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70 Mile, BC planting contract. Spring 2012

Photos by Ethan Foster

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Editorial *by Dirk Brinkman*

The tar sands and the pine beetle

Global fossil fuel emissions hit a record high of 31.6 Gts[1], in 2011, an increase of one billion metric tonnes over 2010 levels. This trend makes dangerous warming difficult to avoid. Since coal, oil and gas will be primary energy sources for several decades before being replaced by clean alternatives, the world needs another solution.

Photosynthesis is the best way to remove atmospheric CO_2. The Earth's other natural sink, the oceans, also absorbs CO_2 , but doing so forms carbonic acid. Ocean acidification is beginning to dissolve the calcariferous exoskeletons of crustacean, bi-valve and shell spawn, and has been shown to affect krill and plankton, the foundations of the ocean food chain, thus reducing local catches.

Terrestrial sinks from increased reforestation, improved agriculture soils, restored wetland and riparian areas can all increase removal of atmospheric CO_2, and are well known for their added benefits -- restoring biodiversity, improved food security, increased water quality and ameliorating poverty. A global conservation program may reverse rural decline.

Restoring terrestrial ecosystems makes sense to most everyone, but 'Who should pay'? Norway, the sixth largest oil exporter in the world, took a lead in answering that question. It committed one billion dollars to Reducing Emissions from Deforestation & Degradation (REDD) in Guyana and one billion in Indonesia; two of the poorest countries with large tropical forests.

However, corruption and weak governance, exacerbated by increasing demand for food, fiber and fuel, prevented these countries from meeting Norway's bilateral conditions for its conservation payments. The UN REDD readiness programs may take too long to help these poorest governments become more transparent, educate local communities and link conservation impacts to regional deforestation drivers.

Brazil, working internally since 2004, reduced deforestation by 73% in its largest rainforest state, Amazonas, and is saving the resulting carbon credits for its energy industry.

A large emission juxtaposed with a large sink offers a similar internal opportunity within a slightly more stable jurisdiction. Canada's fossil fuel sector emitted 592 million tonnes in 2011[2], an increase of 17% over 2010. British Columbia's Mountain Pine Beetle exploded into a super-population from twenty successive warm winters, creating a forest health catastrophe and killed a historically unprecedented 20 million hectares of pine[3] for which there are no funds to adequately reforest the area.

Some two to four million hectares of area is not reforesting adequately. Like Norway with Guyana and Indonesia, Alberta could remove one to two hundred million tonnes of oil sands emissions by restoring BC (and Alberta's) forests from climate catastrophe, while helping the poorest remote communities in Canada.

The current plans to pipe Alberta oil sands raw crude through British Columbia's climate-devastated forests must catalyze this conversation. Even the Alberta section of the route goes through areas with Mountain Pine Beetle mortality. There are several ways for the oil sector to show leadership by responding to the need to reforest these lands.

First, the oil sector can offer to directly fund the reforestation of the beetle devastated area in exchange for the climate credits.

Second, Alberta, BC and Saskatchewan could, like Norway, work with the oil industry to develop a collaborative public private partnership (PPP) to renew the pine mortality regions in exchange for climate credits.

Third, refining oil sand crude in Canada may provide an opportunity for the federal government to play a role in reducing gas prices at the pump[4] and transferring some of those savings to restoration programs in every province in Canada, beginning with BC beetle area.

Fourth, federal and provincial governments could redeploy current oil sector subsidies into restoring Canada's forests, ecosystems and agricultural soils.

A bioethical conversation to explore these pathways will forge the strongest bonds between source and sink.

The UN envoys report on poverty by DeSchutter in May, 2012[5], slammed Canada for its treatment of First Nations noting "Canada has the fiscal space to address the basic human needs of its most marginalized and disempowered." Employing First Nations to restore forest health in their devastated traditional territories and remove atmospheric carbon from the oil sector may truly be a pathway to a more ethical fossil fuel industry, especially if it also made Canada's oil sector CO_2 neutral.

There are many similar large emissions regions juxtaposed with large potential sinks in varying direct relationships. Some are in the same country, like Australia's coal sector and its Carbon Farming Initiative; or Texas oil and Texas rangeland restoration; or Brazil's off-shore oil and reforesting deforested farmlands; or China's coal and shale oil and its Great Green Wall initiative to stop deforestation along its northern borders in Inner Mongolia and Manchuria.

Partnerships like Norway and Guyana require bilateral agreements that are more difficult to deliver but deserve to be championed. All linkages across the world's 200 countries build common cause and unite this fractured world. Difficult sinks like Haiti may wait some time for a strong bilateral suitor.

2012's climate negotiations are being hosted by Qatar in Doha-- a first for the Arab league or OPEC countries. Qatar's offer to host the UNFCCC COP 18 creates a unique opportunity for the global oil sector to develop a green initiative to transition to CO_2 neutral coal, gas and oil energy. Oil & gas emissions from North Africa and the Middle East form a natural bond to mop up CO_2 through soil and forest restoration in the rest of Africa.

Oil, which created this incredible stage of civilization and its climate side effects, may also help manoeuvre the world away from dangerous climate change. After one hundred years of Paul Bunyan stomping around, governments decided harvesters should pay for reforestation. Oil has been spewing fumes into everyone's air for more than one hundred years. It is time for the oil sector to pay to remove atmospheric carbon by restoring forests and soils.

[1] *International Energy Agency an increase of 1 Gt, 45% from coal, 35% from oil and 20% from natural gas. One Gt is one billion metric tonnes.*

[2] *Environment Canada www.ec.gc.ca/publications/A91164E0-7CEB-4D61-841C-BEA8BAA223F9%5CExecutive-Summary-2012_WEB-v3.pdf*

[3] *MoForest 17.5 million ha of Pl (lodgepole pine) and Alan Vyse, 2.3 million ha of ponderosa pine.*

[4] *Enbridge argues exporting raw crude is an economic benefit because the price of oil will double over thirty years. This will result in higher prices at the pump, perhaps from exporting oil sand crude to China and the US and shipping refined products back to Canada. If keeping refining jobs in Canada avoids that cost perhaps there is a savings there. See economist Robyn Allan's analysis at www.robynallan.com/category/northern-gateway/*

[5] *www.thestar.com/opinion/editorials/article/1181071--un-envoy-blasts-poverty-in-canada*

Second Growth: Black Spruce Forests Provide Fibre and Caribou Habitat in Northwestern Ontario

