



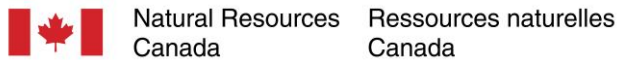
EMEND SYMPOSIUM 2017

Key Takeaways and Future Directions

Peace River, June 6; Edmonton, June 8

Report Prepared by S. Odsen & M. Pyper

Thanks to our partners for their generous support!



FOREST RESOURCE
IMPROVEMENT
ASSOCIATION OF ALBERTA



Peace River Pulp Division

EMEND SYMPOSIUM 2017

Key Takeaways and Future Directions

On June 6 and June 8, 2017, a mix of foresters, landscape planners, government scientists, community members, and students gathered to hear current and former graduate students describe their work at the EMEND research site. The presentations and discussions were part of the EMEND Symposium 2017, hosted in Peace River and Edmonton. Some attendees were familiar or even involved with the EMEND project, while others were just then learning about the world-class experiment operating a short drive from their homes. All of them came away with new insights about ecosystem-based management and the diverse projects being conducted by a new generation of researchers.



Laureen Echiverri discusses Wet Areas Mapping and understory vascular plants.

Why a Symposium?

Every year, graduate students working at EMEND hit the road and visit the offices of three major partners: Government of Alberta, Daishowa-Marubeni International, and Canfor. This year, the EMEND partners wanted to go big, and invite a broader audience to learn about the many exciting projects that are either ongoing or wrapping up.

To reach this larger audience, we hosted sessions in both Peace River and Edmonton, in hopes of reaching a mix of practitioners, planners, technicians, and the public. Our goal was to raise awareness of EMEND, provide an update on the most recent results coming out of the project, and discuss potential applications of the research.

What is EMEND?

“EMEND” stands for Ecosystem-based Management Emulating Natural Disturbances. Located roughly 90 km northwest of Peace River, Alberta, EMEND was established in the late 1990s to test important hypotheses around retention harvesting as an alternative to conventional clear-cutting.

EMEND's Experimental Design

In the winter of 1998-99, experimental harvests were applied to 10-hectare cutblocks across the project area. Harvest treatments leaving behind 2% (clear-cutting), 10%, 20%, 50%, and 75% of trees as residuals were applied to four different forest types (deciduous, deciduous with a spruce understory, mixedwood, and coniferous). EMEND is one of the largest such forestry experiments in the world, and has supported research ranging from biodiversity, to carbon dynamics, to Wet Areas Mapping, and more.



Zoltan Domahidi crosses a beaver dam at the northern end of EMEND.

Facilitated Discussion Session: What We Heard

To round out each day of talks, we hosted a facilitated discussion to capture and discuss what we learned. This session consisted of a series of one-on-one interviews among attendees, with a focus on four key questions. The discussion that followed is summarized below (see Appendix B for the full transcription of the notes recorded by participants).

1. What were some new or unexpected learnings?

The broad range of audience members was reflected in the answers to this question. For some community members in Peace River, the existence, scope, and cross-disciplinary nature of EMEND were surprising. We were very excited for the chance to meet our neighbours and show them some of the work being done nearby!

In both Edmonton and Peace River, many attendees were learning about Wet Areas Mapping for the first time, or were surprised to learn of the extent of the project and potential applications. Many were surprised to learn that forestry companies are already using Wet Areas Mapping for access management, while others were interested to hear of the potential uses in directing placement of either high-retention treatments or patches of residual trees. Laureen Echiverri, for example, recommended using Wet Areas Mapping to ensure that retention patches are allocated across a range of site wetness to promote understory plant diversity, rather than concentrating residual trees on a single site type.

In both sessions, Colin Bergeron’s presentation introduced a novel concept, Ecosystem Memory. Using data from several plant and animal groups, Colin was able to track which taxa responded most strongly to harvest treatments, and which were more strongly influenced by the mixed fire regime history of the last three centuries. By identifying species and groups with a strong ecosystem memory, Colin has suggested that we may be able to manage biological legacies to improve long-term forest resilience.

