Ecosystem Management Emulating Natural Disturbance Project

Interim Progress Report to the Forest Resource Improvement Association of Alberta (FRIAA)

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Revision notes:

Original: Submitted to Christine Quinn, Canfor, on October 30, 2009.

Revision 1: Added graduate research summaries (section 6) from Seung-Il Lee, Marla Schwarzfeld, and Kevin Solarik. Re-submitted to Crhistine Quinn on November 2, 2009.

EMEND Interim Report Contents

1. Executive Summary

This report provides details on the EMEND Project research and infrastructure activities directly and indirectly supported through funding from the Forest Resource Improvement Association of Alberta (FRIAA). Financial support provided by FRIAA is aimed primarily at research activities focusing on the EMEND central question of how much forest structure is required to maintain healthy forest ecosystems. FRIAA funding also supports a vast array of more focused ecosystem questions through assisting with EMEND research infrastructure costs. Here we provide specifics on EMEND Core Crew activities, EMEND Research Facility usage, and EMEND Vehicle usage from 1 January – 30 October 2009. We also summarize non-Core research activities that have occurred during this same time period. This year was the second of three years planned for the 10 year post-treatment survey cycle.

2. EMEND Project Background

Many forest companies operating in the boreal forest have recently adopted harvesting practices based on the natural disturbance model. This model has led away from extensive clear-cutting and toward retention of unharvested residual trees as stand and landscape elements and as a basis for biodiversity conservation and forest regeneration. Although effects of size and distribution of residual patches have been well studied, the important question of "how much residual structure is enough to protect critical aspects of ecosystem function" has received little attention.

The Ecosystem Management Emulating Natural Disturbance (EMEND) experimental forest area, located near Peace River, Alberta, is a large-scale variable retention harvest experiment designed to test effects of residual structure on ecosystem integrity and forest regeneration at the stand-level. EMEND is a long-term project that began in 1997 and is forecasted to run for one stand rotation, or approximately 80-100 years.

The overall objectives of the EMEND Project are: 1) To determine which forest harvest and regenerative practices best maintain biotic communities, spatial patterns of forest structure, and functional ecosystem integrity in comparison with mixed-wood landscapes that have originated through wildfire and other natural disturbances; and 2) To employ economic and social analyses to evaluate these practices in terms of economic viability, sustainability and social acceptability. These objectives are addressed through intensive field research at the EMEND research site.

There are two principal components to EMEND field research: 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 the EMEND site as a template for their work. Work carried out 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 the Forest Research Improvement Association of Alberta (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, 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.

3. Core Personnel

The EMEND "Core Crew" is responsible for the collection, organization, and analysis of experiment-wide data as well as the coordination and administration of research at EMEND. The crew consists of the EMEND Field Coordinator, the EMEND Data Manager (full-time positions), and a temporary summer staff of undergraduate university and college students. The summer Core Crew positions remain highly sought after positions and this year there were applications from students in Alberta, British Columbia and Ontario. The number of summer positions offered is directly related to the work load determined at the spring EMEND management committee meeting.

Jason Edwards served a ninth year as EMEND Field Coordinator and Charlene Hahn carried out her eighth year as EMEND Data Coordinator. The five summer Core Crew assistants were Karen Anderson (returned from 2008 Core Crew), Melissa Buskas, Rebecca Margel, Carmen Riddel, and Elizabeth Wong. All students were from the University of Alberta except Margel who was from University of Ottawa. Brad Tomm continues to manage the EMEND Database. Tomm's position is provided in-kind to the EMEND project by Natural Resources Canada-Canadian Forest Service.

3.1. EMEND Field Coordinator Activities

The full-time EMEND Field Coordinator position is currently supported through the EMEND FRIAA budget. Jason Edwards has held the position of EMEND Field Coordinator since 2001. This position is responsible for supervising the summer Core Crew, for the day-to-day administration of the EMEND Project, managing the EMEND Research Facility, and for representing EMEND at conferences and meetings.

Approximately 45% of Edwards' time from 1 January to 30 October was spent on tasks related to fieldwork. These tasks included supervising the summer Core Crew, maintaining field equipment, and conducting field surveys (see section 4. Category 1 Research Activities for survey details).

Approximately 40% of Edwards' time was allocated to EMEND Project administration tasks. These tasks included meetings, workshops, hiring Core Crew, summer fieldwork preparations, map updates, website updates, report writing, and grant development.

The remaining 15% of Edwards' time was dedicated to the management of the EMEND Research Facility. Most of this time was allocated to securing the summer operating contract and purchasing and maintaining equipment for the facility.

3.2. EMEND Data Manager Activities

The full-time EMEND Data Manager position is also currently supported through the EMEND FRIAA budget. The Data Manager is primarily responsible for compiling and validating 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, organizing the annual EMEND workshop, and running and maintaining the EMEND Research Facility. Charlene Hahn has held this position since 2002.

Approximately 47% of Hahn's time from 1 January to 30 October was allocated to fieldwork. Fieldwork included time spent collecting data as well as training and supervising the core crew as they collected data.

Approximately 42% of Hahn's time was allocated to data-related activities. These activities included field work data preparation, data entry, validation of data, data documentation (metadata) and data analysis/summaries.

The remaining 11% of Hahn's time was dedicated to assisting the field coordinator. Hahn assisted the field coordinator with the following activities: camp set-up/take-down, camp management/maintenance, orientation/training/safety for the core crew and all camp users,

hiring of the core crew, preparations for the EMEND annual workshop, and summer field work preparations.

4. Category 1 Research (Core Research) Activities (1 May 2009 – 30 September 2009)

This summer represented the second year of the 10 year post-treatment measurement cycle at EMEND. The 10 year measurements are scheduled over a three year span. The summer Core Crew worked a total of 600 person-days at the EMEND site during 2009. This time was spread among several activities including experiment-wide projects, research site maintenance, and safety training. The following three sections describe the Core Crew activities for summer 2009.

4.1. Experiment-wide (Category 1) Research.

i) *Understory Vegetation Survey.*
This summer Core Crew spent 166.5 person-days conducting the tenth year post-harvest understory vegetation survey on the 5m x 5m (with nested 2m x 2m) permanent sample plots. Percent ground cover was assessed for all forb, graminoid, moss, lichen, and low shrub species within the 2m x 2m plots. Tree and tall shrub species covers were assessed within the 5m x 5m plots. Additionally, a presence/absence survey for all species and a count of understory tree regeneration was conducted within the 5m by 5m plots. Unknown plant and moss collections are currently being identified by Derek Johnson (Canadian Forest Service). Derek also assisted the Core Crew for 7 days in the field.

