Outcome-Based Forestry: A Case Study of the First Private Landowner's Implementation of an Alternative to Maine's Forest Practices Act

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Master of Forestry
Final Project Report

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ABSTRACT

Outcome-based Forestry (OBF) was approved by the Maine State Legislature in 2001 as an alternative policy to Maine's 1989 Forest Practices Act (FPA). In 2012, Irving Woodlands (IW) became the first private forest landowner to sign an agreement with the Maine Forest Service to implement OBF on its 1.25 million-acre land base in northern Maine. Given the experimental nature of OBF, it is important to understand how this policy is being implemented and its effects on forest management, the landscape, the company, and forest managers implementing the policy. The objectives of this study were to: (1) document how IW is implementing OBF and meeting each of the sustainability goals under the OBF agreement; (2) explore the perceptions of IW foresters about implementing OBF at the corporate, social, and individual level; and (3) investigate the likely landscape-level impacts of OBF policy relative to the FPA. To accomplish these objectives, we documented how IW has incorporated OBF into their forest management planning and operations, and how they are specifically meeting each of the nine sustainability outcomes under their OBF agreement. We interviewed two IW foresters about their perceptions of the advantages and disadvantages of OBF to their corporation, to society, and to their personal responsibilities as professional foresters. To quantify the relative effects of OBF and FPA policies on forest fragmentation and other landscape attributes, we used a 6,000-acre area of IW ownership that had been harvested under the FPA over a 16-year period, and compared how IW foresters would have harvested the same landscape under OBF and FPA policies over the same time period.

We found that IW has incorporated OBF policy into their forest planning and operations using Key Performance Indicators to document their compliance with each outcome, as well as provide the feedback loops needed to monitor and correct for any non-compliance. Forest managers indicated that OBF policy has increased operational efficiencies in their sector planning approach relative to under the FPA, reduced costs for the company, and increased pay for logging contractors. Foresters also indicated that their duties have shifted from spending more time on regulatory compliance under the FPA, to responsibilities they believed were more important, such as focusing on better silvicultural prescriptions and protecting the environment. We found that hypothetical harvest plans written under the constraints of OBF led to lower rates of fragmentation relative to FPA-based harvest plans, as well actual harvesting conducted upon the same landscape under the FPA. This reduction in fragmentation was attributed to spatial and temporal aggregation of harvesting, as clearcut size and frequency did not differ between policies. The percentage of land proposed to be partially harvested also did not differ under the OBF and FPA policies.

ACKNOWLEDGEMENTS

I would first like to thank my advisor Dr. Robert Wagner for everything he has done for me during my time at the University of Maine. His advice and encouragement helped me focus my investigation and improve my understanding of not only forestry, but also the methods and process of research. The perspective he brought to our meetings and imparted upon my writing broadened my thinking and strengthened this project. Thanks also to my other committee members: Dr. Sandra De Urioste Stone, Dr. Robert Lilieholm, and Dr. Erin Simons-Legaard. The input you each provided from your particular fields allowed me to tackle such a diverse spectrum of analysis surrounding this singular policy. I would also like to thank the USFS-NSRC grant that funded this study.

Thanks to the Maine Forest Service personnel, especially Don Mansius, for answering my questions, and providing me information and documentation about the history of Maine Forest Policy. And thanks to the Outcome Based Forestry expert panel for feedback throughout this process.

Without the incredible support and access provided to me by Irving Woodlands this project would have been impossible. Thank you for your countless hours of support, quick responses on emails, and for answering my questions.

To all of my buds in the School of Forest Resources, thanks for playing just as hard as you work. Not all learning happens on purpose, and some of the most insightful conversations I have had, forestry related or otherwise, were over a cribbage board or on Mike's porch on a Wednesday night.

On a personal level, this project provided context to my formal education during my time at the University of Maine. All knowledge gained during my classes was compared and tested against the "real world" examples I had seen in the field or office working with Irving Woodlands. This in turn strengthened my understanding of not only my classwork, but also my research. If I have learned anything from my time with IW, it is the importance of monitoring efforts and documenting results. These are the fundamental tools necessary for improvement. One must know where they started to understand how far they have traveled.

To my parents, who have forever instilled in me a love of Maine, the value of a hard day's work, and an absolute enjoyment for a walk in the woods.

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PROLOGUE

Forest policy has a strong influence over the natural resources it is intended to protect. The outcomes may or may not produce what was intended, and can result in both unintended positive and negative consequences. Maine's 1989 Forest Practices Act (FPA) was created to reduce what the public perceived as unacceptably high rates of clearcut harvesting following the spruce budworm outbreak of the 1970s and 1980s. The policy was a success in that it reduced clearcut harvesting from 45% of the harvest to 5% within a few years of passage. However, it also led to near complete domination of partial harvesting systems that doubled the area harvested each year to yield the same amount of wood, suboptimal or no silvicultural treatment in many forest stands, an inability of foresters to always follow natural stand boundaries, an over reliance on prescriptive rules rather than science, and increased fragmentation of the forest landscape.

As a result, the Maine Forest Service began working on an alternative forest policy in the late 1990s to address these problems. By integrating silvicultural and ecological knowledge with new approaches to environmental policy, Outcome-based Forestry (OBF) was approved by the Maine Legislature in 2001 as an experimental alternative policy. OBF is a voluntary policy focused on reducing rule-based approaches to forest harvesting under the FPA by shifting focus to the production of desirable outcomes and encouraging more scientific approaches to forest management. Landowners agreeing to enroll in OBF are exempt from certain rules of the FPA regulating clearcutting: specifically leaving unharvested buffer areas (or separation zones) around clearcuts in exchange for documenting achievement of nine sustainability standards, as well as oversight by an independent panel of experts appointed by the Governor.

In 2012, Irving Woodlands and Maine's Bureau of Parks and Lands enrolled in OBF. In September 2015, Katahdin Forest Management enrolled in OBF. With nearly two million acres of forestland being managed under this policy, it is important to understand how OBF is being implemented and identify any benefits and early consequences of this alternative forest policy.

Given that Maine's 16.7-million acres of forestland is dominated (94%) by private ownership and that successful implementation of OBF will depend on the acceptance and successful implementation of OBF policy by large, private forestland owners, we focused this investigation on how Irving Woodlands (IW) was implementing OBF. We examined how IW is implementing OBF on their 1.25-million acre landbase in northern Maine, as well as the effects of that implementation on forest management, the landscape, the company, and the forest managers implementing the policy. In Chapter 1 we describe the background of OBF and FPA, how IW has incorporated OBF into their forest management planning and operations, and how they are meeting each of the nine sustainability outcomes under their OBF agreement. Chapter 2 investigates the perceptions of individual IW foresters in their implementation of OBF at the corporate, social, and personal levels. Chapter 3 quantifies the relative effects of OBF and FPA policies on a 6,000-acre portion of IW's ownership that had been harvested under the FPA over a 16-year period, and compares how IW foresters would have harvested the same landscape under both OBF and FPA policies.

CHAPTER ONE

Outcome-Based Forestry: How one private landowner is implementing an alternative to Maine's Forest Practices Act

ABSTRACT

In 2012, the first two landowners (Maine Bureau of Parks and Lands and Irving Woodlands LLC) enrolled in five-year agreements with the Maine Forest Service (MFS) to manage their lands under Outcome-Based Forestry (OBF) policy. In September 2015, Katahdin Forest Management (KFM) became enrolled in OBF bringing the total to nearly two million acres of forestland under OBF policy in Maine. This results-based policy incents enrolled forest landowners to achieve the state's sustainability goals by exempting them from specific regulatory requirements for clearcut harvesting under Maine's Forest Practices Act (FPA). A key issue for a results-based policy is to understand how the policy is being implemented, as well as how compliance is being monitored. After two years of implementation, we were interested in how participating landowners were incorporating OBF policy into their forest management planning and operations, and how they were ensuring that the required outcomes under the agreement were being achieved. Given that Maine's forestland is dominated by private ownership and that successful implementation of OBF will depend upon the acceptance and successful implementation of OBF policy by large, private forestland owners, we focused this investigation on how the first private company, Irving Woodlands (IW), was implementing OBF. IW is implementing OBF using Key Performance Indicators (KPIs) that allow them to measure compliance with each outcome and provide feedback loops in their forest management planning and operations to detect and correct for non-compliances.

INTRODUCTION

Results-Based Environmental Policy

The first environmental protection policies were developed in response to pollution and environmental degradation following rapid growth in U.S. manufacturing following the Second World War. These policies were typically based on a zero-sum view of regulation that is founded on the idea that a for-profit company will only consider environmental values when forced to through government regulation. Initial policies and laws operated on a command-and-control regulatory framework, often "…heavily bureaucratic, prescriptive, fragmented in purpose, and adversarial in nature" (Durant et al. 2004). This style of policy – founded in principal during the 1970s – is exemplified by legislation such as the Maine Forest Practices Act – offering rigid requirements or punitive action. Critics of command-and-control regulation cite that it inhibits flexibility and leads to risk aversion (Durant et al. 2004), and point out that it treats baseline compliance entirely equal to standout environmental performance. This is evident in the reactions of Maine's forest managers since the inception of FPA as dominant operational

patterns emerged across ownerships: clustered clearcuts and the rapid expansion of partial harvesting to avoid clearcutting rules and restrictions.

An alternative approach is a results-based regulatory system for environmental and natural resource protection. These systems specify protections that need be achieved, and provide flexibility to natural resource managers as to how to specifically meet those goals. A strategy based more upon incentives, learning, and accountability – and less upon commands and controls – results-based policies allow government to step back from the role of regulator, and incentivize outcomes that simultaneously benefit private, public, and ecological interests, changing the nature of the relationship between the regulator and industry from adversarial to collaborative (Fiorino 2006). Many of the problems that arose from command-and-control style policies are rooted in the fact that they were designed around preventing worst-case scenarios, and thus regulations were tailored to the worst offenders and applied to the entire industry, regardless of the quality of their management.

This new approach to environmental policy accounts for differences in performance and is often implemented using a tiered system of performance (Fiorino 2006). For a results-based environmental policy to be successful, there need to be clear indicators that determine and signal compliance. Performance can be improved because measured criteria (such as air pollutants) are used. Pollutants can be tracked and quantified, and flexibility in approaches to achieving emission reductions promotes continuous improvement and spurs technological advances.

Adapting results-based systems to forest policy is a complex proposition. Unlike criteria such as point-source air pollution, several policy goals in the forest arena are difficult to quantify, and thus complicate measuring compliance. Also, management decisions should be guided by scientific progress, thus policy should be written to allow for creativity and flexibility in forest management, and standards must be capable of evolving over time. Forestry objectives require large temporal and spatial scales, and often their effects go unnoticed for several years before detection.

Maine's OBF is consistent with current trends in how environmental policies are being structured. Forest managers who can demonstrate achievement of the state's sustainability goals are exempted from specific rules around clearcut harvesting, thus allowing for increased administrative and operational efficiencies. Operating from the principle that deterrence alone is an inefficient manner to influence behavior, OBF policy blends results-based and prescriptive policies, creating a policy approach built on the underpinnings of the FPA and other prescriptive legislation, but supplementing the pure regulatory framework with beneficial environmental, social, and economic objectives.

Similar policies have been implemented on Crown Lands in Canada. In 2004, British Columbia began to pursue results-based forest management to achieve a more cost-effective alternative to a complex prescriptive forest practice code (Innes 2003). Much like Maine's OBF, the B.C. Forest and Range Protection Act employs a mix of regulatory approaches, including mandatory practices and management-based regulation as well as performance goals (Hoberg and Malkinson 2013). Provincial regulators encountered significant difficulties in crafting performance standards capable of allowing flexibility while still providing adequate protections that were enforceable and measurable (Hoberg and Malkinson 2013). More recently, New Brunswick began to implement a results-based framework for Crown Licenses, holding licensees accountable for achieving forest-wide goals. This policy was created to save taxpayer money and reduce management costs, bolstering the waning forest sector in a competitive global market

(New Brunswick DNR 2014). As the program began only in 2014, data concerning its implementation and outcome are still forthcoming.

Brief History of Maine Forest Policy

Prior to the 1970s, policy played a relatively small role in the management of Maine's forest. The Chase Amendment of 1953 – precursor to Maine's Tree Growth Tax – set taxes low for forest management due to long forest rotations and low financial yields of forest investments. The Maine Forest Service existed primarily to monitor forest health, manage a network of fire towers, and mitigate damage from forest pests. Public ownership of Maine's woodlands was viewed as unnecessary, as industrial landowners permitted public access for recreation (Irland 1991).

With the environmental movement of the late 1960s and 1970s, as well as the simultaneous spruce budworm outbreak, the policy and regulatory environment for Maine's forest landowners changed quickly. The Land Use Regulation Commission (LURC) was formed in 1971 to regulate development and timber harvesting in Maine's unorganized territories (Bley 2007). During 1973, the Maine Department of Conservation (DOC) was created, the Bureau of Forestry was reorganized into the DOC (Pare 2001), and the Bureau of Public Lands was formed to begin consolidating and acquiring public tracts of land into large multiple-use management units (BPL 2012). After years of mounting evidence of river degradation caused by sunken woody debris, Maine's log drive was ended in 1976. In 1989, the Maine legislature passed FPA in an effort to reduce the rate of clearcutting. Passage of the FPA was followed during the 1990s by series of failed voter referenda that sought to ban clearcutting entirely. Discussions resulting from these efforts led the 118th Maine Legislature to begin developing a set of sustainability standards in 1998 that would lay the groundwork for future forest policy.

Impacts of Maine FPA

The spruce budworm epidemic of the 1970s and 1980s devastated spruce-fir stands across northern Maine and eastern Canada. Widespread defoliation and resulting mortality resulted in 20 to 25 million cords of lost spruce and fir volume between 1975 and 1988 (Maine Forest Service 1993). Insecticides were aerially applied to protect the foliage of fir and spruce across millions of acres to prevent the loss of valuable stands that could not be harvested in a reasonable period of time. Millions of acres of dead and dying trees prompted forest landowners to salvage the timber, often by clearcut harvesting. The resulting rolling clearcuts – sometimes 2,500-acres or larger – had a substantial visual impact (Hagan and Boone 1997) and raised public concern about forestry practices. Mounting public concern resulted in political pressure that led to passage of the FPA in 1989.

The FPA provided a legal definition of a clearcut, which is *"any timber harvesting on a forested site greater than 5-acres in size that results in a residual basal area of trees over 4½ inches in diameter measured at 4½ feet above the ground of less than 30 square feet per acre"* (Maine Forest Service 1999a). A classification scheme for clearcuts also was introduced: Category I clearcut is 5 to 20-acres in size, Category II from >20 to 75-acres, Category III from >75 to 250-acres. The FPA provided a set of prescriptive rules describing how clearcut harvesting was to be implemented, including: (1) requiring a 250-foot separation zone around the cut comprised of non-clearcut forest of greater basal area and acreage depending on the category

of clearcut to be retained for at least 10 years; (2) a forest management plan must be written for any clearcut greater than 20-acres; and (3) regeneration standards that must be met for 5 years following a clearcut. Required acreages, separation zone widths, regeneration standards, and basal area thresholds were not based upon any scientific forest management or ecological principles. These FPA rules were designed to reduce the aesthetic impact of clearcut harvests, buffering clearcut harvests so that adjacent cuts did not roll into a single larger clearcut, as was the practice during the spruce budworm outbreak, and ensure that these harvests were regenerated to commercially valuable tree species.

Shortly after implementation in 1991, the FPA had a rapid and substantial impact on the type and amount of harvesting across Maine's forested landscape. Clearcutting was reduced from 45% of the harvest in 1989 (the year the FPA was passed) to less than 8% by 1996, and has been less than 6% every year since (Maine Forest Service Silvicultural Activity Reports). Clearcutting was replaced with various forms of partial harvesting that retained stocking levels higher than the FPA definition of a clearcut. However, simply leaving more than 30 square feet of basal area per acre of acceptable growing stock (the residual basal area standards required for a harvest to not be classified as a clearcut under FPA) did little to address the resulting quality and productivity of forest stands. By 1995, an evaluation by the Maine Forest Service showed that the FPA did not discourage the high-grading of forest stands (Maine Forest Service 1995). Permitting costs and added time spent ensuring that clearcut prescriptions were in compliance with the FPA added substantial administrative expense for forest managers – and often led managers to engage in FPA-avoidance partial harvests.

The shift in the rate and pattern of forest harvesting, coupled with years of creating required separation zones, changed the forest landscape leading to increased forest fragmentation and increased forest edge. Hagan and Boone (1997) showed that the FPA encouraged many small clearcuts and partial cuts, thus reducing the connectivity of mature forest on the landscape, and creating an undesirable harvest footprint. The required separation zones often forced suboptimal silviculture in those areas, creating narrow and difficult-to-manage stands that reduced stand quality and productivity in many areas, leaving behind overmature trees and slivers of stands. Under FPA definitions, several silvicultural practices such as thinning and shelterwood establishment cuts often were classified as legal clearcuts (Hagan 1996) – although the FPA allows for its own definition of overstory removal. These restrictions also became impediments to forest managers who wanted to prescribe harvests along natural or logical stand boundaries, elevate the quality and intensity of their forest management, or implement new practices that were shown by scientific research to be more effective and efficient. The resulting dominance of partial harvesting also doubled the harvest footprint in Maine's northern forest from about 250,000 to 500,000 acres per year, while the total volume of wood harvested (6 to 7 million cords) remained relatively constant (Maine Forest Service Silvicultural Activity Reports). There also was a progressive decline in silvicultural investments (such as tree planting, herbicide treatments, and precommercial thinning) made by landowners (Maine Forest Service Silvicultural Activity Reports); although this reduced investment may also have been due to changing landowner objectives.

Principle 4 of the Society of American Foresters (SAF) code of ethics reads: *"public policy related to forests must be based on both scientific principles and societal values"* (SAF 2000). While the FPA was created to address public concerns about clearcutting, it had unintended negative consequences that were inconsistent with the best available forest science

and practice. Its choice of arbitrary prescriptive thresholds *"prevented or frustrated the wise use of scientific forestry"* (MFS 2013b).

Outcome-Based Forestry Legislation

Within a decade of the FPA's implementation, it was widely recognized that the policy was having a series of unintended negative consequences on Maine's forest landscape. In 1999 the Maine Forest Service declared in its State of the Forest report that the state had *"reached the limits of what a command and control regulatory framework has to offer [with respect to regulation of forest practices]. Command and control regulation has many limitations and may result in unintended consequences, such as forest fragmentation and premature harvesting to recover equity in a forest investment"* (Maine Forest Service 1999b).

A proposed solution was development of OBF policy, which first appeared as a provision in the FPA legislation in 2001. The objective of OBF was to allow more flexibility for landowners in how they harvest their forestlands in exchange for ensuring that specific outcomes that protected the forest environment were achieved (Table 1.1). These outcomes were developed by the Maine Forest Service and vetted through a long process of public review. By enrolling in OBF, landowners became exempt from certain clearcutting rules of the FPA – namely separation zones, clearcut management plans, and prior approval for Catergory 3 clearcuts. A governor-appointed panel of technical experts was developed to ensure that the outcomes were achieved and to monitor progress of each OBF agreement with participating landowners. The original language of the provision also stipulated that OBF was an "experimental" policy, and as such, was limited to six participating landowners and no more than 200,000-acres in total.

The underlying assumption of OBF was that the exemption from the rules on clearcut size and separation zones would encourage forest managers to prescribe harvests that were guided by sound scientific and forest management principles, rather than arbitrary prescriptive rules. The hope was that proper forest management and environmental protection could be provided simultaneously, producing both positive economic and environmental outcomes for forest landowners and the people of the state.

Under OBF, forest landowners are required to rigorously plan and document their yearly operations, reporting a variety of metrics to the MFS. Any clearcuts greater than 250 acres must be individually mapped and identified. Annual reports must be submitted within 60 days of year's end that describe the landowner's harvest activities and a set of other metrics, including: separation zones harvested, investments in silviculture, harvest opening size distribution, efforts to increase timber quality/quantity, development stage distribution, and regeneration reports. In addition, the type of harvesting (precommercial thinning, competition control, overstory removal, shelterwood, and clearcut) completed that year must be reported by acreage.

