Interim Progress Report on the EMEND Project

(Unpublished)

1 January 2004 – 30 September 2004

John Spence[1], Jason Edwards[1], Charlene Hahn[1], Jan Volney[2]

[1]Department of Renewable Resources
University of Alberta, Edmonton, Alberta

[2]Northern Forestry Centre
Canadian Forestry Service, Edmonton, Alberta

Contents

Appendices

1. Overview of EMEND Research 2004.

There are two principal components to field research at the EMEND site: 1) collection of experiment-wide or "Core" data, done primarily by the centralized research group ("Core Crew"), as required to ensure that comparisons of all treatments can be made over all 4 forest types; and 2) research planned and executed by researchers interested in using EMEND as a template for their work. Work done under category 2 is comprised mostly of projects by graduate students and by research scientists interested in questions other than the experiment-wide questions addressed in the core research. Support provided by FRIAA is aimed mainly at the Core work although limited financial support is provided for category 2 projects through i) Core Crew assistance to individual projects (Table 2), ii) provision of the majority of camp costs, and iii) a number of small top-up grants for researchers working at EMEND to encourage a full research profile. FRIAA support is the essential basis for the experiment-wide work at EMEND but it also encourages an extensive range of category 2 work at our site.

This report provides details on the research activities of the EMEND Summer Core Crew and the EMEND camp facilities for the period 1 May 2004 through 31 August 2004. Additionally, information is provided about new research commenced this summer and updates are provided for a number of technology transfer activities.

2. Core Crew Activities (1 May 2004 – 31 August 2004).

The Summer Core Crew worked a total of 514 person-days at the EMEND site during 2004. This time was spread among several activities including site orientation, safety training, working on experiment-wide projects, and assisting with category 2 research. Core Crew work allocations are summarized in Tables 1 and 2. The following three sections of this report describe Core Crew activity for summer 2004.

2.1. Experiment-wide (Category 1) Projects.

The majority of Core Crew time (approximately 95%) during summer 2004 was spent working on four experiment-wide projects. Summer 2004 marked the fifth year post-harvest assessment period for many Core projects. Below are descriptions of the work completed on these projects. Core Crew 2004 began no new experiment-wide projects.

i) *Understory Vegetation Survey.*

This summer Core Crew spent 189.5 person-days (15 June – 12 August) conducting the fifth year post-harvest understory vegetation survey. The surveys were completed for each of the 600 5m by 5m with nested 2m by 2m plots. Percent ground cover was assessed for all low shrub (less than 1.5m tall), forb, graminoid, moss, and lichen species in the 2m by 2m plots. In each 5m by 5m plot, all tree and tall shrub (over 1.5m tall) species were assessed for percent ground coverage. Both tall and low shrubs were measured for average height. A count of understory tree regeneration was conducted within the 5m by 5m plots. Plant and moss collections are currently being identified by Derek Johnson (Canadian Forest Service). Detailed study methods are provided in Appendix 2 – EMEND Core Study Survey Methods.

ii) Fate of Snags and Dynamics of Coarse Woody Debris (CWD).
This year marked the fifth-year post-harvest survey of coarse woody debris at EMEND. The coarse woody debris study consists of three aspects: a) standing coarse woody debris (snags) assessment, b) downed CWD survey, and c) "nearest neighbor" snag assessment. All three study aspects are combined to help develop an understanding of the fate and function of residual material left in the wake of harvests or natural disturbances, a central focus of the EMEND project. This work is supervised by David Langor and Daryl Williams of CFS.

Downed CWD was re-surveyed on the 600 permanent 40m by 2m plots. Three temporary "star" plots were placed at the same distances (between 0m and 35m) as was randomly selected during the 1999 experiment-wide or the 2003 slash burn downed coarse woody debris surveys. Each star plot consisted of 3 lines, each 5 m long, separated by 120 degrees. The species, diameter, and decay class was recorded for each piece of wood that intersected the lines. Core Crew allocated 78 person-days to the downed coarse woody debris survey.

Although the experiment-wide snag survey was scheduled for this summer, time permitted for only a selected survey. Slash burn compartments were the only blocks surveyed this summer as data on the immediate post-treatment (burn in this case) effects on standing coarse woody debris are required. The snags were surveyed in the existing permanent 10 x 40m plots. All snags existing within these plots were measured and assessed for diameter at breast height, height, decay, and percent bark. Core Crew spent 9.5 person-days on this survey. The complete experiment-wide survey is scheduled for next summer.

A few protocol changes to the coarse woody debris surveys have been made. As of spring 2004, both the nearest neighbor snag survey and the 10 x 40 meter North and East snag plots located at the SW corner of each compartment have been discontinued. Dave Langor, John Spence, and Jan Volney concluded that the six 10 x 40 meter snag plots per compartment sufficiently capture enough detail to accurately assess snag density. Additionally, the exact height of each snag is now measured using hypsometer rather than assigning each snag a general height class. Detailed methods are provided in Appendix 2 – EMEND Core Study Survey Methods.

iii) *Epigaeic Arthropods*
Summer 2004 marked the fifth year post-harvest epigaeic arthropod survey. A total of 685 pitfall traps, six per compartment, were collected every three weeks (each side of the slash burn compartments were considered as one compartment). The six traps in the harvested, control, and standing timber burn compartments were placed according to the year 2000 epigaeic arthropod survey. Traps in the slash burn compartments were located at the start and end of each mensuration plot. The total trap number was down from 702 in the immediate post-harvest survey of 2000 as the traps located in the ellipses of Aspen Dominated compartments were eliminated for the 2004 survey. The installation, collection, and removal of the pitfall traps used 80 person-days of Core Crew time.

iv) *Forest Productivity Estimates.*
The immediate post-disturbance shrub biomass survey was completed for all 64 slash burn compartment plots. All shrubs of 1.00cm or greater diameter at 30cm from base were assessed for height and browsing in the 2 x 10 meter shrub biomass plots. Detailed methods are provided in Appendix 2 – EMEND Core Study Survey Methods. This task consumed 13.5 person-days of Core Crew activity.

v) *Moth Biodiversity.*
Core Crew 2004 was responsible for the collection of moth biodiversity data again this summer. Traps were set up and collected approximately every 10 days, depending on weather, from the first week of June to the end of August. The moth biodiversity study concentrated on the slash burn compartments this year. Due to lack of equipment and personnel time we conducted the survey in the burnt and non-burnt sides of only 4 compartments (8 traps). The compartments were 885, 897, 916, and 958. A total of 11.3 Core Crew person-days were used for the moth biodiversity study.

vi) *Tree Mensuration and Forest Health survey.*
A small number of trees were missed during the mensuration and forest health survey last year. Core Crew 2004 spent 2 person-days collecting data on these trees and correcting mistakes made last year.

2.2. Assistance for Category 2 Research.

About 5.2% (26.5 person-days) of Core Crew time was spent assisting category 2 projects. Time commitments to each project are summarized in Table 2. Below are details of the assistance provided to category 2 research projects by the Core Crew.

i) *Fire Ecology.*
A total of 14.5 person-days were provided to the fire ecology research group due the successful burn of compartment 937 and the slash burns last fall. Pre-burn and post-burn fuel line sampling and depth of burn sampling was completed in compartment 937. Members of the core crew also made detailed observation notes during the burn. Core Crew also completed sampling the post-burn fuel lines in the slash burn compartments.

ii) *Hydrology.*
Core Crew assisted the CFS/ARC hydrology research team (G. Hillman/J. Diwuu) with the collection of hydrologic well data. It took two core personnel approximately 3/4 of a day once every three weeks to collect the data, totaling 6.5 person-days of assistance. Data collection consisted of measuring the depth of water in the 322 wells and piezometers located throughout EMEND Stand 314.

iii) *White Spruce Regeneration Study* (Silviculture research group).
Core Crew assisted the silviculture research group (Jim Stewart, Canadian Forest Service) with white spruce cone crop surveys and silviculture plot microsite evaluations. These tasks used 3 person-days.

iv) *Graduate Student / Postdoctoral Research Assistance.*
Core Crew assistance to graduate students was very limited this summer. Only 2.5 person-days were provided to Colin Bergeron (PhD student, University of Alberta) to aid the collection of his remaining arthropod traps (refer to EMEND interim report 2003 for details of Bergeron's study).

2.3 Other Core Crew Tasks.

In addition to conducting experiment-wide projects and assisting other researchers, Core Crew conducted a number of plot maintenance activities. All mensuration plots from compartments 850 through 909 were re-flagged and painted. Compartments 910 through 961 still require new flagging and paint. These activities were deemed necessary to aid the Core Crew and other researchers navigate within the EMEND compartments and they used about 18 person-days.

Training, orientation, and infrastructure activities also consumed 48.5 person-days this summer. EMEND puts a priority on maintaining a safe worksite. As such, a significant portion of Core Crew time was spent on training activities this summer. Training included site orientation, defensive driving courses, quad certification, bear awareness, mock emergency response drill, and monthly safety meetings. Infrastructure activities included camp set-up/take-down and equipment maintenance.

Over 37 person-days were consumed by office work. Office work tasks included data entry, data validation and verification, and Sustainable Forest Management Network report preparation. Much work remains in this category and it is expected to consume most of the Core data manager's time this fall.

3. EMEND Summer Camp Facilities.

Camp services this summer were provided again by Whitemud Wilderness Outfitters of Peace River, Alberta. Camp was open from 5 May until 31 August. The camp was used for 1155 nights, up 2% from 2004. Overall, 40 EMEND-affiliated personnel (including core crew, researchers, technicians, summer research assistants, and ASRD fire crews) used the camp facilities this summer. Breakdowns of camp usage are provided in Tables 3 and 4. Additionally, a number of people used the camp facilities during technology transfer activities at EMEND (Table 5) and one industry-affiliated group used the camp for 15 nights (billed separate from EMEND at $75 per night/person). Core Crew vehicle usage and camp fuel usage are summarized in Tables 6 and 7 respectively.

4. Core Personnel.

The summer Core Crew positions remain highly sought after by university and college students. This year there were over sixty applications from students in Alberta, British Columbia, Ontario and New Brunswick.

The 2004 Core Crew consisted of 7 personnel (2 full-time positions and 5 summer positions). Jason Edwards served a fourth year as EMEND Field Coordinator and Charlene Hahn carried out her third year as EMEND Data Coordinator. Brian Carabine (University of Alberta), Dan Jensen (University of Alberta), Kendra Marr (University of Alberta), and Matthew Roy (Maritime College of Forest Technology, New Brunswick) served as Core Crew from 1 May until 31 August. Michael Willing was hired on as a full-time Core Crew member from 1 July until 31 August.

EMEND continued its collaboration with the Boreal Forest Research Centre (Northern Alberta Institute of Technology, Peace River Campus) by taking on two local high school students as members of the Core Crew. John Theberge and Kyle Turpin, both of Fairview spent 4 weeks and 6 weeks respectively at EMEND. This collaboration allows EMEND to further its exposure in the local communities.

4.1. EMEND Field Coordinator Activities.

The full-time EMEND Field Coordinator position is currently supported through the EMEND budget. This position is responsible for supervising the summer Core Crew and for the day-to-day administration of the EMEND Project. Approximately 55% of the Coordinator's time from 1 January to 30 September was spent on tasks related to field work. These tasks included supervising the summer Core Crew, managing the field camp use, maintaining field equipment, and conducting field surveys (see details in section 2 of this report). EMEND Project administration consumed 38% of the Coordinator's time from 1 January to 30 September. Administration tasks included meetings, workshops, hiring Core Crew, summer field work preparations, map updates, website updates, report writing, and grant development. The Coordinator spent the remaining 7% of time on identifying moths and butterflies, as well as creating a moth database, for the EMEND Lepidoptera diversity project.

4.2. EMEND Data Manager Activities.

The full-time EMEND Data Manager position is also currently supported through the EMEND budget. The Data Manager is primarily responsible for compiling, sorting, error checking, and proofing all data collected by the summer Core Crew and is also responsible for assisting the Field Coordinator with field surveys, hiring and supervising the summer Core Crew, and organizing the annual EMEND workshop. Approximately 45% of the Data manager's time was committed to this summer's data management tasks and 20% to assisting the Field Coordinator.

At the start of January 2004 much of the 'Core' data collected prior to summer 2002 still contained errors that required correction. Approximately 35% of the Data Manager's time was dedicated to correcting these errors and creating finalized, error-free datasets to be incorporated into the EMEND database. As of April, all core data collected prior to 1 January 2004 has been entered into the database.

5. Research Personnel.

A total of two graduate students conducted fieldwork at EMEND during 2004. Both of these students are new PhD candidates who commenced their theses at EMEND this summer (see New Research below). Many 'first wave' graduate students have successfully defended their theses (see Table 8 for EMEND graduate students status). Josh Jacobs (MSc student) is scheduled to defend his thesis in late September 2004. Four PhD. students, David Shorthouse, Kirsten Hannam, Lucie Jerabkova, and Colin Bergeron, remain active in either the thesis writing or data collection stage of their program.

EMEND is pleased to welcome Dr. Markus Thormann to our research team. Markus is a mycology research scientist with the Canadian Forestry Service. Dr. Timothy Work completed his Post-Doctoral Fellowship in August 2004 and has taken a position at University of Quebec at Montreal. He looks forward to continuing research at EMEND and to strengthening collaboration between EMEND and the SAFE project.

6. New Research.

6.1. Dr. Marcus Thormann (Research Scientist, Canadian Forestry Service)

<u>Impacts of anthropogenic and natural disturbances on the functional biodiversity of soil fungi at the EMEND experimental area.</u>

The boreal forest is a complex ecosystem dominated by coniferous trees, shrubs, herbs, and mosses. These plants form a mosaic of characteristic forest stands influenced by local and regional environmental conditions, including climate and geology. While above ground macroscopic plant communities are the most obvious feature of the boreal forest, microscopic communities and their ecology are much less known and understood. However, these often hidden microscopic communities are primarily responsible for the diversity and distribution of the much more obvious macroscopic plant communities in the landscape.

