ANNUAL REPORT

Healthy Landscapes Program Annual Report 2016/17

Annual Report

fRI Research Healthy Landscapes Program

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fRI Research
Informing Land & Resource Management

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1. Introduction

1.1 Program History and Overview

Under the auspices of fRI Research, the Healthy Landscapes Program (HLP) has been operating since 1996. Since then, more than 30 funding and academic partners have participated in 44 research, tool, communication, demonstration, and educational projects across western boreal Canada. HLP output has been used widely within virtually all Canadian jurisdictions, as well as certification agencies (i.e. FSC), and the Canadian Boreal Forest Agreement (CBFA).

Since 1996 the HL Program has undergone significant evolution. The original vision of what was then the *Natural Disturbance (ND) Program* was to "*…understand disturbance patterns of all types, at all scales, on the Foothills Model Forest*" (Andison 1998). Within several years, the ND Program project list had expanded well beyond this mandate in terms of geographic extent, the scope of the research, and the types of projects being undertaken. Starting in 2000, each of the annual ND Program work plans, as well as each annual long-term plan revision, defined and tracked projects according to one of three themes; 1) research, 2) communications, or 3) integration. However, while this rapid and early expansion of the Program was encouraging, the evolution was neither agreed upon, nor formally recognized by the Program activity team of the day. This triggered a comprehensive, external Program review in 2012, culminating in a one-day stakeholder workshop. Partner feedback confirmed the value of, and interest in the topic area, but suggested that a new Program vision was in order. The new vision was defined as "…to *understand natural and cultural (forest landscape) patterns, and help partners explore and demonstrate how natural pattern approaches can contribute to sustainable resource management solutions*" (Andison et al. 2012). In so many words, this mandate redefined the focus of the new Program as EBM (Ecosystem-Based Management).

The Program elements shown in Figure 1 reflect this new reality. Research remains at the core of the Program, but we now classify all research projects according to:

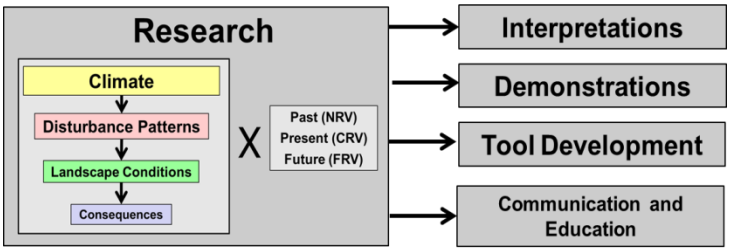

Figure 1. The HL Program elements and long-term strategy.

1) **Level.** Climate, disturbance, conditions, or consequences, and
2) **Era.** Natural (i.e., pre-industrial) range of variation (NRV), current range of variation (CRV) or future range of variation (FRV).

The other four major Program themes expanded slightly from the original three to become: 1) interpretations, 2) demonstrations, 3) tool development, and 4) communication and education (Figure 1). As the summary of projects in this report will demonstrate, there is a great deal of integration between and within project theme areas.

1.2 FUNDING

The total cash contributions to HLP projects in 2016/17 was $514,500, not including in-kind support. Note that only $408,000 of those funds flowed through fRI Research, the rest was accounted for by supporting funds from NSERC, the USFS, Mitacs, and several consultants who donated their time (and thus not "in-kind"). The sources and nature of these funds vary widely, but fall into one of five main types (see below). Most projects are funded via a combination of the five funding types.

1) fRI Research core funding. fRI Research has a number of partners who contribute funds to a general fRI Research fund each year, the disbursement of which to the various Programs is decided by the fRI Research Board of Directors. The HLP applies each year for general fRI Research core funds to be directed to the HLP via a rigorous work plan process. These monies have been pivotal in providing a long-term strategic foundation for HL Program growth, funding outreach, strategic planning, proposal writing, partner support, project administration, and collaborator support. Our partnership expansion from four partners within the west-central Alberta foothills, to more than 25 across boreal Canada over the last 20 years is largely a consequence of the stable support of the HLP by the fRI Research Board of Directors. In 2016/17, fRI Research allocated $143,300 (28%) to the HLP, which was 100% of that which we applied for.
2) HLP Program-based. Any funding provided directly to the HLP at the Program level (to be used to support a variety of projects at the discretion of the Program Lead) above and beyond any contributions from those same agencies to fRI Research overall. The government of the Northwest Territories was the only Program-based funding agency for the HLP this year, contributing $25,000 (5%).
3) HLP Project-based from partners. Project-based funding partners include: West Fraser (WF), Alberta Newsprint Company (ANC), Alberta-Pacific (AlPac), Daishowa-Marubeni International (DMI), Millar Western, Tolko, Mistik Management, Canadian Forest Products (Canfor), Ducks Unlimited (DU), Spray Lakes Sawmills, and the government of NWT. The value of project-based funds to the HLP in 2016/17 was $49,300 (10%).
4) HLP project-based from other funding agencies. The HLP was very successful in attracting matching funding this year from a variety of research funding agencies, including NSERC, CFS, FRIAA (Alberta), MITACS, and University of Laval. The value of these funding sources to the HLP in 2016/17 was $258,000 (50%).
5) Donated time. The HLP has been increasingly relying on donated time from consultants in the form of uncompensated professional and technical time as part of one or more HLP projects. Note that this funding category does not include any "in-kind" support from those who are otherwise being paid for time and/or travel. The estimated value of consultant donated time in 2016/17 to the HLP is $39,000 (8%).

In-kind support for HLP projects is not noted in Table 1, but is considerable. The estimated total value of in-kind support to the 15 HLP projects for 2016/17 is $220,000. That brings the total value of the HLP net income in 2016/17 to $730,000. Lastly, since most projects operate either on a multi-year basis or a different financial schedule, $420,000 technically "rolled over" on April 1, 2017. That brings the total value of funds managed by the HLP in 2016/17 to $1,155,000.