By Doug Reid

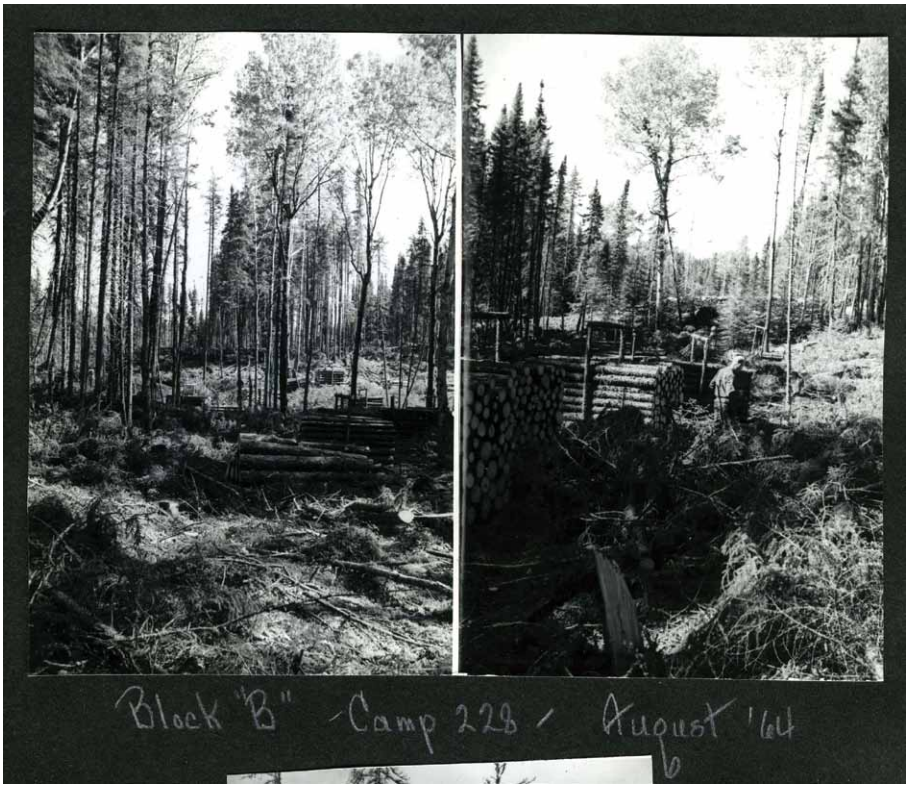
When I got my start in forestry, as a tree planter in Alberta and BC, the only black spruce I saw was in the swamp. As a student at the University of Alberta and later working as a forester in BC, black spruce was a species we never really talked about. Who would want such a slow growing runt of a tree? Towering lodgepole pine, Douglas fir and white spruce were generally the silvicultural objective. That all changed when I moved to Northwestern Ontario to begin my research career. Here black spruce grows bigger than anywhere in North America, and dominates or shares many of the most productive upland sites available. Last summer, while surveying stands in the northern boreal forest I found what I think is the biggest black spruce tree ever measured, 26.4m tall and 34.7cm in diameter. This is the tree with the club-like crown that you will recall from the forests flying past along the trans-Canada highway, if you have ever driven through Ontario's northern boreal shield.

Black spruce is the 'signature' species of Northwestern Ontario's boreal forests, which dominates the landscape between thousands of rocky lakes. It is a truly vast and rugged country that has long been an important source of natural resources. The rocky cliffs and rushing rivers around Lake Nipigon were one of the last challenges that were overcome in the development of the trans-Canada railway. The crossing of the Nipigon River by the trans-Canada highway wasn't completed until 1937. Long cold winters and summers filled with clouds of black flies only made working in these areas an even greater challenge. This seemingly inhospitable environment is nevertheless ideal for black spruce, which produces the highest value softwood pulp, ideal for making everything from newsprint to premium facial tissue, as well as high value dimensional lumber. It was this abundant resource that first attracted investment in silviculture.

These forests are also home to woodland caribou. The animal that graces the Canadian quarter is listed as threatened under Ontario's Endangered Species Act (2007), and is the focus of concern for foresters and environmentalists alike. Where anthropogenic development has moved forward these 'grey ghosts' have tended to vanish. Their northward retreat has been well documented by wildlife researchers across Canada. There are many possible causes, but pinpointing one or more contributing factor is made difficult by the fact that an individual animal can travel over 2,000km in a single year. The Lake Nipigon area also offers a unique opportunity to unravel this mystery as it is one of the few places where woodland caribou have been seen to re-occupy previously harvested stands. What is it about this area that has allowed woodland caribou to persist within a managed landscape? Something about the silvicultural history has resulted in stands that provide at least some woodland caribou habitat.

In the years between 1928 and the start of the World War II, harvesting was done by hand and thousands of men were employed in bush camps. Within the stands that were harvested, spruce was the target. Loggers were expected to cut and pile 2 cords of wood, cut into 8 foot lengths, per day. Other species were either left standing, or sometimes taken and used for heating the camps. The seed bearing cones from the spruce were generally left where each tree was felled, providing a source for regeneration. The second growth that now occupies these sites is typical of northwestern Ontario's boreal forest, containing a mix of black spruce, jack pine, aspen, birch and balsam fir. The wood was moved out onto the lake during winter, and moved to mills in Red Rock and Thunder Bay via huge river drives and massive log booms. The last log drive down the Nipigon River took place in 1973. Before Canada entered WWII, logging and the log drive were primary employers across Northwestern Ontario.

Most of those men enlisted once Canada entered the war on the side of the Allies. Mills had to curtail their operations not due to a lack of fiber, but because there just wasn't enough manpower available. Prisoners of War (POWs) replaced the young men who had left to join the fight against the Nazis, and their contributions kept the mills operating, though at less than capacity. This was the time when large scale logging operations got going in the area where woodland caribou can be found east of Lake Nipigon. The oldest cuts in this area date back to 1938, when a POW camp was located about 3 miles upstream from Lake Nipigon on the Onaman River. Large areas were harvested by the interned German soldiers in the nearby vicinity. After the war, operations ramped up as the pulp and paper industry came into its heyday. Once again thousands



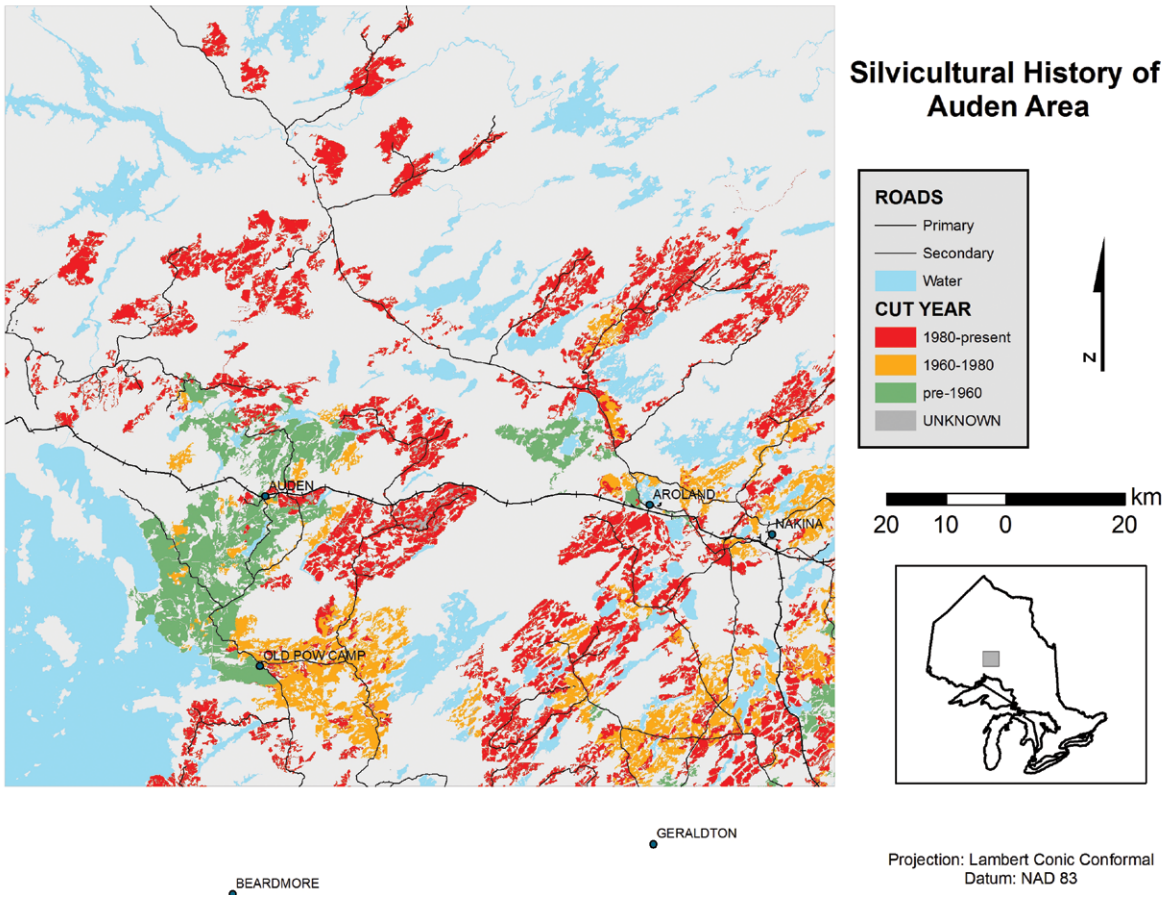
of men (and a few women) headed up to camps and small communities like Auden to supply fiber to various mills. Natural regeneration was still relied upon until the mid to late 1960s when modern silvicultural approaches like planting and seeding first started to be used.