Fungi are one of the least-understood groups of microorganisms, despite their abundance and the significant roles they play in a variety of ecosystem processes. For example, the majority of fungi decompose organic matter, such as wood, leaves, and roots, by producing a suite of enzymes. Enzyme synthesis capabilities differ among fungi, with some being able to degrade complex plant polymers, including tannins and lignins, and others being able to degrade simpler plant polymers, including sugars, fats, and proteins. Hence, fungi are important in the release of nutrients from organic matter, thereby making these nutrients available to plants for subsequent growth and reproduction. Previous research has shown that the enzymatic "fingerprints" (i.e., the ability to synthesize a suite of different enzymes) differ among individual fungi and entire fungal communities. Hence, these enzymatic fingerprints can be used as an indicator of functional biodiversity. Studies of the functional biodiversity of ecosystems are uncommon but are likely more indicative of ecosystem integrity and health than the more commonly used species biodiversity and richness approaches. For example, a larger functional biodiversity suggests that an ecosystem is more stable, because proportionally more species will be able to react well to environmental disturbances. Conversely, low functional biodiversity suggests that the community as a whole will react poorly to disturbances, because proportionally fewer species will be able to react well to disturbances.

The objectives of the proposed research project are to (1) develop enzymatic fingerprints of four natural forests dominated by different tree species; (2) develop enzymatic fingerprints of each of these forests exposed to different anthropogenic and natural disturbance regimes (fire and timber harvest); and (3) provide management guidelines to industry to minimize the impacts of anthropogenic disturbances on soil fungal communities and ensure the long-term health of forest ecosystems. The approach to characterize the enzymatic, or metabolic, fingerprints of soil fungal communities is based on the BioLog system (http://www.biolog.com/microID.html). This system employs MicroPlates with 95 discrete carbon and nitrogen sources that are used to identify a specific unknown fungus or describe physiological profiles of entire fungal communities (the metabolic fingerprint). This novel technique allows for spatio-temporal qualitative and quantitative analyses of soil microfungal communities and it can be used to assess the functional biodiversity of soil fungi across various ecosystems.

6.2. Richard Caners (PhD Student, University of Alberta)

Bryophyte diversity in response to partial harvesting in a northern mixedwood boreal forest.

Bryophytes (mosses, liverworts and hornworts) constitute an important yet often overlooked component of the plant diversity in northern forests, and are key to a wide variety of ecosystem functions. They influence decomposition and nutrient cycling, the retention of surface moisture, soil temperatures, and the germination success of vascular and other non-vascular plants. The diversity and abundance of bryophytes in forest stands are largely controlled by the number, types, and properties of substrates available for colonization on the forest floor. The accumulation of coarse woody debris in various stages of decay, exposed patches of mineral soil from the uprooting of large trees and small-scale disturbances (eg., microtine rodent activity), and tree bases and woody stems are important surfaces that support bryophytes with different habitat requirements. In addition, bryophyte diversity and abundance are determined by the distances between habitats, habitat longevity and size, and species-specific life strategy. Given that many bryophytes (especially liverworts) are sensitive to habitat change, and that bryophytes are commonly dispersal-limited, the effects of habitat modification through forest harvesting may have long-term implications for the persistence of bryophyte communities over large areas. Forest harvesting and the associated removal of canopy trees may alter the microclimate as well as the availability and characteristics (eg., decay stage, size, species) of substrates important for bryophytes; however, few studies have examined the factors affecting the responses of bryophytes in post-disturbance habitats.

This study will examine the effects of partial harvesting on bryophyte diversity in the mixedwood boreal forests of northern Alberta. Sampling will be conducted at the EMEND (Ecosystem Management Emulating Natural Disturbance) research area (Lower Foothills Ecoregion), in an extensive network of treatment blocks that were experimentally harvested in 1998. The specific objectives of this study are to: i) determine the effects of partial harvesting at various intensities on bryophyte diversity in mixed-coniferous (and possibly coniferous-dominated) forest stands five or more years after harvest; ii) examine the effects of partial canopy removal on the forest floor microenvironment and the abundance, distribution and properties of substrates available for bryophyte colonization; iii) to determine the role of the diaspore bank in the regeneration and re-colonization of bryophytes in post-disturbance (logged) sites; and iv) to characterize the relationship between coarse- and fine-scale environmental gradients, and the associations of bryophyte species at different spatial scales. Results will determine which forest harvest practices maintain bryophyte community diversity and structure, guiding decision-makers in the development of sustainable forest management strategies.

Data collected from the first field season (summer 2004) were from mixedwood forest compartments that were previously experimentally harvested at 10, 50, 75, and 100 percent canopy retention. Species identification, diaspore germination, and processing of soil samples will take place over the 2004-5 academic year. Preliminary data analyses (winter 2005) will guide the direction and scope of subsequent field seasons.

6.3. Virginia Chavez (PhD Student, University of Alberta)

Patterns and causes of variation in understory plant diversity and composition in the mixed-wood boreal forest of Alberta.

The objective of this study is to contribute to the understanding of the patterns and causes of diversity variation in understory plant communities in the mixed-wood boreal forest of Alberta. It addresses (i) the relation between broadleaf, conifer and mixed-wood canopy compositions -as well as canopy gaps- and understory diversity at the small and medium scale; (ii) effect of abiotic factors (macro nutrients, light, temperature, moisture and pH) on understory diversity and composition in relation to canopy composition; (iii) patterns of evenness, richness and diversity; (iv) the effect of plant interactions on understory diversity and composition. This study is being carried out at the mixed-wood dominated control stands of EMEND.

7. Changes to the project design and methodology.

No fundamental changes to the project design and methodology have occurred this year. Of note is that mensuration plot P1 in compartment 922 was relocated due to the slash harvesting operations in compartment 923. This plot is now labelled as P8; all future Core studies should use this plot instead of plot P1 with exception of the understory vegetation study. The 5 x 5 meter understory vegetation plot was re-located to compartment 922 plot P7.

8. Prescribed Fires.

8.1. Standing Timber Burns.

Alberta Sustainable Resource Development personnel successfully burnt compartment 937 on 30 June 2004. After the initial burn and three weeks of smouldering, the fire covered between 60% and 70% of the compartment area. Edwards and Hahn observed the burn to collect data on rate of spread and flame height and to photograph the fire. Peter Bothwell (Canadian Forest Service) is currently analyzing the burn data.

Burn conditions at the EMEND site were monitored continuously by CFS and ASRD personnel throughout the 2004 summer. The weather was not conducive for burning other than on 30 June.

8.2. Slash Burns.

None of the three remaining slash burns (compartments 856, 858, 942) have been attempted to date this year. According to ASRD and CFS personnel the three compartments have enough fuel to burn as soon as an appropriate burn window occurs. ASRD and CFS personnel will monitor burn conditions throughout the fall 2004 and spring 2005.

9. Administrative and Organizational Items.

9.1. Annual EMEND Workshop.

The annual EMEND Workshop was held on 30-31 March 2004 at the Northern Forestry Centre, Edmonton, Alberta. This workshop brings together all the researchers, graduate students, and industry personnel involved in the EMEND project to discuss important matters regarding the EMEND project. The workshop featured in-depth presentations by Daishowa-Marubeni International (DMI) and Canadian Forest Products (Canfor) foresters and numerous EMEND graduate students. Discussions revolved around the question of 'how can EMEND research assist DMI and Canfor with their forest management goals?'. A copy of the workshop program is included in Appendix 3.

9.2. Technology Transfer Activities.

i) EMEND Tours.

Only one official tour was held at EMEND this summer; a number of scientists from British Columbia, Quebec, Sweden, and Finland visited 7-8 June. Hugh Seaton, manager of the Boreal Forest Research Centre, Peace River, visited EMEND on 6 July along with two reporters from Peace River area newspapers. A major tour is planned for 6 October 2004 which will demonstrate the EMEND research site to foresters and researchers attending the Canadian Institute of Forestry/Society of American Foresters joint meeting in Edmonton.

Derek Sidders (Canadian Forest Service) has completed upgrades to the display gazebo and added new posters and displays along the main tour trail. Additionally, he has created two new tour trails, one highlights slash-burn compartment 937 and the other highlights a silviculture plot in compartment 953.

ii) *EMEND Web Site*.

The EMEND website is operated and maintained by EMEND Field Coordinator, Jason Edwards. Updates and new features are being added to the website on a continual basis.

The website continues to be one the project's prominent methods of information distribution. The EMEND website address is as follows: http://www.biology.ualberta.ca/emend/index.htm.

iii) *EMEND Compendium.*
Derek Sidders (Canadian Forest Service) has completed the new EMEND compendium and updated Research and Study Guide. The compendium includes updated project descriptions, summaries of preliminary results, and any other information useful to aid the transfer of technology to EMEND partners. The compendium has been distributed to all funding partners involved with the project. Updates will be distributed on an annual basis.

9.3. EMEND Database Progress.
Brad Tomm continues to compile EMEND data into a comprehensive database. It should be noted that Tomm is a Canadian Forestry Service employee and his time is provided to EMEND with CFS funds. The following is an EMEND Database progress report provide by Tomm.

The primary focus of the EMEND Database is to archive research data collected at the EMEND study area that is easily accessible for analysis and to provide a platform where data summaries, with the permission of the researcher responsible for the data, may be shared amongst fellow researchers. The EMEND Database continues to grow with progress being made in several different areas. A security protocol was implemented in 2003/2004 to allow for multiple users to access certain areas within the database using Microsoft Access or PC SAS. Access for each user is limited to the shared general datasets and those datasets the user is providing data for.

The EMEND Database currently consists of sixteen datasets being contributed by eight researchers. The 'Main Support Information', 'Ecosite Classification', 'Permanent Tree Plot', 'Permanent Shrub Plot', 'Understory Vegetation', 'Coarse Woody Debris', 'Snag Plot', and the 'Nearest Neighbor Snags' datasets have been established and continue to have subsequent survey data added. Metadata for these datasets has been drafted and will be finalized in the winter of 2005. These datasets have compartmental level summaries available to other EMEND researchers. The 'Tree Productivity', 'Shrub Productivity', 'Soil Chemistry', 'Foliage Chemistry', 'Growth and Yield Plots', 'Compartment Tree Age', 'Weather', and 'Hydrology' datasets are currently restricted to the researchers responsible for the data or are still being developed and will be available at a later date. The metadata for these datasets will be written as the datasets are incorporated into the EMEND Database.

External requests for data from the EMEND Database by other EMEND researchers continues to increase as more datasets become available and post-harvest surveys are being completed. At this time there have been fourteen formal requests for data summaries completed from 2002-2004. These data summaries have provided valuable up to date information, in a timely manner, to assist fellow researchers with their individual research projects.

9.4. Peer Reviewed Publications & Theses.

Gilmore, D.W. and C.A. Berger. 2004. White spruce basal area as a predictor of seed rain during an exceptional seed year in northwestern Alberta. *Northwest Science* **78(1):** 75-78.

Hannam, K.D., S.A. Quideau, S.-W. Oh, B.E. Kishchuk and R.E. Wasylishen. 2004. Forest floor composition in aspen- and spruce-dominated stands of the boreal mixedwood forest. Soil Science Society of America Journal **69**: 1735-1743.

Lara Almuedo, Pedro. 2003. *Surface fuel characteristics in boreal forests of north-western Alberta: Practical considerations for prescribed burn implementation*. MFC Thesis Research Paper, University of Toronto. 49 p.

Lindo, Zoe and Suzanne Visser. 2004. Forest floor microarthropod abundance and oribatid mite (Acari: Oribatida) composition following partial and clear-cut harvesting in the mixedwood boreal forest. *Canadian Journal of Forest Research* **34**: 998-1006.

Work, Timothy T., David P. Shorthouse, John R. Spence, W. Jan A. Volney, and David Langor. 2004. Stand composition and structure of the boreal mixedwood and epigaeic arthropods of the Ecosystem Management Emulating Natural Disturbance (EMEND) landbase in northwestern Alberta. *Canadian Journal of Forest Research* **34**: 417–430.

9.5. Talks of Interest and Poster Presentations.

A full listing of EMEND related talks of interest and poster presentations can be found on the EMEND website.

Appendix 1: Tables.

Table 1. Summary of core crew work completed for core (Category 1) research from May 1 – August 31, 2004.

Project	Work Description	Total Number of Person Days of Core Crew Activity	% of Total Category 1 Person Days	% of Total Person Days
Vegetation (Derek Johnson)	- Vegetation assessments all tree plots - Preparation of learning materials for vegetation identification	189.5	38.9	36.9
Fate of Snags and Dynamics of Coarse Woody Debris (CWD) (Dave Langor/Daryl Williams)	- Downed CWD survey in all tree plots - Standing snag assessment in slash burn tree plots	87.5	17.9	17.0
Arthropods (Tim Work/Josh Jacobs)	- Pitfall trap collections in all compartments	80.0	16.4	15.6
Training, Orientation and Infrastructure Activities	- Bear awareness course - Quad safety course - Emergency response training and mock drill - Orientation - Quad maintenance, vehicle maintenance, equipment purchases/maintenance, camp set-up/take-down - Tours of EMEND	48.5	9.9	9.4
Office Work	- Data entry, preparation, verification and corrections - Report preparation	37.3	7.6	7.2
Tree Plot and Compartment Maintenance	- Re-establishing lash burn and standing timber burn tree plots - Re-painting and re-marking tree plots	18.0	3.7	3.5
Forest Productivity Estimates (Jan Volney/John Spence)	- Shrub biomass data collection in slash burn tree plots	13.5	2.8	2.6
Moth Diversity (John Spence)	- Light trap collections	11.3	2.3	2.2
Forest Health and Mensuration (Jan Volney)	- Tree plot mortality study - Tree plot health assessment	2.0	0.4	0.4
	Total:	**487.5**	**100.0**	**94.8**

Table 2. Summary of core crew assistance provided for non-core (Category 2) research from May 1 – August 31, 2004.

