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Nature NB

Naturaliste du NB Naturalist

Our forests - Nos forêts

Special edition / édition speciale

Nature NB

924 rue Prospect St.
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Fredericton, NB E3B 2T9

Nature NB is a non-profit, charitable organization whose mission is to celebrate, conserve and protect New Brunswick's natural heritage, through education, networking and collaboration. (The former name of Nature NB – New Brunswick Federation of Naturalists / Fédération des naturalistes du Nouveau-Brunswick is retained for legal purposes.)

Nature NB est un organisme de bienfaisance à but non-lucratif qui a comme mission la célébration, la conservation et la protection du patrimoine naturel du Nouveau-Brunswick par l'éducation, le réseautage et la collaboration. (L'ancien nom de Nature NB, soit « Fédération des naturalistes du Nouveau-Brunswick / New Brunswick Federation of Naturalists », demeurera le nom légal de l'organisme.)

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NB Botany Club / Club botanique du N.-B., Jim Goltz, marph@nbnet.nb.ca, organizes 5-8 outings/year, AGM in September. www.macbe.com/botanyclub/home/html.

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In This Issue *Dans ce numéro*

Front cover photo / page de couverture, old forest/ forêt mature *Photo: Alain Clavette*

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Please submit articles for the next issue by **July 30, 2014**.
S.v.p. soumettre les articles pour le prochain numéro avant le **30 juillet 2014**.
To / à Janet MacMillan, janetmac@nbnet.nb.ca

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Why Old Trees Matter

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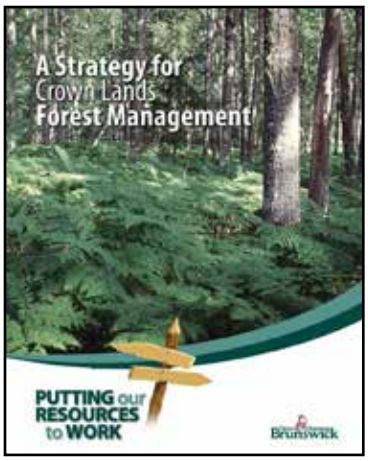

Nature NB is a provincial charitable organization, with a mandate to engage New Brunswickers in, and educate them about, our natural heritage—the wildlife and habitats that make up this province. This special issue of our quarterly magazine is focussed on the ecological and environmental sustainability of our public forest and is intended to provide context for much-needed discussion around forested crown lands in NB. These forests are held in trust by our government for all citizens, and thus need to be maintained in a manner that sustains their ecological values and services. On 12 March, 2014, the New Brunswick government released its new *Strategy for Crown Lands Forest Management* (referred to as the Strategy throughout this document). It has since become clear that this is a strategy about which many New Brunswick citizens have considerable misgivings, both environmental and economic.

The Strategy will see a significant reduction in the conservation forest on Crown Lands (from a recommended 31% to 23%) and a reduction in old forest (from 26% to 10%); an increase in clear cut size from 75 to 100 ha; no protection of Acadian Forest habitat; and an increase in cutting in stream buffers, on steep slopes, and in wet areas. The assumption is that we know enough about our forests to be able to manage them to maintain current biodiversity and ecosystem services. But do we?

A recent analysis (*Assessment of Species Diversity in the Atlantic Maritime Ecozone*) of biodiversity in New Brunswick suggests that vertebrate wildlife only contributes 2% to New Brunswick biodiversity. The majority of forest biodiversity is made up of fungi (approximately 12%) and various invertebrates (72%; beetles, flies, ants, spiders, mites, etc.). We know little about these groups and much of the information we do have is recent and still accumulating rapidly. As an example, in 2013, 2,703 beetle species had been reported for New Brunswick, an increase of 50.5% since 1991. Research over the past decade has shown old growth stands of cedar in New Brunswick support some of the most diverse assemblages of lichens known in eastern North America, with many of these species previously unknown for the region. Biological inventory programs in New Brunswick Protected Natural Areas (all heavily forested), organized out of the New Brunswick Museum, have documented species new for the province, the country, the continent, and new to science virtually every year since the program began in 2009.

This special edition of *NB Naturalist* includes a series of articles, short essays and reflections on the ecological implications of the new forest strategy by some of New Brunswick's best known scientific experts and naturalists, all widely familiar with NB Crown forest.

Dr. Marc-André Villard provides his views of the new Strategy and what it means for the future of science-based decision making in the region, while Dr. James Goltz highlights what the Strategy will mean for wildflower species already threatened in New Brunswick. Mike Lushington, long active as a naturalist in northern NB, reflects on how even small changes on a single tributary stream can be magnified across a landscape. Forest management practices impact soil health in forests, and thus influence what and how growth

occurs. Dale Prest provides research information on how forest soils change with forest management practices. Roberta Clowater explains why the Strategy will hinder the future establishment of old forest protected natural areas, and how New Brunswick lags behind international efforts to maintain forest ecosystems in such areas. Dr. Stephen Wyatt examines the checks and balances that forestry managers have long used to oversee New Brunswick's public forests and comments on the current adequacy of the rules now in place, while Jamie Simpson provides an historical perspective on the now endangered Acadian Forest. Alan Madden, as well as Rod Cumberland, discuss forestry impacts on deer and how deer populations change over time.

While this issue focuses on the ecological aspects of our forests and the new Forestry Strategy, there are also important economic considerations that all citizens need to consider. While we have not covered those here in detail, we do include an article from Dr. Rob Moir and Garth Hood that addresses job creation and the Strategy, and an article by Drs. Stephen Wyatt and Michel Soucy that asks if New Brunswickers are receiving fair market value for the timber from their Crown Lands.

Dr. Kate Frego's lab at UNB Saint John has been working on forest moss and liverwort (bryophytes) species and exploring how these important components of biodiversity are impacted by forest management practices. Watercourse buffers and wetlands are important in maintaining water quality, as well as fish habitat. Dr. Alyre Chiasson from the Université de Moncton discusses the importance of stream buffers and the riparian zone, while Dr. Stephen Clayden focuses on late-successional hardwood forests, a habitat in serious decline in the province.

It is clear that none of these issues is simple, but we urge our readers to inform themselves fully. Bill Parenteau ("Looking back, looking ahead: history and future of the NB forest industry," *Acadiensis* 42, no. 2 (Summer/Autumn 2013): 92-113) provides an insightful historical perspective on the forest industry in NB that provides useful context for anyone considering the economic implications of the new Strategy and how we arrived at the current troubling state of affairs. So, we hope that this special edition of *NB Naturalist* will encourage each of you to think about the future of old forest habitat in New Brunswick, and what it means to you. But especially, we hope that this issue will lead to some sober second thought about the current Stategy and some respectful discussion among all of those who care deeply about the future of the NB forest.

Jacquet River Gorge
Photo by D.F. McAlpine/
New Brunswick Museum

Pourquoi les forêts matures sont si importantes

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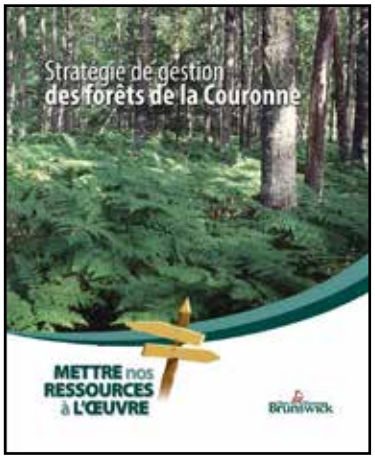

Nature NB est un organisme provincial de bienfaisance qui a comme mandat l'engagement et l'éducation des Néo-Brunswickois sur notre patrimoine naturel — la faune et les habitats qui constituent notre province. Ce numéro spécial de notre magazine se penche sur la durabilité écologique et environnementale de nos forêts publiques et vise à offrir un contexte pour des discussions devenues maintenant essentielles, sur les forêts de la Couronne du N.-B. Ces forêts sont tenues en fiducie par notre gouvernement pour tous les citoyens, et doivent donc être entretenues de manière à conserver leurs valeurs et services écologiques. Le 12 mars 2014, le gouvernement du N.-B. a publié une nouvelle *Stratégie de gestion des forêts de la Couronne* (on y fait référence comme « la stratégie » partout dans ce document). Depuis, il est devenu très clair que cette stratégie inquiète beaucoup de Neo-Brunswikois, tant sur le plan environnemental qu'économique.

La stratégie mènera à une réduction importante de la forêts de conservation sur les terres de la Couronne (de 31 %, qui est le niveau recommandé, à 23 %) et une réduction dans les forêts âgées (de 26 % à 10 %), une augmentation de la superficie maximale des coupes à blanc de 75 à 100 hectares, aucune protection pour les habitats de la forêt acadienne, ainsi qu'une augmentation de la coupe dans les zones tampons, sur les pentes raides et dans les milieux humides. Il est tenu pour acquis que nous avons suffisamment de connaissances à l'égard de nos forêts pour les gérer de façon à maintenir la biodiversité et les services écologiques actuels. Mais, ceci est-il vrai?

Une analyse récente (*Assessment of Species Diversity in the Atlantic Maritime Ecozone*) de la biodiversité au Nouveau-Brunswick suggère que les vertébrés constituent seulement 2 % de la biodiversité de la province. La majorité de notre biodiversité forestière est constituée de champignons (~12 %) et de divers invertébrés (72 %; coléoptères, mouches, fourmis, araignées, mites, etc.). Nous connaissons peu au sujet de ces groupes et beaucoup de l'information que nous possédons est récente et s'accumule rapidement. Par exemple, jusqu'en 2013, 2 703 espèces de coléoptères avaient été répertoriées dans la province, mais celles identifiées depuis 1991 représentent 50.5 % de ce total. Des études au cours de la dernière décennie démontrent que les peuplements de cèdres matures au Nouveau-Brunswick contiennent des assemblages de lichens parmi les plus variés de tout l'est de l'Amérique du Nord, avec plusieurs de ces espèces étant inconnues auparavant dans la région. Des programmes d'inventaires biologiques dans les Zones protégées naturelles du N.-B., organisés par le Musée du N.-B., ont documenté de nouvelles espèces pour la province, le continent et la science essentiellement chaque année depuis le début du programme en 2009.

Ce numéro spécial du *Naturaliste du NB* offre une série d'articles, d'essais et de réflexions sur les impactes écologiques de la nouvelle stratégie forestière par des scientifiques, experts et naturalistes parmi les plus connus de la province, tous très connaissant des enjeux relatifs à la forêt Néo-Brunswickoise.

Dr Marc-André Villard offre son opinion sur la nouvelle stratégie et ce qu'elle signifie pour le futur et la prise de

décision basée sur la science, alors que Jamie Simpson offre une perspective historique sur la forêt acadienne. Dr James Goltz explique ce que la nouvelle stratégie signifiera pour les espèces de fleurs sauvages déjà menacées au Nouveau-Brunswick. Mike Lushington, naturaliste longtemps actif dans le Nord de la province, réfléchit aux conséquences de petits changements sur un petit cours d'eau secondaire qui s'amplifient à travers un paysage entier. Alan Madden, aussi bien que Rod Cumberland, discutent des impacts sur les chevreuils et comment leurs populations changent au fil des ans.

Le laboratoire de Dre Kate Frego à UNB Saint John travaille sur les espèces de mousses et d'hépatiques (bryophytes), explorant comment ces éléments de la biodiversité sont affectés par les pratiques de gestion forestière.

Les pratiques de gestion forestières ont un impact sur la santé des sols, et ainsi influencent quelles espèces repoussent et déterminent leurs croissances. Dale Prest démontre, basé sur la recherche, que les sols forestiers changent selon les pratiques forestières. Roberta Clowater explique pourquoi « la stratégie » nuira à l'établissement de nouvelles Zones protégées naturelles avec de vieux peuplements, et comment le N.-B. tire de l'arrière en ce qui concerne les efforts internationaux pour protéger les écosystèmes forestiers dans des zones protégées. Les zones tampons sont importantes pour maintenir la qualité de l'eau et les habitats pour les poissons. Dr Alyre Chiasson de l'Université de Moncton discute de l'importance des zones tampons pour les cours d'eau et les zones riveraines.

Les forêts anciennes sont très importantes pour maintenir la biodiversité. Dr Stephen Clayden écrit sur les forêts de feuillus en fin de succession, un écosystème en déclin dans la province.

Bien que ce numéro se penche surtout sur les aspects écologiques de nos forêts et de la nouvelle stratégie, il y a aussi d'importantes répercussions économiques que tous les citoyens devraient tenir en compte. Mêmes si nous n'avons pas traité les enjeux économiques en détail, nous incluons un article par Dr Stephen Wyatt et Dr Michel Soucy, abordant la question de la juste valeur marchande pour le bois en provenance des terres de la Couronne sous « la stratégie », ainsi qu'un article par Dr Rob Moir et Garth Hood qui présente les faits à propos de la création d'emplois.

Il est clair qu'aucune de ces questions n'est simple, mais nous aimerions encourager nos lecteurs à bien s'informer. Bill Parenteau ("Looking back, looking ahead: history and future of the NB forest industry," *Acadiensis* 42, no. 2 (Summer/Autumn 2013): 92-113) offre une perspective historique sur l'industrie forestière au N.-B. qui présente un contexte utile pour ceux qui se préoccupent des conséquences économiques de cette nouvelle stratégie et ce qui nous a emmenés à ce point inquiétant. Nous espérons que ce numéro spécial du *Naturaliste du NB* vous encouragera à penser au futur de nos habitats de forêts anciennes au N.-B. et à ce que cela signifie pour vous. Mais surtout, nous espérons que ce numéro vous mènera à des réflexions sérieuses au sujet de « la stratégie » et à des discussions respectueuses entre ceux qui se soucient beaucoup du futur des forêts du N.-B.

Frêne blanc
Photo par B. Brown

Ecological Science and the New Forestry Strategy for NB:

Beyond Noah's Ark

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Dr. Marc-Andre Villard teaches at the Université de Moncton. His research over many decades has focussed on forestry impacts on forest birds and other wildlife.

Much has been written in response to the announcement by the Alward Government that it *will* increase the wood supply to mills across the province. Perhaps I should say *wants* to increase, because "it ain't over 'til it's over," as Yogi Berra used to say!

To me, a major issue arising from the debate now underway is the societal relationship to science and scientists in this province. Both government ministers and Mr. J.D. Irving referred to what they call "good science" and challenged anyone to come forward with evidence that the new forestry strategy would damage the environment. Participating in CBC political panels on the March 13 and 20, 2014, Energy Minister Craig Leonard scoffed at claims that the Strategy would be damaging to the environment, and he referred to scientists as people who present reports and provide opinions, *just like any good taxi driver* (author's emphasis).

My point is not that scientists are more important than taxi drivers, nor that they are smarter. My concern is that the roles of science and scientists are being misrepresented to the general public. Like every citizen, scientists have opinions, some well informed, others certainly not so well informed (my opinions on current political or economic trends are probably no better informed than those of most citizens). However, in their professional work, scientists are trained to follow a rigorous process which involves the collection of original data followed by careful statistical analysis of the collected data. Prior to publication, the interpretation of each scientist's findings are validated by independent experts in the field. Therefore, when a person trained in ecological science uses his or her research to state an opinion within that field, it is not likely to be an uninformed opinion. It should be seen as the distillation of experience on the topic, perhaps gained over many years. It thus carries the weight of long training, rigourous analysis and careful thought.

Brown Creeper
Photo by H. Scarth

There has been limited support provided to researchers studying the ecological impacts of human activities on New Brunswick's varied ecosystems. We can therefore be grateful that New Brunswick's forests have actually captured the attention of ecologists, with research results published widely in respected scientific journals.

What does some of this New Brunswick research ("good science," judging by its acceptance in peer-reviewed journals) show us that is relevant to the new Strategy?

1. Many species of vertebrates require old forests and structures associated with these forests,

such as large snags, big logs, or simply, large-diameter trees.

2. Many species of vertebrates are much more abundant in large blocks of suitable habitat than in scattered forest fragments. Unless protected areas include relatively large blocks, or associated clusters of medium-sized ones, some of these species will decline rapidly.
3. Conifer plantations, even older ones, do not host species requiring features associated with older natural forest stands, such as many woodpeckers, or Brown Creepers,
4. Extensive conifer plantations reduce the breeding success of songbirds in nearby old stands by artificially increasing seed production and boosting populations of efficient nest predators like red squirrels.
5. Clear-cuts and conifer plantations impede the movements of species like flying squirrels or even some deciduous forest birds.
6. Harvesting near watercourses may increase both siltation of spawning grounds and water temperature.
7. Disturbance due to industrial forestry results in profound changes to forest plant communities, as well as processses associated with them.
8. And finally, beyond some intensive studies of forest birds, a few mammals, and a limited suite of plants, we have very little data on forestry impacts on other species in New Brunswick.

The forestry experience in Sweden has shown that it is unwise to let populations decline to a handful of individuals, as was the case for the White-backed and the Middle Spotted Woodpecker. The Middle Spotted Woodpecker, strongly tied to large oak tree stands, is now extirpated from Sweden whereas the White-backed Woodpecker was down to a single pair, with the female born in a captive-breeding facility.

Ovenbird
Photo by H. Scarth

Do we really want to repeat the Swedish experience?

Blackburnian Warbler
Photo by A. Clavette

How the New Forestry Strategy Threatens Plant Species at Risk in NB

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Dr. James P. Goltz is one of New Brunswick's leading field botanists and has long been involved in regional plant conservation issues.

Pinedrops (Pterospora andromeda)
Photo by J. Goltz

The steep coniferous slope, covered in old growth White Pine, Eastern Hemlock and Eastern White Cedar, was exceptionally dry because of a prolonged early summer drought. The hard-packed clay soil and overlying loose blanket of pine needles made the going precarious. Suddenly, a beam of sunlight illuminated a 70 cm tall ruby-red, fuzzy, stalk bearing at least 50 off-white, drooping, bells reminiscent of blueberry blooms. Fortune shone upon us on this sunny day in mid-July. We found a new population of Pinedrops (*Pterospora andromedea)*, an endangered species in New Brunswick, currently known only from 6 or 7 locations in the province. Intensive searching at this site that day, in the valley of a major New Brunswick river, revealed over 20 additional plants of this species, most in peak bloom. Pinedrops is a great rarity in the east, and the only extant locations in northeastern North America east of Bic, Quebec, are in New Brunswick.

How will Pinedrops and other plant species that are at risk and grow only in forested habitats, be affected by the forestry Strategy, made public on March 12, 2014? This strategy will generate an increased Crown softwood supply through activities such as "Better utilization on existing harvest sites (safely accessing some of the steep slopes and the currently available portions of some buffers)." Almost all of the known locations for Pinedrops in New Brunswick occur on sites that fit these criteria. What safeguards will be put in place to ensure that critical habitat for Pinedrops is not destroyed as the new strategy is implemented?

Unfortunately, there is no mandatory scrutiny for species at risk on Crown lands that are accessible for forestry practices. Even if there were, Pinedrops does not bloom consistently every year at its known locations in the province, its numbers tend to fluctuate widely at a site from year to year, and individual plants seldom emerge at precisely the same location where plants were found in previous years. Cutting on steep forested clay slopes could not only harm populations of Pinedrops, but increases the risk of erosion, further threatening critical habitat for this species.

An essential requirement for the germination and growth of Pinedrops is its association with a particular species of mycorrhizal fungus. Molecular genetic studies have shown that the fungal associate of Pinedrops in eastern North America is an undescribed (yet-to-be-named) "false-truffle" in the genus *Rhizopogon*. *Rhizopogon* species fruit entirely underground and depend mainly on flying squirrels for their dispersal. What else remains unknown in this web of interactions? What is/are the pollinator(s) of Pinedrops, for example?