Fortunately, staff at the Nipigon District office in Nipigon retained maps showing the locations of the old cuts. Today we see a wide range of conditions resulting from this very basic silvicultural approach; everything from pure conifer, to mixtures of aspen birch, fir, pine and spruce. Modern silvicultural practices, including planting and seeding of cutovers came later, beginning in the early 1960s. We have seen, through GPS collar locations, woodland caribou occupying stands harvested in the mid 1950's near the Ombabika River and others harvested in the late 1970's near Fullerton Lake. These stands are currently conifer dominated or conifer / deciduous mixedwoods, with black spruce part of the conifer component.

To better understand how the caribou that live near Lake Nipigon have managed to persist within this managed landscape, the Ontario Ministry of Natural Resources, along with partners from the University of Guelph, the Canadian Forest Service, the Forest Ecosystem Science Co-operative and Trent University are engaged in a wide ranging study of woodland caribou, their competitors, predators, stressors and habitats. This work is being led by Dr. John Fryxell of the University of Guelph through an NSERC Collaborative Research Development grant. We are studying both the habitats that have emerged following logging as well as those that emerged from natural disturbances. Some subtle differences in the understory plant community between logged and naturally disturbed habitats have been observed, but we are only at the early stages of our analysis. The historical records of silvicultural activity in this area are vital to allow us to evaluate the long term effects of forest management on the stands that may provide habitat, and by extension the animals that occupy them.

Due to changes in government policy, the records we are using were at one time in danger of being lost. In the early 1990's, all silviculture records were handed over to the forest industry. Some used them, some left them in boxes and some even threw them away or lost them in catastrophic fires. As a result, when the modern digital inventory was developed, the historical records were not explicitly incorporated. By digitizing the old maps, we have been able to confirm not only that woodland caribou are in fact using some of these "second growth" forests, but that they are starting to find their way into the harvest queue. For example, in the latest draft of the Forest Management Plan for the Kenogami Forest, over 23,000 ha of second growth are identified for possible harvest over the next 10 years. We are very fortunate that the silviculture records for our study area were maintained by dedicated foresters from both industry and government. Hopefully all the old records that have been saved from across northern Ontario can be moved into the digital age so they can more easily be incorporated into our planning, research and practical activities.

In terms of silviculture, this area also has a lot to teach us about the long term effects of forest management activities on growth and regeneration of black spruce. Some



of the intensively managed plantations established in the early 1960's have been maintained and are currently producing nearly twice the regional average in terms of merchantable yield. These were established at very high density (2500-3000 stems per hectare) on a range of soil conditions. While there are differences in individual tree size associated with site quality, all are producing similar yields. Taking a closer look at the quality of the wood from these thrifty plantations revealed that over 80% is likely to meet the No.2 or better visual grade. If there was a mill in the area that was properly equipped, 48-98% of this wood would meet a machine stress rating, allowing it to be sold at a premium. This after only 43 years of growth! Where intensively managed plantations were not established, aerial seeding and herbicide were used to favor spruce regeneration. We have also been able to use these records to show a definite increase in the amount of ground lichen (important food for woodland caribou) in stands where prescribed burning was used instead of mechanical site preparation, to establish spruce and pine plantations.

The forests around Lake Nipigon are thus yet another example of how managed forests can provide for multiple benefits to the public. In 1999 the Lake Nipigon Basin Signature Site was identified as part of Ontario's Living Legacy Land Use Strategy (1999) as it provides a broad suite of natural and recreational values. Lake Nipigon has long been known for its fantastic sport fishery, and has been drawing visitors from around the world for over 100 years. In 1919 Edward, Prince of Wales, visited the Nipigon River for three days of speckled trout fly fishing. For almost as long, forest harvesting has been conducted in the area to provide timber resources. This area remains popular today for outdoor recreation, and it's special status seems appropriate given the fact that it is one of the few extensively logged areas that continues to support a woodland caribou population. Whether producing high value second growth black spruce plantations, or high value habitat for rare species like woodland caribou, these forests will continue to provide Ontarians and Canadians with a multitude of values now and into the future.

Douglas E.B. Reid is Boreal Silviculture Research Scientist, Centre for Northern Forest Ecosystem Research, Ontario Ministry of Natural Resources. Doug has a PhD in Forest Biology and Management from the University of Alberta and is an Adjunct Professor in the Faculty of Natural Resources Management at Lakehead University. He can be reached at 807-343-4008

Focus on Safety

By Laura Maguire, BC Forest Safety Council

Worker Fatigue

As the rest of the world prepares for BBQ's and hitting the beach, the silviculture industry is just hitting its stride. Many companies have avoided snow or weather delays and had a good start to the season, allowing for full days of uninterrupted work and contracts finishing on time. It's the ideal scenario for keeping clients and planters happy – and supervisors busy. Now is a good time to consider how to keep the momentum going and avoid some common issues with fatigue.

Fatigue refers to the state of feeling very tired, weary or sleepy resulting from insufficient sleep, prolonged mental or physical work, or extended periods of stress or anxiety. Fatigue can be either acute or chronic.

Acute fatigue usually happens suddenly and is short-term. This is the type of weariness felt after spending all night awake fixing the water pump in camp or chasing bears out of the mess tent. Acute fatigue can be managed by sleep and/or relaxation.

Accumulated fatigue is the constant state of tiredness not relieved by rest. A sleep deficit starts to build with each successive sleep-deprived night (generally defined as being awake for longer than 16-17 hours) and may take two or three conventional sleep cycles to correct[1].

The demands of short, intensive seasons mean supervisors and workers are constantly facing fatigue issues. In addition to countless other examples, fatigue can impact production by increasing the risk of injury out on the block, and safety by impairing your drivers behind the wheel.

Studies on athletic performance have shown that fatigue reduces balance, accuracy, reaction times, technique and decision making[2]. Fatigued workers may trip or fall more and poor technique can contribute to tendonitis, shoulder or back injuries. Boring or repetitive tasks can intensify feelings of fatigue, compounding the problem further.

At the end of the day when fatigued workers become fatigued drivers the implications are potentially more severe.

Most people need 7.5-8.5 hours of sleep each 24-hour day. ***Sleep loss built up slowly over several nights can be as harmful as sleep loss in one night.*** Both produce a decline in performance such as slower reaction times, failure to respond to changes, and the inability to concentrate and make reasonable judgments.

Research that tested a fatigued state from continuous hours of wakefulness against blood alcohol levels concluded that[3]

- 17 hours awake is equivalent to a blood alcohol content of .05
- 21 hours awake is equivalent to a blood alcohol content of .08 (the legal limit in Canada)
- 24-25 hours awake is equivalent to a blood alcohol content of .10

You'd likely notice if a foreman climbed behind the wheel with a six-pack in their hands but it is much more difficult to notice the impairment caused by a late night running tree's to a block or an early morning doing numbers.

Fatigue is a fact of life for silviculture companies but good planning, awareness and management can minimize the impact to worker health and production.

Fatigue Management Strategies in Silviculture Operations

Recognize when the conditions create additional hazards for fatigue impairment

- Long drives, extra days in a shift or longer days;
- Unexpected events that extend the work day and limit rest (flat tire, getting stuck)
- Working fire hours
- Large volume days
- Personal factors (interpersonal conflict, stress, family concerns)

Adapt the work plan to deal with changing conditions

- Schedule shorter days or find closer blocks to ensure adequate rest can be achieved
- Allocate additional crews to blocks with long drives to minimize the fatigue on a single crew

Actively support self-care

- Promote adequate rest –including on days off and after work
- Encourage workers to tend to minor injuries quickly and practice preventative care
- Provide information on the importance of diet and hydration (Dr. Delia Roberts Fit to Plant)
- Discuss pacing strategies for energy conservation (moderate sustained vs. short duration, highly intensive effort)
- Pay particular attention to the lifestyle habits of your drivers – are they limiting alcohol consumption, getting enough sleep and recharging themselves for the additional demands of driving?

