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THE SFM NETWORK NEWSLETTER
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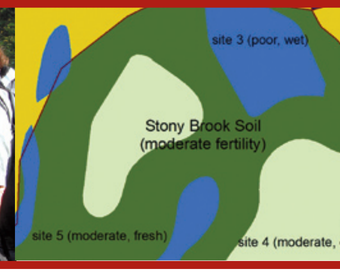

The Importance of Mixed Canopies for Boreal Understory Communities

by Virginia Chávez and S. Ellen Macdonald

A distinctive characteristic of the southern portion of the Canadian boreal forest is the dominance of mesic sites by mixedwood forest stands. Their maintenance in the landscape is an important component in the management and conservation of the boreal forest.

Mature boreal mixedwood stands comprise a mosaic of mono-dominant and mixed patches of conifer (mostly white spruce) and broadleaf (mostly trembling aspen) as well as canopy gaps. This canopy mixture has been associated with greater timber productivity than 'pure' broadleaf or conifer stands and also with higher diversity for several biotic groups, including understory plants.

Understory plant communities fulfill critical ecological roles in boreal ecosystems. They are the most important contributors to overall boreal vegetation diversity, provide habitat for faunal communities, and have economic values for provision of non-timber forest products. Also, understory plants directly and indirectly regulate forest structure by influencing nutrient cycling, competing with tree seedlings at the establishment stage, and modifying micro-climate conditions where tree seedlings grow.

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"Despite the great importance of mixedwood stands and boreal plant communities, we know very little about how the mixture of small canopy patches found within mixed stands affects understory plants," says Virginia Chávez, SFM graduate student at the University of Alberta. Chávez and her supervisor, SFM Network Principal Investigator and University of Alberta researcher Dr. Ellen Macdonald, studied the variation in diversity (number of species) and composition (species identity and relative abundance) of vascular understory species in relation to canopy patch types and their associated structure and environment within natural,

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mature boreal mixedwood forest stands. "Our results indicate that this mosaic of small canopy patch types resembles a 'miniature' boreal mixedwood landscape," Chávez says.

The study showed substantial variation in understory plant communities among small patches (~ 50 m^2) of varying canopy composition (gaps, broadleaf, mixed, conifer). Conifer and mixed patches were more similar in understory composition than broadleaf patches, which mirrored patterns observed among stands of varying composition at the landscape scale. This supports the idea that in a largely aspen-dominated landscape conifers have an important influence on environmental conditions and plant communities in the understory.

In terms of vascular plant diversity, conifer patches had the lowest number of species and broadleaf patches had the highest. There was, however, high variation in community composition among mixedwood patches such that they had, overall, the greatest contribution to total mixed stand diversity. Broadleaf trees created relatively benign conditions of light and nutrient availability, favouring early successional, fast growing forbs and shrubs. Conversely, conifer trees led to lower light and nutrient availability, lessening the number of species but favouring the presence and dominance of later successional understory species that are shade tolerant and low nutrient demanding. When conifer and broadleaf trees cohabited in the proportions seen in mixedwood stands, each patch type created different microhabitat conditions. This allows for the coexistence of both early and late successional understory plants within the same stand, as would be observed at the landscape level among forest stands of different composition stand types.

The results of the study could be applied in the development of regeneration standards to allow for development of natural mixtures following harvest of mixedwood forests. If forest practices and policies favour mono-dominant stand composition, the potential loss of heterogeneity in internal stand structure could have undesirable consequences on the management and conservation of the diverse biotic communities found in mature boreal mixedwood forests.

Further, the results could be useful in planning for patch retention in partial harvesting systems. Large retention patches that include small patches of both conifer and broadleaf trees could help to preserve natural patterns of understory diversity, in turn supporting conservation of associated faunal communities. "The mixture of small canopy patches seems to be quite important to maintaining the natural patterns of understory plants. It likely also underlies diversity of other biota that depend on these plants for food and habitat," states Principal Investigator Ellen Macdonald.

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Left photo: Understory plant communities are the most important contributors to overall boreal vegetation diversity.

Right photo: Understory plants provide food and habitat for faunal communities.

Variable Retention Harvesting and Prescribed Burning as Effective Forest Management Tools for Maintaining Spider Biodiversity

by Jaime Pinzon and John Spence

One of the main objectives of sustainable forestry is to maintain biological diversity. As a consequence, a large body of research has focused on the effects of forest harvesting on charismatic organisms such as grizzly bears, caribou, and a wide variety of birds. However, the largest portion of biodiversity is represented by smaller, often overlooked but nonetheless important creatures such as insects and other invertebrates. Among these, spiders are not only one of the most diverse groups, they also play a key role in the forest. As generalist predators, spiders prey on many other invertebrates, including some pests, which helps to maintain equilibrium in these populations. Spiders are also a main component of the diet of some of those larger vertebrates that are so appealing to conservationists. Thus, by preserving spiders in the landscape, more sustainable forestry is achieved.