Can forests be "managed" for such uncertainties, other than by allowing sizeable portions of them to remain as little modified by human activity as possible?

While searching for rare orchids in Charlotte County one Canada Day, inspired by Austin Squires' book *A Naturalist in New Brunswick*, we came across a small block of Crown land that was surrounded by

clear-cuts bearing large diameter stumps of cedar. The residual patch of old growth mossy cedar woods remaining sported hundreds of Showy Lady's-slippers (*Cypripedium reginae*), standing thigh-high and bearing spectacular pink and white blooms, each about half the size of my fist. Further exploration of this stand revealed eight other species of wild orchids and a few plants of the very rare Swamp Moonwort (*Botrychium tenebrosum*). Fortunately, our discoveries prompted what remained of this site to be removed from harvest considerations and to be eventually designated as a protected natural area.

However, old growth wet cedar forests that are habitat for uncommon to very rare plants on Crown and private lands in New Brunswick continue to be lost every year. New Brunswick's new forestry Strategy will put similar sites at greater risk of being destroyed. Softwood will be harvested at higher levels than in the past, and "Some areas previously managed to provide [wildlife] habitat will be re-arranged and overall objective levels will be reduced." The implications of this for biodiversity in New Brunswick are disturbing. Old growth wet cedar forests support a unique biota of species that are often very rare in North America or very rare in Atlantic Canada. Such species, and others as yet undescribed, continue to be discovered in such habitats through field research in New Brunswick. Many of the plant species that have adapted to old growth cedar forest habitats cannot survive clear cutting, or selective cutting that disrupts the integrity of the stand. Calypso (*Calypso bulbosa*), a beautiful spring-blooming wild orchid of calcareous cedar habitats, is exquisitely susceptible to habitat disturbance, and has disappeared from many of the locations in the southern half of the province where it used to grow, as well as from much of eastern Canada and the eastern United States. One of our rarest native orchids, White Adder's-mouth (*Malaxis monophylla*) is facing the same plight for similar reasons.

Showy Lady's-slipper (Cypripedium reginae)
Photo by J. Goltz

It's not just this new Strategy that puts species like these two native orchids at risk. Rare plant species are also threatened by policies that have been put in place to apparently limit potential restrictions on resource extraction industries. For example, old growth wet cedar forests are wetlands. However, because they are forested, they are not classified as wetlands in New Brunswick, and policies that apply to other wetlands do not apply to them or to many of the other forested wetlands in the province. When New Brunswick revised its Endangered Species Act and Regulations in 1996, it was strategically decided that only those species of plants that were nationally endangered would be listed as endangered in the province. This was despite recommendations by the most knowledgeable scientists in New Brunswick that all of the very rare and rare species of plants that occur in threatened habitats should be listed as endangered for the province. Two regionally endangered animals were listed at that time, but regionally rare plants were to be protected with "spe-

Calypso (Calypso bulbosa)
Photo by J. Goltz

Van Brunt's Jacob's-ladder (Polemonium van-bruntiae)
Photo by J. Goltz

cial management," not legislation. New Brunswick's 2012 Species at Risk Act replaced the earlier endangered species legislation and gives a new committee power to recommend that additional species be listed, but none have been designated yet.

Even before New Brunswick launched its new forestry Strategy, proof of the potential deleterious impacts of forest harvesting on plant species at risk and rare plant species was already in evidence on both Crown and private lands. Clear-cutting has occurred at Black Spruce and Red Maple wetland sites that harbour Southern Twayblade (*Listera australis*), a nationally endangered species of wild orchid. Calypso continues to disappear from sites where cedar forests are logged and populations of this rare species are diminishing. Van Brunt's Jacob's-ladder (*Polemonium van-bruntiae*) was once considered extirpated in New Brunswick, but was recently re-discovered. Immediately adjacent to one of the few sites where this species in now known to occur in New Brunswick, there is a sizeable recent clearcut. Jacob's-ladder grows up to the edge of the clearcut, along a creek that flows through a cedar-alder wetland, but the cutting that occurred nearby eliminated any buffer strip or suitable habitat beyond this point. It seems likely that clear-cutting at the site reduced the size of the population of this plant species here.

Southern Twayblade (Listera australis)
Photo by J. Goltz

Permanent protected natural areas are a crucial tool in the protection of species at risk and rare species. The new Strategy makes a commitment to increase protected natural areas in New Brunswick. This is a significant step forward. However, few protected areas have been designated or planned to protect species at risk or rare species that occur in New Brunswick.

One of the new Strategy's key outcomes is to diminish the amount of forest managed for conservation objectives. This is likely to have serious repercussions for rare plant species and species at risk. This is especially true since so many of these species occur in older growth forests, forested wetlands, and within buffer strips, sites that will be targeted and negatively impacted for biodiversity by the new forest Strategy.

The wild plants of New Brunswick are an important part of our natural heritage, cultural identity and uniqueness. They have intrinsic value and it is our duty to be responsible stewards, to ensure that they will continue to survive and thrive along with us. Policies and strategies that prohibit or diminish good stewards or exacerbate the risk to our endangered, rare and threatened plant species need to be carefully examined and reconsidered.

Comment la nouvelle stratégie forestière menace-t-elle les plantes en péril au N.-B.?

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L'escarpement recouvert de conifères, de vieux pins blancs, pruche et cèdre blanc, était exceptionnellement sec, le résultat d'une sécheresse prolongée au début de l'été. Le sol d'argile dur et la couverture d'épines de pin rendaient la progression difficile. Soudain, un rayon de soleil éclaira une tige rouge de 70 cm qui tenait au moins 50 cloches blanchâtres ressemblant un peu à des fleurs de bleuets. La chance nous a souri en cette journée ensoleillée de mi-juillet. Nous avions trouvé une nouvelle population de Ptérospore (*Pterospora andromedea*), une espèce en péril au Nouveau-Brunswick, connue de seulement 6 ou 7 endroits dans la province. Une recherche intensive du site ce jour-là, dans la vallée d'une importante rivière du Nouveau-Brunswick, a révélé plus de 20 autres plantes de cette espèce, la plupart en fleur. Le Ptérospore est d'une grande rareté dans l'est, et les seuls lieux où cette plante existe en Amérique du Nord à l'est de Bic, Québec, sont au Nouveau-Brunswick.

Comment le Ptérospore et les autres espèces de plantes qui sont menacées seront-ils affectés par « la stratégie », publiée le 12 mars 2014? La stratégie augmentera le montant de bois provenant des terres de la Couronne grâce à des activités comme « Meilleure utilisation des sites d'exploitation existants (accès sécuritaire à des zones comportant des pentes abruptes et des secteurs actuellement disponibles de certaines zones tampons) ». Presque tous les lieux où se retrouve le Ptérospore dans cette province satisfont ces critères. Quelles mesures de sécurité seront mises en place pour assurer que l'habitat du Ptérospore n'est pas détruit avec la mise en place de la nouvelle stratégie ?

Malheureusement, il n'y a aucune recherche obligatoire pour les espèces menacées sur les terres de la Couronne qui sont accessibles à l'exploitation forestière. Même s'il y en avait, sur les sites connus au Nouveau-Brunswick, le Ptérospore ne fleurit pas chaque année, le nombre d'individus varie beaucoup d'année en année et les plantes individuelles émergent rarement à l'endroit précis où on pouvait en trouver les années précédentes. La coupe sur les pentes raides d'argile pourrait non seulement avoir un impact négatif sur les populations de Ptérospore, mais augmenterait aussi le risque d'érosion, menaçant davantage l'habitat critique de cette espèce.

Un élément essentiel pour la germination et la croissance du Ptérospore est son association avec une espèce particulière de champignon mycorhizien. La recherche en génétique moléculaire a démontré que ce champignon est une espèce de « fausse-truffe » non décrite (encore à nommer) du genre *Rhizopogon*. Les espèces de *Rhizopogon* produisent leurs fruits entièrement sous le sol et dépendent principalement des polatouches pour leur propagation. Quelles autres interactions nous reste-t-il à découvrir? Par exemple, quels sont les pollinisateurs du Ptérospore?

Peut-on « gérées » une forêt avec des incertitudes de la sorte, autre qu'en mettant de côté d'importantes superficies avec le moins de perturbations humaines que possible?

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Pinedrops (Pterospora andromeda)
Photo par J. Goltz

Cyprième royal (Cypripedium reginae)
Photo par J. Goltz

En cherchant pour des orchidées rares dans le Comté de Charlotte, étant inspirés par un livre d'Austin Squires, *A Naturalist in New Brunswick*, nous avons trouvé un petit bloc de terre de la Couronne qui était entouré de coupes à blanc avec des souches de cèdre de grand diamètre. Le boisé restant de vieux cèdre et de mousses avait des centaines de Cyprième royal (*Cypripedium reginae*), de la hauteur de nos cuisses, avec des fleurs blanches et roses spectaculaires, chacune la moitié de la grosseur de mon poing.

Une exploration plus détaillée de ce lieu révéla huit autres espèces d'orchidées sauvages et quelques plantes d'un botryche très rare, le *Botrychium tenebrosum*. Heureusement, notre découverte de ce qui restait du site a eu comme effet de mettre fin à l'exploitation forestière et qu'il devienne par la suite une zone protégée naturelle.

Calypso (Calypso bulbosa)
Photo par J. Goltz

Cependant, chaque année nous continuons à perdre des boisés de vieux cèdre qui sont des habitats pour des plantes peu communes et très rares sur les terres de la Couronne et les terres privées au Nouveau-Brunswick. La nouvelle stratégie du gouvernement du Nouveau-Brunswick va mettre des sites semblables à un plus grand risque de destruction. Le bois mou sera récolté davantage qu'auparavant et « Quelques zones auparavant gérées dans un souci de protection des habitats (pour la faune) seront réaménagées et les objectifs globaux seront réduits » .

Les implications pour la biodiversité sont troublantes. Les boisés de vieux cèdre soutiennent un groupe unique d'espèces qui sont souvent rares en Amérique du Nord ou très rares au Canada atlantique. De telles espèces, et d'autres encore non-décrites, continuent à être découvertes dans ces habitats grâce au travail sur le terrain. Plusieurs espèces de plantes qui sont adaptées à des boisés de vieux cèdre ne peuvent pas survivre les coupes à blanc ni la coupe sélective qui dérange l'intégrité de l'habitat. Le Calypso bulbeux (*Calypso bulbosa*), une espèce d'orchidée qui fleurit au printemps dans les habitats calcaires avec des boisés de cèdre est extrêmement susceptible aux perturbations d'habitat, et a disparu de plusieurs des régions où elle se retrouvait dans la partie sud de la province ainsi que la plupart du Canada et de l'est des États-Unis. L'une de nos espèces d'orchidées indigènes les plus rares, le Malaxis à pédicelles courts (*Malaxis monophylla*) fait face au même destin pour des raisons semblables.

Ce n'est pas seulement cette nouvelle stratégie de gestion des forêts de la Couronne qui met les espèces comme celles-ci en péril. Les plantes rares sont aussi menacées par des lois qui ont été mises en place pour limiter des restrictions potentielles sur les industries d'extraction de ressources. Par exemple, les boisés de forêt de cèdre ancien sont des milieux humides. Cependant, puisqu'ils sont boisés, ils ne sont pas classifiés comme milieux humides au Nouveau-Brunswick et donc ne sont pas assujettis au règlement sur les milieux humides. Il en est ainsi pour bien d'autres milieux humides boisés de la

province. Lorsque le Nouveau-Brunswick a modifié sa *Loi sur les espèces menacées d'extinction* en 1996, il avait été décidé que seules les plantes en danger au niveau national seraient classées comme étant en danger au Nouveau-Brunswick. Ceci a été fait malgré des recommandations par les scientifiques les mieux informés dans la province, qui disaient que toutes les espèces de plantes très rares ainsi que les plantes rares retrouvées dans des habitats menacés du N.-B. devraient être classées comme étant en péril dans cette province. À l'époque, deux animaux en péril dans la région ont été classés « menacé », cependant, les plantes rares au niveau régional seraient protégées par une « gérance spéciale », sans réglementation. *La Loi sur les espèces en péril* de 2012 a remplacé la loi précédente et créa un comité avec le pouvoir de recommander la classification d'espèces menacées, mais aucune ne l'a été jusqu'à ce jour.

Même avant la nouvelle stratégie, des preuves des impacts négatifs des pratiques forestières sur les espèces de plantes en péril étaient déjà apparentes sur les terres de la Couronne et les terrains privés. Des coupes à blanc ont été faites dans des milieux humides d'épinettes noires et d'érable rouge qui abritent la Listère australe (*Listera australis*), une espèce d'orchidée sauvage en danger à l'échelle nationale. Le Calypso bulbeux continue à disparaître des sites où les forêts de cèdres ont été coupées et les populations de cette plante rare diminuent. Le Polémoine de Van Brunt (*Polemonium van-bruntiae*) était autrefois considéré extirpé au Nouveau-Brunswick, mais a été récemment redécouvert. Tout près de l'un des seuls sites où nous savons que cette espèce existe, il y a une zone de coupe à blanc. Le Polémoine pousse jusqu'au bord de la coupe à blanc, le long d'un ruisseau qui coule à travers un milieu humide de cèdres et d'aulne, mais la coupe a éliminé tout habitat au-delà. Il semble très possible que la coupe à blanc dans ce lieu y ait réduit la taille de la population de cette espèce.

Le Polémoine de Van Brundt (Polemonium van-bruntiae)
Photo par J. Goltz

Des zones naturelles protégées en permanence sont extrêmement importantes pour la protection d'espèces en péril et rares. La nouvelle stratégie promet d'augmenter les zones protégées au Nouveau-Brunswick. Ceci est un pas dans la bonne direction. Cependant, peu de zones protégées naturelles ont été créées pour protéger des espèces en danger ou rares au N.-B.

L'un des buts de la stratégie est de diminuer le montant de forêt gérée pour la conservation. Ceci aura probablement des répercussions sérieuses pour les espèces en péril et rares, surtout que plusieurs de ces espèces se retrouvent dans des forêts anciennes, des terres humides boisées et dans des zones tampons, tous des habitats qui seront réduits.

Les plantes sauvages du N.-B. sont une partie importante de notre patrimoine naturel et notre identité culturelle. Elles ont de la valeur en soi et c'est notre devoir, comme gardiens responsables, d'assurer qu'elles continuent à exister. Les politiques et les stratégies qui exacerbent le risque pour nos plantes en péril, rares et menacées devraient être examinées avec attention et reconsidérées.

Listère australe (Listera australis)
Photo par J. Goltz

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The New Forestry Strategy for New Brunswick

Reflections on a Small Stream

In the early 1970's my wife and I and our two small children took it upon ourselves to get to know our new home in northern New Brunswick. We were recent transplants from city and university life and the seemingly endless expanses of forest in northern New Brunswick captured our imaginations.

In the course of our ramblings, we "discovered" a small brook back in the middle of nowhere, or at least that is how we thought of it. In short order, it became *our* brook; only later on did we determine that it appeared on topographical maps of the area as Middle Brook, and that it emptied into one of the branches of the Upsalquitch River, in turn a tributary of the Restigouche River. For several years, we took every opportunity to camp at Middle Brook and explore the area around it. It was there that I made my acquaintance with American Redstart, Ovenbird, Northern Waterthrush, and other small forest birds. I also became a trout fisherman; our brook had a generous population of small resident Brook Trout and, in late summer, I discovered a transient population of (sometimes) much larger fish who migrated up into the cold waters of the brook from the warmer river nearby to spawn. As well, we discovered that fiddleheads grew bountifully in the backwaters that would be inundated in spring and that remained damp even in the heat of summer.

It has always been my habit to explore my surroundings, and Middle Brook provided endless opportunities to learn new things about life in and around a small, secluded, hillside stream. Still, I was a city boy and often did not comprehend the network of connections in the environment that linked our brook to the larger landscape – that is, until one particular spring.

We had missed the fiddlehead crop in our usual nearby picking spot one spring. So on a day in early June (still early spring back in the deep woods), I decided to visit our brook, perhaps try for a couple of trout, and pick a supply of fiddleheads. When I got to the brook I was confused; I had to look around to assure myself that I was where I thought I was. It was as though something monstrous had rolled down the streambed, stripping everything before it. Hitherto small pools and eddies were gone; stands of brook-side willows were shattered or uprooted completely; larger trees were tumbled into the brook itself – and my favorite fiddlehead patch was nowhere to be found. I pushed upstream for a few hundred meters until I came to a small gravel beach. There I found a dead beaver.

I didn't stay for long that day, and left assuming that all was in the way of nature. I continued to visit Middle Brook over the course of that summer and one day in August decided to traverse the brook to its headwaters. I drove to a site where the topographical maps showed a small brook crossing a logging road, parked, and set off through a willow stand to follow the stream downhill until I could determine whether or not it was, Middle Brook. I had only gone several hundred meters when I pushed

into what I suddenly realized was a huge clear cut. From where I stood, the cut spanned a good two hundred and seventy degrees of the horizon. The brook was now little more than a muddy channel, struggling down through the clear-cut until it finally reached standing forest at the far end of the cut. The area had been harvested the preceding summer.

And then, it all came together for me: the streambed below gouged as if by a giant trowel; the pools and eddies erased; fiddlehead patches and willow thickets devastated; the dead Beaver on a gravel bed far from its dam and lodge. The spring runoff had nothing to hold it back as it tore through the clear-cut and it had run rampant as it scoured the streambed and adjacent forest floor. A whole summer's worth of water had flushed down through that narrow gorge in a matter of a few weeks.

Twenty years later, Middle Brook still showed signs of devastation; now, thirty years on, it is beginning to assume something of the character of the brook, *our* brook, as exists in my memory. But what a price for a small stream to pay for a few hundred cords of wood! And a depressing lesson that still needs to be learned by far too many of those entrusted with the care of our brooks, rivers, and forests, and the wildlife they support – landscapes don't stand in isolation. We can expect a lot more devastated Middle Brooks as the new forestry Strategy, with its expanded clearcuts and reduced conservation forest, is implemented.

Outlet Stream
Photo by B. Brown

Clear Cutting Causing Long-term Declines in Forest Productivity?

Implications of the Forestry Strategy

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Soils have long been treated as an inanimate substrate from which good things arise; that is, treated like dirt. However, many farmers, gardeners and woodlot owners have long known that this is not the case. Now, science has been catching up in recent decades, confirming that soils are complex systems, where biology, geology and chemistry come together to form the basis of productivity and of much of our economy. In particular, forest soil researchers are now showing the folly of the professional foresters neglect of forest soils, as it is these soils that ensure a sustainable and productive yield of timber into the future.

My own research[1] was undertaken in a region of Nova Scotia with soils and forests very similar to parts of New Brunswick. Walking in the Red Spruce dominated forests of the Eastern Shore of Nova Scotia, one would be forgiven for thinking one were in the Fundy forest: Red Spruce, Yellow Birch, and maples. My work compared two sites that were managed identically until the 1970s. In 1976 one of the sites was clear-cut, while the other one remains intact to this day. Today the clear cut site is a stand of 35 year old Red Spruce and Balsam Fir, while the second site is a stand of 120 year old Red Spruce. Both sites share the same climate and forest cover, with only minor differences between the two in terms of soil.

What I found was that the 35-year-old site now has 27% less organic matter in the top 50 cm of soil, and 26% less nitrogen. That these two soil components have shown a parallel decline compared with the 120 year old site is not a surprise; in our coarse soils just about the only thing that retains nutrients like nitrogen, potassium and calcium, is organic matter. If you lose organic matter in your soil, the nutrients will also be lost.