EMEND and Wet Areas Mapping: Synthesis Lies Ahead

During both sessions, participants heard multiple talks discussing the relationships between site wetness (as predicted by the depth-to-water index) and biodiversity. Each student had taxa-specific recommendations for where to place retention, but it can be difficult to make decisions based on these specific results. We are working on a synthesis of recommendations based on the results of the Wet Areas Mapping projects taken together—Stay tuned!

2. What questions or knowledge gaps do you have after hearing the talks?

Several questions at the end of the day revolved around how the work at EMEND might be scaled up for landscape-level planning. Can the results found at the cutblock level be used to plan retention patterns at a larger scale, and can they be applied to other forests in Alberta (e.g., pine)? Similarly, questions remained around how Wet Areas Mapping could be used for larger-scale landscape planning.

Also at the top of attendee’s minds was how to turn these findings around and apply them in the real world. Questions included a desire for more concrete guidance around retention and rotation age; specifically, synthesizing the findings from many studies to produce recommendations at a higher level (e.g., going from “what is good for mosses?” to “what is most beneficial overall?”). As Ellen Macdonald demonstrated in her keynote presentation, there is no consistent retention “threshold” that benefits biodiversity, and some taxa do better at low retention levels than others. In many cases, the findings from EMEND support using a range of retention levels and patterns—an important challenge will be determining just what this might look like.



Attendees in Edmonton interview each other during the afternoon breakout session.

3. How might the findings at EMEND be applied in your area of work?

A primary outcome for attendees was a better overall understanding of the benefits of retention harvesting, with some concrete examples of taxa that responded positively or recovered more quickly at higher retention levels. A subset of projects also examined biodiversity responses to differences in retention pattern, which may be used to guide future retention planning. Both Caroline Franklin and Seung-Il Lee found that retention patches more effectively conserved old-forest species (understory plants and beetles, respectively), and Seung-Il further found that dispersed retention was important for reducing patch blow-down.

One interesting and thought-provoking suggestion was that the findings at EMEND, and use of Wet Areas Mapping, could be used to identify areas with high conservation value (e.g., biodiversity and/or ecosystem services). These areas could potentially be set aside and traded or otherwise compensated as conservation offset areas.

The long-term nature of EMEND additionally provoked discussion around better understanding boreal forest recovery following disturbance, and raised questions around whether these learnings could be applied to reclamation. Others reflected on Colin's findings around the mixed fire regime of the mixedwood forest, and questioned whether harvest rotation ages are due for an update that better reflects the variable rotation age that occurs through natural disturbance.

4. Specific to Wet Areas Mapping (WAM), what did you learn that could be applied in your work in the future?

Many attendees were excited to hear about the work using Wet Areas Mapping, and had many ideas for how this could be integrated into their own work. Attendees suggested potential or existing applications including planning retention patch locations, managing conservation lands, supporting watershed management planning, and identifying sensitive versus stable sites for summer logging.

A recurring theme, especially among practitioners, was using WAM to avoid making mistakes in the field. Many wet features are difficult to spot, and may be dry most of the year, yet be highly important for biodiversity. Matt Robinson's presentation on the importance of ephemeral pools as breeding grounds for wood frogs clearly illustrated the value of these difficult-to-locate features, and many felt WAM may be a useful tool for ensuring these sites are protected during harvest.

Finally, applications beyond forestry were considered. It was seen as a tool with potential applications in restoration and reclamation, including planning for access, site preparation, and species matching, and possibly for predicting recovery. There was also a keen interest in the potential applications for better understanding, and possibly managing, soil carbon dynamics.



Colin Bergeron presents his group's results during the afternoon breakout session.

Where Do We Go from Here?

The value of EMEND was explored in many ways during the EMEND Symposium, and a key theme was the importance of long-term research for understanding not just the effects of forest harvesting, but also exploring new ecological concepts like Ecosystem Memory. Just as important as long-term data, however, is a long-term connection with the people tasked with taking this information and applying it on the ground. To this end, we took a traditional conference format and turned it on its head by asking all of you: what applications do you see from EMEND, and what questions do you have for future researchers?

