Fundy Model Forest

~Partners in Sustainability~

Report Title: Achieving Greater Precision in Forest Ecosite Classification and Mapping. FMF Project 5714

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The Fundy Model Forest…
…Partners in Sustainability

"The Fundy Model Forest (FMF) is a partnership of 38 organizations that are promoting sustainable forest management practices in the Acadian Forest region."

Atlantic Society of Fish and Wildlife Biologists
Canadian Institute of Forestry
Canadian Forest Service
City of Moncton
Conservation Council of New Brunswick
Fisheries and Oceans Canada
Indian and Northern Affairs Canada
Eel Ground First Nation
Elgin Eco Association
Elmhurst Outdoors
Environment Canada
Fawcett Lumber Company
Fundy Environmental Action Group
Fundy National Park
Greater Fundy Ecosystem Research Group
INFOR, Inc.
J.D. Irving, Limited
KC Irving Chair for Sustainable Development
Maritime College of Forest Technology
NB Department of the Environment and Local Government
NB Department of Natural Resources
NB Federation of Naturalists
New Brunswick Federation of Woodlot Owners
NB Premier's Round Table on the Environment & Economy
New Brunswick School District 2
New Brunswick School District 6
Nova Forest Alliance
Petitcodiac Sportsman's Club
Red Bank First Nation
Remsoft Inc.
Southern New Brunswick Wood Cooperative Limited
Sussex and District Chamber of Commerce
Sussex Fish and Game Association
Town of Sussex
Université de Moncton
University of NB, Fredericton - Faculty of Forestry
University of NB - Saint John Campus
Village of Petitcodiac
Washademoak Environmentalists

Fundy Model Forest Year-end Report 2006/2007

Achieving greater precision in forest ecosite classification and mapping

FMF Project # 5714

Proposed by Chris Norfolk[1] and continued by Jeanne Moore[2]

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Partners and Affiliations:
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Tom Ng – NB DNR
Rolland Gagnon – J.D. Irving Ltd.

Preamble regarding project investigation and reporting changes:

This project was proposed by Chris Norfolk and the New Brunswick Growth and Yield Unit, in partnership with JD Irving, Limited and the NB Department of Natural Resources. Jeanne Moore (FMF project coordinator) took an interest in the work and arrangements were made for her to work for the summer (2006) collecting data. Subsequently she chose to carry out the broader project objectives through a Master's Degree in Forestry. It therefore has become her responsibiltiy to investigate and report the project findings.

The following is a report to the FMF which serves as a final report for the FMF fiscal year 2006-07, however, it is only an early progress report within the context of the complete project. Expenditure of FMF funds and in-kind support is also included.

EXECUTIVE SUMMARY

Scientists, conservationists, and forest managers have commonly identified ecological land classification as a primary means for achieving sound management of the Acadian forest. At the finest scale of the hierarchy used to describe the enduring features of the landscape, ecosites are used to describe the distinct assemblages of physical soil conditions which strongly influence the growth and pattern of associated forest vegetation.

Two hundred and fifty soil and vegetation plots were established and surveyed in the Fundy Model Forest (FMF) area of Southern New Brunswick. Rock and soil analyses have been completed. The data collected will serve to validate the precision of a refined ecosite map for the area which will be created based on detailed relationships between surficial geology, topography, and soil moisture and nutrient characteristics.

The FMF area is primarily comprised of ecosite 5 which is the value assigned to mid-range conditions of soil moisture and nutrient status at any one site. It is of interest to differentiate this value into more refined classifications.

A map indicating these more precise conditions will serve to assist forest managers in determining the most appropriate actions to take on a particular site for greater productivity in operations and growth.

BACKGROUND

Existing ecosite maps although logical, have not been put into widespread use by managers due to perceived deficiencies in both precision and accuracy. In the time that has elapsed since the current ecosite maps were produced (circa 1995); a considerable amount of

new data and technology has been acquired which would facilitate an effort to enhance their spatial resolution. The Fundy Model Forest (FMF) in particular, now has: 1) a high-resolution soil moisture map, 2) a network of soil sample plots describing till lithology and geochemistry, 3) a new (2003) coverage of high-resolution digital aerial photographs, 4) an expanded system of both temporary, and permanent forest inventory plots, and 5) an enhanced digital terrain model. If utilized appropriately, those items stand to improve the predictive ability of the existing ecosite map, thereby facilitating its expanded use in sustainable forest management planning.

