMAH 2004). With respect to environmental sustainability, an important component is the maintenance of biodiversity, with habitat loss and unsustainable land use having been identified as key threats in Ontario (OMNR 2005).

A commitment to rural sustainable development is especially needed in Eastern Ontario,[1] where small-scale forestry and agriculture are important components of the rural economy, and where many rural communities are struggling and in need of economic and livelihood diversification (OMAFRA 2010a; McLeman 2010; Sander-Regier et al. 2010; Eastern Ontario CFDC Network Inc 2007; OMMAH 2004). Over three-quarters of the land in the

[1] For the purposes of this study, "Eastern Ontario" includes the counties of Lanark, Leeds & Grenville, Ottawa, Prescott & Russell, and Stormont, Dundas & Glengarry

region is privately owned, and 35% of this land is forested (Bland et al. 2006), meaning that private woodlot owners have a significant influence on forest biodiversity through their management and land-use practices. Maple syrup is one forest product that is made in many private woodlots in Eastern Ontario, and for which there remains strong domestic and export markets (Chapeskie 2009). A review conducted by Whitney and Upmeyer (2004) of the limited scholarly research presently available suggested maple syrup production could potentially meet the social and economic tenets of sustainable development. However, the environmental sustainability of maple syrup production, especially its impacts on the conservation and maintenance of forest biodiversity, has yet to be fully studied.

Maple syrup has long been a Canadian icon, and holds considerable cultural significance for Canadians. When Europeans arrived in North America, Native Americans were already tapping trees and producing maple sugar – the first sugar produced in North America (Chapeskie 2009). From these origins it has become a longstanding practice for many eastern Canadian farmers to tap and collect sap from their woodlots. Canada produces about 80 percent of the world's maple syrup, with Ontario contributing approximately 4% of Canadian production (Agriculture and Agri-Food Canada 2007). In terms of quantity, the bulk of syrup sold on national and international markets comes from a relatively small number of extensive commercial operations in Quebec. The vast majority of Canadian producers remain family-run operations, producing small quantities of syrup for personal use or local sale. There are approximately 2,600 maple syrup producers in Ontario, whose industry contributed an estimated $11.2 million to the province's economy in 2009 (Leuty 2009). In Eastern Ontario, Lanark County bills itself as the "Maple Syrup Capital of Ontario" on the basis of its 93 producers and 110,000 taps (EOMF 2006).

Although the popularly held image of a maple sugar bush is that of trees bearing metal sap collection buckets, the method developed by early Canadian settlers of European origin, most commercial maple syrup producers today use a pipeline system of plastic tubing to collect sap (Image 1). Each spring, spiles inserted into sugar maples (*Acer saccharum*) are connected to passing tubes, and sap is channeled by gravity or with the aid of vacuum pumps to the collection building where it is reduced to syrup through a combination of reverse osmosis and heating. Collection of sap begins when daytime temperatures rise above zero-degrees Celsius but drop back below freezing overnight, and continues for a few weeks until warming temperatures cause the sap to become stronger and less palatable.

The impacts of present-day collection systems and of broader sugar bush management practices on forest biodiversity are not well known. Since the pipeline collection system itself is relatively un-intrusive once installed, the main determinant of the relationship between forest biodiversity and commercial maple sugaring in a given forest parcel is the management practices of the operator. Concerns have been raised that some commercial producers who manage their forests with the aim of creating maple monocultures may be having effects on biodiversity, such as causing understory species richness to decline (Leniere and Houle 2006). The broad objective of the research presented here was to gain an understanding of the relationship between sugar bush management and forest biodiversity in Eastern Ontario. In particular, it aimed to generate empirical information regarding the management practices of maple sugar bush operators in the study region and to compare these with established management principles for forest biodiversity conservation that have specifically designed for use in this region. In doing so, the project sought to generate suggestions for woodlot operators and government policymakers alike about future

opportunities for research and management decision-making. It was further intended that the study establish a simple baseline of methods and empirical findings that might be developed and modified for application in other maple producing regions. A basic operating assumption is that, if sugaring operations can be managed so that the biodiversity impacts are minimal or benign, maple syrup production could offer an opportunity for enhancing rural sustainable development in all its tenets, economic, social and environmental.

While there is very little literature on sugar bush operators and biodiversity, researchers have studied other private landowners and their attitudes and practices concerning conservation. For example, in an Indiana case study, Raymond & Olive (2008) suggested that when private landowners' beliefs and values about conservation and private property rights are understood, there is an opportunity to collaborate with them to conserve species. Fischer and Bliss (2009) found that conservation easements, habitat mitigation banking, and voluntary grass-roots initiatives appealed to both family forest owners and natural resource professionals wanting to conserve oak woodlands and savannah in Oregon. Fischer and Bliss (2006) also identified the types of policy initiatives that would encourage landowners who want to steward biodiversity but are influenced by economic and social factors that motivate them to do otherwise. Research has shown that adoption of ecosystem-based management practices among private forest owners is most likely to happen if landowners are well-informed and educated and if they self-govern the management program (Creighton et al 2002).

The empirical study was carried out in the winter of 2010-2011, and involved 14 working sugar bushes in Lanark County, 6 in neighbouring Leeds & Grenville County, and 2 in

Frontenac County (Figure 1). The county with the most sugar bush operators and most representation in this study, Lanark County, has a population of approximately 64,000, and is approximately 3,000 square kilometres in size (Statistics Canada 2006). The northern two-thirds of Lanark County is situated on Precambrian shield, while the southern third of the county lies on a limestone plain. Fifty-seven percent of Lanark County (183,575 hectares) is forest cover, and 90% of this forested area is privately owned (Sentesy 2008). Sugar maple is a dominant tree species across the study area.

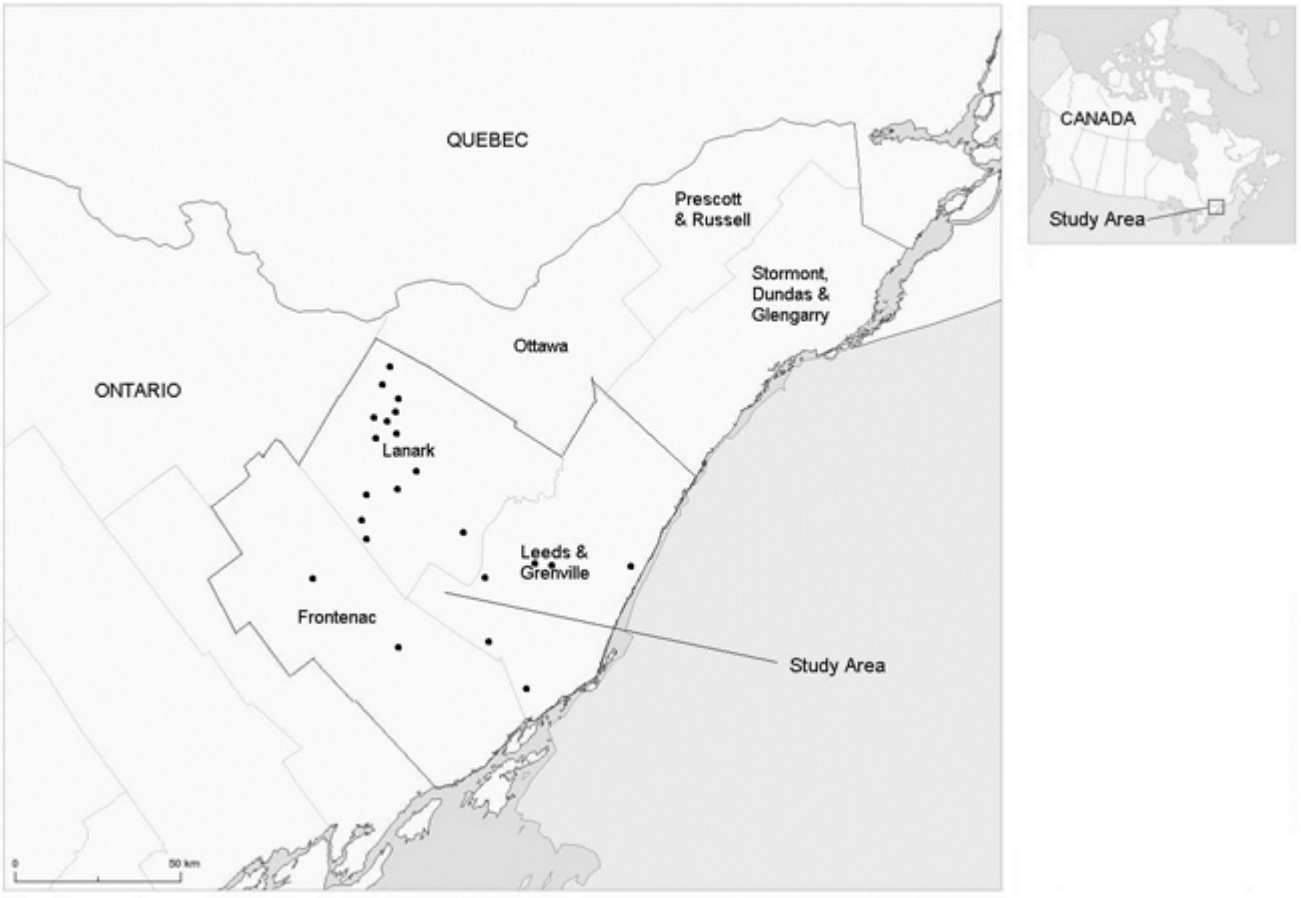

Fig 1 Map of study area with participating sugar bush locations identified

The wildlife in Lanark and vicinity has changed over time in response to human settlement in the area. Generally, wildlife habitat has become fragmented over the past two centuries through the conversion of forests to agricultural land and the development of towns and roadways. The loss of large tracts of forest interior has caused species that rely on this habitat (such as grey wolf (*Canis lupus*), eastern cougar (*Puma concolor couguar*), and wolverine (*Gulo gulo*)) to retreat northward, while those species that prefer edge and open habitats (such as white-tailed deer (*Odocoileus virginianus*) and red fox (*Vulpes vulpes*)) have increased in number (Sentesy 2008).