Additional resources:

ENFORM Fatigue Management

Health & Safety Executive – Sleep & Fatigue Bulletin

Share your ideas at the BC Forest Safety Council Forum

[1] *"Regulatory Impact and Small Business Analysis for Hours of Service Options". Federal Motor Carrier Safety Administration. www.fmcsa.dot.gov/rules-regulations/topics/hos/regulatory-impact-analysis.htm.*

[2] *Simoneau, Begun and Teasdale (2006) "The effects of moderate fatigue on dynamic balance control and attentional demands" www.jneuroengrehab.com/content/3/1/22*

[3] *Dawson, D., and Reid K. (1997). "Fatigue, alcohol and performance impairment." Nature 388, 235.*

Laura worked in the silviculture industry for 11 years. She now brings her field experience to helping companies create practical solutions to their safety issues and wishes she could have taken her own advice when she was putting in trees. She can be reached at Maguire@bcforestsafe.org.

Chittenden Nursery, the USFS, and the CCC as Partners in Reforestation

By Joseph J. Jones | Photos Courtesy of the Forest History Society, Durham, N.C.

CCC enrollees lifting and packing seedlings at Chittenden Nursery

Reforestation in the eastern United States during the Great Depression was a multifaceted process with the involvement of many different government agencies and private groups. The U.S. Forest Service (USFS) managed land purchases, plantation projects, fire suppression, and forest management in the national forests. Each state had a department that provided similar operations for state and local forests. The Civilian Conservation Corps (CCC) furnished significant labor to each of these agencies while being directed by the military. Labor also came from other work relief agencies of the New Deal. Local residents provided quarters, provisions, supplies, or skilled labor for numerous temporary aspects of the field work. Amidst all of this complexity, successful silviculture developed at the direction of a proportionally small number of trained men. Chittenden Nursery in Wellston, Michigan demonstrates the logistical, scientific, and social challenges and benefits of this approach to reforestation work.

The logic behind the New Deal of Franklin Roosevelt can be summarized as relief, recovery, and restructuring. Relief took the form of emergency handouts, work on public projects, and bank holidays. Recovery was returning men to work in the private sector amidst functioning industries and banks. Restructuring involved changing the ways industry, finance, and infrastructure functioned to avoid another collapse of the economy. Roosevelt understood that all of the primary problems of the economic sector manifested themselves in the land. Soil exhaustion and erosion, denuded forests prone to fires, declines in fish and game, the ravages of pests and diseases on the landscape, and the exploitive use of natural resources exhibited the need for relief from present circumstances, recovery to a useable state, and restructuring of how Americans used resources. The CCC was Roosevelt's favorite remedy for the troubles of the 1930s because it provided relief, recovery, and restructuring that conserved both natural and human resources (Phillips 2005, 2007).

While vast public lands were common in the West, federal and state public lands east of the Rockies were small and difficult to manage. However, denuded, burned, eroded, and depleted lands coupled with urban unemployment made this region well suited for the work that Roosevelt envisioned. Therefore, he dedicated twenty million dollars for the purchase of new national forest lands. This money provided the means for starting the Manistee National Forest in Michigan's Lower Peninsula. Once purchases began, the USFS established Chittenden Nursery, named for a forestry professor at Michigan Agricultural College, to supply seedlings and transplants for reforestation plantings throughout the region. On March 1, 1934, CCC workers began to clear eighty-seven acres just east of Wellston for the nursery. Built on the site were a pump house, a warehouse, oil storage, and a residence/office. Buildings for cone storage, seed extraction, and a greenhouse were later added. In addition to the buildings, the grounds had thirty-five acres of seed beds. The first planting of sixty-five million seeds took place in October of that year. The plantings at the nursery were primarily white, red, and jack pine as well as some spruce, cedar, and hardwoods. Originally, it was expected that the nursery's capacity would be over one hundred million seedlings, but decisions to keep seedlings in the seed beds longer, reduced that number to between twenty-five and fifty million (Jones 2007).

Once the nursery was functioning, logistical challenges were evident. While the Wellston CCC camp was only a short walk from the nursery, there was a clear divide between operations of the two sites. The USFS employees operated the nursery, while military officers ran the camp. The Emergency Relief Administration (ERA) paid for local laborers to work on construction in the camp. Thus, the coordination of labor required tracking and directing 200 CCC enrollees and

CCC enrollees hauling cone trays to the Chittenden Nursery extractory

25 local ERA men, none of whom had forestry or nursery training. Additionally, the standard term of enrollment in the CCC was six months, so new enrollees needed to be trained constantly. The supervision, training, and direction of the nursery operations fell to four men in the early years of Chittenden. When enrollees packed seedlings to be shipped for planting, coordination needed to be made not only with CCC and ERA labor but with forest rangers and the thirteen other CCC camps to maximize the success of planting. Given that an individual planter could set 1,500 to 3,000 seedlings in a day, such coordination over such a broad operation required careful planning, foresight, and a little luck. In addition to these logistical problems, there were operational issues with constructing buildings, maintaining equipment, and irrigating seedbeds effectively. During a hot summer drought in 1936 when lake levels dropped to the point that muck was being pulled into the water intake, several employees would have to work through the nights to keep the irrigation lines unplugged. All of these challenges amidst the demands for seedlings kept USFS employees busy on a wide array of tasks throughout most of the year (Crosby 2009).

In addition to these logistical and operational challenges, nursery workers faced scientific challenges as well. Work at the Beal Nursery in the Huron National Forest provided knowledge on the seeding of pines. However, the germination of other species, especially basswood, proved harder to standardize. Similarly, nurserymen had to track the success of plantations with forest rangers to test the efficacy of different bed and transplant durations. Swarms of grasshoppers threatened seedlings in plantations and the nursery especially in the hot, dry summer of 1936. CCC enrollees mixed poisonous bait in camp and then spread it in new growth forests to attract the insects. The work was considered successful since surveys completed afterward found up to sixty dead grasshoppers per square yard. Additionally, weather conditions from severe heat and drought, dust storms from the Dust Bowl, and deep snows in the winter had to be monitored, managed, and to a degree endured (Crosby 2009; Jones 2007).

Social challenges and opportunities existed both with CCC enrollees and local residents. Idle urban youth comprised the bulk of the CCC's enrollees. Not only were they unfamiliar with much of the work that they needed to do, but they were also unfamiliar with the rural life in and around the camps. Camp supervisors had to organize outlets for their youthful exuberance and passions, which at times clashed with the perspectives and values of local residents. Given periodic altercations involving CCC enrollees, USFS and nursery employees assumed responsibility for numerous activities to encourage positive public relations. Generally, local residents supported the national forest because it made denuded and burned land productive, infused the local economy with capital from provision purchases and jobs, and provided property tax support for local services like schools and roads. Nursery personnel did not rest on this good will but

3-0 pinus resinosa seed beds at Chittenden Nursery in 1938 with irrigation lines

actively courted positive public sentiment through nursery tours to locals, tourists, and sportsmen. They also built floats for all the community parades, particularly the Manistee National Forest Festival held in nearby Manistee over the Independence Day weekend. The result of this work was a good relationship with most local people since their livelihoods during the Great Depression were tied to the success of the national forest (Crosby 2009; Jones 2007).