Project	Work Description	Total Number of Person Days of Core Crew Activity	% of Total Category 2 Person Days	% of Total Person Days
Fire Ecology (Peter Bothwell)	- Fuel line measurements in slash burn compartments - Observation and documentation of standing timber burn	14.5	54.7	2.8
Hydrology (Cecilia Feng)	- Well and piezometer data collection	6.5	24.5	1.3
Silviculture (Jim Stewart)	- Cone crop assessments - Germinant measurements	3.0	11.3	0.6
Arthropods (Colin Bergeron/Dan Jensen)	- Pitfall trap collections and removal - Window trap collections and removal	2.5	9.4	0.5
	Total :	**26.5**	**100.0**	**5.2**

Table 3. Number of person-days EMEND camp was used by individuals involved in core (Category 1) research from May 4 - August 31, 2004.

Project	Camp User	Affiliation	Title	Number of Days at EMEND Camp				
				May	Jun	Jul	Aug	Total
Core Crew	Carabine, Brian	U of A	Core Crew	19	23	22	22	86
	Edwards, Jason	U of A	Field Coordinator	24	20	20	22	86
	Hahn, Charlene	U of A	Data Manager	19	23	22	23	87
	Jensen, Dan	U of A	Core Crew	19	23	22	22	86
	Marr, Kendra	U of A	Core Crew	24	22	20	22	88
	Roy, Matthew	U of A	Core Crew	24	22	19	22	87
	Theberge, John	Fairview HS	Core Crew	0	0	16	5	21
	Turpin, Kyle	Fairview HS	Core Crew	0	0	20	7	27
	Willing, Mike	U of A	Core Crew	0	0	20	24	44
					Subtotal:			**612**
Vegetation	Johson, Derek	CFS	Researcher	0	9	0	9	18
	Siltanen, Marty	CFS	Technician	0	9	0	0	9
					Subtotal:			**27**
Forest Health	Brett, Roger	CFS	Technician	0	2	0	0	2
	Tomm, Bradley	CFS	Database Manager/ Technician	0	2	0	0	2
					Subtotal:			**4**
				May	**June**	**July**	**Aug**	**Total**
			Category 1 Research Projects - Monthly Totals:	**129**	**133**	**181**	**169**	**643**

Table 4. Number of person-days EMEND camp was used by individuals involved in non-core (category 2) research from May 4 - August 31, 2004.

				Number of Days at EMEND Camp				
Project	**Camp User**	**Affiliation**	**Title**	**May**	**Jun**	**Jul**	**Aug**	**Total**
Hydrology	Diiwu, John	ARC	Researcher	0	3	0	0	3
	Feng, Cecilia	CFS	Researcher	0	3	0	0	3
	Twitchell, Colin	CFS	Technician	0	3	0	0	3
							Subtotal:	**9**
Soils and Nutrient Cycling	Clark, Steve	U of A	Research Assistant	0	0	0	2	2
	Hannam, Kirsten	U of A	Ph.D. Candidate	4	5	0	2	11
	Jerabkova, Lucie	UBC	Ph.D. Candidate	4	5	0	0	9
							Subtotal	**22**
Silviculture	Czan, Maggie	Silviculture	Research Assistant	6	0	0	0	6
	Jones, Travis	Silviculture	Technician	7	2	7	5	21
	Moskalyk, Monique	Silviculture	Research Assistant	7	2	7	9	25
	Snedden, Jessica	Silviculture	Technician	0	0	0	4	4
	Stewart, Jim	Silviculture	Researcher	6	0	0	4	10
	Thorsen, Lori	Silviculture	Research Assistant	1	2	7	9	19
							Subtotal	**85**
Arthropods	Bergeron, Colin	U of A	Ph. D. Candidate	9	7	0	0	16
	Jacobs, Josh	U of A	Technician	0	7	4	6	17
	Mallet, Rob	U of A	Research Assistant	0	0	0	6	6
	Shaughnessy, Brenda	U of A	Research Assistant	9	7	4	6	26
	Work, Tim	U of A	Researcher	4	3	0	0	7
							Subtotal	**72**

Table 4. (Continued)

				Number of Days at EMEND Camp				
Project	**Camp User**	**Affiliation**	**Title**	**May**	**Jun**	**Jul**	**Aug**	**Total**
Vegetation Structure	Caners, Richard	U of A	Ph. D. Candidate	1	22	21	22	66
	Chavez, Virginia	U of A	Ph. D. Candidate	0	17	20	22	59
	Grant, Andrew	U of A	Research Assistant	0	0	0	10	10
	MacDonald, Ellen	U of A	Researcher	0	2	0	0	2
	Presant, Peter	U of A	Technician	3	0	0	10	13
	Quinlan, Crissy	U of A	Research Assistant	1	22	21	22	66
	Sage, Gina	U of A	Research Assistant	3	17	20	22	62
							Subtotal	**278**
Fire	Fire Crews	ASRD		0	17	18	0	35
							Subtotal	**35**
Mycology	Blanchard, Lisa	Mycology	CFS	1	2	0	0	3
	Thormann, Markus	Mycology	CFS	1	2	0	0	3
							Subtotal	**6**
				May	**Jun**	**Jul**	**Aug**	**Total**
	Category 2 Research Projects - Monthly Totals:			**67**	**150**	**129**	**161**	**507**

Table 5. Number of person-days EMEND camp was used by individuals involved in Technology Transfer Activities from May 4 - August 31, 2004.

			Number of Days at EMEND Camp				
Camp User	**Affiliation**	**Title**	**May**	**Jun**	**Jul**	**Aug**	**Total**
Spence, John	U of A	Project Leader	0	1	0	0	1
Volney, Jan	CFS	Project Leader	0	1	0	0	1
Larson, Stig	SLU, Sweden	Researcher	0	1	0	0	1
Friesen, Nathan	Boreal Forest Research Centre (BFRC)	BFRC Summer Student	0	0	1	0	1
Seaton, Hugh	Boreal Forest Research Centre (BFRC)	BFRC Coordinator	0	0	1	0	1
Kuluuvainen, Timo	U Helsinki	Researcher	0	**	0	0	0
Bergeron, Yves	UQAM	Researcher	0	**	0	0	0
Coates, David	BC Forests	Researcher	0	**	0	0	0
Wilson, Kate	Grimshaw newspaper	Reporter	0	0	*	0	0
(?), Kate	Grimshaw newspaper	Reporter	0	0	*	0	0
			May	**Jun**	**Jul**	**Aug**	**Total**
		Technology Transfer - Monthly Totals:	**0**	**3**	**2**	**0**	**5**

* 1 Lunch only
** 1 Lunch and Supper only

Table 6. EMEND Vehicle Usage from 1 May – 31 August 2004.

Vehicle	Total Mileage (km)
Trucks	
U of A #298 (Suburban)	3857
U of A #278 (Truck)	935
Budget Van	8919
Budget Truck	7683
Quads	
Canfor Green	409
Canfor Red	416
DMI Red 350 (Lic.# PJ764)	1601
DMI Red 450 (Lic.# PJ766)	929
DMI Yellow 350 (Lic.# PJ769)	1324
U of A Red 250 (Lic.# PN102)	* Approx. 1500
U of A Red 250 (Lic.# PN103)	* Approx. 1500

* U of A quads do not have odometers.

Table 7. Summary of Camp Fuel Use

Unit	Total fuel (L)
Canfor green	61.5
Canfor red	81.0
Canadian Forest Service[1]	176.5
DMI Green 350	16.5
DMI Red 350	124.5
DMI Red 450	85.5
DMI Yellow	111.5
George Lake Green	32.0
George Lake Red	19.5
UofA Green 250	7.0
UofA PN 102	117.2
UofA PN 103	134.5
Quad Wash Pump	4.0
Ellen Macdonald[2]	254.5
UofA 298	413.0
Grand Total	**1638.7**

[1] All Canadian Forest Service Quads were lumped into one value.
[2] Lumped sum for four quads ran by graduate students of Ellen Macdonald.

Table 8. Status of EMEND graduate students.

Degree Program	Student	Affiliation	Project Title	Project Status
Masters	Berger (nee Becker), Carrie	University of Minnesota	Modeling early regeneration processes in mixed-species forests of Alberta.	Defended Spring 2002
	Cuthbertson, Lisa	University of Alberta	Spatial patterns of *Armillaria*.	Defended 25 September, 2001
	Wesley (nee Dunlop), Julia	University of Alberta	Effects of forest harvesting on spruce beetle parasitoids.	Defended 19 September, 2002
	Fenniak, Treena	University of Alberta	Understory vascular plant regeneration following disturbance.	Defended August 2001
	Frey, Brent	University of Alberta	Effects of forest floor disturbance and canopy removal on soil nutrient dynamics and response of *Calamagrostis canadensis*, *Epilobium angustifolium*, and *Picea glauca* seedlings.	Defended September 2001
	Harrison, Bruce	University of Alberta	Response of boreal forest birds to experimental harvest and burning.	Defended 31 October, 2001
	Jacobs, Josh	University of Alberta	Saproxylic beetles and coarse woody debris.	Defended 29 September, 2004
	Kembel, Steven	University of Alberta	Spatial patterns of boreal canopies, understory communities, and tree regeneration.	Defended September 2001
	Lazaruk, Lance	University of Alberta	The impact of silvicultural practices on the abundance and biodiversity of ectomycorrhizae in a boreal forest ecosystem.	Defended February 2002
	Lindo, Zoë	University of Calgary	Harvesting effects on soil mesofauna and decomposition /nutrient cycling processes in aspen and spruce stands of the boreal mixed-wood forest.	Defended 2003

Table 8 (Continued). Status of EMEND graduate students.

Degree Program	Student	Affiliation	Project Title	Progress
Masters	Martin, René	University of British Columbia	Reproductive responses of bunchberry (*Cornus Canadensis*) to disturbance in a managed forest.	Defended 2000
	Mills, Suzanne	University of Alberta	Distribution of bryophyte species diversity in relation to microsite and moisture availability at 2 scales within conifer dominated boreal forests.	Defended August 2001
	Morneau, Louis	University of Alberta	Lepidoptera diversity following fire and harvesting.	Defended January 2002
	Park, Jane	University of Calgary	Movement and settlement of bark beetles in a heterogeneous landscape.	Defended Summer 2002
	Patriquin, Krista	University of Calgary	Impacts of fire and harvesting on the foraging ecology of forest dwelling bats.	Defended June 2001
Doctoral	Bergeron, Colin	University of Alberta	Effect of fire behavior on dynamic associations of insects and plants at the landscape level.	Data collection
	Caners, Richard	University of Alberta	Bryophyte diversity in response to partial harvesting in a northern mixedwood boreal forest.	Data Collection
	Chavez, Virginia	University of Alberta	Patterns and causes of variation in understory plant diversity and composition in the mixed-wood boreal forest of Alberta.	Data Collection
	Hannam, Kirsten	University of Alberta	Linking changes in the soil microbial community with changes in soil C chemistry following timber harvesting in the boreal mixedwood forests of northwestern Alberta.	Data collection
	Jerabkova, Lucie	University of British Columbia	Nitrogen transformations in boreal mixedwoods.	Data collection
	Shorthouse, David	University of Alberta	Boreal spiders as bioindicators of forest disturbance and management	Writing Thesis

Appendix 2: EMEND Survey Methods.

EMEND Understory Vegetation Survey Methods

Draft Document. Revised: March 4, 2004

Scientific Authority: Derek Johnson
Position: Plant Ecologist - Northern Ecosystems
Address: Canadian Forest Service
Northern Forestry Centre
5320-122 St.
Edmonton, AB
T6H 3S5
Phone: (780) 435-7306
Fax: (780) 435-7359
Email: Derek.Johnson@nrcan.gc.ca

Citation: Derek Johnson (Natural Resources Canada, Canadian Forest Service, Edmonton, Alberta)
EMEND (Ecosystem Management Emulating Natural Disturbances)
Database Understory Vegetation Data Set
Date Issued:

Introduction:

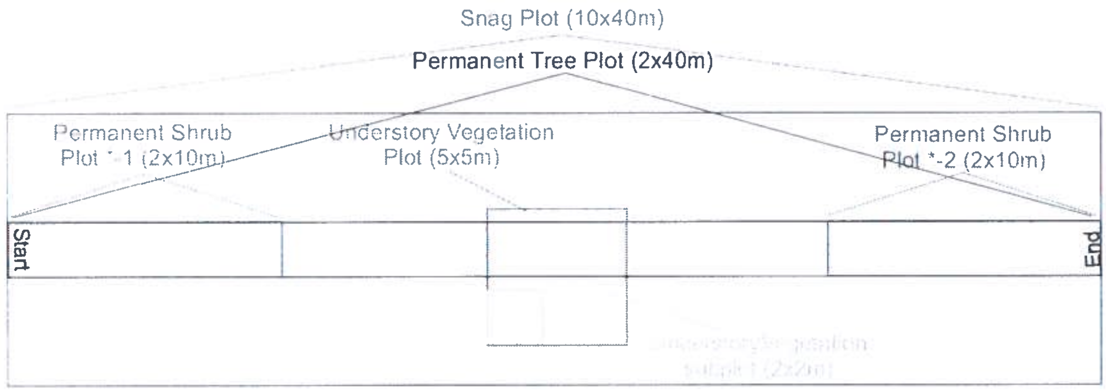
"The goal of the research is to monitor the type, direction and rate of change in the ground vegetation following the various treatments to see if the pattern of change is the same, or if not, what level of tree retention comes closest to emulating the effects of fire" (EMEND Interim Report 1998). A survey to identify the presence and percent cover of vegetation species was conducted at EMEND in each compartment.