Sugar bush operations in the study area range in size from under 20 taps to over 20,000 taps. The average number of taps in a Lanark sugar bush is slightly under 1,200 (EOMF 2006). The smallest operators produce syrup for family use and to share with friends, while the larger operators produce syrup for farm gate, retail and bulk sales. The land area occupied by sugar bushes varies from operations that are a few hectares to ones that encompass several hundred hectares. Some sugar bushes are open to the public, and encourage tourism with pancake houses, nature trails, and/or guided tours. Many producers are members of the Ontario Maple Syrup Producers Association (OMSPA), which promotes among producers quality standards, good management practices, and effective marketing, while encouraging research and development and raising awareness about maple products among the public (OMSPA 2010).

2.0 Methods

The key aim of this project was to identify the woodlot management practices of a range of maple sugar bush operators and assess the extent to which these are consistent with forest

Box 1: Woodlot Management Principles for Conserving Biodiversity (Adapted from Bland et al 2006)

General Management Principles

Create a management plan for your woodlot

Monitor biodiversity on your property

Maintain a contiguous forest of at least 40 hectares to provide adequate habitat

Work with neighbouring landowners to reconnect fragmented habitats and to improve edge habitats between properties

Maintain a diversity of habitats

Work with contractors who understand the importance of protecting wildlife

Consult professional foresters or wildlife biologists to ensure that critical habitats for wildlife are maintained

Avoid handling or touching wildlife, eggs, or nests

Protect animal movement corridors

Specific Management Principles

Remove or narrow trails and roadsides that fragment wildlife habitat by planting them to trees or shrubs. Roads should occupy no more than 2% of the stand

Avoid vehicle use in the woodlot when the ground is wet and restrict ATVs and snowmobiles from sensitive areas

Keep livestock out of woodlands to reduce disturbance, retain understory vegetation and vertical complexity, protect wildlife, and avoid soil compaction

Protect habitats of rare species

Remove alien invasive plant species

Retain individuals of all tree species

Retain at least 10 conifers per hectare

For stands that have been degraded in the past, plant native species of trees and shrubs that are appropriate for site conditions

Leave brush piles as habitat for small animals

Retain rotting stumps, logs, downed trees and limbs to provide cover, escape, nesting, and feeding habitat for snakes, salamanders, toads, small mammals, and birds

Create habitat for herpetiles by putting out boards over wet leaves and letting them rot

biodiversity conservation guidelines for the region. A number of organizations provide forest management information for private forest owners in the study area, including the Eastern Ontario Model Forest (EOMF), the local land stewardship councils, the Ontario Woodlot Association (OWA), the Ontario Forestry Association (OFA), and the Forest Stewardship Council of Canada (FSC). Of these, The EOMF has developed the most detailed set of forest biodiversity conservation guidelines specific to this region (Box 1, left). EOMF also provides woodlot owners with lists of biodiversity indicators and instructions for monitoring them (Hamill 2001, 2002). We chose the EOMF guidelines as a basis for constructing the research framework for this project, after first conducting a small preliminary field trial on three sugar bushes and verifying that the habitat characteristics of sugar bushes are consistent with those identified by EOMF as being significant for regional biodiversity, such as providing adequate forest interior and closed canopy, healthy undergrowth, and clean, adequately sized wet areas.

To collect a broad sample of sugar bush management data, interviews were conducted with twenty-two sugar bush operators in the region. With the assistance of an EOMF biodiversity specialist, an interview guide was developed that prioritized

specific management principles to be focused on during interviews. Potential interviewees were identified through the Ontario Maple Syrup Producers Association's website, and through referrals from other sugar bush operators. Interviews were semi-structured and used a pre-designed interview guide to obtain information about the sugar bushes' physical characteristics, their history, the management practices used by the sugar bush operators, and the operators' broader attitudes with respect to biodiversity conservation generally. At the end of the interviews, interviewees were asked for any additional thoughts they had on the subject of biodiversity and sugar bush management.

Qualitative and quantitative information gathered from interviews was entered into a specially designed spreadsheet and organized according to the type of information gathered, such as sugar bush characteristics (e.g. area, number of taps), nature of management plan (e.g. formal using guidelines from external organization, formal self-developed, informal, none), and so forth. The organization of the data in this way, which is a technique often used in grounded theory research (Bringer et al 2004, Charmaz 2004), allowed for the easy recognition of patterns and comparison with EOMF published guidelines. The results of the data collection and interpretation now follow.

3.0 Results

3.1 Characteristics of sugar bushes and habitats

Twenty-one of the twenty-two sugar bushes ranged in size from 600 to 7,000 taps; one large operation operated 20,000 taps. The area of forest being tapped varied from 4 hectares to 150 hectares. Most operators had additional forested property that was not being tapped.

Most of the smaller sugar bushes provided only a part of the owner's livelihood activities. Ten were incorporated as part of a family farm, while in two cases they were linked to a campground business. Syrup production alone is typically not the sole source of income for operators; many hold a full time job elsewhere, or were retired. Six operators also reported that they sell timber that is logged from their properties. Five of those interviewed operated pancake houses as part of a diversified, maple product-based agro-tourism business.

Eighteen of the twenty-two operators self-described their sugar bushes as family operations. The rest were run independently or with business partners who were not family members. Five of the family-operated sugar bushes had been in the same family for more than 100 years. In the past, these sugar bushes were tapped to a much lesser extent than they are now. All of the operators who considered their sugar bush to be a family operation hoped to pass the business on in the family if there was interest, and this often meant that they managed their bush with long term goals in mind.

All of the interviewees were members of the Ontario Maple Syrup Producers Association. Other woodlot or landowner organizations to which participants belonged included the EOMF (n=6), the OWA (n=6), the local land stewardship council (n=4), the United Canada Wood Co-op (n=1), and the Ontario Forestry Association (n=1). Two interviewees operated FSC-certified woodlots.

Operators were questioned about their attitude toward wildlife in their sugar bush. As long as it did not create a nuisance for their maple syrup operation, thirteen operators stated that they encouraged wildlife and the remainder answered that they ignored wildlife. Specific "nuisance" animals mentioned included porcupines (*Erethizon dorsatum*), squirrels (*Sciurus*

sp.), black bears (*Urus americanus*), deer (*Odocoileus virginianus*), and raccoons (*Procyon lotor*). These animals caused damage by chewing on the plastic tubing that carries the sap or chewing on the maples themselves. Eleven operators also mentioned that beavers (*Castor canadensis*) can harm the bush by cutting down or flooding maples. Thirteen operators shot or trapped at least one of these species to reduce damage.

Seven operators expressed a genuine interest in fostering high levels of biodiversity in their bush, and actively worked to maintain habitats and encourage wildlife. They stated they enjoyed having a forested property where they and their visitors could see wildlife. At least six were hunters who encouraged game animals by keeping conifer groves for deer, putting out food for wild turkeys (*Meleagris gallopavo*), building brush piles, and leaving cavity trees as habitat. Several operators expressed an interest in learning about wildlife management in the sugar bush. One operator said, "I know there's information [on wildlife management] out there and I could get it if I tried. I'm just so busy! It's something that I would be open to and that I am intrigued by."

Operators were asked to identify from an EOMF list of fifteen important wildlife habitats which ones they had on their property. The EOMF list includes the term "old growth forest." Fifteen producers had trees at least 80-100 years old on their property, but it was unclear whether these trees should be considered "old growth forest." Because of this ambiguity it was not possible to make a reliable interpretation of this data. Of the fourteen remaining important habitats identified by EOMF, every operator had at least seven on his/her property, and the average number of important habitats per sugar bush property was ten (Figure 2).