Forest management initiatives are being implemented to emulate natural disturbances, such as fire, by leaving features on the landscape that contribute over time to the recovery process following harvesting. Our research is focused on understanding the effects of different harvesting practices on spiders in the boreal forest of northwest Alberta. This will consequently provide management recommendations to the forestry industry on how best to maintain biodiversity.

Variable retention harvesting (dispersed and clumped retention) is used as a management strategy at the landscape level to mimic fire skips (unburned trees and forest patches). "Our studies have revealed that leaving between 10% and 20% of trees in the stand clearly enhances spider diversity as opposed to clear-cutting," Pinzon states. Results suggest it is even more effective if, in addition, clumped patches of trees are left within the matrix. These patches in harvested areas, together with dispersed retention, are maintaining spider assemblages similar to those observed in uncut forests. This mitigates the effects of disturbance and serves as an effective lifeboat for forest specialist species.

Although these results are attractive, we believe that variable retention harvesting is missing some of the actual effects of fire. Results from previous research have shown that spiders are highly influenced by the main cover type, observing large differences between deciduous, mixed, and conifer stands. Once these forests are disturbed, either by harvesting or prescribed burning, spider species composition is largely homogenized. This allows the colonization of open habitat specialists like wolf spiders. "In the short term, harvesting seems to mimic some of the effects of fire," says Pinzon. "However, as the forest recovers, spider composition in burned sites begins to diverge from harvested sites, implying that some habitat requirements left after fire are lost after harvesting."

Our overall results suggest that harvesting practices alone, even those relevant in a conservation context, do not fully emulate the effects of fire. To effectively manage the boreal forest, the disturbance this ecosystem depends on is needed to maintain structural features not kept by harvesting strategies. Variable retention together with prescribed burning practices are important management tools in maintaining some of the legacies only left after fire. These are necessary to maintain habitat heterogeneity and enhance spider diversity, improving the potential for more sustainable forest management.

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Refining Detail of Forest Site Classification for the Fundy Model Forest in New Brunswick

by Jeanne Moore, MScF candidate

The diversity of soil associations in the Fundy Model Forest in southern New Brunswick, derived from complex formations of bedrock and tills, has created a wide variation of local site conditions. New initiatives in forest management practices have led to a re-examination of current site classification information to predict conditions at high geospatial resolution (5 to 10 m). Existing soil and site maps (Figure 1) do not give forest managers the desired level of detail with respect to soil richness and moisture, and this lack has hindered their use as base layers for detailed forest operations and ecological management planning.

In this project, a new approach using improved soil mapping and a cartographic depth to water index (DTW) was developed to predict site condition. Using knowledge about the most likely landscape position in which a particular soil is found, and updated topographic and hydrographic information, soil polygon borders were realigned, soil wetness delineated, and site classification assigned. This refinement marks a change from current broad drainage classes, which are used in soil mapping to describe wetness, to a more precise mapping of wetness dependent on terrain (topography) and soil characteristics.

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The DTW delineates the terrain into uplands and wet areas. It indicates the likely depth to water as topography changes next to mapped water features, such as lakes, streams, ponds, pools, swamps, bogs, marshes, creeks, rivers, and shores. The wet areas are delineated into contours that indicate classes of potential depth to water. These represent soil moisture ranging from very poorly drained to rapidly drained conditions (where shallower DTW is generally wet and deeper DTW is dry) (Figure 2).

Soil morphological characteristics were the focus of soil classification in terms of nutrient richness. A richness index was calculated based on six properties: lithology, mode of deposition of parent material, texture of soil, texture of parent material, depth to contrasting soil layer, and coarse fragment content (volumetric %). Individual values for this index were then combined with values for soil moisture (classes of DTW) and used to map soil fertility conditions (site index).

The new site index map (Figure 3) gives a more intimate look at the landscape. It provides knowledge at a glance about wet, dry, poor, and rich conditions, and combinations thereof, at high resolution (10m).

The wet areas mapping developed at the University of New Brunswick has many practical applications in land use planning. It is being used extensively in various resource management departments within the government of Alberta. In New Brunswick, forest managers in the Department of Natural Resources have incorporated the DTW and new site classification mapping for forest stratification, growth and yield estimation, and evaluation of site-specific management plans and prescriptions, including ecological planning.