Indeed, any farmer will tell you that two of the most important things to have in your soil if you wish to grow healthy, abundant crops is organic matter (for example green manure) and nitrogen. Without large additions of the two at the right times of the year, farmers would be out of business. The implications of losing soil organic matter and nitrogen on timber yields and forestry are just as severe (albeit over a longer rotation).

Other researchers have also encountered this trend. Dr. Amanda Diochon, doing research for her PhD[2] at St. Francis Xavier University, found that organic matter loss from soils continues for 40 years following clear cut harvesting. It takes 70-80 years for the organic matter to rebuild to the levels present prior to clear cutting.

Inputs of organic matter into the soil are crucial to sustaining soil organic matter, thereby sustaining soil nutrients. Inputs come in the form of deadwood from above and through roots in the form of root growth and sugars injected into the soil. Clearcutting dramatically reduces both of these inputs.
Photo by D. Prest

This suggests that harvest rotations less of than 80 years will inevitably result in a sustained loss of organic matter – and as previously stated, lead to a continued loss of nutrients from our forest soils.

Researchers from Dartmouth University[3] determined that hardwood forests in New Hampshire subject to the greater soil disturbances that occur during clear cutting, suffered greater losses of organic matter than during other forest harvesting practices. These losses of organic matter are still detectable for at least 50 years after harvesting. New Brunswick shares many of the same hardwood tree species with New Hampshire.

These recent insights prompted leading forest scientists,[4] on December 6th, 2013, to urge the scientific community to rethink and re-examine the accepted paradigm that clear cut harvesting has little effect on soil organic matter.

Nitrogen is one of the most important nutrients that sustain productivity on land, and is the nutrient most often in short supply. When added, it most often yields the greatest benefit. Scientists have long known that clear cutting greatly increases nitrogen loss from forests.[5] In particular, when herbicide treatments are used scientists have found nitrogen in groundwater may increase up to 56 times over the two years following harvest as compared to prior levels.[6, 7]

This loss of nitrogen following clear cutting is now being detected in soils, and apparently lasts for decades. Research now underway in the Maritimes suggests that nitrogen levels in forest soils continue to decrease for up to 70 years following cutting. It takes up to 120 years for the nitrogen to recover to pre-harvest levels. This work suggests that any clear-cut rotation of less than 120 years is likely to be unsustainable.

These are important points to consider for anyone concerned about sustaining jobs in rural New Brunswick.

Could it be that we are already experiencing the effects of forest productivity loss as a result of clear cutting? And how would we recognize such a loss?

A forest is a very complex system. However, there are things that we can look at anecdotally that may suggest such a trend of decreasing productivity in forest soils.

I would look for signs that our forests are not growing as quickly as we think they should. Plantations that were expected to be ready for harvest by a specific date may need additional time to produce the desired wood volumes. I would look for signs that some tree species, such as Balsam Fir, which require higher quality soils, may not grow as vigourously as they did in the past. I would look for signs of an increase in the occurrence of species that thrive on low quality, mineral soils, particularly if these species are dominant in the early years following clear cutting. Ecologists call these species pioneer species, because they are the first tree species to colonise area following a disturbance, such as a clear-cut. In forested habitats, Pin Cherry, poplars and White Birch are examples of these early successional stage species.

Could other factors account for such observations? Undoubtedly. Nonetheless, these are the very things one would expect to observe if our forest soils are suffering from a loss of organic matter and nutrients. In the absence

When forestry operations avoid opening the tree canopy too much – less than 10 m some researchers suggest – soil nutrient dynamics aren't necessarily altered, suggesting that soil organic matter is conserved and will continue to sustain healthy timber yields long into the future. Photo by D. Prest

of long-term studies over several decades and rotations, and in a funding climate often hostile to such investigations, these may be the "canaries in the coal mine" for our soils.

Currently, predictions of forest growth form the basis of how much we think we can sustainably cut. These predictions are based on models that I do not believe realistically incorporate new scientific findings. These findings suggest that short rotation clear cut harvesting results in an unsustainable loss of nutrients from our soils, and likely reduces the productivity of our forests. In modeling science there is a saying: "Garbage in; garbage out." If models are not using the best data from the best science to perform their analysis, then the outputs will be close to worthless. It follows that the policies built upon these outputs will be worth even less.

Clear cutting exposes forest soils to increased temperatures, which is known to increase rates of decomposition. In particular, when forest operations tear into the mineral soil losses of organic matter from the soil have been shown to be even worse.
Photo by J. Simpson

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New Forestry Strategy Spells End of Future Forested Protected Areas in N.B.

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In March 2014, the provincial government released a new 10-year Crown Forest Management Strategy. The Strategy will remove more than one-quarter of the amount of our public land that used to be specially managed to conserve fish, wildlife habitat and protect our rivers. Instead, the land is given over to increased logging, including clearcutting.

The Canadian Parks and Wilderness Society-NB Chapter, along with many of the province's wildlife researchers, is concerned that reducing the amount of conservation forest on public land puts our ecosystems at unnecessary risk. Allowing more logging in old forest habitats on steep slopes and other previously inoperable areas adds additional strain on forest ecosystems. It poses a threat to wildlife that depend on large patches of old forests for their survival; like Pine Marten, Flying Squirrel and Brown Creeper. Overstressed forests are not as able to withstand the pressures that will come from climate change impacts; like new diseases, new insect outbreaks, floods or drought.

With this Strategy, government is knowingly going below the threshold of what is recommended by wildlife managers (and based on literature) to maintain viable populations of wildlife that are of conservation concern. They are going below the amounts of old forest habitats that government wildlife managers believe are needed to allow wildlife to thrive. We will be going below the amounts previously set aside for buffers along rivers and streams that allowed our rivers to flow clean, cold and with even flows.

The habitat areas that were managed to conserve larger patches of old forests were also our best options to adding to a network of protected areas over time. New Brunswick is 2nd to last in Canada in the proportion of our land designated in permanent protected areas. NB has 3.1% of the province in protected areas, while other provinces have on average 10% in protected areas. These protected areas are legally designated to be free from industrial activities, while still allowing a range of low impact recreational activities.

Canada has made international commitments, as part of the Biodiversity Convention, to protect 17% of the country by 2020. New Brunswick has a long way to go to protect our fair share of the province's natural areas. Because of the new Strategy, we will have a hard time finding natural forest ecosystems that are large enough, or undisturbed enough, to add to the protected areas network in the future.

Future governments are being locked into an industrialized forest management approach that doesn't leave room for new conservation measures or new protected areas. Government has signed a legally binding agreement with the forest industry. This appears to mean government would need to financially compensate a forest company if any protected areas are established that impact the amount of wood supplied.

Instead of squeezing the life out of our conservation zones, government should look more

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Magnolia Warbler
Photo by A. Clavette

seriously at ways to get additional wood from private woodlot owners. Woodlot owners have said they want to be more integrated into the forest economy. That way, we could support rural jobs and still protect the forest ecosystems that are so important to our province.

This Strategy is not a good plan for either our environment, or our economy. It needs to be abandoned, and replaced with a plan that will ensure survival of our wildlife, our forests and rivers, and will provide us with the flexibility of adding much needed old forest protected areas in the future.

La nouvelle stratégie forestière signale la fin de nouvelles Zones protégées naturelles au N.-B.

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En mars 2014, le gouvernement provincial a publié une nouvelle stratégie échelonnée sur dix ans pour la gestion des forêts de la Couronne. Cette stratégie élimine plus d'un quart de nos terres publiques qui étaient gérées pour la conservation du poisson, des habitats pour la faune et la protection de nos rivières. Au lieu, celles-ci seront abandonnées à l'exploitation forestière, incluant les coupes à blanc.

La Société pour la nature et les parcs du Canada — section du N.-B., ainsi que plusieurs chercheurs de la faune dans la province, s'inquiète que la réduction de la forêt de conservation sur les terres publiques puisse menacer inutilement nos écosystèmes. Une augmentation de la coupe dans les habitats de forêt ancienne, sur les pentes raides et dans des zones jusqu'à maintenant inopérables apportent un stress additionnel sur les écosystèmes forestiers. Cela pose une menace pour la faune qui dépend de grandes étendues de forêt ancienne pour leur survie, tels la martre, le polatouche et le grimpereau brun. Les forêts surstressées résisteront mal aux pressions qui accompagneront le changement climatique tel que de nouvelles maladies, de nouvelles éruptions d'insectes, des inondations ou des sécheresses.

Avec ce plan, le gouvernement va délibérément au-dessous du seuil recommandé par les gestionnaires de la faune (et basé sur la littérature) pour maintenir des populations viables d'espèces préoccupantes. Soit un niveau au-dessous de celui que l'on croit être nécessaire pour permettre aux espèces vivant dans des forêts matures de prospérer. Les zones tampons, qui permettaient à nos rivières d'être propres, froides et de couler d'un flot régulier, seront réduites.

Les zones d'habitat qui étaient gérées afin de conserver de plus grandes zones de forêts anciennes étaient aussi nos meilleures options pour ajouter au réseau de zones protégées dans le futur. Le Nouveau-Brunswick est l'avant-dernière province au Canada en ce qui concerne la proportion des terres désignées comme zones protégées en permanence. Le N.-B. protège 3.1 % de ses terres, alors que la moyenne canadienne est de 10 %. La désignation légale des zones

protégées empêche les activités industrielles, tout en permettant une diversité d'activités récréative à faible impact.

Le Canada comme signataire de la Convention sur la biodiversité s'est engagé au niveau international à protéger 17 % du pays d'ici 2020. Il reste encore beaucoup à faire pour que le Nouveau-Brunswick y apporte sa juste contribution. En raison de la nouvelle Stratégie sur les forêts de la Couronne, dans le futur, nous aurons plus de difficulté à trouver des écosystèmes forestiers qui seront assez grands et assez intacts pour ajouter au réseau de zones protégées.

Les gouvernements futurs seront pris avec une approche industrialisée de gestion des forêts qui ne laissera pas de place à des mesures de conservation ou à de nouvelles zones protégées. Le gouvernement a signé une entente juridiquement valable avec l'industrie forestière. Cela semble vouloir dire que le gouvernement devra compenser financièrement une compagnie forestière si de nouvelles zones protégées étaient créées et avaient un impact sur la quantité de bois disponible à celle-ci,

Au lieu d'étrangler nos zones de conservation, le gouvernement devrait examiner plus sérieusement des façons d'obtenir plus de bois de propriétaires privés. Ces derniers ont déclaré qu'ils voulaient une plus grande participation dans l'économie forestière. De cette façon, nous pourrions soutenir des emplois ruraux et en même temps protéger les écosystèmes forestiers qui sont si importants pour notre province.

Cette stratégie n'est pas un bon plan, ni pour notre environnement ni pour notre économie. Elle devrait être abandonnée et remplacée par un plan qui assurera la survie de nos espèces, nos forêts et nos rivières, et un qui nous donnerait la flexibilité d'ajouter dans le futur, plus de zones protégées avec de vieux peuplements forestiers qui ont tant besoin de protection.

Forests at Kedgwick River
Photo by R. Clowater

Freins et contrepoids dans le régime d'aménagement forestier au N.-B.

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La clé de voûte de l'aménagement forestier au Nouveau-Brunswick est la Loi sur les terres et forêts de la couronne (LTFC), qui établit les règles de base et les responsabilités du ministère de Ressources naturelles (MRN) et des compagnies forestières. Mais, il y a également d'autres outils qui contribuent à veiller à ce que les forêts soient gérées afin de générer les retombées attendues par les Néo-Brunswickois – notamment les revenus, les emplois, l'eau potable, l'habitat faunique et les activités récréatives.

Les chercheurs en gestion forestière utilisent le terme « régime politique » afin de décrire l'ensemble de règles, d'organisations et de comportements qui détermine comment les forêts sont gérées.[1] Bien que la foresterie à travers le Canada ait plusieurs points communs, chaque province a son propre régime, qui change de temps à autre.[2]

Mare printanière
Photo par B. Brown

Un jeu de freins et contrepoids

Le régime forestier au N.-B. est basé sur quelques éléments principaux :

- La Loi sur les terres et forêts de la Couronne date de 1982, mais elle a subi quelques modifications depuis;
- Les boisés privés sont une source importante de bois, mais la récolte a chuté au cours de dernières années;[3]
- Quatre grandes compagnies détiennent des permis pour récolter du bois et doivent, en échange, entreprendre certaines activités d'aménagement.
- Les opérations industrielles sont contrôlées par les règlements du MRN et par un système de certification et de vérification indépendantes.
- Les valeurs environnementales sont protégées par d'autres lois, par les agences gouvernementales et par les aires protégées.

Assurer les bonnes pratiques forestières

Chaque province utilise une combinaison de méthodes pour s'assurer que les pratiques forestières sont acceptables.[2] Le N.-B. utilise trois méthodes et une quatrième est proposée.

1. Les règlements sont établis par le gouvernement sous la LTFC. En 2009, le MRN, qui fait respecter ces règlements, a introduit un système de vérification partielle, mais l'efficacité de ce système n'a pas été évaluée de façon indépendante.
2. Les plans d'aménagement forestier sont préparés par les grandes compagnies forestières selon les normes du MRN. Le MRN s'assure que les activités prévues sont acceptables et que les plans sont respectés.
3. La certification forestière est un système volontaire où les compagnies s'engagent à respecter des normes établies par un organisme indépendant. Toutes les grandes compagnies forestières au N.-B. détiennent une certification selon la

norme SFI. SFI est reconnu pour le maintien de la productivité forestière et les valeurs économiques alors que FSC est renommé pour son attention aux enjeux sociaux et écologiques.[4] La certification est maintenant reconnue comme un outil important pour la gouvernance forestière, mais pas à titre de mécanisme unique pour garantir les bonnes pratiques forestières.

4. La gestion par résultats (proposé) permet au gestionnaire de déterminer les meilleurs moyens pour atteindre les objectifs ou les résultats fixés de concert avec le MRN. Seule la Colombie-Britannique utilise un tel système, adopté en 2004 après quelques années de consultation et l'adoption d'une nouvelle loi. Des évaluations ont souligné certaines difficultés et même noté un retour vers l'utilisation de règlements.[5]

Équilibrer les forêts publiques et privées

51 % des forêts au N.-B. sont sur les terres de la Couronne, 29 % sur les boisés privés et 18 % sous la propriété de grandes compagnies forestières. Assurer un approvisionnement adéquat pour l'industrie forestière nécessite la contribution de toutes ces sources.

Depuis dix ans, les forêts publiques ont fourni 4 à 5 millions m^3 de bois chaque année. Jusqu'en 2006, les boisés privés fournissaient 2,5 à 3 millions m^3, mais cette quantité a chuté à moins d'un million m^3 – à cause des prix trop bas selon les propriétaires de boisés[3]. Selon les estimations, l'approvisionnement durable provenant de boisés privés est approximativement 2,5 millions m^3.

Des rapports en 2008[6] et 2011[3] formulaient des recommandations pour améliorer l'équilibre entre forêts publiques et privées, mais peu de changements ont été apportés

La transparence et la participation du public

De plus en plus la participation du public est reconnue comme un élément essentiel d'un régime forestier. En 2004, les députés provinciaux recommandaient que la province bonifie les processus de consultation, observant que le mandat du MRN « ne peut être réalisé sans l'apport précieux de la population de la province. »[7] L'opinion du public a été sondée en 2007 et a fait l'objet de recherches par des groupes de travail, mais la population ne participe pas à la préparation de plans d'aménagement. Dans les faits, le N.-B. manque de mécanismes de participation qu'on retrouve souvent ailleurs.

Garder un régime à jour

La société et l'industrie forestière évoluent et un régime forestier doit également être modifié pour demeurer efficace. La Colombie-Britannique, l'Ontario et le Québec ont adopté des lois forestières semblables à celles du N.-B. dans les années, mais ont depuis modifié leurs régimes afin de tenir compte des préoccupations et des défis actuels. Le Québec a adopté une nouvelle loi en 2010; la C.-B. en 2004; l'Ontario a apporté plusieurs changements depuis 2000;[2] et la Nouvelle-Écosse a introduit une nouvelle politique de ressources naturelles en 2012 après 2 ans de consultation. Même si le gouvernement du N.-B. a commandé

Frêne blanc
Photo par B. Brown

Qu'est-ce que donne la nouvelle stratégie forestière[8]?

- La « stratégie » cible l'augmentation de l'approvisionnement en bois résineux, mais ne modifie pas les autres éléments du régime.
- La stratégie propose une gestion par résultats, tandis que l'entente entre le MRN et JD Irving précise que cette approche devrait être négociée et implantée d'ici le 1er septembre 2014. L'entente ne mentionne aucun processus de consultation sur ce nouveau mode de gestion ni de période d'essai.
- L'entente entre le MRN et JD Irving semble remplacer certains processus et règles de la LTFC. Elle pourrait également restreindre le pouvoir du gouvernement de modifier les règles en réponse aux besoins futurs de la province.
- L'entente entre le MRN et JD Irving stipule qu'elle doit être gardée confidentielle.
- La stratégie prévoit que les dépenses gouvernementales diminueront, suggérant que le rôle du MRN dans la gestion forestière sera réduit.
- La stratégie ne propose aucune bonification pour l'aménagement de boisés privés ni pour la participation du public.

plusieurs rapports depuis 14 ans, aucun changement significatif n'a été apporté à la LTFC ni au régime forestier.

Conclusion

Au N.-B., un ensemble d'institutions et de règles contribuent à gérer les forêts de façon à ce qu'elles génèrent les retombées auxquelles les citoyens s'attendent. Ce système est en place depuis presque 35 ans, mais il n'a pas évolué aussi vite que la société ou l'industrie forestière. De nouvelles règles sont nécessaires, mais les modifications doivent tenir compte de l'ensemble des mécanismes qui contribue à assurer que les forêts sont gérées pour répondre aux besoins de la province.

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La vue de Mt-Denys
Photo par S. Dietz

Checks and Balances in New Brunswick's Forest Management Regime

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The centerpiece of forest management in New Brunswick is the Crown Lands and Forests Act (CLFA), which sets out the basic rules and responsibilities for the Department of Natural Resources (DNR) and the forestry companies. However, other tools help to ensure that forests are managed to provide the benefits that New Brunswickers expect – revenue, employment, water, wildlife habitat and recreation among others.

Forest management scientists often use the term "policy regime" to describe the overall set of rules, organisations and behaviour that determines how forests are managed.[1] Although forestry across Canada shares many similar characteristics, each province has its own regime, and these change from time to time.[2]

A system of checks and balances

New Brunswick's forestry regime comprises the following key elements:

- The Crown lands and Forests Act, dates from 1982 although some parts have been modified;
- Private woodlots are important for wood supply, but harvests have fallen in recent years.[3]
- Four large companies hold licences that allow them to cut wood on Crown land in exchange for undertaking certain management activities.
- Industry operations are controlled by the DNR using regulations and through an independent forest certification system.
- Environmental values are also protected through other Acts, by other government agencies and with Protected Areas.

Ensuring good forestry practices

All provinces use a combination of methods to ensure that forest practices are acceptable.[2] NB has three main methods, and a fourth is proposed.

1. Regulations, are set by the government under the CLFA and enforced by the DNR. In 2009, full enforcement was replaced by an audit system, but the effectiveness of this has not been independently evaluated.
2. Forest management plans are prepared by the major companies

Hall's Creek/ Ruisseau Hall
Photo by A. Clavette

to standards set by the DNR. The DNR ensures that actions in the plan are acceptable, and that plans are being followed.

