Canadian landscape fire management in the past, present and future?

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Abstract*: Within this big picture, possible past landscape fire management practises are proposed. First Nations fire use practices since their colonization of North America are inferred from historical records, along with classical biological theory, where fire use maximizes reproductive fitness in humans. The North American biota was formed and adapted to these human practices, but was disrupted by European colonization, bringing a distinctly different approach to fire. Much of North American biota is in a fire deficit as a result of at least 100 years of fire protection and continues to suffer the vagaries of fire climate. Big fire years with uncontrollable fire seem to be appearing with increased regularity and it's risky for the people and their fixed assets. The future of fire management in Canada requires active management, where objectives for fire are planned, delivered and continually evaluated on local lands. These objectives need to include those for both fire protection and fire use, as North American biota is biologically adapted to frequent fire.*

Thanks for the invitation. The invitation is really special for me as my rookie season in 1981 was spent across the valley on the bench at the Boundary Ranger Station. The old Boundary Cabin, our 100-year-old honeymoon suite and party shack is still there. The deluxe cedar sauna, completed with power and plunge pool is gone. I was lucky to be at the boundary and lucky I had a great boss, Ranger Ray Hill, who was nearing the end of his long career in the Bow/Crow Forest. The crew called the base the Holiday Camp, as we didn't see many fires and also because of the happenings in the valley. The Alberta government was creating K Country and there were many young people building trails, campgrounds and other basic infrastructure. The Alberta Forest Service, once responsible for land management in the valley was left with only fire protection, delivered out of the Boundary by an initial attack crew. We had the only first class camp in the valley, very few fires and mostly did odd jobs, but remained ready to fuel any incoming ships loaded with the executive from the Alberta Government. The ships were either Air Alberta ones captained by the likes of Cliff Hendrix, the ex Air America contractor from the 1960's or the private Bell 206 JEL, with the old flying pirate James E. Lapinski in command. We didn't wear yellow and ended up sporting snappy dark blue flight suits, dark blue ball caps, and dark shades. We kept the firebase spotless, ready to serve refreshments to the thirsty officials. We never exported my first season and I spent Black Thursday, August 27, 1981 on base at the Boundary comm's shack listening to dire reports coming out of the northern boreal on the AFS radio network. It was my 24th birthday and I was hooked on fire. The only person from my first crew still fire active is Bruce Mayer, who was the crew equipment operator and my roommate.

This invitation isn't for tales from the fire line though. Instead, I was invited to talk about landscape fire management and I've decided to give my big picture of this complex view. I'm fortunate in being fire mobile during my career and during the last 15 or 20 years, able to self-dispatch to see fire across a wide range of Canadian landscapes. I tried to keep my eyes wide open and like to study fire. I guess I'm saying this to substantiate myself as an expert witness to landscape fire and one worthy of speaking to you. I`ll begin at the beginning as I see it.

With the retreat of the continental and cordillera ice during the Wisconsin era, humans first colonized the landscapes of Canada, bringing their fire with them. Their lives were dependent on this unique tool of ready fire. They were discriminating fire users in order to survive, passing on their genes to maximize biological fitness. They manipulated the environment with fire, managing the abundance of potential resources in their favour. The vegetation of the biota, fuel for the fire environment, shows obvious adaptations to periodic fire through their various reproductive strategies. Canadian landscapes, brand new after the ice and now thousands of years old, adapted to periodic fire from human ignition. These are human environments and have been so since most of the ice retreat.

Fire use by aboriginal people in Canada was sophisticated, having developed over thousands of years. They used fire to manage habitat for their important prey species, reducing the effort required for predation. Spring fire in grass greens up fast and retains greenness longer, providing a magnate for bison, elk, deer any other important prey. Fall fire excludes over-winter use as it creates poor hunting opportunities. In Canadian climates, humans would be concerned where to spend the winter and around here, it is assumed they'd shelter where there is some topography to get out of the wind. Setting up for winter camp would be serious as our northern winters are bitter. Fitness required a snug camp with lots of dead wood to chop with stone tools or to snap with moccasins, a fat larder, a tight weatherproof shelter, and many kin to share the load and the long winter nights. Moving was not favourable, as before the horse, everything had to be carried or dragged by the kin group and the dogs. The trained dogs were needed for hunting too and would only be eaten as a last resort. I guess their optimal strategy for fire use should be obvious. Prepare your winter camp in the spring.