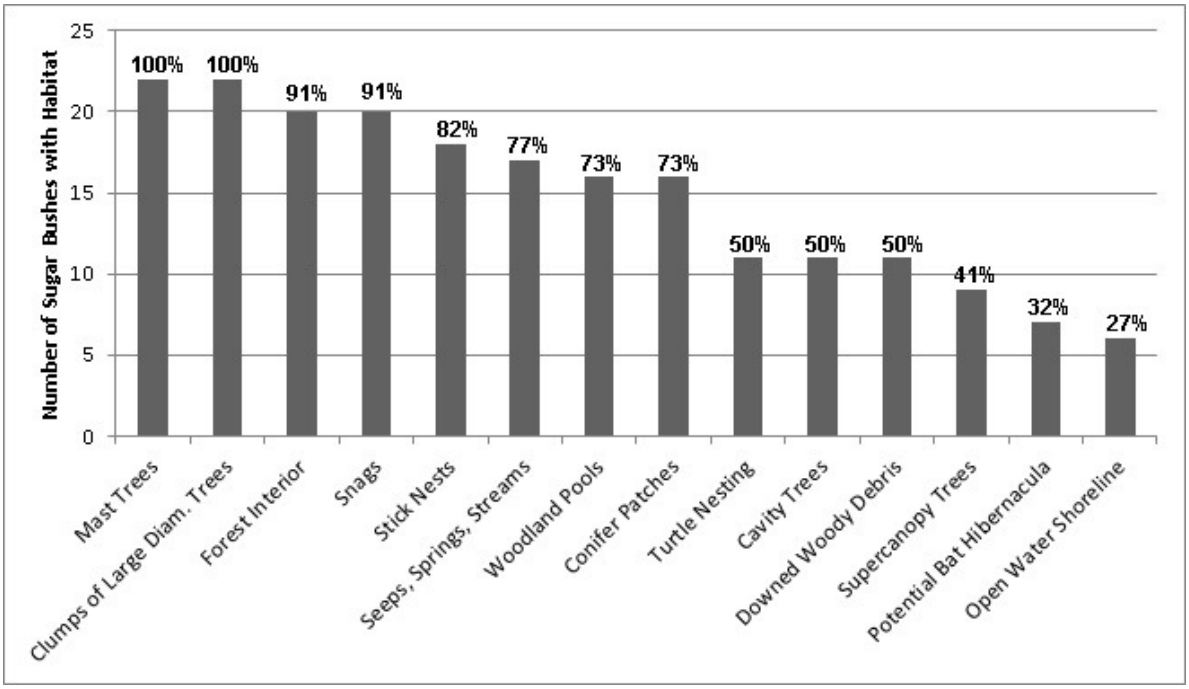

Fig 2 Important habitats on sugar bushes as reported by operators

3.2 General Management Principles Employed by Operators

Table 1 (below) summarizes the general management principles about which operators were interviewed and the results. As can be seen, the following general principles are being implemented in whole or in part by the majority of operators: following a management plan, monitoring biodiversity, maintaining a diversity of habitats, consulting with professional foresters or biologists, and avoiding unnecessary contact with wildlife.

Table 1: Operator adherence to general management principles for conserving biodiversity

EOMF Management Principle (adapted from Bland et al, 2006)	**Operators Following this Principle**	**Operators Partially Following this Principle**	**Operators Opposing this Principle**	**Operators Neither Following nor Opposing this Principle**
Create a management plan for your woodlot	**3 (14%)**	**19 (86%)**		
Monitor biodiversity on your property		**16 (73%)**		**6 (27%)**
Maintain a contiguous forest of at least 40 hectares to provide adequate habitat	**11 (50%)**			**11 (50%)**
Work with neighbouring landowners to reconnect fragmented habitats and to improve edge habitats between properties	**1 (5%)**	**8 (36%)**		**13 (59%)**
Maintain a diversity of habitats	**10 (45%)**			**12 (5 of these operators do not have a diversity of habitats) (55%)**
Work with contractors who understand the importance of protecting wildlife				**22 (100%)**
Consult professional foresters or wildlife biologists to ensure that critical habitats for wildlife are maintained	**4 (18%)**	**18 (82%)**		
Avoid handling or touching wildlife, eggs, or nests		**22 (100%)**		
Protect animal movement corridors				**22 (100%)**

For most interviewees, management planning was done on an informal basis. Only three had formal management plans, two of which were created as part of a tax incentive program.

The nineteen remaining operators had informal management plans. These were not written documents, but rather mentally guarded, easily stated management objectives for different sections of their woodlot. As an example of the types of response that were common, one operator said, “We have a management plan informally. There are two main things: crown development (for syrup production) and keeping a certain level of tree diversity (for the public to see and because of the dangers of a monoculture). We also thin in strips.” Fourteen operators claimed that wildlife conservation was something they considered as part of their planning, through such things as leaving cavity trees, mast trees, and building brush piles.

The types of information sugar bush operators could easily recall included the cover type that existed in each section of the property, the drainage directions in each section, past use of the woodlot in each section, and when and where they plan to actively manage their bush in the future. Their stated objectives included such things as promoting crown development in their maples, opening up new areas of the bush for tapping, and promoting the growth of healthy timber species. Four operators had an aerial photograph to help describe their property during the interview. One of the operators had a sketch of his property, separated into management blocks, with a prescription for each block. Another stated:

> Our management plan is informal. We leave cavity trees for wildlife. We let old trees die at their own pace, one branch at a time, so that by the time we cut them, it’s usually just the bole left. Thinning practices are included. We keep all of our customers and equipment on the trails; we use the 4-wheeler as much as possible rather than the tractor. We take out wood that’s of good value, and leave all the rotting stuff.

As with planning, monitoring of wildlife tends to be done informally rather than systematically. Sixteen operators mentioned noticing fluctuations in the populations of certain species such as deer, squirrels, porcupines, and fishers. The operators generally avoid

handling or touching wildlife, eggs, and nests unless an animal was doing significant damage to the sugar bush operation, or if the operator was a hunter. Figure 3 below shows the animals reported to do damage in sugar bushes, and the number of operators that shot or trapped them. When operators were asked if they had any animal movement corridors in their sugar bush, all operators mentioned having many deer trails throughout, which operators did not disturb.

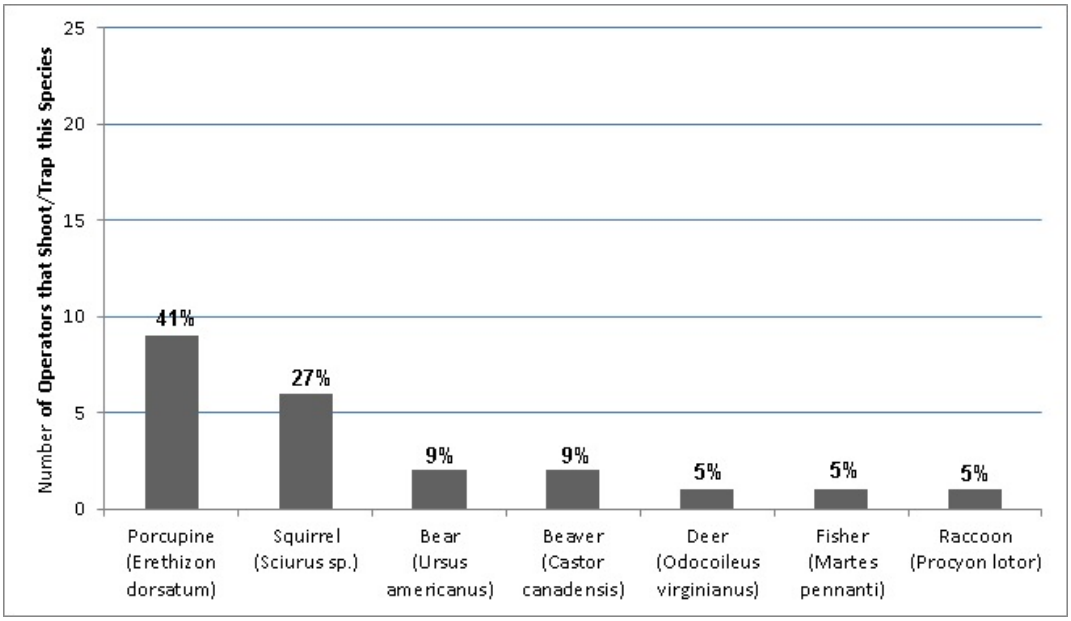

Fig 3 Nuisance animals shot or trapped on sugar bushes as reported by operators

As recommended by EOMF, all operators had consulted a professional forester at some point, although only four of them did this specifically for questions relating to wildlife or biodiversity. One of these operators had his understory plants identified. He stated that as a result of this, "Now I'm more aware of these plants and am careful not to run them over or harm them." Another had help creating a brochure for his nature trail. One operator was himself a fish and wildlife technician. Thirteen operators had their trees marked for thinning

by professional foresters, created their management plan with a forester, or spoke with a forester about specific problems such as insect outbreaks. Three operators mentioned that foresters had marked trees for timber extraction purposes, but they did not necessarily follow all the marker's instructions when doing so would conflict with the sugar bush operation.

The general principles of maintaining a contiguous forest of at least 40 hectares and maintaining a diversity of habitats are being followed by 45-50% of interviewees. Only half the operators had a sugar bush that was part of contiguous woodland of at least forty hectares. Ten of these operators owned the entire forty hectares or more, while the other operator's sugar bush connected to adjacent forested properties to make up the 40 hectares. Five operators reported having a relatively homogeneous hardwood forest on their property, while the others reported having a variety of other habitats such as swamps, marshes, wetlands, bramble areas, high rocky areas, conifer groves, gravel and sand pits, open water shoreline, and ponds. As an example, one operator described the diversity of habitats on his property when he stated, "The bush is swampy in some areas, but there's no tapping there. About 60% is low and wet. Other parts of the property are high and wet with white cedar, white pine, tamarack, and white birch." Ten operators stated they were pleased to have diverse habitats on their properties and were careful not to harm them, while the others were indifferent to having the diversity of habitats but took no actions to alter or remove them.