Despite introduction of the OBF provision to the FPA in 2001, landowners chose not to enroll in the program. A sunset date of July 1, 2012 apparently made the legislation tenuous and unattractive to large landowners. In addition, a 200,000-acre cap on enrollment meant that large landowners would need to separate parcels of their landbase and manage them under different policies and management plans. To facilitate enrollment in OBF, the Maine Legislature removed the 200,000-acre cap in 2007 (Giffen 2007). However, this change still produced no landowner interest to participate in OBF. Therefore, in 2012 the Maine Legislature repealed the sunset provision from the law. Shortly thereafter, Director of the Maine Forest Service (Doug Denico),

enrolled the first two landowners (Irving Woodlands LLC and Maine Bureau of Parks and Lands) in OBF agreements (Denico 2013).

A 2014 public hearing and work-session by the Agriculture, Conservation, and Forestry Committee of the Maine Legislature to review progress of the OBF, which included testimony by a variety of interested parties, resulted in removal of the "experimental" status of the OBF provision in the FPA. This change made OBF a stronger policy alternative to the FPA by allowing the State Forester to renew agreements for five-year periods providing that participating landowners were meeting the terms of their agreement. Oversight and reporting standards also were changed at this time, requiring public notification of new participants within 15 days of signing an OBF agreement, yearly reports on OBF projects by the first of March each year, and five-year reports on the OBF process as a whole – including recommendations regarding the continuation of the program.

Sustainable Forestry Certification

In addition to forest policy changes during this time, the advent of third-party forest certification systems had a strong influence on forest management in Maine. Over 10 million acres of Maine forests are currently certified by the Sustainable Forestry Initiative (SFI) and/or Forest Stewardship Council (FSC). These certified lands undergo periodic audits holding landowners to standards of sustainability that in turn signal assurance of responsible management to consumers.

Forest certification draws its roots from a series of international conferences through the 1980s and 1990s intent on reversing trends of resource exploitation and environmental degradation. These meetings of the United Nations Conference on Environment and Development (UNCED) produced the Brundtland Report in 1987, which coined the phrase *"sustainable development"* and laid the framework for their 1992 Rio Earth Summit (Brown 2002). There, UNCED employed these concepts of sustainability in natural resources management, creating the Forest Principles, which state *"forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations"* (Vallejo and Hauselmann 2000). Although both major forest certification systems in the United States – FSC and SFI – grew directly from these ideas and principles, their direct origins are from very different organizations. FSC was created in 1993 by a group of international environmental organizations, whereas the industry-based American Forest and Paper Association launched SFI in 1994 (Brown 2002).

These forest certification systems verify the sustainable sourcing of fiber through a third-party audit. To obtain certification, an interested landowner must have their practices audited by an accredited independent firm, tasked with assessing compliance against the standard set by the certifying body (FSC/SFI). Any non-compliance is dealt with through a system where low-level non-conformances may be corrected over time, but significant violations must be addressed immediately. These certifications operate as a market-driven initiative, under the assumption that sustainably sourced products will receive a market preference or premium (Moore et al. 2012).

Table 1.1 – Required outcomes under Maine's Outcome-Based Forestry Policy. Source: Maine Forest Service 2012.

Outcome 1: Soil productivity - Site productivity will be maintained or improved, and the area in roads and yards will be minimized.

Outcome 2: Water quality, wetlands and riparian zones - Forest management in shoreland areas protects water quality and aquatic and riparian forest biodiversity.

Outcome 3: Timber supply and quality - The management strategy and harvest levels for the lands will increase the quality and quantity of the forest resource as appropriate in the medium and long term (20 -50 years).

Outcome 4: Aesthetic impacts of timber harvesting - 1) The landowner will minimize visual impacts of harvests, roads, landings and other management activities. 2) The landowner's planning staff are trained in and apply principles of visual quality management.3) The landowner identifies areas with high and moderate visual sensitivity, and takes appropriate measures to avoid significant visual impacts whenever necessary.

Outcome 5: Biological diversity - 1) Management addresses the habitat needs of the full range of species present. 2) Maintain or manage for acreage in the late successional (LS) condition through management and protection. 3) Maintain a reasonable component of standing dead trees, live cull trees, and down logs across the landscape (not necessarily on every acre). 4) High Conservation Value Forests are properly identified and values are protected on the ownership. 5) Rare, threatened and endangered species habitats are properly identified, and the land is managed to protect the habitats and occurrences of rare, threatened and endangered species. 6) Important plant communities are properly identified, and the land is managed to protect important plant communities. 7) Deer wintering areas are properly identified and managed to maintain or improve their value as winter cover for deer.

Outcome 6: Public accountability - 1) The landowner will maintain independent 3rd party certification with a nationally recognized sustainable forestry management certification system without major, unresolved non-conformances on managed lands. 2) A Licensed Forester within the company will review and approve the landowner's Forest Management Plan. 3) The landowner will employ Licensed Foresters who are actively involved in the management, planning and supervision of operations on the land. 4) All timber harvesting contractors will employ at least one person possessing Certified Logging Professional or Qualified Logging Professional certifications or the equivalent.

Outcome 7: Economic considerations - The landowner's management activities support as vibrant and diverse a forest products industry as is practicable, including loggers, truckers, and production facilities.

Outcome 8: Social considerations - The landowner provides opportunities for appropriate historic and traditional recreational uses that do not conflict with the landowner's values or objectives.

Outcome 9: Forest Health - Landowner does what is prudent and practicable to monitor for and prevent and control insects, disease, and fire, consistent with good practice in the industry and assists MFS in forest health monitoring programs on the ownership.

OBF policy treats certification by FSC, SFI, and American Tree Farm System as *"prima facie evidence that the participant has achieved compliance with the state's sustainability goals and outcomes"* (MFS 2012). This approach allows the state to work with an established framework of forest sustainability principles and practices, as well as an established third-party auditing process to avoid developing another independent system of compliance for OBF. A member of the OBF expert panel is invited to participate in each certification audit field visit and the panel is encouraged to *"provide input to the third party lead auditor on behalf of the panel"* (MFS 2012). There have been concerns that certification systems are not a stringent enough assessment of sustainability (Sherwood 2014) and regarding the use of certification systems as evidence of compliance (Patterson 2013). However, certification alone is not sufficient for participation in OBF. Participating landowners must report separately to the OBF expert panel as part of their enrollment in OBF.

OBF Expert Panel

OBF was designed to provide participating landowners with flexibility and creativity in their forest management while meeting the required outcomes in the agreement. The overall goal of OBF is to encourage the landowner to focus on science-based forestry practices rather than prescriptive rules and regulations. To assist with this goal and ensure that the landowner is achieving the agreed upon outcomes, a panel of governor-appointed technical experts is charged with overseeing the implementation, monitoring, and achievement of the OBF agreements.

The current panel is comprised of six forestry professionals. Their backgrounds range from silviculture to entomology, including wildlife biologists, University of Maine professors, FSC auditors, and active members of Maine's forest industry. They attend yearly site visits and field inspections - including certification audits - and process the metrics reported by IW and BPL. Their diverse experience in managing Maine's natural resources is key to making OBF a robust policy capable of benefiting the public, landowner, and environment. The complexities of each individual outcome demand the diversity and experience of an OBF panel capable of interpreting within each individualized agreements whether landowners have met constraints ranging from operational to silvicultural to ecological.

Public Concerns Regarding OBF

Following enrollment of OBF's first two participants, newspaper articles and an April 2014 public hearing and work session in the legislature's Agriculture, Conservation, and Forestry (ACF) committee elucidated public concerns about OBF: "*the change happened without public knowledge; it appeared to be a big policy shift in how Maine's forests are managed, since Irving is the largest forest landowner in the state; and it was not clear how the success of Outcome Based Forestry would be measured"* (The Free Press 4-3-2014). These concerns led to the passage of LD 1847 – An Act to Clarify Outcome-Based Forestry – in 2014. This act amended OBF's reporting standards, both between enrolled participants and the Maine Forest Service, as well as between the MFS and the ACF committee. A new seat was created on the OBF panel to be filled by the public, with the entire ACF committee serving as their proxy.

Alongside these issues of transparency, the close relationship between IW and the MFS, and the ties between OBF panel members and the forest products industry raised concerns of regulatory capture (Pine Tree Watchdog 9-16-15), (Portland Press Herald 11-23-2013).

Regulatory capture occurs when a government agency created to regulate industry functions instead to advance the interest of the industry that it was intended to regulate.

MAINE FOREST LANDOWNER AGREEMENTS UNDER OBF

Irving Woodlands

OBF agreements are unique documents, containing different desired outcomes, reporting standards, and technical constraints – tailoring the policy to the participating organization. IW enrolled its entire ownership of 1.25 million acres in OBF. As part of their agreement, IW committed to maintain certification with the FSC, and to promptly address any Nonconformance or Corrective Action Request issued by that system. The OBF Expert Panel uses the standards provided by the sustainable forestry certification system, periodic third-party audits, and the overall management framework provided by certification, as well as its own reviews of company performance to determine whether IW is meeting the state forest sustainability standards under the OBF agreement.

The desired outcomes of IW's agreement are to *"improve timber quality and quantity through active forest management while reducing the forest's susceptibility to disease, insect infestations and damage caused by fire, wind and climate change,"* as well as to *"improve reforestation success, growth rates, and/or timber quality on site specific areas and on a landscape basis, using a variety of forest management techniques that may include but are not limited to the establishment of planted areas, vegetation management, matching species to site, tree improvement techniques, fertilization, and pre-commercial and commercial thinning."* To demonstrate their compliance with the agreement, IW provides annual reports to the MFS that include a detailed list of metrics:

- Acres of high risk separation zones harvested during the year
- Trends in silvicultural investments organized by Forest Operations Notification (FON) number
- Estimates of harvest acreage for the next five year summarized by silvicultural prescription (overstory removal, commercial thinning, shelterwood, or clearcut)
- A more specific annual harvest plan which describes planned acreage for harvests for the coming year in each township separated by prescription, with clearcuts exceeding 250-acres mapped individually
- Annual harvest summary for the previous year, including a summary of area harvested by prescription (actual vs. planned) and total volumes
- Annual regeneration report for clearcuts as well as acres planted by species and site class organized by FON number
- Road density (miles per acre of township by township)
- Harvest opening size distribution
- Development stage distribution (between regeneration, sapling, young, immature, mature, and overmature)

As many of these metrics are proprietary information, the agreement also features a section stipulating the confidentiality of information released to the MFS, including an Appendix listing

which parts of the metrics fit under the definition of proprietary, and thus would be exempt from disclosure under Maine's Freedom of Access Act request. Should IW breach any provision of the agreement, the Maine Forest Service may terminate the agreement if IW "*has failed to cure such breach to the reasonable satisfaction of the MFW within [a] ninety day period," or longer if the "cure cannot be reasonably effectuated within such ninety day period*" (MFS 2012).

Maine Bureau of Parks and Lands

Relative to the OBF agreement with IW, the Maine Bureau of Parks and Lands (BPL) agreement is focused on targeted application of OBF – enrolling only specific parcels of land into OBF – roughly 3,000-acres in total - with two main desired outcomes: (1) to enhance deer wintering areas, and (2) to ensure the successful establishment and increased timber growth and quality of high value species such as sugar maple (*Acer saccharum),* yellow birch (*Betula alleghaniensis),* and white pine (*Pinus strobus)*. In the Appendix to their agreement BPL describes specific outcomes and methods for achieving these goals – testing low density pine management, low thinnings of spruce poletimber, hardwood seed tree harvests, as well as treatments of mixedwoods to accelerated their development into deer wintering areas and the creation of browse and edge.

BPL must also maintain its certification with the SFI and invite a panel member on the audit field visits with their Silvicultural Advisory Committee. Their reporting metrics are less extensive than those for IW, because of their limited acreage and low rate of clearcutting, and include:

- Periodic results of their efforts to improve deer cover and quality timber resources
- Estimates of harvest acreage for OBF projects for the next five years summarized by silvicultural prescription
- A more specific annual harvest plan mapped by prescription and with clearcuts greater than 60-acres identified, an annual harvest summary of the previous year's harvest by prescription (actual vs. plan)
- Regeneration targets and success for natural stands

Katahdin Forest Management

Katahdin Forest Management's (KFM) OBF agreement with the state is similar to that of IW. All of their 300,000-acres fall under the purview of their enrollment. KFM is responsible for reporting the same harvest management metrics listed above in IW's agreement, and protected by similar confidentiality stipulations. Several minor differences in participant commitments may reveal extra emphasis put on concerns by the state or either participant in formulating the agreement, or regionally specific details. For example, while in IW's agreement they agree to prepare an annual report regarding efforts to maintain and protect critical deer wintering habitat, KFM's agreement includes a similar report for all important wildlife habitat, as well as providing copies of their policies addressing specific habitat features such as vernal pools. KFM also agreed to prepare an annual report regarding their efforts to support economic development in the Katahdin region. Noticeably absent from KFM's agreement is a commitment to retain sustainable forestry certification. The lack of a certification requirement was due to a 2014 change in OBF law, stating that 3rd-party certification cannot be legally required or used as a proxy for attaining the outcomes (Don Mansius, Personal Communication). KFM is certified by SFI, and agreed to allow a panel member to participate in their audits. However, the language

used in the commitment included flexibility regarding their certification status: allowing a panel member *"to participate in any third party certification review of the Participant's forest management practices, if any…"*

HOW IRVING WOODLANDS IS IMPLEMENTING OBF

In order for forest landowners to achieve specific forest management outcomes, such as those mandated in their OBF agreement, they must be able to document certain qualitative and quantitative measures of their operations. IW uses Key Performance Indicators (KPIs) as a primary tool for meeting their business management objectives and engaging in a process of continuous improvement. Therefore, in order to measure their compliance with the nine sustainability goals under OBF, IW developed and uses a list of KPIs. Tracing these KPIs through their implementation, monitoring, and internal enforcement reveals how IW's management framework and philosophy are used to ensure compliance with its OBF agreement.

Key Performance Indicators

KPIs are not simply standards or statistics to be measured against, but rather a list of policies, past actions, and procedures that serve as indicators of IW's achievement of the nine sustainability goals of OBF. In many cases, IW's practices have not changed to include these indicators specifically, but are a regular part of their land management that also allows them to monitor their compliance with OBF.

Standard Operating Procedures (SOPs), along with IW's environmental policies and management plan constitute the majority of KPIs spanning many of the OBF outcomes. IW's harvesting SOPs are a set of rules that provide the backbone for all harvest operations. They cover a range of issues from fuel and oil spills, to protective equipment, to working near water and boundary lines. They act as a first order reference, or as a portable guide for addressing environmental and safety concerns. Specific environmental issues are treated in more depth within IW policies. For example, when a stick-nest (a nesting site for raptors) is encountered during a harvest operation, the SOPs instruct contractors: 1. Avoid the area, 2. Communicate the incident to the supervisor, and 3. Supervisor must follow appropriate policies. A review of IW's written environmental policy reveals proper identification of stick-nests, along with required buffers on a species-by-species basis. If there is any doubt about the identification or if it belongs to a species of concern such as a Bald Eagle or Great Blue Heron, the company naturalist and Maine Department of Inland Fisheries and Wildlife will consult to make recommendations concerning the harvest treatment around the nest. Other KPIs are focused on a single OBF sustainability goal, such as IW's use of a depth-to-water table to identify riparian zones – aiding in road and harvest layout to determine the most efficient stream crossings, as well as equipment choice for harvests.

Table 1.2 shows the list of KPIs that IW uses to monitor and meet the state's nine sustainability goals. This table shows the objective of each KPI, how it is implemented, how compliance is defined, and how feedback is used to correct non-compliance or reward excellence. Each KPI is a measure that IW uses to demonstrate achievement of the specific goals of OBF.

Table 1.2 - IW Key Performance Indicators for OBF compliance.

Outcome 1 – Soil Productivity	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Standard Operating Procedures (SOP)	The SOPs are a list of rules that provides guidelines for: fuel/oil spills, road/culvert damage, site disturbances.	The harvesting SOP list is a list of rules that can be found in every company vehicle and/or piece of equipment. The list is updated periodically, and all Irving employees and contractors are trained to the procedures in their environmental training. The work order, a document filled out for each harvest, describes risk potential at the operation, for example: potential rutting.	Contractors must do a periodic quality assurance check and file a compliance check for SOPs. Harvesting supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the SOPs are considered a non-conformance. These non-conformances are entered into the environmental management system (EMS) database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving SOPs they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during regular meetings with operations superintendents. Issues with the SOP list itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. The Sustainable Forestry Initiative (SFI) audits Irving to its compliance with company policy.
Measure Road Density	Irving tracks their road density by township.	Irving's GIS specialist tracks the percent of land in roads per township. This statistic is reported to OBF panel.	Road width and length are measured in GIS to calculate the area in roads per township. These figures are compiled and reported in excel spreadsheet.	Road density by township is reported to the OBF panel in Irving's yearly report.
Irving Best Management Practices (BMP)	Irving constantly is evaluating their choice of harvesting system, and other equipment to minimize impact (steep vs. riparian vs. etc.).	When Irving determines there is a need for a new or updated BMP, they work with their contractors as part of their contractor improvement plan to develop company BMPs specific to each piece of equipment, as well as for each type of terrain (steep, wet, etc.). Irving uses (and is acquiring more) cut to length systems with forwarders allows for	Compliance with BMPs is checked by harvesting supervisors during biweekly audits and by operations superintendents at quarterly site visits.	In order to develop BMPs, Irving incents contractors with performance bonuses. Those contractors with good behaviors and high productivity are eligible for the full environmental & perfomance incentive bonus. Irving chooses contractors for specific harvests – example steep slopes - based on their performance and equipment.

		longer skid distances and thus less area in roads. Irving also maintains its own road building crews and equipment.		
Work Order	The work order is a form given to contractors describing the harvest - how to cut: pecking order, harvest treatments, and risk potential - for example: steep slopes.	A specific work order is given to the contractor for each harvest. Any changes to the work order must be approved by forester and recorded in the work order.	Violations of the work order are considered a non-conformance and are reported and tracked in the EMS. Work orders from completed harvests are kept on file at Irving.	If contractors are non-compliant with Irving work orders they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during meetings with Operations Superintendents.
Outcome 2 – Water Quality, Wetlands, and Riparian Zones	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Standard Operating Procedures (SOP)	The standard operating procedures are a list of rules that provides guidelines for: working near watercourses, road and culvert damage procedures, and control and disposal of hazardous material	The harvesting SOP list is a list of rules that can be found in every company vehicle and/or piece of equipment. The list is updated periodically, and all Irving employees and contractors are trained to the procedures in their environmental training. The work order, a document filled out for each harvest, describes risk potential at the operation, for example: unmapped brooks, temporary crossings, and vernal pools.	Contractors must do a periodic quality assurance check and file a compliance check for SOPs. Harvesting supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the SOPs are considered a non-conformance. These non-conformances are entered into the environmental management system (EMS) database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving SOPs they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during regular meetings with Operations Superintendents. Issues with the SOP list itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Environmental Policy	Irving environmental policy addresses proper identification and protection of watercourses and	Irving's yearly environmental training educates employees and contractors on environmental policy. All company policies are available in written form on the company intranet. Each Irving	Contractors must do a quality assurance check and file a compliance check detailing several items from environmental policy. Harvesting Supervisors conduct a periodic audit of each	If contractors are non-compliant with Irving Environmental Policy they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during regular meetings with Operations Superintendents. Issues with

	vernal pools (buffers), and responsible herbicide use.	operational district has a "champion" who is in charge of identifying vernal pools/stick nests – all questions are directed to him; more difficult environmental questions are directed to company naturalist/biologist.	contractor, as well as unannounced visits to all harvest operations. Violations of the policy are considered a non-conformance. These non-conformances are entered into the EMS database, which tracks and compiles weekly incident statistics.	Environmental Policy itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Depth to Water Table (DWT)	A map interpolating soil, contour, and stream data describing the depth to water at any point on Irving's landbase	The DWT is shown as a GIS constraints layer. When blocking harvests or laying out roads foresters use Trimble Arcpads loaded with constraints layer to identify sensitive areas.		
Management Plan	Irving's management plan describes their treatment of special management zones such as riparian zones.	The plan describes Irving's treatment of riparian zones to "meet or exceed all regulatory standards." The public version of Irving's management plan is made available online.	Harvesting Supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Any non-compliance is reported in EMS database.	If contractors are in non-compliant status they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during meetings with Operations Superintendents.
Irving BMPs	Irving constantly is evaluating their choice of harvesting system, and other equipment to minimize impact i.e. choosing rubber tire harvesters for riparian zones. In partnership with their contractors Irving developed BMPs to rdescribe how to mitigate environmental	When Irving determines there is a need for a new or updated BMP, they work with their contractors as part of their contractor improvement plan to develop company BMPs specific to each piece of equipment, as well as for each type of terrain (steep, wet, etc.). Irving uses (and is acquiring more) rubber tire harvesters to minimize rutting.	Compliance with BMPs is checked by harvesting supervisors during periodic audits and by Operations Superintendents at site visits.	In order to develop new BMPs Irving incents contractors with performance bonuses. Those contractors with good behaviors and high productivity are eligible for the full bonus. Irving chooses contractors for specific harvests – example steep slopes - based on their capabilities, performance, and equipment.

	issues.			
Outcome 3 – Timber Supply and Quality	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Management Plan	Irving's management plan addresses 80 years of future forest management with the first 25 years examined spatially to form a blocked management plan.	The plan describes growing stock, Irving's annual allowable cut (AAC), the mix of product classes, and silvicultural investments – and how each of these elements will change over the next 80 years. The public version of Irving's management plan is made publically available online.	Irving tracks their silvicultural investments and yearly metrics such as harvest volume and product classes.	Irving's "Focus Items" – areas where they have struggled in the past or critical metrics such as achieving AAC are identified and tracked in company SFM report card – an incentive based corporate report of performance of each Region.
Standard Operating Procedures (SOP)	The Standard Operating Procedures are a list of rules that provides guidelines for working near plantations, thinnings, and residual trees	The harvesting SOP list is a list of rules that can be found in every company vehicle and/or piece of equipment. The list is updated periodically, and all Irving employees and contractors are trained to the procedures in their environmental training. The work order, a document filled out for each harvest, describes risk potential at the operation.	Contractors must do a periodic quality assurance check and file a compliance check for SOPs. Harvesting supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the SOPs are considered a non-conformance. These non-conformances are entered into the environmental management system (EMS) database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving SOPs they are ineligible for their environmental & performance incentive bonus. Persistent contractor issues are dealt with during regular meetings with Operations Superintendents. Issues with the SOP list itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Work Order	The work order is a form given to contractors describing the harvest - how to cut: pecking order, harvest treatments, and risk potential - for example: steep slopes.	A specific work order is given to the contractor for each harvest. Any changes to the work order must be approved by forester and recorded in the work order.	Violations of the work order are considered a non-conformance and are reported and tracked in the EMS. Work orders from completed harvests are kept on file at Irving.	If contractors are non-compliant with Irving Work Orders they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during meetings with Operations Superintendents.