The HLP had 21 agencies contributing cash to the HLP in 2016/17 (Table 1). Of that there are four government agencies (three Canadian and one US), one non-government organization (NGO), eleven forest industry companies, and four research funding agencies. The remaining agency, fRI Research, is funded through nine shareholders. Not included on this list is the unpaid professional time donated to the HLP from Bandaloop, Fuse Consulting, and WOLF.

The vast majority of the HLP partner contributions were at the project level. Only fRI Research and the government of NWT contributed funding at the Program level.

Table 1. Overview of partner participation level in the HLP during 2016/17

Agency	Support Level	
	Program	Project
fRI Research	yes	yes
Gov't of NWT	yes	yes
Alta Agriculture & Forestry	no	yes
Ducks Unlimited	no	yes
AlPac	no	yes
ANC	no	yes
Canfor	no	yes
DMI	no	yes
Millar Western	no	yes
Weyerhaeuser	no	yes
Mistik	no	yes
Spray Lakes Sawmills	no	yes
Tolko	no	yes
Loiusianna Pacific	no	yes
West Fraser	no	yes
CFS	no	yes
NSERC	no	yes
USFS	no	yes
Mitacs	no	yes
FRIA of Alberta	no	yes
Alberta Innovates	no	yes

2. THE 2016/17 HLP PROGRAM

2.1 HLP PROGRAM OVERVIEW

During the 2016/17 fiscal year, the HLP had 14 active projects, including one for ***Program Management***, none for ***Interpretations***, three ***Communication and Education*** projects, two ***Demonstration*** projects, one ***Tool*** project, and seven ***Research*** projects (Table 2). Of those, one is now finished (12) and three others only require final reports and/or manuscripts (5, 9, and 11). Another three (2, 4, and 7) are long-term products (the HL website, the HL course, and NEPTUNE). The total output produced over the year included 19 funding proposals (11 of which were successful, and another three pending), 12 final reports or other products, nine publications or submitted manuscripts, and 26 presentations (Table 2).

Table 2. Overview of the progress and products from the 2016/17 Healthy Landscapes Program. Also included is breakdown of the funding to each project based on the five funding types from Section 1.0.

Project No.	Project Name	Project Type	Breakdown of funds spent in 16/17					Funding proposals	Products	Papers	Presents
			fRI Core	HLP							
				Program-based	Project-based	Other research	Donated time				
1	Project management	Strategic	80	15	0	0	5	12	5		5
2	HL website	Communication & Education	55	0	35	0	10		1		1
3	EBM Dialogue sessions	Communication & Education	0	0	0	100	0				
4	Planning for healthy landscapes short course	Communication & Education	95	0	0	0	5		1		
5	The Stony 800 Integrated planning HL demo in NE Alberta	Demonstration	0	0	0	0	0				
6	Linking NRV patterns with fine-filter values	Demonstration	0	0	0	0	0				4
7	NEPTUNE spatial decision-support tool	Tool	0	0	90	0	10				
8	LandWeb simulation modelling	Research	0	10	60	30	0	2	3		9
9	Historic wildfire burn patterns at sub-landscape scales	Research	0	0	0	0	0				
10	Creating wildfire mortality maps and metrics from Landsat imagery	Research	10	0	50	30	10		1	2	
11	Determinants of wildfire remnant survival	Research	10	0	0	65	25			1	
12	Comparing cultural to natural disturbance patterns	Research	20	0	10	40	30			2	1
13	Historic fire regimes, water and climate in the foothills	Research	50	0	0	25	25			4	5
14	Mixed-severity fire regimes in the southern foothills of Alberta	Research	0	0	0	100	0	5	1		1
	TOTALS							**19**	**12**	**9**	**26**

Three of the 14 projects required no funding from the HLP in 16/17 (5,6, and 9)(shaded in Figure 2). Any progress made on these projects was due to in-kind contributions. Of the remaining 11 projects, four each were largely funded from fRI Research core funds and other research funds, and three by project-specific HLP funding (Table 2).

2.2 2016/17 HLP PROJECTS

A summary of each project, including the specific accomplishments during the 2016/17 fiscal year, the partners involved, and the current status, are to follow. All of the documents and presentations listed in this document are available on the fRI Research website, or upon request to Dr. David Andison (andison@bandaloop.ca)

2.2.1 PROGRAM MANAGEMENT

This "project" represents the coordination of the existing 14 HLP projects in terms of writing funding proposals and coordination and administration including contracts, approvals, fRI Research requirements with respect to updates, meetings, and workshops, developing annual workplans, bi-annual HLP activity team meetings, compiling the annual HLP report, and responding to partner requests and updates as they arise. The summary of activities and outcomes for the 2016/17 fiscal year are as follows:

- Funding model:
  - 80% #1 (fRI Research core)
  - 15% #2 (HLP program-based from NWT)
  - 5% #5 (donated time – Andison)
- Funding proposals:
  - For the various C&E projects:
    - *EBM workshop: Gaining perspective and developing a roadmap with stakeholders.* EOI submitted to FRIAA OPEN FUNDS. ***Successful*** – invited to submit full proposal.
    - *Understanding public perceptions in an effort to enhance public outreach for, and advance the implementation of, ecosystem-based management (*Project 2.1.3). EOI submitted to FRIAA OPEN FUNDS. ***Successful*** – invited to submit full proposal.
    - *Understanding public perceptions in an effort to enhance public outreach for, and advance the implementation of, ecosystem-based management* (Project 2.1.3). Full proposal submitted to FRIAA OPEN FUNDS initiative. ***Successful*** ($141,115)
    - *Small project shopping list for 2017/18 Healthy Landscapes Program.* Funding request to HLP partners to support 11 different C&E objectives in support of the HL website and ongoing C&E efforts both internal and external to the HLP. ***Pending***
  - Proposals submitted to support project 2.1.6 (Linking NRV patterns with fine filter values)
    - *A spatiotemporal investigation of natural and anthropogenic disturbances on landscapes and species resilience*. EOI submitted to FRIAA OPEN FUNDS initiative. ***Successful*** – invited to submit full proposal.
  - Proposals submitted to support project 2.1.11 (Creating wildfire maps and metrics from Landsat imagery)
    - To the government of BC to use northeastern BC as the test site for the next phase of this project. ***Not successful***.
    - To Canfor to use northeastern BC as the test site for the next phase of this project. ***Not successful***.