If successful, researchers, managers, and woodlot owners would be able to utilize the improved ecosite map to aid forest management planning in the region. Lessons learned during the exercise would also be of great importance to those looking to expand toward a provincial mapping effort.

Why do we need a new classification?

In recent years, those charged with forest management planning in N.B. have sought a meaningful site classification map for conducting forest stratification, growth & yield research, and assessing appropriateness of alternative silviculture & harvesting techniques. The ecosite framework is generally accepted as having multiple applications for forestry and conservation science, however, poor precision with current mapping has prevented its widespread use. A reclassification effort will allow forest managers to rely on information that will pinpoint the locations of conditions on the landscape for more precise management and productivity.

Objectives (as noted in the original proposal to FMF)

1. Produce a higher-precision ecosite map for the Fundy Model Forest area.
2. Undertake a complete validation and error analysis of final output.
3. Produce a cost analysis of the map production and projected costs of completing a provincial exercise. (This objective has been omitted due to the change in project lead from the original proponent to becoming a graduate study.)
4. Documentation of the process and results in the form of a technical publication (Master's thesis.)

Objectives (as a result of the change to a Master's project)

1. Reclassification of ecosites based on soil lithology and drainage characteristics (depth to water table) which will represent soil fertility and moisture regimes.
2. Validation of a new ecosite map with data from sample plots.

3. Documentation of the process and results in the form of a technical publication (Master's thesis.)

Study Area

The area of interest for the reclassification project is the Fundy Model Forest (FMF) located in southern New Brunswick in the Acadian Forest region. The land base area is 420,000 hectares and is comprised of private woodlots, industrial freehold (private industrial), Crown land and Fundy National Park. It is a complex land base and through the work of the model forest partnership, a 15 year history of research and sustainable management is in place. Because of this history, the extent of forest management in the area and data that have been gathered, it is a good pilot area to assess a new mapping tool.

Ecological Land Classification

An Ecological Land Classification (ELC) is a hierarchical system that describes the "enduring features" of the landscape (soil, geology, climate and topography) at those various scales. Maps depict the classifications and range from broad national-level zone maps (e.g. a map of Canada showing forest types) to small-scale maps of ecosites (local forest conditions). At the finest level of New Brunswick's ELC, "ecosite" is a term used to describe vegetation composition (indicative of the soil nutrient regime) and soil drainage (indicative of the soil moisture regime) inherent in a soil, at a particular area or site.

There is an interest on the part of the forest industry and government to manage our forests more carefully and a classification based on current data and information will help to achieve this. "An awareness of landscape - its biological diversity, its habitat fragility, the interconnectedness of its elements - can help us make informed decisions on land use and conservation within our local communities." (Zelazny et al, 2003).

Edatopic Grid (soil moisture and nutrient regimes)

Current ecosite maps for New Brunswick are based on an edatopic grid for site classification. The grid represents a gradient along two axes of moisture regime and nutrient regime of a site based on soil characteristics and vegetation type. An assignment of a value (1-8) within the grid indicates a combination of moisture and nutrient status of any one site. A classification of the landscape based on these values then represents their distribution across the landscape.

Using new data and technology and the edatopic grid to classify the landscape will reflect more detail about soil moisture and nutrient status, and be interpreted in forest

management planning for operational productivity related to activities such as harvesting, post-harvest site preparations, tree planting, and precommercial thinning. An improved ecosite classification will improve the ability to predict potential forests for a given region and improve the design of silviculture prescriptions and forest management plans which can maintain the ecological integrity of a site.

Wet areas mapping (depth to water table mapping)

In order to improve the predictive ability of an ecosite map, the depth to water table map layer (DWT) created at the Nexfor Bowater Forest Watershed Centre at the University of New Brunswick (Dr. Paul Arp) will be incorporated. This map layer shows the expected depth to water at any point in the landscape. When water channels are "full to the brim" and water flows into the landscape beyond this point, under wet conditions, the depth to water is measured as the distance (elevational rise) from the water to the soil surface (Figure 1). The effective use of this layer of information in combination with current ecosite and soil information (NBDNR) will lead to better delineation of ecosite conditions that will accurately represent forest conditions.