Outcome 4 – Aesthetic Impacts of Timber Harvesting	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Standard Operating Procedures (SOP)	The Standard Operating Procedures are a list of rules that provides guidelines for: working near legal boundary lines.	The harvesting SOP list is a list of rules that can be found in every company vehicle and/or piece of equipment. The list is updated periodically, and all Irving employees and contractors are trained to the procedures in their environmental training. The work order, a document filled out for each harvest, describes risk potential at the operation, for example: islands.	Contractors must do a periodic quality assurance check and file a compliance check for SOPs. Harvesting supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the SOPs are considered a non-conformance. These non-conformances are entered into the environmental management system (EMS) database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving SOPs they are ineligible for their environmental & performance incentive bonus. Persistent contractor issues are dealt with during regular meetings with Operations Superintendents. Issues with the SOP list itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Irving Visual Policy	Areas identified as visually sensitive are treated specially by planning foresters to consider: the viewshed of the harvest, trail patterning, choice of prescription, hill contour, and time of year. They also attempt to minimize the impact of harvesting with irregular edges, islands, and use of topography.	Currently there is no formal policy for harvesting in visually sensitive areas. These areas are identified by stakeholder group, the public, and Irving foresters, and are dealt with on a case-to-case basis.	Any public complaints are logged in EMS database.	Complaints are discussed during operations meetings.

Environmental Policy	Irving environmental policy addresses maintaining vertical structure using islands and peninsulas.	Irving's environmental training educates employees and contractors on environmental policy. All company policies are available in written form on the company intranet.	Contractors must do a periodic quality assurance check and file a compliance check detailing several items from environmental policy. Harvesting Supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the policy are considered a non-conformance. These non-conformances are entered into the EMS database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving Environmental Policy they are ineligible for their weekly incentive bonus. Persistent contractor issues are dealt with during bimonthly meetings with Operations Superintendents. Issues with Environmental Policy itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Allagash Wilderness Waterway	Harvesting along the Allagash Wilderness Waterway requires permits and compliance with extra rules for harvesting.	One planning forester is in charge of these operations. The areas alongside the AWW are identified in the constraints layer in GIS.	Allagash Wilderness Waterway signs off on these permits.	Violations of AWW permit results a warning or fine.
Informational Signs	Irving posts informational signs at key locations on their roads.	These signs are posted at high traffic roads and main intersections for safety and directional purposes, as well as marking closed roads. Irving also maintains informational signs identifying PCT and plantation sites.	Foresters report installation of these signs, and often photograph and file information regarding important signs.	
Outcome 5 – Biological Diversity	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Ongoing Research Partnerships	Irving maintains many research partnerships and membership on committees such as the Cooperative Forestry Research	Irving contributes funds which fuel research across the spectrum of forestry and the environment.		

	Unit, the Forestry Research Advisory Council, the Forest Products Council, and several other committees.			
Environmental Policy	Irving environmental policy addresses late successional forests, invasive species, islands and peninsulas, legacy trees, threatened and endangered species, vernal pools, deer wintering areas, stick nests, riparian zones wildlife habitat, and species of concern.	Irving's environmental training educates employees and contractors on environmental policy. All company policies are available in written form on the company intranet.	Contractors must do a periodic quality assurance check and file a compliance check detailing several items from environmental policy. Harvesting Supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the policy are considered a non-conformance. These non-conformances are entered into the EMS database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving Environmental Policy they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during regular meetings with Operations Superintendents. Issues with Environmental Policy itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Standard Operating Procedures (SOP)	The Standard Operating Procedures are a list of rules that provides guidelines for: site specific habitat procedure.	The harvesting SOP list is a list of rules that can be found in every company vehicle and/or piece of equipment. The list is updated periodically, and all Irving employees and contractors are trained to the procedures in their environmental training. The work order, a document filled out for each harvest, describes risk potential at the operation.	Contractors must do a periodic quality assurance check and file a compliance check for SOPs. Harvesting supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Violations of the SOPs are considered a non-conformance. These non-conformances are entered into the environmental management system (EMS) database, which tracks and compiles incident statistics.	If contractors are non-compliant with Irving SOPs they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during regular meetings with Operations Superintendents. Issues with the SOP list itself are dealt with during Irving operations meetings, management reviews (Maine level), and corporate management reviews. Irving is audited to its compliance with company policy by SFI.
Cooperative Deer Wintering Areas (DWA)	Irving voluntarily entered into an agreement with MDIFW to manage	In coordination with MDIFW, Irving has determined the DWA's on their landbase and treats them as a special	Any violations of the agreement are reported in EMS.	If contractors are in non-compliant status they are ineligible for environmental & performance bonus. Persistent contractor issues are dealt with during regular

	DWA's according to MDIFW standards.	management zone. They are treated with an independent AAC. Irving has over 120,000-acres of DWA in special management.		meetings with Operations Superintendents.
High Conservation Value Forests (HCV,)	Irving works to identify and protect areas of high conservation value.	Through yearly petition of state agencies, consultation with MNAP and Manomet, Irving determines which areas should be preserved on their landbase. These HCV forests are tracked in the constraints layer in GIS.	Irving reports on the number of sites and acreage to FSC.	
Unique Areas Program	Irving's Unique Areas Program identifies and protect sites for a number of different purposes: Aesthetics, Birds and Mammals, Fish, Old Growth and HCV Forests, Lakes and Wetlands, Plants, Historic, Geological and Fossil, Reptiles and Amphibians, and Unique Forest Stands. The Unique Areas Program also protects places for social considerations such as swimming spots.	New potential protected areas are identified by input from the Stakeholder Advisory Group, the public, yearly petitions to state government (including Maine Historic Preservation Committee, consultation with MNAP, and on-the-ground operations. Each site/type has a unique management plan written for it by company biologist/expert such as an archaeologist. Any harvest near these areas would identify them in the work order.	Protected areas are entered into a constraints layer in Irving GIS, and the number of sites and acreage are reported through the Irving Unique Areas Program. Any violation of their special management plan would be a non-compliance reported in the EMS.	
Management Plan	The management plan addresses favoring uncommon tree species and	Describes Irving treatment of special management zones – i.e. Deer Wintering Areas, Unique Areas, Riparian Zones, and Late Successional Areas.	Harvesting Supervisors conduct a periodic audit of each contractor, as well as unannounced visits to all harvest operations. Any non-compliance	If contractors are in non-compliant status they are ineligible for their environmental & performance bonus. Persistent contractor issues are dealt with during regular meetings with Operations

	treatment of special management zones.	The management plan also stipulates that uncommon species are treated as "invisible" in PCT and thus not harvested. The public version of Irving's management plan is made publically available online.	is reported in EMS database.	Superintendents.
Standing Dead Policy	Standing dead trees are retained on Irving land unless they are located in a clearcut, in which case they are cut for safety reasons.	No formal policy.		
Down Woody Debris (DWD) Study	An Irving study assessing whether current Irving practices met the FSC DWD standards.	A MIFW Wildlife biologist conducted a line sampling study on DWD showing that Irving more than satisfies FSC standards for DWD.		
Outcome 6 – Public Accountability	**Objective**	**Implementation**	**Monitoring**	**Feedback**
3rd Party Certification	Multiple 3rd parties, including: the Forest Stewardship Council, the Sustainable Forestry Initiative, and ISO 14001 certify Irving to be practicing sustainable forest management.	Irving's Certification Coordinator facilitates the audit processes.	Irving's compliance with certification standards is assessed during periodic 3rd party audits. The reports from those audits are posted on IW's website.	Address all non-conformances, addresses observations/opportunities for improvement.
Management Plan	Irving's management plan is prepared by an expert team that	The public version of Irving's management plan is made publically available online.		

	includes a Maine licensed forester			
Stakeholder Advisory Group	Irving conducts periodic stakeholder advisory meetings to gather input on recreational issues as well as other matters from representatives of various interest groups.	The stakeholder advisory group is currently composed of biologists, guides, First Nation groups, camp lessees, local representatives, contractors, Maine Forest Service employees, and consulting foresters. The meetings typically address topics such as Irving's Operational Plan for the year, the new Ashland mill, Outcome Based Forestry, and herbicide use.	IW staff members attend the meetings. Issues and concerns raised in meetings are noted by IW staff and tracked in EMS.	Issues raised during the stakeholder advisory group meeting are discussed during operations meetings.
Harvesting Contract	Irving's harvesting contract stipulates that contractor must employ a CLP/QLP.	CLP/QLP employees are identified and reported in the contracts.	At each contract signing Irving checks certificate of CLP from each contractor to ensure they comply.	Most contractors have CLP regardless due to the insurance incentive. Irving won't hire a contractor without CLP on staff.
Licensed Foresters	The company must employ licensed foresters.	Irving's planning foresters are licensed foresters and plan or review all operations; in addition many other licensed foresters are on staff.	Irving files a list of licensed foresters to MFS.	Irving preferentially hires licensed foresters.
Outcome 7 – Economic Considerations	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Diversity of product/customers	Irving sells wood to large and small buyers. A multitude of products are created from their wood. Irving also has a program and dedicated staff to purchase wood from local suppliers.		Irving tracks the statistics of wood procurement and sales, specifying: purchasing company, species, product, end use.	

Economic Impact Report	A yearly report detailing the economic impact of Irving Woodlands. The economic impact report details: direct employment, contractor employment, indirect employment, salary fairness, tax levels, local spending, charitable donations, capital investments in IW facilities, and company purchases in the community.	Irving contracts a third party consulting firm to compile a yearly economic impact report.	This report is submitted to the FSC.	
Contractor Growing Business Plan	Irving works to create and grow new contractors for trucking and harvesting.	Irving provides and guarantees loans, training, schooling, coaching of contractors as well as a forming a startup plan for them. Irving requires any contractor with Irving financing to engage in BMPs for equipment maintenance.	Irving monitors the success rate of these contractors.	Irving works with their contractors via contractor improvement plans to increase productivity and improve their operation.
Donations	Irving provides numerous charitable donations within local communities.			
Local Impact	Irving works to align with local economic development goals.	Irving coordinates with Northern Maine Development Commission to achieve local economic goals.		
Ashland Mill Decision	Irving invests in new production facilities within the	In 2013 Irving made a $30 million investment in the new Ashland Mill.		

	state.			
Outcome 8 – Social Considerations	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Management Plan	The management plan describes how traditional uses are protected on Irving lands. Irving meets with the Maine Department of IF&W, various local outfitters, the Maine Snowmobile Association, and a number of local ATV clubs to coordinate public use of Irving land. Irving roads are open for public use.	The public version of Irving's management plan is made publically available online.		
Stakeholder Advisory Group	Irving conducts stakeholder advisory meetings to gather input on recreational issues as well as other matters from representatives of various interest groups.	The stakeholder advisory group is currently composed of biologists, guides, First Nation groups, camp lessees, local representatives, contractors, Maine Forest Service employees, and consulting foresters. The meetings typically address topics such as Irving's Operational Plan for the year, the new Ashland mill, Outcome Based Forestry, and herbicide use.	IW staff members attend the meetings. Issues and concerns raised in meetings are noted by IW staff and tracked in EMS.	Issues raised during the stakeholder advisory group meeting are discussed during operations meetings.
Unique Areas Program	Irving's Unique Areas Program identifies and protect sites for a number of different purposes:	New potential protected areas are identified by input from the Stakeholder Advisory Group, the public, yearly petitions to state government (including Maine Historic Preservation	Protected areas are entered into a constraints layer in Irving GIS, and the number of sites and acreage are reported through the Irving Unique Areas Program. Any violation of their special	

	Aesthetics, Birds and Mammals, Fish, Old Growth and HCV Forests, Lakes and Wetlands, Plants, Historic, Geological and Fossil, Reptiles and Amphibians, and Unique Forest Stands. The Unique Areas Program also protects places for social considerations such as swimming spots.	Committee, consultation with MNAP, and on-the-ground operations. Each site/type has a unique management plan written for it by company biologist/expert such as an archaeologist. Any harvest near these areas would identify them in the work order.	management plan would be a non-compliance reported in the EMS.	
North Maine Woods	Approximately 60% of Irving lands west of Route #11 and south of route #161 are part of the nonprofit cooperative recreational management North Maine Woods (NMW) program. The NMW provides recreational opportunities for the public in working forestland.	Irving contributes funds to NMW for road construction and maintenance (among other things).		
Outcome 9 – Forest Health	**Objective**	**Implementation**	**Monitoring**	**Feedback**
Fire Policy	Irving fire policy details how to deal with a fire, stipulates proper	In order to maintain preparedness Irving employees are given yearly training in coordination with MFS: pump	Irving audits its fire preparedness – checking all fire suppression systems: fire trucks, pumps and water tanks, airports.	After the mock fire all participants take place in a debrief with the Maine Forest Service to discuss successes and areas for improvement. The internal audit is

	notification procedures and chain-of-command. Irving coordinates their fire fighting efforts with the Maine Forest Service	training, resource sharing (trucks/fire caches), Incident Command System Training (the emergency protocol system used by the MFS). The fire plan centrally located in Irving's office.	The audit also involves a yearly mock fire allows employees to practice skills in the field.	coordinated by Irving's corporate office and feedback is given upon completion.
Management Plan	In Irving's management plan they describe the forest health concerns that Irving is working to mitigate: Emerald Ash Borer, Asian Longhorn Beetle, Gypsy Moth, Sudden Oak Death, Japanese Knotweed	The public version of Irving's management plan is made publically available online.		Irving internally audits themselves through their Sustainable Forest Management program (SFM), which assess Irving divisions on how well they meet each of the year's focus items – regionally specific environmental and forestry goals.
Pest/Disease Monitoring	Irving coordinates their pest and disease monitoring efforts with the Maine Forest Service.	Irving monitors for pests – especially those of concern to the Maine Forest Service – through flights, on-the-ground operations, and traps.	Areas affected by forest health problems – burned, blowdown, defoliated, pesticide application – are created as GIS layers.	

Implementation

Ensuring successful implementation of KPIs is necessary for IW to meet its goals under OBF. This is a difficult proposition because most of IW's harvest and trucking operations are contractor owned, and therefore somewhat removed from their direct management. IW works for uniformity through a program of education, technology, and a detailed harvest planning with their contractors. Company naturalists conduct periodic environmental trainings. These training sessions focus on the SOP list, changes to IW environmental policies, and addressing any non-conformances or areas of improvement noted by 3rd-party audits. All IW employees attend the training which functions as a "train-the-trainer" style of education, as harvesting supervisors follow up with contractors and instruct them in the field.

The other critical element in meeting OBF sustainability goals is the work order. This document is the written interface between forester and contractor, stipulating elements like pecking order, prescription, and basal area target, but also special features of the harvest – potential rutting, steep ground, bear dens, retention of islands, etc. A planning forester must approve any changes to this harvest plan. IW's use of technology also helps implement KPIs. Many foresters carry Trimble Arcpads loaded with a depth-to-water table as well as constraints layers that identify sensitive areas such as stick nests, legacy trees, and HCV forests. This helps foresters to avoid encroachment of these sensitive areas, as well as to design a harvest that minimizes stream crossings. Every piece of equipment – whether it be company or contractor owned – is loaded with a computer system linked to IW's GIS, helping to curtail cutting riparian buffers or operating outside of the block as well as other problems often associated with nighttime harvests or inclement weather.

Monitoring

IW uses both internal and external scrutiny to measure compliance with their policies and procedures. All contractors must complete a quality assurance checklist, as well as file a compliance check covering a range of items from SOPs and environmental policy. IW's Harvest Supervisors visit each contractor they are responsible for on a regular basis to audit the job, and IW's Operations Superintendents administer unannounced visits of each harvest job. Failure to meet the environmental policy or violation of SOPs results in an immediate non-conformance for the contractor and is entered into the environmental management system (EMS) to track the offense. If a certain non-conformance becomes a repetitive issue, disciplinary action is taken.

External monitoring exists in the form of visits from the Maine Forest Service, the OBF expert panel, and yearly 3rd-party audits from SFI, FSC, and ISO. Due to the newness of the OBF agreement these MFS and OBF panel visits are relatively frequent.

Feedback Loop

Process improvement is an important part of IW's focus as a company, which has led to the creation of an adaptive management structure. Operations meetings take place at regular intervals to review active harvests and road construction, debrief closed operations, and prepare for the future. At these meetings, contractor non-conformances are reviewed and corrective actions are taken. Management reviews at the Maine and corporate levels deal with reviewing and improving overarching issues, such as internal policies or overall performance. These meetings are the structure in place for incorporating feedback such as audits and public opinion

to modify environmental policy, operating plans, and to set objectives or targets for the next year. IW's Sustainable Forest Management program (SFM) is an inter-divisional report that compares results of each Irving Woodlands district in categories known as management focus items– items such as survival of planted trees or attaining their annual allowable cut for the year.

Contractors are incented to improve their operations through the environmental and productivity incentives, which include a bonus that can be earned through conformance with policies and achieving a specific level of productivity. Contractor behavior is measured by their work on a contractor improvement plan, a plan created by Operations Superintendents and each contractor individually to work toward certain goals, sometimes remedial actions such as minimizing soil rutting, other times these plans include items like developing a new IW BMP manual for a specific piece of equipment. Environmental considerations are a requirement for eligibility in this incentive program. Any non-conformance will result in a temporary forfeit of the bonus. If the same non-conformance becomes a regular offense, it is dealt with through mutually agreed remedial actions and discipline.

Non-Timber Resources and KPIs

Several criteria and goals of OBF pertain to practices involving non-timber resources such as the economic and social considerations of IW's land management. These requirements broaden the definition of sustainability beyond sustained yield timber supply, requiring IW to *"optimize benefits to the local and regional economy," "support the communities surrounding their land and operations"* and *"provide historic and traditional recreational opportunities."* To allow for public input regarding their operations, IW facilitates a Stakeholder Advisory Group, composed of representatives from a variety of interest groups, which discuss issues such as the annual operational plan. This advisory group is privy to confidential and proprietary details of IW's management – serving as a liaison to the public interest. To satisfy economic goals, IW works in multiple scales. IW helps to develop the business of their contractors, by providing and guaranteeing their loans, facilitating training, schooling, and coaching, as well as forming a startup plan for their business. They are very aware of their presence within the local and regional economy: contracting a yearly economic impact statement from third party consulting firm. In 2013, IW invested $30 million in a new sawmill in Ashland, Maine and made clear that such an investment was related to their ability to manage their forestlands under OBF.