3. Forest certification is a voluntary system whereby companies agree to abide by requirements set by an independent organisation. All major companies in NB hold SFI certification and JDIrving has also sought certification by FSC. SFI is seen to be strong in maintaining forest productivity and economic values, while FSC is strong in social and ecological issues.[4] Certification is recognised as an important tool in forest governance, but not as a stand-alone way of ensuring good forestry practices.
4. Performance-based management (proposed) allows the manager to decide the best ways of meeting outcomes or objectives agreed with the DNR. Only British Columbia uses such a system, introduced in 2004 after consultations over several years and a new Act. Evaluations of the BC experience have shown difficulties associated with this, resulting in a move back towards regulations.[5]

Forest trail
Photo by B. Brown

Public and private forests – balancing supply

Fifty-one percent of NB forests are on Crown land, with another 29% on private woodlots and 18% owned by major forestry companies. Both public and private forests are important in ensuring that the forest industry has sufficient supplies of wood.

Over the last 10 years, Crown forests have supplied between 4 and 5 million m^3 of wood each year. Woodlots used to supply 2.5 to 3 million m^3 each year, but since 2006 this has fallen to under 1 million m^3, with woodlot owners blaming low prices offered for their wood.[3] It is estimated that woodlots can sustainably supply about 2.5 million m^3 per year.

Reports in 2008[6] and 2011[3] recommended improving the balance between Crown and public forests, but few changes have been made.

Transparency and public participation

Public participation is increasingly recognised as an essential part of any forestry regime, and provincial MLAs recommended in 2004 that NB improve public consultation, noting that the

DNR can only accomplish its role with "meaningful input from the citizens of the Province."[7] Public views have been sought through a public opinion survey in 2007 and by task forces, but the public is not involved in preparation of forest management plans. In practice, NB lacks public participation mechanisms that are found in other provinces.

Keeping a forestry regime up-to-date

Society and forest industries change and so forestry regimes also need to change to stay effective. Provinces such as British Columbia, Ontario and Quebec all passed forestry laws similar to NB's during the 1980s but have updated their regimes to reflect current expectations and challenges. Quebec passed a new Act in 2010; BC made major changes with a new Act in 2004; Ontario has made a series of changes since 2000[2], and Nova Scotia introduced a comprehensive natural resources policy 2012 after 2 years of consultations. Although the NB government has commissioned a number of reports and task forces over the last 14 years, no major changes have been made to the CLFA, or to the forestry regime.

Conclusion

In NB, different organisations and rules work to manage forests to provide the variety of benefits that citizens expect. The basic rules have been in place for nearly 35 years, but have not changed as fast as society or the forest industry. New rules are needed, but modifications need to consider the set of checks and balances that ensure that forests are effectively managed to meet the province's needs.

The New Forestry Strategy[8]

- The new Strategy focuses on increased soft wood timber allocations, but does not specify changes in other elements of the regime.
- The Strategy proposes a "results-based framework" while the agreement with JDI states that this is to be negotiated and implemented by September 1st. No mention is made of consultation or testing of this framework.
- The agreement between JDIrving and the DNR, appears to replace existing procedures and rules in the CLFA. It may also limit government ability to change rules in the future, or to modify the forestry regime to take account of NB's needs.
- The agreement between JDIrving and the DNR, states that it is to be kept confidential.
- The Strategy states that government expenditure will decrease, suggesting that DNR's role in forest management will be reduced.
- The Strategy does not propose improvements in private woodlot management or in public participation.

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La Forêt Acadienne

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Il est difficile de décrire la Forêt acadienne. Dans un sens, nous sommes entourés par la Forêt acadienne. Comme région, elle recouvre chacune des provinces maritimes, s'étendant jusqu'au Maine et à des parties du nord de la Nouvelle-Angleterre et de l'est du Québec. Mais comme type de forêt, la Forêt acadienne dans son état naturel est désormais une rareté, se retrouvant seulement dans des secteurs isolés éparpillés un peu partout dans la région qu'elle occupait autrefois.

Sans surprise, cette distinction échappe à la plupart des gens. On peut voir la forêt autour de nous, peu importe où nous sommes dans les Maritimes. Il est facile de conclure qu'il s'agit de la forêt naturelle des Maritimes : une forêt dense de petits, jeunes arbres d'espèces telles que le sapin baumier, le bouleau blanc, l'épinette blanche ou le peuplier. C'est seulement lorsqu'on tombe sur un peuplement de forêt ancienne qu'on réalise ce qu'on a perdu. De vieux géants entremêlés avec des arbres morts, soit debout ou tombés, avec des arbrisseaux remplissant les trous dans le couvert forestier laissés par des arbres morts. Les espèces de la forêt ancienne dominent cette forêt : épinette rouge, pruche, cèdre, pin blanc, érable à sucre, bouleau jaune, hêtre, frêne blanc, ostryer de Virginie. Les peuplements de Forêt acadienne naturels sont devenus rares maintenant, mais ces forêts anciennes recouvraient autrefois la majorité de la région.

Old-growth forest
Photo by B. Brown

La perte de la Forêt acadienne a commencé par le déboisement afin de faire place à l'agriculture. La hache était lente, mais efficace. Le feu était souvent l'outil de choix pour les premiers colons, et n'était pas toujours restreint aux terres destinées au déboisement. Le feu devint une occurrence commune dans les forêts des provinces maritimes à cette époque. Les trains et les opérations forestières étaient des sources d'incendies de forêt accidentels. Le Feu de Miramichi de 1825 fut le plus grand feu connu aux maritimes, brûlant à peu près un cinquième de la masse terrestre du Nouveau-Brunswick.

Dans les dernières décennies, les opérations forestières industrielles ont remplacé beaucoup de ce qui reste de la Forêt acadienne par des coupes à blanc. Une étude au Nouveau-Brunswick a démontré que la forêt mature restante diminuait à un taux net de 1.5% par an sur une période d'étude de 1975 à 2001 (Betts, M.G., D. Mitchell, A.W. Diamond, J. Bety. 2006. « Uneven Rates of Landscape Change as a Source of Bias in Roadside Wildlife Surveys. » *Journal of Wildlife Management*. 71(7). 2226-2273.) Les coupes à blanc sont souvent remplacées par des plantations et d'autres traitements intensifs de sylviculture telles que l'application de

pesticides et l'éclaircissement, modifiant ainsi le caractère de nos forêts.

Ces pressions passées et présentes ont réduit la Forêt acadienne naturelle au point où elle est classifiée comme type de forêt en danger par le World Wildlife Fund. Mais la Forêt acadienne n'est rien si non résistante. Bien que le retour du caribou aux provinces maritimes soit peu probable, les espèces d'arbres de la forêt mature pourraient reprendre leur dominance sur le paysage. Elles ont été réduites en abondance, mais pas entièrement perdues. La forêt ancienne existe seulement en minuscules peuplements isolés, mais avec le temps, elle pourrait reprendre sa place dans le paysage. Il n'y a rien qui empêche un retour sauf la volonté politique de créer un réseau d'aires protégées et d'exiger des pratiques forestières écologiquement responsables.

The Acadian Forest

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Describing the Acadian Forest is tricky. It requires qualifiers. In one sense, Maritimers are surrounded by the Acadian Forest. As a region, it covers each of the Maritime Provinces, and extends into Maine, and parts of northern New England and eastern Quebec. But as a forest type, Acadian Forest in its natural state is now a rarity, found only in isolated pockets scattered throughout its former range.

This distinction is understandably lost on many people. We see forest around us almost wherever we find ourselves in the Maritimes. It's easy to assume that this is the Maritime's natural forest: dense growths of small, young trees of species such as Balsam Fir, White Birch, White Spruce, or Poplar. It is only when we happen upon a remnant patch of old forest do we know what we've been missing. Old, tall giants of trees, mixed with standing and fallen dead trees, and seedlings and saplings filling the gaps in the canopy left by the dying trees. Old-forest tree species dominate these natural forests: Red Spruce, Eastern Hemlock, Cedar, White Pine, Sugar Maple, Yellow Birch, Beech, White Ash, Ironwood. Remnant patches of natural Acadian Forest are rare now, but these old-growth forests once covered the majority of the Acadian Forest region.

The loss of natural Acadian Forest began with clearing land for agriculture. The axe was effective, but slow. Fire was often the land-clearing tool of choice for early colonizers, and it was not always contained to the land destined to be cleared. Fire became common in Maritime forests during this time. Trains and forestry operations were other sources of accidental forest fires. The Miramichi Fire of 1825 is the largest fire ever known in the Maritimes, burning approximately a fifth of New Brunswick's landmass.

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Hemlock and Cedar
Photo by B. Brown

Philomycus *and* Arion *slugs and mushrooms (Caledonia Gorge)*
Photo by D.F. McAlpine/ New Brunswick Museum

In recent decades, industrial forestry operations have replaced much of what remains of the Acadian Forest with clearcuts. A study in New Brunswick found that remaining mature forest was lost at a net rate of 1.5% per year over the study period of 1975 to 2001 (Betts, M.G., D. Mitchell, A.W. Diamond, J. Bety. 2006. "Uneven Rates of Landscape Change as a Source of Bias in Roadside Wildlife Surveys." *Journal of Wildlife Management*. 71(7)). 2226-2273.). Clearcuts are often followed with plantations or other intensive silviculture actions such as herbicide applications and thinning, thereby further altering the character of our forests.

These pressures, both past and present, have reduced natural Acadian Forest to the point that it is classified as an endangered forest type by the World Wildlife Fund. But the Acadian Forest is nothing if not resilient. While we will not likely see caribou return to the Maritimes, old-forest tree species could regain their dominance on the landscape. They've been reduced in abundance, but not lost entirely. Old forest exists only in tiny remnants now, but with time, old forest could regain a presence on the landscape. There is nothing stopping the Acadian Forest from returning from its endangered status, save for the political will to create an effective protected areas network, and to require ecologically responsible forestry practices.

Timber Overharvest and the Future of N.B.'s Deer Yards

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Throughout New Brunswick, from early winter to spring, White-tailed Deer concentrate in low-lying forested areas, referred to as deer yards. This enables them to survive when the going gets tough. As snows deepen, deer seek shelter in the older softwood stands of spruce, fir or cedar or any mixed stands of these tree species. Having walked through dozens of deer yards, and having studied the movements of deer in the 1970s as a DNR biologist, I quickly learned just how important large conifers were to deer. Most deer beds (depressions made by the body of a resting deer) I observed were within 65 cm of a tree whose trunk diameter was 30 cm or greater and at least 90 years old. Surprisingly, the snow depths just outside the edge of deer beds I observed averaged 25 cm less than at 3 m distant, even though these latter measurements were still within the stand of large conifers. The conclusion drawn was that, not only were the mature stands of conifers critical for deer survival, but the largest trees within the mature stands were selected by the deer. These large trees provide a presumed windbreak and specific canopy, reducing deer heat loss during the coldest nights of winter.

In northeastern N.B., (Miscou-Kedgwick River), where I was stationed for more than 30 years, there were 300 active deer yards in 1983 when the deer herd peaked. Thereafter, the deer population

steadily declined, not so much due to severe winters or habitat loss, but through coyote predation. We conducted numerous surveys, including aerial surveys, and found that at least 80 deer were killed every two weeks by coyotes on the Restigouche River and its major tributaries alone. Additional mortality included deer killed by coyotes on the conifered slopes of those same rivers and in the dozens of deer yards elsewhere. Within just a few short years, the largest yard on the Nepisiguit (Bathurst) contained no deer, nor did most of the other yards. The largest deer yard (with approximately 1,000 deer) in the entire administrative region, at Simpson's Field (Upaslquitch Lake), was 8,000 hectares (16,000 acres), but its entire deer herd was likely extirpated by coyotes by the late 1980s, as examination of hundreds of dead deer confirmed. By 1994, only 6 of the 300 yards had any deer left. At that time, and during the late 90s, it was rare for a DNR enforcement officer to see a deer, even when on night patrol. Due to lack of deer prey and an outbreak of mange, coyotes rapidly declined by the late 90s.

Since then, due to the lack of coyotes, the deer population has slowly but steadily increased. About 20-30 % of the 300 previously unoccupied yards were recolonized by deer by 2013 (unpublished NB DNR data), with the "seed" for this re-colonization originating from the few deer yards still in use.

The new forestry Strategy for New Brunswick will allow timber companies to eliminate all yards currently unoccupied by deer in winter. If the public allows politicians and government bureaucrats to do this, we will never again see the numbers of deer we saw in New Brunswick the early to mid-80s. There will simply not be adequate habitat available to support deer during the winter months.

What can citizens do to correct this situation before it is too late? Express your concern, not only to politicians, but also directly to senior officials within the individual timber companies. There are previous cases where individual companies have not exercised the liberty allowed by the Province. For example, when buffers for medium width streams were officially set at 30 m on each side of a water course, Frasers Co., requested that I establish buffers on maps twice that width. This was the direct result of a media campaign criticizing the narrow buffer strips that we put in place. Likewise, where government policy required 60 m buffers on larger streams, Frasers and Avenor (Dalhousie Mill) both requested 100 m buffers on each side of such streams. Finally, on the Restigouche River, the timber licensee requested a 150 m buffer on each stream side, mainly for aesthetic purposes.

By speaking up now, you can help save the several hundred deer yards about to be eliminated for all time.

Restigouche River
Photo by S. Dietz

La surexploitation forestière et l'avenir des ravages du Cerf de Virginie

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À partir du début de l'hiver jusqu'au printemps, dans l'ensemble du Nouveau-Brunswick, le Cerf de Virginie se concentre dans des terres basses qu'on surnomme ravages de chevreuils. C'est une stratégie qui leur permet de survivre aux conditions difficiles de l'hiver. Alors que la neige devient plus profonde, le chevreuil se réfugie dans des peuplements plus âgés de résineux comme l'épinette, le sapin ou le cèdre. Ils peuvent aussi utiliser des peuplements mixtes de ces trois espèces. En tant que biologiste auprès du Ministère des Ressources naturelles dans les années '70, j'ai eu l'occasion de me déplacer dans des douzaines de ravages de chevreuils alors que j'étudiais les mouvements du chevreuil, et je me suis vite rendu compte de l'importance cruciale des grands conifères pour le chevreuil. La plupart des sites de repos de chevreuils (indiqués par l'enfoncement dans la neige laissé par le corps d'un chevreuil au repos) que j'ai pu observer étaient à moins de 65 cm d'un arbre dont le tronc avait un diamètre de 30 cm ou plus, et qui était âgé d'au moins 90 ans. Curieusement, la profondeur de neige juste au rebord des sites de repos de chevreuils que j'ai eu l'occasion d'observer était en moyenne de 25 cm moindre que ce qui se trouvait à 3 m de distance. Et cela, même si les seconds sites étaient, eux aussi, à l'intérieur des peuplements de grands conifères. La conclusion que nous en avons tirée était que, non seulement les peuplements matures de résineux étaient cruciaux pour la survie hivernale du Cerf de Virginie, mais qu'en plus, la zone près des plus gros arbres était recherchée par le chevreuil. On peut imaginer que ces grands arbres servaient de coupe-vent aux chevreuils, mais offraient aussi un couvert qui réduisait la perte de chaleur par le chevreuil pendant les nuits les plus froides de l'hiver.

Dans le nord-est du N.-B. (Miscou - Rivière de Kedgwick), où j'ai eu l'occasion de travailler pendant plus de 30 ans, il y avait 300 ravages actifs en 1983, alors que le troupeau de chevreuils avait atteint son nombre le plus élevé. Par la suite, on a assisté à un déclin continu de la population de chevreuils, non seulement à cause de la sévérité des hivers ou de la perte d'habitat, mais aussi à cause de la prédation du coyote. Nous avons fait plusieurs relevés, dont des relevés aériens, et avons découvert que 80 chevreuils étaient tués toutes les deux semaines par les coyotes sur la seule rivière Restigouche et ses affluents majeurs. En plus, la mortalité incluait les chevreuils tués par les coyotes sur les berges de conifères de ces mêmes rivières, et dans la douzaine de ravages des alentours. En seulement quelques années, le plus grand ravage des abords de la rivière Nepisiguit (Bathurst) n'abritait plus aucun chevreuil, tout comme la plupart des autres ravages. Le plus gros ravage (environ 1,000 chevreuils) de l'ensemble de la zone administrative de Simpson's Field (lac Upaslquitch) s'étendait sur 8,000 hectares (20,000 acres), mais l'ensemble du troupeau de chevreuils en a probablement été extirpé par le coyote dès la fin des années '80, comme l'a démontré l'observation de centaines de carcasses de chevreuils. Par 1994, il ne restait des chevreuils que dans 6 des 300 ravages de la région. À l'époque, comme

pendant l'ensemble des années '90 en fait, il était devenu rare pour un officier du Ministère des Ressources naturelles d'apercevoir un chevreuil même lors de patrouilles nocturnes. Par la suite, avec le déclin des chevreuils comme proie potentielle, combinée avec une épidémie de gale, le nombre de coyotes a décliné rapidement par la fin des années '90.

Depuis, à cause de la diminution des effectifs du coyote, la population de chevreuils s'est lentement mais surement rétablie. Environ 20 à 30 % des 300 ravages qui s'étaient retrouvés vides ont été recolonisés par le chevreuil par l'année 2013 (données non encore publiées du M.R.N. du N.-B.). On pense que les rares ravages où on trouvait encore du chevreuil ont été la source de cette recolonisation.

La nouvelle « stratégie » permettrait aux compagnies forestières d'éliminer tous les ravages présentement non occupés par le chevreuil. Si le public laisse les politiciens et les fonctionnaires gouvernementales faire cela, il est clair que nous ne reverrons jamais la population de chevreuils atteindre les nombres que nous avions connus entre le début et le milieu des années '80. L'habitat nécessaire ne sera tout simplement plus disponible pour permettre la survie des chevreuils en hiver.

QUE POUVONS-NOUS FAIRE POUR CORRIGER CETTE SITUATION AVANT QU'IL NE SOIT TROP TARD?

Faites connaître vos préoccupations, non seulement aux politiciens, mais aussi directement aux cadres responsables des différentes compagnies forestières. Il existe des précédents où des compagnies ont choisi individuellement de ne pas exercer les droits de coupe qui leur avaient été accordés par la province. Par exemple, quand les limites de coupe sur les berges ont été établies à 30 m de chaque côté pour les cours d'eau moyens, l'entreprise Frasers Co., m'a demandé d'établir des cartes avec des zones tampons qui occupaient deux fois cette distance. Et cela était en réaction directe à une campagne dans les médias qui critiquait la taille réduite des zones tampons mise en place par le gouvernement. De la même façon, quand la politique gouvernementale avait établi à 60 m les zones tampons sur les plus grands cours d'eau, Frasers et Avenor (moulin de Dalhousie) ont tous les deux demandé que des limites de 100 m soient établies sur chaque côté de ces cours d'eau. Enfin, sur la rivière Restigouche, les détenteurs de licences de coupe demandaient que l'on conserve 150 m de zone tampon sur les berges de toutes les rivières en grande partie pour des raisons esthétiques.

Si vous vous exprimez dès maintenant, vous pouvez encore sauver les centaines de ravages qui sont sur le point d'être détruits à jamais.

Cerf de Virginie
Photo par B. Noel

Forestry Jobs and Forestry Management in the Maritimes and Northeastern USA

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New Brunswick's new forestry Strategy[1] was released on 12 March 2014. The next day, provincial forestry leader, J.D. Irving (JDI), announced it would be making over 80% of the expected new investments in the industry. As highlighted in Table 1, a memorandum of agreement (MoA) between the government and JDI[2] indicates that JDI is to receive 62.1% of the additional wood fibre annually released from Crown lands, make over 85% of the expected new investments, and create 65.2% of the expected new jobs in the industry. While other important questions can be asked about the Strategy, the question we focus on here is: are these job figures a reasonable goal given the additional access to Crown lands? Could the public reasonably ask the government to do better?