For winter camps, good prey habitat in the immediate region of your camp going into the fall would provide biological fitness. Traditional kill sites would best be close by so the energy required to transport prey would be minimized. Energy expended collecting firewood would also be minimized. This means aboriginal wintering grounds would be periodically burned in the spring to ensure a good summer season growth of grass and dead wood for winter. Firing off non-wintering grounds in the fall would exclude game there, leaving you camped on the primary winter habitat created by previous spring burning. In this area, White from Banff believes aboriginals set spring fires up valley into the mountains, then winter camped at tight pinch points at the valley mouths, penning up their winter prey upstream and upwind for easy kills. Bison like humans, don`t like standing around in the winter wind on the Prairies, but took shelter in the rougher Chinook country. To think aboriginal fire use wasn't as sophisticated as this lacks any substantiating evidence, while there is much evidence for discriminating fire use. Lewis, the late world-renowned anthropologist from Edmonton, provides details about this fascinating ecological feature in the local boreal. Other excellent related works you might like to read is Jenness's *Indians of Canada* or Dempsey's books about the local First Nations. You might consult the Smithsonian's *Handbook of North American Indians* too. Aboriginal people did not suffer fire but instead survived and prospered because of fire, shaping the landscape. This all changed with the second wave of colonization, which brought European-based fire practices.

Before I go on, I must recognize lightning as the only other source of Canadian fire, negating volcanism or extra-terrestrial sources. Lightning and lightning fire varies with the fire environment with a distinct seasonal flavour. Although lightning can occur anytime during the year, it really starts-up in the spring

when the land begins to flush. In fact, research by Hogg and others from Edmonton, shows how plant phenology plays a role in lightning occurrence. The land flushes and the lightning begins, boosted by the moisture feed from transpiration. The grass and aspen quickly become fire proof and the conifer foliage moistures spikes once the convective season is well underway. Early lightning before the flush can result in extreme fire behavior with high spread rates and large area burned. Chroseiwicz from Edmonton and Van Wagner from Deep River show that conifer foliar moisture is lowest at the spring dip, allowing easier crowning. Spring ground and surface fuel moisture would be high relative to later in the fire season, except in the case of multi-seasonal drought, which would occasionally allow severe fires in terms of ground and surface fuel consumption even in the spring. Big early season lightning fires happen and these "early" seasons can sometimes persist into the summer due to something I call the phenological foul-up. Cool spring temperatures retards green-up, and relatively cured fuels can be plentiful through June due to cold and dry climatic conditions. Lightning likes to hit conifers over hardwoods and favours older stands too, producing the big blow-ups that characterise Alberta's boreal, as Krawchuk and others from Edmonton showed. In northern Alberta, you're in the heart of early season lightning bust country, with the northwest boreal figuring prominently in big fire events nationally. Upstream the Rockies create a completely different environment. There's lots of summer lightning in their lee in the Foothills, but it's usually wet or golf balls. They even spray here for golf ball control. Lightning fire is rare as you proceed into the front and main ranges, then sharply spikes across the Divide into BC. Wierzchowski from Calgary and others show the lee of the Rockies get lots of lightning and little fire from it, while BC gets way less lightning and way more fire. There's tighter lightning fire hotspots too, areas treated to frequent lightning fire. They're created by local variations in topography and differential moisture features across the landscape. Powell from Edmonton showed the presence of deep valley bottom inversions and mid-slope thermal belts during big high-pressure ridges. The pattern of lightning fire varies through time and space but I can't see why historical patterns of lightning should be too much different from the pattern over thousands of years. Locally, this would be especially true east of the Divide, where lightning fire is so rare. The only thing different with the fire environment is absence of intentional burning, which abruptly halted, beginning some hundreds of years ago. The current fire environment is ignition limited. The initial blow came with the new diseases brought over by the European invasion. Aboriginal populations were decimated and their adaptive pattern of land use in rapid decline, finally ending with the Treaties and Reserves. As expected, the rate of burning declined according to some local evidence.

