THE WESTERN NEWFOUNDLAND NATURAL DISTURBANCE REGIME RESEARCH PROGRAM

MODEL FOREST NETWORK
RÉSEAU DE FORÊTS MODÈLES

Project : Balsam fir landscape dynamics modeling with Landis in Western Newfoundland Ecoregion (Corner Brook subregion)

Preliminary report (1)

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Project III : Balsam fir landscape dynamics modeling with Landis in Western Newfoundland Ecoregion (Corner Brook subregion).

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Partners:
- Western Newfoundland Model Forest
- Institut Québécois d'Aménagement de la Forêt Feuillue (IQAFF)
- Corner Brook Pulp and Paper Ltd. (A division of Kruger Inc.)
- Department of Forest Resources and Agrifoods, Newfoundland and Labrador Forest Service, Ecosystem Management Division,
- Canadian Forest Service

This document presents the progress accomplished to date, expenses related to the progress and a revised schedule for next year.

Work completed

The NDR research program is divided in three phases:

1- Balsam fir stand dynamics after insect outbreak disturbances in Western Newfoundland Ecoregion (Corner Brook subregion)

2- Studying insect outbreaks using past aerial photographs and historical documents in the Corner Brook ecological subregion

3- Balsam fir landscape dynamics modeling with Landis in Western Newfoundland Ecoregion (Corner Brook subregion)

The first phase has been completed. A workshop on stand-level dynamics and structure will be held during the next trip to NF. For the second phase of the program, because of the difficulties we encountered with the aerial photographs availability the analytical part of this project has been postponed to year 2003-2004, until Jim Gosse, the specialist appointed on that job, will finish the photo-interpretation.

Consequently, a new schedule has been proposed to the BAP/NDR steering committee at the end of January (January 20 2003) (Table 1). With this new schedule, we swapped phase II (aerial

photos) with part of the time and resources allocated to phase III (NDR simulation) in order to make sure that Yves Jardon's time (and postdoct grant!) will be optimized. During that time, it was understood that the WNMF took in charge the photo-interpretation part of the phase II. Hence, Yves Jardon started the parameterization and calibration of the model LANDIS. Our goal was to have it ready to be operating once we will get the information from the aerial photographs analysis. Therefore, all the time that Yves Jardon has spent until now since that time was to prepare the input coverages and the parameter files for making LANDIS running for the WNMF.

The purpose of the landscape modeling phase is to simulate the natural dynamic of the balsam fir forest in Western Newfoundland at the landscape level. We started phase III of the project by getting familiar with the new version of LANDIS (Task 1, Table 1). Simulation will be done with LANDIS, a spatially explicit model designed to simulate forest landscape change over large spatial and temporal domains (Mladenoff *et al.*, 1996; Mladenoff and He, 1999; He *et al.*, 2001). The Landis is a DOS application written in C++ (object-oriented model) operating on raster GIS maps. As input, the model is using species characteristics, stand species composition, forest ecological type, and disturbance characteristics. This task is 100% completed.

Table 1: Schedule submitted for January to March 31 2003 for the Landis modeling

Task	Schedule	Done	Cost
1. To get familiar with the new version of LANDIS	- January 20-24 (1 w.)	100%	$ 2192
2. To prepare the input coverages	- Jan. 27 – Feb. 28 (4 w.)	100%	$ 8768
3. To prepare the species attribute, the map attribute, the land type attribute parameter files	- March 3 - March 31 (4 w.)	50%	$ 8768

After understanding the new features of LANDIS, we started preparing the input coverages (Task 2, Table 1). This task is now 100% completed. Two input coverages are required for running LANDIS: one is the actual forest vegetation and the other is the land types map (ecological sites). The information used for defining the vegetation coverage came mainly from the forest inventory coverage (1985 updated) with all the descriptive features (composition, age, density, height). The forest harvest cutblock history map was also used to validate stand age and last disturbance age. To get a better description of the forest structure, we also used the

information from (1) the Newfoundland temporary sample plot database and (2) from the stand structure and dynamics analysis (phase I of this project). 112 vegetation types were defined and spatially located (Table 2).

For the second coverage describing the land types, we used the Damman forest types map as produced at the stand polygon level by IQAFF from a previous task in BAP phase II. Fifteen Damman types groups were defined. In the absence of the disturbance information that will be coming further on from the aerial photograph analysis, defoliation map of the 1965's and 1985's hemlock looper outbreaks and the 1970's spruce budworm outbreak, provided by CFS, were used for determining mean outbreak return interval on each of these Damman type groups. A closer analysis of this coverage showed that HL outbreak frequency and severity was higher in areas surrounding lakes (spatial contagion). Based on this result, land types were split in two (30 land types), given their distance to lakes (two classes: near/far) (Table 2).