Jobs are an important issue in New Brunswick. Recovery from the 2007-08 financial crisis has been slow and province-wide unemployment has generally been rising since 2007.[3] The most recent Statistics Canada data suggest an increase in the provincial unemployment rate in the last month coupled with a decrease in the participation rate. Unemployment rates are higher in the northern part of the province. Especially worrying is the near 20% unemployment rate for 15-24 year olds in the province.[4] These depressing statistics coupled with an upcoming provincial election make the current government desperate to see employment increases. Indeed, a significant selling point of the Strategy, at least as advertised by the government, is the number of new jobs created in the near future.

	Strategy	MoA with JDI	MoA/Strategy
Fibre (thousand m^3)	660	410	62.1%
Investment (millions)	$600	$513	85.5%
Jobs	500	326	65.2%

Table 1 - New Forestry Strategy and the MoA with JDI - Figures at a glance

It is not unreasonable for New Brunswickers to ask if the Strategy is a good deal for the province especially with so much of the newly released wood going to JDI. JDI is the largest single player in provincial Crown land forestry and owns a significant freehold (It is also true that JDI is a major forester in Maine and has forestry interests in Nova Scotia.). The goal of JDI is to make profits. JDI is not in the business of creating jobs or generating revenues for the province.

A firm that has market power in the purchase of an input is predicted to drive down the input price (thereby saving costs and increasing profits) by purchasing less of that input. Given JDI's size, access to Crown land leases, management contracts for Crown land, and large freehold, it is quite reasonable to expect that JDI has market power in the forestry products labour market and in establishing the purchase price of wood in the province. As it relates to employment in the forest products sector, one indicator that JDI has market power would be a low number of jobs created in the sector. In other words, there is sound economic reasoning for New Brunswickers to be worried

about their government's recent Strategy for Crown lands as it may enhance the market power JDI likely has in the forest product sector, further limiting job-creation strategies in the future.

Are 500 jobs in return for annual removal of 660,000 cubic metres of Crown timber a good deal for New Brunswickers? To assess this Strategy, we must find comparative data, ensure that we define jobs in a common manner, and find a common way to assess different wood harvests and the conversion of harvest into jobs.

Fortunately, comparative provincial data is publicly available from the Canadian Forest Service[5] and nearby American data is available from the North East State Foresters Association.[6] Like Natural Resources Canada, in its *State of Canada's Forests* reports[7] (see page 35 of the report), we adopt the language of a "direct" job in the forest product sector as being one that occurs within the forest product sector (in the woods, the mills, wood product manufacturing, and forestry support activities) as distinct from "indirect" jobs (such as investors and equipment manufacturers). These distinctions are clear in the data from both the Canadian Forest Service and the North East State Foresters Association. They are also clear in the MoA (see page 10), and in a JDI press release regarding investments at the St. Leonard's veneer mill.[8] Oddly, it is only in the government's Strategy where such a distinction is not made. Like the *State of Canada's Forests* reports, we too will adopt a comparison of "direct" jobs because of data availability and to ensure comparability.

Different regions harvest different quantities of wood and employ different numbers of people in the forest products sector. We define employment intensity in a region as the number of direct jobs in the forest products sector divided by the thousands of cubic metres harvested (i.e., direct jobs/1000 m^3). Further complicating the analysis, state-level data is measured in softwood, hardwood, and mixed cords and must be converted to cubic metres. This was done using industry-accepted methods.[9]

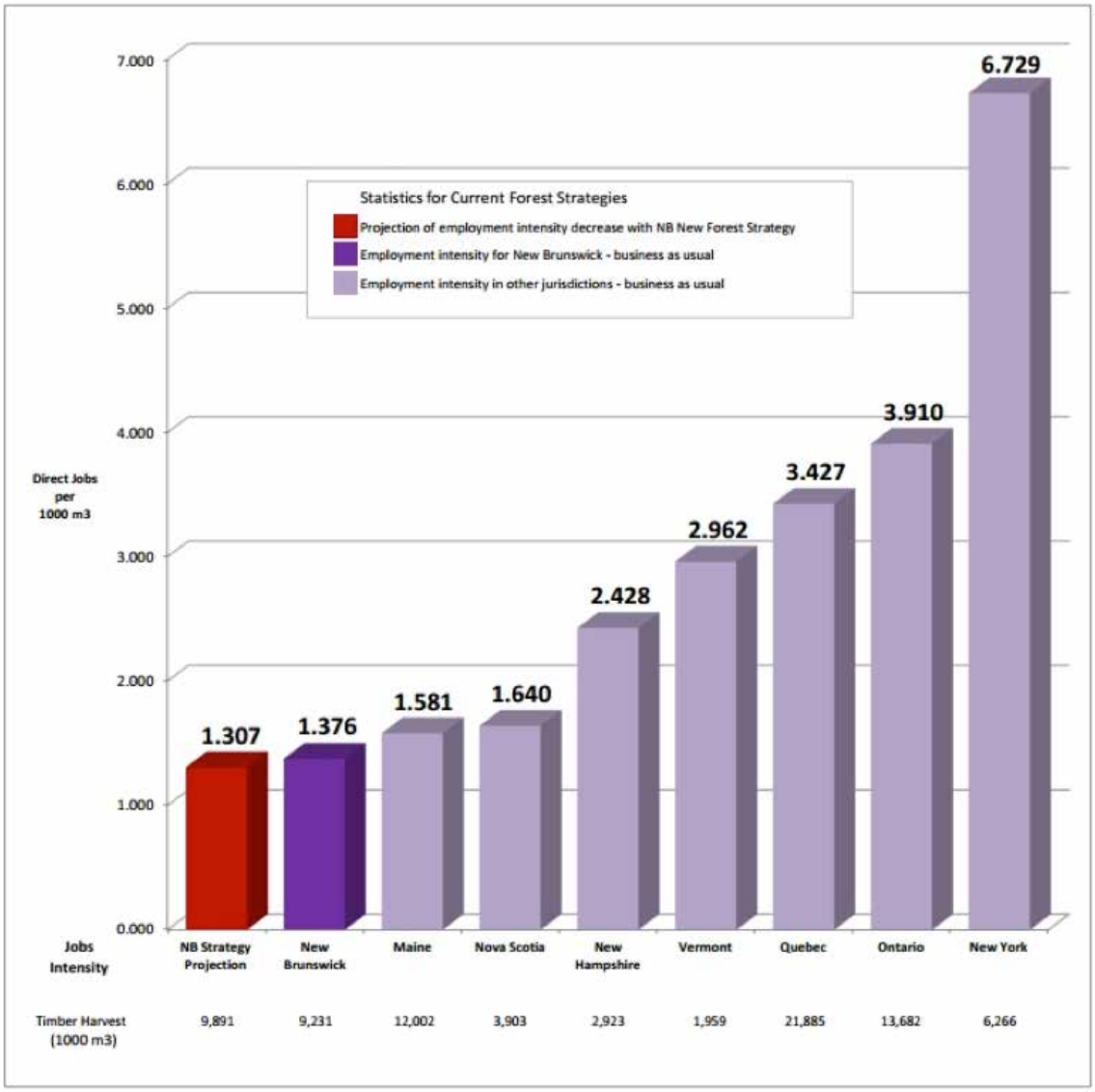
Figure 1 presents a graph of employment intensity in the forest products sector for New Brunswick and nearby regions for 2011, the latest year for complete data. Prince Edward Island data is dropped because of its small harvest and lack of data availability. Note that New Brunswick (at 1.376) is at the bottom of the intensity ranking in this group, followed by Maine (1.581), and Nova Scotia (1.640). This ordering may be coincidental in 2011, but it is worthy to note that these three jurisdictions are closer to each other in terms of employment intensity than they are to the next lowest jurisdiction – New Hampshire (2.428) – and well below the regional average of 2.815. It could be that market power in labour demand in the forest product sector has helped to keep New Brunswick's employment intensity low.

Greater detail can be gleaned from a detailed look at the sub-categories within the forest products sector (refer to Table 2 on page 39). "Jobs in the woods" show both lower intensity and lower variance than "jobs in the mills." It seems that if job expansion was the goal, it would have to happen in mills and other secondary manufacturing plants. Some very preliminary research suggests that in jurisdictions with a large amount of timber resources devoted to pulp production, employment intensity is lower, but more data and analysis is needed to draw a firm conclusion. Note, however, that of the $513 million of new investments as outlined in the MoA (Table 1), JDI has announced that $450 million will go to upgrade the pulp

and paper mill in west Saint John[10] – that is almost 88% of the contracted investment. While the company's press release indicates the number of construction jobs created, no mention is made of new permanent positions at the mill itself. That is in stark contrast to JDI's announcement at the St. Leonard's mill.[8] Pulp mill investment is typically capital intensive.

Equally telling, however, is what is missing from these provincial data as compared to their American counterparts. The North East State Foresters data provide employment information on wood energy (1,795 jobs across the four states), Christmas trees and maple products (1,898 jobs), and forest-related tourism and recreation (72,576 jobs). These states seem to have a broader concept of forest management; a forest is something greater than a source for fibre generation. More research and policy exploration

Figure 1 – Direct Jobs: Forest Products Employment Intensity by Jurisdiction. See Table 2 for details



in this area is definitely warranted.

How will the new Strategy impact the already-low employment intensity in New Brunswick? The MoA clearly delineates "direct" and "indirect" jobs (see p. 10). Of the 326 jobs expected to be created in total, 178 (or 54.6%) are "direct." The Strategy makes no such division, but given that over 60% of the annual timber volume is contracted to JDI through the MoA, it is a reasonable first approximation to apply the MoA percentage to the Strategy's total jobs figure of 500. In this case, the Strategy is predicted to create approximately 273 direct jobs (i.e., 178/326 x 500) in the forest products sector. In other words, the Strategy has an employment intensity of 0.414. But, the Strategy is also only incremental to existing harvests in New Brunswick.

Adding the Strategy to existing management is comparable to having a passing grade on a series of quizzes in a class, but then failing the next quiz. Your average will fall; not to the value of your latest quiz, but it will fall. Using a weighted average technique, we can cumulate the existing employment intensity in 2011 with the Strategy's intensity and get a projected intensity of 1.307. In other words, this Strategy is using Crown land to make New Brunswick less job intensive in the forest products sector.

Employment intensity in the forest product sector has been declining in New Brunswick for the last few decades.[11] The government's new Strategy only enhances this trend. In part this reflects the increasing capital intensity that has taken place in the existing forestry industry. In part this reflects the government's decision to implement a Strategy that, for the most part, has been negotiated as a contract (the MoA) with the largest forestry firm in the province. Moreover, that firm likely has the ability to exercise market power in the relevant labour market that would serve to lower employment intensity. The use of Crown land (i.e., land jointly owned by all New Brunswickers) to implement such a Strategy and further enhance this market dominance seems misguided. Finally, this Strategy might be classified as lacking in creativity. It seems to be more-of-the-same with no public consultation and no analysis of what other options might exist for dealing with Crown land management and licensing, industry structure, and a broader concept of the role a forest plays in society.

A study like this raises additional questions that deserve further analysis:

- Are there additional reasons for New Brunswick having the lowest forest products sector employment intensity in the northeastern region of North America, and how can this inform forestry policy?
- Does New Brunswick keep statistics on alternative forestry uses such as maple syrup products, Christmas tree and wreath production, and forest-

Caledonia Gorge
Photo by D.F. McAlpine/New Brunswick Museum

related tourism and recreation? If so, why are these revenue-generating and job-creating uses not integrated into the province's forest management plan and especially into the Crown land management plan?

- Has New Brunswick's government explored the strategies used in nearby jurisdictions to compare alternatives for Crown land management?
- Would the government consider setting aside Crown land timber allotment to explore forest management innovation and study employment intensity performance?
- Should New Brunswick more carefully explore the uses of its Crown timber resources? For instance, should so much of the fibre be devoted to the manufacture of pulp?

Clearly the forestry Strategy for Crown lands management will create some additional jobs in New Brunswick at a time when the province is desperate for jobs. But, does desperation necessarily lead to good decisions? We need to ask if this is the best we can do with our crown timber resource? Could we create more jobs for New Brunsickers and more revenue for New Brunswick with a better strategy that might allocate more of our timber resources across many small, medium and large business partners in new and diverse projects? The data suggest that New Brunswick is at the bottom of the regional heap when it comes to turning trees into jobs and the analysis here indicates that implementing the Strategy will put New Brunswick further behind. It may not be wise to use additional Crown timber for this purpose.

Jacquet River Gorge
Photo by D.F. McAlpine/ New Brunswick Museum

	Jurisdiction								Proposed NB	
	NB	**NS**	**QC**	**ON**	**ME**	**NH**	**VT**	**NY**	**Strategy**	**MoA**
Year	**2011**	**2011**	**2011**	**2011**	**2011**	**2011**	**2011**	**2011**	**2014**	**2014**
Harvest (thousand m^3)	9,231	3,903	21,885	13,682	12,002	2,923	1,959	6,266	660	410
"Direct" Jobs	12,700	6,400	75,000	53,500	18,980	7,096	5,802	42,166	273	178
Forestry and Logging	2,200	1,200	9,200	3,900	5,200	2,860	875	2,300		
Pulp and Paper	3,300	1,800	28,100	23,800	7,300	1,100	1,000	16,500		
Support Activities for Forestry	1,100	1,300	3,300	3,400	n/a	n/a	n/a	n/a		
Wood Product Manufacturing	6,000	2,100	34,400	22,300	6,480	3,136	3,927	23,366		
	Jobs per 000's m^3									
Direct	1.376	1.640	3.427	3.910	1.581	2.428	2.962	6.729	0.414	0.434
*Forestry and Logging**	0.238	0.307	0.420	0.285	0.433	0.978	0.447	0.367		
Pulp and Paper	0.357	0.461	1.284	1.740	0.608	0.376	0.510	2.633		
Support Activities for Forestry	0.119	0.333	0.151	0.249						
*Wood Product Manufacturing***	0.650	0.538	1.572	1.630	0.540	1.073	2.005	3.729		

Table 2: Forest Products Employment Intensity Across North Eastern North America

* US state data includes Forestry, Logging, and Trucking while Canadian data separates Forestry and Logging from Support Activities for Forestry. As a first approximation, one should add these two intensity measures for the Canadian data before comparing it to American data. This does not change the result.

** US state data here include furniture manufacturing. It is not clear if provincial data do the same. Removing furniture manufacturing from the data changes quantitative results but not rank ordering nor qualitative conclusions.

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Forest Management on New Brunswick's Crown Lands

The Bryophyte Perspective

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Dr. Kate Frego teaches in the Biology Department of the University of New Brunswick. Her research and that of her students over the past decades has focused on the impacts of forest management in New Brunswick on bryophytes. Sean Haughian, Krystal Mathieson, Leah McIntosh, Joe Mudge, Mark Pokorski, and Amy Witkowski are all her current or former students who have studied the ecology of bryophytes in the Acadian Forest ecosystem.
*Authors' names are in alphabetical order

In an ideal world, humans would harvest natural resources, like trees, without losing or seriously harming other organisms or processes in the ecosystem. We don't live in an ideal world, but the most promising way to harvest trees is to ensure that our impacts mimic the natural events that occur in forest ecosystems: if the disturbance created by our actions is equivalent to natural disturbances, it seems safe to assume that populations of most naturally occurring organisms are adapted to survive, or recover from, such impacts. The first step in predicting impacts of a management strategy is to assess its ecological "equivalence" to natural disturbances of the region, by comparing their component characteristics (e.g. spatial extent, frequency, intensity to natural events). For example, much of the native biodiversity of the Acadian Forest region is well adapted to frequent, patchy, low-intensity disturbances, such as the deaths of clumps of trees due to insect infestation, wind and ice storms, but less so to extensive, high-intensity events, such as relatively infrequent forest fires that remove shade, topsoil and nutrients.

Studying impacts of disturbance

Comparison to natural disturbances allows us to predict the effects of different forest management practices, but these predictions can be verified only through observation of biodiversity responses: if biodiversity returns to its "natural" levels for that ecosystem after the disturbance, and if those levels are maintained across the landscape over multiple returns of the disturbance, then the disturbance can be said to be sustainable at its present spatial extent, frequency and intensity. "Natural" levels of biodiversity are determined by observation of pre-disturbance conditions and continuing observations of comparable but undisturbed sites. While it is easy to recognize catastrophic negative effects, experience has taught us that the accumulation of small effects can be just as serious, and can be difficult or impossible to reverse.

Although we still have much to learn about exactly how forest floor plants (and biodiversity more generally) respond to different combinations of high-intensity disturbances, such as those that occur in plantation forests, it is clear that forests with minimal human disturbance make larger contributions to native biodiversity. It is also clear that with more frequent or more severe disturbances, there is a corresponding decline in biodiversity. For example, we have found that NB plantations contain approximately 30% fewer moss and liverwort species (bryophytes) than naturally-regenerated forests.

Bryophytes: who cares?

Our research group has studied the impacts of forest management in NB, on the plants of the forest floor, focusing on a group of small, primitive, poorly understood plants: the bryophytes. The term "bryophyte" covers three groups: mosses, liverworts and hornworts (Figure 1). NB's Acadian Forest contains several hundred species, most of them less than 1 cm tall and very sensitive to drying. This is because, unlike the more advanced plants, bryophytes have no

water-proof layer to prevent water loss, no true roots to absorb water from the soil, and no well-developed "pipelines" to move water internally. They thrive in the shady, cool, moist conditions of the forest floor where they may form small tufts or extensive turf, usually a mixture of many species intertwined (Figure 2, page 40).

Many bryophytes can propagate from small fragments of tissue, such as those snipped off by birds or rodents for bedding, or by specialized structures designed to enhance cloning; e.g. tiny fragile branchlets that detach easily. Long-distance travel is generally thought to be by reproductive spores, the bryophyte parallel of seeds, but simpler and small enough to be carried by air currents. When the spores germinate, most form a tangle of green filaments that resemble algae, before the first recognizable shoot and delicate leaves emerge. Reproduction requires that a flagellate sperm cell from one plant be splashed to another plant, so that it can swim to an unfertilized egg – a very precarious process! Success results in a distinctive structure, the sporophyte, with a long slender stalk supporting a capsule that, at maturity, releases spores, either gradually over years (most mosses, Figure 3a) or in a single burst (peat moss and liverworts; Figure 3b). For most species, we know almost nothing about the ecology of these juveniles: how far spores travel, what triggers (or prevents) their germination, or even how many are produced.

While our knowledge about their details is fairly limited, there is ample evidence that bryophytes are ecologically important components of the forest. In some forests, there may be as much carbon tied up in the bryophytes as in the trees. They provide habitat for numerous invertebrates, and nesting material for a variety of rodents and birds. Although

Figures 1 (a) - (c). Three common forest-floor bryophytes; From top: Figure 1(a) Conocephalum conicum; *Figure 1(b)* Lophocolea heterophylla, *a leafy liverwort; Figure 1(c)* Pleurozium schreberi, *a moss., Photos by M. Pokorski*

Clockwise from top left: Figure 2. A mixed colony of mosses Pleurozium schreberi *and* Ptilium crista-castrensis; *Figure 3(a)* Bazzania trilobata, *(liverwort); Figure 3(b)* Brachythecium sp *(moss); Figure 3(c)* Sphagnum sp *(peatmoss) each with attached sporophyte: a slender stalk topped by a capsule containing the developing spores.*
Photos by M. Pokorski

they are relatively indigestible for most organisms, they are eaten by slugs, snails, and some forest birds and rodents. At a broader scale, their extensive mats harbor nitrogen-fixing bacteria and absorb water, slowly releasing it to the feeder roots of trees and other rooted plants, thereby influencing water and nutrient cycles as well as soil temperature. Their influence on tree and shrub regeneration varies with species; some tree seeds and seedlings are inhibited by a thick moss layer, while the survival of others is enhanced.