Plot Location and Size:

An Understory Vegetation plot was located at the midpoint of each permanent tree plot in a compartment. Therefore, six Understory Vegetation plots measuring 5x5 m were established in each compartment for a total of 600 plots. In 1998, the plots were number 1 – 6, but after the treatments were conducted in the winter of 1998 some plots were destroyed beyond the limits of the prescribed treatment and were therefore replaced. In 1999, plots numbering 7 – 9 were established where required to replace those that were destroyed in order to maintain the six plots per compartment design. The mid-line UTM coordinates for the start and end of each plot was determined in SAS using the coordinates provided for the associated permanent tree plot. The Understory Vegetation plot (measuring 5x5 m) was used to assess the percent cover of trees and tall shrubs. A 2x2 m subplot was nested in the southeast corner of each Understory

Vegetation plot and the percent cover for species belonging to the vegetation strata low shrubs, forbs, graminoids, bryophytes, and lichens were assessed.

Figure 1.



The difficulty in conducting the prescribed "burn" treatments resulting in 14 compartments having their prescribed treatment revised. Each of the designated compartments was split in half, thereby creating two new compartments. From the original compartment, one half was treated with a 10% Residual Slash Harvest and the other half was treated with a 10% Residual Slash/Burn Harvest. Three Understory Vegetation plots were retained or re-established in each of these new compartments.

Understory Vegetation Data Collection:

The percent cover of foliage for each species (Appendix 1) was estimated as follows: 0.1%, 0.5%, 1-20% (to nearest %), and 20%+ (to nearest 5%). Vegetation species were classed into 7 different vegetation strata:

1. Trees (DBH > 5 cm)
2. Tall Shrubs (DBH < 5 cm and Height > 1.5 m)
3. Low Shrubs (DBH < 5 cm and Height < 1.5 m)
4. Graminoids
5. Forbs
6. Bryophytes
7. Lichens

The percent cover for trees and tall shrubs was determined on the 5x5 m Understory Vegetation plot. The percent cover for low shrubs, forbs, graminoids, bryophytes, and lichens was determined on the 2x2 m nested subplot. Species from the low shrubs, forbs, graminoids, bryophytes, and lichens strata that were not assessed on the 2x2 m nested subplot, but were found within the 5x5 m Understory Vegetation plot were recorded in the data with the percent cover as –1% to indicate the presence of the species.

In 1998, a survey of Understory Vegetation was conducted on the compartments that were subjected to the following treatments: control, clear-cut, 50% residual harvest, and burn (medium & high). In 1999, the compartments subjected to 10% residual harvest, 20% residual harvest, 75% residual harvest and burn (high) were assessed. The decision was made to combine the 1998 and 1999 to serve as the pre-treatment baseline, "...because responses of the ground vegetation will require several years" (EMEND Interim Report 1999). The first post-treatment survey was conducted in 2001 on all the compartments. In 2003 the new Slash Burn compartments were survey. Understory Vegetation surveys will continue on a 3 year cycle with the next assessment scheduled for 2004.

Data Quality and Assurance:

The estimate of percent cover for a species is a subjective variable that can be the source of errors depending the individuals collecting the data. Initial viewing of the data from the control sites show an overall decrease in the percent cover in 2001 as compared to 1998. This could possibly be a result of an actual decrease in the percent cover or a sampling error. Analysis of the data collected on the various treatments should be weighed by the change in percent cover from the control compartments.

Reference:

EMEND Interim Report 1998
EMEND Interim Report 1999
EMEND Interim Report 2001
Johnson, D., Kershaw, L., Mackinnon, A., Pojar, J.. 1995. Plants of the Western Boreal Forest & Aspen Parkland. Lone Pine.

Species found on EMEND Understory Vegetation Plots

Species	Common Name	Scientific Name	Vegetation Type
Ambser		Amblystegium serpens	B
Bletri		Blepharostoma trichophyllum	B
Brasal		Brachythecium salebrosum	B
Bravel		Brachythecium velutinum	B
Brycae		Bryum caespiticium	B
Brypse		Bryum pseudotriquetrum	B
Calcor		Calliergon cordifolium	B
Calnee		Calypogeja neesiana	B
Calric		Calliergon richardsonii	B
Calspp		Calypogeja species	B
Camhis		Campylium hispidulum	B
Dicfra		Dicranum fragilifolium	B
Dreadu		Drepanocladus aduncus	B
Funhyg		Funaria hygrometrica	B
Hertur		Herzogiella turfacea	B
Hyppra		Hypnum pratense	B
Isopul		Isopterygium pulchellum	B
Jamaut		Jamesoniella autumnalis	B
Leppyr		Leptobryum pyriforme	B
Leprep		Lepidozia reptans	B
Livspp		Liverwort species	B
Lopgut		Lophozia guttulata	B
Lophet		Lophozia heterocolpos	B
Loplon		Lophozia longidens	B
Lopmin		Lophocolea minor	B
Lopspp		Lophozia species	B
Lopven		Lophozia ventricosa	B
Marpol		Marchantia polymorpha	B
Mylano		Mylia anomala	B
Ortobt		Orthotrichum obtusifolium	B
Ortspe		Orthotrichum speciosum	B
Plaasp		Plagiochila asplenioides	B
Placil		Plagiomnium ciliare	B
Pladen		Plagiothecium denticulatum	B
Plajun		Platydictya jungermannioides	B
Plalae		Plagiothecium laetum	B
Plarep		Platygyrium repens	B
Polstr		Polytrichum strictum	B
Bracol		Brachythecium collinum	B

Species	Common Name	Scientific Name	Vegetation Type
Bryrec		Bryoerythrophyllum recurvirostre	B
Pohcru		Pohlia cruda	B
Splrub		Splachnum rubrum	B
Mossspp	unknown moss species	Unknown moss species	B
Braspp	brachythecium species	Brachythecium species	B
Cerpur	purple horn-toothed moss	Ceratodon purpureus	B
Cliden	common tree moss	Climacium dendroides	B
Dicacu	sharp-leaved cushion moss	Dicranum acutifolium	B
Dicfla	whip fork moss	Dicranum flagellare	B
Dicfus	curly heron's-bill moss	Dicranum fuscescens	B
Dicpol	electric eels	Dicranum ploysetum	B
Dicund	wavy dicranum	Dicranum undulatum	B
Dreunc	hook moss	Drepanocladus uncinatus	B
Eurpul	common beaked moss	Eurhynchium pulchellum	B
Hylspl	stair-step moss	Hylocomium splendens	B
Mnispi	red-mouthed mnium	Mnium spinulosum	B
Oncwah	mountain curved-back moss	Oncophorus waglenbergii	B
Placus	woodsy leafy moss	Plagiomnium cuspidatum	B
Pladru	drummond's leafy moss	Plagiomnium drummondii	B
Plaell	marsh magnificent moss	Plagiomnium ellipticum	B
Plamed	common leafy moss	Plagiomnium medium	B
Plesch	red-stemmed feathermoss	Pleurozium schreberi	B
Pohnut	copper wire moss	Pohlia nutans	B
Polcom	common hair-cap	Polytrichum commune	B
Poljun	juniper moss	Polytrichum juniperinum	B
Pticil	northern naugehyde liverwort	Ptilidium ciliare	B
Pticri	knight's plume	Ptilium crista-castrensis	B
Ptipul	naugehyde liverwort	Ptilidium pulcherrimum	B
Pylpol	stocking moss	Pylaisiella ployantha	B
Rhipse	felt round moss	Rhizomnium pseudopunctatum	B
Sphspp	sphagnum species	Sphagnum species	B
Thurec	hook-leaf fern moss	Thuidium recognitum	B
Tomnit	golden moss	Tomenthypnum nitens	B
Rhytri		Rhytidiadelphus triquetrus	B
Ricmul		Riccardia multifida	B
Sphang		Sphagnum angustifolium	B
Sphwar		Sphagnum warnstorfii	B
Splvas		Splachnum vasculosum	B
Tetpel		Tetraphis pellucida	B

Species	Common Name	Scientific Name	Vegetation Type
Aulpal	tufted moss	Aulacomnium palustre	B
Bramil		Brachythecium mildeanum	B
Brasta		Brachythecium starkei	B
Concon		Conocephalum conicum	B
Dicspp		Dicranum species	B
Helbla		Helodium blandowii	B
Rhigra		Rhizomnium gracile	B
Sphfus		Sphagnum fuscum	B
Arncha		Arnica chamissonis	F
Astalp		Astragalus alpinus	F
Botlun		Botrychium lunaria	F
Botvir		Botrychium virginianum	F
Carpen		Cardamine pensylvanica	F
Cormac		Corallorhiza maculata	F
Epicil		Epilobium ciliatum	F
Epipal		Epilobium palustre	F
Fraves		Fragaria vesca	F
Genama		Gentianella amarella	F
Geuriv		Geum rivale	F
Habvir		Habenaria viridis	F
Hieumb		Hieracium umbellatum	F
Impnol		Impatiens noli-tangere	F
Menarv		Mentha arvensis	F
Pedlab		Pedicularis labradorica	F
Petvit		Petasites vitifolius	F
Potnor		Potentilla norvegica	F
Rangme		Ranunculus gmelinii	F
Ranlap		Ranunculus lapponicus	F
Ranmac		Ranunculus macounii	F
Rubarc		Rubus arcticus	F
Rumocc		Rumex occidentalis	F
Senpau		Senecio pauperculus	F
Siusua		Sium suave	F
Smitri		Smilacina trifolia	F
Solcan		Solidago canadensis	F
Stecal		Stellaria calycantha	F
Stelon		Stellaria longifolia	F
Taroff		Taraxacum officinale	F
Thaspa		Thalictrum sparsiflorum	F
Trihyb		Trifolium hybridum	F
Tripra		Trifolium pratense	F
Urtdio		Urtica dioica	F

Species	Common Name	Scientific Name	Vegetation Type
Viocan		Viola canadensis	F
Anecan		Anemone canadensis	F
Arcuva		Arctostaphylos uva-ursi	F
Chrtet		Chrysosplenium tetrandrum	F
Cirarv		Cirsium arvense	F
Coraur		Corydalis aurea	F
Cretec		Crepis tectorum	F
Drapar		Dracocephalum parviflorum	F
Empnig		Empetrum nigrum	F
Habhyp		Habenaria hyperborea	F
Phafra		Phacelia franklinii	F
Potgra		Potentilla gracilis	F
Trieur		Trientalis europaea	F
Valdio		Valeriana dioica	F
Vioadu		Viola adunca	F
Forbspp	unknown forb species	Unknown forb species	F
Achmil	common yarrow	Achillea millefolium	F
Actrub	red and white baneberry	Actaea rubra	F
Adomos	moschatel	Adoxa moschatellina	F
Aranud	wild sarsaparilla	Aralia nudicaulis	F
Arncor	heart-leaved arnica	Arnica cordifolia	F
Astame	american milk-vetch	Astragalus americanus	F
Astcil	fringed aster	Aster ciliolatus	F
Astcon	showy aster	Aster conspicuus	F
Calbul	fairyslipper	Calypso bulbosa	F
Chriow	golden saxifrage	Chrysosplenium iowense	F
Ciralp	small enchanter's-nightshade	Circaea alpina	F
Corcan	bunchberry	Cornus canadensis	F
Cortri	yellow coralroot	Corallorhiza trifida	F
Delgla	tall larkspur	Delphinium glaucum	F
Distra	fairybells	Disporum trackycarpum	F
Drycar	spinulose shield fern	Dryopteris austriaca	F
Epiang	fireweed	Epilobium angustifolium	F
Equarv	common horsetail	Equisetum arvense	F
Equpra	meadow horsetail	Equisetum pratense	F
Equsci	dwarf scouring-rush	Equisetum scirpoides	F
Equsyl	wood horsetail	Equisetum sylvaticum	F
Fravir	wild strawberry	Fragaria virginiana	F
Galbor	northern bedstraw	Galium boreale	F
Galtri	sweet-scented bedstraw	Galium triflorum	F
Geoliv	northern bastard toadflax	Geocaulon lividum	F
Gerbic	bicknell's geranium	Geranium bicknelli	F

Species	Common Name	Scientific Name	Vegetation Type
Geumac	large leaved avens	Geum macrophyllum	F
Goorep	lesser rattlesnake-plantain	Goodyera repens	F
Gymdry	oak fern	Gymnocarpium dryopteris	F
Habobt	blunt-leaved bog-orchid	Habenaria obtusata	F
Haborb	round-leaved bog-orchid	Habenaria orbiculata	F
Herlan	cow-parsnip	Heracleum lanatum	F
Impcap	spotted touch-me-not	Impatiens capensis	F
Latoch	creamy peavine	Lathyrus ochroleucus	F
Linbor	twinflower	Linnaea borealis	F
Lycann	stiff club-moss	Lycopodium annotinum	F
Lyccom	ground-cedar	Lycopodum complanatum	F
Maican	wild lily-of-the-valley	Maianthemum canadense	F
Merpan	tall bluebells	Mertensia paniculata	F
Mitnud	bishop's-cap	Mitella nuda	F
Moelat	blunt-leaved sandwort	Moehringia lateriflora	F
Monuni	Indian-pipe	Monotrapa uniflora	F
Ortsec	one-sided wintergreen (2 latin names)	Orthilia secunda	F
Osmdep	spreading sweet-cicely	Osmorhiza depauperata	F
Petpal	palmate-leaved coltsfoot	Petasites palmatus	F
Petsag	arrow-leaved coltsfoot	Petasites sagittatus	F
Polacu	jacob's ladder	Polemonium acutiflorum	F
Pyrasa	common pink wintergreen	Pyrola asarifolia	F
Pyrchl	green wintergreen (2 latin names)	Pyrola chlorantha	F
Pyrsec	one-sided wintergreen (2 latin names)	Pyrola secunda	F
Pyrvir	green wintergreen (2 latin names)	Pyrola virens	F
Rubpub	dewberry (running raspberry)	Rubus pubescens	F
Smiste	star-flowered false soloman's-seal	Smilacina stellata	F
Thaven	veiny meadow rue	Thalictrum venulosum	F
Vacvit	bog cranberry	Vaccinium vitis-idaea	F
Vicame	american vetch	Vicia americana	F
Viopal	bog violet	Viola palustris	F
Vioren	kidney-leaved violet	Viola renifolia	F
Aqubre		Aquilegia brevistyla	F
Haldef		Halenia deflexa	F
Oxymic		Oxycoccus microcarpus	F
Ranabo		Ranunculus abortivus	F
Rubcha		Rubus chamaemorus	F