Some key knowledge gaps and future questions emerged from our discussions. These are summarized in the table below, and will be considered in future discussions of EMEND research priorities. A potential future project may be synthetic work that parallels the current work to synthesize the ecological results at EMEND, but with a focus on synthetic outcomes for management.

Key Knowledge Gaps and Future Questions

How do we go from graphs to practice? How do we scale up to the landscape level?

A consistent recommendation springing from EMEND has been advocating for variability in retention prescriptions. As part of an adaptive management approach, it may be time to test this hypothesis by studying larger harvested landscapes, allowing researchers to make more concrete recommendations.

What is an “optimal” approach that considers multiple values?

Future work may address a cost-benefit analysis of the ecological and economic tradeoffs inherent to retention harvesting. A socio-economic study would likewise help assess how retention harvesting is perceived and whether it benefits boreal communities (including Indigenous communities).

Key Knowledge Gaps and Future Questions

How would the results at EMEND differ on managed cutblocks?	Common industry practices including site preparation, planting, and herbicide application all lead to young stands that differ from the natural regeneration strategy followed at EMEND. Future work examining stands that combine retention harvesting with typical intensive silviculture and management would help will this gap.
Can these lessons be carried over to reclamation?	Can these findings, as well as tools including Wet Areas Mapping, be used to improve reclamation or restoration efforts? Ideas that could be tested include using Wet Areas Mapping to improve species matching or to better manage carbon stocks.
Can we analyse interactions among multiple taxa?	We have data across many taxa - if we combine them, what patterns might we find? One example would be to see whether invertebrate and songbird responses to retention are interrelated.
Applications for Ecosystem Memory?	What strategies can we employ to enhance the ecosystem memory of managed forests and reduce the risk of state change? How can we use ecosystem memory to improve forest resilience against climate change?
How does burn history reflect topography?	Can we detect a relationship between the depth-to-water index and the burn history of a forest?
How can Wet Areas Mapping be used for larger-scale planning?	Do the relationships between WAM and various forest parameters hold at the landscape scale? Can WAM be used as a tool for better managing carbon stocks? Can we test other WAM applications (e.g. conservation area management)?

EMEND was built from partnerships, and collaboration continues to be a cornerstone as this forestry experiment evolves into something larger and broader than originally imagined. Keep your eyes and ears open as the next generation of researchers works to fill the gaps and explore new avenues of inquiry. We will see you at the next Symposium!

Appendix A. Symposium Agenda

EMEND Symposium 2017: Agenda

June 6, 2017
Peace River, Alberta
Chateau Nova Hotel
Elk Room

June 8, 2017
Edmonton, Alberta
Lister Conference Centre
Wild Rose Room

- 8:30** **Opening Remarks**
- 8:45** **EMEND: A Ten-Year Synthesis**
Ellen Macdonald
- 9:30** **EMEND: A Look at Ecosystem Memory**
Colin Bergeron
- 10:15** **Coffee Break**
- 10:30** **Influence of timber retention on wood frog abundance in post-harvest mixedwood forests**
Matthew Robinson
- 10:50** **Vascular plant and mammal responses to variable green-tree retention harvesting**
Caroline Franklin
- 11:10** **Nesting preference and productivity of cavity nesting owls in managed landscapes**
Zoltan Domahidi
- 11:30** **Breeding songbird responses to retention harvesting: a 15-year perspective**
Sonya Odsen
- 11:50** **Recovery of a boreal carabid fauna 15 years after variable retention harvest**
Linhao Wu
- 12:10** **Lunch**
- 1:10** **Comparisons of large-scale variable retention experiments in the world and the true value of EMEND**
Seung-Il Lee
- 1:30** **Identifying post-harvesting recovery patterns of understory vegetation using the depth-to-water index**
Laureen Echiverri
- 1:50** **Influence of depth-to-water on bryophyte community response to variable retention harvesting in managed boreal forest**
Samuel Bartels
- 2:10** **Topographic influences on soil respiration in the boreal forest**
Paul Sewell
- 2:30** **Coffee Break**
- 2:45** **Looking for Synergies and Applications with a Focus on Wet Areas Mapping at EMEND**
- 4:15** **Concluding Remarks**
- 4:30** **Closure**

Appendix B. Results of Facilitated Sessions

This appendix includes the raw documentation of the results of our interview-style session in each afternoon of the EMEND Symposium.