Only one general principle was not being followed by most interviewees, that being to work with neighbours to reconnect fragmented habitats and improve edge habitats. Those sugar

bushes that were part of a larger farm often had crops growing at the edges, or were fenced at the edges to prevent livestock from entering.

Although EOMF suggests woodlot owners hire contractors who understand the importance of protecting wildlife, all of the interviewees reported they generally did their own work, and tried to minimize damage to their trees.

3.3 Specific Management Principles Employed by Operators

Table 2 (below) summarizes the specific EOMF principles about which operators were questioned and the results. Of these, the majority of operators were implementing the following principles in whole or in part: keeping trails to a minimum, restricting vehicle use in wet or sensitive areas, retaining a variety of tree species (including a minimum of conifers), and leaving brush piles and downed trees for habitat. The actual execution of these practices varied considerably between sugar bushes.

Most operators had relatively little of their acreage in trails, but the density and width of trails varied from none at all to several large trails wide enough for a tractor. All but one operator reported using some sort of vehicle in his sugar bush, but most used these primarily in winter when the ground is frozen and/or in the sugaring season.

Table 2: Operator adherence to EOMF specific management principles for conserving biodiversity

EOMF Management Principle (adapted from Bland et al, 2006)	**Operators Following this Principle**	**Operators Partially Following this Principle**	**Operators Opposing this Principle**	**Operators Neither Following nor Opposing this Principle**
Remove or narrow trails and roadsides that fragment wildlife habitat by planting them to trees or shrubs. Roads should occupy no more than 2% of the stand	**1 (5%)**	**21 (95%)**		
Avoid vehicle use in the woodlot when the ground is wet and restrict ATVs and snowmobiles from sensitive areas	**5 (23%)**	**17 (77%)**		
Keep livestock out of woodlands to reduce disturbance, retain understory vegetation and vertical complexity, protect wildlife, and avoid soil compaction	**8 (36%)**		**2 (9%)**	**12 operators do not have livestock (55%)**
Protect habitats of rare species		**2 (9%)**		**20 (91%)**
Remove alien invasive plant species		**5 (23%)**	**2 (9%)**	**15 (68%)**
Retain individuals of all tree species	**7 (32%)**	**13 (59%)**	**2 (9%)**	
Retain at least 10 conifers per hectare		**22 (100%)**		
For stands that have been degraded in the past, plant native species of trees and shrubs that are appropriate for site conditions	**4 (18%)**			**18 (82%)**
Leave brush piles as habitat for small animals	**14 (64%)**		**8 (36%)**	
Retain rotting stumps, logs, downed trees and limbs to provide cover, escape, nesting, and feeding habitat for snakes, salamanders, toads, small mammals, and birds	**7 (32%)**	**14 (64%)**	**1 (5%)**	
Create habitat for herpetiles by putting out boards over wet leaves and letting them rot				**22 (100%)**

In terms of maintaining tree diversity, twenty sugar bushes supported tree species other than sugar maples, with at least thirty-one different species represented. Twelve operators actively supported a variety of tree species, the others simply accepted the mix of species for what it was. Two of the smaller operators, where sugaring is only part of a larger farm enterprise, had selectively cut to achieve maple monocultures, although they did maintain a buffer of conifers around the edges. When thinning trees, sugar bush operators gave preference to healthy sugar maples and took out other species for various reasons, including canopy thinning, firewood or lumber harvesting, or to reduce pests or disease. The following quotes illustrate the difference in practices among operators:

> I cut ironwood, cherry, basswood, and beech (unless they are really nice specimens). And I keep maple.
>
> I cut out everything but maples. I like to leave a wide area of empty space around the maples to let them grow. The only other species I leave are the pines as a wind buffer at the edge.
>
> I thin out the cedar, but try to leave a little bit of everything.

Most operators did not know how many conifers they had per hectare, but all of the operators reported having conifers in or near their sugar bush. For thirteen operators, conifers were simply left to inhabit areas not suitable for maples. Three operators purposely kept conifers as wind buffers, deer habitat, or to draw squirrels away from pipeline areas. Four operators cut conifers out of the working parts of the sugar bush to prevent shading young maples and their pipeline, and to eliminate squirrel habitat for squirrels.

Fourteen of the twenty-two operators created habitat by leaving brush piles when thinning their sugar bush. The other operators did not pile brush because this is time-consuming and because it rots faster when not piled. Seven operators left all downed woody debris in their

bush unless it posed a safety hazard. One operator took everything out to keep the bush clear and accessible. The rest of the operators took out some woody debris, usually what was good for firewood, and left everything else to rot.

Only ten of the twenty-two operators kept livestock. Eight of these kept their livestock fenced out of the sugar bush. Of the other two, one said that the cattle were not fenced out of the bush, but usually did not go in because they had better pasture elsewhere. The other operator planned to start keeping the cattle out of the bush because of the lack of regeneration from the cattle grazing the undergrowth.

Adherence to other specific EOMF management principles varied considerably from one operation to another. Species listed on Ontario's Species at Risk list (OMNR 2011) were reported by a number of operators. (Figure 4 below). Two operators protected the areas where American Ginseng (*Panax quinquefolius*) grows; one of these operators actively planted ginseng. Operators did not specifically protect the habitats of other rare species, although two had actively planted butternut trees (*Juglans cinerea*) to help re-establish this species.

Many of the sugar bushes also hosted invasive species (Figure 5 below), which the EOMF encourages operators to eradicate. Four operators cut buckthorn; the other invasive plants were typically left alone. One operator mentioned a failed attempt to get rid of dog-strangling vine. Nine operators actively remove prickly ash (*Xanthoxylum americanum*), but this weed species is native to Ontario.