- To government of Ontario to use Ontario as the test site for the next phase of this project. ***Not successful***.
- To government of Manitoba to use Manitoba as the test site for the next phase of this project. ***Not successful.***
- To government of Saskatchewan to use northern Saskatchewan as the test site for the next phase of this project. ***Not successful.***
- To government of NWT to use NWT as the test site for the next phase of this project. ***Successful*** ($76,000 over two years).
- To NSERC ENGAGE with Timberworks Inc. to support San Miguel. ***Successful*** ($25,000 over one year)

o Products:
  - Andison, D.W. 2017. The HL Program annual 2017/18 workplan. fRI Research, Hinton, Alberta. (available online to HLP and fRI partners).
  - Pyper, M, and D.W. Andison. 2016. HL Program communication and education initiative for 2016/17. May 23, 2017
  - 2015/16 fRI Research annual report.
  - HLP test for the annual fRI Research "value-report"
  - HLP text for the 2016/17 fRI Research annual report

o Presentations:
  - Andison, D.W. 2016. Turning the world on its head: Forest management as a tool to create healthier landscapes. Presentation at the Biodiversity and Forestry workshop hosted by Alberta Agriculture and Forestry. Spring 2016.
  - Pyper, M. 2016. Healthy Landscapes C&E Initiative. Presented at the Feb. 16th, 2017 HLP team meeting
  - Andison, D.W. 2016. HLP Team meeting: Updates. Presented at the May 26th, 2016 HLP Activity Team meeting.
  - Andison, D.W. 2016. HLP Team meeting: Updates and new projects. Presented at the Feb. 16th 2017 HLP Activity Team meeting.
  - Andison, D.W. 2016. Healthy Landscapes 4U? Presentation given to Tolko, Sept. 29, 2016.

o Meetings: (minutes available upon request)
  - HLP activity team meeting. May 26th, 2016. Edmonton, Alberta
  - HLP Executive team meeting. Oct. 24th, 2016 (conference call)
  - HLP overview to Tolko. Sept. 26th, 2016. Edmonton, Alberta
  - HLP activity team meeting. Feb. 16th, 2017. Edmonton Alberta
  - fRI Research Program Lead meeting on the fRI Research publishing policy

o Notes:
  - Provided two rounds of feedback on the fRI Research publishing policy

- The large number of proposals for both new and ongoing projects written this year required considerable time and resources

2.2.2 HL Website

Starting in 2013, the HL Activity Team has directed the HL Program to invest more resources and effort into communication and education on the topic of EBM / Healthy Landscapes. In 2013, this resulted in the first draft of a HL Program C&E plan, which has been updated annually since. One of the foundations of the strategy was a stand-alone website designed to provide an objective but complete profile of EBM (ecosystem-based management) in simple terms using photos, text, interviews, and narrated videos. A summary of activities and outcomes during the 2016/17 fiscal year are as follows:

- Funding model:
  - 55% #1 (fRI Research core, partially banked from previous years)
  - 35% #3 (HLP project-based from ANC, West Fraser, DMI, AlPac, Weyerhaeuser, Tolko, Millar Western, Spray Lakes Sawmills, Mistik, Canfor, Ducks Unlimited, government of NWT)
  - 10% #5 (Donated time from Andison & Pyper)
- Funding proposals:
  - The (one omnibus) proposal written and submitted in support of upgrades to and marketing of the HL website was funded by *Program Management* (see Section 2.1.1)
- Products:
  - HLP www.Lessonsfromnature.ca website launch July, 2016.
- Presentations:
  - Pyper, M. 2017. Presentation of website feedback to the HLP Activity Team, Edmonton. Feb. 17th, 2017.
- Notes:
  - Preliminary user stats suggest a healthy number and range of visitors to the site overall, but also a large proportion of repeat visitors, which is a good sign for an education site.
  - Still, we are not reaching some folks. The site was launched with minimal social media outreach and advertising due to budget constraints. At the request of the HLP team, a (small projects) proposal was drafted, in part to fund supporting elements for the HL website (see Section 2.1.1)
  - ***This project will require ongoing financial support***

2.2.3 EBM Dialogue Sessions

Another element of the HLP C&E plan was to host a series of 'dialogue sessions', designed to explore the source(s) of both support and discomfort with the concept and application of EBM principles. The sessions are open to any stakeholders or members of the public, but specifically target senior managers and policy-makers. The idea of dialogue is to introduce an active listening component, as opposed to more of a workshop style event where lectures are given on EBM. These sessions are designed to help understand the nature of what is often a highly uneven

acceptance level of EBM across Alberta - and beyond. A summary of activities and outcomes during the 2016/17 fiscal year are as follows:

- Funding model:
  - 100% #4 (Other research funds via Alberta FRIAA Open Funds initiative)
- Proposals:
  - The (two) proposals written and submitted for this project were funded by *Program Management* (see Section 2.1.1)
- Meetings:
  - EBM Dialogue Team planning meeting, Edmonton, Jan. 10th, 2017.
  - Dialogue Team planning, Edmonton. Feb. 17th, 2017.
- Notes:
  - The last four months of 16/17 were spent planning and developing the agenda, surveys, session flow, identifying locations, dates, and venues, and developing an invitation list
  - Four EBM dialogue sessions planned for 2017: May 30 (Athabasca), Sept. 12 (Grande Prairie), Oct. 25th (Calgary) and Dec. 12th (Edmonton). The invitation and outline available at http://friresearch.ca/file/hl-dialogueflyer-17-04-26pdf