Using dendrochronology, fire events can be determined going back hundreds of years. Around here, fire history has seen a real focus due to the research of Johnson from Calgary. His work and prior work by Hawkes occurred in the Kananaskis, spurring other local jurisdictions to look at their own fire histories. White, Rogeau, Masters, Tande, Tymstra and others completed this research on neighboring lands. Van Wagner and others looked at these fire histories from seven contiguous parks on both sides of the Divide. Seven centuries of time since fire data showed a landscape that supported a 60-70 yr fire cycle for nearly five centuries before 1760, abruptly changing to about 175 yr fire cycle until 1940. Since then, fire activity has continued to decrease with increased fire protection, variable fire climate, and no aboriginal fire. This reality led to recent attempts at fire reintroduction and loosened reins on lightning fires. Evidence from further afield in the boreal is also supportive for evidence of declining burning rates.

Larsen and others from Calgary studied the history of fire in Wood Buffalo NP using techniques from palaeoecology and dendrochronology. An eight century fossil pollen and charcoal sediment record from Rainbow Lakes, just down the road from the old park fire base at Pine Lake, provided evidence of at least 12 local large fires, with an average interval between fires of about 70 years. A park wide denchronology study showed a temporal break around 1860, when the fire cycle decreased from 38 years to 63 years. Park fire reports from 1950 to 2007 show a recent cycle of 88 years, more than halving the burning rate since 1860. In Prince Albert NP Saskatchewan, Weir and others developed a high resolution dendrochronological fire record showed a similar shift in the fire cycle but thirty years later in 1890. Incredibly, the northern half of the park supported a fire cycle of 15 years before 1890, decreasing to 75 years for 1890-1945. Post WWII fire activity continued to taper there too until the last decade or so, when large lightning fires busted loose. I guess modern protection is winning the war on fire. Think of the potential carbon credits!

Amiro and others from Edmonton studied the effect of fire on the carbon budget, using a half century record of both fossil fuel and forest fire contributions. Comparing this to Canadian portion of the well-known hockey stick, they showed annual forest fire carbon emissions occasionally approach those from fossil fuel burning because of large fire seasons. This feature is interesting to me in light of the drastically reduced burning rates that local fire histories show. Amiro and others also showed that following fire in the boreal plains of Alberta, net primary production (carbon uptake) triples in the first twenty to thirty years following fire then levels off. This seems oddly similar to the pre-European colonization fire cycles, and I wonder whether the now ignition limited biota isn't adapted to these higher burn rates than we see in the modern record. Besides the extinction of aboriginal burning, fire protection must play a role in observed increase in fire cycles.

Murphy from Edmonton wrote the book *History of Forest and Prairie Fire Control Policy in Alberta*, tracing organized protection from its initiation more than a century ago to the beginning of the information age in the 1980's. White's book *Wildland Fires in Banff National Park 1880-1980*, also includes local fire protection history, while Pyne's book *Awful Splendour: a Fire History of Canada*, offers a coast-to-coast overview through time. All three show how the second wave of colonists quickly adopted technological advancements in attempts to exclude fire from their fixed assets on the land. Initially, there was lots of firing by the immigrants in their attempts to clear land for agriculture and other activities like mineral prospecting. Legally speaking, this ended with the scare from the 1910 flare-up, with the mechanization, communication technology, and organizational advancements from the First War quickly applied to fire protection activities. The 1930 transfer of natural resources to the provinces resulted in the creation of provincial fire control organizations, along with the federal government who administered fire protection on their lands and conducted research. By the early 1980's, fire protection was in the hands of 10 provinces, two territories looking at devolving, and the federal government. This Dirty Dozen have pretty much shaped fire management across Canadian landscapes since then.