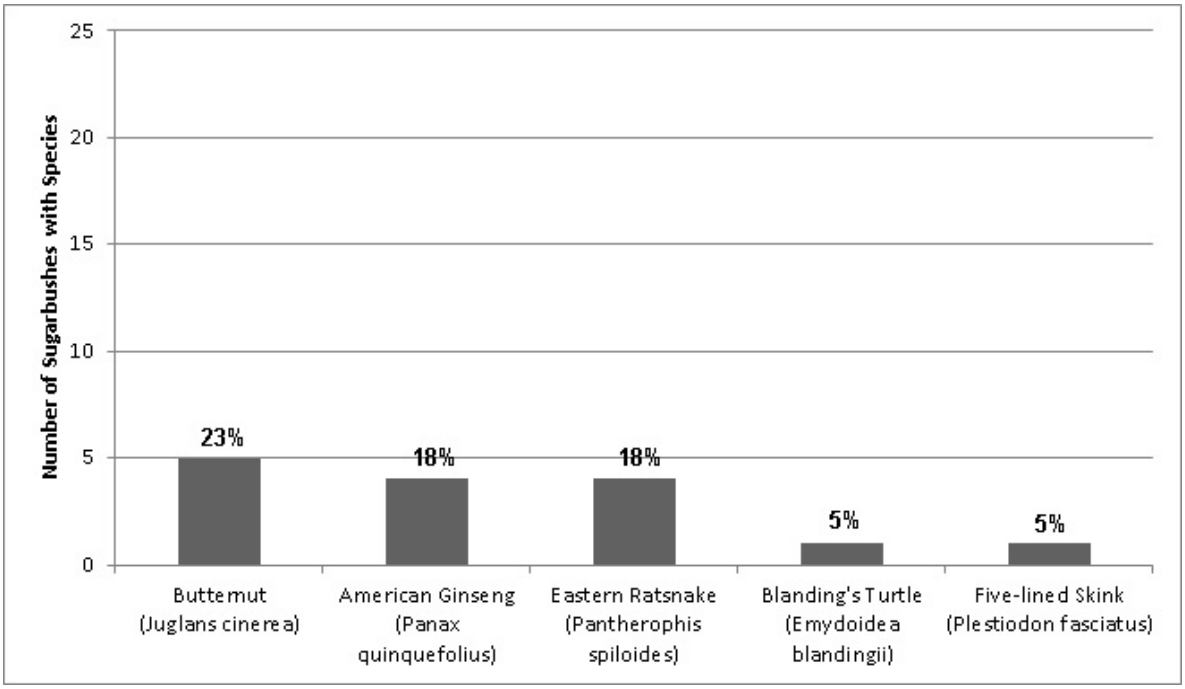

Fig 4 Rare species on sugar bushes as reported by operators

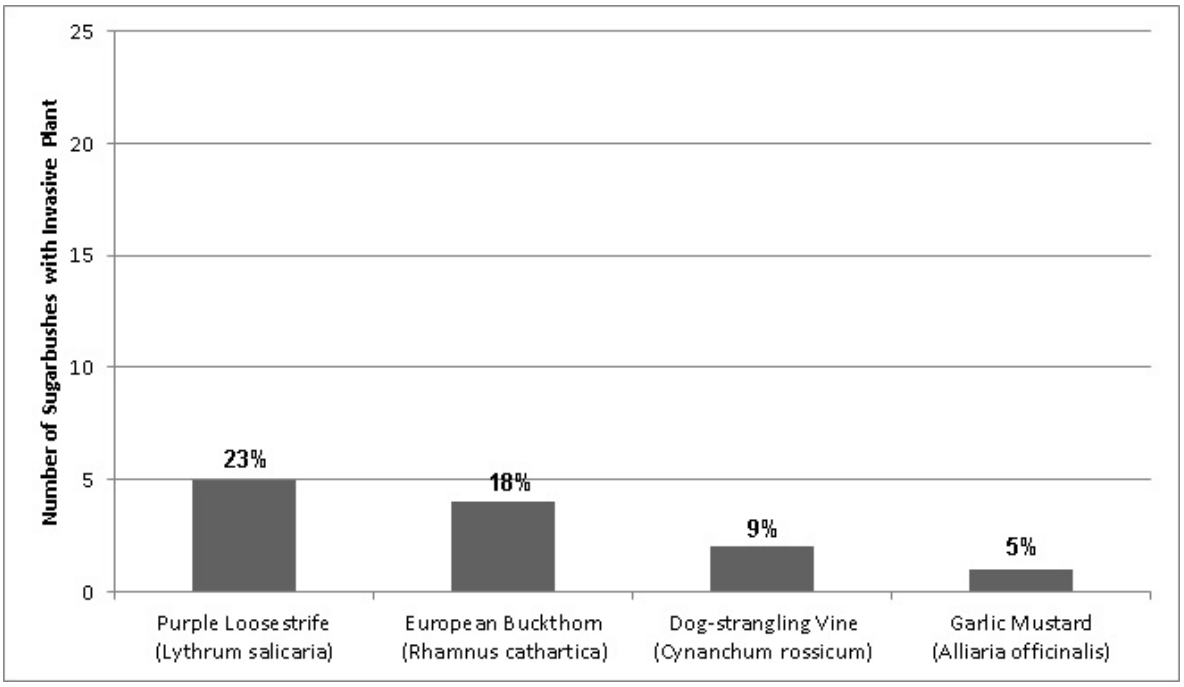

Fig 5 Invasive plants on sugar bushes as reported by operators

All operators mentioned woodlots having been damaged by a severe ice storm in 1998, with some mentioning past damage from livestock grazing in the bush (n=6), droughts (n=2), windstorms (n=2), and gypsy moth (*Lymantria dispar*) (n=1). While EOMF encourages active replanting of native species, operators noted that sugar maples regenerate naturally quite successfully. Four operators helped the process along by planting new maples; other operators planted species other than maples. Two planted butternuts in partnership with programs to help re-establish this endangered tree species. One operator planted walnuts. Three operators planted conifers; one planted mainly white spruce and another planted a few hundred red and white pines, jack pines, and white spruce on his property because they had been cut out in the past and were not regenerating naturally.

As well as questions relating directly to management principles, operators were also asked for any other thoughts they had on the subject of biodiversity and sugar bush management. Operators mentioned both positive and negative influences of sugar bush management on biodiversity. Positive influences included the maintenance of contiguous forest habitat that might be lost through other land uses, increased benefits for species that rely on maples, protection of hardwoods that are being heavily cut in other areas, and the creation of food sources and cover habitat that result from thinning practices. Negative influences reported by operators included disturbance of wildlife by human presence in the bush, removal of den trees and nut trees to discourage nuisance animals, aggressive promotion of maples that results in monoculture, loss of species richness due to the promotion of maples and loss of other tree species, and the restricted movement of larger mammals due to pipelines.

4.0 Discussion and recommendations

Through this comparison of sugar bush operators' management practices with established best practices for woodlot management for forest biodiversity conservation, a number of insights emerge that are relevant to gauging the environmental sustainability of Eastern Ontario's maple syrup industry. The results indicate that it is indeed possible to manage a sugar bush in ways that conserve biodiversity, and many sugar bush operators are already doing this in many respects, even in the absence of formal biodiversity management plans. This suggests there are a number of opportunities for enhancing sugar bush operators' roles as biodiversity stewards, and for strengthening their potential to contribute to rural sustainable development.

Of twenty general and specific management principles, thirteen were being followed or partially followed by the majority of operators to whom they apply. Operators do so for a variety of motives. Some principles are followed because they are inherently beneficial to the sugar bush operation and they make good business sense. For example, sugar bush operators keep livestock out of their sugar bushes to avoid soil compaction, which makes it harder for trees to grow, and to prevent young maples from being grazed. For similar reasons, human movement through the bush is minimized. Operators build brush piles because it makes it easier to move through sections of the bush where they need periodic access. While these practices happen to be good for biodiversity, they are undertaken primarily because they make good business sense.

Other biodiversity principles are respected simply because the operator would have to do something deliberate to "break" the principle, and there is no logical reason to do so. For example, many operations have a naturally occurring diversity of habitats. There is no logical reason for the sugar bush operator to actively fragment the forest or destroy habitats; these are inherent properties of a successful land use system. Similarly, by keeping disturbance and fragmentation to a minimum, operators ignore or passively observe wildlife in their bush, and so comply with principles that warn against touching or handling wildlife, eggs, or nests. They would have to go out of their way to violate this principle, and there is little reason for them to do so beyond dealing with nuisance animals. None of the nuisance animals mentioned by operators are scarce in the study region or appear on protected species lists.

Operators could be encouraged to apply more thoroughly some of the principles which they are currently only partially following. Although nineteen of twenty-two operators do not have a formal management plan for their woodlot, their informal management plans intuitively include many of the biodiversity management principles recommended by the EOMF. The particular mix of principles employed varies from one operation to the next, but interestingly, only five of the management principles are actively opposed, and these only by a relatively small number of operators. This implies that in Eastern Ontario there is not a strong opposition to managing for biodiversity, and it may therefore be possible to motivate operators to adopt the full suite of principles, or close to it. This suggests it may be worthwhile considering initiatives to encourage, assist, and train sugar bush operators in developing formal management plans which would help them manage for biodiversity. Doing so would entail familiarizing operators with biodiversity conservation principles,

assisting them in identifying important biodiversity features on their properties, and providing tools and incentives for creating and maintaining such plans. Professional foresters already employed by the Ministry of Natural Resources could aid sugar bush operators in creating management plans for their woodlots.

The need for incentives seems particularly important. Of the three operators that have a formal, written management plan for their sugar bush, two did so because of tax incentives under the Ontario Ministry of Natural Resources (OMNR) Managed Forest Tax Incentive Program (MFTIP), which reduces their property taxes by 75% if they have an approved management plan. However, MFTIP provides little motivation for most sugar bush operators to create management plans for their woodlots because of competing benefits under the provincial tax code. The nineteen operators without formal plans do not participate in the MFTIP program because their operations fall into the Farm Property Tax Class, where property taxes are already reduced by 75%. To fall into this tax class, the property must be classified as farmland and generate at least $7,000 annually (OMAFRA, 2010b). Since most of the sugar bushes in this study meet these requirements, or are part of a larger farm property that meets these requirements, the producers avoid the bother of creating a management plan for their woodlot by going with the farm property tax break instead of MFTIP. Operators who already receive a tax break might be motivated to create a management plan with a fee-for-service incentive. In a fee-for-service scenario, operators with a formally managed woodlot could receive payments for maintaining environmental services from which many other people reap benefits. This kind of incentive has been successful with farmers and ranchers participating in the Alternative Land Use Services program in other regions of Ontario (Norfolk ALUS 2010).

In the case of management principles where adherence is mixed, we observed no obvious patterns in terms of the size or type of sugar bush; rather, these seemed to depend on the concerns and priorities of the individual operators. In such cases, education and outreach might increase their adoption of particular principles. For instance, if operators do not know the ecological reasons and methods for protecting habitats of rare species or improving edge habitats, they are unlikely to take the time and effort to do so.

One area where nearly all operators could improve is in systematically monitoring the biodiversity on their sugar bushes. Without standardized and systematic monitoring, it is difficult to gauge changes in biodiversity over time, or assess the progress and success of operators in maintaining or improving biodiversity (Bland et al. 2006). Some EOMF monitoring procedures require time, skills, and/or additional effort to implement, which may be a barrier to their uptake. One operator suggested that a simple one-page tally sheet that is easy and clear to use for observations in the bush would be a good idea. Many of the operators who participated in this study were generally interested in supporting biodiversity in their sugar bushes and would likely take advantage of programs that make active monitoring worthwhile. Operators who ran a large farm tended to be less interested in managing for biodiversity, but there were exceptions to this. The information produced from biodiversity monitoring might also be used to educate and attract wildlife enthusiasts to those sugar bushes that are open to the public.

Of the five EOMF management principles where we encountered a small percentage of operators acting directly opposite, we again see room for outreach. For example, one operator who currently allows livestock in his bush recognizes the importance of keeping

them out, and plans to start doing so. This demonstrates that once the underlying basis for a principle is recognized by an operator, they may adopt it. One operator illustrated this idea when he said, "It would be good to find out what works for sugar bushes and wildlife, and promote it. Sell it in publications: What's in it for us? Why should people build things for wildlife?"