2.2.4 PLANNING FOR HEALTHY LANDSCAPES SHORT COURSE

In 2010, the HLP Activity Team and fRI Research Board approved funding of professional course to help planners design cultural disturbance events (from harvesting, fire, or other activities) that look and feel more like natural disturbances. The course uses the spatial language developed by Andison (2012) and used in the NEPTUNE DSS tool, as well as the 12 years of research results from the Wildfire Patterns Study. In 2010, a course DACUM (Developing A Curriculum) developed with a focus group, and after some negotiations, fRI Research singed a contract in 2014 with WOLF (Woodlands Operations Learning Foundation) from Slave Lake, Alberta, to create the course. A summary of activities and outcomes for the 2016/17 fiscal year are as follows:

- Funding model:
  - 95% #1 (fRI Research core – all banked from previous years)
  - 5% #5 (donated time – Andison & WOLF)
- Products:
  - "Planning for healthy landscapes" course is completed and is now available on-line, live-online, or live by WOLF (www.w-o-l-f.ca/event/planning-for-healthy-landscapes/)
- Meetings:
  - ½ day meeting in Edmonton, April 20th, 2016.
  - 1 day meeting in Nelson, BC, August 15, 2016
- Notes:
  - Next live-online course June 13th, 2017
  - Agreement between fRI Research and WOLF still outstanding

2.2.5 THE STONY 800 INTEGRATED PLANNING HEALTHY LANDSCAPES DEMO

In July of 2014, the HLP sent a proposal to CEMA (Cumulative Environmental Management Association) to look at how a *planning process* based on healthy landscape concepts might be used to restore culturally-modified landscapes in northeastern Alberta – a landscape in which the energy sector is particularly active. In September 2015, our proposal was formally accepted.

This unique demo project involved several stages; a) understanding the nature of the larger problem-to-be-solved, b) devising an alternative, innovative, and fully integrated planning process, c) providing OR developing the science necessary for the new planning process, and d) testing and comparing the short and medium-term outcomes of our planning process against business-as-usual. There were two take-home messages of note from this project. First, we found that an HL approach created significantly greater levels of landscape scale biodiversity than any of the other policy options. Second, ALL of the consultants involved in this project donated some of their time to ensuring that the final product was of the highest quality. This project and the final report were completed in 2015. A small amount of time was spent in 2016/17 to create a first draft of a manuscript, although no funds to do so were available.

- Funding model:
  - No HLP resources were spent on this project in 16/17
- Notes:
  - Downloads of this final report on Andison's *Research Gate* account have been both broad and deep, suggesting interest in this from a variety of audiences is significant
  - Manuscript in draft by Andison, and will be completed - pending the status of donated time

2.2.6 LINKING NRV PATTERNS WITH FINE-FILTER VALUES

One of the more compelling questions around the idea of adopting a healthy landscapes approach is the degree to which the local biota respond to historical patterns. This project addresses this knowledge gap by overlaying several fine-filter species models from the Alberta Biodiversity Monitoring Initiative (ABMI) onto NRV landscape conditions generated by a scenario modelling exercise. The output is one of the first attempts at defining to what degree and in what direction an NRV planning strategy might change / influence fine-filter values, and the degree to which NRV of species habitat is possible via management. The original project was a relatively simplistic proof-of-concept project. It was completed in 2016, but a final report is still outstanding. Work on a new proposal to extend the project to include more realistic wildfire and management planning scenarios commenced early in 2017 involving Mr. Tim Vinge's MSc thesis project.

- Funding model:
  - No HLP resources were spent on this project in 16/17
- Funding proposals:
  - The (one) proposals written and submitted for this project was funded by *Program Management* (see Section 2.1.1). Note that the resources to help develop this proposal were 100% donated by Andison

- Presentations:
  - May 26th presentation of final results to the HLP Activity Team, Edmonton Alberta.
  - Presentation of final results to Alberta Agriculture and Forestry (AAF) Wildlife Branch, Edmonton, Alberta
  - Presentation of final results to AAF Forest Management Branch, Edmonton, Alberta
  - Presentation of final results to AAF Senior Managers, Edmonton, Alberta
- Meetings:
  - Research team meeting, spring 2016, Edmonton, Alberta
- Status:
  - Final report to fRI Research pending
  - Funding for phase II pending

2.2.7 NEPTUNE SPATIAL DECISION-SUPPORT TOOL

NEPTUNE (Novel Emulation Planning Tool for Understanding Natural disturbance Events) is a web-based spatial decision-support tool designed to help planners create more "natural" disturbance events. NEPTUNE uses the spatial language published by Andison (2012) to create "events" from input shapefiles of disturbed and residual patches. It then calculates 10 standard pattern metrics from the input data, and compares the results to that of NRV based on the work of Andison and McCleary (2014). NEPTUNE, and its associated research, meet and/or exceed the requirements of provincial regulations, FSC, and the CBFA for any and all within-fire metrics. NEPTUNE is calibrated for all of Alberta and central Saskatchewan, and our ultimate goal is to expand NEPTUNE calibration to northeastern BC, NWT, northern Saskatchewan, and/or Manitoba (see Wildfire photo-imagery project).

NEPTUNE is uniquely administered as a shareholder entity. There are eight shareholders at this time; West Fraser, Parks Canada, government of Alberta, government of Saskatchewan, Mistik Management, ANC, AlPac, and Bandaloop. Any employee or designate of a shareholder can request and will be granted access to NEPTUNE via the web portal and sign-in protocols. The current cost for a new shareholder is $40,000, which grants them these same rights for all employees. NEPTUNE shareholders are also responsible for making decisions on all model changes or upgrades. A summary of activities and outcomes for the 2016/17 fiscal year are as follows:

- Funding model:
  - 90% #3 (HLP project-based from the seven NEPTUNE partners listed above)
  - 10% #5 (donated time – Andison)
- Status:
  - This project (i.e., tool) requires continual financial input in the form of maintenance costs
  - Seeking new partners

2.2.8 LANDWEB SIMULATION MODELLING

By far the most ambitious HLP project is LandWeb (Landscape modelling in Western Boreal Canada). The objective of LandWeb is to define historical NRV conditions at landscape scales across 140 million ha of the western boreal from spatially explicit simulation modelling. The output will provide NRV for landscape scale metrics such as seral-stage

levels and old forest patch sizes that will be CBFA, FSC, and all provincial NRV regulations compliant. There are 15 partners involved in LandWeb; the governments of Alberta, Saskatchewan and NWT, West Fraser, DMI, AlPac, Mistik Management, Alberta Newsprint Company, Millar Western, Canfor, Tolko (Alberta), Weyerhaeuser, Louisiana Pacific (Manitoba and BC), and Ducks Unlimited.