What we have learned about forest management impacts

Forest management encompasses multiple activities – from harvesting, through regenerating and tending, to harvesting again (Figure 4a-e). Choices at each step have the potential for a range of impacts on the forest ecosystem. Our research group has worked to tease apart the effects on bryophytes of those forest harvesting options commonly used in NB forests.

Canopy removal. With tree extraction, the shade of the tree canopy is lost, and the forest floor experiences increased light intensity, and temperature and humidity fluctuations. Sensitive bryophyte species succumb quickly, while others may persist, depending on the degree of change. However, the degree of change varies with the proportion of trees removed, the understory layers retained, and the expanse of the cleared area. Foresters have developed a broader range of harvesting prescriptions to address multiple priorities. These include "variable retention", i.e. leaving clumps of mature trees either for potential nesting sites or as seed sources (e.g. clear-cut with dispersed retention, Figure 4c). It can be more cost-effective to leave young trees of desirable (i.e. marketable) species, than to remove them and plant seedlings. We found that patches of natural vegetation only 1.5m tall are enough to maintain the temperature, humidity, and populations of many forest bryophytes. Even more effective are larger aggregated retention patches: islands of mature, intact forest within a clear-cut (Figure 4e). While serving the purpose of maintaining seed trees and advanced regeneration, these also preserve intact communities of forest floor biodiversity. However, these "arks" are not perfect: the conditions of closed forest are maintained only within the core, 25m or more from the island edge, and the islands themselves may ultimately be slated for harvest. In addition, sufficient area must be allocated to these retention patches to ensure that the most uncommon (and vulnerable) species are captured and conserved within them. We are currently assessing other patterns of dispersed retention harvest, in which various proportions of mature trees are left scattered through a clear cut.

Substrates. Not all changes occur above the bryophytes. In the process of removing the trees, machinery can crush patches of bryophytes or churn up the surfaces on which they grow. Logging also leaves various amounts of debris – coarse and fine branches, bark, leaves – that bury existing bryophytes. These direct impacts on the forest floor cause the greatest immediate loss of bryophytes in the harvest process. The most extreme example is scarification (Figure 4d, e): deliberate scraping of the soil to prepare the site for planting and increase success of planted tree seedlings. Typical forest bryophyte species do not usually colonize bare mineral soil – they tend to occupy the rich organic substrates of thick humus and rotting logs found in forests – so scarification tends to favour pioneer (non-forest) species. Liverworts in particular tend to be lost when their preferred substrates are disturbed. Foresters can reduce

this mortality by minimizing the areas impacted by machinery tracks (limiting them to "skidder trails"), by encouraging advanced regeneration over planting whenever feasible, and by their choice of scarification equipment. For example, scarifying in trenches, or in relatively small patches at intervals for individual seedlings, is preferable to wholesale tilling.

Bryophyte diversity may be impacted by even more subtle changes in the available substrates. In managed forests, humus and rotting wood are less abundant, and the extraction of timber reduces the future supply (and diversity) of rotting wood. We are currently assessing substrate requirements, but we already know that individual units of rotting wood are transient in nature and offer diverse physical and chemical properties that change throughout the decay process. So far it seems that bryophyte diversity is strongly related to the degree of decay, and to the size and species of rotting logs. For example, well-rotted logs, and in particular large (diameter > 20 cm) hardwood logs, seem to support the most diverse communities. However, many industrial forestry operations (especially silviculture plantation forestry) skew forest composition towards softwoods, and leave behind only small stems (diameter < 10cm) after cutting. This effectively eliminates the future supply of optimal microhabitats. A current study is assessing additional roles of rotting wood, and the possibility of increasing conservation of bryophyte diversity by increasing rotting wood in silviculture plantations.

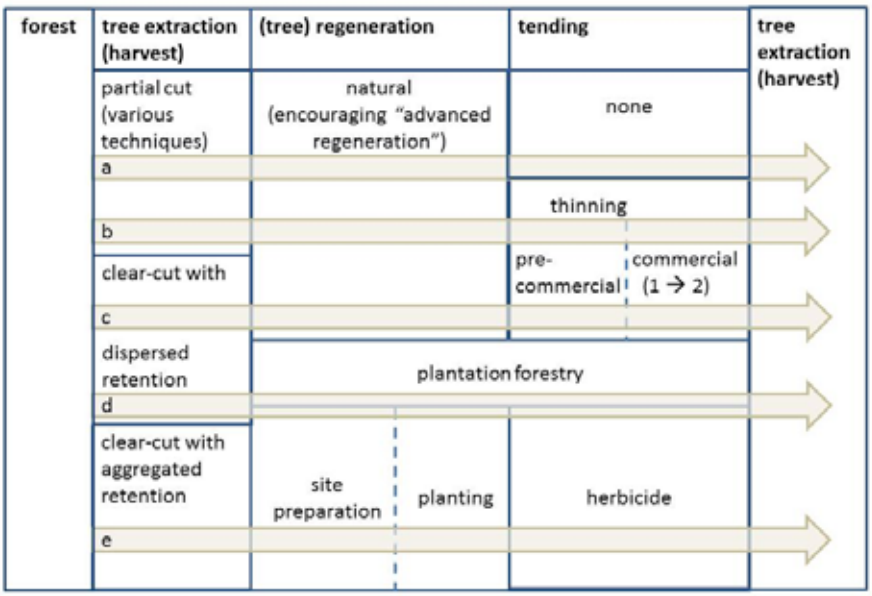

Figure 4 - Through each rotation (harvest cycle) of a managed forest, choices are made in terms of harvest, regeneration and tending of trees depending on a variety of ecological and economic factors. Each uses specific machinery, and produces a distinct suite of impacts on the forest flora and fauna. Five relatively common combinations are illustrated, from lowest to highest ecological impacts:
Partial harvest with natural regeneration – removal of selected trees, followed by natural regrowth of existing seedlings, with no further interference, or
b. with thinning to space trees for optimal growth.
c. Clear-cut with dispersed retention, natural regeneration - scattered seed trees and immature trees are left to harvest later. Pre-commercial thinning reduces crowding of natural regeneration, leaving slash on site; commercial thinning continues the process but does so by removing merchantable trees.
d. Clear-cut with dispersed retention, planted - similarly harvested, the site is prepared (e.g. tilled) and planted with seedlings of desirable species. Herbicide is often used to reduce growth of competing broad-leaved trees and shrubs in the silviculture plantation.
e. Clear-cut with aggregated retention – clear-cuts designed to retain patches of forest that contain mature seed trees, nesting sites, and immature trees; between them, the area is prepared, planted and tended as a silviculture plantation.

Thinning. Because harvested stands that are allowed to regenerate naturally are frequently overcrowded, resulting in poor tree growth, they are frequently thinned one or more times before they are harvested again (Figure 4b, c). The initial pre-commercial thinning is done by hand, strategically cutting saplings to optimize the spacing of the remaining trees. This low impact disturbance, which also leaves the debris on site, does not

appear to affect the bryophyte community. One or more commercial thinnings may follow, using various harvesting machinery; besides reducing competition among the trees, this technique produces timber that is large enough to be marketable. We are currently evaluating the impacts of commercial thinning, which appear to be midway between pre-commercial thinning and clear-cutting.

Herbicide. Planted areas are often treated with herbicide (typically Vision®, with the active ingredient glyphosate) to reduce competing vegetation that might slow the growth of conifer seedlings (Figure 4d, e). Our laboratory studies on several species indicate that bryophytes are damaged by contact with the herbicide. The contradictory evidence from field studies (either no, or slightly positive, effects) may result from coarse aerial application, with many bryophyte patches escaping contact with the herbicide. The mechanism of the damage is also poorly understood, but it is possible the surfactant (wetting agent) added to the glyphosate preparation has its own negative impact on the bryophytes.

Shortened rotation. Genetic selection for faster-growing trees and optimized growing conditions (e.g. spacing of seedlings, and removal of competitors using thinning and/or herbicide) have allowed NB forest managers to reduce the rotation (time between tree harvests) to 40-60 yrs. – much less than the historical frequency of similar extensive natural disturbances in the Acadian forest. We do not yet know the impact of this increased frequency of disturbance, but we have a long term study in progress to determine how much time is needed for the bryophyte community to recover. Our best guess is that many forest mosses can either resume growth, or recolonize via airborne spores, within decades, but liverworts appear to require much longer. Some managed forests have lower liverwort diversity than unmanaged forests more than 60 years after the last operations; however, we cannot be sure what has been lost because we do not know what species were present before the harvest.

Where are the source populations?

If bryophyte species are to recolonize disturbed areas, viable reproductive units (usually spores) must come from some source within reasonable dispersal distance, and must experience conditions that allow them to germinate and become established. Expanses of NB's potential source populations – mature forests – have been removed by human expansion, as forests are cleared for agriculture, roads, and urban growth. Pristine or "old-growth" forests are all but gone. Potential areas that provide sources of bryophyte reproductive units become smaller and further separated as greater proportions of the remaining forested landscape are managed for timber extraction. What remains is the pool of bryophytes that persist in several categories of forested land across the province:

Conservation Forest areas, e.g. Protected Natural Areas (PNAs); forested buffers around watercourses, water-bodies, and wetlands; old forest communities; and old forest wildlife habitats – are generally not harvested, although limited harvesting is allowed in some of them. These areas are likely effective at conserving the species they contain, and are most representative of "natural" conditions, however they are relatively small areas and not necessarily near enough to managed sites for spore dispersal. In addition, it is not certain whether they represent the full suite of bryophyte species found in the province, and some contain dif-

ferent species from the target upland forests. If the new Crown Lands Forest Management Strategy increases harvesting in these areas, it will reduce the source populations of upland forest species, and could put other groups of species at risk.

- *Steep slopes* occasionally support mature, relatively undisturbed forests that have been left unharvested because they are too dangerous for harvesting equipment. These make up a tiny proportion of the province's forest.
- *Plantations* have been shown to have lower bryophyte diversity, particularly of liverworts, and experience the shortest rotations because they are managed for maximum wood production. As a result, they are not reliable sources of the bryophytes that are most vulnerable to harvesting operations, and are unlikely to acquire them before the end of their rotation. We are conducting experiments to determine whether alternative management practices that protect large pieces of rotting wood will allow source populations to persist, and contribute to biodiversity in the silviculture plantations and elsewhere.
- *Second-growth forest* (either managed or unmanaged) – makes up the greatest proportion of our remaining forest, and our most extensive source for bryophyte regeneration. The habitat conditions of second growth forests are likely to be more similar to natural forests than silviculture plantations or wetland buffers, however they differ widely in their habitat features, history of disturbance, and resulting bryophyte flora. As a result, the bryophyte species composition, and therefore their value as a source of bryophytes, also varies.

What do we need to know to conserve forest bryophytes?

Currently, there are enormous gaps in our general knowledge of bryophyte biology and ecology. Bryophyte species

Mossy log
Photo by B. Brown

differ in their responses and ecological requirements, suggesting that they do not operate, nor should they be managed, as a single ecological unit. Basic conservation efforts await answers to several critical puzzle pieces.

- *Basic biology.* What is the natural diversity of mosses and liverworts in specific components of the Acadian forest (e.g. stand age, canopy composition)? Which bryophytes are truly rare/threatened/endangered?
- *Recovery after disturbance*. What are the relative recovery times of bryophyte communities that have experienced specific suites of management operations (Figure 1), e.g. clear-cut with dispersed vs. aggregated retention, site preparation, herbicide treatment? (Our longest study is only 20 yrs.) What are the ecological bottlenecks to recovery: availability of spores or other reproductive units, or availability of suitable habitat conditions, including specific substrates and microclimates?
- *Dispersal and source populations.* What is the species composition of the "spore rain", how far and in what patterns does it travel? How does the probability of recolonization relate to distance to a source population?

The new Strategy increases silviculture plantations (which have markedly reduced bryophyte diversity) while decreasing the area of designated Conservation Forest (the small proportion of forested areas that can be expected to maintain bryophyte diversity, and act as source populations for the rest). In order to maintain natural diversity of bryophytes, we must ensure that we maintain enough mature forest (even if it is second-growth) across the landscape to account for the wide range of habitat conditions and to supply populations of the large number of inherently infrequent species. We do not yet know how much mature forest across the landscape is enough to conserve bryophytes. Invoking the precautionary principle, changes to management policies that further reduce the amount of mature forest in New Brunswick risk long-term, irreversible, impacts on bryophyte diversity.

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L'impact de l'utilisation d'herbicides sur le chevreuil au N.-B. et la nouvelle stratégie forestière

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Depuis des années le publique se pose la question suivante : pourquoi le Ministère des ressources naturelles du Nouveau-Brunswick fait-il la pulvérisation d'herbicides glyphosate sur les plantations forestières, et quels sont les impacts de cette pratique d'épandage d'autant de produits chimiques sur nos forêts chaque année? Parmi les réponses possibles, on trouve les suivantes :

1. Nous ne pulvérisons que 1% de nos forêts.
2. Les feuillus reviennent vite.
3. Et aussitôt que les feuillus reviennent, la faune utilise les plantations.

En résumé, le gouvernement laisse sous-entendre que l'épandage d'herbicides sur les forêts est bénéfique pour le chevreuil. Avec la nouvelle stratégie de gestion des forêts de la couronne qui sera bientôt mise en place, et qui aura comme conséquence que le nombre d'hectares pulvérisés augmentera dramatiquement, je crois qu'il est temps de revoir l'impact réel de la pulvérisation de nos forêts publiques avec des herbicides au glyphosate.

Faon et biche
Photo par B. Noel

Durant mes 15 années (1997-2012) en tant que biologiste provincial des chevreuils pour le Nouveau-Brunswick, l'utilisation par le chevreuil des ravages sur les terres de la couronne a diminué, et j'ai, en fait, vu les populations de chevreuils diminuer en général sur l'ensemble des terres de la couronne, alors que la population de chevreuils en milieu urbain et en banlieue a augmenté. Plutôt que de faire des suppositions gratuites, je me suis plongé dans les documents de recherches, jeté un regard sur le territoire et analysé les données sur la régénération des forêts dans les zones plantées et pulvérisées.

Pour plus de 20 ans, la zone pulvérisée annuellement a été d'environ 13,000 hectares, ou plus de 32,000 acres. Parfois, les forestiers nous disent que seulement environ 25% de toutes les terres récoltées sont « traitées » avec des herbicides, mais dans les faits, les données sur la régénérescence du MRNNB suggèrent plutôt qu'entre 35 et 40% seraient en fait pulvérisés. En plus, il est clair que les « meilleurs » sites sont pulvérisés et replantés. Il s'agit en fait des sites les plus propices à la repousse de feuillus. Ces sites sont transformés en plantations parce que les résineux poussent aussi mieux ici qu'ailleurs. Cette pratique ne laisse donc que les sites suboptimaux comme habitats potentiels pour la faune, dont le chevreuil.

Quand j'ai commencé à me pencher de plus près sur les recherches publiées, j'ai été très surpris de me rendre compte qu'il y avait en fait, très peu de recherches qui démontraient, de façon crédible, la proposition selon laquelle l'épandage d'herbicides était bénéfique au chevreuil. La publication la plus récente à proposer cette théorie date déjà de plus de 10 ans (2004) et ses résultats sont basés

sur une étude de 2002 qui arrive à des conclusions en faisant essentiellement un résumé d'uniquement 3 autres études, dont une faite sur le comportement du Cerf mulet en Oregon, une autre sur le Chevreuil européen en France, et une dernière provenant du Maine, qui ne portait pas vraiment sur l'observation de l'utilisation de l'habitat par le Cerf de Virginie suite à l'épandage d'herbicides.

J'étais aussi septique pour ce qui est de la théorie voulant que « les feuillus reviennent vite » suite à l'utilisation d'herbicides. Toute mon expérience de terrain et mes suivis aériens me démontrent que pratiquement toutes les plantations sont constituées de résineux. En fait, l'actuelle Coupe annuelle permise (CAP) gonflée est dépendante de plantations où on fait pousser *beaucoup* de bois mou et où il y a *très peu* de compétition de bois dur. Et lorsque je vérifie dans la recherche crédible faite sur le terrain, c'est *exactement* ce qui y est rapporté – le glyphosate – l'herbicide de choix dans plus de 95% des cas dans l'est du Canada – est très efficace quand il s'agit de détruire la compétition par les feuillus. En plus, les données contenues dans les rapports du MRN sur la régénération démontrent que dans toutes les plantations qui furent traitées subséquemment avec des herbicides, on retrouvait de 90-100% de résineux…et presque pas de feuillus! C'est ce que j'ai moi-même constaté lors de suivi aérien ainsi que des visites dans les nombreuses plantations que l'on retrouve le long des autoroutes du N.-B. Si un épandage de glyphosate n'avait pas suffit a tué tous les feuillus (et dans le cas des érables cela pourrait être le cas) le site subit un second épandage et même un troisième afin de s'assurer que 95% des peuplements sont composés de résineux.

Donc, si on part du fait que l'on sait que beaucoup du territoire subit de l'épandage de glyphosate chaque année, et que l'on prend en considération que cela détruit les zones de broutage du chevreuil, quel est l'impact? Combien d'aire de broutage est soustrait de la forêt chaque année à cause de l'épandage d'herbicides? La recherche provenant du Nord-est nous suggère que la plupart des coupes à blanc peuvent produire entre 20,000 à 40,000 tiges de feuillus à l'acre. En extrapolant à partir de ce chiffre, on peut affirmer qu'un acre de coupe à blanc peut produire une tonne de broutage en un an. Parce qu'un chevreuil mange environ 2 kg de broutage chaque jour, on peut donc calculer que si un chevreuil mange 4.5 livres de nourriture par jour, cela revient à 132 livres par mois et donc 1,600 livres de nourriture par an, donc un peu moins qu'une tonne de fourrage à chevreuil pour cette période. Conclusion : l'utilisation d'herbicides dans une coupe à blanc détruit 40,000 tiges à l'acre donc suffisamment pour nourrir un chevreuil pendant toute une année. Et si on étend cela au plus de 32,000 acres où on fait de l›épandage chaque année, on peut dire que les méthodes de « sylviculture » moderne tuent suffisamment de nourriture pour nourrir près de 40,000 chevreuils. Et c'est comme ça a chaque année sur les terres de la couronne.

Et on se demande pourquoi il y a si peu de chevreuils de nos jours sur les terres de la couronne et pourquoi il y a tant de ravages abandonnés. Lorsque l'on pose des questions sur les impacts de l'herbicide glyphosate, on nous répond souvent qu'il n'y a aucun effet négatif, ni pour les humains, ni pour la faune, ni pour l'environnement. Mais la littérature récente suggère autre chose. En cherchant un peu, j'ai découvert les points suivants :

- Le Glyphosate est toxique et a des effets nocifs pour le système endocrinien de l'humain.[1]

- Il y a une relation entre le Glyphosate et les affections rénales chroniques.[2]
- Le Glyphosate est toxique pour le métabolisme normal de la vache.[3]
- Le Glyphosate a un effet négatif sur la structure et les fonctions des écosystèmes d'eau douce.[4]
- Un examen référencé démontre que le glyphosate est toxique et peut causer un ensemble de problèmes chez les humains et la faune.[5]
- Le Glyphosate cause des problèmes au niveau des cellules de l'embryon et du placenta humain.[6]
- Les adjuvants ainsi que le glyphosate sont *tous les deux* toxiques au niveau cellulaire de l'humain.[7]
- Le Glyphosate est responsable de l'intolérance au gluten.[8]

Le Glyphosate a été et continu d'être largement épandu et à répétition sur nos terres publiques. D'autre part, il y a des preuves que cet épandage peut être nocif pour l'environnement, pour le cheptel de chevreuils et pour les humains. Il est temps de réévaluer cette pratique.