Unfortunately only 274 of 600 (46%) of the sample plots were completed this summer. This was due to a late vegetation flush, approximately 2 weeks later than normal, and comments from Derek Johnson stating more care to details must be taken during the surveys. All plots within the deciduous and conifer harvest and control compartments were surveyed. All deciduous with spruce understory, mixedwood, and slash harvest/burn compartments remain to be surveyed.

ii) *Epigaeic Arthropods – Experiment-wide collections*
Summer 2009 marked the tenth year post-harvest epigaeic arthropod survey. A total of 685 pitfall traps, six per compartment, were collected every three weeks. The six traps per compartment were placed according to the year 2004 epigaeic arthropod survey. The installation, collection, and removal of the pitfall traps used 158 person-days of Core Crew time. Additionally, the Spence Lab contributed 24 person-days of assistance for pitfall trap collections. All samples currently reside with the Spence Lab and will be sorted and identified when funding becomes available for this task.

iii) *Forest Health and Mensuration and Deadwood Dynamics*
The Core Crew completed the Forest Health and Mensuration and the Deadwood Dynamics survey for the slash-burn plots not surveyed in 2008 and fixed all data collection errors from the 2008 survey. See the 2008 EMEND Interim Report for detailed project descriptions. Approximately 82 person-days were allocated to completing these projects.

iv) *Hydrology*
The EMEND hydrology program has been continued under the direction of Dr. David van Everdingen of the Alberta Research Council (ARC). The Core Crew assisted van Everdingen with bi-weekly water level measurements of the hydrology well sites located in blocks 917 – 922. Approximately 11 person-days were allocated to the well measurements. van Everdingen

has left ARC and is now working for a private consulting firm. He remains interested in the EMEND hydrology program and the 2009 data has been forwarded to him.

v) *Prescribed burns*
Alberta Sustainable Resource Development, Peace River, continued to monitor prescribed burn conditions at EMEND this past summer. Despite the drier than average summer, conditions were not suitable for burning. ASRD decided to focus on Aspen dominated blocks this fall and hope the dry weather continues. As such, they decided to refresh the burn guards around compartments 867, 865/866, and 945. Jason and Charlene spent 7.5 person-days mapping the permanent sample plot trees and snags and re-marking the fuel lines in the compartments in preparation for burning.

4.2. Category 2 Research Assistance

Occasionally Category 2 researchers require extra assistance to complete portions of their field work. A small portion of Core Crew time is allocated for this purpose. Researchers' needs for Core Crew time are dealt with on an as-needed basis and time allocations to each project are at the discretion of the EMEND Field Coordinator. Category 2 researchers are encouraged to return the favor by assisting Core Crew whenever possible. There was no assistance provided to Category 2 research in 2009.

4.3. Other Core Crew Tasks

i) Training, Orientation, and Infrastructure Activities
Approximately 21 person-days were allocated to training EMEND core employees for working in the remote northern areas of Alberta. Training included site orientation, defensive driving courses, ATV certification, bear awareness, and data collection protocols. See Section 8 for details on the EMEND Safety Program.

Approximately 80 person-days were allocated to infrastructure related activities and other tasks. Core Crew spent 3 days at the start of May preparing the research facility for use. The Crew spent 2 days at the end of summer packing equipment and cleaning the research facility. Edwards and Hahn spent approximately 40 person-days on infrastructure related activities. The majority of this time was for travel to Peace River for quad and vehicle maintenance as well as for field and research facility equipment purchases. A small portion of this time was for general research facility maintenance. Other tasks consisted primarily of travel days between EMEND and Edmonton.

Over the past few years, many of the compartment boundaries have become difficult to determine due to fading paint and flagging. Core Crew 2009 spent 37 person-days remarking some of the worst boundaries. Between this year and 2008, nearly three quarters of the compartment boundaries have now been remarked. It is highly recommended that considerable time be set aside to remark the remaining compartment boundaries.

ii) Office Work
Over 35 person-days of Core Crew time were allocated to office work. This time is limited to Hahn's efforts to manage incoming data from the summer fieldwork and Edwards' efforts in managing the camp facilities.

5. EMEND Research Personnel

5.1. Senior Researchers

David van Everdingen (EMEND Hydrology Program) has left Alberta Research Council to work for a private consulting company. He remains interested in the EMEND project but notes his capacity may be limited to the nature of his current employment. A collaboration between ASRD, DMI and Dr. Paul Arps' Wet Areas Mapping Program at University of New Brunswick (UNB) began this summer. UNB is developing wet area maps for the Province of Alberta and required a field site to test new map models for wetland/bog (low-slope) landscapes.

5.2. Graduate students

EMEND is a world-class training site for graduate students. Students from around the world continue to eagerly seek out graduate research programs at the EMEND site. EMEND welcomes two new PhD students, Guillaume Blanchet (University of Alberta, He) and Sueng-Il Lee (University of Alberta, Spence) along with one MSc student, Kevin Solarik (University of Alberta, Lieffers). EMEND offers congratulations to Matthew Pyper and Chris Pengelly for completing their theses. Two students, Marla Swartzfeld and Mathew Swallow, upgraded their studies from MSc to PhD in early 2009. A large number of students are in the final stages of their programs and are expected to defend their theses over the upcoming year. A summary of the status of EMEND graduate students may be found in tables 7 and 8.

6. Graduate Student and Category 2 Research Updates.

The following sections provide updates to a number of on-going research projects at EMEND. The list of projects does not include all active studies as updates are provided only for those researchers who submitted one.

6.1. Gastropod diversity in the boreal mixedwood forest of northern Alberta – variation among forest types and response to partial harvesting.

Suzanne Abele, M.Sc. Candidate
Dr. Ellen Macdonald and Dr. John Spence, Supervisors
University of Alberta

Gastropods have an important role in forest ecosystems as decomposers, herbivores, and prey items. Understanding how gastropod communities are affected by forest harvesting is important to ensure their legacy on the landscape. The objectives of this study are to: i) conduct an overall diversity survey of the gastropod fauna in deciduous, mixed-wood, and coniferous stands of the northern Alberta mixedwood forest; ii) examine the effects of partial and complete harvesting on gastropod fauna; and iii) describe gastropod microhabitat variation in relation to bryophyte diversity and cover.

In the summer of 2007, sampling was focused in unharvested stands of different forest types to address the first study objective and to serve as a basis for sampling harvest treatments this summer. In 2008 sampling was focused in all of the harvest treatments of the Mixedwood cover type. Gastropods were sampled using a combination of board traps and soil samples. Each sampling site was characterized for vegetation cover, basal tree area, canopy cover, and soil moisture. During the summer of 2009, soil sample processing was completed, and gastropod

and bryophyte samples were identified. 14 gastropod species have been collected from the EMEND site. Analysis and thesis composition is currently underway.

Preliminary results show that different gastropod communities exist in different cover types. Of environmental parameters measured, those that influence gastropod community composition differ among cover types. Rarely collected species are more strongly associated with specific environmental parameters than more commonly collected species. When harvesting is introduced to the system, distribution patterns are adjusted at both stand and microsite levels, and these responses differ between species. Harvesting with higher levels of green tree retention maintains a gastropod composition more similar to that of an unharvested forest.

Over the last year, these results have been presented at Forest Explorers 2008 (poster presentation, Nov 2008, Manning, AB), the Annual EMEND Workshop (oral presentation, April 2009, Edmonton, AB) and the SFMN 2009 Conference (poster presentation, April 2009, Gatineau, QB).

6.2. Mesostigmatan mite communities of EMEND.

Irma Diaz, Ph.D. Canadidate
Dr. Sylvie Quideau and Dr. Barb Kishchuk, Co-supervisors
Department of Renewable Resources, University of Alberta.

Irma has finished reviewing the identification of mesostigmatan species and database set for making the final statistics of first chapter. She had already presented preliminary advances of her first chapter in the SFM Network Conference "Envisioning Tomorrow's Forests: Knowledge Networking for Sustainability" (21-23 April 2009), and reported results to ACA Grants in Biodiversity which will published in the biennial report 2009. She will begin to write chapter 1 which is about community ecology of mesostigmatan mites in three types of boreal forest.

In relation to chapter II, about understanding food webs and exploring trophic interactions of two boreal forests, she has finished the preparation of mesostigmatan mites by species and they will be sending to analyze 15N stable isotope ratios. However, she has been delayed for her lab research due to technical and instrumental reasons, especially in measuring small sample size of stable isotopes

In chapter III, her research project involved establishing a new technique and she begin to work on the neutral lipid fatty acid's protocol. The objective to know dietary preferences in two different types of boreal forest: coniferous and deciduous, and neutral fatty acid analysis will be an indicator of the incorporation of fatty acids from food source into the body tissue of soil mites.