Species	Common Name	Scientific Name	Vegetation Type
Tribor		Trientalis borealis	F
Verame		Veronica americana	F
Agrsca		Agrostis scabra	G
Brocil		Bromus ciliatus	G
Caraen		Carex aenea	G
Carbru		Carex brunnescens	G
Cardew		Carex deweyana	G
Cardis		Carex disperma	G
Carnor		Carex norvegica	G
Carutr		Carex utriculata	G
Carvag		Carex vaginata	G
Poapal		Poa palustris	G
Poapra		Poa pratensis	G
Agrrep		Agropyron repens	G
Becsyz		Beckmannia syzigachne	G
Broine		Bromus inermis	G
Caraur		Carex aenea	G
Cardef		Carex deflexa	G
Carpec		Carex peckii	G
Grasssp	unknown grass species	Unknown grass species	G
Luzpar		Luzula parviflora	G
Agrtra	slender wheat grass	Agropyron trachycaulum	G
Calcan	bluejoint	Calamagrostis canadensis	G
Carspp	sedge species	Carex species	G
Cinlat	drooping wood-reed	Cinna latifolia	G
Elyinn	hairt wild rye	Elymus innovatus	G
Poaspp	bluegrass species	Poa species	G
Schpur	purple oat grass	Schizachne purpurascens	G
Carcon		Carex concinna	G
Carlol		Carex loliacea	G
Glystr		Glyceria striata	G
Clabac		Cladonia bacillaris	L
Clabot		Cladonia botrytes	L
Clacar		Cladonia cariosa	L
Peldid		Peltigera didactyla	L
Lichspp	unknown lichen species	Unknown Lichen species	L
Clamit	yellow reindeer lichen	Cladina mitis	L
Claran	grey reindeer lichen	Cladina rangiferina	L
Claspp	cladonia species	Cladonia species	L
Nepres	nephroma resupinatum	Nephroma resupinatum	L
Pelaph	studded leather lichen	Peltigera aphthosa	L
Pelcan	dog lichen	Peltigera canina	L

Species	Common Name	Scientific Name	Vegetation Type
Peleli	peltigera elisbethae	Peltigera elisabethae	L
Pelmal	boxboard felt lichen	Peltigera malacea	L
Pelnec	peltigera neckeri	Peltigera neckeri	L
Pelneo	finger felt lichen	Peltigera neopolydactyla	L
Biasph		Biatora sphaeroides	L
Ceteri		Cetraria ericetorum	L
Clachl		Cladonia chlorophaea	L
Clacon		Cladonia coniocraea	L
Clacor		Cladonia cornuta	L
Clacri		Cladonia crispata	L
Cladef		Cladonia deformis	L
Clafim		Cladonia fimbriata	L
Clagra		Cladonia gracilis	L
Clamul		Cladonia multiformis	L
Clapyx		Cladonia pyxidata	L
Clasub		Cladonia subulata	L
Icmeri		Icmadophila ericetorum	L
Lepsat		Leptogium saturninum	L
Lepsub		Leptogium subtile	L
Lepter		Leptogium teretiusculum	L
Lobpul		Lobaria pulmonaria	L
Panpez		Pannaria pezizoides	L
Pelret		Peltigera retifoveata	L
Pelsca		Peltigera scabrosa	L
Pelspp		Peltigera species	L
Clacen		Cladonia cenotea	L
Clasca		Cladonia scabriuscula	L
Hypphy		Hypogymnia physodes	L
Parsul		Parmelia sulcata	L
Vulpin		Vulpicida pinastri	L
M	missing data	Missing Data	O
Unk	unknown species	Unkown species	O
Salgla		Salix glauca	S
Salpla		Salix planifolia	S
Alncri	green alder	Alnus crispa	S
Alnrug	mountain alder	Alnus rugosa	S
Alnspp	alder species	Alnus species	S
Alnten	river alder	Alnus tenuifolia	S
Amealn	saskatoon	Amelanchier alnifolia	S
Betgla	bog (scrub) birch	Betula glandulosa	S
Betpum	dwarf (swamp) birch	Betula pumila var. glandulifera	S

Species	Common Name	Scientific Name	Vegetation Type
Corsto	red-osier dogwood	Cornus stolonifera	S
Ledgro	labrador tea	Ledum groenlandicum	S
Londio	twining honeysuckle	Lonicera dioica	S
Loninv	bracted honeysuckle	Lonicera involucrata	S
Ribgla	skunk currant	Ribes glandulosum	S
Ribhud	northern black currant	Ribes hudsonianum	S
Riblac	black gooseberry	Ribes lacustre	S
Riboxy	northern gooseberry	Ribes oxyacanthoides	S
Ribtri	wild red currant	Ribes triste	S
Rosaci	prickly rose	Rosa acicularis	S
Rubida	wild red raspberry	Rubus idaeus	S
Salspp	willow species	Salix species	S
Shecan	Canada buffaloberry	Sherpherdia canadensis	S
Sorsco	western mountain-ash	Sorbus scopulina	S
Symalb	common snowberry	Symphoricarpos albus	S
Vaccae	dwarf blueberry	Vaccinium caespitosum	S
Vibedu	low bush-cranberry	Viburnum edule	S
Salbeb		Salix bebbiana	S
Salmyr		Salix myrtillifolia	S
Salpse		Salix pseudomonticola	S
Salsco		Salix scouleriana	S
Bethyb		Betula hybride species	S
Salarb		Salix arbusculoides	S
.	no trees		T
Abibal	balsam fir	Abies balsamea	T
Betpap	white birch	Betula papyrifera var. papyrifera	T
Conifer	unknown conifer species	Conifer species	T
Larlar	tamarack	Larix laricina	T
Picgla	white spruce	Picea glauca	T
Picmar	black spruce	Picea mariana	T
Picspp	spruce species	Picea species	T
Pinban	jack pine	Pinus banksiana	T
Pincon	lodgepole pine	Pinus contorta var. latifolia	T
Pinspp	pine species	Pinus species	T
Popbal	balsam poplar	Populus balsmifera	T
Popspp	poplar species	Populus species	T
Poptre	trembling aspen	Populus tremuloides	T

Understory Vegetation Field Data Collection Form

ECOSYSTEM MANAGEMENT EMULATING NATURAL DISTURBANCE (EMEND)

Compartment: **Plot:** **Date:** ,2001 **Observers:**
Tagged Tree Numbers: ______________ Standing Dead Trees: Sp. _______ No: ___ Sp. _______ No: ___
2x2 Machine Corridor: On / Off / Edge 2x2 Disturbance Scale: 0 1 2 3 4 5 (by 20% inc.) # Cut Stumps in 5x5
Comments:

Strata	ht(cm)	cov	**Strata Cover**		**Tree Understory** (<5 cm DBH)	spp	ht (cm)	no.
tree (>5cm DBH)		___	grass cover	___	Based on 5 x 5 m plot			
tall shrub (>150 cm)			forb & dwarf shrub cover					
low shrub (<150 cm)			moss cover		>150 cm			
Note: Trees smaller than 5 cm DBH are put into the appropriate shrub strata.			lichen cover	___		___	___	___
					<150 cm	___	___	___
						___	___	___

Cover: + (0.1), 0.5, 1-20 (to nearest %), 20+ to nearest 5 %. This is based on foliage cover. Tree and tall shrub cover based on 5x5 m plot, the rest based on 2x2 m plot. Record low shrub, forb, moss & lichen species found in 5x5 m plot but not found in 2x2 m plot as P (present)(shown as -1 on the data spreadsheets).

Trees LS TS T(%,# Live)
Abi bal ,
Bet pap ___ ___ ___,___
Pic gla ,
Pic mar ,
Pin con ___ ___ ___,___
Pop bal ___ ___ ___,___
Pop tre ,
,

Shrubs **Low** **Tall**
Aln cri
Aln ten
Ame aln ___ ___
Bet pum ___ ___
Cor sto
Led gro
Lon dio
Rib gla
Rib hud
Rib lac ___ ___
Rib oxy ___ ___
Rib tri
Ros aci
Rub ida ___ ___
Sal ___ ___ ___
She can ___ ___
Sym alb
Vac cae ___ ___
Vib edu

Graminoids
Agr tra
Cal can ___
Cin lat
Car
Ely inn ___
Poa
Sch pur ___
___ ___ ___
___ ___ ___

Forbs
Ach mil ___
Act rub
Ara nud
Arn cor ___
Ast ame ___
Ast cil
Ast con
Cal bul
Cir alp ___
Cor can
Cor tri ___
Del gla ___
Dry car
Epi ang
Equ arv ___
Equ pra ___
Equ sci ___
Equ syl ___
Fra vir
Gal bor
Gal tri
Geo liv ___
Goo rep ___
Gym dry
Hab orb ___
Her lan ___
Lat och
Lin bor
Lyc ann ___
Lyc com ___
Mai can ___
Mer pan ___
Mit nud
Moe lat
Mon uni
Osm dep ___
Ort sec ___
Pet pal
Pyr asa
Pyr chl ___
Rub pub
Tha ven
Vac vit
Vic ame ___
Vio ren ___
___ ___ ___
___ ___ ___

Mosses
Amb ser ___
Aul pal ___
Bra spp ___
Cer pur
Cli den
Dic fra
Dic fus ___
Dic pol ___
Dic und
Dre unc ___
Eur pul ___
Hyl spl
Mni spi
Onc wah ___
Pla cus
Pla dru ___
Pla ell ___
Ple sch
Poh nut
Pol com
Pol jun ___
Pti pul ___
Pti cri
Pyl pol ___
Rhi pse ___
Sph ___
Thu rec
Tom nit
___ ___ ___
___ ___ ___

Lichens
Cla mit
Cla spp
Cla ___
Nep res ___
Pel aph ___
Pel can
Pel eli ___
Pel mal
Pel nec
Pel neo
___ ___ ___
___ ___ ___

EMEND Downed Coarse Woody Debris Survey Methods

Draft Document. Revised: March 5, 2004

Scientific Authority: Dr. David Langor
Position: Research Scientist
Address: Canadian Forest Service
Northern Forestry Centre
5320-122 St.
Edmonton, AB
T6H 3S5
Phone: (780) 435-7329
Fax: (780) 435-7359
Email: David.Langor@NRCan.gc.ca

Citation: David Langor (Natural Resources Canada, Canadian Forest Service, Edmonton, Alberta)
EMEND (Ecosystem Management Emulating Natural Disturbances)
Database
Coarse Woody Debris Data Set
Date Issued:

Introduction:

The goal of the research is to monitor the structure and the decay of the downed Coarse Woody Debris (CWD) component of a forest stand when subjected to various harvesting treatments so as to determine which treatment best emulates a natural fire disturbance. CWD is an important aspect of the structure and dynamics of forests. It provides critical wildlife habitat, contributes to nutrient cycling and energy flow, and provides structure for regulating sediment displacement. Insight into the dynamics of CWD will help to understand the impact of proposed experimental treatments on the CWD cycle. A survey to identify the species, diameter (cm) at intersect, and decay class was conducted at EMEND in each compartment.

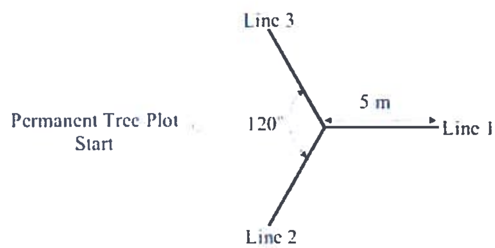
Plot Establishment:

The CWD survey utilizes the six permanent tree plots (measuring 2x40 m) that were randomly located with in each compartment. All permanent tree plots were established in an east-west orientation so that the are perpendicular to the north-south orientated machine corridors. Please refer to the Permanent Tree Plot Survey Methods for a detailed description on how these plots were established.

In 1998, a CWD survey was carried out on the permanent tree plots. A transect line (40 m) was established down the centre of the permanent tree plot. Logs (downed material) that were over 7.0 cm in diameter found inside the plot, as well as snags and stumps (standing material) were all measured in the same pass.

In 1999, a three star-plot system was adopted in place of the single transect line which failed to capture CWD pieces that fell parallel to the transect line. For each survey three temporary star-plots are located along centre line of the permanent tree plot for a total of 18 plots per compartment. Three star-plots are randomly placed at intervals of 0, 5, 10, 15, 20, 25, 30, and 35 meters as measured from the start point of each permanent tree plot except that distances selected will be in 5 meter intervals to avoid overlapping of plot lines. Each star-plot consists of 3 lines (numbered 1 to 3 in a clockwise fashion), 5 meters long, separated by 120° s with line 1 placed along the permanent tree plot center line in the direction away from the permanent tree plot start (Figure 1.).

Figure 1.



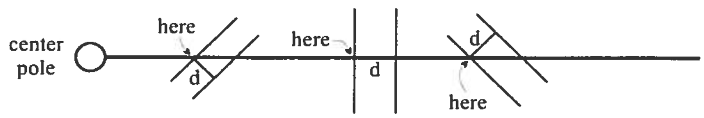
The difficulty in conducting the prescribed "burn" treatments resulting in 14 compartments having their prescribed treatment revised in 2002. Each of the designated compartments was split in half, thereby creating two new compartments. From the original compartment, one half was treated with a 10% Residual Slash Harvest and the other half was treated with a 10% Residual Slash/Burn Harvest. Three permanent tree plots were retained or re-established in each of these new compartments and subsequent CWD surveys will be conducted on these plots.