In 2014, the HLP formed a partnership with the CFS at the Pacific Forestry Centre to develop the model. The framework in which LandWeb will be developed is called SpaDES (Spatially Discreet Event Simulator). SpaDES is actually not a model, but rather an innovative framework in which other models and modules can "talk" to each other. SpaDES will be free, available on-line, and customized for each HLP partner with the LandWeb configuration. A summary of activities and outcomes during the 2016/17 fiscal year are as follows:

- Funding model:
  - 10% #2 (Program specific funding from the government of NWT)
  - 60% #3 (HLP project-specific from the 15 partners listed above, plus the CFS)
  - 30% #4 (other research from NSERC, FRIAA)
  - We benefited from approximately $160,000 of in-kind support from salaries of modelling experts from the CFS, University of Calgary, and University of Laval in 2016/17
- Funding proposals:
  - Contribution from CFS. ***Successful*** ($20,000)
  - Contribution from Manitoba government and Tolko combined to extend the study area to the Ontario border. ***Not successful.***
- Products:
  - Final version of a seamless vegetation layer for the study area completed by UBC PDF
  - Final version of historical (pre-industrial) long-term fire cycle map for western boreal Canada
  - FRIAA update report #3 (January 1, 2017)
- Presentations:
  - Graduate level course taught on SpaDES at University of Laval. *Introduction to forest landscape modelling (FOR 7043A).*
  - Two-day workshop on how to use SpaDES. May 2016, Victoria, BC
  - Cumming, S.G., J. Marchal, and E.J.B. McIntire. 2016. Methods for spatial simulation of fire regimes. Wildland Fire Canada, Oct. 25, 2016, Kelowna, BC
  - Cumming, S.G. 2017. Statistical challenges in forecasting wildland fire regimes. American Association for the Advancement of Science. Session on "Human impacts on Ecosystems". Feb. 21, 2017, Boston, Mass.
  - Three presentations to CFS staff on SpaDES / LandWeb by Dr. Eliot McIntire
  - Two presentations at U. of Calgary on SpaDES by Dr. Alex Chabutny
- Meetings:
  - April 19 2016, strategic and technical meeting at CFS Victoria
  - June 18, 2016 partners meeting in Edmonton, Alberta

- Nov 16, 2016 partners meeting in Edmonton, Alberta
- Feb. 15, 2017 Landweb demo to the HLP team

- Status:
  - Completion of Upper Peace pilot study results. Final presentations to Canfor, Weyerhaeuser, and government of Alberta, and final reports expected mid-2017.
  - Cumming is developing SpaDES modules for quantifying and simulating fire regimes from fire management agency data
  - Cumming also has published or submitted three other manuscripts this year related to fire size, risk, and spread, all of which will form the science foundation for the fire regime module(s)
  - Second year of modelling post-doc (PDF) funding at UBC / CFS Victoria – succession modelling
  - Anticipate preliminary results for the entire study area late 2017
  - This (first) phase of the project will be completed mid-2018, including final reports and presentations.

2.2.9 Historic wildfire burn patterns at sub-landscape scales

The assumption of a so-called "coarse-filter approach" in the boreal forest is that historic patterns can and will be closely approximated by cultural disturbance activities. This assumption is largely true at landscape scales. One can reasonably expect to compare metrics such as old forest levels, interior forest, and edge density between NRV and the likely future range of variation (FRV) under forest management - since it is under the control of harvesting levels. At event scales the focus becomes residual levels, types, and locations, for which the same rule about the alignment of NRV with FRV generally holds. Again, harvest plans can dictate residual levels and locations to align with NRV.

However, the concept of "approximation" breaks down at intermediate scales. It is well recognized that the vast majority of the boreal forest that we see today is a result of the impact of a very small number of fires larger than 10,000 ha. Yet harvesting "guidelines" almost universally limit the size of harvesting events to less than 10,000 ha. This project tests the (untested) hypothesis that a simple event size metric adequately captures natural landscape dynamics at intermediate scales. This project tests that hypothesis using the natural wildfire database from northern Saskatchewan. This project was completed in 2015/16, but a manuscript has not been completed. No funds were allocated to complete this project.

- Funding model:
  - No HLP resources were spent in 16/17
- Status:
  - Manuscript in draft, will be completed pending the status of other donated time
  - This project will end next fiscal year

2.2.10 Creating wildfire mortality maps and metrics from Landsat imagery

The "Burning patterns of natural wildfires" research project now includes data and historic NRV results for all of Alberta and central Saskatchewan. The detailed database of 129 wildfires is the largest and most precise of its kind in the world, and has thus far generated five published papers and at least 10 scientific conference presentations. It is

also one of the cornerstones of the collective NRV requirements at the event-scale for provincial governments, the FSC, and the CBFA. Unfortunately, these data have been expensive and time-consuming to create using historical aerial photos. The reliance on finding timely, high quality aerial photos before and after each fire event also limits the utility of this method geographically. Landsat has become the tool of choice for most other burn severity projects since it is free and full spatial coverage exists since the mid-1980's. However, until now, the ability of Landsat procedures to predict mortality from wildfires has been poor to moderate, which makes it unsuitable in its current form as being scientifically-defendable (as per most forest management NRV requirements).