6.3. Influence of Patch Size on Saproxylic Beetles of Boreal White Spruce Stands.

Seung-Il Lee, PhD Student
John Spence, Supervisor
Department of Renewable Resources, University of Alberta

Saproxylic beetles (i.e. beetles that depend on dead or dying wood during some part of their lifecycle) are a diverse group of organisms that provide essential ecosystem functions. They have important trophic role such as bark- and wood-feeder, fungivores, predator, and

scavenger. Their sensitivity to environmental changes results because many saproxylic beetle species have strong relationships with specific microhabitats, especially quality and quantity of dead wood. The dead wood habitat of saproxylic beetles is a basic functional component of forest ecosystems. It provides unique structural characteristics as a specific habitat for many species, as well as essential ecological elements of forests.

My specific objectives are to: (1) describe the saproxylic beetle assemblages using logs and snags of various size and decay classes of white spruce, (2) compare the saproxylic beetles among two sizes of clumped retention patches (0.20 ha and 0.46 ha) within different retention level of matrix and CWD profiles on the EMEND landscape, (3) determine if there is a threshold for forest retention patch size to minimize landscape impacts on saproxylic beetles identifying edge effects, (4) examine saproxylic beetles in white spruce downed dead wood ranging from freshly dead to well decayed.

During the first field season of 2009, a total of 126 window traps and 84 emergence traps were deployed among two sizes of clumped retention patches (0.20 and 0.46 ha) in white spruce compartments (c. 10 ha each) harvested to 2 (clear-cut), 20, and 50 percent dispersed retention, the surrounding dispersed retention matrix and in non-harvested compartments. Additionally, twenty four white spruce logs ranging from decay class (DC) 1 to DC 6 were chosen in non-harvested compartment. Logs were cut off 60 cm and moved to rearing cages near the camp.

Based on the preliminary result collected by emergence traps, I found 2873 beetles representing 31 families and 112 species, of which 136 individuals from 11 families and 15 species were larvae. Curculionidae was the most abundant family occupying 88.1% of the total abundance, followed by Nitidulidae (2.2%), Colydiidae (2.0%), Staphylinidae (0.9%), Cleridae (0.8%), and etc. Wood-borer was dominant in the DC 2 (freshly dead wood) white spruce logs occupying 92.2%, followed by predator (2.3%) and fungivore (2.0%), but predator was the most abundant feeding group in the DC 4 logs occupying 44.4%, followed by fungivore (31.3%) and wood-borer (17.1%). Species richness and abundance of saproxylic beetles in the large ellipse were higher (72 species, 1787 individuals) than those in the small ellipse (56 species, 868 individuals).

6.4. Patterns of diversity and impact of forest management on a boreal parasitoid (Ichneumonidae: Pimpliformes) community.

Marla Schwarzfeld, Ph.D. student
Department of Biological Sciences, University of Alberta
Supervisor: Felix Sperling

Because of their abundance, diversity and important ecological roles in forest ecosystems, arthropods are an essential part of any biodiversity study. However some of the most speciose groups of arthropods (e.g. Diptera and Hymenoptera) have been essentially ignored, due to a paucity of taxonomic experts. These groups nevertheless have essential ecosystem functions that must be understood if we are to properly assess the impacts of land-use strategies.

The Ichneumonidae comprise the largest hymenopteran family with at least 60,000 described species worldwide. While there are many exceptions, the majority of species are parasitoids of endopterygote insect larvae and pupae, particularly among the Lepidoptera and Symphyta. As such, they play a large role in the regulation of potential pest species, and in maintaining the

equilibrium of ecosystems. Because of their highly specialized life histories, they may also be particularly vulnerable to ecological disturbances, and it has been found that parasitoids do not necessarily respond to habitat fragmentation in the same manner as their hosts. This could in turn lead to an increase in outbreaks of herbivorous insects. However despite their abundance and ecological importance, the Ichneumonidae remain relatively unstudied and are rarely used in biodiversity inventories.

I performed this work at the EMEND research site, as well as in the surrounding area. Throughout the summer of 2007, I used Malaise traps and sweep-netting to sample Ichneumonidae in a variety of boreal habitats in the EMEND area. During the summer of 2008, I assessed the impact of forestry methods on the ichneumonid community of EMEND's deciduous-dominated stands by comparing uncut, partially-cut (50% and 80% tree removal) and clearcut treatments. I used two Malaise traps in each of two replicates of each treatment type, for a total of 16 traps. Traps were run continuously from late May until late August 2008, and were collected at approximately two-week intervals.

All specimens were identified to subfamily. Because of the number of specimens collected, and the poor state of taxonomy for most groups, identification to species is focused on three related subfamilies (the Pimpliformes: Pimplinae, Rhyssinae and Poemeniinae). All of these subfamilies have been used in other ichneumonid biodiversity research which will allow this study to be directly comparable to other studies. The Pimplinae have a greater range of hosts and life-history strategies than any other subfamily. Rhyssinae and Poemeniinae are much smaller subfamilies, and primarily parasitize insects living inside wood.

A total of 12,645 specimens in 2007 and 46,687 specimens in 2008 were sorted to subfamily, for a total of 24 subfamilies. Some of the 2008 samples were sub-sampled; the total number of ichneumonids collected in 2008 likely exceeds 100,000 individuals. Cryptinae and Orthocentrinae dominated the samples in both 2007 and 2008, making up over half of the total number of specimens. The Pimplinae are the third most abundant subfamily; the three subfamilies of the Pimpliformes totaled 3729 specimens in 71 species, with 99% of the individuals and 59 species belonging to the Pimplinae. The Pimpliformes species composition has a typically skewed distribution, with a few very common species and many rare species. The most abundant species (*Pimpla aquilonia*) makes up 39% of the total number of individuals, and the most abundant genus (*Pimpla*) makes up 73% of the total. Forty-six species are represented by fewer than 10 individuals, and 16 species are represented by singletons. Statistical analyses of treatment, habitat and seasonal variation in the species composition of the Pimpliformes are ongoing.

6.5. Tree survival and establishment in the 10 years after the variable-retention harvests at the EMEND experiment.

Kevin Solarik[1], Dr. Victor Lieffers[1], Dr. Jan Volney[2]
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Background:
The forestry industry is considering using partial harvesting techniques as a strategy for emulating natural disturbance in order to maintain ecological functions and habitat stability within a forest ecosystem. EMEND, offers us the ability to study features of forest stand dynamics at both a long-term and operational scale. Although, increasing in popularity within the

last couple decades, partial harvesting systems still remain poorly understood in regards to health of residual trees a decade after logging and seedling establishment. In our two studies we attempt to answer these two major overlying questions: (1) what factor(s) influence residual tree mortality and health following variable retention harvests, (2) what affects the natural regeneration of white spruce 10 years following harvesting?

Project(s) Objectives:
Mortality Study: To determine which factors best influence and allow the predictability of overall residual tree health and mortality by assessing: (1) skid trail proximity, (2) species, (3) harvesting intensity (0%, 10%, 20%, 50%, 75% and 100%) (4) overstory canopy composition ((a) deciduous dominated (D) (>70% of basal area composed of aspen and/or balsam poplar), (b) deciduous dominated with an extensive conifer understory (Du) (conifer understory at least 50% of canopy height), (c) mixed (Mx) (~35-65% of basal area composition of deciduous and conifer), (d) conifer dominated (C) (>70% of basal area composed of white spruce (5) height (6) diameter at breast height (DBH) (7) crown class, (8) basal area, (9) stem volume.

Regeneration Study: To determine the conditions that provide the highest densities, tallest seedling height and greatest stocking rates of natural white spruce regeneration by: (1) harvesting intensity (see above) (2) overstory canopy composition (see above) (3) distribution of white spruce seed trees (4) the influence of soil disturbance in relation to logging equipment, (5) competition from trees, shrubs and grasses and (6) presence of fresh and decomposed logs.