Regulatory Measures Guiding IW Practices

IW's land management is governed by a combination of voluntary and legal guidelines – a multi-tiered regulatory system aimed at improving forestry practices and achieving or maintaining sustainability. The first tier is state law and regulations, such as paying taxes and abiding by standards for Deer Wintering Areas as zoned by the Land Use Planning Commission. The second tier is federal law: following EPA regulations like the Clean Water Act. These tiers are mandates, the required elements of running a business. The third tier of IW practices is governed by suggestions – Best Management Practices developed either independently or by the Maine Forest Service. These rules, while not always of legal necessity, elevate the environmental standards and sophistication of practice. The fourth tier is independent certification by 3rd-party agencies such as the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), and International Organization for Standardization (ISO). These organizations conduct periodic

audits of IW forest practices and management to an overlapping yet also complementary standard; each seems to have a separate focus.

SFI operates on a policy philosophy – an "if it isn't written, it doesn't exist" attitude. Their first priority is to crosswalk their standards against IW policy and look for gaps. Once those gaps are addressed, SFI's mission is to assess IW's compliance with their own policy – i.e., are your contractors familiar with IW policy? Do all of your operations have oil spill kits on site?

FSC tests the silvicultural knowledge and applied science of IW forestry. Their audits are more freeform, but equally rigorous. Instead of a plan-based approach their audits measure IW against a performance-based requirement, ensuring that they meet specific criteria.

ISO 14001 certification demanded the creation of an EMS to track any aspect of IW practices that could have a significant impact on the environment. With the EMS in place, IW can set objectives – such as to minimize rutting – and track their progression towards the goal with temporal, spatial, and empirical data. This EMS system is critical for continuous improvement, allowing IW to understand its environmental impact and where it should focus improvement efforts.

The final tier of oversight and improvement is OBF. OBF is not the creation of a new certification, but rather an alternative policy framework that allows new management flexibility while ensuring environmental protections that were already part of IW's management under certification, Maine law, as well as those defined in the OBF agreement. Many OBF principles align with certification standards – as shown in the FSC Crosswalk (Maine Forest Service, 2013). The OBF expert panel is comprised of professionals and academics in the fields of entomology, silviculture, wildlife biology, and former FSC auditors who have spent much or all of their careers practicing in Maine. Their understanding of Maine forestry allows them to hold IW to a high standard of management and to integrate what they see with other 3rd-party certification audits. Their annual audits of IW are times not only to reflect upon the efficacy of OBF, but also to talk about the scientific bases for IW decisions and suggest or mandate new measures that improve the implementation and measurement of OBF policy. This relationship exemplifies the collaborative focus of results-based environmental policies between regulators and industry.

Irving Woodland's Management System Related To OBF Implementation

Several factors eased IW's transition into adopting OBF, facilitating their efforts to implement and document achievement of the outcomes. IW employs an adaptive management structure that uses internal studies and an Environmental Management System (EMS) to track progress and inform decisions across all of their operations. While these measures are often oriented towards improving productivity (e.g., assessing the correct equipment mix for a certain harvest, or the correct machine head for a given piece of equipment) they are also well suited for documenting achievement of OBF goals. IW's formal review process, set in place to utilize data from this monitoring, incorporates regular meetings across levels of the company. This structured approach to implementation, monitoring, and incorporating feedback has allowed IW to enroll in OBF with relatively minor changes to their overall approach to forest management. By assigning each policy/internal action under their requisite OBF outcome, IW was able to assess their achievement of OBF policy, as well as identify and correct for any non-compliances. Further, they could demonstrate their achievement of OBF objectives, using quantitative data in many cases.

In addition, IW's use of GIS aided their ability to compile the statistics required for OBF reporting standards, items such as road density by township, or silvicultural investments by FON number. IW tracks many of these same metrics as part of their normal management planning, and thus little additional effort was required to implement OBF requirements. These efficiencies in implementation eliminated the barriers and costs of enrolling in OBF that other landowners without such a system of management might find to be a significant limitation to developing an OBF agreement.

CHAPTER TWO

Perceptions of Irving Woodlands Forest Managers Regarding Implementation of Outcome-Based Forestry Policy Relative to the Forest Practices Act

ABSTRACT

Successful adoption and implementation of a new policy requires the understanding and support of the policy by those responsible for its implementation. To understand the views of forest managers implementing Maine's new Outcome-Based Forestry (OBF) policy relative to the Maine Forest Practices Act (FPA), we interviewed two Irving Woodlands (IW) foresters in northern Maine to explore their perceptions of the policy at the corporate, social, and personal levels. IW foresters indicated that OBF provided significant benefits relative to FPA across all levels of their organization, and found it difficult to identify negative effects of adopting the policy. A major operational benefit of OBF identified by the foresters was the increased opportunity to spatially concentrate yearly/seasonal forest operations into sectors, resulting in reduced fixed costs such as road construction, increased contractor productivity, and a smaller annual harvest footprint – potentially decreasing landscape fragmentation. Increased spatial concentration of harvest operations under OBF required increased coordination to reduce conflict among those using IW lands for recreation and other purposes. Foresters also felt that since enrollment in OBF, their day-to-day duties have shifted from paperwork and other forms of regulatory compliance to tasks they feel increases the quality and value of their work. Perceived negative consequences of enrollment were adverse public perception about the policy, as well as increased oversight and costs associated with compliance to a new policy.

INTRODUCTION

Understanding how natural resource managers perceive and interface with policy is critical to predicting the success of their implementation. Marshall (2007) found that negative perceptions held by commercial fishers towards policy regulating the resource *"significantly and adversely influence their behavior and emotional response,"* which in turn affected their ability to cope with the risk of policy change and adaptation of the new policy.

In studies about the implementation of Ecosystem Management by the US Forest Service, researchers determined that *"the commitment and 'buy-in' of a policy by employees who work 'on-the-ground' should be of the utmost importance"* to successful implementation of the policy (Butler and Koontz 2005). Key challenges to policy implementation in that case were the organizational change and funding required to develop an adaptive management process, as well as the integration of social and economic components into their efforts. They believed that this was because *"natural resource managers are most often educated or trained in natural science, rather than social science"* (Butler and Koontz 2005). Thus, their focus and strengths are more frequently directed towards the environmental aspects of policy compliance.

The concept of sustainability in forest management has increased in breadth during its evolution, beginning with balancing harvest levels with growth – through sustained yield forestry

– to now include preserving a wide range of environmental and cultural elements, and spiritual values derived from the forests (Clark 2011). These spiritual and cultural qualities are the values with which individuals establish a deep connection to their place, which has been shown to *"influence environmentally responsible behavior in an individual's everyday life"* (Vaske and Kobrin 2001). Natural resource policy now incorporates the perceptions of local citizenry and their sense of place to guide management actions (Cantrill 2009). For forest managers, who live, work, and recreate in the same location, this place-based connection may affect the way they practice forestry, the pride they feel in their work and stewardship, and their attitudes towards society.

Forest policy has a tremendous effect upon the professionals who are charged with implementing them. The Forest Practices Act (FPA) has dominated harvest policy in Maine since it was passed in 1989, and has been successful at its intended goal - lowering the rate of clearcutting in Maine (MFS Annual Reports). For forest landowners that use clearcutting, however, the FPA introduces significant complications, difficulties, costs, risk, and anxiety. In addition, it created suboptimal or no silvicultural treatment in many forest stands, an inability of foresters to always follow natural stand boundaries, an over reliance on prescriptive rules rather than science and sound management, and increased fragmentation of the forest landscape.

As an alternative policy to the FPA, OBF provides a new approach to managing Maine forests. To understand the views of forest managers implementing OBF policy, we interviewed two Irving Woodlands (IW) foresters in northern Maine to explore their perceptions of OBF as an alternative to the FPA at the corporate, social, and personal levels.

METHODS

Case Study Design

This study employed a single-instrument, holistic, case-study design, whereby the case is of secondary interest, but is used to explore a particular phenomenon such as OBF (Stake 2010). We interviewed two IW foresters that had experience conducting forest management planning and operations under both FPA and OBF to explore their perceptions about OBF and FPA policies. Because Maine's forestland is dominated by private ownership, the future of OBF will depend upon the acceptance by and successful implementation of OBF policy by large, private forestland owners, we focused this investigation on IW - the first private company to implement OBF. Interviews were conducted on November 3, 2015, roughly 2.5 years after IW's enrollment in OBF.

Description of Case

IW is the last of the large industrial forest owners in Maine, with 1.25 million acres of timberland in Maine. This family-owned company is vertically integrated, with in-house trucking, rail, road construction, as well as several processing facilities throughout Maine and Canada. IW has managed a large ownership in Maine since the 1940s, expanding to its current acreage in the late 1990s (Hagan et al. 2005).

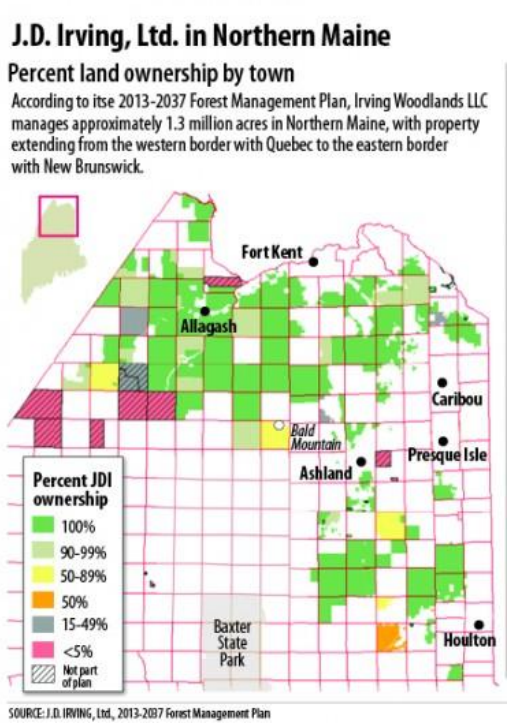

Figure 2.1 - Location of study site

As a company, IW focuses heavily upon continuous improvement and productivity. Managers are trained in process improvement through the Six-Sigma system, taught to identify and eliminate waste in each segment of the company, leading to a lean, streamlined, and productive operation. Environmental statistics are tracked through their Environmental Management System (EMS), and loggers are incentivized to both self-report infractions, and work with IW harvesting supervisors or operations superintendents to study and increase the productivity of their operation, or identify and progress in other areas of improvement. This continual, data-driven, self-assessment makes IW a strong candidate for studying policy implementation, as they know how and where they can benefit from their enrollment in an alternative policy like OBF.

Data were collected primarily at IW's office in Fort Kent, Maine, with other supporting information gathered during field visits and external conversations, as well as from MFS reports or other written sources.

Participant Selection

We interviewed two planning foresters from IW for this study. These participants were selected on the basis of their involvement in key aspects of forest planning and management within Irving Woodlands relating to OBF, as well as their extensive history operating under the FPA. During the first year of the study, I spent a full month working at the Fort Kent office, generating data for the first chapter of the study, reviewing internal policies, and meeting with representatives from each aspect of IW's operations. During that time I refined my understanding of OBF and IW's forest planning and operations by speaking with a variety of IW staff. That

time provided me with the opportunity to understand the specifics of their jobs, as well as their history within the company, and how they interface with OBF policy. Potential interview participants were selected based on my understanding of the staff's knowledge and experience.

Levels of Inquiry

Interview responses in the form of audio recordings of the participants' perceptions were collected using individual in-depth interviews to ascertain the effects of IW's enrollment in OBF. The questioning progressed through three levels of inquiry; each with a separate objective (Table 2.1) to keep participants focused within that frame of reference and stimulate new thoughts and connections.

Table 2.1 – Research objectives for three levels of inquiry

Level of Inquiry	Objective
Corporate	Identify areas where IW benefited from enrollment through increased productivity and efficiency, as well as costs and risks of OBF policy.
Social	Determine the effect of IW's operational responses to enrollment in OBF on environmental, economic, recreational, and cultural resources.
Personal	Understand how enrollment in OBF affected IW forester's professional responsibilities, as well as their stewardship of the land and connection to their community.

Questions investigating why certain effects of policy change manifested were posed with "how" instead of "why" after Becker (1998) to keep participants from feeling defensive. An interview protocol form (Appendix A) was used and the interviews were audio-recorded. Interview questions also can be found in Appendix A. Interviews were semi-structured and comprised of mainly open-ended questions. The interviewer was free to deviate from the protocol if new ideas or questions arose during the interview (Creswell 2007).

Questions were developed to provide equal weight for each level of investigation. At the end of each line of inquiry, participants were asked if there were any implications of the policy change that we had missed in our questioning. Interviewing multiple participants allowed us to compare their perceptions, to identify areas of corroboration, disagreement, or unique ideas. This corroboration between participants and also with data from other sources allowed us to ensure data quality, minimizing several limitations of interviews: such as bias, poor recall, and inaccurate articulation (Yin 2009). The small sample size was a conscious decision due to their close involvement with the policy, our relationship with the participants, and the richness of the data they were capable of providing. A concerted effort was made to probe for negative results of IW's enrollment.

Archival evidence in the forms of IW's written policy and internal studies, as well as testimony from the OBF panel, newspaper publications, and interviews of IW contractors were used to assess the veracity of interview data. Participant observation during several field tours also provided information used to assure data quality.

Analytical Approach

Effects of the policy change were identified from the interviews for each of the three hierarchical levels (company, societal, and personal). Analysis was done using NVivo as the First Cycle coding (Miles et al. 2014). This form of coding uses words or short phrases from a

participant's answers or explanations to detect reoccurring patterns. These patterns were identified in Second Cycle coding, which synthesizes codes into thematic categories. Coding is valuable as a form of analysis, a useful filing system, and can help to direct a line of inquiry. Data were not fully transcribed; instead only key ideas were coded and recorded.

Quality Assurance and Ethics

The quality of the study (i.e., trustworthiness) was maintained using triangulation, member checking, and rich description. Triangulation involves using multiple methods of data collection, including interview data, archival sources, participant observation, etc. to confirm the accuracy of results, as well as multiple sources (participants) to further assess consistency of data (Miles et al. 2014). Member checking involves using the study participants to review the findings to assess the accuracy, fairness, and credibility of the results (Creswell 2007). Following the interviews we transcribed the key ideas, and spoke with each participant, checking that our transcriptions of their responses as well as key ideas were accurate, and were not biased by our interpretations of their data. Rich description is a complete verbal depiction of the case, providing readers with sufficient data and context to personally determine key ideas, even prior to our analysis. Because IW has embraced and supported OBF policy, it was recognized that there may have been an incentive for IW employees to promote the positive aspects and minimize the negative effects of IW's enrollment in OBF.

RESULTS

Responses from the participants were coded into corporate, societal, and personal themes, and further categorized based upon effects of the policy change, separating between beneficial and detrimental outcomes. Table 2.2 summarizes the key ideas expressed by the two participants.

CORPORATE

Reduction in "Red Tape" Increases Efficiency and Value-Added Tasks

Enrollment in OBF led IW foresters to shift their focus during management planning and field visits. IW foresters feel that since enrollment they have been able to expend greater effort on value-added tasks, and much less on legally mandated "red-tape." Participants' responses to the question of how OBF has changed the time spent in harvest planning illustrates this change in focus, and how they felt it increased the effectiveness and efficiency of their operation to the benefit of the company and the environment.

Forester 2: "I don't think the time is any different, I'm still probably half and half woods and office, but I spend my time on things that line up better with our goals and objectives as a landowners and with the sustainability standards under outcomes."

Forester 1: "He [an IW forester] is spending much less time on having to develop individual clearcut plans…to maintain a paper-trail that really had no long-term benefits for forest management. I would say that it has probably cut-in-half the amount of time that he would have had to spend planning a road, or planning a watershed, or planning a landscape than he would have had to under the FPA."

Forester 2: "When I am spending time in the field I am spending time coaching the guys laying out wood for me on prescription, and picking the right prescription for the stand type and looking at quality islands and legacy trees to leave, talking about how things fit together in the landscape more so than – ok, here's where your lines should be because we can't get any closer to the next block."

Exemption from separation zone regulations has removed several tasks from the workload of IW field foresters, replacing them with efforts that IW employees perceive as more valuable, shown in Table 2.3. Under the FPA, prior to creating a clearcut foresters would need to check the entire separation zone to ensure that it met the basal area and size requirements required for the category of clearcut that they wished to create. This task required them to take quadrat plots, a time-consuming sampling effort – the same used by the Maine Forest Service - to assess the suitability of separation zones. Next, they would have to complete a Clearcut Harvest Plan. These documents detail the justification of the clearcut and actions necessary for riparian protection, assess the soil erosion and windthrow risk, describe the regeneration strategy, as well as provide a map of the harvest. These plans were required for every clearcut, and according to many of the foresters I have spoken with – inside and outside of IW - offered little value towards protection of the resource. Physical evidence at the IW office support this time savings, as binders full of clearcut management plans – which are required to be kept on file until regeneration standards are achieved (roughly 5 years) filled a shelf and closet at the IW office.

Forester 1: "You had to fill out forms, fill out paperwork and send it in. It was non-value added stuff for us as foresters, because you know nobody really looks at the things."

IW's GIS specialist also noted the time savings in the office. Under the FPA he was responsible for maintaining a rolling inventory of current separation zones, and creating numerous maps to file within clearcut harvest plans. With the removal of the legal necessity of this paperwork, his focus has also shifted towards less regulatory compliance-based tasks.

In the field, foresters reported an increased focus upon harvest layout and silvicultural decisions; assessing the site conditions and species mix to design a plan to maximize productivity or regenerate a quality stand. These are decisions and tasks that IW foresters feel lead to increased profitability for the company, a viewpoint that was shared by OBF panel member Peter Triandafillou during his testimony to the Maine Department of Agriculture, Conservation, and Forestry in a 2013 work session regarding the policy.

From an environmental standpoint, IW foresters have allocated more time to identifying unique features such as vernal pools, nesting sites, and legacy trees, and protecting them, often by placing them in the center of an island – uncut patches left within clearcuts or overstory removals to retain vertical structure and preserve biodiversity. IW's environmental policies and Standard Operating Procedures (SOP), as well as periodic environmental training are designed to prepare employees and contractors for dealing with these special features – corroborating this increased focus. IW foresters believe that separation zones added almost no conservation value to their landscape, and that this change in focus allows them to practice better environmental stewardship, including site-specific issues as well as landscape-scale environmental planning (discussed in Chapter 3).

*Table 2.2 - Thematic coded description of responses from both foresters interviewed. Descriptions with a * were mentioned by both participants during separate interviews.*

Theme	Categories	Nodes/codes	Description
Corporate	Benefits	Changes focus of time spent in harvest planning and fieldwork	*Ended legal necessity of clearcut management plans
			*No longer need to do quadrat plots
			Time in field spent making correct silvicultural prescription
			*Ended legal necessity of laying out and checking separation zones
			No longer maintain shapefile of FPA buffers
			No longer must build in safeguards (basal area/separation zone width)
		Increased management flexibility	*Can manage every acre
			*Increased silvicultural flexibility
			*Makes IW more competitive
			Ended legal necessity of 60-day category 3 clearcut notification and approval process
		Decreased costs/increased productivity	Road maintenance now more focused on improving main roads
			*Less mortality without separation zones
			*Increase in silvicultural investments
			*42 less miles of roads built in 2013 vs. 2012
			*Contractors move less miles/frequently between jobs
			Foresters drive less between jobs
	Costs	Negative public perceptions	*Lack knowledge/understanding of policy among public
			*Critical newspaper articles
		Compliance costs	*Reporting is much more in depth, but consolidated
			Metrics include proprietary information - specific to Irving
			*More audits/public tours
			Time spent learning new policy
			Cost of tracking and compiling reporting metrics
Societal	Pros	Landscape level planning	*Focused on long-term landscape scale habitat goals
			Stacking conservation values
			Maintaining connectivity
			Decreasing fragmentation
		Change in oversight	*Feedback from panel improves forest practices
			*Panel of Maine experts offer opportunities for improvement across broad range of topics
		Natural stand boundaries	Separation zones often led to fracturing natural stands
		More time for environmental inventory	*Looking for nests, rare plants, unique areas/features
			quality legacy trees and island placement
		Employment	*Built new mill - employing 70+
			*Direct and indirect economic benefits to mill creation
			Operational efficiencies have led to 21% increase in contractor earnings
		Environmental protections	Better timing of operations for water quality/soil sustainability
			*Equal or better environmental protections required
	Cons	Concentrated operations	*More intensive harvesting on a smaller portion of the landscape
			*Potential for impact on traditional users in isolated incidents
Personal	Positive	Increased job satisfaction	*Proud of their operation
			*Removed fear of violating the law
			*Increased feelings of stewardship
			*Freedom to practice forestry without artificially regimented boundaries

Table 2.3 - Change in focus of day-to-day operations from FPA mandated red tape towards value added tasks.