Despite being closed in 1973 because of the decreased demand for seedling stock, Chittenden Nursery and the work done by the USFS, CCC, and ERA had a lasting legacy environmentally, economically, and socially in Michigan. The USFS with the help of the CCC planted 101,154 acres from 1934-1942 in the Manistee National Forest. In a few short years, particularly with the rapid rate of pine tree growth, the cutover was converted from a denuded district to an area with many healthy stands of pines. The change was so swift that the national director of the CCC, Robert Fechner, isolated the reforestation work in western Michigan as a sign of renewed productivity on lands that had long been idle. This renewed forest has provided a place of recreation and economic opportunity for numerous tourists and locals since World War II (Jones 2007).

Yet more broadly, the experience in the scientific management of forest resources for young men previously untrained in such work generated a dedication to the conservation of natural resources that proved to be a good seedbed for the post-World War II environmental movement. Roosevelt's vision of restoring both the land and the men became regenerative in its own right. It made the men not only self-sufficient but dedicated them to the protection of land and resources to prevent another decimation of the landscapes they had rebuilt (Maher 2005, 2008).

Joseph Jones is an interdisciplinary scholar who holds a Ph.D. from Michigan State University. His forthcoming book, Land of Poor

Character: Creating National Forests in the Eastern United States, explores the social, political, and environmental elements of logging, farming, and reforesting the Great Lakes region in the late-nineteenth and early-twentieth centuries. He can be reached at jonesj58@msu.edu.

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A Word of Advice

By Heather Mcansh

Out of breath and exhausted, I struggled from step to step as I planted my first bag up of the morning. After days of sleeping in my tent, only waking up for about six hours each day, I wanted to get back out and try to plant. I couldn't string a sentence together without gasping for a breath, and my body seemed to be in the grips of a flu, unlike any I had previously experienced. My joints and bones were constantly aching; my vision was blurry with floating spots; I was short of breath with chest pains and heart palpitations; night sweats; dizzy; menstrual pain throughout the month; unexplained shaking and stabbing sensations in my body; unusual depression and anxiety; difficulty concentrating and with memory; and continual infections. After one excruciating bag up of trees, I knew it was time to go back to Vancouver and figure out what was going on in my body.

I had been to two doctors while planting in Cranbrook, BC; one had told me I had a lung infection, the other thought I may have strep throat. Upon arriving back to Vancouver, a doctor gave me a few days worth of antibiotics, but I continued feeling awful. I went to go see a family member who is an electro dermal therapist, hoping an alternative form of medicine could provide some answers. I hadn't even thought about the possibility that I might have lyme disease, as I never found ticks on my body and I didn't get the 'bull's eye' rash, indicative of a tick bite. However, the bacterium which causes lyme disease, *Borrelia burgdorferi*, turned up in the electro dermal test so I decided to follow it up with a doctor.

I went to see a family doctor in Vancouver to ask about being tested for lyme, and her immediate reaction was that there could be no chance of having it. I explained to her that I had just been tree planting in the interior of BC and that health authorities have found borrelia bacteria in ticks collected from many areas of BC, leading them to believe the organism is present throughout the province. She *begrudgingly* ordered the blood work for the lyme test, but it came back negative. I had read that the Canadian lab test for lyme disease is considerably unreliable and many people who suspect they have the disease, pay to have their blood work sent to a lab in America for a more reliable diagnosis.

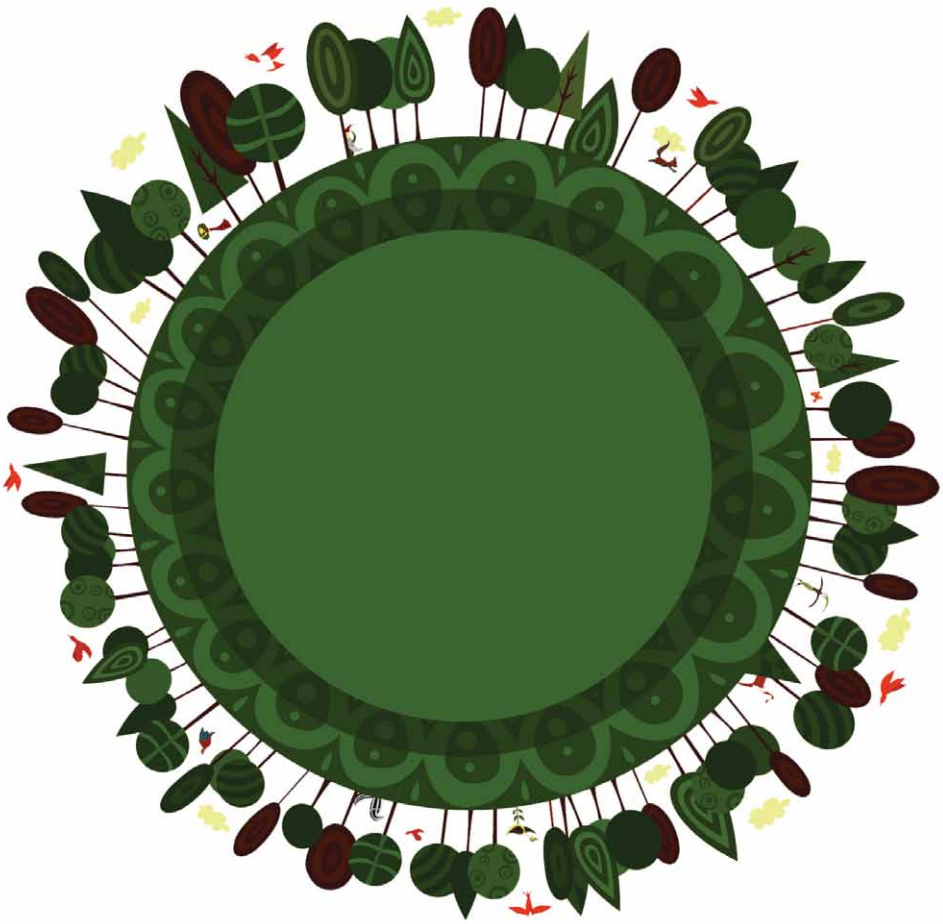
Fortunately, at that time, I was relocating to Scotland and was able to receive free health care through my ancestry visa. I was referred to an infectious disease specialist whom I was able to see within a couple of weeks. Acknowledging the lab tests are often unreliable, the specialist thought a clinical diagnosis was the best course of action. Over the next few weeks, the specialist tested me for any possible disease that may be causing my symptoms. Results came back negative on every test and he deduced that it was most likely lyme disease. He prescribed three weeks of doxycyclin antibiotics and the symptoms disappeared within the first week of taking them; I was back to normal after having struggled for five long months. The only lasting effect of the disease was on the cartilage in my knees which had been damaged by the bacteria and cause swelling and pain with certain activity. I was lucky to access a doctor who was able (and willing) to diagnose and treat lyme disease in a relatively short time. Chronic lyme disease, which can develop if left untreated long enough, is very serious and incredibly difficult to treat. Why Canadian doctors are reluctant to diagnose lyme disease and why there are so few reported cases in Canada compared to just south of the boarder, is an important and disconcerting question.

There are a number of preventative measures that can be taken to avoid being bitten by a tick while out on a cut block. Tucking pants into socks, shirts into pants, wearing a cuffed shirt and slathering on some DEET will help, but this isn't always practical and it's hard to find a planter without rips in their clothes. The best way to catch lyme early is to do daily examinations, with particular attention to the pubic area, base of the skull and scalp. Also, make sure to check clothes for ticks and never take your planting clothes into your tent at night. If a tick is found, remove it very carefully (refer to the relevant safe work procedures), bag it, and send it for testing. However, do not rely on finding the tick, instead, be aware of the symptoms so that if they persist, you can rule out the possibility of lyme disease, or be diagnosed and recover after a simple dose of antibiotics.

Heather has spent her planting days in BC`s interior and writes from camp in 70 Mile. Farming on Vancouver Island or city-dwelling in East Vancouver, she can be reached at hmcansh@gmail.com.