Methods & Data Collection:
In May and June of 2009, the distance of each residual tree (n=1905) were taken along the 40m permanent transects plots (established by Volney, 1999). Furthermore, corridor edges were also spatially identified along these permanent plots, as skid trail proximity would then be coupled with previous data collections (1999, 2003 and 2009) in order to assess residual trees health and mortality predictability. Performed simultaneously with residual tree and corridor distances, eight regeneration plots of $10m^2$ (1.78m radius) were established in line, parallel to permanent transect plots established by Volney (1999). These regeneration plots were established at 5m north (4 plots) and 5m south (4 plots) of the permanent transect at approximately every 10m (two plots positioned within the machine corridors and two plots in the retention strips) (Totalling 3456 regeneration plots). Within each of the regeneration plots, 7 variables were collected: (1) Number of advanced white spruce regeneration (trees >10 years of age based upon whirl counts); advance growth included understory spruce (trees < 3m in height), (2) number of white spruce seedlings (minimum of 10 cm in height, <10 years (based upon whirl counts), (3) maximum height of tallest white spruce seedling within each of the 8 plots, (4) percentage of grass cover within each plot, (5) percentage of deciduous cover with in each plots; this included all shrub species, such as green alder (Alnus crispa (Ait.)Pursh), willow (Salix spp.), low-bush cranberry (Viburnum edule (Michx.) Raf.), prickly rose (Rosa acicularis Lindl.), Canada buffalo-berry (Shepherdia Canadensis (L.)Nutt.) and Labrador tea (Rhododenron tomentosum). It also included cover of the sub canopy tree species (aspen and balsam poplar) that regenerated after logging, (6) percentage coverage of advanced decomposed logs and (7) percentage coverage of fresh logs.

Results:
Mortality Study: Results for this study have yet to be analyzed at the time of this report; however it should be assessed and completed by the spring of 2010.

Regeneration Study: Results show that harvest intensity had a slight affect on seedling densities and stocking rates, as higher retentions resulted in lower regenerations numbers in general

(Objective 1) and had no effect on the height of the seedling. Overstory canopy composition was a strong indicator of seedling densities and stocking rates as C-stands experienced the highest densities and rates, while Mx and Du provided similarly mid-range densities and D-stands the poorest. These results were similar for seedling height as C-stands provided the tallest seedlings, while D-stands the shortest (Objective 2). Although contrary to popular scientific belief, grass and deciduous competition was not found to be a strong inhibitor of seedling presence (Objective 5). Although the presence of highly decomposed logs provides a good location for seedling recruitment (i.e. moist, nutrient rich), on the operational scale of this study, no increase in densities was identified in its presence (Objective 6). Seed source trees were strongly correlated with seedling density. However, establishment was 3.5 times higher in the places with physical disturbance (corridors) than the undisturbed interiors (Objective 3 and 4). Ultimately, it was found that the regeneration of white spruce was highest when the following occurred: (1) seed source trees present (i.e. C-stands) (2) a disturbance of the forest floor (machine corridor) (3) lower over story retention (i.e. higher cut intensities).

6.6. Saproxylic beetle – deadwood habitat associations

Charlene M. Wood[1], M.Sc. Candidate
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As trees die and decay, they provide heterogeneous habitats which are anything but devoid of life. Beyond providing feeding and nesting sites for cavity-nesting birds and small mammals, deadwood supports a diversity of forest dwelling arthropods which are classified as "saproxylic" (ie. dependent upon standing or fallen dead trees or wood-inhabiting fungi). Although saproxylic arthropods are important in providing crucial ecosystem services (decomposition, nutrient cycling), and are sensitive to disturbance, our knowledge of the fauna and their required habitats is limited.

My objectives are to: i) examine saproxylic assemblages from a range of deadwood decay states and sizes, ii) determine specific habitat associations of saproxylic arthropods with deadwood characters and iii) propose a deadwood habitat classification system for *Populus.*

Beetles were collected during the 2007-2008 summer seasons in mature deciduous-dominated stands on the greater EMEND (Ecosystem Management Emulating Natural Disturbance) landscape. To adequately sample a baseline of saproxylic beetles, various collection methods were used, including: hand collection, funnel extraction, rearing, window trapping and emergence trapping. Sample processing and beetle identification to species is currently in progress.

To date, I have identified approximately 166 species of beetles residing within 38 families, some of which are new records in western Canada. The most abundant groups (in descending order) are the "minute brown scavenger beetles" (Latridiidae), "rove beetles" (Staphylinidae) and "featherwing beetles" (Ptiliidae). Preliminary results suggest that fallen deadwood houses a richer fauna of saproxylic beetles than standing dead trees, yet each type of deadwood houses a unique fauna (few species overlapping). Beetle assemblages varied greatly even between deadwood replicates (maximum 60% similarity) and across decay classes and site. Upon completion of species identifications, I will determine beetle-habitat associations and differences in community composition across various decay states of *Populus* deadwood.

The data collected in this study will provide a thorough baseline of the saproxylic beetle species from *Populus* deadwood of northwestern Alberta. Increased understanding of our saproxylic fauna and their required habitats will aid in developing ecologically meaningful forest management strategies. The key to conserving our biological diversity, and thus ecosystem function, is in the preservation of a wide range of deadwood habitats across the landscape and through time.

7. EMEND Research Infrastructure

7.1. Research Facility

The EMEND Research Facility is located 10km west of Dixonville, Alberta along the Sulphur Lake Road and approximately 40km away from the EMEND research site. The University of Alberta owned facility can accommodate up to 30 researchers but optimal capacity is around 15 people. The summer of 2009 was the fourth summer of full-time operations at the facility.

The facility operating costs are covered primarily through FRIAA funding to the EMEND project. The FRIAA contributions cover the accommodation costs for all researchers working at the EMEND research site on projects approved by the EMEND management committee. All costs exceeding those outlined in the EMEND FRIAA budget are cost-shared by the individual researchers based on their facility use. Occasionally researchers not working on the EMEND project wish to use the EMEND facility. These researchers are assessed a cost-recovery plus 15% fee for their use of the research facilities.

Whitemud Catering Ltd. of Peace River, AB was contracted for facility catering and operating services from 1 May through to 30 September, 2009. Full services (catering and operating services) were provided from 1 May through 31 August while operating services (water and sewer) only were provided from 1 September through 30 September. Whitemud Catering provided all food and cleaning services, potable water delivery as well as all sewer and garbage disposal services.

The facility was used under contract (May 5 – 31 August) by 27 EMEND associated researchers and research assistants for a total of 851 person-days, a 34% (440 person-days) decrease in usage from 2008. The decrease in facility usage is due primarily to a reduction in new graduate student projects. This decrease may be a part of a natural down-cycle in graduate student projects or it may be due to reduced graduate student stipend funding by NSERC (National Science and Engineering Research Council), the primary funding agency for graduate student work.

Category 1 researchers accounted for 642 person-days of use while Category 2 researchers used the facility for 209 person-days (tables 2 and 3). The facility was not used by any non-EMEND related researchers this year. The facility was used an additional 56 person-days in September (table 4). EMEND is not charged a per-person usage rate for September as the full-time service contract (cook and food supply) ends August 31 but is charged for water and sewer services as required.

7.2. Vehicles

The Core Crew used three vehicles this summer; two 4x4 trucks owned by the Department of Renewable Resources and allocated to EMEND (UofA 290, and UofA 260), and one passenger

van that was rented from the University of Alberta Vehicle pool. The trucks were primarily used to transport Core staff between the research facility and the research site while the van was used to transport Core personnel between Edmonton and the research facility. EMEND core vehicle use is summarized in table 5.