Question 1

What are 2–3 new or unexpected things you learned today?

Synthesis	
Peace River	Edmonton
<ul style="list-style-type: none"> • WAM: new, surprised, applications • Ecosystem Memory • Scope of EMEND and other research projects • Retention size and placement: usefulness of dispersed retention • Scale of research on different organisms • Owl nest boxes: flying squirrels; owls not using the boxes 	<ul style="list-style-type: none"> • Not summarized by group.

Raw notes	
Peace River	Edmonton
<ul style="list-style-type: none"> • Depth of vernal pools affected frog survivorship • Scale is important for birds and megafauna • WAM is really important • Lots of good research!! • EMEND was new, WAM, and predictions of tree species makeup • Drier sites for deciduous retention for bryophytes (x4)¹ • Dispersed retention effective • Ecosystem memory - time and intensity of disturbance: pre and post soil condition measurements, no difference • How (or can) you provide a black and white answer? 	<ul style="list-style-type: none"> • Size and scope of EMEND <ul style="list-style-type: none"> ○ Connection with WAM ○ Value of EMEND in context of world research ○ Limitations of short-term studies • Ecosystem memory <ul style="list-style-type: none"> ○ Different memory pools interacting? • Retention effect on biodiversity (success!) <ul style="list-style-type: none"> ○ No early effect ○ Spiders/beetles indicator species (return to predisturbance condition) ○ Benefits of aggregated over dispersed retention ○ Composition still changing at 15 years ○ Speed of 50-75% recovery

¹ See box on page 4 for clarification on this item.

- Owls do not necessarily use owl boxes, or there may not be that many owls.
- WAM is getting more fine-tuned. Looking forward for new modelling.
- Specific EMEND species
- Originating wildfire years for EMEND
- Ecosystem memory concept (new to several)
- Similar responses of taxa to disturbance
- Did not fully understand scope and timelines of EMEND
- Similar projects around the world
- Flying squirrels live in owl nestboxes
- 50 cm depth of water for wood frog to complete life cycle
- Utilizing WAM for retention placement
- Surprised by owl's inability to find nestboxes
- Varying retention placement between wetter and drier sites on different stand types
- Potential sensitivity of dry sites and retention placement
- Thought there would be more impact from logging
- Industry is interested in retention placement
- Number of people who know about WAM
- Songbird research - happy to hear abundance come back after 17 years

- Scale differences in effects/species
- Owls!
 - Nests and predation
- Frogs: vernal pools, importance and connectivity
- Earthworms
- Soils: carbon in duff
 - Lack of differences between harvest and control
- WAM
 - Spatially direct retention placement
 - So many different applications
 - Thresholds can be set
- Fire regimes
 - Overlapping recruitment/multiple cohorts
 - Mixed intensity

Question 2

What questions or knowledge gaps do you have after hearing the talks today?

Synthesis	
Peace River	Edmonton
<ul style="list-style-type: none"> Not summarized by group. 	<ul style="list-style-type: none"> How do we go from graphs to practice? Carbon stocks! Can we do this in different ecosystem types? E.g. pine Understanding community ecology e.g. food webs