FPA - Mandated Tasks	**OBF - Value Added Tasks**
Separation zones	Ecological inventory
Quadrat Plots	Nests, vernal pools, legacy trees
Maintaining GIS shapefile of current zones	Increased time for planning
Clearcut management plans	Tuning silvicultural prescriptions
Writing plans	Landscape-level planning
Creating clearcut maps	Road location/design
Filing and maintaining records	Quality island placement (uncut patch within clearcut)
	Increased time for harvest supervision

Increased Management Flexibility

With the increase in available time due to enrollment in OBF came an added flexibility in decision-making. Easing of restrictions (notably separation zones) allowed IW to employ a strategy of harvesting that aligns with their objectives of managing for quality products on every acre, and using clearcutting and planting within their management scheme. IW foresters value this flexibility to implement scientific-based prescriptions without the restrictions of the FPA, which they felt unnecessarily complicated their operations.

Forester 1: "We were trained as foresters to practice sustainable forest management without any artificially regimented landscape boundaries, and under the FPA you have to deal with artificially regimented landscape boundaries"

Separation zone requirements complicated management, and often led foresters to make the choice between *"sub-stand or sub-standard decisions."* For example, if a forester wanted to employ a silvicultural prescription that lowered basal area below 30 square feet per acre in a 40-acre stand (legally a Category 2 clearcut under the FPA), they would have to ensure stocking was adequate surrounding the clearcut to meet separation zone requirements. If stocking was too low, they would have three choices: (1) lower the acreage of the treatment to a Category 1 and hope that the separation zone met the lower Category 1 standards – fragmenting the natural stand; (2) treat the stand with a less aggressive prescription, despite having decided upon what he/she considered the correct science-based treatment; (3) abandon the harvest altogether. Field visits to IW harvest sites treated since enrollment showed the benefit of these changes, allowing clearcuts to directly abut hardwood shelterwood establishment cuts and areas with spruce/fir commercial thinning with low residual basal areas.

Without the requirement for separation zones, the difference between what is and is not a legal clearcut no longer exists. Managers can treat any acre the way that aligns with corporate goals and is scientifically defensible, based upon current silvicultural knowledge, without fear that it will complicate later operations or risk noncompliance and legal fines. Below is an example of treatments that prior to OBF would have not been legal, but often complicated by

clearcut adjacency restrictions – which at times resulted in adjusting the harvest prescription in an undesirable way.

Forester 2: "Quality tolerant hardwood management with a big beech component, I can't leave 60 square feet [of basal area] it'll be too much shade, I will get beech instead of the sugar maple and yellow birch that I want…[OBF] allows that freedom to be able to prescribe the right thing in every spot."

Prescribing the best silvicultural prescription for a stand at times requires foresters to reduce basal areas below the legal limit that defines a clearcut. For example, removing beech and fir to leave a more desirable species mix and allow enough sunlight for regeneration of those desirable species to outcompete beech. Today these stands can be treated in the manner that IW foresters believe that they should be handled, regardless of treatments performed in adjacent stands. This increased flexibility allows IW to implement any silviculture they can scientifically justify, and to reduce costs through increased operational efficiencies.

One of the main mechanisms whereby IW is realizing these efficiencies is through what they call sector planning. Sector planning is the aggregation of seasonal or yearly harvest plans in specific geographical locations (e.g., a ridge, valley, or watershed) or along a single road. IW foresters estimated that under the FPA between 30 to 40% of these sectors would be tied up in separation zones.

Forester 1: "You are on a road, and you've got wood that is biologically ready for some sort of a harvesting intervention, and under Outcome-Based Forestry you can do your harvesting in all of that wood. And under the FPA, you might be able to only harvest half of it, and then you'd have to go find a replacement volume somewhere else."

In order to access that extra "replacement wood," previously IW had to spread its operations across a much larger area of its landbase. That required a larger annual investment to create and maintain a longer road network than was necessary, and diverted main road maintenance into keeping branch roads open for longer periods of time to allow multiple entries. By aggregating their yearly harvesting into sectors, IW has seen a 40% reduction in overall road building, which translates to a substantial reduction in annual fixed costs. IW foresters also believe that this change contributes to less forest fragmentation.

Beyond the direct savings in road budget, concentration of harvesting has also allowed IW to increase the efficiency of their operations. Since enrollment in OBF, contractors have had to move less frequently, and shorter distances between jobs. Due to the payment structure of contracts between IW and the loggers they work with, this resulted in a productivity boost for IW, and according to an IW internal study, a 21% increase in earnings across all Irving contractors.

Forester 2: "For a contractor, there is so much money in their rate every year for lowbedding [trucking their equipment], so if they only move every other week instead of every week, that is basically money they are saving, in their pocket."

I spoke with six IW contractors about increased earnings since the implementation of OBF policy. They all agreed that the new policy has led to increased efficiency in their

operations. Although none had quantified it, most felt that their earnings had not increased by 21% since the policy was implemented.

For foresters supervising harvest operations, time previously spent driving between operations can be invested into checking whether their prescriptions are being carried out properly, monitoring stream crossings, checking for rutting, ensuring proper merchandizing of wood, or other value added tasks.

Public Perception and Compliance Costs

Negative corporate effects of enrollment in OBF were more difficult to obtain from the foresters interviewed. These negatives were generally focused around issues of public perception and compliance costs. Following the announcement of IW's enrollment in OBF, local newspapers ran headlines like: *"J.D. Irving gets exemption from clear-cutting rules"* (Portland Press Herald 11-23-13), and *"Is Irving deal a path to 'scientific forestry' or loophole for clearcutting?"* (Bangor Daily News 11-26-13).

Forester 1: "The only thing that I feel ill at ease sometimes about is just lack of understanding, you know people's lack of understanding about Outcome-Based Forestry because its perceived as just a Irving or whoever the landowner is that signs an Outcome-Based Forestry agreement has the opportunity to do whatever they want, without really understanding what they want…"

IW foresters feel that the main risk of OBF is that it places them in the spotlight. Reporting standards for enrollment include proprietary information specific to IW. The first participant in a new policy also faces increased scrutiny and accountability, which opens up another avenue for their opponents to speak negatively about the company. To address this issue, IW has increased their public outreach, leading more field tours than ever.

Forester 2: "It's not the easy way out…we have never had this many people view our landscape, view our details about how we are managing, specific information we are giving on our state reporting that's specific to us versus just lumped in with every other landowner in the state of Maine. You have to be willing to do that as a landowner."

While IW foresters see this outreach as a positive aspect of their job, and value the opportunity to interact with the public, there is a compliance cost associated with these tours, changing how IW invests their time, money, and staff resources. When asked about potential corporate disadvantages of OBF, one forester responded:

Forester 2: "…from what I've seen from the first few years would be the time and commitment of staff…to make sure that the panel is well informed, the public is informed, the stakeholders are well informed…spending people and resources doing upfront planning and backend reporting."

SOCIETAL

Environmental Stewardship

IW foresters believed that the societal implications of enrollment on OBF were largely beneficial. In orienting their management to align with the OBF's outcomes, and through interaction with the OBF panel, foresters noticed increased attention towards landscape-level goals in their planning process, and feel that their professional standard of practice has increased.

Forester 1: "Its positive work that we do today, all things that I truly believe help us improve what we are doing on a day-to-day basis, looking at those long-term habitat values more than ever, and we're being asked hard questions that are based on scientific thinking."

These long-term habitat values are features such as deer wintering areas, late-successional forests, and riparian buffers. Although OBF did not catalyze the protection of these features - each had internal policies governing their management before - it did stimulate conversations in their planning process. Discussions with several OBF Panel members confirm that cooperative work between IW and the Panel has focused especially within this realm of forest management. This has facilitated the implementation of landscape-level planning directed towards the protection of environmental values, resulting in an increase in connectivity and layering of conservation features.

Forester 1: "The whole idea of the landscape thinking of Outcome-Based Forestry is thinking bigger. It's thinking how do you maintain connectivity, how do you stack multiple conservation values on top of each other in areas that flow across the landscape?"

Managing to introduce connectivity or layering conservation features in the landscape increases the value of those areas. From a habitat standpoint, layering a deer wintering area with a riparian buffer allows deer to use the riparian area as a travel corridor, to move about the greater landscape, and perhaps provides connectivity with another wintering area or food source – improving the usefulness of the area for wildlife.

Sector planning has been important for environmental planning, and IW foresters indicate that it has resulted in other significant ecological benefits. Removal of separation zones and concentration of harvesting has reduced the area accessed to harvest IW's annual cut. IW foresters believe that sector planning, combined with the associated decrease in road building, has resulted in decreased forest fragmentation across their ownership.

Forester 1: "The big thing that I think of with the FPA is if you look at it high level…you see a forest across the state and on our ownership that has seen increased road building, because Irving and other landowners have had to open up more areas across more of the landscape to operate in to derive the same volumes of wood. We are still bounded to sustainable levels, you just have to – under the FPA – find more places to go to get that same volume…and under Outcome-Based it's helped to reduce that landscape fragmentation. We are working in bigger sectors, but there is less overall impact across the landscape."

The effect of sector planning on reducing forest fragmentation under OBF is shown in Chapter 3 of this study. Aggregation of yearly harvesting, without the constraints of separation zones, creates larger stands and less total edge in OBF harvest plans as compared to FPA harvest plans.

Change in Oversight

IW foresters feel that since enrollment in OBF their interaction with regulators has changed, morphing into a much more positive interaction for mutual gain. Where prior regulators were more concerned with assessing compliance with separation zone width, or proper paperwork, under OBF, meetings with the MFS involve more discussion and feedback. Panel member Gary Donovan confirmed this relationship, speaking about the interaction during his November 2013 testimony to the Maine Legislature's Joint Standing Committee on Agriculture, Conservation, and Forestry, and panel member Maxwell McCormack expressed that several panel suggestions had been implemented by IW, specifically regarding management of riparian areas and diseased beech. IW foresters view OBF as another form of certification, whose nuanced criteria is focused upon each facet of forestry – entomology, wildlife biology, silviculture – as they matter within the state. This Maine-centric perspective forces foresters to answer hard, specific questions, and to defend their answers with scientific justification. On field tours and audits, as well as periodic meetings, the OBF panel keeps dialogue open, and the law current with the scientific advances across their fields of expertise, and practices tailored to Maine's concerns. IW foresters described the collaborative focus of their meetings with regulators and the OBF panel, saying:

Forester 1: "There is a tremendous amount of feedback that never occurred before…"

Forester 2: "It's been a great opportunity to get to interact with that panel…that interaction back and forth with those professionals that are experts in their field across a varying group…having that experience to draw from, and the years of experience that's on that panel, and their different views of the forest, of society, of the user groups, of different parts of the state of Maine, you know they bring that all to the table and you are sitting there and you can sound off of them."

Forester 1: "It's the Gary Donovan's, Maine wildlife biologist, tremendous reputation in the state, very concerned about Maine values. Gary shows up on one of our audits, and you see the FSC people saying: 'Well, what is Gary thinking? Because this is very specific to Maine.' And a guy like Gary, he knows Maine intimately."

IW foresters see the panel's value as keeping OBF a living, evolving policy, growing alongside new silvicultural research, and providing feedback to enrolled landowners regarding their forestry practices. The panel's long history within Maine elevates OBF from reliance upon FSC/SFI standards, allowing OBF agreements and implementation to be tailor made to the challenges and concerns of the state and the landowner.

Economic Impacts

From an economic standpoint, IW has credited implementation of OBF for a series of financial investments that they have made, which have contributed to direct and indirect employment opportunities, as well as improving the wood supply on IW lands. The creation of a new spruce/fir sawmill in Ashland provided 75+ new jobs in the forest products industry, as well as a new higher value market for small diameter wood, increasing the profitability of early commercial thinning (Denico 2013, Irving Woodlands 2013). Alongside those jobs came indirect employment: construction workers and manufacturers in the state involved in the construction of the mill, truck drivers moving wood in and out of the mill. And confidence in the state and the new value-added market has resulted in increased investments in silviculture and equipment, including a fleet of new smaller thinning machines.

Forester 1: "…you've got new machines that you are buying from local dealers…and then you've got to hire and train people to run those machines, and then you've got to hire trainers to go out in the woods and help the folks learn how to run the machines…on an annual basis we are probably training 15 new people to run machines."

Potential Conflicts due to Aggregated Harvests

Foresters struggled to identify negative implications of their OBF enrollment. They had difficulty identifying negative environmental impacts of OBF, citing that they were operating under the same or higher levels of environmental regulation as prior to their enrollment in OBF. However, both foresters did cite conflict could potentially rise from the concentration of harvesting in distinct sectors.

Forester 2:"...when we go into a watershed, if somebody was bearbaiting or had a snowmobile trail that ran through there, and we focused our operation there for two seasons, as opposed to being there before for two or three weeks, that has a potential for impact."

However, that may be tempered by the fact that this concentrated harvest footprint frees up the rest of the landbase for these other uses.

Forester 2: "In the past few years I have had less interaction and conflict with snowmobile trails and ATV trails and our operations since we've been doing Outcomes, because when were not in an area, we are just completely not there."

PERSONAL

Connection to the Land

IW foresters generally believed that enrollment in OBF had only benefits, and no negatives to them, increasing their job satisfaction and stewardship value. They feel a strong connection to their land and community, and want to do right by both. OBF has allowed them to practice forestry the best way that they know how, affecting not only their management

decisions, but also their position within the community, as well as the pride they feel in their work. Issues of social accountability came up early in the interviews. As one forester put it:

Forester 1: "For me, for Aroostook County, it's a tough environment it's a tough place to make a living. We are pretty isolated up here…We make our livings off of the natural resource base and we want to protect that. You feel that connection that you want to make everybody proud of your operations here in the state, and you'd like everybody to be proud and you'd like not to hear any criticism. But unfortunately, you are going to have naysayers no matter what you are doing. And they might not have been here or ever seen what you are doing, but for us that live here, we live and work and recreate; we spend all of our time in this forest in this area, and you feel a connection to it. And Outcome-Based Forestry is something that we are proud of, and we want to do well with it. The objectives are honorable and at the end of the day we want to make sure we are sustaining the environment and that we are sustaining jobs, because we live and work in these communities."

Fear of the FPA

Foresters working under the policy constraints of the FPA indicated that they suffered substantial anxiety – both from working under the fear of accidental FPA violations, and through the knowledge that they were often improperly managing stands simply to achieve compliance with the law. They often undermanaged stands, or built in safeguards to ensure they achieved arbitrary thresholds of basal area, separation zone width, or acreage. Since enrollment in OBF they felt that their job satisfaction and pride in their operations had increased.

Forester 2: "Personally, I feel way better about being able to manage the acres we are touching in the proper way the first time. Rather than create the substandard management – 'alright I either can't manage an acre because I clearcut an acre', or 'I have to choose something below what I think is the right thing for that stand to be able to meet a specific criteria under FPA'. And with Outcomes you don't have to. You can say 'ok: this acre should be clearcut, the acre right next to it should be overstoried, and the acre next to that should be shelterwood.' And you can implement that perfectly on the landscape without having to worry about – 'well if I do that and its 50 square feet instead of 60…I had better write it to leave 70 so I can maybe get 60 when I am done.' You are always trying to make sure you are covering for the guys that are coming behind you."

Forester 1: "You spend a lot of time worrying about funny things: clearcut size, separation zone widths and area, does it all match up? You spend a lot of time worrying about that. Because we've got human beings out there working in a changeable landscape with a whole bunch of environmental factors – rain snow, sleet, dark…and human beings are prone to make mistakes. And if the law says that your separation zone needs to 250 feet wide and some guy at 6 o'clock in the evening, and he's tired and it's raining or snowing a blizzard out, and he happens to reach over the line a couple trees, all of the sudden you've got a potential issue."

Foresters reported that they had lost sleep at night worrying about the potential for FPA violations in ongoing harvests. The change to OBF was incredibly personal for the foresters we interviewed. When asked how they would react to OBF ending, and having to return to the FPA,

they expressed profound concern, leading them to contemplate quitting their jobs, and comparing the FPA to a disability or prison.

Forester 1: "It would be a hard hard change to go from being in a cage to being allowed to come out of the cage, to going back into the cage, would be a tough tough tough thing to have to do. Now that we've realized how nice it is to be able to think about sustainable forest management and applying scientific principles it's been awfully nice not to have anything constraining that kind of thinking…"

Forester 2: "I would probably deal with it, because I like our landbase and the people I work with. But it would, it's almost like, I would probably equate it with being someone who is in a car accident that seriously debilitated their ability to do part of what they had done before…I would seriously consider doing something different [career-wise]. It's like telling a carpenter you have to build a house but you can't use 2x4's. Everything else is available but this tool that you've used forever."

DISCUSSION

Forest managers working under the constraints of OBF felt that the policy has improved their practices, allowed them more flexibility in management options, and increased their overall job satisfaction. This personal contentment with the policy signals early success in adopting OBF by practitioners on the ground. Several of the barriers to implementation listed in similar studies of natural resource policy implementation, including lacking adaptive management structure, negative perception of policy, and lack of commitment to the policy (Butler and Koontz 2005, Marshall 2007), were absent in our study. Investment in the long-term acceptance of OBF motivated IW foresters to increase their public outreach – attempting to identify the social and economic components of their forest management that resonate with the public and dispel negative perceptions of IW as a company.

Using a series of observations from field visits, documents such as internal policies, testimonies from OBF panel members, internal studies, and other research, this study has confirmed the veracity of several statements from our participants. Table 2.2 shows areas where participants listed the same effects of enrollment during separate interviews, further corroborating the quality of the data.

Reflecting upon their shift from the FPA to OBF awakened a deeply personal reaction by both foresters interviewed. These ideas revolved around issues of stewardship, their connection to the land and their community, and pride in their operations. We found that forest managers felt a strong connection to the forest resource they manage, and its positive effect on the economic and recreational value to their community. This connection should motivate increased responsibility and sustainable environmental practices (Vaske and Kobrin 2001). Now that they are exempt from certain FPA related barriers, IW foresters are excited to explore new options for forest management. Interaction with the OBF panel provides a unique opportunity for continuing education and improvement in scientific forest management across a spectrum of topics. Compared to the paperwork required under FPA, reporting metrics seem more useful and informative, not simply binders full of information that IW must file and collect for each clearcut they plan to create.

Enrollment in OBF required incorporating corporate values with the Maine sustainability standards under the nine outcomes under OBF. IW has been able to address that integration

through an increased focus upon landscape-level planning, working to increase landscape connectivity and layering in areas containing high conservation value. Adopting suggestions of the OBF panel and maintaining certification by the Forest Stewardship Council has allowed IW to systematically incorporate new scientific advances in natural resource management, while further signaling their achievement of the outcomes.

IW foresters feel that the only negative impact of OBF upon society could be the effects of concentrated harvesting upon traditional users in specific areas and for limited times. IW foresters believed that OBF has had a net benefit on economic results from increased employment and a new wood processing facility. Regarding the ecological effects of OBF, IW foresters indicated that the only easing of environmental restrictions due to enrollment in OBF was the ending of separation zones. However, they believed that the separation zones had a negative environmental impact by contributing to more road construction and a larger harvest "footprint" across the landscape that resulted in higher levels of forest fragmentation (See Chapter 3). Eliminating the need for separation zones also permitted IW foresters more freedom to allocate uncut acreages in areas that had greater conservation value.