Core Crew 2009 used eight ATV's this summer. Four ATV's are owned by the Department of Renewable Resources and allocated to EMEND, three are owned by DMI, and two are owned by Canfor. EMEND Core ATV use is summarized in table 5.

The new research facility has a large gasoline tank on site for researchers to use in their ATV's and vehicles. Funding from FRIAA covers all gasoline costs associated with ATV use at the EMEND research site (for both Category 1 and Category 2 research) as well as EMEND Core vehicle use. All fuel usage is summarized by research group in table 6.

7.3. Access road upgrades

Maintenance grading of the main access road (DMI P2-200) to the EMEND research site was completed this September. Annual grading of the access road ensures a safer commute between the research centre and the research site and reduces wear and tear on EMEND vehicles.

8. EMEND Safety Program

The EMEND Project places a high priority on maintaining a safe workplace since the research site is situated in a remote location over 40 minutes from the nearest emergency assistance. Over the past few years the EMEND Project has developed a safety program consisting of due diligence guides and emergency response plans that all researchers using the EMEND research site and facilities are required to follow. The adoption of a strong safety focus has led to reduced work related injuries and a positive attitude towards safety at the EMEND research site. **There were no accidents or injuries reported in 2009**. EMEND is now incident free for two consecutive years.

A well-developed emergency response plan and forest protection plan has been created with the assistance of DMI and Canfor. These plans include specific instructions on how to plan for and react to certain emergency situations such as medical emergencies, overdue/loss persons, and forest fires. All researchers are responsible for bringing their own required safety supplies, and researchers are not allowed to work on the site without them. The EMEND Field Coordinator works closely with DMI and Canfor representatives to enforce these plans at the EMEND site.

A formal test and review of the EMEND Emergency Response Plan was conducted this summer by Kozabek Safety Consulting, Inc (DMI covered the incurred costs directly). A recommendations and commendations report has been submitted to DMI and the University of Alberta and is available upon request to Edwards.

9. Administrative and Organizational Items

9.1. Annual Workshop

The annual EMEND Workshop was held on 16-17 April 2009 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 this year provided a forum for current researchers and graduate students to present their research results and for new researchers to propose research projects. It also provided an opportunity for EMEND partners to present current issues in forest management where results from EMEND research may prove useful. Two EMEND partner presentations were provided along with seventeen research presentations. Approximately 40 people attended the workshop.

9.2. Technology Transfer Activities

The EMEND Management Committee maintains a contract with NovaNAIT's Boreal Forest Research Centre to conduct local (NW Alberta) technology transfer activities, such as tour trail maintenance, local seminars, and public engagement. Details of this plan are reported elsewhere. The EMEND Field Coordinator is responsible for additional technology transfer activities not covered by the contract; these activities are listed below.

i) *Tours.*
EMEND conducts numerous tours of the research area each year for a diverse array of interested groups from the general public to professionally trained foresters. All active researchers are encouraged to attend the tours to provide information relating to their research interest. Two tours were conducted this summer. EMEND hosted the Peace region Junior Forest Wardens on 26 July and the DMI summer and operations staff on 13 August.

ii) *EMEND Website*
The EMEND website is currently hosted by the University of Alberta and managed by the EMEND Field Coordinator. No updates have been made to the website over the past year due to the University restructuring their web servers and blocking access to the website folders by all users other than central University webmasters. As such, Edwards has purchased a new domain name for the EMEND website, www.emendproject.org, and plans to move the website to servers at the Northern Forestry Centre, Canadian Forest Service.

Additionally, EMEND has partnered with the SFMN to produce a series of SFMN Research Notes based on work at EMEND. Three notes have been published to date and a number more are planned for spring 2010.

9.3. EMEND Publications and Theses

Caners, R., S.E. Macdonald and R. Belland. Viability of epiphytic bryophytes depends on forest structure along a gradient of partial harvesting. *Botany* (revised and returned to journal following favorable reviews).

Caners, R., S.E. Macdonald and R. Belland. 2009. Recolonization potential of bryophyte disaspore banks in harvested mixedwood boreal forest. *Plant Ecology* 204: 55-68.

Craig, A., S.E. Macdonald. 2009. Threshold effects of variable retention harvesting on understory plant communities in the boreal mixedwood forest. *Forest Ecology and management* (in press).

Fageria, M.S., Fageria and Om P. Rajora. 2009. Does Harvesting Of Different Intensities Affect Genomic Diversity In Post-Harvest Naturally-Regenerated Populations Of White Spruce?. Plant & Animal Genomes XVII Conference, January 10-14, 2009, Town & Country Convention Center, San Diego, CA.

Fageria, Manphool and Om P. Rajora. 2009. Does Harvesting Of Different Intensities Affect Genomic Diversity In Post-Harvest Naturally-Regenerated Populations Of White Spruce?. Proceedings: Plant & Animal Genomes XVII Conference, January 10-14, 2009, Town & Country Convention Center, San Diego, CA..

Gray, Laura Kelsey. 2008. Spatial patterning of tree distributions and density-dependent competition in a boreal forest of Alberta. MSc. Thesis. 2008. University of Alberta. 86 pp.

Jacobs, Josh and David Langor. 2009. Deadwood-associated insect biodiversity in mixedwood forests. Sustainable Forest Management Network Research Note Series No.42.

Lieffers, Victor, Derek Sidders, Tomasz Gradowski, Simon Landhäusser, Brent Frey, Alison Munson, Tim Keddy, Jan Volney, John Spence, and Peter Blenis. 2009. Spruce and aspen regeneration following variable retention harvests at EMEND. Sustainable Forest Management Network Research Note Series No. 41.

Swallow, M., Quideau S.A., Mackenzie, M.D., Kishchuk, B.E. 2009. Microbial community structure and function: The effect of silvicultural burning and topographic variability in northern Alberta. Soil Biology and Biochemsitry 41: 770-777.

Work, Timothy T. 2009. Responses of arthropod biodiversity to variable green-tree retention at the EMEND experiment. Sustainable Forest Management Network Research Note Series No. 43.

9.4. Talks of Interest and Poster Presentations.

Abele, S.E., S.E. Macdonald, and J.R. Spence. 2009. Gastropod Distribution Following Retention Harvest. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Blanchet, F. Guillaume and Colin Bergeron. 2009. What structures beetles communities in boreal forest?. Sustainable forest management network meeting. Gatineau, Québec, Canada. Poster Presentation.

Bodeux, Brett. 2009. Investigating patterns of species diversity for a moth assemblage in a boreal forest stand. EMEND Annual Workshop - 2009. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Canada.

Caners, R., S.E. Macdonald and R. Belland. 2009. Short-term response of boreal bryophytes to forest structure along a gradient of partial harvesting. Ecological Society of America 94th Annual Meeting, Aug. 2 – 7, 2009; Albuqueruqe, New Mexico.

Chávez, Virginia and S. Ellen Macdonald. 2009. The importance of canopy patches on vascular understory plants in boreal mixedwood forest. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Diaz, Irma and Sylvie Quideau. 2009. Mesostigmatan mite assemblages of the boreal mixedwood forest floor. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Glassier, James. 2009. Ants of EMEND, with special attention to the carpenter ants. EMEND Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

He, Fangliang. 2009. Tree size distribution: Linking patterns to processes. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Hahn, Charlene, John Spence and Jan Volney. 2009. Forest Biomass Change in Response to Harvest at EMEND. EMEND Annual Workshop - 2009. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta.

Langor, David W. and Daryl J. Williams. 2009. Coarse Woody Material at EMEND: Pattern and Processes. EMEND Annual Workshop - 2009. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta.