From our results, we suggest a number of general findings may apply more broadly to other sugar producing areas. First, managing for biodiversity conservation needs to be considered within the context of, and not separate from, the syrup production process as a whole. Operators have a variety of land management responsibilities, and for many of them, the sugar bush is only one part of their larger livelihood activities. Biodiversity conservation activities that divert their labour or resources from other parts of their livelihood system are not likely to receive great buy-in unless operators are required or incented to do so. Research elsewhere suggests that incentives are more effective than restrictions and regulations in getting private landowners to conserve biodiversity on their properties (Vanclay 2007), a sentiment mirrored in our study. One operator suggested that "a good idea would be government programs that reward good behavior like having high tree diversity. Right now there is no incentive to do anything like that – it makes no difference if you have all maples, or high diversity." When asked about formal monitoring, some operators expressed concern that government officials might find species at risk on their properties and consequently impose restrictions on their operations. Such concerns are not unique to sugar bush operators, but are reflective of a larger, growing trend in rural Ontario of suspicion and resentment of government land use regulations that are perceived as becoming onerous (OLA 2010).

Engaging private landowners in habitat protection is an explicit aim of Ontario's Biodiversity Strategy (OMNR 2005), as it is in many other jurisdictions (Government of Saskatchewan N.d., Nova Scotia Department of Natural Resources 2011). This study suggests sugar bush operators could make receptive and effective partners. However, it is also clear from the study that operators could benefit from an increased awareness of the broad aims of such strategies. This might be done through producer organizations such as Ontario's Maple Syrup Producers Association (OMSPA).

The challenge, therefore, is to get into place the mechanisms necessary to transmit these established biodiversity conservation principles to individual operators and encourage their adoption in an era of reduced government resources. For example, one reason for the gap between knowledge and uptake may be the longer-term legacy of cutbacks to Ontario MNR-provided forestry services made during the 1990s. Operators mentioned that in the past, MNR had staff foresters landowners could consult. Operators would generally like to see such services reinstated, although ideally these services would include more foresters who are familiar with the particular dynamics of a sugar bush (we noted earlier that a number of operators had had mixed experience with the prescriptions of foresters lacking such knowledge). An alternative option to recreating government forester positions could be building greater capacity among existing organizations that promote stewardship on private woodlots (e.g. OWA, EOMF, FSC), to which many sugar bush operators already belong. Yet another opportunity is to borrow good ideas from other land use incentive programs, such as the Alternative Land Use Services (ALUS) program, a fee-for-service program that operates in parts of Alberta, Manitoba and Norfolk County, Ontario, to incent, train and

reward farmers and ranchers to restore native habitat on lands where it has been severely diminished (Norfolk ALUS 2010).

Much more research remains to be done on the questions explored in our study. All participants in our study are members of the Ontario Maple Syrup Producers Association who willingly volunteered to participate. We do not know the attitudes of operators who declined to participate, or who are not members of OMSPA, Lanark County happens to be one of the larger syrup producing regions in Ontario, but pales in scale with operations in Quebec. Whether our findings are replicable and relevant in smaller Ontario regions or in other jurisdictions with other land management regulations remains to be seen.

This study looked at the management practices employed by sugar bush operators and their potential influence on biodiversity in the sugar bush, and would benefit from complementary research that measures biodiversity on sugar bushes directly. The species and habitats found on sugar bushes could be directly compared with those found in unmanaged forests and in forests managed for other uses, an initiative that was beyond the scope of the present study. Doing so, and communicating the results through producer associations, could provide sugar bush operators a clearer idea of what important species and biodiversity features they could work to preserve. As well, further social science research would be useful to determine what kinds of programs, incentives and additional information might best encourage sugar bush operators to more actively conserve biodiversity on their properties and generate more rigorous management plans.

5.0 Conclusion

Maple syrup production is socially and economically sustainable, and it is widely believed that sales of maple products will continue to grow in the future (Whitney and Upmeyer 2004). In Eastern Ontario, as in many other maple syrup producing regions, sugar bushes are family operations that provide livelihoods and incomes in rural areas that are often struggling economically. Like governments elsewhere, the Ontario government is actively seeking sustainable ways to enhance the wellbeing of rural communities while at the same time promoting the protection of ecological goods and services, including biodiversity. This study suggests that, when practiced well, there is an inherent environmental sustainability in small scale sugar bush operations. Those who work in these enterprises are in many instances unconsciously practicing good biodiversity conservation principles as they go about their day-to-day operations. With relatively little investment, institutions could be working much more closely with sugar bush operators to enhance and expand the operators' stewardship of the forest. Consequently, we suggest that small scale maple sugar bushes can make an important contribution to rural sustainable development in Eastern Ontario, and likely in other maple producing regions as well. We recommend that they be the target of increased research and investment in the future.

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Chapter 3

3.1 Summary and Conclusions

3.1.1 Review of the research results

This project studied the woodlot management practices on 22 sugar bushes in Eastern Ontario with the overarching goal of assessing whether maple syrup production might contribute to the maintenance and conservation of forest biodiversity, and therefore be promoted as a form of rural sustainable development in this region. While previous research has helped in many ways to link the maple syrup industry with the economic and social pillars of sustainable development, research on the industry's influence on biodiversity – a key ecosystem service and element of environmental sustainability – has been noticeably lacking. Since there are many threats to biodiversity in Canada (Environment Canada 1995), an industry's influence on biodiversity is an important factor in determining whether the industry can be considered a form of sustainable development. Therefore, in this study I engaged Eastern Ontario sugar bush operators directly to find out whether they are managing their woodlots in ways that are consistent with established biodiversity conservation management principles specifically designed for the region. By doing so, I was able to develop further insights into sugar bush operations as a potential contributor to rural sustainable development, and make a new contribution to existing scholarly knowledge. The key findings can be summarized as follows.

- *Eastern Ontario's working sugar bushes are important habitats for forest biodiversity, including species at risk*

Of 14 habitats identified by EOMF as being critical, every sugar bush property in the study has at least seven, and the average property has ten. Operators generally do not actively maintain these habitats for biodiversity, but also do not work to alter or remove them. Operators reported five different species at risk on their properties. Others are also likely present since some of the operators noted that they are not familiar with all the species that are at risk and how to identify them. The presence of many important animal and plant species and habitats on the sugar bushes in this study indicates that the use of a woodlot for maple syrup production can be consistent with habitat diversity preservation.

- *Most operators follow no formal management plan but most operational practices are nonetheless consistent with EOMF's recommended forest biodiversity conservation practices*

The interview results show that only three out of the 22 sugar bush operators in the study have formal, written management plans for their woodlots, while the rest have informal, mental management plans. This is noteworthy. The EOMF regards having a formal management plan as the first step to conserving biodiversity and there is an OMNR incentive for woodlot owners to create one. Two of the formal management plans were developed as part of OMNR's Managed Forest Tax Incentive Program (MFTIP). For woodlot owners having an approved management plan for their woodlot, MFTIP reduces their property taxes by 75%. While this is a significant reduction in property taxes, few

operators participate in the program because their land is already being taxed at 25% since it satisfies the eligibility requirements of the Farm Property Tax Class.

Developing a management plan that includes the goal of biodiversity conservation, could make operators familiar with each of the biodiversity conservation management principles. And while many operators are inadvertently managing in ways consistent with biodiversity conservation principles, some might not understand the ecological significance of their actions. In creating a management plan, operators could work with a forester or wildlife biologist to create a profile of their property with all of the important biodiversity features identified. Operators might learn the significance of some parts of their bush of which they were previously unaware. Having the biodiversity principles and goals for achieving them on the operator's property in writing would allow the operator to reference them if needed and could help to keep these principles more present in the operator's mind while managing. While some of these might be things that an operator is currently doing informally, following a management plan could help the operator work to conserve biodiversity more effectively. Since most of the sugar bushes are family operations and the current operators hope to pass the business on in the family, a written management plan would also provide a valuable record of past management practices to the future operator. MNR and other forestry organizations such as the EOMF do provide foresters to help woodlot owners develop management plans.

- *Of twenty EOMF management principles for biodiversity conservation, 13 are being followed or partially followed by the majority of operators; the remaining 7 are being neither followed nor actively opposed by the majority of operators*

While there was a wide range of management styles and practices, every operator was following a range of EOMF-recommended management principles. Operators were following management principles primarily because the principles were inherent to operating a sugar bush, made good business sense, or because the operator would have to go out of his way to oppose the principle and had no reason to do so.

The particular mix of principles employed varies from one operation to the next, but interestingly, only five of the management principles are actively opposed, and these by only a relatively small number of operators. This implies that in Eastern Ontario there is not a strong opposition to managing for biodiversity, and it may therefore be possible to motivate operators to adopt the full suite of principles, or close to it.