For IW, OBF policy has created additional operational efficiencies and a reallocation of time toward value-added tasks. These benefits were manifested primarily through IW's sector planning approach, which has allowed them to reduce road construction by 40% and increase productivity by reducing the amount of time harvesting equipment must be transported between operations.

CONCLUSION

The long-term success of OBF policy rests upon its ability to financially benefit the companies that voluntarily enroll in the program, protect the natural resources identified under the nine outcomes, and the public's perception that OBF policy leads to improved forest management relative to the FPA. The forest managers responsible for implementing OBF policy for the first private landowner in Maine expressed an overwhelmingly positive opinion about its effects at the corporate, social, and personal levels.

Foresters felt that their employer benefitted economically, implementing better silviculture and landscape-level planning, that they were contributing more to their local communities, and were more efficient and effective professionals under OBF policy than the FPA. Overarching themes of OBF enrollment were saving time and money, and also reinvestment in infrastructure, silviculture, and the environment. Aggregated harvesting under sector planning increased harvest intensity in local areas for a period of time, but reduced road building and the associated financial costs and negative environmental impacts. They felt that focused harvest activities and reduced road building also reduced forest fragmentation and increased contractor earnings. Forest managers also believed that OBF led to more landscape-oriented planning, which increased layering and connectivity of conservation features.

The change from FPA to OBF had a dramatic effect on the foresters implementing the policy: increasing their sense of pride about their work and how they benefit their employer, the contractors that they work with, and the local community that they live in. When questioned about the impact of OBF policy being canceled, interview participants indicated dramatic negative consequences for them as professional foresters (including analogies of a physical disability or going to prison).

Future work will benefit from a having a longer period time for organizations to experience OBF policy and to obtain opinions from a more diverse group of professional foresters. A similar investigation could be done exploring the viewpoints of the OBF panel members regarding their perceptions of OBF policy implementation, as well as MFS personnel who work directly with IW, including the state forester. Exploring public perceptions of OBF and FPA policy will also be important because the future of OBF will rely on the public perceiving it as a socially desirable approach to forest policy.

CHAPTER THREE

Landscape Consequences of Outcome-Based Forestry Policy on a Private Forestland Ownership in Northern Maine

ABSTRACT

Outcome-Based Forestry (OBF) policy was written into Maine law in 2001 to explore mitigating the unintended consequences of the 1989 Maine Forest Practices Act (FPA). A principal unintended consequence of the FPA included increased forest fragmentation due to the requirement for separation zones around clearcuts and increased use of partial harvesting approaches. Working with the first private forest landowner in Maine to implement OBF policy, we quantified the relative effects of OBF and FPA policies on a 6,000-acre landscape in northern Maine that had been harvested under the FPA over a 16-year period. Forest managers designed spatially explicit, landscape management plans that extracted the same wood volume under both FPA and OBF policies over the same period. Plans developed under OBF policy resulted in less forest fragmentation (as measured by higher area-weighted mean patch size, lower total edge, and fewer number of patches) than plans developed under the FPA. Clearcut size and frequency did not differ between policies, nor did the percentage of land partially harvested. Reduction in the rate of forest fragmentation under OBF policy resulted from aggregation of proposed harvest operations (referred to as sector planning). Harvesting that actually occurred on the same landscape under the FPA resulted in the higher levels of fragmentation than the proposed FPA and OBF plans during the same period. Differences between actual and proposed harvest plans may have been due to heavy reliance upon partial harvesting, more diffuse pattern of operations, and complications of on-the-ground implementation when actual harvesting took place.

INTRODUCTION

FPA and Landscape Fragmentation

In 1999, the Maine Forest Service declared their intention to pursue an experimental policy as a potential alternative to FPA. OBF policy was proposed to help mitigate some of the unintended consequences of the FPA (MFS 1999). Hagan and Boone (1997) described these unintended negative consequences of the FPA on Maine's forest landscape. Because larger harvests required larger buffers, a strategy of harvesting employing numerous small-clearcuts (<35 acres) enabled forest managers to extract a greater volume of timber and harvest for a longer time interval before available acreage became tied up in separation zones or harvested ground. When these spatial strategies for harvesting were projected forward, Hagan and Boone (1997) showed that small clustered clearcuts generate a higher degree of fragmentation due to the effects of compounding separation zones embedded within the landscape across multiple years and harvests.

Habitat fragmentation is a process where *"a large expanse of habitat is transformed into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original"* (Wilcove et al. 1986). Fragmentation disrupts the connectivity of habitat across the landscape, increases the edge to interior ratio, and lowers contiguous habitat

areas below minimum requirements for certain wildlife species. Fragmentation disrupts species such as the wide-ranging American Marten, which require large patches of undisturbed forest with layered canopy (Chapin et al. 1998).

Forest management responses to the FPA largely mirrored Hagan and Boone's (1997) hypothesis. Sader et al. (2003) observed this trend using change detection on a time series of Landsat imagery. The average size of a clearcut decreased significantly after 1991 (the year the FPA was implemented) and Category 1 clearcuts (originally 5 to 35-acres in size) became more spatially clustered. As clearcutting decreased (dropping from 45% of harvest in 1989 to less than 8% by 1996, and remained <6% every year since), a wave of partial harvesting dominated (MFS Annual Reports). Forest managers determined that this strategy could be sustained longer, allowing more wood to be removed from the landscape while leaving less mature wood standing (Hagan and Boone 1997), avoiding time and costs spent complying with FPA regulations. The expansion of partial harvesting doubled the harvest footprint to produce the same volume of wood, and accelerated reduction of intact mature forest (Legaard et al 2015).

The intention of separation zones in the FPA is to mitigate the negative visual impact of clearcutting. Although not true in every case, the FPA generally requires one acre of separation zone for each acre clearcut. Leaving unharvested areas also was thought to serve as wildlife habitat to mitigate habitat lost following clearcut harvesting. In practice, however, the spatial constraints resulted in several negative landscape consequences. Smaller clearcuts, encouraged by the less restrictive Category 1 separation zone requirements, resulted in stands with inflated edge-to-area ratios. This led to a decreased abundance of forest interior, fragmenting the landscape to the detriment of area-sensitive species such as the American marten (Chapin et al. 1998). By requiring the separation zone to completely encircle a clearcut, the FPA ensured that any opportunity for landscape connectivity between similar, recently cut patches was eliminated. Harvest layouts often ignored natural stand boundaries in favor of geometrically regular cuts to facilitate measurement of compliance by the MFS.

Relative Effect of Outcome Based Forestry on Forested Landscapes

The purpose of the FPA was to reduce the number and size of clearcuts, not to accelerate fragmentation and increase the overall harvest footprint. These unintended negative consequences emphasize the importance of modeling the effects of a forest policy prior to or early into its implementation in order to examine the potential impacts and compare possible alternatives. The stated benefits of OBF on a landscape scale are that Irving Woodlands (IW) can *"operate on less of the landbase [leading to] less fragmentation of the forest"* (Irving 2013). Improvements in technology (including GIS, remote sensing, and spatial statistics) developed since the FPA was passed now provide an opportunity to project potential landscape outcomes, as well as associated ecological effects.

In cooperation with two foresters from IW, we simulated two separate 16-year harvest plans under both OBF and FPA policies. Comparing these simulations with actual harvests that occurred on the same landscape between 1996 and 2012, we can demonstrate the potential effects of both policies. Therefore, the objective of this study was to assess and compare the relative landscape-scale effects of OBF and FPA policies on the same forest landscape. By removing the separation zone constraint in harvest planning (an FPA requirement), operating under OBF should allow foresters to follow natural stand boundaries, create larger clearcuts where desired, optimize silvicultural prescriptions in stands, and arrange harvests spatially in a

more practical manner. We hypothesized that harvest planning under OBF policy should reduce landscape fragmentation relative to operating under FPA.

METHODS

Study Area

The test landscape for this study was a 5,982-acre (quarter township) area owned by Irving Woodlands in northern Maine (Figure 3.1; 47° 7.929'N, 68° 12.490'W). The landscape was chosen due to its intensive harvest history, which largely occurred after inception of the 1989 FPA, and contained minimal non-forest cover. At year 0 of the planning exercise (1996), the forest was 70.8% mature forest (>70 years in age), 12.2% intermediate (30 to 70 years in age), 13.5% regenerating (<30 years in age), and 3.5% non-forested land cover (including roads, ponds, swamps, and other non-productive forestland). Hardwood stands comprised 46.4% of the forest, spruce/fir comprised 26.9%, mixedwood 20.8%, and softwood 2.4%.

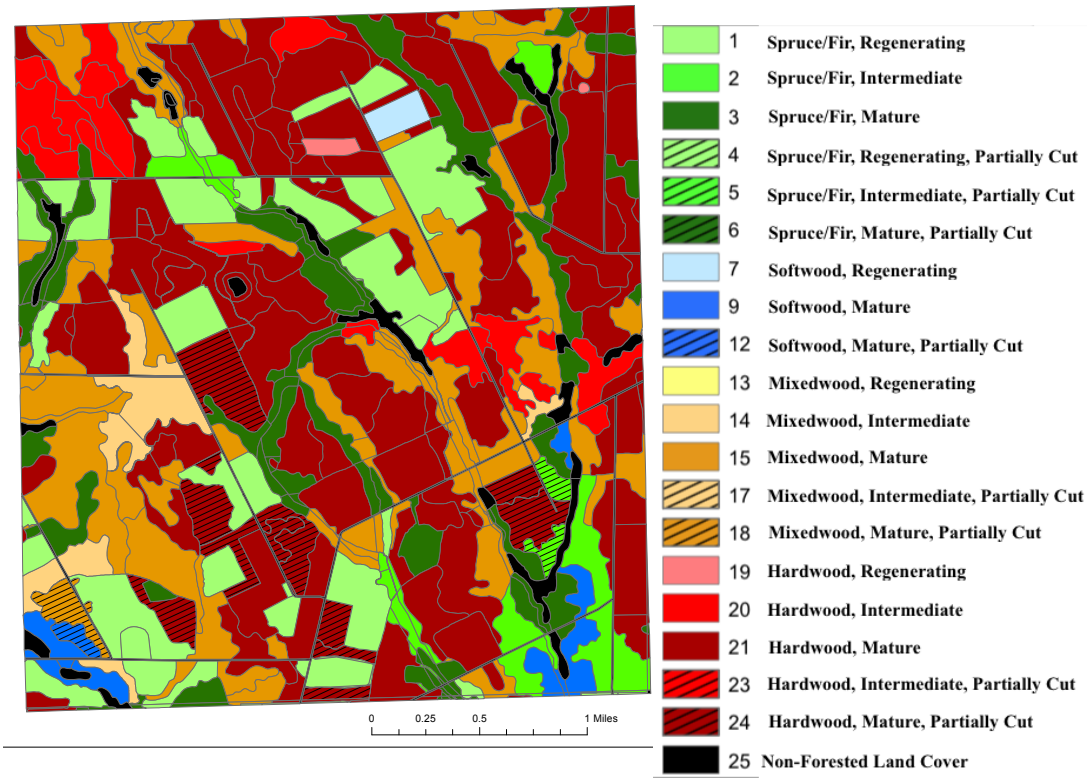

Figure 3.1 - Test landscape in 1996 (year 0 of study).

Historical GIS data from IW was collected for the years 2002, 2007, and 2012 to determine how the scene was harvested and regenerated over time. Over the course of the next 16 years (until IW signed its OBF agreement with the State of Maine), 2,928 acres, or 49% of the landscape had been harvested: 639 acres of final harvest (582 acres of which was by clearcutting) and 2,289 acres of partial harvests (504 acres using shelterwood establishment

cuts). Areas where regeneration data was not provided in GIS shapefiles were filled using photo-interpretation of 2013 fall-color data accessed from Google Earth.

Planning Process

To compare the relative effects of FPA and OBF policies, two planning foresters from IW were asked to model how they would design a 16-year, spatially explicit, harvest plan under both policy scenarios. The planning process was designed to resemble the planning process used by IW foresters in their annual harvest planning. Each participant was a Maine licensed forester and had practiced forestry in the same area under both the FPA and OBF policies, so were familiar with the rules and constraints of each policy.

Using the 1996 data from IW's GIS, each forester created a unique, spatially explicit harvest plan for OBF and for the FPA. Data included in the shapefiles used for the exercise were:

- Top five dominant tree species
- Percentage and development stage of each dominant tree species
- Crown closure percentage for the stand
- Forest structure type
- Forest unit name (FUNA)
- Polygon area (acres)
- Non-forest land cover designation (wetland, stream, pond, road, etc.)

To standardize each harvest plan so that the FPA and OBF landscape plans were comparable, each plan was required to remove the same volume of wood that had been harvested from the landscape over the period studied. Harvest plans were divided into three stages of approximately five years to represent the temporal nature of the actual harvest planning process, as well as aid in approximating separation zone timing. Required wood volumes were separated by species-groups and harvest stage. For example, during stage one each forester was required to remove 6,348-tons of softwood, 8,185-tons of hardwood, and 162-tons of cedar – the same amount of wood that was harvested from 1996 to 2001. Each harvest treatment removed a specified amount of wood, divided into volumes for each species group based upon the forest type harvested. For instance a shelterwood establishment cut on a tolerant hardwood balsam fir stand will remove 35-tons per acre total: 16-tons of softwood, 19-tons of hardwood, and no cedar. These numbers were determined with the help of the IW foresters to best approximate how they would treat each stand type, and were used to back-calculate the volume removed from the landscape during the actual harvest.

Only one harvest was allowed per stand; participants could not partially harvest a stand in stage one and then clearcut it in stage three. Although this restriction would interfere with shelterwood treatments, which require separate treatments for establishment and release, it streamlined data processing and removed a loophole to potentially skew the harvest footprint. As regeneration often takes 10 or more years to establish and reach an appropriate condition for release, this rule may only affect full shelterwood systems planned to begin in stage 1. The participants were not allowed to see the test landscape before the planning exercise, nor discuss their harvest plans until after they had completed the exercise.

Harvest treatment options were as follows: clearcut, shelterwood establishment cut, overstory removal, partial cut, riparian harvest, and multiple entry selection harvest. Clearcut and overstory removals harvested equal volumes, but resulted in different regeneration. Each form of

partial harvest removed different volumes: partial cutting < riparian harvest < multiple entry harvest < shelterwood establishment cut. Partial cutting was only used in separation zones, while other forms of partial cutting were used elsewhere. Each harvest treatment removed a specific volume per acre, divided into a specific volume per species group by the forest unit type (see appendix). Each plan was required to be within 10% of the volume removed for each species group within each 5-year harvest stage.

Road creation, although a major contributor to landscape fragmentation, was not included in the harvest layout. All new roads constructed in the actual harvest plan were removed from the plan to hold the effect of roads constant between plans.

Planning by Policy Scenario

Each harvest layout was designed to closely match how IW would block the landscape for harvest under the policy constraints used today. For the FPA, this meant that foresters could partially cut in separation zones. IW often employs a 300-foot separation zones to limit the possibility of an FPA violation (Ked Coffin, personal communication 9/20/15). The only constraints within OBF plans were that unharvested "islands" be left in clearcuts, as stipulated by IW's internal policy.

Table 3.1 - Variables used in reclassification of stands into stand types.

Forest Age	
Regenerating Forest	
Intermediate Forest	
Mature Forest	
Species Composition	
Spruce-Fir	≥ 70% conifer, ≥ 50% spruce-fir
Softwood	≥ 70% conifer, < 50% spruce-fir
Mixedwood	< 70% conifer and deciduous
Hardwood	≥ 70% deciduous
Harvest History	
Partial Harvest	Partial cut, riparian harvest, multiple entry, shelterwood establishment
Undisturbed	Untouched since even-aged regeneration treatment

Reclassification

Completed harvest exercises were reclassified at the end of each harvest stage into distinct stand types based upon their harvest history, age, and species composition (Table 3.1). These stand types were considered to be ecologically similar to allow a functional-based view of the landscape. Stand age was often described as mature, intermediate, young, regenerating, etc.; while ages in years were generally reported for spruce/fir stands.

Several basic rules were followed to project the trajectory of future stand conditions after harvest for each stage of the exercise. Stands that were clearcut were regenerated to spruce-fir, under the assumption that they would be planted. Overstory removals were regenerated to the

forest type that had existed there previously. Partial harvests (depending on the stand) often led to changes in species composition, which were treated individually based upon their FUNA (Table 3.2). Each treatment required a certain volume removal by species group, and these amounts were used to calculate whether the partial harvest would lead to a change in tree species composition. For example, a balsam fir - tolerant hardwood stand that was harvested using a shelterwood establishment cut would become a hardwood stand. Each FUNA is described in the Appendix. Reclassification resulted in a possible 25 separate stand types, although not all were represented in the final landscapes.

Table 3.2 - Species composition reclassification following various methods of partial harvest used in the planning exercise.

FUNA	Multiple Entry	Partial Cut	Shelterwood Establishment	Riparian Harvest
BFIH	Mixedwood	Mixedwood	Mixedwood	Mixedwood
BFSP	Spruce/Fir	Spruce/Fir	Spruce/Fir	Spruce/Fir
BFTH	Mixedwood	Mixedwood	Hardwood	Mixedwood
IHBF	Hardwood	Hardwood	Hardwood	Hardwood
IHSP	Hardwood	Mixedwood	Mixedwood	Mixedwood
IHTH	Hardwood	Hardwood	Hardwood	Hardwood
INHW	Hardwood	Hardwood	Hardwood	Hardwood
OTSW	Softwood	Softwood	Softwood	Softwood
PSSP	Mixedwood	Spruce/Fir	Mixedwood	Spruce/Fir
SPBF	Spruce/Fir	Spruce/Fir	Spruce/Fir	Spruce/Fir
SPIH	Mixedwood	Mixedwood	Hardwood	Mixedwood
SPTH	Mixedwood	Mixedwood	Hardwood	Mixedwood
THBF	Hardwood	Hardwood	Mixedwood	Hardwood
THIH	Hardwood	Hardwood	Hardwood	Hardwood
THSP	Hardwood	Hardwood	Hardwood	Hardwood
TOHW	Hardwood	Hardwood	Hardwood	Hardwood

Analysis

Once shapefiles were reclassified, we used five metrics (Table 3.3) within FRAGSTATS version 4.2 software to depict the landscape consequences of OBF and FPA scenarios (McGarigal and Marks 2012): (1) Percentage of landscape (PLAND) describes the amount of a landscape in each particular composition. (2) Total edge (TE) is a landscape metric that sums the length of edges between every patch in the landscape. As each scene utilizes the same area, total edge is comparable between landscapes, and higher total edge signals lower core area, and higher likelihood of edge effects. (3) Area-weighted mean patch size (AREA_AM) is a landscape metric that describes the average size of each patch within the landscape. (4) Number of patches (NP) is a landscape metric that describes the number of patches within the scene. (5) Area weighted Euclidean nearest neighbor (ENN_AM) is a landscape and class metric that describes the distance between patches of the same classification.

This study employed area-weighted means when available as they provide a landscape-centric view of structure that is less affected by small patches (McGarigal 2015). While mean patch size would simply average all patches of a similar type together, area-weighted means do

the same, but factor larger patches with a higher significance during this averaging. Therefore, in the case of mean patch size, when small patches or slivers are created, either through a minor error in GIS, or a purposeful decision – such as patches cut for group selection – these small patches are not considered equally, and thus do not dramatically skew the results.

Table 3.3 - Spatial metrics used in data analysis and their ecological significance.

Metric	Description	Ecological Significance
PLAND	Percentage of Land	Relative area within the landscape belonging to a certain habitat type. Higher values reflect larger areas of habitat or disturbance.
TE	Total Edge	Linear measure of border between all dissimilar patches in the landscape. Edge habitats experience altered moisture, light, and temperature regimes (Murcia 1995) and favor generalist species (Jones et al. 2000). As total area is equal between landscapes, higher total edge is higher edge density.
AREA_AM	Area-Weighted Mean Patch Size	Size of habitat patch. As value decreases, quality of habitat may go below ecological thresholds (Radford et al. 2005), lead to declining species richness (MacArthur and Wilson 1967), and subpopulations of less competitive species may be lost from the patch (Tilman et al. 1994).
NP	Number of Patches	Total number of patches of all classes within landscape. As total area is held constant within this exercise, a greater number of patches signals a division of habitat.
ENN_AM	Area Weighted Euclidean Nearest Neighbor	Simple measure of habitat isolation (McGarigal 2015). Larger values indicate greater distance required for species dispersal.

