Forest Ecological Classification and Mapping: Their Application in Ecosystem Management

Moores, L.J.
Department of Natural Resources, Newfoundland Forest Service
P.O. Box 2006, Herald Building
Corner Brook, NF, A2H-6J8

Pittman, B.
Department of Natural Resources, Newfoundland Forest Service
P.O. Box 2006, Herald Building
Corner Brook, NF, A2H-6J8

ABSTRACT

A prerequisite to sustainable ecosystems is the inventory and classification of landscape structure and composition. Ecological classification mapping involves the delineation of landscapes into easily recognizable units. Topography, soils, vegetation, physical landscape form, and successional pathways are the delineation criteria commonly used.

Damman (1967) developed a forest type classification system for Newfoundland using vegetation, soil and landforms as the defining criteria. Damman's forest types were used in combination with mensuration data to assign forest types to each productivity class (Meades and Roberts, 1992). Since each of the Damman forest types is associated with characteristic soils, parent materials, moisture regime and topographic position, the mapping units are similar to the Canada Land Inventory (CLI) units. The CLI maps were recoded and Damman forest type maps were produced. These ecosystem-based maps provide a common framework to assess forestry/wildlife interactions in an ecosystem planning process.

Project 6-103-001

INTRODUCTION

Over the past number of years there has been a dramatic shift in the perception of the forest and its management (Thomas and Telfer 1981). The forest is now viewed by managers as a reservoir for a variety of environmental, ecological, economic, cultural, and social values and there has been a growing recognition of the legitimacy of these values in forest management. The traditional approach to resource management, in which each resource is managed as a single entity independent from all other resources is no longer valid. Single resource management results in activities being undertaken that are not rationalized within the context of the whole ecosystem. Managers must manage forest resources in ways that will ensure resource integrity, productive capacity, resiliency, and biodiversity and satisfy society's economic, environmental, cultural and social values.

In Newfoundland forestry management ideology has changed direction from managing timber to management of forest ecosystems. The Newfoundland Forest Service defines ecosystem management as integrating scientific knowledge of ecological relationships and their limits of growth with social values to attain the goal of sustaining natural system integrity and health over the long-term. Involvement of all stakeholders in management of forest ecosystems is essential to this management philosophy. Resource managers appreciate that ecosystem management involves genetics, species, population dynamics, ecosystems, landscapes, and the interactions or linkages between these elements. The philosophy of ecosystem management is to sustain the patterns and processes of ecosystems for the benefit of future generations, while providing goods and services for each generation (Everitt, 1994). The challenge is to define characteristics of ecosystems and landscapes that promote long-term ecological sustainability, to manage land and water ecosystems in ways that maintain sustainability, and to address societal values and expectations.

ECOLOGICAL CLASSIFICATION

A common framework is required for development of ecosystem management strategies. An ecological-based framework would be more versatile for dealing with a wide array of forest values than a strict economic, social or technology-based framework.
An ecological classification system provides a framework that enables the recognition of on-the-ground characteristics of vegetation, soils, landforms, general climate and regional physiography (Simms, 1993). Defining ecologically based 'land units' facilitates, 1) mapping and surveying activities, 2) evaluating suitability of a landscape for a particular land use, and 3) transferring landscape knowledge from evaluations to applications (Zonneveld, 1989). In addition, an ecological classification system can serve as a means of linking existing individual resource databases, (i.e., timber inventory data and wildlife survey data). Integrated databases would help foster ecosystem management by making all existing data available to all resource managers.

Damman developed an ecological classification system which delineated major forest types based on vegetation, soil and landform criteria (Meades and Roberts, 1992). This classification system emphasized the use, where possible, of vegetation as an indication of differences in soil moisture and soil fertility between forest sties. Vegetation is combined with soil types to define forest types. In addition to classifying forest vegetation, Damman developed successional relationships between forest types and their response to disturbance by fire and logging.

In 1966 the Newfoundland Forest Service became involved in a national program, Canada Land Inventory Capability (CLI) Classification, to assess and map land use potential for forestry activities. The objective of the forest capability survey was to delineate land based capability classes and to express this information in map form at scales appropriate for potential users (Delaney, 1974). Damman's forest type classification was used in the calibration of the Canada Land Inventory Capability Classification. Damman's classification grouped together forest sites occupying a similar landscape position. Each forest type has a definite environment with a characteristic soil, parent material, moisture regime, local climate and topographic position. Since these factors control the rate of growth, similar forest types within a climatic region were assigned the same capability class and sub-class. In order to assign a capability class to a forest type, it was necessary to find a number of fully stocked stands at or near rotation age for each forest type. On the basis of merchantable volume associated with a Damman forest type, a capability class was assigned (Table 1). The end product of the Canada Land Inventory Capability Classification project was the production of a series of maps for Newfoundland delineating the capability classes.