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Cerf de Virginie
Photo par B. Noel

Herbicide Impacts on Deer, and the New Forestry Strategy

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For years the public has inquired why NBDNR sprays glyphosate herbicides on plantations, and asks about the impact of spraying so much of this chemical every year on the forest. The response includes the following:

1. We only spray 1% of the forest;
2. Hardwood growth bounces back; and
3. As soon as the hardwoods bounce back, wildlife uses the plantations.

In short, government tells us that herbicide spraying of forest is beneficial for deer. With a new Crown Lands Forest Management Strategy about to be implemented, and the number of hectares to be spayed likely to increase dramatically, I think it's time to re-examine the impact of spraying our public forests with glyphosate herbicides.

During my 15 years (1997-2012) as a provincial deer biologist in New Brunswick, deer use of Crown land deer yards declined. I also saw deer numbers decline in general across Crown land, while deer in urban and suburban areas grew. Rather than assume anything, I dove into research papers, surveyed the landbase, and analyzed forest regeneration data on the areas planted and sprayed.

For over 20 years, the area sprayed annually has been 13,000 hectares, or over 32,000 acres. Foresters have sometimes suggested that 25% of all harvested area is "treated" with herbicides, however, regeneration data from DNR suggests that between 35 and 40% is actually sprayed. Further, the BEST sites are sprayed and planted – sites with indices suggesting they may be better suited to growing hardwoods. These sites are converted to plantations because softwoods also grow better here than on other sites. This leaves the suboptimal sites to provide much of the habitat for wildlife, including deer.

When I began to look harder at the published studies, I was shocked at how little research there actually is which supports the position that herbicide use benefits deer. The most recent paper to make this claim is already 10 years old (2004) and the results are based on a 2002 summary that reached its conclusions on the basis of a mere three studies, including – one dealing with Black-tailed Deer behavior in Oregon, a study on Roe Deer in France, and a third from Maine that did not actually observe deer use of the sites following herbicide application.

I was also skeptical that hardwood "bounced back" after herbicide use. All my field experience and aerial surveying showed that nearly all plantations

White-tailed Deer doe
Photo by R. Cumberland

consisted of softwood trees – indeed, the current inflated Annual Allowable Cut (AAC) depends on plantations growing *lots* of softwood trees *free* of competition from hardwoods. When I looked at the forest-based research, this is *exactly* what is reported – glyphosate – the herbicide used for over 95% of all herbicide use in eastern Canada – was extremely effective at killing hardwood competition. Further, the DNR regeneration data also showed that all plantations that were subsequently treated with herbicides were stocked with 90-100% softwood trees.....not hardwoods! This is what I witnessed from the air and in the many plantations that adjoin the highways of NB. If one glyphosate treatment did not kill all the hardwoods (and in the case of maples it may not) then the site was sprayed a second time, and even a third, to ensure the plantation is 95% stocked with evergreens.

So – knowing that a *lot* of land mass is sprayed with glyphosate annually, and knowing it kills deer browse, just what is the impact? How much deer browse is removed from the forest annually through herbicide spraying? Research from the northeast suggests that most clear-cuts produce at a minimum 20,000 to 40,000 stems of hardwoods per acre. Using this number, one acre of clear-cut would produce a ton of deer browse in one year. Because a deer eats 2 kg of browse a day, this equates to one deer consuming 4.5 pounds of food a day, or 132 pounds of deer food a month, or just over 1,600 pounds of food in one year.....a little under a ton of deer browse. Therefore, spraying a clear-cut and killing 40,000 stems per acre removes enough food to feed a single deer for an entire year. If we expand this to the total 32,000+ acres sprayed each year, our modern "silviculture" kills enough food to feed nearly 40,000 deer every single year on Crown land.

And we wonder why so few deer now reside on Crown land and why numerous deer-yards are vacant? Questions about the impacts of the herbicide glyphosate often result in the statement that it is not harmful to humans, to wildlife, or the environment [Editors note: see page 45, Frego et al., for comment on the evidence for bryophyte damage in NB from glycophosphates]. But recent literature suggests otherwise. I found authors reporting that:

- Glyphosate is toxic and disrupts the human endocrine system[1]
- Glyphosate is strongly associated with chronic kidney failure[2]
- Glyphosate is toxic to normal dairy cow metabolism[3]
- Glyphosate negatively affects the structure and function of freshwater ecosystems[4]
- A review shows glyphosate is toxic and causes a host of problems in humans and wildlife[5]
- Glyphosate causes problems in human embryonic and placental cells[6]
- Adjuvants as well as glyphosate are *both* toxic to human cells[7]
- Glyphosate is responsible for gluten intolerance[8]

Glyphosate has been, and continues to be, sprayed repeatedly on publicly owned land. There is evidence this spraying may be detrimental to the environment, to our deer population, and to humans. It is time for a reassessment of this practice.

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White-tailed Deer buck
Photo by E. Hazboun

Riparian Zones: Where the Water Meets the Land

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Although the origin of the word "riparian" refers to the land bordering rivers and streams, it is generally understood to also include those areas adjacent to wetlands and lakes. Buffer zones, of which riparian zones are a part, are more encompassing and less specific as they can be applied to both terrestrial and aquatic habitats. Riparian zones, because of the transition from aquatic to terrestrial habitats are areas of high biodiversity. Within the context of forestry, riparian zones are mandated strips of vegetation which can be of varying width left along watercourses to meet specific objectives. Partial harvesting may be permitted within these zones.

Originally, riparian zones were specifically implemented to protect stream habitat and fish populations. An excellent introduction to the history or riparian zones as well as the widely accepted 30 m width on both sides of watercourses can be found in Richardson.[1] Riparian zones help accomplish many functions. They maintain lower water temperatures through shading, a function cited as becoming more important in the face of global warming.[2] Riparian zones also provide critical habitat for flora and fauna, protect against invasive species, stabilise soils, filter sediments and nutrients, provide erosion protection, provide migration corridors and furnish coarse woody debris.[3,4,5] The leaf litter from riparian zones provides a major source of energy and nutrients to the detrital food web for in-stream communities. Approximately one-third of leaf litter in watercourses can originate from vegetation beyond 30 m riparian zones.[6] Buffer zones can regulate watercourse microclimates by modifying light, temperature, and humidity,[7,8] as well as influencing the type, amount and timing of nutrients important to stream productivity.[7,9,10]

Leopard Frog
Photo by A. Clavette

Whereas the benefits of riparian zones are unquestionable, their width, the application to intermittent and ephemeral streams, the managing for resilience rather than impacts and harvesting within the zones themselves are not as easily resolved. Linking polices to objectives that address scale would help alleviate some of these issues. The integration of riparian zones as part of an overall watershed plan as well as at the landscape scale becomes apparent when dealing with the movement of animals.[3] Nevertheless, there are local factors to be considered such as water body type, slope, water body size class, soil types, precipitation, resistance to wind-throw and type of adjacent activity[11,12,13,14]. Although considerable land would be involved, various authors;[3,12] state that buffers on low order streams including ephemeral streams (those

that dry up in the summer) should be protected as they define and characterise the receiving waters below. Buffers must also be contiguous, as any gaps would provide a point of access for sediment flow. Although, the definition of slope varies, slope is a variable in virtually all models of buffer width,[3] with an increase in width with increasing slope beyond an established baseline which is often 30 m.[15]

Partially harvesting within buffer zones in both Canada and the US occurred in 80 percent of the studies reviewed by Lee et al.[11]. Prescriptions vary and can include diameter of trees, volume, and species removed. However, there are limits. When 28% average basal area was removed in a riparian zone study by Wilkerson et al.,[14] daily maximum water temperatures were significantly higher by about 4 degrees C, believed to have resulted from disruption of groundwater flow.

The 2004 interim *Forest Management Manual for New Brunswick Crown Land*, Table 3 on page 51, lists specific buffer zones objectives, buffer zones modifiers (decisional considerations) and buffer zones widths.[17] With the exception of small watersheds of less than 600 hectares, a minimal 30 meter buffer zone is the norm and 60 meters and greater under special circumstances such as high wind-throw, critical fish habitat, provincially significant wetlands, NBDELG designated watersheds, certain wildlife travel corridors and recreational waters, and slopes greater than 25%. A descriptive text of the above with some background reference documents can be found in O'Carroll.[16] The NB Forestry manual responds to the frequently cited need to state clear objectives in setting riparian widths. Experimental design and monitoring are required to validate that the objectives are being attained or in testing alternative strategies to managing riparian zones. What Richardson proposed recently in 2012[1] appears equally true today; "Strategies to maintain ecologically functional aquatic and riparian ecosystems in the face of forest practices will require carefully designed, large-scale field experiments, coupled with long-term monitoring and explicit incorporation of spatial (catchment vs reach) and temporal scales."

Shoreline of the Restigouche River
Photo by S. Dietz

Damselflies
Photo by A. Clavette

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Outlet Stream
Photo by B. Brown

Old Tolerant Hardwood Forests in New Brunswick

Going Down Fast

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The new forestry Strategy in New Brunswick centres on yields of spruce and fir. It sets the "sustainable harvest of softwood" at 3.9 million cubic metres per year, an increase of about 20 per cent over the average spruce/fir harvest allowed during the past few decades. On hardwoods, the Strategy has less to say—only that "the [annual] objective will remain at the current level of 1.8 million cubic metres." (A cubic metre is slightly less than a third of a standard cord of wood.) A rationale for maintenance of the hardwood yield at this level can be found in the 2008 report of the provincial Task Force on Forest Diversity and Wood Supply. The report noted that New Brunswick has "a long-standing tolerant hardwood policy that prevents clear-cutting and promotes tolerant hardwood in stands where it dominates." It concluded "the supply of tolerant hardwood is sustainable under the status quo" and under several other forest management scenarios.

Is all well, then, in our hardwood forests? The question needs context. Tolerant hardwoods are shade-tolerant, long-lived species like Sugar Maple and Beech that can become established and grow slowly in the understory of an existing forest, or in small gaps. Old hardwood forests thus come to include trees of many ages. They also accumulate large volumes of standing and fallen, dead and decaying wood. Conifers that are similarly shade-tolerant and long-lived—particularly Red Spruce and Hemlock—often form mixed associations with tolerant hardwoods, the proportions of species varying with soil fertility, regional and local-scale climate, and other factors. Yellow Birch is another frequent component of old hardwood and mixed forests in New Brunswick. It is less shade-tolerant than Sugar Maple, but rivals it in longevity.

Hardwoods like Poplars and White Birches are relatively intolerant of shade and have shorter lifespans. They dominate early stages of forest succession initiated by larger-scale disturbances such as intensive harvesting or fire. Alone, or with fir and spruce, they typically form even-aged stands, but are replaced by shade-tolerant species in old, uneven-aged forests. Intolerant hardwoods have increased greatly in abundance in the province over the past few hundred years. In contrast, forests dominated by Sugar Maple have declined in extent and average age through clearance for settlement and agriculture, and ongoing harvesting. At present, they make up about nine percent of the Crown forest.

Although all hardwoods are treated together in general reporting on yields, forest management in the province takes detailed account of the ecological differences between tolerant and intolerant stands and species. The overall objective for tolerant hardwood forests is to maximize the sustainable yield of good quality sawlogs while meeting standards (thresholds) for biodiversity conservation and other non-timber values. Achieving this balance is a complex, many-layered challenge. The threshold for conservation of old tolerant hardwood and other old forest communities in the province is currently set at 12% of their approximate natural occurrence (area). This percent-

Barred Owl
Photo by H. Scarth

age is based largely on modelling of the habitat requirements of old-forest-dependent indicator species of birds and mammals—Barred Owls and Black-throated Blue Warblers, for example, in the case of old tolerant hardwoods. "Old forest" definitions are based, in turn, on stand composition and structural features specific to each forest community type; the criteria include, for example, the number of trees per hectare in various size-classes, the volume of coarse woody debris on the forest floor, and the frequency of dead standing trees (snags) of different sizes.

Harvesting "prescriptions" for tolerant hardwoods are likewise based on site-specific measurements of stand composition and structure. Licensees carry out pre-harvest assessments (cruises), and the New Brunswick Department of Natural Resources approves the prescriptions (treatments). In stands considered to have good potential for sawlog production, harvesting techniques are required that promote the development or maintenance of uneven-aged structure. The recommended treatments are variations on "selection-cutting": "Individual tree selection" removes scattered trees in all size-classes in any one cut, up to a maximum of 30% of the total basal area of the stand. "Group selection" involves small patch-cuts totaling less than 10% of the overall stand-area at any one time.

Black-throated Blue Warbler
Photo by H. Scarth

Against this backdrop of definitions, prescriptions, annual allowable cuts, and conservation thresholds, the harvesting of old tolerant hardwood forests in New Brunswick has increased sharply over the past few decades. On the ground, in low-level aerial photographs, and in satellite images, the evidence is stark. Throughout the province's major hardwood regions, extensive, formerly intact forests of Sugar Maple, Yellow Birch and Beech on slopes and uplands have been gridded with new forest-roads and subjected to unprecedented levels of strip- and selection-cutting.

Developments in technology and markets have driven these changes. In earlier decades, the major products of the province's tolerant hardwood forests were sawlogs, veneer, maple syrup, and firewood. Now, a major portion of their yields is in the form of wood-chips. These are processed into dissolving pulp (from which rayon and related textiles are made), toilet paper and other tissues, wood (fuel) pellets, and other non-lumber products. Many old trees that were formerly left in the woods owing to their crooked trunks or other "defects" are now routinely chipped during harvesting operations. Bioenergy generation from the combustion of harvesting residues ("biomass") is also creating new demands for tolerant hardwoods.

Data is not readily available on the nature and extent of the structural changes that are overtaking these forests—for example, the percentage tree cover and wood-volume that are being removed from stands under various harvest treatments and in various regions, the time-intervals between treatments, or the current and projected numbers and sizes of old trees and snags. It is difficult, therefore, to reconcile statements about policies or "best management practices" that apply to tolerant hardwood stands with the visual evidence of large-scale intensive harvest-

Figure 1. Hardwood–hemlock forest in Odell Park, Fredericton, 2014. Photo by S.R. Clayden/ New Brunswick Museum

ing. Selection cutting and small-patch (group selection) cutting are meant to be the norms for stands with uneven-aged structure. However, variations on strip cutting and patch cutting that remove large fractions (30–40%) of stands at a time appear to be common. The scale of these disturbances, from individual stands to whole landscapes, far exceeds the natural, historical, small-gap dynamics of our tolerant hardwood forests. The high yields of hardwood might be sustainable from a production standpoint. Their sustainability in relation to biodiversity conservation is far from certain.

To illustrate some potential consequences of the intensified harvesting of old tolerant hardwood forests, it may be helpful to consider examples from some species-rich groups of organisms:

Bryophytes. Old forests provide a rich array of microhabitats for mosses and liverworts. Figure 1 shows an ironwood tree in a mixed hardwood–hemlock stand in Fredericton's Odell Park. The tree-base is covered by one of the tongue-mosses (*Anomodon attenuatus*) (Figure 2), among other species. A neighbouring boulder has a distinct community: a haircap-moss (*Polytrichastrum pallidisetum*) on a thin layer of organic debris over the flat to gently inclined surfaces, and Silver-broom Moss (*Paraleucobryum longifolium*) on the steeper faces. The trunks of nearby sugar maples have overlapping tiers of a pinnately-branched liverwort (*Porella platyphylla*) (Figure 3).

Figure 2. Anomodon attenuatus *(moss), Odell Park, 2014. Photo by S.R. Clayden/ New Brunswick Museum*

These are not rare species in New Brunswick. However, they are best developed in long-undisturbed habitats. Rocks, trees, snags, logs, and stumps in such forests are somewhat like islands, gradually acquiring floras and faunas that undergo successions of species. *Anomodon attenuatus* forms a dense cover only on the bases of older hardwoods (or on shaded calcareous rock outcrops). These moss-carpets shelter assemblages of smaller, little-studied organisms. Five other *Anomodon* species occur in

Figure 3. Porella platyphylla *(liverwort), Odell Park, 2014.*
Photo by S.R. Clayden/ New Brunswick Museum

similar habitats in the province; *A. minor* and *A. triste* are rare, and unlikely to persist here without extensive older hardwood stands to accommodate them.

Lichens. The lichens *Pertusaria globularis* and *Lobaria quercizans* (Figure 4) are not rare in the province, but both are of interest in relation to old hardwood stands. *Pertusaria globularis* is a "crustose" species that overgrows bryophytes on the trunks of old hardwoods (or sometimes cedar). It is scarce or lacking in younger forests. *Lobaria quercizans* is one of the lungwort lichens. It has broad greyish lobes and prominent disk-shaped fruiting bodies.

A study of *L. quercizans* and another lungwort species, *L. pulmonaria*, in tolerant hardwood and mixed forests in northwestern New Brunswick found that the lichen individuals growing in uncut stands were significantly more fertile (produced more fruiting bodies) than those in stands that had undergone selection cutting up to 35 years previously (M. Edman, A.-M. Eriksson, and M.-A. Villard, 2008, *Journal of Applied Ecology* 45: 26–33). These differences might be attributable to the contrast in microclimate between the interior of the intact versus the harvested stands. Many other studies have shown that forest lichen diversity, and the occurrence of rare species, are strongly correlated with the continuity of old trees and snags in space and time.

Figure 4. Pertusaria globularis *and* Lobaria quercizans *(lichens) on a Sugar Maple, 2014.*
Photo by S.R. Clayden/ New Brunswick Museum

Fungi. From wood-decay species that form large fruiting structures on trees to mushrooms and microfungi (Figures 5 to 7 - see next page), fungal diversity in New Brunswick's forests much exceeds that of their green plants. However, the fungi are much less well known, as the number of specialists (mycologists) dedicated to their study is very small in relation to the scope of the task. The fungi of spruce–fir forests have received more attention to date than those of tolerant hardwoods.

About 600 mushroom-forming species have been identified from all forested and other habitats in the province, less than half the number known in Nova Scotia. However, these differences again reflect contrasting survey-efforts, not real differences in the expected diversity of species. The numbers do offer a caution, however. Intensive modification of the province's remaining old forests will likely result in losses of yet-to-be discovered fungal species before their identities and ecological relationships are elucidated. Recent surveys of parks and Protected Natural Areas in New Brunswick have detected numerous fungi that were not previously known to occur here. Among those in tolerant hardwood and mixed

forests are the mushroom *Kuehneromyces mutabilis* (Figure 6) and the tiny, asexually reproducing basidiomycete, *Leucogloea compressa* (Figure 7 - see page 62).

Beetles. Like fungi, beetles and other insects are key agents in the breakdown and recycling of the large quantities of dead wood that accumulate in old forests. Many species are "saproxylic," living and feeding directly in or on wood. Other beetles live in the fruiting bodies produced by wood-decay fungi, in some cases preying on smaller invertebrates within these niches. The beetles that consume wood do so via symbiotic bacteria and yeasts that live in their guts and produce enzymes able to break down cellulose and lignin. A relatively small number of species (beetles and others) in these habitats have been investigated in depth, owing to economic concerns over the damage they can cause to living trees. Apart from these species, the biodiversity and complex food webs of dead wood communities in New Brunswick's old forests remain relatively little studied. In the face of ongoing reductions in the frequency of large snags and logs in intensively managed forests, these knowledge gaps increase the likelihood of losses of species and ecosystem functions.