Raw notes	
Peace River	Edmonton
<p>WAM</p> <ul style="list-style-type: none"> How can LiDAR/WAM facilitate large scale, landscape level planning? Can EMEND's data/design/results regarding using WAM to predict other forest parameters be used in larger scale landscape planning? Does the WAM reflect historical wildfire data? What resources are required to collect LiDAR data to generate WAM products? Drones? What actual question will be addressed by WAM and carbon dynamics at EMEND? <p>Retention</p> <ul style="list-style-type: none"> How are the block-level retention questions/studies at EMEND scaled up to landscape level inferences? Differences in microclimates in between aggregate and dispersed retention, control and clearcut sites at EMEND? Can we pull together multiple "fine filter" studies on retention to build a broad, robust, practical tool to inform practitioners on the implications of various retention strategies? How does this synthesis occur? 	<ul style="list-style-type: none"> As a practicing forester, what is the measurable? - Exacts for retention What are the results at 20 years? Other species (plant or animal) impacted by retention Will there be more studies on small animals? Abundance? Distribution? We should have more studies on cohort fire trees - what are other disturbances besides fire If consistent disturbance can wipe out EM, how can we prevent that? How do we go from graphs to practice? How does burn history reflect/influence topography or vice versa? Minimum sizes of retained patches Value of vernal pools and clear cuts More about depth to water table and water table index Knowledge gaps - validating models for future refinement Carbon stocks! Can we do this in difference ecosystem types? (e.g. pine) How does it affect growth and yield Know more about the NRV of depth to water and moisture

<ul style="list-style-type: none"> • How does snag creation post-fire relate to single-tree retention during harvest? • What is “optimal,” considering environmental, economic, and practical standards? <p>Disturbance</p> <ul style="list-style-type: none"> • How do we account for large, significant, and rare events, in terms of planning for resilience? • How does herbicide impact forest variable in conifer stands after disturbance? • How would the measured parameters of EMEND change if conifer stands were planted and treated with herbicide, as per usual business practices in AB? • What is resilience of managed vs an unmanaged stand? <p>Other</p> <ul style="list-style-type: none"> • Is there a more holistic rotation term that is not just centered around maximum fibre productivity? 	<ul style="list-style-type: none"> • Understanding community ecology e.g. food webs • Do cutblocks meet regen standards? E.g. site prep, natural regen, planted
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Question 3

What EMEND findings offer opportunity for improvements in your area of work (policy, certification, stewardship etc.)?

Synthesis	
Peace River	Edmonton
<ul style="list-style-type: none"> • What we've learned needs to be applied at the landscape level • Findings need to be made available (especially as tools) - people can be encouraged to use them and understand <i>why</i>. • WAM has important potential applications for biodiversity, soil carbon, operations, watershed management, and managing conservation areas. 	<ul style="list-style-type: none"> • Apply understanding of recovery times to other contexts, e.g. reclamation, and better understanding of effect of retention on recovery time. • Provides basis for using retention in forestry but work remains to help scale it up and find economically feasible applications. • Suggests there may need to be variability in, or changes to, rotation age.

Raw notes	
Peace River	Edmonton
<ul style="list-style-type: none"> • WAM has great potential for finding features, e.g. ephemeral ponds, and avoiding mistakes in the field. • Opportunities for more research. • Summer logging - is the model good for both frozen and unfrozen conditions? Could be used to ID sensitive sites? • Predicting and managing soil carbon. • WAM for finding best location for forest retention patches (automated!). <ul style="list-style-type: none"> ◦ Field work becomes ground-truthing/verification instead of discovering. • WAM could be used for management strategies for conservation lands or even agriculture. • Findings from EMEND have applications in many different places because so many of the questions and variables are interrelated. • Using to understand how the disturbance regime influences carbon distribution. 	<ul style="list-style-type: none"> • Species thresholds are good to know and edge effect thresholds • EMEND gave idea of recovery time with different retention • How long biodiversity can improve after reclamation (for <i>oilsands work</i>) <ul style="list-style-type: none"> ◦ WAM: planting, access • For forestry: solid basis for variable retention. Their current dilemma is volume vs ecological benefits <ul style="list-style-type: none"> ◦ want to review internal retention amounts ◦ how to scale up these results to larger blocks and landscape levels ◦ how to correlate WAM tools to natural, e.g. biodiversity and carbon • finding of how long pure spruce forests take to develop → implications for management and rotation <ul style="list-style-type: none"> ◦ Do we need variability in rotation age? • WAM: use for best practices in sensitive areas like boreal wetlands (policy use)