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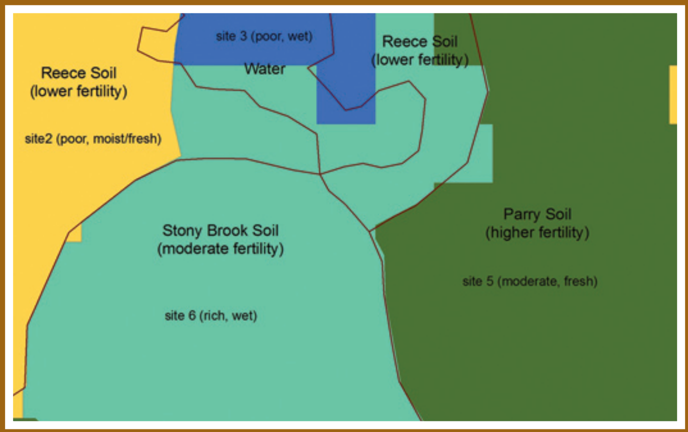

Figure 1. Current site mapping is based on broad drainage classes to indicate soil wetness and richness, lacking detail.

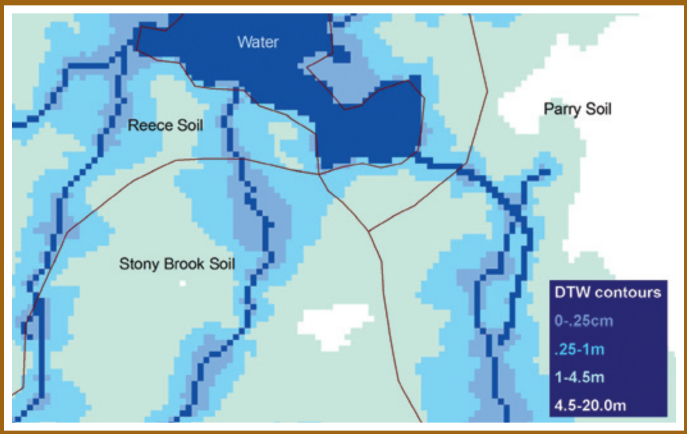

Figure 2. Cartographic depth to water index (DTW). Colours represent classes of depth to water and indicate slope, with deeper DTW associated with greater slope.

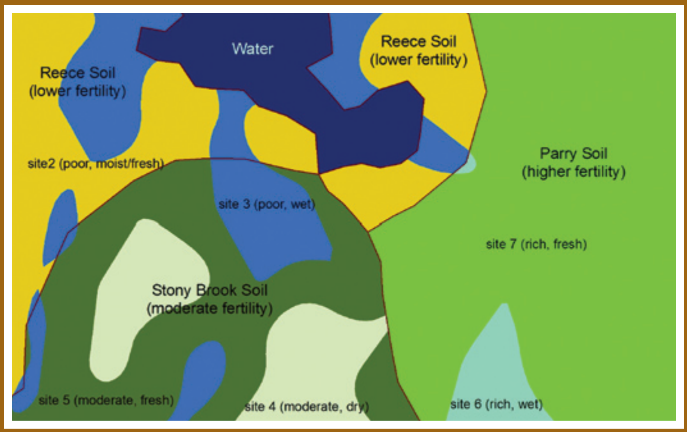

Figure 3. New site index map delineating soils and site classes based on the DTW.

Keekeenuhwuhcheecheekun *Reading the Signs*:

Constructing a Cultural Landscape Framework for Cheekahnahwaydahmungk Keetahkeemeenaan *Keeping the Land* in the Whitefeather Forest

by Janene Shearer, Iain Davidson-Hunt, Alex Peters, Paddy Peters and PFN Elders' Council of Pikangikum First Nation,
Whitefeather Forest Management Corporation

Cultural landscapes have become a useful concept in the realm of natural resources management, exemplifying the key elements of the field: environment, people, and perceptions. Criteria and indicators (C&I) have also become increasingly important as a tool for assessing sustainability. Currently, the development of local-level C&I are at the forefront of this discipline. Yet recent literature illustrates that C&I frameworks continue to be entrenched in values of dominant society rather than being grounded in local values to achieve community-based cultural landscape management goals.

Keekeenuhwuhcheecheekun "Reading the Signs" is a cooperative research project undertaken between the Whitefeather Forest Management Corporation of Pikangikum First Nation and the Natural Resources Institute of the University of Manitoba. The methodology included a review of narratives gathered through the Whitefeather Forest community-based land use planning process, collaboration with community research partner Paddy Peters, and workshops with community Elders. Approached from a cooperative learning perspective, the research was participatory and iterative in nature. This allowed for the co-production of knowledge (i.e. the cultural landscape framework) and the development of shared understandings of the values and institutions for *Keeping the Land*.