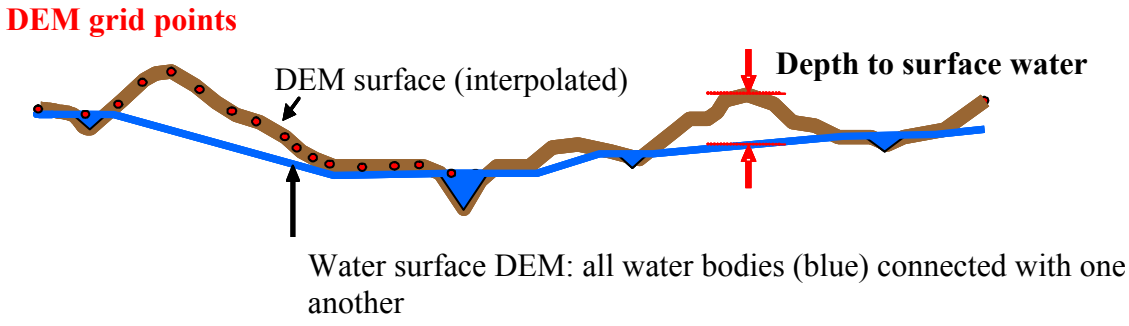

Figure 1. Wet-area modeling and mapping principle (UNB Nexfor-Bowater Forest Watershed Centre).

METHODS

A total of 250 sample sites were chosen that represent each combination of ecoregion and ecosite within the FMF. The distribution of the plots mirrors the area distribution of these unique combinations based on current site mapping, at an intensity of 1plot/2000 hectares. Plots were located within permanent sample plots (PSPs) if they were already established in the area to take advantage of available site data. Sampling (summer 2006) was for the purpose of completing, validating or initiating soil and vegetation surveys at the plots. With the

establishment of new plots (those not related to PSPs) there was an attempt to capture data about the moisture gradient as indicated by the DWT along transects.

GPS data, forest floor thickness, soil profile (texture and drainage information) and a vegetation survey were conducted at each site. Soil and coarse fragment (pebble) samples were collected. Digital photographs were taken at each plot, one of the surrounding vegetation and one of the soil pit.

Using vegetation and soil keys to determine site richness and wetness indicated by the edatopic grid (soil and nutrient regimes), ecosite values (field ecoelements) were assigned to each site.

Soil drainage will be examined and the effects of soil texture (soil permeability), slope, slope position, elevation, and aspect investigated. These factors will be assessed and the information included in the reclassification (delineation) of ecosites. Observations from field samples will be compared to the new map and used to verify the relationship between soil, vegetation and moisture.

PROGRESS TO DATE

Throughout the summer of 2006 the focus was establishing the network of sites which will serve to validate the upcoming GIS analysis. A two-person field crew was trained in soil and site classification by local experts provided through the NB Dept. Natural Resources. That crew geo-referenced 250 site classification plots according to a stratified sampling plan which targeted the establishment of sites across the existing mapped ecoregions and ecosites of the Fundy Model Forest at an intensity of approximately 1 plot / 2000 ha of forest. Where possible, existing site classification data and permanent forest inventory sample plots were used to supplement the plot selection.

Specific information collected for each plot included:

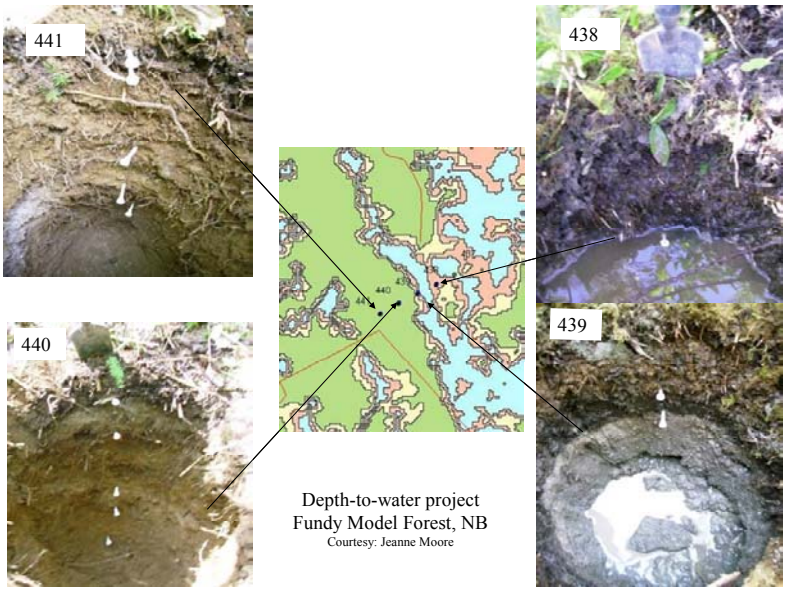

Figure 2. Photos of soil pits along a transect in the FMF showing various moisture characteristics.