To make LANDIS working for the WNMF, we had to modify many parameters (Task 3, Table 1). The most important LANDIS module allows simulating three types natural disturbance: fire, windthrow and wood harvesting. Fires are negligible in the context of the humid climate of western Newfoundland (Meades and Moores, 1994) and assessing the effects of harvesting in combination of the NDR is not part of the purpose of the research. The major driving natural disturbances in the WNMF area are insect outbreaks (hemlock looper and spruce budworm outbreaks) and windthrow. Consequently, we adjusted the parameter and attribute files to "trick" LANDIS and therefore replaced fire disturbances by hemlock looper outbreak. To simulate spruce budworm outbreaks, we are using the harvest module. Finally, windthrow is kept as it is in the model, acting simultaneously with outbreaks.

We then worked on the parameter files. We almost completed the species attribute file, land type attribute file, and the map attribute file (Table 2, Annexe 1). We are now working on the disturbance file (Table 3). As forecasted, we completed half of the parameterization of the model at the end of March. Preparing parameter files will be finished for the end of April 2003 (Table 3) after then we will be able to do some preliminary simulation and to start calibration of the model. The information coming from photo-interpretation analysis will allow later modifying the disturbance parameters file (HL, SBW, windthrow). Until then we will use the outbreak disturbance history coming from different CFS sources.

Table 2: Parameter files and their attributes. We are still working on the attributes or variables in italic.

Parameter file	Parameters	Attributes or variables
Species attribute file	Species: bF, bS, wS, wB, yB, tL, lA, wP, rM, K, mM	Longevity Mature age Age tolerance Fire tolerance Effective seeding distance Maximum seeding distance Vegetation propagation probability Maximum sprouting age *Reclassification coefficient*
Land type attribute file	We grouped the 31 Damman types into 13 Damman groups: FDH, FDR, FT, FH, FP, SM/R, SO, SM/M, BD, FC, BR, SS, SK, NPL, then splitted in two according the distance to water body (near or far).	Nurse cohort age Mean HL outbreak return interval (y.) HL outbreak ignition coefficient HL outbreak probability coefficient *Time since last winthrow*, Time since last HL outbreak Establishment coefficient by species *HL outbreak curves* *HL outbreak class* *Wind class* *Modified disturbance class*
Map attribute file	We defined 112 species-age-density groups.	For each species we established: vegetative propagation flag p/a of each age cohort by species
Disturbance file	*Windthrow and HL outbreaks*	
Harvest module	*Harvest regime*	

Schedule and cost proposed for the years 2003-2004

Table 3.

1. Landscape dynamic history using old aerial photographs

Office	Task	Schedule 2003-2004	COST
WNMF	1. End of the photo-interpretation		N/A
WNMF	2. To digitize, rectify, georeference the photos and build up the database		N/A
IQAFF	3. To analyse the frequency, intensity, size and shape of disturbance by insect, forest type (ecosite), stand types previous to disturbance (age, composition, structure), and topographical features (elevation, slope, etc.) by period	July 1 – August 1	$ 7,500
IQAFF	4. To generate a transition matrix showing probability of vegetation changes according to variables of above.	Aug. 1 – Aug. 21	$ 7,500
IQAFF	5. To interpret results	Aug. 22 – Sept. 21	$ 5,000
IQAFF	6. To write the report	Sept. 22 – Oct. 12	$ 2,000
	Total		22,000

2. Landis modeling (all done by IQAFF)

Task	Schedule 2003-2004	COST
To prepare parameter files (end)	- April 1 – 11 (2 w.) 2003	$ 4,384
To write preliminary report	- April 18 (1 w.)	$ 2,192
To calibrate the model	- April 21 – June 27	$ 8,768
To compute sensitivity analysis	- Oct. 13 – Dec. 26	$ 10,960
To simulate	- Jan. 5 - 30	$ 4,384
To analyse output	- Feb. 2 - 27	$ 8,768
To write the report	- March 1 - 31 2004	$ 2,192

Conduct a training workshop on Landis in Corner Brook		$ 2,192
Total		$ 43,840

Two trips to Corner Brooks	$ 7,200
Total of the project	$73,040
WNMF contribution (Total – postdoct grant)	**43,040**

References

Meades, W. J. and Moores, L.1994. Forest site classification manual. A field guide to the Damman forest types of Newfoundland. 2 ed. Western Newfoundland Model Forest Inc.; Newfoundland Dep. For. Agric.; Nat. Res. Can., Can. For. Serv., FRDA Report 003.

Mladenoff, D.J., and He, H.S. 1999. Design and behavior of LANDIS, an object-oriented model of forest landscape disturbance and succession. *In* Spatial modeling of forest landscape change: approaches and application. Cambridge University Press, pp. 125-162.

Mladenoff, D.J., Host, G.E., Boeder, J., and Crow, T.R. 1996. LANDIS: a spatial model of forest landscapes disturbance succession, and management. GIS World Books, Fort Collins, Colorado, U.S.A. pp. 175-180.

He, H.S., Mladenoff, D.J., Nimerfro, K.K. and Gustafson, E. J. 2001. Landis. A spatially explicit model of forest landscape disturbance, management, and succession. Landis 3.0 user's guide. University of Missouri-Columbia

Annexes 1

We provide three data file documents as examples of what are the parameter file:

1- Land Type Attribute.xls

2- Map Attribute.xls

3- Species Attribute.xls