In Support of Community Forests

By Jim and Jeff McWillams



The principles of community forests, when applied by local management to an area which can support a viable forest enterprise, can provide significant benefits, of which Wells Gray Community Forest provides an example.

Distinctive features of a community forest are:

- an area-based tenure in the vicinity of a community
- local management which integrates community objectives and knowledge into operational plans and activities with a long term perspective.
- a forest based enterprise, which has greater incentive to reinvest in the forest than a manufacturing-based licensee, and which can benefit financially from freer access to diverse customers for its logs (by species, grade and specification) and other forest products.
- net revenue from product sales can be distributed to local projects or reinvested in the forest.

In B.C., several forms of tenure have these characteristics. Included are several First Nations' tenures and Tree Farm Licences held by Mission, Revelstoke and Burns Lake. The largest group, now about 46 in number, (with more applications under review), are "Community Forests." (CF). This tenure originated from 1998 legislation which provided for mostly small volume licences to be held by communities in rural areas. The first five year probationary CF licence was granted in 2000.

CFs are not homogeneous. They exhibit very significant differences in ownership, structure, land base, allowable annual cut, (AAC) forest type, site quality, proximity to customers and management. Consequently, generalizations are not appropriate and comparisons are problematical.

Because of the authors' familiarity with Wells Gray Community Forest (WGCF) during its development by knowledgeable volunteers and since its establishment in 2006, as well as a recent opportunity to interview George Brcko, RFT, General Manager (GM) its structure and operating practices are described. WGCF is centered at Clearwater, B.C. in the North Thompson valley.

After a 5 year probationary period, (no longer mandated) WGCF was granted a 25 year, renewable licence. The productive land base of approx. 10,000 hectares consists of 3 areas close to Highway 5, one being part of the District of Clearwater watershed. The initial AAC

was 20,000 cubic metres (m^3), similar to many other CFs Because the Licence area contained a substantial volume of beetle killed pine, the Ministry granted a temporary AAC increase of 13,500 m^3. This dead pine became the first logging priority and was completed in 2011.

The imminent return of the AAC to 20,000 m^3 led Directors of the WGCF Corporation to invest $30,000 for an intensive Terrestrial EcoSystem Mapping (TEM) and Site Index Adjustment (SIA) project. With this new data the Ministry is expected to support a permanent AAC of 33,000 m^3.WGCF consists of a forest type transitory between Dry Douglas Fir and Interior Cedar Hemlock and benefits from productive sites, now mostly green timber within economical proximity of multiple customers. On the other hand WGCF, like most community forests, has a significant number of management constraints including watershed disturbance restrictions, visual quality concerns, urban interface fire hazards and high use of recreational trails.

WGCF is structured as a corporation, with shares held by a society. It has a 7 member Board of Directors, including one from Simpcw First Nation. The GM reports to the board, who also has an Advisory Committee consisting of 6 members of the general public. The Society has 7 members: 2 Directors, 2 Advisory Committee, District of Clearwater, Thompson-Nicola Regional District and one member at large. WGCF recently distributed approx. $100,000 to local entities, after considering 26 applications.

Forest development planning within the WGCF is based on extensive feedback from the community. Once areas are planned for harvest, the GM negotiates and supervises contracts for main road location, road construction, logging, reforestation and other silvicultural activities. Currently, cutblocks are offered for sale to local logging contractors who are invited to submit a single price bid per m^3 for the timber on the block, including pulp grade. Prospective contractors are responsible for making the most favorable log sales agreements with customers within economical trucking distance. This business approach has netted WGCF a return of $10-11per m^3 over the last few years.

Log sorting for customers is done on the landings at the time of logging. Typically, pine has been purchased by Interfor's Adams Lake mill, cedar by Gilbert Smith mill in Barriere, peeler fir by Tolko's Heffley Creek plywood plant, pulp by Domtar's mill in Kamloops and fir sawlogs by local sawmills.

Where feasible, harvesting, silviculture plans and other activities are integrated to optimize long term results. With a silviculture background, the GM's declared standard for logging and reforestation is "best practices" as compared to "common" or regulated practices in the region. Species selection and stocking density for reforestation are carefully considered relative to producing the best mix of long term volume and value.

Further discretionary expenditures are being considered for:

- Post free growing brushing
- Pruning high value fir stands
- Fertilization of 80-100 year old stands outside the watershed
- Producing and supplying bio-fuels

The most positive feature of a community forest tenure is retention of public ownership with localized management. This provides a better reference framework for integrating decision-making between competing resource values and promotes a longer term management focus. This tenure provides opportunities for partnerships between First Nation communities and other interests which can benefit forest management.

While BC's community forest model has many positive attributes, changes to forest policy are required to maximize the opportunities from promoting this form of tenure. For example, the stumpage system could be replaced with a taxation system that supports local management and provides incentives for communities to invest further in their forest resources. Many CFs, to be economically sustainable, need larger AACs, even if this requires reallocation from other tenures or sources.

Within the mix of publicly administered tenures in B.C., the community forest model is worthy of further policy development and wider application.

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Jeff McWilliams, RPF, is a senior associate with B.A. Blackwell & Associates Ltd. Jeff has over 24 years of experience in forest resource management in BC.

Western Canada

By Bob Gray and John Betts

B.C. Land Use and Timber Supply: We Need a Better Conversation.

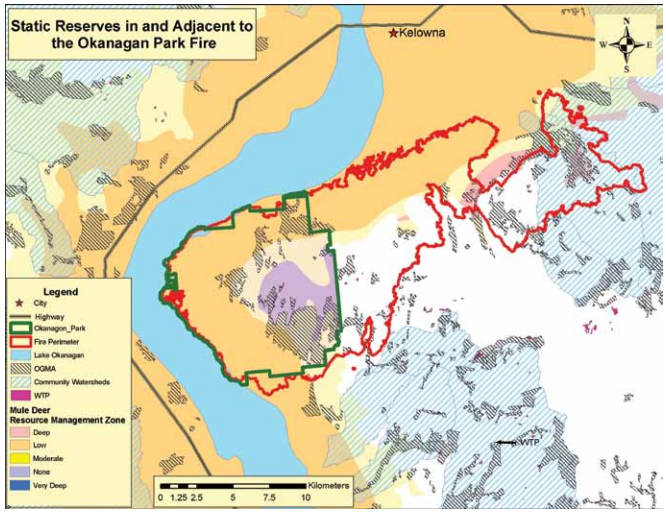
BC's forest and range ecosystems are far more complex and subtle than the arguments we have over how to manage them. The current dispute centred on the recently leaked government timber supply document is a case in point. Politicians' consideration of logging in what critics describes as forest preserves has quickly led to two opposing and simplistic positions. To propose logging sensitive areas to mitigate timber supply is driven by short-term thinking. And the opposing position, that these areas are off limits, is animated by ideology more than a careful observation of events on the ground. Neither do the subject proper justice.

The wise public policy that circumstances call for, which should have a lot to do with restoring resilience to our forest and range ecosystems, will not be found in resorting to the old polarities of logging versus preserving our forests. Those positions do not answer to the dynamic forces that have swept the landscape already in one remarkable wave of insects. Continuing effects are now gaining potential to create a series of aftershocks including unprecedented fire, unexpected flooding, and economic disruption. As demonstrated already, these events have little regard for our timber supply assumptions or the boundaries we have drawn on maps designating who gets what, and for what purposes. Our conversation on forest management has to reflect these emerging complexities and the dramatic new ecological paradigm that we are just beginning to realize we are caught up in.

One area this new conversation will have to explore is the actual disposition of "static reserves" which have produced so much contention. BC's system of static reserves (static in time and place), including Protected Area's, Old Growth Management Area's, riparian reserves, Ungulate Winter Range, Wildlife Tree Patches, Wildlife Habitat Area's, and other constraints on landscape management (e.g., Visual Quality Objectives), have not been successful in meeting their intended objectives.