"This unique strategic plan represents the community's efforts to ensure that their stewardship and customary use of the land is maintained as they invite more economic development to occur in their ancestral territory," says Principal Investigator Iain Davidson-Hunt, "The document provides a framework that the community can use as a cross check to ensure it is staying on the right track." (See www.whitefeatherforest.com)

In a 2007 paper by Davidson-Hunt and O'Flaherty, the term co-production was used to emphasize the process by which actors come together to produce new knowledge about a subject. This research documented the *process* by which a framework was developed to assess the outcomes of human practices on the land through an interaction amongst community and university researchers.

The resulting cultural landscape framework serves to 1) communicate Pikangikum concepts for *Keeping the Land* in a cross-cultural setting and 2) assess and monitor the outcomes of human practices on the land (i.e. a local-level approach to criteria and indicators). The results serve to reaffirm Pikangikum values and customary approaches for *Keeping the Land*. This enables Pikangikum First Nation to mobilize their own knowledge by contributing to an emerging forest management paradigm that recognizes local values as valid indicators in sustainability monitoring.

References:
Davidson-Hunt, I. J., and R. M. O'Flaherty. 2007. Indigenous peoples, researchers and place-based learning communities. *Society and Natural Resources*, 20:291–305.

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Left: Oliver Hill, Elder Advisor to WFMC and Iain Davidson-Hunt.
Right: Pikangikum Elder and visionary, the late Jake Keesic.

Insect damage: Can we predict how much will occur? Should we control? If yes, then where?

by Javed Iqbal, Ph.D. candidate and Dr. David A. MacLean

Insects are the most damaging agents in our forests, especially in eastern Canada. Defoliators like spruce budworm, hemlock looper, balsam fir sawfly, and forest tent caterpillar are among the most serious, in terms of their reduction of tree growth and survival. But how much damage will occur to our individual trees and forests as a whole? How accurate are our predictions of outbreaks and impacts, and how much uncertainty is there? What actions can alleviate or minimize these effects?

Questions like these are on the minds of forest managers facing insect outbreaks. In order to address them and determine the inherent complexities involved with a dynamic insect-tree system, a Decision Support System (DSS) was built for spruce budworm. This has proved to be a useful tool in synthesizing knowledge about the effects of spruce budworm outbreaks on forests and maximizing the benefits of control programs using the biological insecticide *Bt*. Unfortunately, no such DSS is available for other important insects in eastern Canada.

The objectives of this research are twofold: 1) to address similar questions for other insects, such as hemlock looper and balsam fir sawfly, using the existing spruce budworm DSS framework; and 2) to improve the DSS by incorporating measures of uncertainty and future defoliation prediction.

Balsam fir is the primary host species for spruce budworm, balsam fir sawfly, and hemlock looper, but interestingly the feeding pattern differs. Spruce budworm feeds largely on current-year foliage, balsam fir sawfly feeds on all age classes except the current year, and hemlock looper feeds on all age classes of foliage. This feeding difference as well as the variation in duration and severity of outbreaks results in different patterns of damage to the forest by the three insects. The research involves quantifying and modeling these differences in growth reduction and mortality caused by these insects to increase our understanding of balsam fir response to defoliation.

Every year, aerial defoliation surveys are used to detect the area and level of damage. In order to provide foliage loss data to the DSS, this research has established a link between the severity of defoliation over multiple years, measured from aerial defoliation surveys and amount of defoliation over trees per age class of foliage. Using permanent sample plots in Newfoundland, field work has quantified growth and mortality impacts for hemlock looper and balsam fir sawfly under different defoliation patterns, while also assessing variability and causes of uncertainty.

An important element in designing an insecticide control program is the prediction of future defoliation, especially in the upcoming year. Current practices involve an egg-count survey and hand-drawn maps. To improve this process, a Bayesian network model has been created for this project, based on consultation with field experts. Such a model, once linked with forest inventory data, can be used by forest managers to accurately map future defoliation predictions, while automating the whole process of prediction. Through collection of the necessary information and development of DSS frameworks, we will be able to answer questions that have long been unaddressed. The software program is expected to be available for professional use by summer 2010.

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The forests of Canada will maintain their extent, diversity and ecological vitality and be managed in a manner that will provide for the broad social, cultural and economic needs of all Canadians.

Mission

The Sustainable Forest Management Network is a national partnership in research and training excellence. Its mission is to deliver an internationally recognized, interdisciplinary program that undertakes relevant university-based research. It will develop networks of researchers, industry, government and First Nations partners, and offer innovative approaches to knowledge transfer. The Network will train scientists and advanced practitioners to meet the challenges of modern natural resource management.

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