- *Sugar bush operators are generally open to biodiversity conservation and allowing wildlife to inhabit their sugar bushes.*

Thirteen of the operators encourage wildlife on their properties, while the rest ignore it. There is an exception for "nuisance" species, e.g., squirrels and porcupines, which harm the bush and which most operators work to remove. In describing the values that influence how they manage their properties, many operators spoke about the long-term sustainability of their operation and the promotion of sugar maples for syrup production. To the idea of biodiversity conservation, sugar bush operators' responses ranged from active interest to indifference. None of them were opposed to the idea. This also indicates openness to biodiversity conservation principles within the syrup producing community.

- *The findings suggest that well-managed family-operated sugar bushes can be positive contributors to achieving policy objectives given in Ontario's Rural Plan and Biodiversity Strategy.*

Ontario's Biodiversity Strategy strives to protect the province's biodiversity by protecting it from threats. One of the main threats to Ontario's biodiversity is habitat loss, and this study shows that sugar bushes support a diversity of habitats. It also shows that the management of sugar bushes can be consistent with managing for forest biodiversity conservation. Since sugar bushes can be managed to support and conserve biodiversity, they can help meet the goals of Ontario's Biodiversity Strategy.

Ontario's Rural Plan seeks to strengthen the province's rural communities. This study shows that sugar bushes can be considered a form of rural sustainable development that would help rural communities thrive. Specifically, with its goal of maintaining a healthy environment, the Rural Plan notes the importance of the environmental pillar of sustainable development. This study shows that if managed properly, sugar bushes can help achieve this goal and support this aspect of rural sustainable development.

3.2 Contributions of the study

This study contributes to the body of knowledge on maple syrup production as a form of sustainable development. There have been few studies that look at the environmental impacts of sugar bush management. Leniere and Houle (2006) studied the effects of traditional sugar bush management on species richness in the understory, and Whitney and Upmeyer (2004) demonstrate that various other authors have looked at the detrimental

impacts of maple monocultures, the effects of tapping on tree health, the results of allowing animals to graze in the sugar bush, and the effects of the maple syrup industry on forest composition. This study is unique in that it looks at how sugar bush management affects biodiversity on a broader scale.

3.2.1 Discussion of findings; recommendations for operators and policymakers

The results of this study allow us to more accurately consider how the maple syrup industry fits into the framework of sustainable development. The concept of sustainable development posits that an industry should benefit or have a neutral effect on the economy, society, and environment. Other researchers have shown that the maple syrup industry is economically, socially, and in some ways environmentally sustainable. This study shows another important side of the industry's environmental sustainability by demonstrating that it is possible to manage a sugar bush in accordance with biodiversity conservation management guidelines.

Sugar bush owners and their local governments have occasionally put forward the idea that sugar bushes are working forests that support high levels of biodiversity. This study provides evidence to assess the truth of these claims by determining the extent to which sugar bush operators manage their woodlots within biodiversity conservation guidelines. We conclude that it is indeed possible to manage a sugar bush in a manner consistent with biodiversity conservation guidelines, and happily many sugar bush operators are currently doing so to a large extent.

These results show that sugar bush operators can help Ontario reach its goals for conserving biodiversity and building strong rural communities. The province's Ministry of Natural Resources created Ontario's biodiversity strategy in 2005. This document outlines the

threats to Ontario's biodiversity and the steps that should be taken to deal with them. In addition to helping reach some of the overarching goals for Ontario's biodiversity, sugar bush operators would specifically benefit from and might contribute to Action 3 (Promoting Stewardship; Engaging Private Landowners) of Ontario's Biodiversity Strategy. This action seeks to "enhance and promote private land resource stewardship and biodiversity conservation" (OMNR, 2005 p.25) through a number of methods including:

- *Communicating what biodiversity conservation means in the context of private land ownership and existing practices*

Sugar bush operators can receive stewardship/biodiversity conservation information from the woodlot organizations of which they are members. All the operators in this study are members of OMSPA and so could be reached through this medium to receive consistent information about how they and others would benefit from conserving biodiversity. The EOMF has a wealth of this kind of information (see: Bland et al 2006)

- *Developing and promoting best management practices for the conservation of biodiversity on agricultural and other private lands*

Biodiversity management practices have already been developed for private woodlot owners. The EOMF biodiversity guidelines for private owners of forested land are particularly pertinent in the study region, but many others have been developed as well (Lindenmayer et al. 2006; CCFM 2004; McEvoy 2004). Sugar bush operators need to be

made aware of the availability and importance of these guidelines.

- *Developing a strategy for the management of problem wildlife in cooperation with the agricultural community*

Sugar bush operators would specifically benefit from strategies dealing with squirrels, porcupines, bears, and beavers. Some of these species (like squirrels and bears) might not be considered as problem wildlife by other types of woodlot managers, so it is important that sugar bush operators be consulted when coming up with the list of problem animals for which to develop management strategies. Two syrup operators noted that while squirrels chewing on their pipelines were a problem in the past, these operators have stopped cleaning their pipelines with chlorine which attracts the squirrels, and they no longer have problems with them. Alternative solutions such as this one might exist to prevent damage from other wildlife species too.

- *Improving technical assistance and the stewardship support tools available to landowners/farmers where needed (e.g., work sheets, extension notes)*

Several operators mentioned the current lack of assistance available through MNR compared to the past when MNR foresters were readily accessible. They would likely appreciate having this service back. To assist sugar bush operators with their conservation goals, these foresters must be familiar with sugar bush dynamics rather than just the logging dynamics of timber extraction. In the past some operators have had negative experiences with foresters lacking this expertise.

- *Seeking ways to strengthen existing stewardship organizations (e.g., Ontario Stewardship Councils, Conservation Authorities, the Ontario Heritage Foundation, Land Trusts, NGOs)*

There are many organizations that promote stewardship on private woodlots (OWA, EOMF, FSC, etc). Assisting these organizations in doing their work to promote biodiversity would likely influence sugar bush operators to manage their woodlots with biodiversity more in mind since many operators are members of these organizations.

- *Creating recognition programs to profile exemplary stewardship actions by farmers and other landowners.*

These kinds of programs could provide incentives for sugar bush operators to promote biodiversity on their properties. Many sugar bush operators are already doing a lot to support biodiversity. One operator said sugar bush operators would appreciate being recognized for this. Sugar bushes that are open to the public could benefit from the publicity of these kinds of programs too, since they might attract visitors who are interested in seeing wildlife.

Ontario's Ministry of Municipal Affairs and Housing created Ontario's Rural Plan in 2004 which outlines the province's goal to build strong communities in rural Ontario. Since sugar bushes are a form of rural sustainable development, they can help Ontario reach this goal. The Rural Plan notes the importance of protecting the environment and ensuring that natural resources are conserved and used in a sustainable way. This study demonstrates how sugar bush operators can help do this.

3.3 Suggestions for further research

This study looked at the management practices employed by sugar bush operators since these influence biodiversity in the sugar bush. Further research could examine the biodiversity on sugar bushes directly. The species and habitats found on sugar bushes could be compared with those found in unmanaged forests and in forests managed for other uses. This kind of study might quantify more clearly the influences of sugar bush management on biodiversity. It would also provide sugar bush operators a clear idea of what important species and biodiversity features exist on their properties that they should work to preserve.

As well, further research would be useful to determine what kinds of incentives might encourage sugar bush operators to more actively conserve biodiversity on their properties. If developing a management plan is the first step to conserving biodiversity, it would be valuable to ascertain what kinds of programs, information, and incentives might persuade operators to develop one. Inspiration might be drawn from other successful incentive programs such as the Alternative Land Use Services (ALUS) program. The ALUS concept is a 'fee for service' proposal that recognizes and rewards farmers and ranchers for the role they play in creating healthy, sustainable countrysides vital to healthy human populations" (Norfolk ALUS 2010). Research could be conducted on how to adapt this kind of program to apply to sugar bush operators.

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Appendix A: Measurement and Analysis of Biodiversity Indicators

Spring Ephemerals (presence/abundance)

The EOMF manual lists eight species of spring ephemerals that indicate healthy undergrowth in a forest. These species are:

White Trillium (*Trillium grandiflorum*)

Bloodroot (*Sanguinaria canadensis*)

Wild Leek (*Allium tricoccum*)

Wild Lily-of-the-valley (*Maianthemum canadense*)

Blue Cohosh (*Caulophyllum thalictroides*)

Solomon's-seal (*Polygonatum biflorum*)

Foamflower (*Tiarella cordifolia*)

Dutchman's-breeches (*Dicentra cucullaria*)

The manual explains that if at least four of these species are present in the forest, the undergrowth is in a healthy state and is protected or has recovered from grazing. I measured these seven species in each of the sugar bushes.

To measure spring ephemerals, I established three 25m x 25m sample plots in each woodlot. In each sample plot, I counted and recorded the number of spring ephemerals in 25 1m x 1m quadrats. Each 1m x 1m quadrat was separated from other quadrats by 5 m. This gave me seventy-five 1m x 1m quadrat measurements for each sugar bush. The EOMF manual recommends having at least twenty 1m x 1m quadrats per woodlot. My study exceeded this

recommendation. As well as counting spring ephemerals in the established plots, I also recorded which species I saw as I walked throughout each sugar bush.