This project attempts to manage this knowledge gap by building a methodological "bridge" between photo-based and imagery-based interpretations of fire mortality maps. A PhD student (Mr. San Miguel) under the supervision of Dr. Nicholas Coops, UBC Forestry is looking at this question. The government of NWT has agreed to fund the last phase of this work into NWT over the next two years. We have already identified the criteria, the sample fires, and the imagery. The fires have all been mapped by Greenlink Forestry Inc. using criterial identical to previous fire mapping projects under the auspices of the HLP, and the data delivered to UBC. A summary of activities and outcomes for the 2016/17 fiscal year are as follows:

- Funding model:
  - 10% #1 (fRI Research core)
  - 50% #3 (HLP project directed by the government of Saskatchewan – rolled over)
  - 30% #4 (other funding from NSERC, student awards and scholarships)
  - 10% #5 (donated time Andison)
- Funding proposals:
  - The (seven) proposals written and submitted for this project were funded by *Program Management* (see Section 2.1.1)
- Products:
  - San-Miguel, I. 2016. Progress report
- Papers:
  - San-Miguel, I, D.W. Andison, N.C. Coops, and G. Rickbell. 2016. Predicting post-fire canopy mortality in the boreal forest from dNBR derived from time serices of Landsat data. Int. J. Wildland Fire. 16 May, 2016.
  - San-Miguel, I, D.W. Andison, and N.C. Coops. (submitted). Characterizing historical fire patterns as a guide for harvesting planning using landscape metrics derived from long-term satellite imagery. *Under review by Forest Ecology and Management.*
- Meetings:
  - 1-day meeting with Greenlink (GIS consultant) to review attribute, interpretation, and final products for NWT wildfire mapping. Jan. 17th, 2017.
- Status:
  - Preparing draft of a third manuscript "*Detailed wildfire event patterns across the western boreal forest from satellite imagery*" (expected submission date: Sept. 1, 2017).

- Given recent forest management proposals in Alberta during 2016/17, this dataset is ideally suited for determining the historical proportion of "merchantable" forest that burns.

2.2.11 DETERMINANTS OF WILDFIRE REMNANT SURVIVAL

Having determined the amount and type and spatial distribution of burned vs. unburned vegetation in the "Burning patterns of natural wildfire" project, the next logical question is whether the amount, location, or nature of the remnants were entirely random, or related in some way to a range of biotic or abiotic factors such as topographic position, fire weather, or fuel type. Towards this question, our plan was to hire a Post-Doctoral Fellow (PDF) collaboratively with the USFS. A summary of activities and outcomes for the 2016/17 fiscal year are as follows:

- Funding model:
  - 10% #1 (fRI Research core)
  - 65% #4 (other research funding from US Forest Service)
  - 25% #5 (donated time from Andison)
- Papers:
  - Ferster, C., B. Eskelson, D.W. Andison and V. LeMay. 2016. Vegetation mortality within natural wildfire events in the western Canadian boreal forest: What burns and why? (Special issue of) Forests 7(9). **doi:10.3390/f7090187**
- Status:
  - The PDF working on this project, Dr. Ferster, has moved on to another PDF position, but has agreed to continue working on analyses for the second paper
  - Expect to have a draft of the second paper completed by Sept. 1, 2017
  - This project will end in the next fiscal year

2.2.12 COMPARING NATURAL TO CULTURAL DISTURBANCE PATTERNS

This project began in 2012 with seed funding from Alberta Newsprint Company (ANC), Alberta Pacific (AlPac) and Hinton Wood Products (West Fraser), which since then was matched by NSERC, and later supplemented by core HLP funds and additional NSERC funding. The objective was to understand if and how cultural disturbance patterns differed from pre-industrial natural patterns. The work was undertaken by a PhD student (Dr. Paul Pickell) under the supervision of Dr. Nicholas Coops, UBC Forestry. The work progressed in stages, starting at local scales using NEPTUNE model and metrics, then comparing the patterns of forestry to those of the energy sector, and then to landscape, and biome scales using satellite imagery. Five papers have already been published from earlier results prior to this year. This project was completed in 2016/17. A summary of activities and outcomes for the 2016/17 fiscal year are as follows:

- Funding model:
  - 20% #1 (fRI Research core)
  - 10% #3 (HLP project-based from ANC, West Fraser, and AlPac)
  - 40% #4 (other research support)
  - 30% #5 (donated time from Andison)

- Papers:
  - Pickell, P.D., N.C. Coops, S.E. Gergel, D.W. Andison, and P.L. Marshall. 2016. Evolution of Canada's boreal forest spatial patterns as seen from space. PLOS ONE. http://dx.doi.org/10.1371/journal.pone.0157736
  - Pickell, P.D. 2015. Characterizations of boreal anthropogenic disturbance regimes from multi-scalar Earth observations. PhD thesis. UBC. December 2015. http://hdl.handle.net/2429/55965
- Presentations:
  - Pickell, P.D. N.C. Coops, S.E. Gergel, D.W. Andison, and P.L. Marshall. 2016. Evolution of Canada's boreal forest spatial patterns as seen from space. Paper presented at the International Association for Landscape Ecology. April 15, 2016.
- Status:
  - This project is now complete.

2.2.13 HISTORIC FIRE REGIMES, WATER AND CLIMATE

The genesis of this project is worth noting, if only to demonstrate how knowledge truly grows via an iterative process – and by extension the value of investing in long-term research Programs that can address this dynamic. In 1999, the first results of the (then titled) "Island Remnants Project" (now known as the Historical Fire Patterns project) suggested that the amount of surviving remnants from historical wildfires in the Alberta foothills ranged from very high to very low. The fires with very high remnants were unexpected. The expansion of this work to other parts of the western boreal forest confirmed these findings, suggesting that the western boreal may not be a simple stand-replacing ecosystem. However, the evidence at this point was fairly simplistic since it only captured the patterns of one (i.e., the most recent) fire at any given location. This spawned a pilot study in the northwestern area of the Hinton Wood Products FMA to look at the fire history of specific sites using dendrochronology (i.e., tree-ring) methods, which would allow us to extend fire history much further back in time. The results indeed suggested that some historical fires were lower severity, and they occurred on a higher frequency than previously assumed (Amoroso et al. 2011).