The mayhem I listened to my rookie season, as well the events during the previous two seasons, prompted the Dirty Dozen to get together to begin to build a unified approach to fire, without relinquishing individual agency command, as is typical Canadian fashion. The Mutual Aid Resource

Sharing agreement – MARS was signed off, creating the Canadian Interagency Forest Fire Centre to facilitate resource sharing coast to coast. Fire control went mobile and fire technology took off with the dawn of the information age. Fire was something to systematically eliminate from the Canadian landscape and every new tool useful to this campaign was brought to bear on the problem. Computers brought information of every conceivable fashion to the fight, along with all the latest advancements in hardware adopted from military and industrial applications. Land, sea, air and space, fire got it all. Fire fighters trained to national standards, able to use all the intelligence and weaponry available to the fight. Organizationally, the Dirty Dozen adopted a single organizational command and control model, able to exchange people like spares for the ship, all singing from the same song sheet. Canada created this professional fire management service in the last 30 years, able for export nationally and internationally. The tactics and strategies to control fire have also evolved within this period.

Direct attack has been the preferred option for fire control during my career. With speed and hitting power, initiating fires can be hammered before they spread. They all can't be caught during extreme events though, allowing relatively few fires to account for most of the area burned. Fire protection efforts in the last 30 years has focussed on reducing these escaped fires through enhanced monitoring and prediction of the fire environment for preparedness purposes, allowing more focused control operations. Monitoring advancements include remote automatic networks for fire danger, lightning and fire detection. Complex models now accurately predict fire spread across variable fuel, weather and topographic landscape features. This is just the fire intelligence side of fire exclusion attempts, but you all can imagine the rest of the mobilized resources, all working together in a concerted attempt to exterminate fire. Today, direct attack continues as champion for fire control, although there are some interesting twists.

Fire control concepts have always allowed for losing some ground when direct attack fails to check the spreading fire. For instance, fire is intentionally used during parallel or indirect attack, allowing control forces to back off, firing fuels between the spreading fire and anchors when under the gun. These counter firing operations are effective in restricting spread in many cases but they need to be backed up with strong anchor points and adequate resources to ensure control. Like direct control success though, fires continue to escape during extreme events. Is fire control attainable and if so, at what cost? Prescribed fire provides an interesting opportunity for both fire ecology and fire protection.

Perhaps the most indirect form of fire control is the use of prescribed fire. Here, strong anchor points are selected, undergo further strengthening through some sort of fuels modification and then they're blacklined with fire. Guard blacklining is best conducted during periods of fire danger that ensure control without affecting desired fire effects from the physical features of the fire behavior. These physical features include fuel removal, scorch height, and other measures of fire severity. Ecologically, these features may be tied to desired effects on the biota. Fire control is not compromised during prescribed fire, but rather is enhanced as the intentional use of fire picks the time and place of burning, allowing the most advanced preparedness. This is the theory and there are numerous examples from Canada where prescribed fire has been used with incredible success. The challenges for fire use are many and as Pengelly from Banff once mentioned for me to repeat to the American Interior Secretary Babbitt, the reason prescribed fire is scarce is due to fear, ignorance, apathy and greed.

The fear of losing a prescribed fire is real. European colonization brought European laws and no matter how well you have your cow penned up, if it gets away and damages another person's property, it's your fault. Fearful of losing prescribed fire, most agencies are uncomfortable with the torch, except during emergencies. Various agency administrators assume responsibility, even though they may lack sound operational knowledge of fire use. The rise of fire professionalism in Canada makes things even more difficult, as the fire service and the land managers are often isolated by bureaucratic organizational models. Then there's the public they serve, who are often completely ignorant of fire in their environments or have special interests in opposition to fire use. It should be readily apparent why there aren't more prescribed fires in Canada. This lack of intentional fire has led to further developments in fire protection faced with a problem that just won't go away. The landscape seems to have born to burn, and to burn at rate that is becoming increasingly alarming.

In the last decade, at least, large landscape fire events in North America have occurred with increasing frequency. It's assumed this is due to variation in the fire environments fuel and weather components, as topography has remained static (except Mt. St. Helens). These large landscape fire events have occurred across the country with their control attempts dependent on large, costly suppression organizations. The fire fight relies on the full milieu of resources from tanked up jets, heavy lift helicopters, regiments of dozers, battalions of fire fighters, and the rest of the nightmare that goes with a campaign fire, including the torch. In fact, when faced with the nightmare, fire professionals have increasingly gone to the torch during attempts for control. Fire guards once installed, are treated with a nice clean burn and any unburned pockets cleaned up to prevent post spread event flare-ups. There's the Hail Mary's too, when burning is conducted against fuel and topographic irregularities in attempts to slow the spreading Beast.