GPS data, forest floor thickness, a soil profile including texture and drainage information, and a comprehensive vegetation survey. Materials collected on-site included soil matrix and coarse fragment samples which are currently being analyzed at the UNB soil science laboratory. Digital photographs were also taken at each plot (Figure 2).

Sampling progressed faster than expected during the summer and sites were added to the original proposed set to supplement gaps in either geographic areas or ecological conditions not previously sampled.

Coarse fragment samples (pebbles) have been analyzed for each plot (count, size, coarseness, shape, colour, calcariosity) and will be used in analysis of soil quality. Soil matrix analysis is ongoing and measurements include texture, pH, total exchangeable cations, carbon, nitrogen and sulfur analysis.

DISCUSSION OF PRELIMINARY RESULTS

As expressed in the table below the immediate outcomes of the proposed project are being addressed through the current study. The network of control points (for which FMF funding was requested in particular) has been established. The further outcomes remain as potential avenues for the results of the current study.

Immediate Outcome: *An improved ability to spatially predict the pattern of eco-sites across the landscape of the FMF using existing information and technologies.*	Intermediate Outcome: *An expansion of the techniques learned in the FMF to the provincial level.*	Final Outcome: *The use of eco-site as a stratification variable for 2012 Crown forest management planning models. The design of eco-site driven harvesting & silviculture plans for crown forests.*
Success Indicator: Network of control points indicates a statistically significant improvement in the agreement between actual vs. predicted ground conditions in new ecosite map over existing map.	**Success Indicator**: Provincial level ecosite map is revised by 2010 using processes gained in FMF exercise.	**Success Indicator**: 20122092 strategic forest management plans for the 10 Crown licenses of NB incorporate eco-site as a management driver.

Very preliminary descriptions of the Fundy Model Forest are shown in the following graphs. They show the distribution of drainage classes (Figure 3), ecosite values as per the edatopic grid (Figure 4), and the distribution of drainage classes in each ecoelement (ecosite value assigned in the field) (Figure 5).

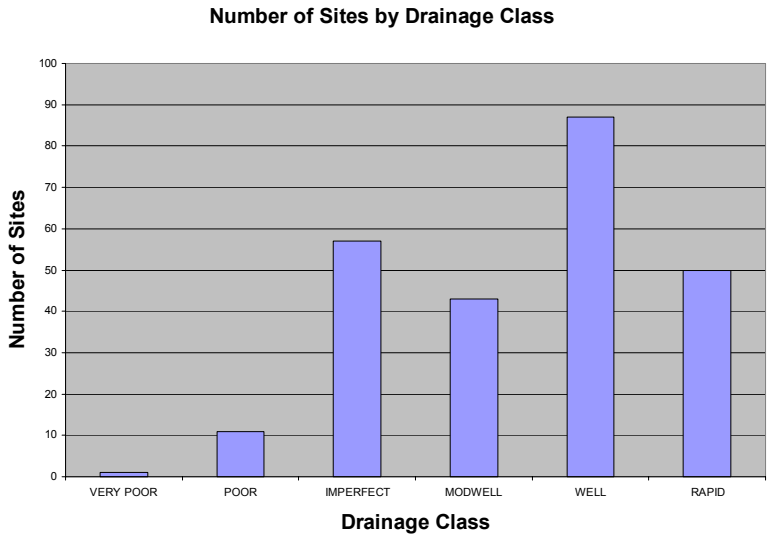

Figure 3. Drainage distribution of sample sites.