So now we knew there were some lower-severity fires in the central foothills area historically, but there was not enough evidence to make conclusive statements about the degree to which a "mixed severity fire regime" (MSFR) was operating in the area. However, the HLP Team agreed that it was enough to justify expanding the scope of the study. With the full support of the HLP Activity Team, in 2011, a team of four Principle Investigators (PIs) from four different Canadian Universities (Daniels, Gedalof, Pisaric, and Moser) submitted a proposal to NSERC to look for evidence of a MSFR across the southern Rockies (including study sites in both BC and Alberta) using both dendroecology (i.e., tree ring) and paleo-ecological (i.e., lake sediment) sampling methods. This project is largely completed, with some outstanding manuscripts remaining. The exception to this is the extension of the work of Raphael Chavardes who is continuing his work on fire history in the Jasper area for his PhD. A summary of activities and outcomes during the 2016/17 fiscal year are as follows:

- Funding model:
  - 50% #1 (fRI Research core)
  - 25% #4 (other research from NSERC, Chavardes scholarships)
  - 25% #5 (donated time from Andison)
- Papers:
  - Davis, E.L, C.J.C. Mustaphi, A. Gall, M.F.J. Pisaric, J.C. Vermaire, and K.A. Moser. 2016. Determinants of fire activity during the last 3500 yr at a wildland-urban interface, Alberta, Canada. Quaternary Research. http://dx.doi.org/10.1016/j.yqres.2016.08.006
  - Stretch, V., Z. Gedalof, J. Cockburn, and M.F.J. Piscaric. 2016. Sensitivity of reconstructed fire histories to detection criteria in mixed-severity landscapes. Forest ecology and Management 379: 61-69.
  - Chavardes, R.D. and L.D. Daniels. 2016. Altered mixed-severity fire regimes has homogenized montane forests of Jasper National Park. Int. J. of Wildland Fire. http://dx.doi.org/10.1071/WF15048
  - Chavardes, R.D., L.D. Daniels, Z. Gedalof and D.W. Andison (under review) Human influences supercede climate to alter fire regimes in Jasper National Park. *Submit to Dendeochronlogia*.
- Presentations:
  - Daniels, L.D. 2016. Altered states: Mixed-severity fire regimes in the Montane forests of western Canada. Plenary presentation at Amieridendro: Third American Dendrochronology Conference, Mendoza, Argentina. Friday, April 1, 2016.
  - Chavardes, R. 2016. Altered fire regime reduced montane forest diversity. Wildland Fire Canada Conference. Oct. 25, 2017, Kelowna, BC
  - Chavardes, R., and L.D. Daniels. 2016. Altered fire regime reduced montane forest diversity. Poster presented at the Southern Interior Silvicultural Committee. Feb. 23, 2016, Kelowna BC
  - Two other conference presentations by L. Daniels
- Status:
  - Chavardes is the only remaining active student on this project.
  - The last of the outstanding manuscripts should be published in 2017/18

2.2.14 MIXED-SEVERITY FIRE REGIMES IN THE SOUTHERN FOOTHILLS OF ALBERTA

This project has two inter-related components, both related to the idea that not all boreal fires kill most of the vegetation within the boundaries of the wildfire event. In 1998, empirical evidence that not all fires in the Alberta foothills were "stand-replacing" started to grow. The HLP project "*Burning patterns of natural wildfires*" was the first to note that the proportional of surviving vegetation "remnants" was quite often above the classic 20% threshold. This spawned the support and completion of the Berland pilot study under the auspices of the HLP, which found that indeed lower severity fires on more frequent intervals could occur (Amoroso et al. 2011). The presence of lower severity fires *suggests the presence of* a mixed-severity fire regime, but it does not define it. Moreover, a simple pilot study says nothing about the prevalence of local conditions on the larger landscape. The only way to know for sure is to understand the relationship(s) between the severity, size, and frequency of historical fires over both time and

space. The methods necessary to capture these regime dynamics are very specific: intensive field sampling to create a standard tree-ring chronology over one or more extended areas of a landscape. In other words; the sampling must reflect the need to understand not just fire mortality, but also fire size, fire frequency, and the main fire weather and fuel conditions. Although many pieces of this puzzle have been studied, no one has attempted to solve the puzzle as a whole.

The second component of this project is the development of a partial-severity burn module. There are several landscape scenario simulation models right now that will create NRV conditions – but they all include fire modules that assume complete mortality of a given pixel or cell. This is a function of both convenience and knowledge. We now have enough new knowledge to suggest that fire burning modules should be capturing partial mortality. The module will be SpaDES and LandWeb compatible, and we plan on using the research from part I of this study to calibrate it for the southern Alberta foothills study area.

- Funding model:
  - 100% #4 (other research from Alberta Innovates)
- Funding proposals:
  - Proposal to West Fraser and Spray Lakes Sawmills to provide support. ***Not successful***.
  - EOI to FRIAA OPEN FUNDS: *Understanding and modelling historic landscape dynamics in the SW foothills.* ***Successful*** (asked to submit a full proposal)
  - Full proposal to FRIAA OPEN FUNDS: *Understanding and modelling historic landscape dynamics in the SW foothills.* ***Pending***
  - Mitacs application for PDF support for the fire regime position. ***Successful*** ($22,500 over one year)
  - Canada Jobs Grant application for 4 field crews. ***Successful.***
- Products:
  - Alberta Innovates annual update report
- Presentations:
  - Andison, D.W. 2016. Mixed severity fire project: Kickoff meeting. Presented at the 1 day project team workshop June 1, 2017, UBC, Vancouver
- Meetings:
  - 1 day team workshop. June 1st, 2017, UBC, Vancouver
  - ½ meeting. Feb. 1, 2017. Edmonton
- Status:
  - Dr. Cameron Naficy was hired January 2017 as the PDF for the fire regime work at UBC Forestry under the supervision of Dr. Lori Daniels
  - Dr. Ceres Barros will start September 2017 as the PDF for the fire modelling work at UBC / CFS in Victoria under the supervision of Dr. Eliot McIntire
  - A second and third MITACS applications are underway to continue supporting both PDFs
  - If the FRIAA OPEN FUNDS application is not successful, a scaled back version of this project is a likely consequence in the absence of other funding