Pengelly, Chris and Ralph Cartar. 2009. Bumble bees and bumble bee visited plants at EMEND. EMEND annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Pinzon, Jaime, John Spence, and Dave Langor. 2009. Prescribed Burning and Variable Retention Harvesting: What have we learned in 10 years from a Spider perspective?. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Pyper, Matthew , J.R. Spence, D.W. Langor. 2009. Influence of retention patch isolation on ground dwelling beetles: Implications for harvest block design. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Schwarzfeld, Marla and Felix Sperling. 2009. Patterns of ichneumonid (Insecta: Hymenoptera) diversity in a boreal forest ecosystem. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Schwarzfeld, M., F. Sperling. 2009. Patterns of ichneumonid diversity in a boreal forest ecosystem. Oral presentation at the 2009 Prairie Universities Biological Symposium, Lethbridge, AB.

Schwarzfeld, M., F. Sperling. 2008. Patterns of diversity in a boreal ichneumonid community. Oral presentation at the 2008 Entomological Society of Canada Annual Meeting, Ottawa, ON.

Solarik, Kevin, Vic Lieffers, and Jan Volney. 2009. Tree survival and establishment in the 10 years after the variable-retention harvests at the EMEND experiment. EMEND Annual Workshop 2009, 16-17 April 2009.. Northern Forestry Centre, Edmonton, Alberta.

Stadt, John. 2009. Alberta Government perspectives. EMEND Annual Workshop 2009, 16-17 April 2009. Northern Forestry Centre, Edmonton, Alberta.

Spence, John. 2009. The Road to EMEND. EMEND Annual Workshop - 2009. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Canada.

Spence, John, Jan Volney, and Jason Edwards. 2009. Taking EMEND Beyond the Boundaries. Foothills Research Institute 2009 Annual General Meeting. University of Alberta, Edmonton.

Spence, John, J. Edwards, S. Luchkow, C. Quinn, J. Stadt, T. Vinge, J. Volney, P. Wearmouth, J. Witiw, T. Archibald, T. Barker, C. Hahn, F. He, D. Johnson, B. Kishchuk, D. Langor, V. Lieffers, E. Macdonald, K. McClain, E. Phillips, S. Quideau, F. Schmiegelow, D. Sidders, B. Tomm and T. Work. 2009. EMEND: Managing forestry in light of natural disturbance on western boreal landscapes. Sustainable Forest Management Network 5th National Conference: Envisioning Tomorrow's Forests. April 21- 23, 2009. Gatineau, Quebec.

Witiw, Jim. 2009. A partner's perspective on industry drivers and 10th-year deliverables. EMEND Annual Workshop, 16-17 April 2009. Northern Forestry Centre, Edmonton, Ab.

Wood, Charlene M., John R. Spence and David W. Langor. 2009. Deadwood habitats important for maintaining saproxylic beetle biodiversity. Envisioning Tomorrow's Forests: Knowledge Networking for Sustainability. SFM Network Conference. April 21-23, 2009. Gatineau, Quebec. Poster Presentation.

Wood, Charlene M., John R. Spence and David W. Langor. 2009. Deadwood management and saproxylic beetle biodiversity. EMEND Annual Workshop. April 16-17, 2009. Edmonton, Alberta.

Wood, Charlene M., David W. Langor and John R. Spence. 2009. Deadwood-dependent beetles and forest management. EMEND Annual Workshop. April 16-17, 2009. Edmonton, Alberta. Poster Presentation.

9.5. Additional Administration Items

i) EMEND Memorandum of Understanding for new research projects.

A new Memorandum of Understanding (MOU) for collaborative research at EMEND was developed to outline expectations of the collaboration between the EMEND Management Committee and new researchers. The MOU is to be signed by an EMC representative and the researcher prior to the start of any research project. The current MOU is found in Appendix 2.

Appendix 1: Tables

Table 1. Summary of EMEND core crew work completed for Core activities from May 4 – September 30, 2009.

Project	Work Description	Total Number of Person Days of Core Crew Activity	% of Total Person Days
Understory Vegetation	- Survey experiment-wide permanent understory vegetation plots for species richness and percent cover. Only half of the plots were surveyed 2009.	166.5	27.8
Arthropod Diversity - Experiment-wide pitfall traps	- Collected experiment-wide pitfall traps as part of the EMEND biodiversity program	158	26.3
Forest Health and Mensuration / Dead Wood Dynamics	- Completed all plots remaining from 2008 survey - Fixed all measurement errors from 2008	82.5	13.8
Infrastructure/ Equipment Maintenance and Other	- Quad maintenance, vehicle maintenance, equipment purchases and maintenance, - Camp maintenance/set-up and take-down - Field-site maintenance (trail clearing/signage etc.) - Tours of EMEND - Travel between Edmonton and EMEND	80.5	13.4
Tree Plot and Compartment Maintenance	- Block boundary marking	37	6.2
Office Work	- Data management - Camp management/administration	35.5	5.9
Training, Orientation and Safety	- Bear awareness - Quad safety course - Orientations - Data collection training	21.5	3.6
Hydrology	- Piezometer and well measurements	11	1.8
Prescribed Fire	- mapped trees and snags in permanent sample plots - marked fuel lines in preparation for burns	7.5	1.3
	Total:	**600**	**100**

Table 2. Number of person-days EMEND Research Facility was used by individuals involved in Core research from May 4 – August 31, 2009.

				Number of Days at EMEND Camp				
Project	**Camp User**	**Affiliation**	**Title**	**May**	**Jun**	**Jul**	**Aug**	**Total**
Core Research	Andersen, Karen	U of A	Core Crew	20	25	21	24	90
	Buskas, Melissa	U of A	Core Crew	20	18	21	24	83
	Edwards, Jason	U of A	Core Crew	20	23	21	24	88
	Hahn, Charlene	U of A	Core Crew	20	25	21	24	90
	Margel, Rebecca	U of A	Core Crew	15	25	21	12	73
	Riddel, Carmen	U of A	Core Crew	15	24	21	24	84
	Wong, Elizabeth	U of A	Core Crew	20	25	21	24	90
	Bourassa, Stephane	U of A	Research Technician	8	4	5	4	21
	Johnson, Derek	CFS	Research Technician	0	0	0	9	9
	Abele, Suzanne	U of A	Volunteer	0	0	0	4	4
	Garcia, Sergio	U of A	Volunteer	0	0	5	0	5
	Pinzon, Jaime	U of A	Volunteer	5	0	0	0	5
			Category 1 Research Projects - Totals:	**143**	**169**	**157**	**173**	**642**

Table 3. Number of person-days EMEND Research Facility was used by individuals involved in non-core (category 2) research from May 4 – August 31, 2009.

				Number of Days at EMEND Camp				
Project	**Camp User**	**Affiliation**	**Title**	**May**	**Jun**	**Jul**	**Aug**	**Total**
Arthropods and Invertebrates								
(Spence)	Katulka, Jeremy	U of A	Research Assistant	0	17	14	12	43
	Lee, Seung-Il	U of A	PhD Student	4	21	14	12	51
	Wood, Charlene	U of A	MSc Student	1	0	0	0	1
							Subtotal:	**95**
Wet Areas Mapping	Campbell, David	UNB	MSc Student	0	0	0	18	18
	Josephson, Samuel	UNB	Research Assistant	0	0	0	12	12
	Noseworthy, Josh	UNB	Research Assistant	0	0	0	12	12
	White, Barry	Gov AB	Government Representative	0	0	0	5	5
							Subtotal:	**47**
Soils	Rahi, Ali	UBC	PhD Student	0	0	4	0	4
(Quideau/Kishchuk)	Rahi Assistant	UBC	Research Assistant	0	0	4	0	4
							Subtotal:	**8**
Silviculture	Lieffers, Victor	U of A	Researcher	3	0	0	0	3
(Lieffers)	Serben, Candace	U of A	Research Assistant	11	0	0	0	11
	Sherritt, Ryan	U of A	Research Assistant	12	5	0	0	17
	Solarik, Kevin	U of A	MSc student	23	5	0	0	28
							Subtotal:	**59**
			Category 2 Research Projects - Totals:	**54**	**48**	**36**	**71**	**209**

Table 4. Number of person-days EMEND Research Facility was used by individuals involved in core (Category 1) and non-core (Category 2) related research from September 1– 30, 2009.