A good example is from 2003 Okanagan Mountain Park Fire, where a natural process (wildfire) negatively affected the many static reserves within its perimeter. None of the reserves had been actively managed to build in resilience ahead of the fire (and haven't post-fire) with the result now leaving large areas of forest that are not meeting the intended objectives behind the reserve designation. Numerous other examples from the last decade (Nuntzi Provincial Park, Stein Valley Provincial Park, etc.) suggest this trend is on the rise. The inference from these observations is the paradox that a certain amount of intervention—e.g. in the Okanagan case, thinning would have offset the denied effects of the area's historical fire regime—is required to keep reserves in the condition we would like to think of as their natural state.

The obverse of this is true as well, particularly when we try to sustain a land use objective that runs contrary to the ecological forces that want to play out on the landscape. For example, if we intend to maintain unnaturally high density stands of Douglas-fir in the Okanagan for ungulate winter range or flammulated owl habitat, then managers are forced to protect them from those natural processes that tend to affect that unnatural forest structure (wildfire, spruce budworm, Douglas-fir beetle, tussock moth, etc.).



This requires active, overwhelming fire suppression and spraying to maintain this state.

But practices to date don't generally include active management of most reserves. The issue is that dynamic forces of nature continue to impact them and affect the goals under which they were established. Conflicts then are likely to arise in the future when the static reserves are lost to natural disturbances. Advocates for those reserves are likely to come to the province with demands to replace them. Legislation may compel the province in some cases, such as in the case of the federal Species At Risk Act, to enter into costly and time-consuming negotiations with licensees and tenure holders to replace lost reserves. There is a good chance that our current course will put us in the future in the same untenable land-use position we currently find ourselves, only it will originate from the conservation side.

It is interesting to note that threats to static reserves come mostly in the form of wildfire, insects and diseases; similar to threats facing our timber supply in many regions. It is also worth noting that the most threatened reserves are located in the ecosystems most departed in structure and composition from historical conditions, in particular, where fire suppression has led to dramatic increases in density and in species shifts. Also embedded in these landscapes are millions of dollars of public investments in reforestation as well as the current capital we are counting on to supply timber.

Nature of course will not be fooled by much of the ongoing partisan posturing. If we want to preserve what is valuable to us on the land we will need to manage the entire landscape under an ecosystem management paradigm. This will mean no longer subscribing to the fallacy of static reserves. Nor will it tolerate treating the landscape as a convenient means to obtain a particular commercial commodity. By managing fluidly to restore resilient ecosystem structure and species composition we may be able to live off a landscape similar to pre-European settlement. Unfortunately we are a long and discouraging way from having that kind of conversation, let alone seeing it realized.

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PEI

By Ken Mayhew

New PEI Woodlot Owners' Association: Moving Forward

After lots of meetings across the Island and many months of discussions, Island forest owners are about to move forward with a new woodlot owners' association. Almost 88% of the Island's forest land is owned and managed by private land owners. Privately owned forests provide income and employment to hundreds of Islanders and wood from private lands is used to make building materials, paper products, and firewood to heat our homes. Medicinal plants such as ground hemlock are harvested for use in cancer treatments while nuts, berries and twigs are used to make foods and decorative products. As at the same time these forests provide wildlife habitats, clean air and water, protect our soil, beautify our landscape and offer places for recreation and solitude.

The importance of these forested lands to all Islanders cannot be overemphasized but often the interests and concerns of the owners are overlooked or poorly understood by decision makers. Unlike farmers and fishermen who have groups that represent their ideas and concerns, Island forest owners tend to act individually. This often limits their ability to voice their collective concerns, deal with wood buying companies, or develop the many other values of their lands in an effective and consistent manner.

Over the years, a variety of woodlot owners' organizations have come and gone. In some cases, these groups were formed to address specific economic and marketing opportunities. Others gave voice to concerns over issues that mattered to land owners. In each case, these associations had many positive impacts for their membership but changing economic times, land owner population demographics, and new private land forest issues led to a gradual decline in interest and participation for most groups.

This story of forest owner groups that come and go is not unique to the Island. Similar groups in other parts of eastern Canada have had varying degrees of success reflecting the issues and opportunities of the time. Still, today most provinces have organized and effective forest owner groups that help their members meet a variety of needs and interests in areas such as education, silviculture, recreation, environmental stewardship and marketing forest products.

Finding the right direction and focus for the new Island organization is an ongoing process but a steering group has been working to identify and distill the key concerns and opportunities participants offered at the various meetings. By asking what forest owners want and expect first, and then developing ideas and strategies that could address those issues, they felt the chances of success would be much greater over the long term.

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New Brunswick

By Jasen Golding and Ed Czerwinski

Association of Registered Professional Foresters of NB

The Association of Registered Professional Foresters of New Brunswick (ARPFNB) presented to our Legislative Assembly a revised version of "An Act to Incorporate the Association of Registered Professional Foresters of New Brunswick", as Bill 22. The main objective of this new Act is to move from Right to Title as Registered Professional Foresters (RPF) to Right to Practice (RTP), for our members. This initiative provides protection to the public by ensuring the competency, independence, professional conduct and integrity of registered professional foresters who manage private and publicly-owned forest resources. It is our belief that all foresters be accountable for their actions in all activities as they relate to the practice of forestry. The Right to Practice will ensure the code of ethics, as defined by the ARPFNB, is abided by producing the highest practicing standard in the province.

The ARPFNB believe all foresters should protect the public interest on private and public lands. We extol the importance of having regulated professionals *accountable to the public, employers, clients and profession, subject to continuing competence requirements, a complaint resolution system with a code of ethics*.

It is our sincere belief that Right to Practice will achieve the high standards required in the practice of professional forestry for New Brunswick. The professional forestry associations in British Columbia, Alberta, Ontario, and Quebec have similar legislation. In addition, Nova Scotia, Newfoundland and Labrador as well as Saskatchewan are currently pursuing legislation with mandatory registration for foresters in their respective province.

The proposed Act does not impose any requirements, restrictions or limitations on forest technicians or forest technologists who may be working within the practice of professional forestry as defined in the Act, and who are competent to do so by virtue of their education and training. Nor does the proposed Act apply to: Harvesting contractors, harvesting equipment operators, manual fellers, clearing saw operators (thinners), tree planters, nursery workers, and other related professions of those working in "forestry" business. They will not be required to be registered with our association. Neither will persons working in a "supervisory" role in forestry-related activities who are managing people, budgets, buildings, vehicles and other equipment.

The RTP is at a critical stage. This change in legislature can only improve the conduct of our professional foresters by holding them accountable to the public, employers, employees or clients and other members by promoting just and honourable professional and human relations, mutual confidence and respect and competence role to society.

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Québec

par Shanie Lévesque-Baker, Association Des Entrepreneurs en Travaux Sylvicoles Du Québec

Nouveau régime forestier : le décompte est commencé

À l'aube du changement majeur qui attend les entrepreneurs sylvicoles du Québec avec la venue du nouveau régime forestier, en 2013, la dernière saison sous l'actuel régime ne s'annonce pas de tout repos.

Certes, tous les projecteurs sont tournés vers le Ministère des Ressources naturelles et de la Faune, qui tiendra le premier rôle de cette mise en œuvre. Bien que les entrepreneurs sylvicoles se réjouissent de l'adoption, en septembre 2009, de la nouvelle *Loi sur l'aménagement durable du territoire forestier*, qui régira les activités forestières dès avril 2013, ils vivent encore une fois un début de saison d'opérations sylvicoles, chaotique.

En effet, ce sont plusieurs entrepreneurs, qui, en date d'écrire ces lignes, ne s'était toujours pas fait confirmer de travaux pour la saison 2012. Malheureusement, cette période d'incertitude qui plane sur les entreprises n'est pas sans conséquence sur les travailleurs saisonniers qui attendent impatiemment de débuter la saison.