Coarse Woody Debris Data Collection:

In 1998, each piece of CWD on the permanent tree plot with a diameter of 7.0 cm or greater that intersected the transect line 'A' (the left side plot edge) was assessed for species (Appendix 1), diameter A, and decay class (Appendix 2). In addition, a diameter at the mid point of the length, diameter B, elevation and percent bark retention was also measured. All pieces of CWD found inside the permanent tree plot were also assessed. The additional variables and assessment of all CWD pieces found inside the permanent tree plot were subsequently dropped from other surveys and therefore, not included data set. Diameters shall be measured (to 0.1 cm) at the point where the line first intersects the material, and shall be the true diameter (perpendicular to the long axis of the piece), not the length crossed by the plot line (Figure 2.).

An immediate post-harvest survey of CWD was conducted in 1999 with subsequent surveys being conducted every two years.

Figure 2.



Data Quality and Assurance:

No field program has yet been established to cross-check the quality assurance and control of the data being collected in the field for the Coarse Woody Debris plots. Field data is subjected to a series of SAS validation programs before being incorporated into the EMEND Database.

Equipment Required:

1. 60m tape
2. compass
3. star-plot center pole with 5m cord
4. DBH tape
5. data sheets or data-logger

Reference:

EMEND Interim Report 1998
EMEND Interim Report 1999
EMEND Interim Report 2001

Tree Species Code List

Species	Common Name	Scientific Name	Vegetation Type
.	no trees		T
Abibal	balsam fir	Abies balsamea	T
Alncri	green alder	*Alnus crispa*	S
Alnrug	mountain alder	*Alnus rugosa*	S
Betpap	white birch	*Betula papyrifera var. papyrifera*	T

Species	Common Name	Scientific Name	Vegetation Type
Conifer	unknown conifer species	*Conifer species*	T
Larlar	tamarack	*Larix laricina*	T
Picgla	white spruce	*Picea glauca*	T
Picmar	black spruce	*Picea mariana*	T
Picspp	spruce species	*Picea species*	T
Pinban	jack pine	*Pinus banksiana*	T
Pincon	lodgepole pine	*Pinus contorta var. latifolia*	T
Pinspp	pine species	*Pinus species*	T
Popbal	balsam poplar	*Populus balsmifera*	T
Popspp	poplar species	*Populus species*	T
Poptre	trembling aspen	*Populus tremuloides*	T
Salspp	willow species	*Salix* species	S
Unk	unknown		

Coarse Woody Decay Class Coding

Decay Class	Decay Class Definition
.	Missing.
1	Leaves/Needles few or absent, >20 Limbs (>1m long), 0-10% Stem covered by moss/lichen, <10% Cross-sectional area showing decay, 90-100% Bark cover on stem.
2	Leaves/Needles absent, 5-19 Limbs (>1m long), 11-30% Stem covered by moss/lichen, 10-50% Cross-sectional area showing decay, 60-90% Bark cover on stem.
3	Leaves/Needles absent, <5 Limbs (>1m long), >30% Stem covered by moss/lichen, >60% Cross-sectional area showing decay, <60% Bark cover on stem.

EMEND Snag Plot Survey Methods

Draft Document. Revised: September 16, 2004

Scientific Authority: Dr. David Langor
Position: Research Scientist
Address: Canadian Forest Service
Northern Forestry Centre
5320-122 St.
Edmonton, AB
T6H 3S5
Phone: (780) 435-7329
Fax: (780) 435-7359
Email: David.Langor@NRCan.gc.ca

Citation: David Langor (Natural Resources Canada, Canadian Forest Service, Edmonton, Alberta)
EMEND (Ecosystem Management Emulating Natural Disturbances)
Database
Snag Plot Data Set
Date Issued:

Introduction:

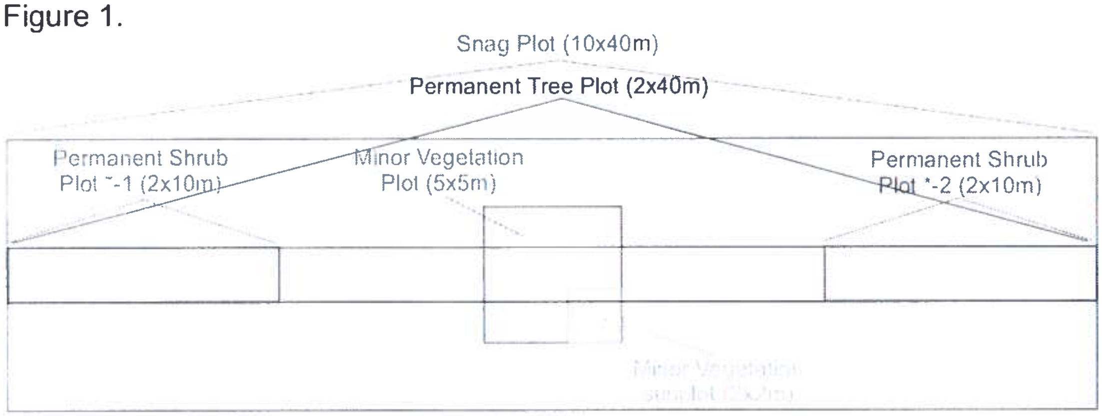
The goal of the research is to monitor the structure and the decay of the standing dead tree (snag) component of a forest stand when subjected to various harvesting treatments so as to determine which treatment best emulates a natural fire disturbance. A survey to identify the species, DBH, height, height class, percent bark retention, and decay class was conducted at EMEND in each compartment.

Plot Establishment:

The snag survey initially utilized the six permanent tree plots (measuring 2x40 m) that were randomly located within each compartment, for a total of 600 plots in the EMEND project. All permanent tree plots were established in an east-west orientation so that the are perpendicular to the north-south orientated machine corridors. A measuring tape was stretch out in a west or east direction from the plot start point for 40 meters to establish the mid-line of the plot. The mid-line UTM coordinates for the start and end of each plot was determined using a GPS unit with differentially corrected data. "A hand-held Geo Explorer II was used to collect the points to give the positions.... The data from the GPS unit was downloaded at DMI and their GPS technician..." corrected the data (EMEND Interim Report 1998). The start and end of the mid-line in each plot was marked with a pig-tail. The plot sides are 1 meter on either side of the plot mid-line for a plot width of 2 meters. "To allow greater visibility of the plot boundaries, wooden stakes painted pink were put in at the start and end of all the plots. Solid aluminum redi-rods with a length of approximately 3 feet were also pounded into the ground. The intent of the metal rods is to make a more permanent marking of the plots so that they ca be re-located in the future" (EMEND Interim Report 1999). In 1998, the plots were number 1 – 6, but after the treatments were conducted in the winter of 1998 some plots were destroyed beyond the limits of the prescribed treatment and were therefore replaced. In 1999, plots numbering 7 – 9 were established where required to replace those that were destroyed in order to maintain the six plots per compartment design. "The first tree plot is usually located from a baseline. Double pink ribbon on a tree on the baseline indicates the start of the trail to the first plot. A trail in pink X's (marked on trees) lead the way between each plot" (EMEND Interim Report 1998).

In 2000, it was decided that the permanent tree plots did not provide a sufficient sample area to survey snags. An expanded snag plot design (10 m x 40 m) was overlaid on the existing permanent tree plot. Figure 1 illustrates the layout of the snag plot in relation to permanent tree, permanent shrub, and minor vegetation plots.

Figure 1.



The difficulty in conducting the prescribed "burn" treatments resulting in 14 compartments having their prescribed treatment revised in 2002. Each of the designated compartments was split in half, thereby creating two new compartments. From the original compartment, one half was treated with a 10% Residual Slash Harvest and the other half was treated with a 10% Residual Slash/Burn Harvest. Three snag plots were retained or re-established in each side of these new compartments.

Plot Tree Numbering:

All standing dead trees (snags) meeting the following criteria of DBH >=7.0cm, height >=1.3m, and lean <45° from vertical were assessed. The compartment number, plot number, tree number, and species was recorded. Appendix 1 lists the coding used to identify tree species. Once the experimental treatment was conducted in the compartment a unique metal tree tag was attached to each tree still standing with electrical phone wire at DBH. This metal tree tag number is now used to identify the tree. New snags since the last assessment will be added to the data and tagged with a unique metal tree tag.

Snag Data Collection:

Each snag is assessed for status (dead, fallen, cut), DBH (cm), height (m), height class (appendix 2), percent bark retention (to the nearest 20%), and decay class (appendix 3). In 1998, the height of each snag was measured. Surveys conducted in 2000, and 2001 did not measure the height of each snag, but instead assigned each snag a height class. The full height in meters was assessed again in 2004 for all snags surveyed. The height (m) should be collected for all future snag surveys. The snag plot surveys will continue on a 2-year cycle with the baseline year as 1998 and the next assessments scheduled for 2004.

Data Quality and Assurance:

No field program has yet been established to cross-check the quality assurance and control of the data being collected in the field for the snag plots. Field data is subjected to a series of SAS validation programs before being incorporated into the EMEND Database.

Reference:

EMEND Interim Report 1998
EMEND Interim Report 2000
EMEND Interim Report 2001

Tree Species Code List

Species	Common Name	Scientific Name	Vegetation Type
.	no trees		T
Abibal	balsam fir	Abies balsamea	T
Alncri	green alder	*Alnus crispa*	S
Alnrug	mountain alder	*Alnus rugosa*	S
Betpap	white birch	*Betula papyrifera var. papyrifera*	T
Conifer	unknown conifer species	*Conifer species*	T
Larlar	tamarack	*Larix laricina*	T
Picgla	white spruce	*Picea glauca*	T
Picmar	black spruce	*Picea mariana*	T
Picspp	spruce species	*Picea species*	T
Pinban	jack pine	*Pinus banksiana*	T
Pincon	lodgepole pine	*Pinus contorta var. latifolia*	T

Species	Common Name	Scientific Name	Vegetation Type
Pinspp	pine species	*Pinus species*	T
Popbal	balsam poplar	*Populus balsmifera*	T
Popspp	poplar species	*Populus species*	T
Poptre	trembling aspen	*Populus tremuloides*	T
Salspp	willow species	*Salix* species	S
Unk	unknown		

Snag Survey Height Class Coding

Height Class	Height Class Definition
1	1.3 – 5 m
2	5 m – below canopy
3	canopy+

Snag Survey Decay Class Coding

Decay Class	Decay Class Definition
.	Missing.
1	Recently dead, all twigs present, spruce with fading needles.
2	Partially rotten, major branches left, small branches mostly gone, bark still mostly intact, sound wood.
3	Rotten, missing bark in places (bark loose), no (or few) branches left.

EMEND Permanent Shrub Plot Survey Methods

Revised: March 4, 2004

Scientific Authority: Dr. Jan Volney
Position: Research Scientist
Address: Canadian Forest Service
Northern Forestry Centre
5320-122 St.
Edmonton, AB
T6H 3S5
Phone: (780) 435-7329
Fax: (780) 435-7359
Email: Jan.Volney@NRCan.gc.ca

Scientific Authority: Dr. John Spence
Position: Chair & Professor
Address: Department of Renewable Resources
University of Alberta
751 General Services Building
Edmonton, AB
T6G 2H1
Phone: (780) 492-1426
Fax: (780) 492-4323
Email: john.spence@ualberta.ca

Citation: John Spence (Department of Renewable Resources, University of Alberta)

Jan Volney (Natural Resources Canada, Canadian Forest Service, Edmonton, Alberta)
EMEND (Ecosystem Management Emulating Natural Disturbances) Database

Permanent Shrub Plot Data Set
Date Issued:

Introduction:

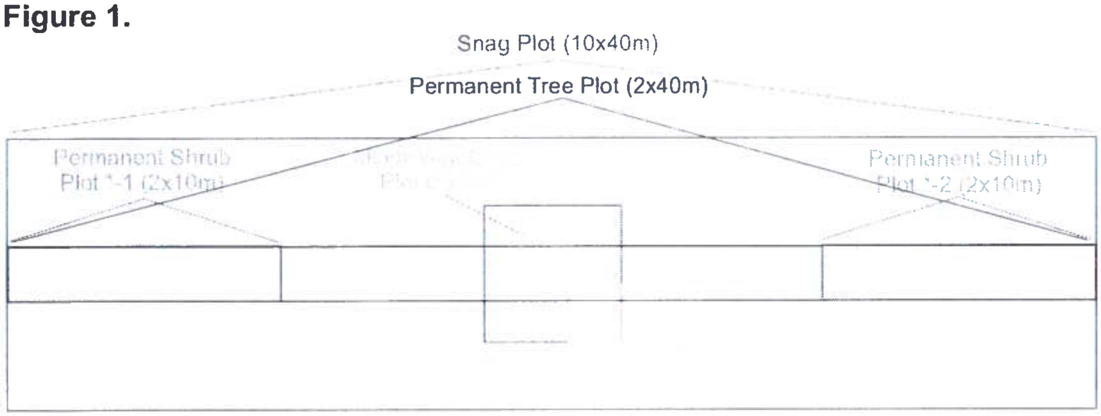
The goal of the research is to monitor the structure and the rate of change of biomass in the shrub component of a forest stand when subjected to various harvesting treatments so as to determine which treatment best emulates a natural fire disturbance. A survey to identify the species, height and diameter at 0.3 m above the point of germination for shrubs was conducted at EMEND in each compartment.