For fixed assets, Fire Smart techniques are being used in attempts to reduce fire damage. Fuel manipulation is the primary target, along with improvements to structural fire resistance, human ingress and egress corridors, and control of ignition sources. Occasionally, fuel manipulation is followed closely by prescribed fire, which may be construed as fire smarter, as the assets are not left to being run at by fire, but instead see fire backing off from them. This type of operation requires comprehensive understanding by those affected, and not only be affected by the flame front, but also by smoke production.

Carbon, global warming, and smoke from forest fires figure prominently in this new millenniums challenge for landscape fire management. Smoke is bad for humans for sure, but in environments prone to smoke production, what are the options? Smoke production is closely tied to fuel moisture while dispersion is more concerned with atmospheric properties. Spring fires flash off the fine fuels, producing a big blast of smoke but have lower ground and surface fuel combustion than summer or fall season fires, often producing less smoke in the long run. Summer high-pressure ridges impede venting, while spring seasonal flow patterns may enhance dispersion. Smoke is inevitable with fire, but choices can be made. Prescribing fire allows some control in smoke production and dispersion features. In other words, fire use can provide smoke control where wildfire can't. Despite these positive operational, social and ecological aspects of fire use, fire remains way under prescribed across Canada. So far this season, less than 4000 hectares have been treated to prescribed fire, while over 1.9 million

hectares have been burned by wildfire. It seems the current Canadian strategy is that the landscape will be treated to only accidents, arson or lightning with little or no intentional fire. This is risky and it's been getting riskier as fixed assets and fuel both increase. Throw in some climatic variability and you've got all the ingredients for a wreck, coast-to-coast. Moreover, the big wreck is way over due based on our understanding of fire history. The solution to modern fire protection challenges is fire use, and the way to fire use is through community involvement.

When the Dirty Dozen got together they left out the community level of governance. This did a few things. First, it left the municipalities' way behind in terms of joint training, fire intelligence, communications, standardization and resource sharing offered to the signatories of the MARS agreement. Many municipal departments in Canada are rural, composed of community volunteers isolated from the larger pool of professional partners. This is especially evident on the Prairies and adjacent parkland areas, where the volunteer departments struggle to understand basic fire management concepts of fire danger rating and fire behavior prediction. Landscape fire management requires community understanding, involvement and support. It seems the simplest way to do this would be for the Dirty Dozen to recognize the municipalities, opening up their membership and ridding themselves of that unlucky number. Fire management could become local instead of the *Pro's from Dover* approach now taken by many agencies, where specialists drop in temporarily in an attempt to solve immediate problems and then disappear. Wouldn't it be better to have the local people participating in the protection of their fixed assets, relying on increased understanding and support at the community level, while backing them with the full weight of the Canadian fire machine?

The larger landscape is another dilemma. Here there are two choices, wild or prescribed? I think the old style fire corridors, maintained by periodic fire, could offer a modern solution. Fire was once used to ease travel in forested landscapes, maintaining and clearing these routes. Fire corridors were generally located along riparian areas and other edge habitat, which could be considered relative barriers to fire spread, as frequent firing favours grass, shrubs, hardwoods and other species that regenerate through sprouting. Firing off against snow in the shaded conifers early in certain springs allows control within the corridors, with timing related to snowmelt key. Prairie-like environments made it a long way down the Peace here in Alberta and I feel we all understand how they got there. These old corridors could be rejuvenated and used to control large spread events occurring later during the summer lightning season.

Fire could thus be used to protect fixed assets and also to manage landscape spread events but for this to happen, it would take a sea change in current practices. Improved partnerships at the community level with the current Canadian fire establishment would be the first step. Information technology would ease the dialogue between the professional practitioners and their engaged and informed publics, allowing communities to build their own fire management plans, participate in their implementation and evaluate their effectiveness. The fire professionals of the future need to give fire back to the people. To go public today means full disclosure of all that relates to past, present and future fire, coast to coast. With an engaged public, knowledgeable of local fire regimes, control would be enhanced. Active fire management would also allow perpetuation of the Canadian biota that is biologically adapted to frequent fire. Share the flame!