Cependant, la situation actuelle ne devrait plus se reproduire dans les années à venir car dès 2013, les contrats de travaux sylvicoles seront directement octroyés par le gouvernement, aux entrepreneurs. L'impasse actuellement vécue sera éventuellement évitée par ces contrats de cinq ans qui lieront les entrepreneurs au MRNF, sans intermédiaire. En assurant ainsi aux entreprises leurs travaux pour les cinq prochaines années, ce sont également des milliers de travailleurs sylvicoles, souvent pères de famille, qui bénéficieront de cette sécurité d'emploi.

Des investissements qui rapportent

La crise économique qui a débuté en 2002 est encore omniprésente au pays et chez nos voisins du Sud, et l'est encore davantage au sein de plusieurs communautés du Québec. En effet, les fermetures d'usines et les pertes d'emplois qui y sont reliées ont eu des répercussions très lourdes.

Ce sont donc des communautés durement touchées par la crise forestière qui espèrent qu'à travers l'investissement et les contrats à long terme dans les travaux sylvicoles, une certaine reprise économique sera possible. L'occupation du territoire reprendra alors tout son sens, dans certaines régions où les industries ont dû fermer leurs portes, et les travailleurs, quitter leur communauté afin d'assurer leur emploi.

En ce sens, les travaux sylvicoles doivent être au centre de la reprise économique, notamment en assurant des volumes de bois de qualité, prêts à être récoltés, mais surtout en permettant aux travailleurs de gagner leur vie à proximité de leur famille. Il est légitime de souhaiter que ce changement de régime aura, par le biais des activités sylvicoles, un effet structurant pour plusieurs communautés.

translated by Teri Shaw

A New Forestry Regime: The Countdown Has Started

On the eve of the major changes that await Quebecois silviculture entrepreneurs with the coming of the new 2013 forestry regime, the last season of the current regime does not look easy.

Certainly, the spotlight is on the Ministry of Natural Resources and Fauna which holds the most important role in this new undertaking. Even though the silviculture entrepreneurs are thrilled with the adoption of the new September 2009 policy, *The Law on the Sustainable Development of Forest Land*, which will redirect forestry activities starting in April 2013, they are currently under a rather chaotic start to the current silviculture operation season.

In fact, several entrepreneurs, at the time of writing, still have not been guaranteed work for the 2012 season. Unfortunately, this period of uncertainty for businesses is not without consequence for seasonal workers who are also eager to start the season.

Nevertheless, the current situation should not repeat itself in the coming years because, as of 2013, silviculture work contracts will be directly granted by the government to contractors. With the passing of the new policies, the current obstacles will be avoided by implementing five-year contracts which will link the entrepreneurs directly to the Ministry of Natural Resources and Fauna without having to pass through an intermediary. By assuring work for a five year period, thousands of silviculture workers, many of whom are dependent on this work for their livelihood, will benefit from this promise of job security.

Investments that pay off

The 2002 economic crisis, still omnipresent across our country as well as south of the border, is even more severe in several communities in Quebec. In fact, factory closings and job losses resulting from the economic crisis have had heavy repercussions.

Therefore, these communities which have been rather hard hit by the forestry crisis are hoping that through investment and long term silviculture contracts, a certain amount of economic gains will be possible. Occupation of forest lands will regain its full meaning in some areas where industries have closed their doors and workers have left their communities in search of employment.

In this way, silviculture work will have to be at the center of the economic recovery strategy, notably by assuring enough quality wood is ready to harvest, but also by allowing workers to earn their livelihood where they currently reside with their families. It is not off-base to hope that the change in regime will, though forestry activities, offer a beneficial restructuring of many communities.

Forest Health

By Laura Maguire, BC Forest Safety Council

Toward sustainable biomass harvesting: the fungal perspective

Globally, concern over rising carbon emissions is driving intensive woody biomass harvesting for use as feedstock in the bioenergy sector. The rationale behind this trend is simple: using wood residue as a fuel source can provide energy products while dramatically reducing carbon emissions, potentially mitigating the effects of climate change. Scandinavian countries are already intensively harvesting woody residues for bioenergy production; Finland saw a 22-fold increase in woody residue harvesting from 1995 – 2003 (Walmsley et al., 2009), and stump harvesting is becoming increasingly common. Bioenery production in Canada is largely within the forestry sector, accounting for 6% of Canada's energy needs (Bradley, 2006). With a 16.3 million ha mountain pine beetle outbreak, British Columbia is poised to drastically increase its woody residue harvesting (Ministry of Forests and Range, 2010). However, reduced carbon emissions may be negated if removal of forest residue reduces long-term carbon gains in aboveground biomass via loss of soil fertility associated with residue removal. Striking a balance that guarantees a reliable feedstock without compromising future forest productivity presents a challenge to foresters and ecologists – just how much of the dead stuff can we take?

The effects on site fertility of logging residue removal have been studied extensively since the 1970s. A common fear present throughout the literature is that harvesting of logging residue exports nutrients and organic matter off site, resulting in long-term loss of soil productivity. This research has largely concluded that the short-term effects of residue removal vary widely depending on site conditions; however, one observation remains fairly consistent: the nitrogen content of woody reside left on site increases over time. Woody residue can be likened to a nutrient sponge; it somehow soaks up nitrogen from the forest floor though the decay process.

Wood decay fungi have largely been hypothesized as responsible for the 'nutrient sponge' capacity of woody residue. While an excellent source of carbon, the primary requirement for growth of decomposing fungi, woody residue is a poor source of nitrogen. Without access to a more abundant nutrient source, fungal growth on wood is often limited. Wood decay fungi have overcome this limitation through use of their extensive networks of hyphae, which explore through the soil for nutrients. Once these nutrients are found, they are then transferred back through the hyphal network to the woody residue and used to decompose the abundant carbon resource, hence the nutrient sponge.

Recent research using radioisotopes has estimated that a common wood decay fungus, the sulphur tuft (*Hypholoma fasciculare*), can increase the nitrogen content of woody residue by more than 200%, suggesting that wood decay fungi can act as a strong sink for nitrogen (Philpott, 2012). How much, when, and in what form the fungal-scavenged nitrogen is released from woody residue remain important research questions. In northern temperate forests, nitrogen is the one of the most limiting nutrients for tree growth, and silvicultural prescriptions often aim to reduce post-harvest nitrogen losses via leaching. Given that fungi growing on woody residue are capable of accumulating nitrogen from the surrounding forest floor, promoting conditions to maximize this fungal-mediated sponge phenomenon may help retain nitrogen on site. This would involve ensuring woody residue is distributed homogenously throughout a cut-block and is in contact with the forest floor to promote fungal colonization.

Above: Slash piles in a cut block. Left: The common sulphur tuft (hypholoma fasciculare)

Current regulations regarding woody residue management in British Columbia require retention of a minimum of 4 logs per hectare (Forest and Range Practices Act, 2010). While a recent report by British Columbia's former Chief Forester provides guidance for woody debris management, binding regulations are limited to the 4-log rule (Snetsinger, 2010). Management guidelines for slash and smaller woody residue are non-existent and this material is often piled, and burned or left to decompose during site preparation. As it stands, this resource is largely wasted, but as markets for bioenergy products open in British Columbia, much of this logging residue may eventually be more thoroughly utilized.

If one of the goals of biomass harvesting is to lessen the impact of climate change by reducing the use of carbon-intensive energy products, then sound science should guide residue management that balances demand for feedstock with potential losses of site productivity through residue removal. The science has demonstrated that fungi growing on woody residue accumulate nitrogen through the decay process and this mechanism may represent an important nitrogen sink after harvest. The merits of biomass harvesting far outweigh other energy alternatives, but there are also risks to future forest productivity. As always, policy should strive to strike a balance between forest health and human demands for forest products.

Tim Philpott recently completed his MSc at UBC (Forest Sciences) and is currently a graduate intern at the the UBC Malcolm Knapp Research Forest.