Frogs (presence/abundance)

The EOMF manual states that chorus frogs are indicators of good water quality in shallow or temporary pools. Northern Leopard frogs indicate adequate size and good connections, and American Bullfrogs indicate protection of permanent water habitat and pond shoreline.

To measure frogs, I took 3 frog call surveys. I identified the wet areas at two sugar bushes, and visited them on three separate evenings to measure the abundance of frogs. These surveys were according to the EOMF manual and Marsh Monitoring Program protocol. The first survey was done when night temperatures were at least five degrees, the second survey when night temperatures were at least 10 degrees, and the third survey when night temperatures were at least 17 degrees. This ensured that the surveys were done during the calling season of each species of frog. The surveys were completed one half hour after sunset and before midnight. At each survey, I recorded the species of frog calling and assigned a call level:

Level 1: individuals can be counted, calls not overlapping;
Level 2: calls overlap, individuals can be counted or estimated;
Level 3: full chorus, calls continuous and overlapping, individuals not distinguishable

Birds (presence/abundance)

The EOMF manual lists several bird species that are indicators of adequate forest interior, adequate size or good connections, and adequate closed canopy. To measure the presence of these species, I established three monitoring stations on each sugar bush. These stations were at least 100 m from the forest edge and at least 100 m from each other. With the help of an expert birder, I visited each station twice between May 24 and July 10. Each visit was five minutes and occured between 05:00 am and 10:00 am. We listened for bird songs and recorded the species we heard calling.

Data Analysis

Collecting information about biodiversity indicators on three sugar bushes in Lanark was a preparatory step for my project. The analysis of this data was relatively straightforward. Since each of the indicators that I measured corresponded to a specific biodiversity criterion, I simply created a list of the biodiversity criteria that are present on each sugar bush according to which biodiversity indicators were present. Below is a table of the indicators that I was looking for, the biodiversity criteria that they indicate, and their presence on the three sugar bushes that I studied.

Table 1: Presence of biodiversity indicators on three sugar bushes in Lanark, Ontario.

Habitat Criterion	**Indicator**	**Sugar Bush 1**	**Sugar Bush 2**	**Sugar Bush 3**
Protection/recovery from grazing, good undergrowth (at least four species from the list)	White Trillium (*Trillium grandiflorum*)	X	X	X
	Bloodroot (*Sanguinaria canadensis*)		X	

	Wild Leek (*Allium tricoccum*)	X	X	X
	Wild Lily-of-the-valley (*Maianthemum canadense*)	X	X	X
	Blue Cohosh (*Caulophyllum thalictroides*)	X	X	X
	Solomon's-seal (*Polygonatum biflorum*)	X	X	X
	Foamflower (*Tiarella cordifolia*)		X	X
	Dutchman's-breeches (*Dicentra cucullaria*)			
Adequate forest interior	Hermit Thrush (*Catharus guttatus*)	X	X	X
	Veery (*Catharus fuscescens*)	X	X	X
	Barred Owl (*Strix varia*)			
Adequate forest interior and closed canopy	Ovenbird (*Seiurus aurocapillus*)	X	X	X
	White-breasted Nuthatch (*Sitta carolinensis*)	X	X	X
	Black-throated Green Warbler(*Dendroica virens*)		X	
	Brown Creeper (*Certhia Americana*)			
	Winter Wren (*Troglodytes troglodytes)*			
	Hairy Woodpecker (*Picoides villosus*)	X		X
Closed canopy	Red-eyed Vireo (*Vireo olivaceus*)	X	X	X
	Wood Thrush	X	X	X

	(*Hylocichla mustelina*)			
	Yellow-bellied Sapsucker (*Sphyrapicus varius*)			X
	Least Flycatcher *(Empidonax minimus)*			
Canopy species requiring closed canopy	Scarlet Tanager (*Piranga olivacea*)	X		
Protection of permanent water habitat; pond shoreline	American Bullfrog (*Lithobates catesbeianus*		NA	X
Good water quality in shallow or temporary pools	Western Chorus Frog (*Pseudacris triseriata*)	X	NA	
Adequate size or good connections	Northern Leopard Frog (*Lithobates pipiens*)		NA	X

Appendix B: Interview Guide

About the Sugar Bush and Owners

How long have you had the sugar bush for?

Do you know the history of this property? How long was it used for maple syrup production before you owned it? What other purposes was it used for?

Is the sugar bush a family operation? Did you inherit it from your parents? Do you intend to leave it to your children? Does this influence how you use the property? Have you considered the possibility of a conservation easement or a land trust for the future of your property?

How large is the sugar bush? How much area does it cover? How many taps do you have?

What method do you use to collect sap?

Do you produce maple products for commercial purposes, your own consumption, or both?

On average, how much syrup do you produce in one season?

Is your sugar bush open to visitors (tourism)?

Do you use biodiversity to market your sugar bush to visitors (ie. nature walks, birdwatching opportunities, etc)?

Besides sugar maple, what are the other dominant tree species on your property?
Approximately what number of tree species are on your property?

About Sugar Bush Management

Are you aware of the Eastern Ontario Model Forest, the Ontario Woodlot Association, or the Ontario Maple Syrup Producers Association?

Are you a member of any of these organizations?

Do you have a formal or informal management plan for your sugar bush/woodlot? Is your management plan part of the Managed Forest Tax Incentive Program

Does your management plan involve the conservation of biodiversity?

Is your woodlot part of a contiguous forest (at least 40 hectares or 100 acres)? Do you work with neighbouring landowners to reconnect fragmented habitats and improve edge habitats?

Are you aware of different cover types in your sugar bush? Do you strive to support a rich diversity of cover types? How?

Do you ever work with contractors to develop your sugar bush (ie. to put in roads, build structures, remove timber, etc)? Is it important to you that contractors understand the importance of protecting wildlife habitats? Do you ensure that they follow best management practices?

Have you ever consulted with a professional forester or wildlife biologist to identify habitats and ensure that they are conserved? Was this helpful? Did it affect how you managed your sugar bush?

Do you ever come in contact with wildlife (vertebrates), eggs, or nests? Do you have any specific protocol for these situations?

Are there any animal movement corridors that you are aware of on your property? How are these treated?

Do you have any undisturbed areas on your land, or areas with restricted access? How much? What kinds of areas are these (seeps, ginseng habitat, etc)?

How are trails maintained on your property? Are they maintained throughout the year, or just seasonally? What percentage of your property is occupied by trails? Are the trails open or closed canopy?

Do you have any livestock? Are they allowed to enter your sugar bush?

Do you enter your sugar bush with vehicles? What kind? When do vehicles enter the sugar bush? Is the ground frozen during those times?

Do you have ATV/snowmobiles trails through your sugar bush in the winter? Are there any parts of your property where they are restricted? How come?

Are you aware of potential invasive plant species that could be in your sugar bush? How do you deal with these species?

Do you ever clear timber in your woodlot? Do you leave brush piles?

Do you do anything to actively improve habitat for reptiles and amphibians (ie. stacking wood or placing boards in suitable areas and allowing them to rot)?

Do you selectively cut any species of tree or shrub from your sugar bush? How come? Would it be practical to stop doing this? Would the negative affect on syrup production be too great?

Do you have conifers in your sugar bush? About how many per hectare/acre? Is your site type conducive to conifer growth?

Do you clear woody debris, both downed and standing from your sugar bush? How come? About what percentage do you leave? Do safety guidelines play a role in how you manage standing woody debris?

How do you treat stands that may have been degraded in the past? Do you ever plant native tree and shrub species?

Which of the following “important habitats” do you have on your sugar bush property?

- forest interior (at least 100 m / 110 yards from edge)… approximately how many hectares/acres?
- clumps of large diameter trees (at least 38 cm / 15 in dbh)
- mast trees (oak, beech, hickory, basswood, black cherry, ironwood, butternut, dogwoods, viburnums, chokecherry, serviceberry, winterberry, pin cherry)
- old growth forest (trees at least 80-100 years old, spread apart, canopy gaps)
- stick nests
- supercanopy trees (living trees that stick up above main canopy)
- open water shorelines
- woodland pools (temporary or permanent)
- turtle nesting sites (sand/gravel shoreline)
- bat winter hibernacula (caves, rock crevices)
- seeps, springs, or streams
- snags
- conifer patches within a hardwood forest
- dead or living trees with hollows or cavities

- downed woody debris (adjacent to water or animal movement corridors is best)

Do you retain these habitats on purpose? Do you do anything to improve them? Do any of the sugar bush operations affect them either positively or negatively? How?

Do you know of any unusual species that are present on your woodlot (ie. American Ginseng, Maiden's-hair Fern, Butternut, etc?). Do you know what their habitats are? Do you treat these species any differently than typical species?

What are values that affect how you make management decisions (e.g. money, government, environmental concerns, etc)?

What is most important to you about the management of your sugar bush?

About Monitoring Biodiversity

Do you monitor biodiversity on your sugar bush? How? Would you be willing to start?

Have you noticed any changes in the biodiversity of your woodlot over time? Do you think these changes are a result of your sugar bush operations?

Conclusion

Can you suggest any ways that sugar bushes might influence biodiversity that I have not spoken about?

What kinds of programs/information would you find useful to help you conserve biodiversity in your sugar bush?