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| <ul style="list-style-type: none"> • Start thinking about harvest in terms of ecological rotation age instead of harvest rotation age. • Absolutely more use of LiDAR and WAM in government (and revelations around how siloed information is - this point was from a government GIS staffer who had no idea WAM existed). • Any info from EMEND around pest species? Opportunities for future research? • Opportunities for studies linking multiple taxa (any way to use biotic data as independent variable?). • Applying findings to model/predict areas with high conservation value or ecosystem services, protect these sites, and trade them as conservation offset areas. Opportunity for compensation for high-value retention patches? • Improving knowledge of social and traditional values, not just biodiversity. • Variety is key: targeting a range instead of narrowly focusing on a single target. • WAM could be used as a tool for watershed management planning. | <ul style="list-style-type: none"> • For land stewardship: understand more about carbon credit/carbon stores on site • From a wet areas modeller: reminder of how complex these forest systems are, 1000s of species, can model something but is important to see biological linkages • Good explanation of how to apply patterns of variable retention • Still confusion/unclear whether to apply aggregate or dispersed • Researcher: these presentations help to ask the <i>next</i> set of questions, perhaps to apply in operational settings? Perhaps to pine? • WAM could be used for planting, to assess alternative access. |
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Question 4

Specific to Wet-areas mapping, what did you learn that could be applied in your work in the future?

Synthesis	
Peace River	Edmonton
<ul style="list-style-type: none"> • Land-use planning opportunities • Species-related decision-making • Conservation of important areas • Integrity of the data is important 	<ul style="list-style-type: none"> • Management planning (industry, conservation, reclamation) • Overall better understanding to allow promotion and advocacy • Future research • Use for understanding carbon dynamics

Raw notes	
Peace River	Edmonton
<ul style="list-style-type: none"> • Recognize areas that attract other mammals/species that may be sensitive to water loss, change of temperature. • Use WAM to ferret out vernal pools • Trail maintenance • Provide potential tool for other grad students to assist in their research • Caution on use of WAM data because it tends to be taxa-specific • Have a better understanding of north/Peace region for restoration purposes • Help to identify summer ground for harvesting activities • Investigate flow initiation prior to making planning decisions • Can have potential impacts on site prep • How can you incorporate drought code into the WAM data model? • How often is the validity of the WAM data tested by company/area? • Could be useful for input on carbon models • WAM could help in predicting recovery on seismic lines 	<ul style="list-style-type: none"> • Flow initiation threshold: how can be used • Potential limitations (cautionary) • DTW relationship with soil carbon - insights • Road placement and other Best Management Practices (energy companies: where to place roads and well pads) • Introduce to colleges for education • Trail maintenance at EMEND sites • Look at different species (caribou and grizzlies) • Tool for forest managers to look at values at risk • Beetles and other invertebrates • Use for reclamation to match species to a specific site • Harvest planning so machinery avoids getting caught in lowland/wet areas • Identify conservation areas • Inform placement of retention patches in cutblocks • Mapping soil dynamics (interest in lack of variation in carbon stocks mentioned in Paul's talk) • Placement of habitat manipulations for different species

- Using WAM data as an input to determine the effects on vegetation when a road/structure is affecting water flow.
 - How might a structure or road affect the validity of WAM data?
- Using WAM to identify priority wetland lands for conservation. Linkages to policy on wetlands conservation and in that way conserving more [HA? Hectares?]
- Learn the differences in sensitivity between coniferous and deciduous sites and then more attention can be put on coniferous retention
- Dry areas could use more retention for deciduous sites
- How it is related to insect populations
- Reverse the WAM data to create DAM data (dry areas mapping) to determining species' areas at risk in hardwood sites

- Clarification of flow initiation thresholds and possible explanations as to WHY biological responses vary with threshold
- Administrative: knowledge of WAM can help better evaluate funding/research proposals
- Knowledge of WAM would allow academic administrator to promote or advocate for use of WAM in future research or collaborations