Project	Camp User	Affiliation	Title	Number of Nights
Core Research (Category 1)	Edwards, Jason	U of A	Field Coordinator	21
	Hahn, Charlene	U of A	Data Manager	21
			Subtotal:	**42**
Arthropods and Invertebrates (Category 2)	Bourassa, Stephane	U of A	Research Technician	4
	Lee, Seung-Il	U of A	PhD Student	4
			Subtotal:	**8**
Wet Areas Mapping (Category 2)	Campbell, David	UNB	MSc Student	3
	White, Barry	Gov AB	Government Representative	3
			Subtotal:	**6**
			Category 2 Research Projects - Total:	**56**

Table 5. EMEND Core vehicle mileage from May 4 – October 30, 2009.

Vehicle	Total Kilometers
Trucks	
U of A # 290 (Yukon)	11090
U of A # 260 (Truck)	7883
Rental Van	5500
Quads	
U of A Yellow 500 (Lic # US952)	1137
U of A Yellow 500 (Lic # US953)	1167
U of A Yellow 500 (Lic # US954)	1598
U of A Yellow 500 (Lic # US955)	1264
DMI Red 450 (Lic # PJ766)	983
DMI Red 350 (# 404)	882
DMI Yellow 350 (# 405)	901
Canfor Red 350 (# 1268)	Odometer does not work
Canfor Orange 350 (# 1267)	Did not use

Table 6. EMEND Research Facility fuel use by work group.

Work group	Truck gasoline (L)	Quad gasoline (L)	Equipment gasoline* (L)	Total gasoline (L)
EMEND Core	776	498	10	**1284**
Spence Lab		128		**128**
Lieffers Lab		20		**20**
Total	**776**	**646**	**10**	**1432**

Note: * Equipment includes chainsaws, lawnmowers, and brush saws.

Table 7. EMEND master student project status.

Student	Affiliation / Supervisor	Project Title	Project Status
Abele, Suzanne	University of Alberta - Macdonald / Spence	Gastropod diversity in boreal mixedwood forests of northwestern Alberta.	Writing Thesis
Bodeux, Brett	University of Alberta - He	Spatial patterns of boreal forest moth diversity	Writing Thesis
Longpré, Félix	Université du Québec à Montréal - Work	Carabidae trophic interactions	Writing Thesis
Pengelly, Chris	University of Calgary - Carter	Impacts of forestry on the bumble bee-influenced pollination community	Defended Fall 2009
Pyper, Matthew	University of Alberta - Spence / Langor	Clumped retention methods and their importance in conserving biological diversity	Defended Spring 2009
Solarik, Kevin	University of Alberta - Lieffers	Tree mortality	Writing Thesis
Wood, Charlene	University of Alberta - Langor / Spence	Saproxylic beetle – coarse woody debris habitat associations	Data Collection / Writing Thesis

Table 8. EMEND doctoral student project status.

Student	Affiliation / Supervisor	Project Title	Progress
Bergeron, Colin	University of Alberta -Spence	Effect of fire behavior on dynamic associations of insects and plants at the landscape level.	Writing Thesis
Blanchet, Guillaume	University of Alberta, - He	Spatial patterns of EMEND biodiversity	New 2009
Caners, Richard	University of Alberta -Macdonald	Patterns of bryophyte diversity in response to partial harvesting in northern mixedwood boreal forests.	Writing Thesis
Chavez, Virginia	University of Alberta -Macdonald	Patterns and causes of variation in understory plant diversity and composition in the mixed-wood boreal forest of Alberta.	Writing Thesis
Diaz, Irma	University of Alberta -Quideau / Kishchuk	Effects of harvesting, fire and climate change on forest floor mesofauna in the boreal mixedwood forest.	Writing Thesis
Fagaria, Manphool	University of New Brunswick	White spruce genetics following harvesting in the boreal forest	Writing Thesis
Kamunya, Esther	University of Alberta -Spence	Dynamics of a Lepidoptera (moth) community in managed boreal forests of North Western Alberta, Canada.	Writing Thesis
Lee, Seung-Il	University of Alberta -Spence	Saproxylic beetles in spruce deadwood	New 2009
Pinzon, Jaime	University of Alberta -Spence	Composition and structure of epigeaic, understory and canopy spider assemblages in mixedwood forest cover-types after variable retention harvest	Writing Thesis
Schwarzfeld, Marla	University of Alberta - Sperling / He	Parasitic wasp diversity in the boreal forest	Data Collection; Upgraded project from MSc to PhD
Shorthouse, David	University of Alberta - Spence	Boreal spiders as bioindicators of forest disturbance and management.	Writing Thesis
Swallow, Mathew	University of Alberta - Quideau / Kishchuk	Controlled burning influence on forest floor processes.	Data Collection; Upgraded project from MSc to PhD

Appendix 2: EMEND MOU

Memorandum of Understanding

April 2009

for Collaborative Research at the Ecosystem Management Emulating Natural Disturbance (EMEND) Project.

BETWEEN

[Name of Researcher, Name of Research Institute], hereinafter referred to as the "Collaborator"; and, where Collaborator is a graduate student, **[Name of Collaborator's primary supervisor, Supervisor's Research Institute]**, hereinafter referred to as the "Supervisor"

AND

the **Ecosystem Management Emulating Natural Disturbance (EMEND) Project Management Committee**, hereinafter referred to as the "Committee."

WHEREAS the Collaborator and Supervisor and the Committee (hereinafter collectively referred to as the "Parties") recognize that the Ecosystem Management Emulating Natural Disturbance Project Research Facility, Research Site, and Database, hereinafter referred to as "EMEND Infrastructure", have been installed and are operated through the University of Alberta and its partners in EMEND;

WHEREAS the Parties recognize the EMEND Project is a collaborative research project involving numerous funding agencies, research personnel, and partners working together toward common goals;

WHEREAS the Parties recognize the roles and responsibilities, both financially and otherwise, as listed in Roles and responsibilities of the Committee and Roles and Responsibilities of the Collaborator;

WHEREAS the Parties recognize the EMEND Project, as directed through the Committee, has defined long-term core research goals (Core research) to which collaborator research projects address ecosystem-process questions to add additional capacity to these goals;

WHEREAS the Parties recognize the EMEND Infrastructure is in place to serve primarily the core research goals but is made available to the Collaborator for research purposes under the terms listed in **Roles and Responsibilities of the Collaborator**.

THE PARTIES therefore agree as follows:

Definitions

EMEND Project
The encompassing identity representing the research infrastructure, research projects, Collaborators, the Committee, and all products (images, reports, manuscripts, theses, etc.) produced in association with the collaborative research.

EMEND Infrastructure
The EMEND Research Site(s), Research Facility, and Database.

EMEND Research Site
Specifically, the EMEND Research Site refers to the 1000 ha of experimental land base established through harvesting and prescribed burning treatments. However, the Research Site may expand to include additional land base as defined by the Committee.

EMEND Research Facility
The infrastructure established to support research at EMEND. The facility includes, but may not be limited to, the cooking and residence facilities west of Dixonville, AB and the associated equipment such as ATVs, vehicles, and field equipment.