Plot Location and Size:

A permanent shrub plot (measuring 2x10 m) was located and overlaid at the start and end of each permanent tree plot in a compartment, therefore, twelve permanent shrub plots were established in each compartment for a total of 1200 plots in the EMEND project. With one measuring tape run the mid-line (as accurately as possible) from the start to the end of the 2 x 40 m permanent tree plot. Extra care needs to be exercised to get as close as possible to the mid-line. Create the 2 x 10 m plot box using the second measuring tape with one metre of the plot box on each side of permanent tree plot mid-line (figure 1). Put a pigtail marked with blue flagging tape at the end of each shrub sub-plot. All permanent shrub plots located at the start of the permanent tree plot were numbered with the 'permanent tree plot number'-1 (eg. 1-1 is the permanent shrub plot located at the start of the permanent tree plot). Permanent shrub plots located at the end of the permanent tree plot were numbered with the 'permanent tree plot number'-2 (eg. 1-2 is the permanent shrub plot located at the end of the permanent tree plot). The mid-line UTM coordinates for the start and end of each plot was determined in SAS using the coordinates provided for the associated permanent tree plot. After the treatments were conducted in the winter of 1998 some plots were destroyed beyond the limits of the prescribed treatment and were therefore replaced. In 1999, new shrub plots were established where required to replace those that were destroyed in order to maintain the twelve plots per compartment design.

Each plot was assessed for the percentage falling in a machine corridor, vegetation strip, or clear-cut in 2001/2002.

Figure 1.



The difficulty in conducting the prescribed "burn" treatments resulting in 14 compartments having their prescribed treatment revised. Each of the designated compartments was split in half, thereby creating two new compartments. From the original compartment, one half was treated with a 10% Residual Slash Harvest and the other half was treated with a 10% Residual Slash/Burn Harvest. Six permanent shrub plots were retained or re-established in each of these new compartments.

Shrub Data Collection:

The permanent shrub plot was used to assess the species, height, diameter at 0.3 m, and status of each individual shrub within the plot. For a shrub stem to be considered "on-plot" it must be rooted inside the permanent shrub plot. A shrub stem can be rooted inside the plot and be leaning out. All tree and shrub species with a diameter greater that 1.00 cm at a height of 0.3m, but less than 5.0 cm in DBH were assessed regardless if they share the same base. In 2001/2002 and 2004 shrubs were also assessed for presence browsing, lean, and broken stems.

Some areas around the EMEND site were observed to be heavily browsed by ungulates (moose and deer). As such, a survey, done in conjunction with the shrub biomass project, was conducted to estimate the amount of ungulate browsing at the EMEND site. Each shrub was measured in the shrub biomass study (shrubs of diameter greater than or equal to 1.00 cm at 30cm above ground) was assessed for any indication of browsing. Browsing was defined as any twig or branch that appeared cleanly snipped off. In addition, a count of all shrubs under 1.00 cm diameter at 30 cm above ground but greater than 30 cm tall was conducted and all counted shrubs were assessed for browsing." (EMEND Interim Report 2001). Defoliated leaves and leaves removed at petiole are not considered evidence of browsing. All shrubs were assessed for browsing and recorded as yes or no. Initial analysis of the 2001 Shrub "Browsing" data of stems <1.00 cm in diameter indicated non-significant results and as such, no 2002 shrub browsing data for stems <1.00 cm in diameter was collected.

In 1998, a survey of shrubs in the permanent shrub plots was conducted in all compartments. In 2001/2002, permanent shrub plots were reassessed for the first time following the experimental treatments. New permanent shrub plots were established in permanent tree plots that were set up to replace those plots that were damaged during the experimental treatment. In 2001, deciduous and coniferous compartments were assessed. In 2002, mixed-wood and deciduous dominant with coniferous under-story compartments were assessed. Only slash burn compartments were surveyed in 2004.

Data Quality and Assurance:

In some compartments it was difficult to differentiate between the vegetation (retention) strips and the corridors (eg. in 10% and 20% treatments). VEG TOTAL and COR TOTAL values may thus seem strange for some shrub plots in these compartments. In addition, some plots in higher retentions (eg. 50%, 75% and Burns) had COR TOTAL values that were high (or, in the case of burns, present when they should not have been). Smaller variations in corridor width for plots in 50% and 75% residuals were normally due to minute inconsistencies during harvesting. Larger variations were most often due to factors such as adjacency to compartment boundaries or ellipses.

Some shrubs in the data set seem unusually short when compared with their corresponding diameters. These shrubs were most likely broken, but the absence of being indicated as broken is likely a result of recording error.

No program has been established to cross-check the quality assurance and control of the data being collected in the field for the permanent shrub plots. Field data is subjected to a series of SAS validation programs before being incorporated into the EMEND Database.

Equipment required:

1. 40m tape
2. 30m tape
3. Metric carpenter's tape
4. 6 pigtail pegs
5. Small calipers
6. Marker
7. DBH tape.

Reference:

EMEND Interim Report 1998

EMEND Interim Report 2001

EMEND Interim Report 2002

Appendix 3: EMEND Workshop Program

Ecosystem Management Emulating Natural Disturbance

EMEND Workshop 2004

Program and Abstracts

March 30-31, 2004

Northern Forestry Centre
Edmonton, Alberta, Canada

Workshop Objectives

- Provide EMEND researchers with a better idea of DMI's and CANFOR's current forest management strategies; what they are doing on the ground and why.
- Obtain researchers' initial feedback to these strategies considering their research results - do their results suggest DMI/CANFOR should alter what they are doing?
- Prepare researchers for the 5th year re-measurement. Researchers should consider the following:
  How can I help DMI/CANFOR improve their management?
How can my results be reported so that DMI and CANFOR can use them?
- Provide a forum for graduate students and new researchers to present their research results and interests.
- Update researchers with current news and events surrounding EMEND.

Tuesday, March 30
Pine Room, Northern Forestry Centre
08:30 – 16:00

08:30 – 09:00 Morning Coffee.

09:00 – 09:15 Welcome and Opening Remarks.

09:15 – 12:00 DMI and Canfor Presentation.
- Tim Barker, Frank Oberle, Steve Luchkow, and Tim Vinge

(Coffee Break scheduled for approximately 10:30-10:45).

12:00 – 13:00 Lunch Break (Lunch provide by EMEND).

New Research Presentations
Moderator: John Spence

13:00 – 13:15 Bryophyte diversity in response to partial harvesting in a northern mixedwood boreal forest.
- Richard Caners, Ellen Macdonald, and Rene Belland

13:15 – 13:30 Impacts of anthropogenic and natural disturbances on the functional biodiversity of soil fungi at the EMEND experimental area.
- Markus Thormann

Graduate Student Research Presentations
Moderator: John Spence

13:30 – 13:45 **Changes in organic C composition following clearcutting at EMEND.**
- Kirsten Hannam

13:45 – 14:00 **Fire and forest mosaic.**
- Colin Bergeron, John Spence, and Jan Volney

14:00 – 14:15 **On the determination of optimal levels of forest harvest for biological diversity.**
- Timothy T. Work, John R. Spence, and W. Jan A. Volney

14:15 – 14:30 **Spider behavior modified by harvesting intensity.**
- David P. Shorthouse, John R. Spence, and W. Jan A. Volney

14:30 – 14:45 Coffee Break.

14:45 – 15:00 **Effects of variable retention harvesting on saproxylic beetle assemblages**
- Joshua M. Jacobs, John R. Spence, and David W. Langor

EMEND Update Presentations
Moderator: John Spence

15:00 – 15:15 **EMEND database update.**
- Brad Tomm

15:15 – 15:30 **EMEND prescribed burns update.**
- Peter Bothwell

15:30 – 15:45 **EMEND Core Crew and camp update.**
- Jason Edwards

Wednesday, March 31
Pine Room, Northern Forestry Centre
08:30 – 12:00

08:30 – 09:00 Morning Coffee

09:00 – 11:15 **Open discussion of DMI and CANFOR's management strategies.**
Moderators: Jan Volney and John Spence

(Coffee Break scheduled for approximately 10:30 – 10:45)

11:15 – 11:30 **Researcher's Summary of Discussion.**

11:30 – 11:45 **Industry's Summary of Discussion.**

Industry Presentation Abstract

To all Participants in the EMEND project seminar March 30 and 31, 2004

As we near the fifth-year remeasurements in the EMEND project, it is time once again for the Company to meet with researchers, to discuss direction and planning. This year, we intend to give the researchers a more thorough introduction to DMI. We hope to explain to you our beliefs in forest management, the approach we have taken to management as a result of this, and how we see the EMEND project (or all future research) fitting in to our management approach. The purpose of this paper is to give you a very brief introduction to a more detailed presentation you will see on Tuesday, March 30. Hopefully, this paper and the presentation will provide you with a clear understanding of why we initiated EMEND and what we hope to gain from it.

Several years ago now, you will recall that the Alberta Forest Conservation Strategy laid forth the concept of Ecological Management in Alberta. DMI actively participated in the development of the strategy, and firmly supported the EM concept. Despite the obvious need for research, and the obvious need for policy changes to allow it, DMI decided to try and implement Ecological management in our Peace River tenure.

The concept of EM detailed in the Conservation Strategy was very simply stated. In short, the strategy argued that harvesting activities should more closely mimic the effects of natural disturbance on the landscape. It argued that cutblocks should be variable in size and have varying amounts of structure left behind. In addition, forest management should strive to leave a broader range of stand ages on the landscape than traditional sustained-yield forest management does, so that species that depend on older stands are accommodated.

Since the completion of the Strategy, this has come to mean that harvesting should emulate fire. The thinking seems to be that by replacing fire with fire-like harvesting, we can sort of "naturally" manage a forest. This belief does not form part of DMIs approach – we believe it is flawed and doomed to failure. To begin with, fire is not at all the only disturbance agent operating on the landscape, and to think only at that scale is probably dangerous. Secondly, harvesting does not and will not emulate the effects of fire, for a whole host of reasons. We do not believe it is possible to emulate natural disturbances, nor is it possible to eliminate them from the landscape so that harvesting can replace them.

However, we do believe that it is possible to learn lessons from disturbances, and from disturbance-driven forests, so that they can shape our approach to forest management. We believe that the forest that we have today has been shaped largely by natural disturbances and, if we can provide a forest in the future that is not radically different from the forest we have today, then we should be able to maintain the array of species and processes we see in today's forest.

If we wish to target a future forest condition that is not unlike the forest we see today, then we believe that the current sustained-yield approach to forest management is probably risky. We know this approach is going to significantly change the age, the pattern, the patch size, the vegetation species mixtures, and other parameters in the future forest through harvesting with a simplistic alternating clear-cut pattern, and through reforestation with simple mixtures of species. While we are not aware of any definitive proof that this will not be ecologically sustainable, clearly it has got to be a high-risk approach if we wish to maintain ecological integrity and biodiversity.

We believe that it is not in our best interests to manage using a high-risk approach. We feel that our ability to access our tenures in the long term will be dependent upon the quality of our management approach in meeting the needs of the owners (the public). Our greatest security in future access will come as a result of our ability to manage in a sustainable fashion (by the public's definition of sustainable, not ours). In the absence of any recipe on how to sustainably manage a forest, we believe that the ecological management concept provides a lower risk of irreversible consequences.

In fact, risk management probably best describes our approach to forest management. Forestry is a business of managing unknowns, and in the absence of certainty we are well advised as forest managers to understand and manage the associated risks. We believe that Ecological Management is a risk management approach, because it minimizes the risk of loss in the future.

Another fundamental pillar of our approach to management is "management by objective". We believe that in order to implement Ecological Management, we need to explicitly set objectives for the conditions we want to see in the future forest, and we need to take actions in the forest in order to achieve those objectives.

Management by objective, like Ecological Management, is also a departure from current forest management practices. In current forest management, the objectives are set around the harvested resources (fibre). The future forest condition is simply the end result of the harvesting activities, and is not explicitly planned for. In designing the harvest and reforestation activities, considerable thought is given to maximizing desired tree species and excluding non-desired species, while minimizing cost. Little or no thought is given to the implications of this approach for the non-fibre attributes of this complex system.

In our approach of management by objective we have set specific future forest objectives, and we have designed a scheme to frequently measure our success in achieving them. We want to be able to find early warning signs that something is not turning out as we predicted it would. We need to be able to adjust our assumptions, remodel the strategy we have chosen to meet our objectives, and adjust our strategy as necessary. We call this "closing the loop", a logical requirement of management by objective. To us, this is clearly what was meant by "adaptive management" in the Conservation Strategy.

In measuring what we do, and measuring how it turns out, we could categorize our questions into three basic levels:

1. Did we do what we said we were going to do? This is not as simple as it may sound – there are very few forest management systems that measure the actual implementation of the management strategy relative to the planned implementation. The measurement of this is relatively simple, but it is very important.

2. Assuming we took the actions we planned, did our actions produce the desired effect? We have predicted that if we harvest and reforest in certain ways, we will achieve regenerating stands of desired structure. Are our models correct or do they require adjustment? In our models, are we missing some key variables?

3. If we do what we intend to do, and we get the desired results, does the system as a whole respond as we predicted? We are really assuming that our designed forest structure at various scales will be related to ecological function in the same way that natural forest structure is. We are assuming that we can maintain ecological integrity if we can design and achieve the right future forest, while still extracting fibre in an economically viable fashion. Is this a good assumption?

In considering the above framework, it is maybe clearer that forest management ultimately involves rather large and probably risky assumptions. We need to understand where the greatest risk in our approach lies, and to address it through research.

This is why we established and why we continue to support the EMEND project. On one level, it answers questions about how leaving varying amounts of structure in various configurations affects the regenerating stand. It also addresses operational questions like how such a strategy impacts the economics of harvesting, or what sorts of regeneration treatments can we do underneath this residual structure. But EMEND is much more important to us as a long term experiment in forest change, and we will use it to calibrate our predictions of change. What happens over the long term when we place this variety of treatments on the landscape? What future stand conditions can we predict? Do these conditions interact with each other – is there a larger pattern effect that cannot be explained at the stand level?