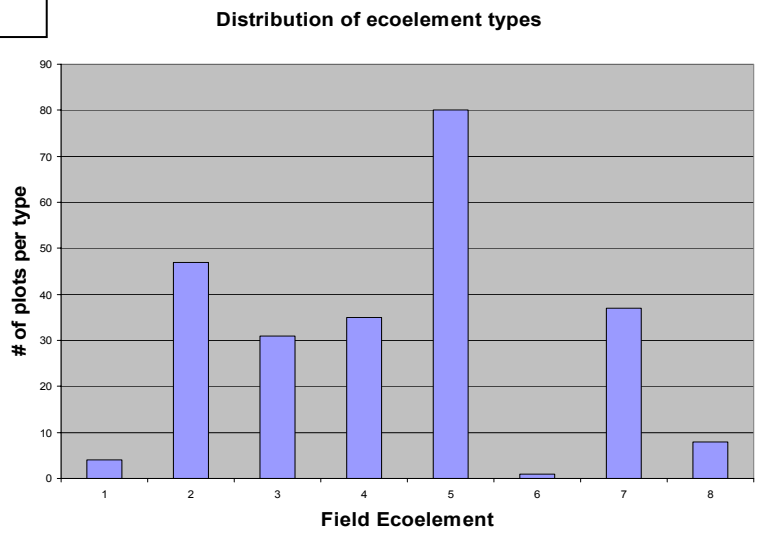

Figure 4. Distribution of ecosite values (field ecoelement).

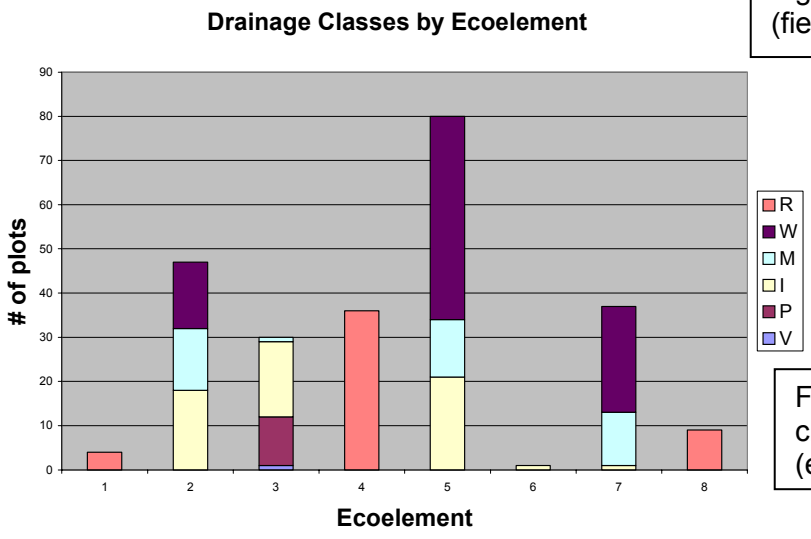

Figure 5. Distribution of drainage classes within each ecosite (ecoelement) value.

These graphs show that the FMF is mostly comprised of the mid-range values for nutrient and moisture conditions (edatopic gris value 5). In order to refine this information for greater precision in management it is necessary to reclassify the ecosites based on more detailed input about the soils and drainage characteristics of each site. This should serve to refine the map and indicate where on the landscape particular conditions arise.

Some questions I will attempt to answer with this project are:

- Using field data, how does field-assessed drainage compare to the DWT map at each particular site (validation of DWT)?
- How does this compare to the current ecosite classification and drainage?
- How much more precise is the new map than the current map?
- What is the difference in predictive ability between the two maps (percentage of correct classification)?

BUDGET

The budget was spent as originally projected. The $10,000 contribution of the FMF was completely utilized in the salaries of the field crew.

List of leveraged cash and in-kind support

COLLABORATIVE FUNDING		
AGENCY	**LEVERAGED CASH ($)**	**IN-KIND EQUIVALENT ($)**
Fundy Model Forest	$10,000 (received)	
New Brunswick Growth & Yield Unit	$3,000 (received)	$13,950 (ongoing)
J.D. Irving Ltd.	$6,000 (received)	$1,500 (received)
NB Dept. Natural Resources	$3,500 (received)	$4,000 (received)

References

Zelazny, V. et al 2003. Our Landscape Heritage: The Story of Ecological Land Classification in New Brunswick. Department of Natural Resources and Energy, Province of New Brunswick

Zelazny, V. 1986. Toward a forest site classification for the New Brunswick lowlands ecoregion. Forestry Abstracts, 1985, Vol. 46, No. 10, pp. 649-650