EMEND Database
The EMEND Database is the central data storage repository located at the Northern Forestry Centre, Edmonton and is maintained by the EMEND Database Administrator and Manager.

Parties
The Collaborator and Supervisor and the Committee as a cooperative group, not a legal partnership.

Research Personnel
Includes undergraduate and graduate students, postdoctoral fellows, research assistants, research associates, technicians, programmers, analysts, etc., who may contribute to the research activities of a Collaborator.

Researcher
Anyone who carries out research related activities.

Core Research
Experiment-wide research projects as directed by the Committee to meet the central goals and objectives of the EMEND Project. Core Research is supervised by the EMEND Field Coordinator and EMEND Data Manager.

Collaborator Research
Non-Core research studies conducted to address ecosystem process questions.

EMEND Field Coordinator
Person responsible for management of EMEND Infrastructure and Core research program including the delivery of a Health and Safety Program, and Environmental Management System.

EMEND Data Manager
Person responsible for management of Core data and assisting the EMEND Field Coordinator.

Roles and responsibilities of the Committee:

In general, the Committee directs all research and logistical activities of the EMEND Project. The Committee is the central management body of the EMEND Project and consists of selected representatives from EMEND Partners.

1. The Committee sets the strategic research, funding, and technology transfer goals and objectives for the EMEND Project.

2. The Committee is responsible for securing funding for Core research activities and EMEND Infrastructure operations and maintenance.

3. The Committee is responsible for reviewing and approving all research activities at the EMEND Infrastructure. The Committee holds the authority, as designated through this agreement, to approve and deny access to the EMEND Infrastructure.

4. The Committee reserves the right to charge access fees for use of EMEND Infrastructure.

5. The Committee is responsible for the hosting and maintenance of the EMEND website and database.

6. The EMEND Project operates under a formal health and safety program, and an environmental management system (EMS). The Committee requires research facility users to comply with these programs while staying at the camp or conducting work at the research site(s).

Roles and responsibilities of the Collaborator:

In general, a collaborator is a research partner utilizing any aspect of the EMEND Infrastructure to address ecosystem-process level questions. Collaborator projects should be relevant to the overall goals of EMEND.

1. The Collaborator will agree to and sign the EMEND Collaborative Research Agreement (this agreement) prior to conducting activities in collaboration with the EMEND Project.

2. The Collaborator will submit a research proposal for approval by the Committee prior to conducting activities in collaboration with the EMEND Project.

3. The Collaborator is responsible for securing all funding for personnel, materials, and equipment required to conduct their research study at EMEND.

4. The Collaborator is responsible for securing all funding related to primary dissemination materials (*i.e.* manuscripts and thesis).

5. The Collaborator shall work directly with the EMEND Field Coordinator prior to commencing any field work to ensure efficient use of resources, to ensure the proposed research study will not interfere with other studies, and to ensure Collaborator has a full understanding of EMEND Safety protocols and procedures.

6. The Collaborator agrees to submit research data as outlined in Schedule 1: EMEND Data and Database Terms upon completion of Collaborator's study.

7. The Collaborator agrees to submit, on a continual basis, required research output and technology transfer products as identified in Schedule 2: Technology Transfer and Communications.

8. The Committee encourages supervisors of graduate student Collaborators to ensure all items listed in Schedule 3: Requirements for Study Completion are completed prior to final approval of a research thesis.

9. The Collaborator will ensure appropriate acknowledgements of all funding agencies and partners, as well as all core research data used, are provided in all communication and technology transfer products (*i.e.* manuscripts, research notes, presentations, posters, etc.) resulting from Collaborator's study.

Schedule 1: EMEND Data and Database Terms

As directed by the Committee, the EMEND Database is hosted and maintained by Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre. The EMEND Database provides the Collaborator with the opportunity to archive and distribute scientific data with other participants in the EMEND project. Additionally, online access to the EMEND Database, available to all EMEND Parties, provides the Collaborators with the tools to access and maintain their contact, study, publication and presentation information. The intent of the database is to serve the short term and long term objectives of EMEND by creating a central storage location for all EMEND data. This agreement will not supersede any existing data ownership rights held by research institutions or funding agencies.

Below are the general conditions and terms each Collaborator in EMEND is to agree with concerning the submission and archiving of their data in the EMEND Database.

1. A single validated electronic copy of all data and metadata must be submitted to the EMEND Database upon completion of the Collaborator research project.

2. The metadata for each data set must be submitted with the data to the EMEND Database Administrator.

3. Proprietary rights of data submitted to the EMEND Database will remain with the appropriate Collaborator and the EMEND Project. The distribution of Core data will be managed at the discretion of the data owner through the use of the EMEND Data Use Agreement. The distribution of Collaborator data will be at the discretion of the data-owning Collaborator.

4. The Committee may require additional conditions to be met by Collaborators prior to distribution of Core data (*i.e.* updated study information, submission of data to the database, submission of a thesis copy to the Committee, *etc.*)

Schedule 2: Technology Transfer and Communications

The EMEND Project undertakes numerous technology transfer and communications initiatives to ensure research results are adequately disseminated to EMEND partners and general audiences. In order to do so effectively, the Committee relies on Collaborators for continual updating and final submission of a number of technology transfer products.

1. The Collaborator is to update their online study information and funding on an annual basis until completion of the study. Upon completion of the study their study information and funding must be updated to indicate the completion of the study (a final results summary).

2. The Collaborator is to submit to the EMEND Field Coordinator, or online via the EMEND Database, the citation and, preferably an electronic copy, of any technology transfer product (i.e. posters, presentations, notes, etc.) produced from EMEND related research.

3. The Collaborator is to submit a copy of any completed theses and/or publications to the Committee.

4. The Collaborator is encouraged to attend and present study findings at the annual EMEND workshop.

5. The Collaborator is to submit at least one partner reviewed Research Note upon study completion.

6. The Collaborator agrees, by signing of this agreement, to allow EMEND to use their name, work related contact information, and study information and results in EMEND related technology transfer products (*i.e.* website, posters, presentations, pamphlets, tour trails, *etc.*)

Schedule 3: Checklist of Requirements for Study Completion

These checklists are to assist the Collaborator with ensuring all requirements listed in this Memorandum have been met. The Committee also asks any graduate student supervisors to ensure these checklists are complete prior to awarding any degrees.

Annual requirements:

	Study information, funding, and results have been updated on the EMEND database.
	Citations, and preferably copies, of any manuscripts, presentations, theses, reports, etc. have been submitted to the EMEND Field Coordinator or the EMEND Database.
	Attend and present research study and findings at the annual EMEND workshop.

Study completion requirements:

	Study information, funding, and results have been updated on the EMEND database.
	Citations, and preferably copies, of any manuscripts, presentations, theses, reports, etc. have been submitted to the EMEND Field Coordinator or the EMEND Database.
	The Collaborator is to submit at least one partner reviewed Research Note upon study completion
	The Collaborator is to submit a copy of any completed theses and/or publications to the Committee
	A single validated electronic copy of all data and metadata must be submitted to the EMEND Database upon completion of the Collaborator research project. The metadata for each data set must be submitted with the data to the EMEND Database Administrator.

Signed by the Collaborator

The Collaborator acknowledges and agrees to fulfill their roles and responsibilities as identified under this Memorandum of Understanding and its accompanying Schedules.

_____ _____

Signature Date

_____

Name (please print)

Signed by the Collaborator's Supervisor (where applicable)

_____ _____

Signature Date

_____

Name (please print)

Signed by the Committee

The Committee acknowledges and agrees to fulfill its roles and responsibilities as identified under this Memorandum of Understanding and its accompanying Schedules.

_____ _____

Signature (on behalf of Committee) Date

_____

Name (please print)