ECOLOGICAL MAPPING

A District Forester from the Newfoundland Forest Service involved with the Canada Land Inventory Program was seconded to develop the methodologies needed to produce a forest ecological mapping system based on Damman's forest types using the Canada Forest Inventory Capability maps and field survey information. Table 2 illustrates the relationship between the Damman forest types and the Canada Land Inventory Capability classes. With mapping at a 1:50,000 scale extensive field work was required to verify the correlations between capability classes and Damman forest types as identified on the maps. Figures 1 and 2 illustrate the recoding from the Canada Land Inventory map to produce a forest ecological classification map.

Table 1. Summary of Canada Land Inventory (CLI) forest capability classes, subclasses and approximate yield (Meades and Moores, 1989).

Capability Class	Merchantable Volume		Mean Annual Increment		Major Subclasses
	m3/ha	Cords	m3/ha/yr	ft3/ac./yr	
2	> 386	>65	>6.3	>90	C
3	297-386	50-65	5.0-6.3	71-90	FM
4	214-291	36-49	3.6-4.9	51-70	FW
5	131-206	22-35	2.2-3.5	31-50	FMW
6	48-125	8-21	0.8-2.1	11-30	FMWU
7	< 41.5	< 7	< 0.7	< 10	FMP

Table 2. Diagrammatic Key to the Balsam Fir - Fern Rich Forest Types (Modified from Damman, 1967)

STAND STRUCTURE

BALSAM FIR - FERN RICH FORESTS Dryopleria spinulose var. americana (30) Abundant

DIFFERENT SPECIES

Open Fern Layer 30 - 50% Cover	Ferns Dominant 75-95% Cover	Ferns in Large Patches 25-75% Cover
Moss Carpets 30-50% Cover	Mosses Sparse	Mosses in Small Patches 15-25% Cover
Dominant Mosses Hylocomium splendens (76) Pleurozium schreberi (79)	Dominant Mosses: Rhytidiadelphus loreus (81) Dicranum majus (73) Hylocomium umbratum (77) Common Shrub: Vaccinium ovalifolium (19)	Lycopodium annotinum (35 Lycopodium lucidulum (36) Viola incognita (71) Actaea rubra (44)

SOIL TYPE AND MOISTURE REGIME (MR)

Orthic Ferro-Humic Podzol on Sandy Loam or Loamy Sand; ± See page ≥ 30 cm	Orthic or Fragic Humic Podzol on Loams and Silt Loams; Slight See page	Gleyed Ferro-Humic Podzol on Calcareous Basal Till Loam or Silt Loam	Fragic Humic Podzol Or Humic Gleysol; See Page in C horizon
MR 2-3	MR 2+-3	MR 3-4	3 - 4

FOREST CLI CLASS AND SUBCLASS

3M-4M	2C-3S	3S-4S	2C-3N

FOREST TYPE: SYMBOL AND FACT SHEET #

Dryopteris-Hylocomium-Balsam Fir	Dryopteris-Balsam Fir	Dryopteris-Rhytidiadelphus-Balsam Fir	Dryopteris-Lycopodium-Balsam Fir
Fdh (#5)	Fd (#6)	Fdr (#7)	Fd; (#8)

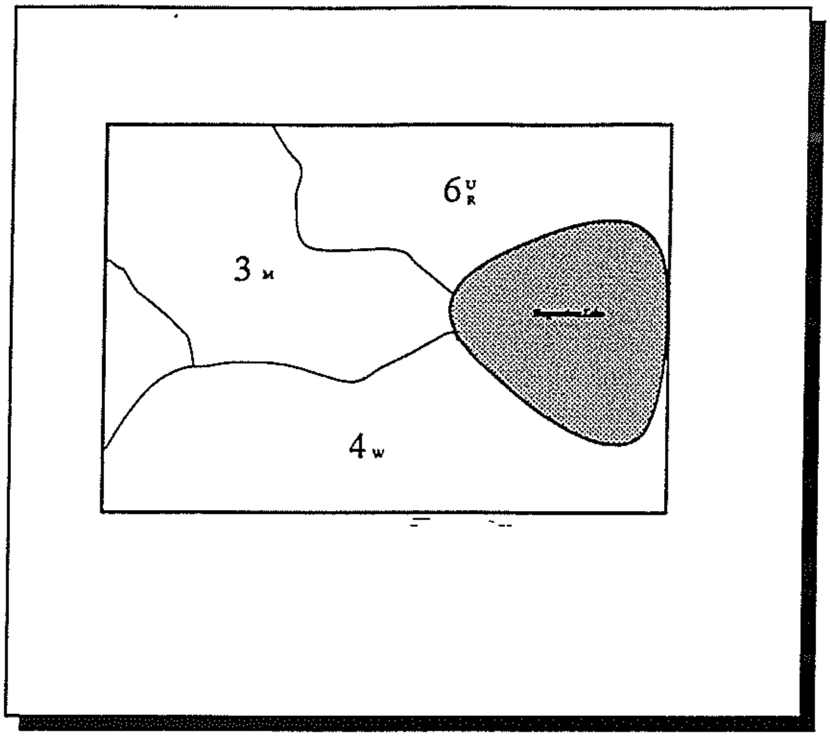

Figure 1. Section of a simplified 1:50,000 Canada Land Inventory Capability Map for the Serpentine River mapsheet