RESULTS

Landscape Changes

Changes in landscape metrics resulting from FPA and OBF policy simulations by the two foresters, and actual changes under the FPA from 1996 to 2012 are shown in Figure 3.2. Under the FPA policy, the area-weighted mean patch size decreased from 100.6 acres in 1996 to between 54.1 and 59.0 acres by 2012, which also matched the actual harvest that occurred during the period. In contrast, average patch size under OBF policy was not reduced as much, reaching 71.4 and 76.1 acres by 2012. Total number of patches was also highest in two of three FPA plans, with 367 patches in FPA Plan 1 and 475 patches under the actual harvest. The other plans created substantially fewer patches, ranging from 279 to 292. Total edge followed a similar pattern as number of patches, the FPA Plan 1 created 30,000 more feet of edge than FPA Plan 2, OBF Plan 1, and OBF Plan 2, while the actual plan created 130,000 more feet of edge than FPA Plan 1. Percentage of land partially harvested varied by plan, with the actual harvest employing the most partial harvesting, followed by OBF Plan 1 > FPA Plan 1 > OBF Plan 2 > FPA Plan 2.

The FPA plans also created more isolated patches by creating greater distances between similar patches than OBF plans (Figure 3.2.d).

Among these metrics, only area-weighted mean patch area was responsive to policy differences. OBF landscapes contained patches that were >12.5 acres larger on average than FPA patches. Total edge and number of patches were less responsive to policy differences; OBF Plan 1, OBF Plan 2, and FPA Plan 2 all behaved nearly identically. This result may reflect forester preference in harvest treatments, especially the area ratio of even-aged to uneven-aged silviculture. Euclidean nearest neighbor was responsive to simulated FPA and OBF policy differences, but actual harvesting under the FPA produced the least isolation among like patches.

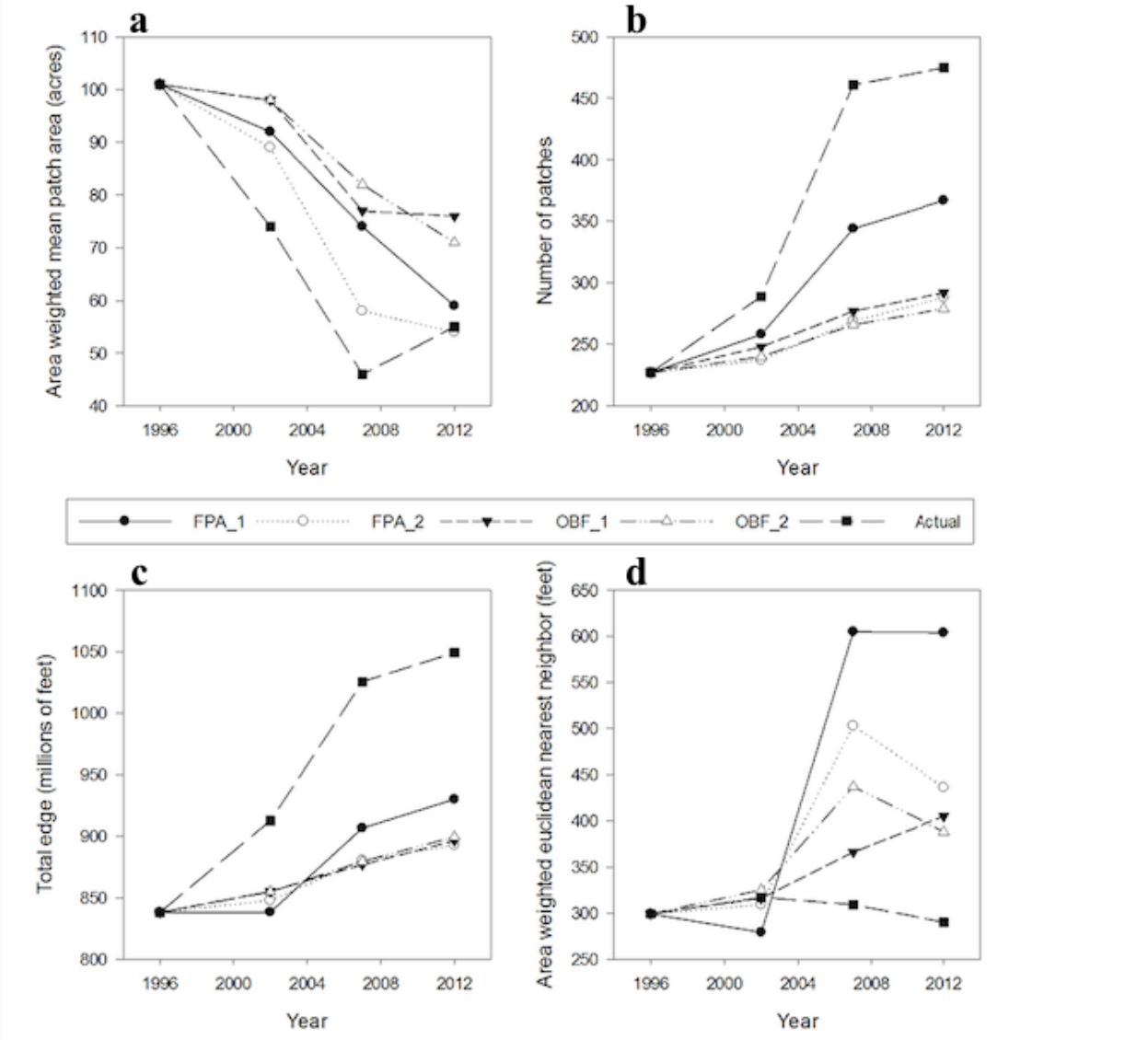

Figure 3.2 - Actual and simulated changes in key landscape metrics (area-weighted mean patch area, number of patches, total edge, and mean weighted Euclidean nearest neighbor) under FPA and OBF policies from 1996 to 2012. Harvest layouts are labeled such that FPA_1 is the Forest Practices Act plan created by Forester 1, OBF_1 is the Outcome Based Forestry plan created by Forester 1, and so on, with Actual representing how the landscape was actually harvested. ***a.*** *Area weighted mean patch size (AREA_AM).* ***b.*** *Number of patches (NP).* ***c.*** *Total edge (TE).* ***d.*** *Area weighted Euclidean nearest neighbor (ENN_AM).*

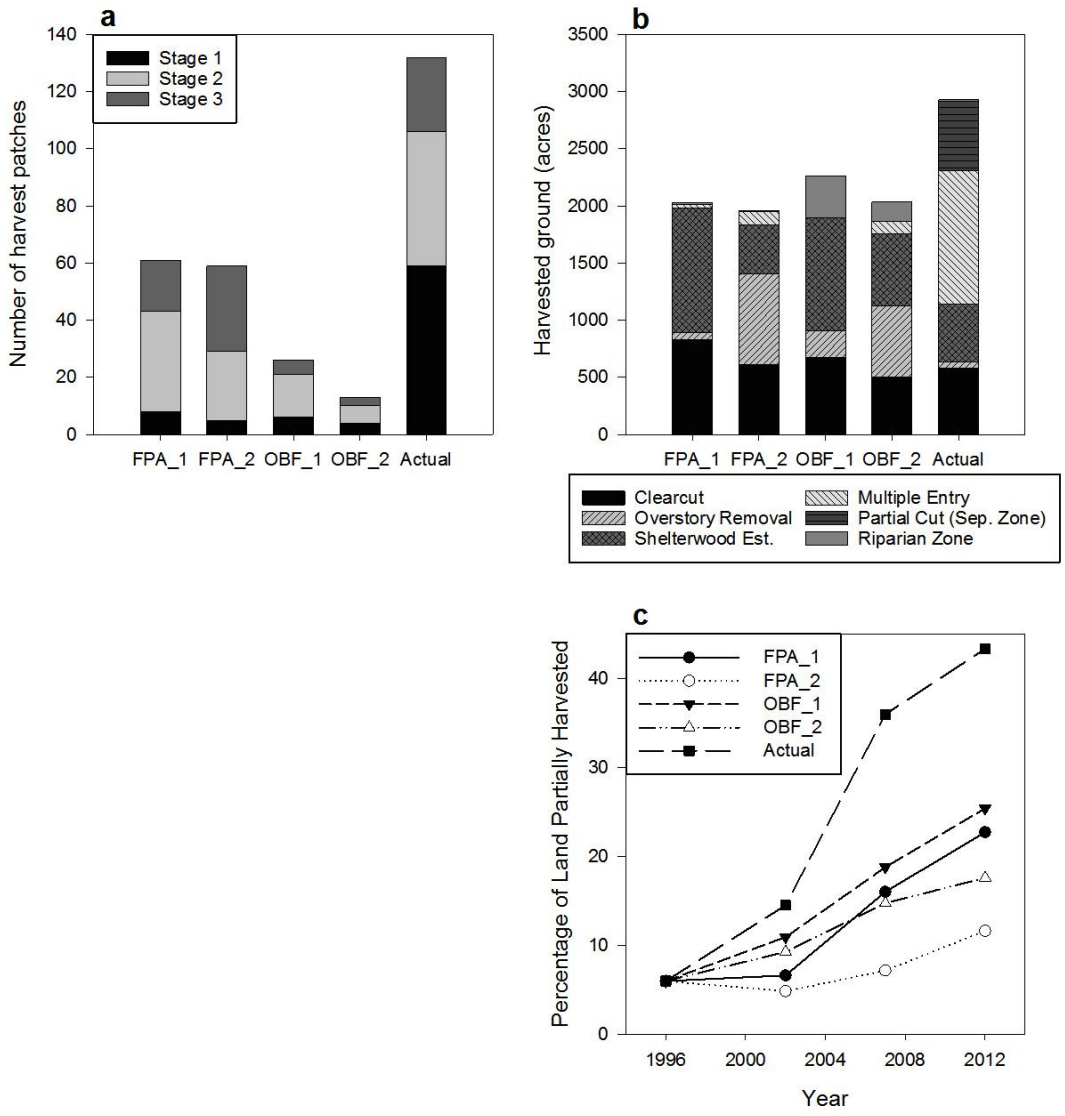

*Figure 3.3 - Breakdown of harvest treatments by plan. **a**. Number of harvest patches (NP) created during each harvest stage. These patches are contiguous areas harvested during each stage regardless of treatment type. **b.** Harvest treatment in acres separated by plan. **c.** Percentage of landscape (PLAND) treated with any method of partial harvest over time.*

Harvest Treatments

Figure 3.3 shows that the simulated FPA plans created more harvest patches than OBF plans, with the actual harvest under FPA opening 132 separate harvest patches (for context FPA Plan 1 opened 61 patches, FPA Plan 2 opened 59 patches, OBF Plan 1 opened 26 patches, and OBF Plan 2 opened 13 patches). The choice of specific harvest prescriptions by the foresters was not related to policy, and appeared to be determined by preferences of the foresters; FPA Plan

and OBF Plan 1 employed nearly twice as many acres of shelterwoods as FPA Plan 2 and OBF Plan 2. The combined area of all forms of partial harvesting covered 43% of the actual landscape, 20-22% of the OBF Plan 1 and FPA Plan 1, and 12-17% of the FPA Plan 2 and OBF Plan 2. Neither simulated FPA plan harvested in separation zones, however, partial harvesting was used in 605-acres of separation zones under the actual FPA harvesting. The harvest footprint of the actual plan was between 663 and 969-acres larger than any other plan.

Figure 3.4 shows the spatial differences in harvest locations among plans. Separation zones are especially clear in *a*/*b* where neither forester elected to partially cut. Without such spatial constraints the OBF plans are free to locate multiple-entry harvests and shelterwood establishment cuts directly adjacent to clearcuts created in the same harvest stage. In the actual harvest layout, foresters did operate in separation zones, thus less separation zones are obvious Figure 3.4e, as it displays all harvests conducted in the same stage with the same color.

These figures also demonstrate how under the OBF policy, foresters were better able to use natural stand boundaries when prescribing harvest treatments. In Figures 3.4a and 3.4b several separation zones are clearly visible, dark bands - as they were not partially cut – spacing between harvests. In areas where foresters elected to clearcut in these plans, they either did not treat adjacent stands, or had to treat the adjacent stand with two different prescriptions (one part untouched separation zone, the other part harvested) effectively fracturing the stand in two. In Figures 4c and 4d harvest plans were less dispersed across time and space. Foresters used natural stand boundaries to guide harvesting almost exclusively, and treated large swaths of adjacent stands during each harvest stage. In Figure 3.4e, the actual harvest plan, there are numerous occasions where actual harvesting differed from the GIS stand lines. Only in this plan were on-the-ground realities involved. For example, because this stand type map was created from interpretation of aerial photography, there may be areas where stand lines do not exactly match where they are on the ground. Also, depending on the season of harvest, wet or steep ground in the stand may not be included in the harvest block to minimize soil damage. Finally, the hierarchical restrictions of clearcut category also can mandate the size of a clearcut be smaller than the size of the stand intended for harvest. For example, if foresters wanted to clearcut a stand greater than 20-acres, a separation zone would be required that included a strip >250 feet in width and >60 square feet in basal area completely encircling the stand. The separation zone must equal the total acreage of the stand. If a forester cannot satisfy these conditions due to a previous entry into an adjacent stand, even when conducting a non-silvicultural clearcut prescription such as a thinning, they must either reduce the size of the clearcut or chose a different site or harvest prescription. While this restriction is imposed across all harvest plans, only in the actual plan would unanticipated realities – such as poor stand typing, windthrow, or other reasons – get in the way of fulfilling separation zone standards.

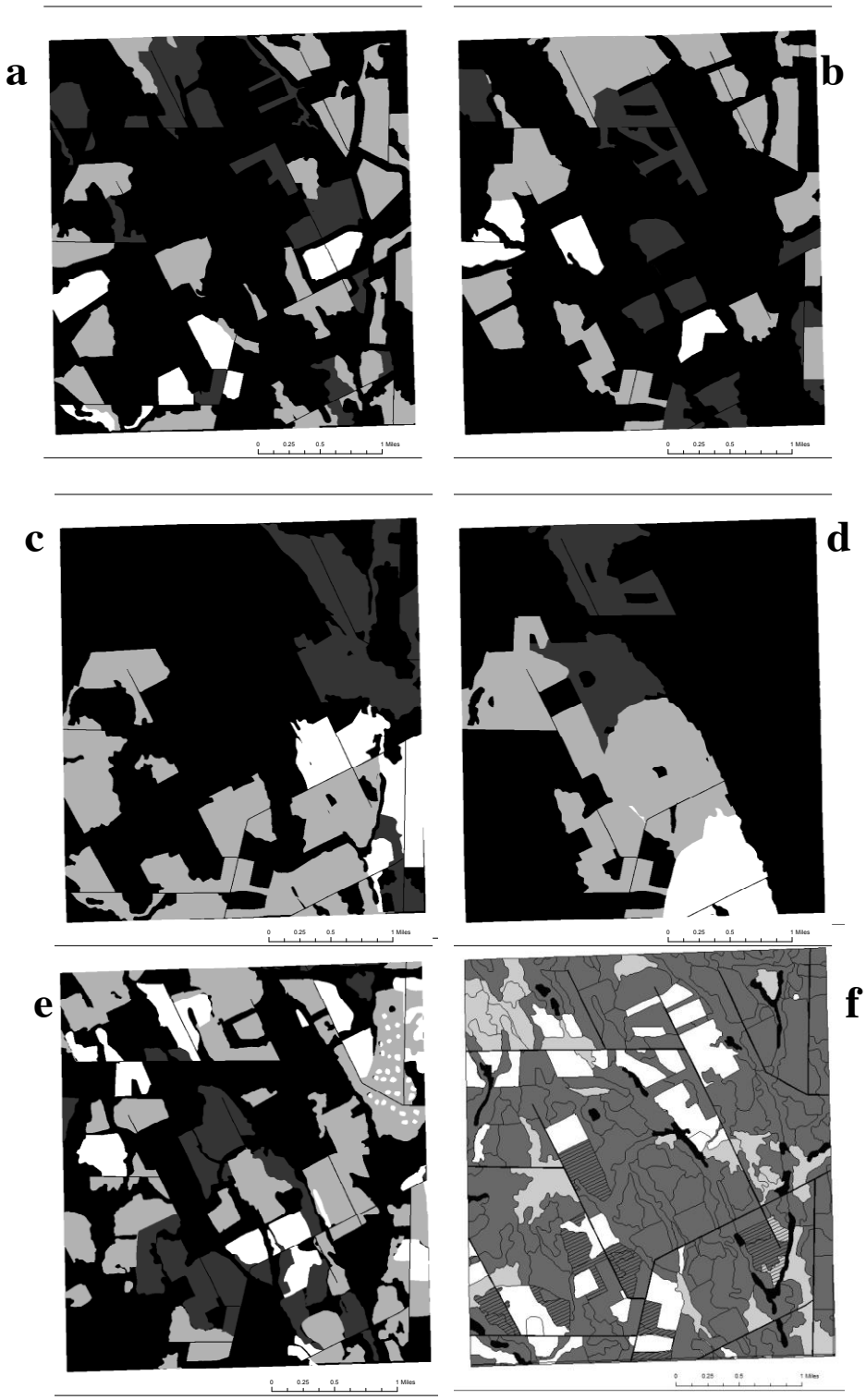

*Figure 3.4 - Spatial layout of harvest plans and original landscape stand lines. **a** FPA plan 1. **b** FPA plan 2. **c** OBF plan 1. **d** OBF plan 2. **e** Actual plan. **f**. Original landscape stand lines at time 0. In a-e black is unharvested ground, white is stage 1 harvest, light grey is stage 2 harvest, dark grey is stage 3 harvest. In f black is non-forested land cover, white is regenerating ground, light grey is intermediate age forest, and dark grey is mature forest.*

DISCUSSION

A key difference in the forest landscapes produced under simulated FPA and OBF policies was the spatial arrangement of harvests. Clearcut size and frequency did not differ between policies, nor did the percentage of land partially harvested appear tied to policy restrictions. FPA Plan1 harvested roughly 200 fewer acres than OBF Plan 1, used less partial harvesting than OBF Plan 1, and resulted in smaller average patch size, greater total edge, and more patches. The reason for this difference is shown in Figure 3.4. The spatial aggregation of harvest blocks, described by IW as "sector planning" allowed a >50% reduction in the number of non-contiguous harvest openings, regardless of harvest prescription. Sector planning is landscape-level harvest planning, where the removal of separation zones has allowed IW to aggregate their yearly or seasonal harvesting, leading to increased efficiency, and a decreased harvest footprint.

Fahrig (2003) divides fragmentation into two categories: habitat loss and change in habitat configuration, and suggests that only the latter be considered actual fragmentation. Therefore, this study describes true fragmentation, as land-use conversion does not occur. According to this definition of fragmentation, three processes are at work: increase in number of patches, decrease in mean patch size, and increase isolation among patches. Based upon these metrics, FPA policy led to a higher degree of landscape fragmentation than OBF policy.

The actual landscape produce by IW under FPA policy differed substantially from the simulated FPA landscapes produced by the two foresters. Its heavy reliance upon various methods of partial harvests – especially lighter treatments in separation zones – led to the disturbance of substantially more area than any other plan, and its scattered distribution of harvests also contributed towards creating substantially more harvest patches and total edge, as well as minimizing the average patch size. The simulation FPA and OBF plans were purposefully simplified and were not constrained by the many on-the-ground issues faced by foresters when implementing management plans. Factors such as wet or steep terrain, weather conditions, logging contractor issues, etc. lead to difficulties in harvest operations and often necessitate separate treatment of single stands, further decreasing average patch size relative to that produced on the simulated landscape.

The use of clearcutting did not differ between FPA and OBF policies, nor did use of overstory removal. This result is consistent with IW's silviculture since enrollment in OBF (Irving 2013), and could result for a number of reasons. Hardwood and mixedwood stands made up over 75% of the landscape at year 0 of the study. Hardwood silviculture relies much more on forms of partial harvesting to generate high-quality sawlogs, employing selection harvests instead of clearcuts that tend to regenerate lower-value species such as aspen and birch. Also, IW is very conscious of the public concerns around the use of clearcutting. The passage of the FPA and the clearcutting referenda of the 1990s were motivated by the perceived overuse of clearcutting. Concerns were raised in the press following the announcement of IW's enrollment in OBF policy about the potential increase in the use of clearcutting (See Chapter 2).