All of the questions we could associate with the EMEND project, and all of the research we will undertake in the future, will be targeted at the same basic principle. We need to improve our ability to predict change, in order to reduce risk. You will be exposed to our approach in more detail at the seminar next week, and we certainly look forward to your feedback.

Frank Oberle,
Management Forester, DMI

New Research Presentation Abstracts

Bryophyte diversity in response to partial harvesting in a northern mixedwood boreal forest.

Richard Caners, Ellen Macdonald and Rene Belland

Department of Renewable Resources, University of Alberta, T6G 2H1

Bryophytes (mosses, liverworts and hornworts) constitute an important yet often overlooked component of the plant diversity in northern forests, and are key to a wide variety of ecosystem functions. They influence decomposition and nutrient cycling, the retention of surface moisture, soil temperatures and the germination success of vascular and other non-vascular plants. The diversity and abundance of bryophytes in forest stands are largely controlled by the number, types and properties of substrates available for colonization on the forest floor. The accumulation of coarse woody debris in various stages of decay, exposed patches of mineral soil from the uprooting of large trees and small-scale disturbances (eg., microtine rodent activity), and tree bases and woody stems are important surfaces that support bryophytes with different habitat requirements. In addition, bryophyte diversity and abundance are determined by the distances between habitats, habitat longevity and size, and species-specific life strategy. Given that many bryophytes (especially liverworts) are sensitive to habitat change, and that bryophytes are commonly dispersal-limited, the effects of habitat modification through forest harvesting may have long-term implications for the persistence of bryophyte communities over large areas. Forest harvesting and the associated removal of canopy trees may alter the microclimate as well as the availability and characteristics (eg., decay stage, size, species) of substrates important for bryophytes; however, few studies have examined the factors affecting the responses of bryophytes in post-disturbance habitats. This study will examine the effects of partial harvesting on bryophyte diversity in the mixedwood boreal forests of northern Alberta. Sampling will be conducted at the EMEND (Ecosystem Management Emulating Natural Disturbance) research area (Lower Foothills Ecoregion), in an extensive network of treatment blocks that were experimentally harvested in 1998. The specific objectives of this study are to: i) determine the effects of partial harvesting at various intensities on bryophyte diversity in deciduous, mixed-coniferous and coniferous forest stand types five years after harvest; ii) examine the effects of partial canopy removal on the forest floor microenvironment and the abundance, distribution and properties of substrates available for bryophyte colonization; iii) to determine the role of the diaspore bank in the regeneration and re-colonization of bryophytes in post-disturbance (logged) sites; and iv) to characterize the relationship between coarse- and fine-scale environmental gradients, and the associations of bryophyte species at different spatial scales. Results will guide decision-makers in the development of sustainable forest management strategies.

Impacts of anthropogenic and natural disturbances on the functional biodiversity of soil fungi at the EMEND experimental area.

Markus N. Thormann

Northern Forestry Centre 5320-122 St., Edmonton, AB, T6H 3S5, Phone: (780) 435-7321
E-mail: mthorman@nrcan.gc.ca

The boreal forest is a complex ecosystem dominated by coniferous trees, shrubs, herbs, and mosses. These plants form a mosaic of characteristic forest stands influenced by local and regional environmental conditions, including climate and geology. While above ground macroscopic plant communities are the most obvious feature of the boreal forest, microscopic communities and their ecology are much less known and understood. However, these often hidden microscopic communities are primarily responsible for the diversity and distribution of the much more obvious macroscopic plant communities in the landscape.

Fungi are one of the least-understood groups of microorganisms, despite their abundance and the significant roles they play in a variety of ecosystem processes. For example, the majority of fungi decompose organic matter, such as wood, leaves, and roots, by producing a suite of enzymes. Enzyme synthesis capabilities differ among fungi, with some being able to degrade complex plant polymers, including tannins and lignins, and others being able to degrade simpler plant polymers, including sugars, fats, and proteins. Hence, fungi are important in the release of nutrients from organic matter, thereby making these nutrients available to plants for subsequent growth and reproduction. Previous research has shown that the enzymatic "fingerprints" (i.e., the ability to synthesize a suite of different enzymes) differ among individual fungi and entire fungal communities. Hence, these enzymatic fingerprints can be used as an indicator of functional biodiversity. Studies of the functional biodiversity of ecosystems are uncommon but are likely more indicative of ecosystem integrity and health than the more commonly used species biodiversity and richness approaches. For example, a larger functional biodiversity suggests that an ecosystem is more stable, because proportionally more species will be able to react well to environmental disturbances. Conversely, low functional biodiversity suggests that the community as a whole will react poorly to disturbances, because proportionally fewer species will be able to react well to disturbances.

The objectives of the proposed research project are to (1) develop enzymatic fingerprints of four natural forests dominated by different tree species; (2) develop enzymatic fingerprints of each of these forests exposed to different anthropogenic and natural disturbance regimes (fire and timber harvest); and (3) provide management guidelines to industry to minimize the impacts of anthropogenic disturbances on soil fungal communities and ensure the long-term health of forest ecosystems. The approach to characterize the enzymatic, or metabolic, fingerprints of soil fungal communities is based on the BioLog system (http://www.biolog.com/microID.html). This system employs MicroPlates with 95 discrete carbon and nitrogen sources that are used to identify a specific unknown fungus or describe physiological profiles of entire fungal communities (the metabolic fingerprint). This novel technique allows for spatio-temporal qualitative and quantitative analyses of soil microfungal communities and it can be used to assess the functional biodiversity of soil fungi across various ecosystems.

Graduate Student Presentation Abstracts

Fire and forest mosaic.

Colin Bergeron[1,2], John Spence[1], and Jan Volney[2]

[1]*Dept. Renewable Resources, University of Alberta, Edmonton*
[2]*Northern Forestry Centre, Canadian Forest Service, Edmonton*

Forest landscape-level management in North American boreal forests is focused on homogeneous single-cohort stands dynamics resulting from catastrophic fires or insect outbreaks. However, disturbance regime (size, intensity, severity, frequency, and season) varies temporally and spatially on the landscape inducing concomitant variation in stand structure and species composition. In areas where the return period of catastrophic disturbance is longest, stand succession is driven by gap dynamics. Such stands maintain late-successional species composition and multi-cohort tree structure. In this case, the practice of clear-cutting alone may not adequately sustain the full range of stand structures, landscape patterns and biological communities across the landscape. In order to emulate the effects of natural disturbance on forest community structure and composition, ecosystem management must consider a mosaic of clear- and partial-cutting that more closely approximates natural disturbance characteristics. Consequently, accurate knowledge of spatial variations of forest and disturbance regime and the associated fauna are required to develop locally relevant forest prescriptions that will preserve biodiversity associated with specific forest structure and composition.

This project aims to relate forest structure and composition of the EMEND (Ecosystem Management Emulating Natural Disturbance) study area (8 420 ha of boreal Mixedwood forest in northwestern Alberta) to past disturbances and physiographic features. For this purpose, reconstruction of fire and insect outbreak histories from dendrochronology is being included in a GIS (Geographic Information System) analysis of the EMEND landscape based on Alberta Vegetation Inventory (AVI) data, air photos and field sampling. This talk present a spatiotemporal analysis of fire history based on fire scarred trees and compares it to AVI data making assumptions about the impact of changing fire regime on forest mosaic development. The second aim of the study is to link specific forest structure (originating from different disturbances) to biotic variables (arthropods) required to sustain community characteristics of the landscape.

Changes in organic C composition following clearcutting at EMEND.

Kirsten Hannam

Department of Renewable Resources, University of Alberta

One year post-harvest, nitrate concentrations were elevated in forest floors from aspen stands but not from white spruce stands at EMEND. Recent studies suggest that such a pattern may be caused by harvesting-induced changes in the organic C quality of the forest soil. Forest floors from clearcut and undisturbed white spruce and aspen stands at EMEND were examined five and six years post-harvest to determine whether elevated nitrate concentrations were associated with changes in the composition of forest floor organic matter. Proximate analysis and CPMAS ^{13}C NMR spectroscopy revealed no changes in the organic matter composition of these forest floors five years after clearcutting. However, the ^{13}C signature of the Klason lignin fraction of forest floor from clearcut aspen stands was significantly enriched. Six years post-harvest, aromatic C was significantly greater in forest floor from both clearcut aspen and white spruce stands. These observations suggest that changes in forest floor organic C quality do occur following clearcutting. However, the relationship between forest floor organic C quality and mineral N availability remains unclear because nitrate concentrations were no longer elevated in clearcut aspen forest floors when samples were collected for organic C quality determination.

Effects of variable retention harvesting on saproxylic beetle assemblages

Joshua M. Jacobs[1], John R. Spence[2], and David W. Langor[3]

[1]*Department of Biological Sciences, University of Alberta, email: josh.jacobs@ualberta.ca*
[2]*Department of Renewable Resources, University of Alberta, email: john.spence@ualberta.ca*
[3]*Canadian Forest Service, Northern Forestry Centre, email: dlangor@nrcan.gc.ca*

In many forest ecosystems, large and diverse communities of organisms are associated with coarse woody debris (CWD). These organisms, known as 'saproxylic' organisms, use CWD for food, shelter, foraging or reproductive activities. Saproxylic organisms are defined as those that depend, during some part of the life cycle, upon dead wood, wood-inhabiting fungi or the presence of other saproxylic organisms. Saproxylic organisms, especially rare and threatened species, are sensitive to anthropogenic disturbances and industrial forestry has resulted in biologically significant declines in diversity. We examined the short term effects of different levels of dispersed variable retention harvesting on saproxylic beetles in white spruce dominated stands at the EMEND research site. Sampling of saproxylic beetles was conducted in the second and third years post-harvest using flight intercept traps. There were little observed effects of variable retention harvesting on saproxylic beetles, however CWD quality (*i.e.* time since tree death) was a major factor determining saproxylic beetle assemblages in all treatments. There was a distinct change in saproxylic beetle assemblages between the two years of study, indicating a succession of species inhabiting CWD. Although harvesting had little immediate affect on most of the saproxylic beetles, as these stands age and the rate of input of CWD is altered, the effects of variable retention harvesting on saproxylic beetles will become evident. The large scale reduction of CWD due to forest harvest is the greatest threat to saproxylic beetle communities.

Spider behavior modified by harvesting intensity.

David P. Shorthouse[1], John R. Spence[2], and W. Jan A. Volney[3]

[1]*Department of Biological Sciences, University of Alberta, email: dps1@ualberta.ca*
[2]*Department of Renewable Resources, University of Alberta, email: john.spence@ualberta.ca*
[3]*Canadian Forest Service, Northern Forestry Centre, email: JVolney@NRCan.gc.ca*

Previous analyses of spider assemblages in the context of the EMEND-wide experiment revealed temporally-mediated spatial associations to habitat structure. This prompted a scrutiny of spider movement on the ground floor through directional pitfall traps and individual-based tracking. The former revealed little information about population redistribution as a function of treatment configuration while the latter illustrated that, at least for the dominant spider species at EMEND, movement behaviour is altered by harvesting intensity. Path data demonstrate circuitous spider movement and increased residency in clearcuts compared to uncut stands or the juncture between cut and uncut stands. Implications for the ground-dwelling invertebrate fauna shall be discussed.

On the determination of optimal levels of forest harvest for biological diversity

Timothy T. Work[1], John R. Spence[1], and W. Jan A. Volney [2]

[1]*Department of Renewable Resources, University of Alberta, Edmonton, Alberta, Canada, T6G 2E9, twork@ualberta.ca, Tel: 780-492-6965, Fax: 780-492-1767*
[2]*Northern Forestry Centre, Canadian Forest Service, Edmonton, Alberta, Canada*

Conservation of biological diversity under the natural disturbance model of boreal forest management relies on the assumption that natural mosaics of stand composition and structure can be adequately recreated through forest management activities. Here we test the effectiveness of green-tree retention, a coarse-filter conservation strategy widely implemented throughout Western Canada on two dominant groups of epigaeic arthropods; ground beetles (Coleoptera:Carabidae) and rove beetles (Coleoptera:Staphylinidae). We evaluated the interaction between six levels of dispersed retention (0-2%, 10%, 20%, 50%, 75% and 100%) and four successional boreal-cover-types on community composition of both groups of beetles in response to 1- and 2-year post treatment in 100 replicated boreal-mixedwood stands (>10 ha each) at the EMEND (Ecosystem Management Emulating Natural Disturbance) experiment in northern Alberta, Canada. Over 111,000 individual beetles representing 189 species were collected over the two-years. Thirty-eight of these species represent over 95% of the total beetle abundance. Beetle community composition differed significantly among four boreal cover-types and was defined by differences in the relative abundance of habitat specialists. Cover-type differences in community composition were more closely related to structural features associated with the forest floor such as coarse woody debris, cover of mosses, and cover of forbs than to overstory features. Beetles showed significant response to retention treatments particularly in late successional cover-types. Community composition of ground beetles differed significantly between 0-75% retention treatments and uncut control stands and was more apparent two-years post treatment. Changes in beetle community composition were defined by the loss of habitat specialist species from stands with lower levels of retention.

EMEND Project Sponsors

Canadian Forest Products (CanFor)
Canadian Forest Service (CFS)
Daishowa-Marubeni International Ltd. (DMI)
Forest Resource Improvement Association of Alberta (FRIAA)

EMEND Project Partners

Alberta Sustainable Resource Development
Alberta Research Council
Canadian Wildlife Service
Forest Engineering Institute of Canada
Forintek Canada Corp.
Laval University
Manning Diversified Forest Products
Pulp and Paper Research Institute of Canada
Sustainable Forest Management Network
University of Alberta
University of British Columbia
University of Calgary
University of Lethbridge
University of Minnesota
Weyerhaeuser