Exceptional progress in understanding beetle diversity in New Brunswick is being made by entomologist Dr. Reginald Webster (Figure 8 - see page 62). His surveys of old forest communities have yielded hundreds of new provincial records, and numerous species new to science. Among those he has found only in old tolerant hardwood and mixed forests are several rare rove beetles (*staphylinids*) in the genus *Lordithon*. Two of these, *L. niger* and *L. quaesitor*, inhabit fleshy polypore fungi on large hardwood snags and logs. They are known here only in a few places in southern and western New Brunswick, including Bell Forest along the Meduxnekeag River. Another remarkable group of ecologically specialized beetles occurs high above the ground in such stands—more precisely, in the nests of Barred Owls in the cavities of large hardwood trees.

Such examples hint at the untold diversity and interactions of organisms in our old tolerant hardwood forests. The challenge before us is to make wise decisions on the long-term stewardship of this rich natural capital.

Figure 5. Tinder polypore (Fomes fomentarius) *on Yellow Birch, Caledonia Gorge Protected Natural Area. Aleta Karstad, 2011, oil on canvas, 5 × 7 inches (reproduced with permission).*

Figure 6. Kuehneromyces mutabilis, *in forest dominated by Sugar Maple and Beech, Jacquet River Gorge Protected Natural Area, 2010; collected by Stephen Clayden, identified by David Malloch. Photo by S.R. Clayden/ New Brunswick Museum*

Figure 7. Leucogloea compressa *(fungus) with* Nowellia curvifolia *(liverwort), on well-rotted birch log, Fundy National Park, 2013; collected by Jason Karakehian; identified by Joey Tanney.*
Photo by Roger Smith

Figure 8. Entomologist Dr. Reginald Webster, collecting beetles from dead wood in an old mixed forest, Currie Mountain, 2013.
Photo by S.R. Clayden/ New Brunswick Museum

Ebony Jewelwing
Photo by A. Clavette

Does New Brunswick Receive Fair Market Value for Timber from Crown Lands?

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In 2011, New Brunswick received approximately $40 million in royalties (or stumpage) from Crown lands.[1] While this is lower than the Department of Natural Resources' (DNR) operating cost, the DNR has a broader range of responsibilities. Nevertheless, the population of New Brunswick wants to know if it is receiving a fair price for timber from Crown Lands.

Setting royalties, and determining if these are a "fair price," is a complicated process. While there has been no scientific research on this in New Brunswick, a number of independent studies and reports are available. Most importantly, the provincial Auditor-General reviewed the DNR royalty process in 2008, concluding that "the flaws in the system for establishing fair market value mean that the royalties do not reflect fair market value."[2] Although the DNR made some changes to the system, the Auditor-General considered that significant problems remained.

Trends in royalties in NB from 2004 to 2014

Changes in NB Crown royalties for 4 products[3] are illustrated in the Figure 1, in $ / m^3.

Spruce-fir sawlog royalties are currently $23.74, their highest level for ten years.[3] Sugar Maple select sawlogs are at $22.90, having risen and fallen in recent years. Pulpwood royalties have fallen significantly over the ten years, from $10.35 to $2.57 for softwood and $4.99 to $1.00 for hardwood. All rates are after deduction of the management fee (currently $4.75).

The difference between pulpwood and sawlog prices for softwood is also significant. In 2004-06 and 2009-11, softwood pulp was about half the price of sawlogs, but in 2014, the pulpwood royalty is about one-tenth of the sawlog rate. Large differentials require greater supervision by DNR staff to ensure that sawlog quality logs are not being sold as pulp.

Comparing royalities in NB and Elsewhere

Comparing royalties between provinces is difficult as items such as road building or replanting may be paid for by industry or government depending upon the province. As a result, it is almost impossible to state with certainty that royalties are higher or lower in New Brunswick than elsewhere. Nevertheless, some comparisons can help.

In 2008, the Roberts Report found average softwood royalties of $9 in Quebec compared to $15 in New Brunswick.[4] In 2011, an auction system was introduced for Crown timber in Quebec. Royalties for spruce and fir sawlogs in the Temiscouata region (adjoining northern NB) rose from $12.46 in 2012-13 to $14.96 in 2013-2014.[5] Similar rises occurred elsewhere.

Acadian Timbers, who manage both Crown and private forests in northern New Brunswick, reported a 5% increase in weighted sawlog prices in 2013.[6] Interestingly, the company's income from timber sales is higher than its operating costs.

Royalties on Crown Lands and on Woodlots

In New Brunswick, royalties for Crown timber are based on a survey of prices from private woodlots in New Brunswick

and Nova Scotia, prepared for the DNR by a consultant. Average prices (2011-12) were $22.69 for spruce-fir sawlogs and $8.15 for hardwood pulpwood.[7] These averages do not become the royalty – instead the DNR makes its own calculations based on these averages and on monitoring of prices in the formal market.

The use of a market price has meant that the Maritime provinces have been exempted from restrictions under the 2006 Softwood Lumber Agreement for timber exported to the USA.

However, the system has been criticized because Crown lands provide more timber than any other source.[2, 8] Originally, industry was expected to purchase timber principally from woodlot owner associations, with Crown lands providing a "residual" supply to enable the industry to meet its needs. However, in 1992, this system changed and Crown lands now provide a guaranteed volume while woodlots provide a residual source to meet fluctuating demand.

The guaranteed supply of large amounts of Crown timber creates an uneven-access market in NB, rather than an open market. When demand is low, as during the recent forest industry crisis, then prices for woodlot timber will fall faster and lower than in an open market. This will then be reflected in Crown royalties. The Auditor-General warns of a "continual spiraling down of prices and therefore royalties."[2]

Demand for timber products is currently increasing in North America and so demand for timber from all New Brunswick sources will probably increase. However, the dominance of Crown timber suggests that price rises for timber from woodlots will be slower and less than in an open market.

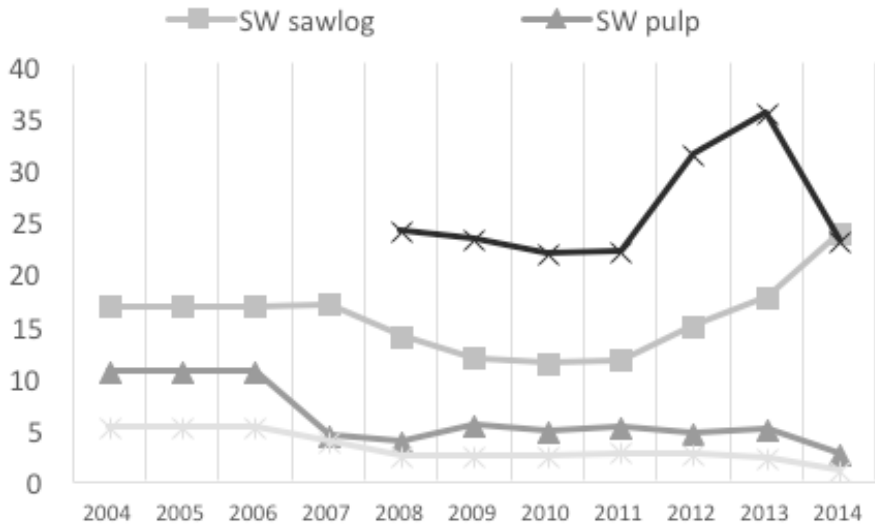
Royalties in difficult-to-operate areas

Under current policy, the DNR reduces royalty rates for timber coming from difficult to operate areas, with reductions of 25% for thinning and 50% for steep slopes. This is intended to compensate for higher costs involved in harvesting this timber.

Conclusion

Existing research and evidence does not confirm whether NB receives fair market value for Crown timber. However, the existing system creates an uneven-access market that disadvantages woodlot owners and that appears to exert a downward pressure on Crown royalties.

Figure 1 – Changes in NB Crown royalties for 4 products, in $ / m^3



What does the new forestry strategy provide?[9]

The new forestry strategy predicts an increase in Crown royalty revenues, but does not indicate how much of an increase is expected.

Royalties on several major products fell significantly in 2014 and so it is unclear whether revenue from additional sales will be sufficient to offset the lower royalties.

Increasing the supply of Crown timber will enable industry to continue to rely primarily upon Crown Lands, making the existing market less open and exerting further downward pressure on prices for timber from woodlots.

If the USA concluded that NB did not pay market prices, then exports could become more difficult. Low prices from woodlots, or prices that rise slowly, will contribute to low Crown royalties in the future.

Much of the additional volume under the strategy is to come from wildlife habitat and difficult-to-access areas, and DNR may be requested to reduce royalty rates to compensate for higher harvesting costs.

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Blue Flag/ Iris versicolor
Photo by D.F. McAlpine/New Brunswick Museum

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Est-ce que le N.-B. reçoit la juste valeur marchande pour le bois des terres de la Couronne?

En 2011, le Nouveau-Brunswick a reçu des redevances (droits de coupe) correspondant à environ 40 millions de dollars à partir des terres de la Couronne.[1] Bien que cela soit moindre que les coûts d'opération du ministère des Ressources naturelles (MRN), le MRN a des responsabilités qui dépassent la simple production de bois. Néanmoins, la population du Nouveau-Brunswick veut savoir si elle reçoit un prix juste et équitable pour le bois des terres de la Couronne.

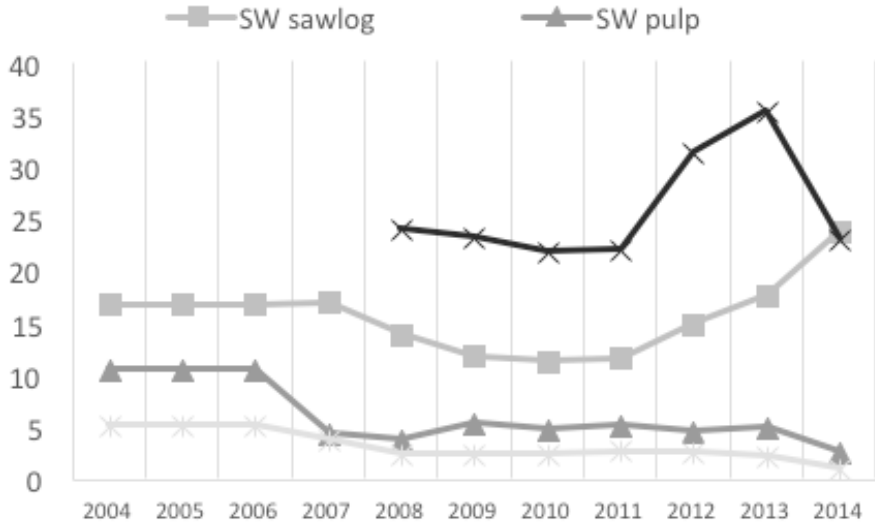
Fixer les redevances, et déterminer si elles correspondent à la « juste valeur marchande » est un processus complexe. Bien qu'il n'existe pas de recherche scientifique à ce sujet pour le Nouveau-Brunswick, plusieurs études indépendantes et rapports sont disponibles. Plus encore, le vérificateur général de la province a examiné le processus de fixation des redevances du MRN en 2008 et a conclu que « ... les faiblesses dans le système signifient que les redevances ne reflètent pas la juste valeur marchande. »[2] Malgré que le MRN ait apporté certains changements au processus, le vérificateur général considérait qu'il y avait toujours des problèmes importants.

Tendances des redevances au N.-B. de 2004 à 2014

Le graphique suivant illustre l'évolution des redevances, en $/m³, pour 4 produits.[3] Les redevances pour les billes de sciage d'épinette et de sapin (SW sawlog) sont actuellement 23.74 $/m³, soit leur niveau le plus élevé en dix ans. Celles des billes de sciage de choix d'érable à sucre (HW sawlog) sont 22.90 $, après avoir fluctué dans les dernières années. Les redevances pour le bois de pâte ont grandement diminué depuis dix ans, passant de 10.35 $/m³ à 2.57 $/m³ pour les résineux (SW pulp) et de 4,99 $/m³ à 1,00 $/m³ pour les feuillus tolérants (HW pulp). Tous les taux présentés sont les prix après réduction pour les frais de gestion (actuellement 4,75 $/m³).

La différence entre les prix pour le bois de pâte et le bois de sciage pour les résineux est aussi très importante. En 2004-06 et 2009-11, le bois de pâte de résineux avait une valeur d'environ la moitié de celle du bois de sciage, mais en 2014, les redevances du bois de pâte ne sont plus qu'environ un dixième de ceux du bois de sciage. Un tel écart nécessite une plus grande surveillance par le MRN pour veiller à ce que le bois de qualité sciage ne soit pas vendu comme étant de qualité pâte.

Figure 1 – évolution des redevances, en $/m³, pour 4 produits



Comparaison des redevances au N.-B. et ailleurs

Il est difficile de comparer les redevances entre les provinces étant donné que selon la province, certaines activités, telles que la construction de chemin et le reboisement, peuvent être payées soit par l'industrie soit par le gouvernement. Par conséquent, il est pratiquement impossible d'affirmer avec certitude que les redevances sont plus élevées ou plus faibles au Nouveau-Brunswick. Néanmoins, certaines comparaisons peuvent aider à comprendre la situation.

En 2008, le rapport Roberts indiquait que la moyenne des redevances pour les résineux était de 9 $/m³ au Québec comparativement à 15 $/m³ au Nouveau-Brunswick.[4] En 2011, une méthode de vente aux enchères a été introduite pour la vente du bois des terres publiques du Québec. Les redevances pour le bois de sciage d'épinette et de sapin pour la région du Témiscouata (à la frontière du N.-B.) ont monté de 12,46 $/m³ en 2012-13 à 14,96 $/m³ en 2013-14.[5] Des hausses similaires se sont produites ailleurs.

L'entreprise Acadian Timber, qui gère à la fois des terres publiques et des terres privées au Nord-ouest du N.-B., a rapporté une augmentation de 5 % du prix pondéré des billes de sciage en 2013.[6] Il est intéressant de constater que les revenus que l'entreprise tire de la vente de bois dépassent leurs frais d'exploitation.

Redevances des terres de la Couronne et des boisés privées

Au Nouveau-Brunswick, les redevances pour le bois des terres de la Couronne sont déterminées en s'appuyant sur une enquête, préparée pour le MRN par un consultant, des prix obtenus pour le bois provenant de boisés privés au N.-B. et en Nouvelle-Écosse. Le prix moyen (2011-12) était de 22,69 $/m³ pour le sciage d'épinette-sapin et de 8,15 $/m³ pour le bois de pâte de feuillus tolérants.[7] Ces moyennes ne deviennent pas automatiquement les redevances pour le bois sur les terres de la Couronne – à la place, le MRN fait ses propres calculs basés sur ces moyennes, et en fonction des négociations avec l'industrie.

Grand Pic
Photo par H. Scarth

L'utilisation du prix du marché a fait en sorte que les Provinces maritimes ont été exemptées des restrictions prévues par l'Accord sur le bois d'œuvre résineux pour le bois exporté aux États-Unis.

Ce système a cependant été critiqué parce que les terres de la Couronne fournissent plus de bois que toute autre source.[2, 8] Originalement, il était attendu que l'industrie achète en priorité le bois provenant de boisés privés, et que les terres publiques soient une source résiduelle d'approvisionnement afin de permettre à l'industrie de combler ses besoins. Cependant, ce système a été modifié en 1992 pour faire des terres publiques le fournisseur d'un volume garanti alors que les boisés privés sont devenus le fournisseur du volume résiduel.

La prépondérance du bois des terres de la Couronne crée un accès inégal au marché au N.-B. plutôt qu'un marché libre. Lorsque la demande est faible, comme durant la récente crise forestière, les prix pour le bois des boisés privés descendent plus rapidement et à des niveaux plus bas que ce à quoi l'on s'attend dans un marché libre. Ces prix influenceront par la suite

les redevances pour les terres publiques. Le vérificateur général dit « il pourrait s'ensuivre une spirale continuelle à la baisse des prix et donc des redevances. »[2]

La demande pour les produits forestiers est actuellement à la hausse en Amérique du Nord et il est probable que le N.-B. verra une plus forte demande pour le bois de toutes sources. Par contre, la prépondérance du bois des terres de la Couronne suggère que le prix du bois provenant de boisés privés augmentera plus lentement que dans un marché libre.

Redevances pour les endroits difficiles à exploiter

La politique actuelle prévoit une réduction des redevances pour le bois provenant d'endroits plus difficiles à exploiter, par exemple une réduction de 25 % pour les coupes d'éclaircie et une réduction de 50 % pour le bois issu de coupe en pente forte. Ces réductions visent à compenser les coûts d'exploitation plus élevés dans ce genre de conditions.

Conclusion

La recherche et les données disponibles ne permettent pas de confirmer si oui ou non le Nouveau-Brunswick reçoit la juste valeur marchande pour le bois des forêts publiques. Cependant, le système en place crée un accès inéquitable au marché qui désavantage les propriétaires de boisés privés et qui semble exercer une pression à la baisse sur les redevances.

Qu'est-ce que donne la nouvelle stratégie forestière?[9]

La nouvelle stratégie forestière prévoit une augmentation globale des revenus tirés des redevances, mais ne fait aucune mention de l'ampleur de l'augmentation attendue.
Les redevances pour certains produits importants ont diminué considérablement en 2014 et il n'est pas certain que les recettes des ventes supplémentaires compenseront les redevances réduites.
L'augmentation du volume de bois disponible pour la récolte en forêt publique permettra à l'industrie de continuer à s'approvisionner d'abord à cette source, rendra l'accès au marché encore moins équitable et exercera une pression vers le bas sur les prix de bois provenant de boisés privés.
Si les E.-U. concluent que le N.-B. ne paie pas le prix du marché, il pourrait devenir plus difficile d'exporter du bois.
De faibles prix pour le bois des boisés privés, ou des prix qui augmentent lentement contribueront à maintenir les redevances à des taux faibles dans le futur.
La nouvelle stratégie forestière prévoit qu'une bonne partie du volume supplémentaire proviendra de zones où l'exploitation est plus difficile, il est donc probable que les redevances qui seront perçues pour ce volume seront à des taux réduits pour compenser les coûts de récolte plus élevés.

Sources

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6 Acadian Timber Annual Report 2013

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8 Groupe de travail sur les terres privées, 2012, MRN N.-B

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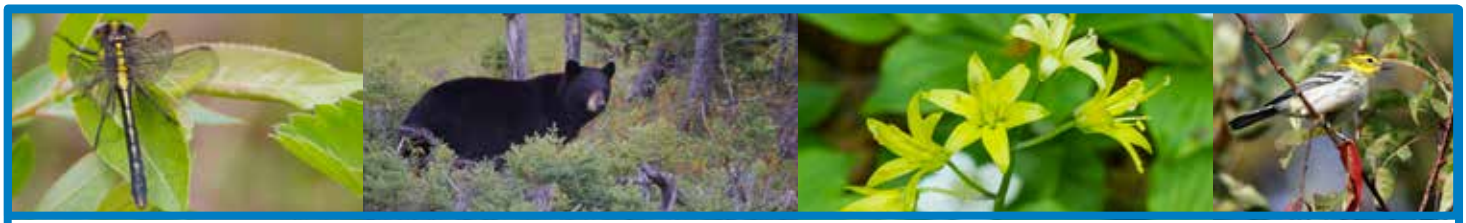
Nature NB

Forêt ancienne
Photo par B. Brown



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