3. LOOKING AHEAD: CHALLENGES AND OPPORTUNITIES

2017/18 will be a busy and interesting year for the HLP. Several projects are winding down, but we have two fairly large ones (8 and 14) that will consume considerable time and resources. This is our final year of one of our largest projects ever - the LandWeb modelling project. The results should be of great interest to industry, governments, NGOs, and ENGOs across Canada. We also managed to find support for a number of key elements in the HLP Communications and Education Initiative, which was one of the priorities for the HLP Activity Team. The EBM Dialogue Sessions represent a particularly new and exciting social-earth science partnership for the HLP. The HLP remains one of the only holistic research-tool-education programs in Canada focused on EBM, and the influence of the output of the HLP are evident across Canada.

However, our experiences in 2016/17 revealed several challenges. First, although total funding to the HLP this year was similar to that from the last few years, the sources of those funds have shifted significantly over that period. Over the last three years, the average annual project-based partner support accounted for most of the HLP funding at 45%. This year, over 50% of the funding came from external sources via formal proposals, and another 28% from fRI Research. Partner contributions to individual projects accounted for only slightly more than that from time donated by consultants (10% versus 8% respectively). This suggests an increasing reliance on the success of external funding applications. We were fortunate this year to attract over 300k in external funding from those proposals in addition to maintaining our baseline "ask" from fRI Research core funds of ~143k. However, this trend represents a high-risk funding model in the long term. The vast majority of proposals are written using Program level funding (since often no project yet exists to charge for this). However, right now, only one HLP partner is contributing funds at the Program level other than fRI Research. Thus, any future reduction of the fRI Research core fund "ask" to the HLP will negatively impact our ability to apply for - and potentially be successful in attracting - external funding. Moreover, a heavy reliance on funding proposals redirects valuable resources. The time required to write and submit 19 proposals this year was considerable – time that could have been spent working on research and other project deliverables. Thus, one of the goals of the HLP for 2017/18 will be to *increase Program level support from HLP partners*.

Another challenge revealed in 2016/17 for the HLP was knowledge dissemination. We took advantage of a number of funding and partnership opportunities over the last 5-7 years, which has created a large amount of knowledge and associated publications. However, the main messages from this research are not getting out to all of our partners in a timely fashion, and in appropriate formats. Towards this, the C&E omnibus proposal (Section 2.2.1) includes several items such as webinars and updates to the HL website. The HLP will also re-launch its most popular communication product of all time – the *Quicknote*.

The last challenge for the HLP is ensuring that the research is published, which supports one of the tenets of EBM – a credible scientific foundation. It is a constant challenge to get manuscripts completed. There is a backlog of at least five manuscripts in various stages of progress from the 14 projects described above. This is not unusual given that many graduate students and post-docs move on to new positions before completing all of their manuscripts.

Hopefully most will be completed in 17/18. There is also a backlog of manuscripts from HLP projects that have been 'de-listed' over the last few years (see list below). There was some progress on some of these this year, and those near the top are the closest to submission. The challenge at this point is allocating both time and resources to completing these. Some of the time spent this year to advance the progress on papers near the top of the list below was donated.

The plan was to publish two of these in 16/17, and progress was made towards this goal, but the time required to write proposals became overwhelming on top of the day-to-day administrative load for 14 projects and several grad students. The plan for next year will be to submit at least the first three on the list below to journals, but that goal will be dependent on the amount and allocation of the funding in 17/18.

1) Andison, D.W. and J. Stadt. xxxx. A comparison of traditional and NRV-inspired harvesting patterns on four landscapes in western boreal Canada. Suggested journal: *The Forestry Chronicle*.
2) Andison, D.W. xxxx. An alternative indicator for capturing natural disturbance patterns at sub-landscapes scales in the Canadian boreal. Suggested journal: *Forest Ecology and Management*
3) Andison, D.W. xxxx. Tracking the evolution of forest land management in boreal Canada. Suggested journal: *Conservation Biology*. (based on the report just completed)
4) Andison, D.W., E. Dzus, and R. Bonar. xxxx. Historical ranges of landscape conditions compared to woodland caribou habitat requirements across Alberta. *Conservation Biology.*
5) Andison, D.W., R. Bonar, D. Hebert, L Van Damme, S. Boutin, T. Moore, and M. Donnelly. xxxx. Using natural patterns as the foundation for land use planning. Suggested journal: *Conservation Biology.*
6) Andison, D.W., B. Christian, T. Moore, M. Donnelly, T. Gooding and T. Vinge. Xxxx. Using a Healthy Landscape approach to restore a modified landscape in northeastern Alberta (based on the Stony 800 final report). Suggested journal: Plos ONE
7) Andison, D.W. xxxx. Partial burning in boreal and mountain landscapes: More common than we think. Suggested journal. *Int. J. Wildland Fire.*
8) Using forest inventory data to generate time-since-fire maps. To be submitted to: *Landscape Ecology.*
9) Andison, D.W., B. Maier, and K. Nice. NEPTUNE: A decision support tool for evaluating natural features of landscape disturbances.
10) Andison, D.W. xxxx Multi-scalar old forest patterns in the boreal forest.
11) Andison, D.W. and K. McCleary. xxxx. Boreal wildfires burn through riparian zones, sometimes. To be submitted to The Forestry Chronicle

4. Literature Cited

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