Interestingly, while the choice of harvest treatments was not associated with policy differences, simulated harvest planning exposed a preference of individual foresters for specific silvicultural prescriptions. For example, Forester 1 employed nearly 1,000 acres of shelterwood harvests under both FPA and OBF plans, while Forester 2 used only 500 acres. Conversely, Forester 2 implemented many more even-aged final harvest techniques (OSR and CC) as seen in Figure 3.3b.

In the northeast corner of Figure 3.4e, 28 small patches were harvested in the first stage of the actual plan. These openings were part of a group selection harvests aimed at regenerating tolerant and mid-tolerant hardwoods. These patches will affect the results of certain landscape metrics, increasing total patch number and edge, while decreasing the mean patch size. Because the matrix they were harvested into was not treated until the next stage (which was arbitrarily broken into a separate 5-year interval), this potentially had a disproportionately large effect on the spatial metrics measured in our landscape analysis. Although this is a legitimate silvicultural practice in these conditions, it did increase fragmentation in the actual landscape. Perhaps it would have been preferable to model the whole stand with two multiple-entry harvests, half in stage one and half in stage two. Regardless, it serves as a good example of how choices in modeling can affect final interpretations.

CONCLUSION

Differences in the simulated application of OBF and FPA policies on a 6,000-acre forest landscape influenced the spatial characteristics of the landscape over time. This case study found that the FPA policy led to harvest plans that created higher levels of forest fragmentation, lower mean patch size, and often created a greater number of patches, greater isolation and higher total edge relative to the OBF policy. As clearcutting did not increase in prominence nor partial harvests decrease, this reduction in fragmentation was attributed to the spatial aggregation of planned harvests, known by IW as “sector planning”. Carlson and Kurz (2007) also demonstrated that harvest aggregation reduces landscape fragmentation.

Including roads in our simulations would have further increased the amount of fragmentation beyond that caused by forest management policies as modeled here. Including roads would have also further increased the difference in forest fragmentation between OBF and FPA policies due to sector planning that is more possible under OBF. Actual implementation of OBF policy across IW lands has reduced road building by 20 to 40 miles per year (Ked Coffin personal communication 11-3-15).

OBF also allowed foresters to use natural stand boundaries more effectively than FPA. Although we were not able to quantify the degree to which OBF did so, a visual inspection demonstrates that in this case, OBF harvests more closely followed stand boundaries, fractured fewer stands, and maintained higher mean stand area.

This study did not investigate the suitability of silvicultural choices of IW foresters. Our only finding in this regard was that prescriptions seemed less tied to policy restrictions than to forester preference. However, this observation was constrained by the fact that only two foresters provided plans for this study. Had more foresters been involved in the exercise, we may have been able to better assess the effect of OBF and FPA policy on the choice of silvicultural prescription.

It is important to recognize that this is a case study investigating only a single landscape. Other foresters developing harvest plans on other landscapes would likely produce very different results. Given the high degree of IW’s interest in the OBF policy, the foresters who designed these harvest plans were also motivated to see OBF succeed, thus possibly biasing our final results. The 16-year planning period used in this study also may not have been long enough to quantify the full differences between the policies. Similarly, changing the size of the landscape used may also have produced different outcomes. Forest landscape changes manifest over long time periods and large areas.

Future studies should investigate differences between actual implementation of OBF and FPA. Several realities of harvest planning (such as site visits, road creation, and seasonal timing) were removed from this exercise to facilitate policy comparisons. These and other factors contributed to the dramatic difference between the actual harvest plan relative to the simulated harvest plans.

EPILOGUE

As the five-year terms of the initial OBF agreements are nearing completion, and IW has already renewed a revised OBF agreement with the State of Maine, it is important to understand this alternative forest policy, which if widely adopted could determine future forestry practices and shape Maine's future forest landscape. While the MFS and OBF expert panel have released documents strongly supporting OBF policy and its effects, this is the first study to document details of OBF implementation and investigate possible landscape-level impacts of OBF policy relative to those of the FPA.

The primary motivation for the creation of OBF was to focus on specific forest sustainability outcomes, and eliminate the unintended negative consequences of the FPA by reducing reliance on partial harvesting systems, improving silvicultural treatment of forest stands, increasing use of natural stand boundaries, and greater incorporation of forest science understanding and principles.

What We Found

We found that OBF did not lead to an increased use of clearcutting and that aggregation of harvesting led to lower levels of forest fragmentation under OBF harvest plans. Simulated OBF harvest plans by IW foresters incorporated roughly equal levels of clearcutting, overstory removal, and partial harvesting relative to their FPA harvest plans, but still led to larger average patch size, less total patches, and less total edge. Interviews with IW foresters indicated that OBF has reduced road creation by roughly 40%. This reduction in road creation is a strong indicator that forest fragmentation has decreased under OBF more than simulated in this study, as roads invariably shrink and isolate forest patches, and roads creation was prohibited in the harvest planning exercise. IW foresters expressed that forest operations planning under OBF was easier to design and implement than under FPA. They indicated that the time saved in stand-level planning under OBF was reinvested in landscape-level planning: identifying potential areas for connectivity or layering of conservation values that cannot be easily done under FPA.

Although we did not quantify changes in silvicultural choices due to enrollment in OBF, IW foresters provided a multitude of examples where the FPA had led them to sub-stand or substandard silvicultural decisions. Their perceptions were that in order to create the required separation zone around a clearcut, they were often faced with the decision to undertreat areas surrounding their clearcut (including the separation zone), or decrease the size of the clearcut to lower the separation zone requirements, thus fracturing the natural stand. Under OBF, foresters are free to make what they consider to be the best silvicultural decision for each acre. Furthermore, interactions with the OBF panel often relate to current issues in silviculture, wildlife, and ecosystem management, resulting in dialogue and feedback that promote constant improvement in their forest management decisions at both the stand and landscape levels.

While not a motivating factor for the creation of OBF, the removal of the large amounts of paperwork required for regulatory compliance under the FPA resulted in IW foresters believing that the quality of their work had improved, that they have increased their value to the landowner with better management, and raised their overall job satisfaction. IW foresters

indicated that separation zones often led them to implement suboptimal silvicultural prescriptions, or fracture natural stands to meet arbitrary acreage restrictions under the FPA, and that under OBF they now have the flexibility to manage each acre in accordance with IW objectives and current scientific forestry knowledge.

IW seems to have made a conscious commitment to not increase its rate of clearcutting, despite the lifting of arduous separation zone requirements, likely with an eye towards public perception. Each of the nine outcomes in the OBF policy was written by the State without specific targets. The KPI table shown in Chapter 1 (Table 1.2) provides insight as to how IW believes that it is meeting each of the nine agreed outcomes under their OBF agreement, and how IW audits itself and incents its employees towards compliance and continuous improvement.

In conclusion, OBF has allowed IW to reduce costs, improve silviculture, reduce forest fragmentation, and improve the morale of its forest management staff. These outcomes signal the early success of OBF implementation. OBF also has increased IW's confidence in the future of forest policy in Maine, and encouraged them to invest more into silviculture and a new, state-of-the-art sawmill in northern Maine. In doing so, IW is still held to an equal or higher level of environmental regulation and oversight as when under the FPA. IW has also demonstrated a commitment to landscape-level conservation and planning. Foresters practicing OBF feel better about their forest management, stewardship, and perceive an increased value in their day-to-day duties.

Limitations to this Study and Future Research

This study was limited by the short time of IW's enrollment in OBF, as the effects of forest management play out over longer time. It also only focused on one landowner's implementation of OBF. As a case study, however, we were still able to investigate a number of factors at some depth. However, due to the flexibility in OBF agreements and policy, effects of forest management attributed to policy change may be unique to IW, and may not be applicable to all companies that might enroll in OBF.

Further study on the perceptions of other enrolled companies, or involved parties such as MFS personnel, the OBF panel members, and the general public would improve the overall understanding about the benefits and costs of OBF policy. Has OBF created the changes involved parties believed it would? Has it achieved equal or better environmental protections? Are there areas where they feel oversight should be increased? How does IW's implementation compare to that of BPL or KFM? These studies will benefit from time, as OBF seems to be evolving as landowners invest more in the planning process, and incorporate feedback from the panel.

Future of OBF

Looking forward, there are potential challenges to the future of OBF. While we found that the collaborative relationship between IW and the OBF panel is a stated strength of the program, the reliance on volunteer members for the expert panel, a body for which the director of the MFS admits is hard to find members (Personal Communication, Doug Denico), could limit future growth of the program. Further, increased enrollment in OBF will stretch the time available for the volunteer panel to perform reviews, thus reducing their capability to provide needed oversight and detailed feedback to enrolled landowners and the State.

With only three landowners currently enrolled in OBF, higher enrollment will likely be needed if OBF policy is to develop into a viable, long-term alternative policy to the FPA. The MFS and State Legislature will need to continue their efforts in trying to better understand the real and perceived obstacles for forest landowners to enroll in OBF, just as they have for the past decade or more. The current enrollment of only three landowners in OBF may indicate that additional modifications are needed in the policy to make it more attractive for forest landowner participation.

Finally, political turnover in the Governor's Office and State Legislature from future elections, as well as different priorities for future Directors of the MFS, have the potential to shift focus away from further improving or pursuing OBF as a forest policy alternative.

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APPENDIX

Section A

INTERVIEW PROTOCOL

Time of interview:

Date:

Place:

Interviewer(s):

Interviewee (code):

Position of Interviewee:

INTERVIEW QUESTIONS:

Corporate Level:

In your view, what are the advantages of adopting OBF at a corporate level?
Disadvantages?

Have you noticed OBF affect your ability to achieve Maine law? How?

Do you think OBF is risky to your company? Why?

Have you seen OBF improve your ability to reach corporate goals and compete better in your intercompany SFM report card program? How so?

Has OBF changed the costs of your operation?

Has OBF changed your planning/management activities?

What about your ability to comply with BMP's and improve wildlife habitat?

Do you believe that enrollment in OBF affected your ability to meet forest certification requirements?

How do you believe that this distinguishes your company from others that are not enrolled in OBF?

Benefits? Costs? Perceptions?

Has OBF changed the amount of oversight and reporting IW is subject to from the Maine Forest Service? How?

Has OBF changed the focus of your meetings with the MFS? How?

Has OBF changed the breakdown of time you spend on each task in harvest planning and your focus at each stage? How?

-Planning, site visits, etc.

Has OBF changed your planning process? If so, how?

-Has it made operations more efficient? How?

-Has it made your harvest planning more complex? How?

Do you perceive that there are any other aspects that OBF has affected Irving on a company level?

Societal?

What do you see are the effects OBF has on the environment?

- Wildlife habitat
- Water quality
- The nine outcomes
- Likelihood of rolling clearcuts

What do you see are the effects OBF has on state/local economics?

- Wood supply
- Employment
- Rural Economy

What do you see are the effects OBF has on society and culture?

- Recreational use
- Public perception of company
- Local communities

Personal:

As a professional forest manager, what do you think are the advantages of adopting OBF?

Disadvantages?

Has OBF changed the way you view your landbase as a professional forester? If so, how?

Has adopting OBF changed the way you feel about your work as a professional forester? If so, how?

In your day-to-day responsibilities as a professional forester, what do you perceive are the advantages of OBF?

How has it affected your ability to achieve your standards as a professional?

How has it affected your view of your stewardship responsibility to the land?

How has OBF affected your ability to meet your responsibilities to IW?

As a professional forester, what do you think would occur if OBF was eliminated as a policy option?

Are there any other aspects that OBF has affected on a professional level?

Further Questions?

Could changes to OBF be made to facilitate enrollment of other private businesses in Maine? What would those be?

Are there changes propagated by your enrollment in OBF that we did not cover in these questions?

INTERVIEW CONSENT FORM

You are invited to participate in a research project being conducted by Jonathan Doty, a Master of Forestry student in the School of Forest Resources at the University of Maine. Dr. Robert Wagner, Henry W. Saunders Distinguished Professor in the School of Forest Resources, and Director of the Center for Research on Sustainable Forests at the University of Maine is the faculty sponsor. The title of this project is *Implementation of Outcome-Based Forestry by a Large, Private Landowner in Northern Maine*. The purpose of this project is to understand the forest management changes made by Irving Woodlands as a result of their enrollment in Outcome-Based Forestry, and the advantages and disadvantages resultant in these changes necessary to comply with the nine specified outcomes of their agreement with the Maine Forest Service.

What Will You Be Asked to Do?

The interview will take approximately one hour. The interview will include a series of open-ended questions (example questions provided below):

Has OBF changed the amount of oversight and reporting IW is subject to from the Maine Forest Service? If so, how?

A tape-recording device will be used to preserve the exact language of your response, in order to best capture your precise meaning and wording.

Risks

Foreseeable risks or discomforts of this study are only time and inconvenience.

Benefits

There may be no direct benefits of the study to you, however the research in general should further the understanding and implications of Outcome Based Forestry both to Irving and the State in general.

Voluntary

Participation is voluntary**.** You can stop at any time, and refrain to answer questions you do not want to address.

Confidentiality

Data will be kept on a password-protected computer in the investigator's locked office. Your name or other identifying information will not be reported in any publications. A code number will be used to protect your identity. The electronic key linking your name to the data will be stored using software that provides additional security and will be destroyed after data analysis is complete (within a year approximately). Audio recordings will be erased in five years. Transcribed data will be kept indefinitely.

Contact Information

Please contact Jonathan Doty at jonathan.l.doty@maine.edu**, for any questions about the research. Any further questions may be directed to my faculty advisor Dr. Robert Wagner at** robert.wagner@maine.edu.

If you have any questions about your rights as a research participant, please contact Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board, at 581-1498 (or e-mail gayle_jones@umit.maine.edu).

Thank you.

SCRIPT FOR INTERVIEW RECRUITMENT

Dear Mr(s)…

My name is Jonathan Doty, I am a Master of Forestry student from the University of Maine. I am conducting a study to understand the forest management changes made by Irving Woodlands as a result of their enrollment in Outcome-Based Forestry, and the advantages and disadvantages resultant in these changes necessary to comply with the specified outcomes of their agreement with the Maine Forest Service.

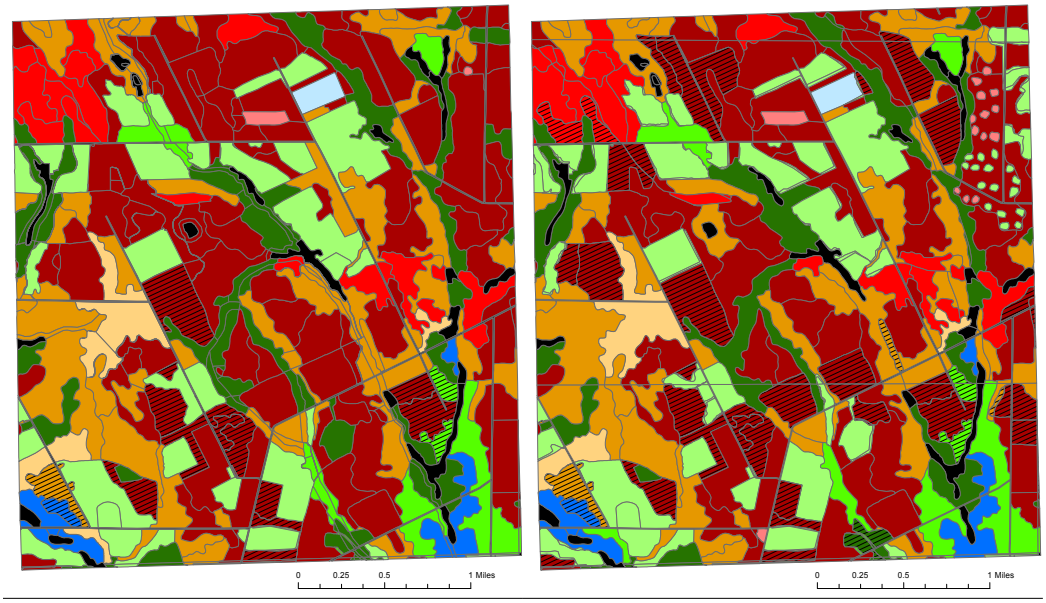
Due to your extensive experience with OBF, I would like to set up a meeting with you during the month of November to discuss your perceptions of Outcome Based Forestry, and the changes in forest management that have occurred as a result of enrolling in OBF. The interview should take roughly a half-day, but we would appreciate any time you can commit to the project. Participation is voluntary, and you risk only time and inconvenience by engaging in the interview. The interview will be recorded to aid in data collection, and will take place at Irving's Fort Kent office.

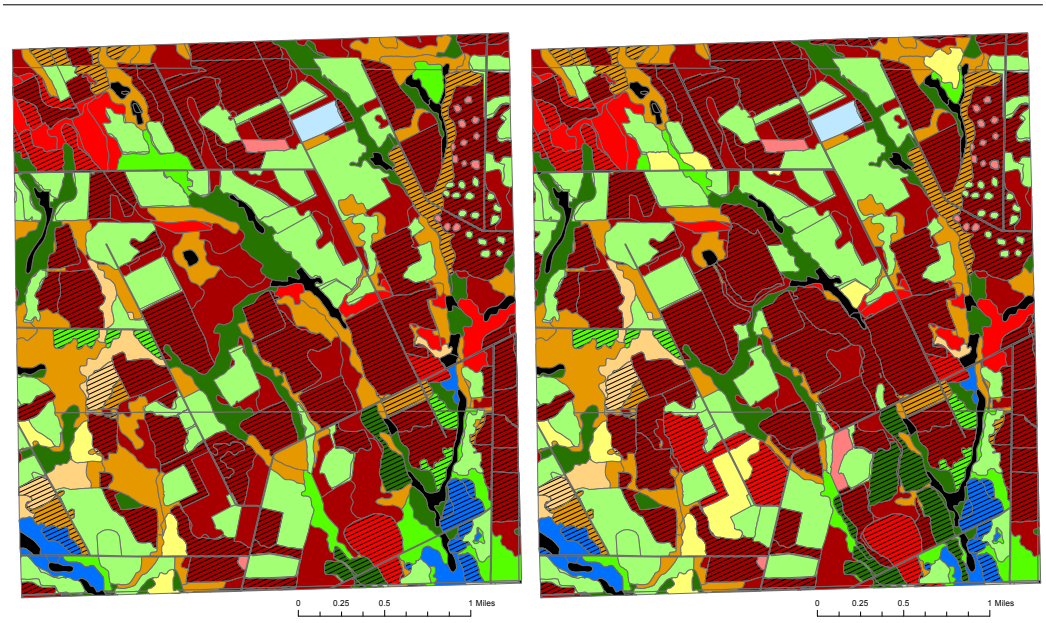
If you are willing to participate, please advise me about the date and time convenient for you to conduct the interview in person.

Thank you.

Section B

ACTUAL HARVEST PLAN TIME SERIES OF STAND DEVELOPMENT





Read left to right, top to bottom: 1996, 2002, 2007, 2012.

HARVEST REMOVALS BY STAGE AND SPECIES GROUP – REPORTED IN TONS

Harvest Stage:	Required Volume (softwood)	Required Volume (hardwood)	Required Volume (cedar)
Stage 1	6,348	8,185	162
Stage 2	27,051	27,330	967
Stage 3	10,768	13,507	135

PARTICIPANTS' HARVEST REMOVALS BY STAGE – REPORTED IN TONS

	FPA_1	FPA_2	OBF_1	OBF_2	Actual
Stage 1	14,770	13,440	14,588	14,183	14,695
Stage 2	53,512	62,193	55,020	54,304	55,348
Stage 3	24,693	26,871	26,332	26,815	24,410

FOREST UNIT NAME DESCRIPTIONS

FUNA	
BFIH	Balsam Fir / Intolerant Hardwood
BFSP	Balsam Fir / Spruce
BFTH	Balsam Fir / Tolerant Hardwood
IHBF	Intolerant Hardwood / Balsam Fir
IHSP	Intolerant Hardwood / Spruce
IHTH	Intolerant Hardwood / Tolerant Hardwood
INHW	Intolerant Hardwood / Hardwood
OTSW	Other Softwood
PSSP	Scots Pine / Jack Pine / Spruce
SPBF	Spruce / Balsam Fir
SPIH	Spruce / Intolerant Hardwood
SPTH	Spruce / Tolerant Hardwood
THBF	Tolerant Hardwood / Balsam Fir
THIH	Tolerant Hardwood / Intolerant Hardwood
THSP	Tolerant Hardwood / Spruce
TOHW	Tolerant Hardwood / Hardwood