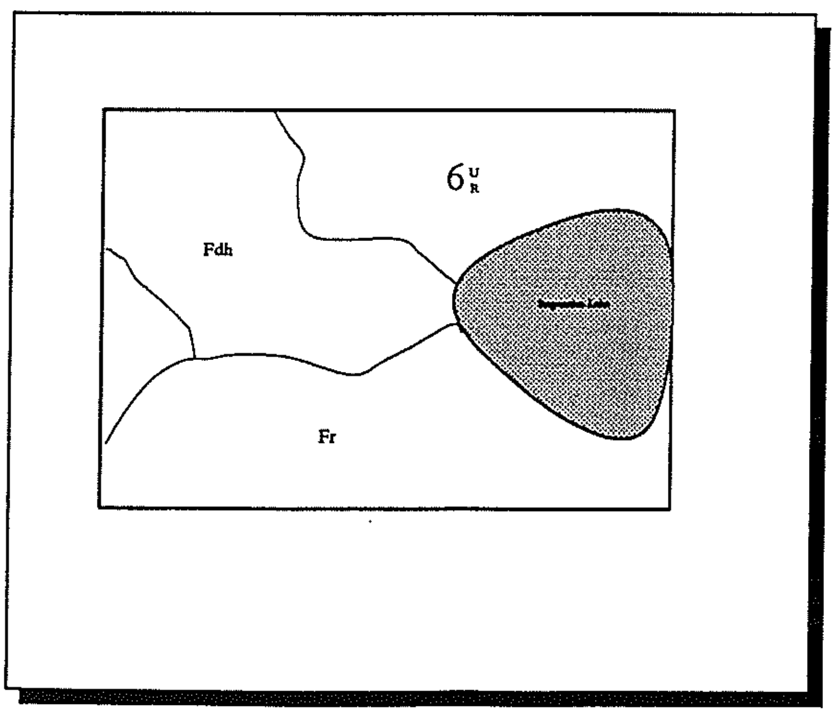

Figure 2. Forest Ecological Classification of a simplified portion of the 1:50,000 Serpentine River mapsheet.

WILDLIFE/FORESTRY APPLICATIONS

The Western Newfoundland Model Forest (WNMF) (Figure 3) is one of ten model forests established across Canada under the Federal Government's Green Plan Initiative. Development of innovative tools for integrated resource management is a Green Plan objective. In cooperation with the management group of the WNMF, the model forest was selected as the area where the preparation of forest ecological classification maps will be initiated. Utilizing GIS technology, the ecological classification maps will be overlaid with traditional timber inventory maps to assign each forest stand a Damman forest type. This stand level classification will supply valuable ecological information presently not available in the Newfoundland Forest Service's geographic database. Concurrently, wildlife habitat characteristics within the WNMF are being defined by Damman forest types. An ecosystem-based framework now exists to establish a connection between wildlife habitat elements and the Newfoundland Forest Service timber inventory.

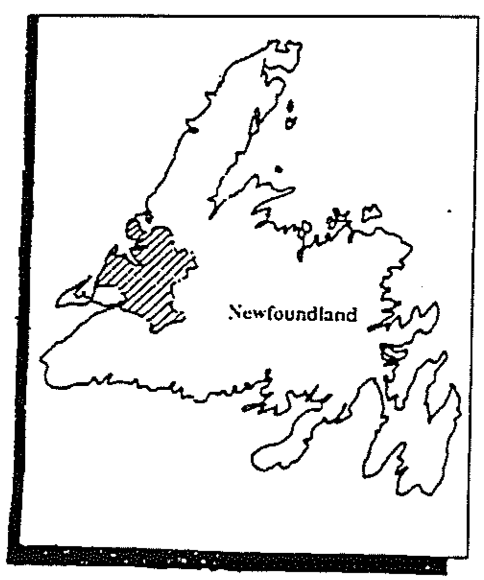

Figure 3. Location of the Western Newfoundland Model Forest.

In additional, cooperation between the WNMF, Forestry Canada (Newfoundland and Labrador Region) and Memorial University is underway to develop a forest succession simulation model based on the successional patterns of Damman's forest types. Computer simulations of successional scenarios resulting from management actions will provide forecasts of landscape composition at discreet time intervals. This simulator combined with the a wood supply model and wildlife habitat models (presently under development within the WNMF), will permit the projection of future wildlife habitat and timber availability. This system will allow managers to test and evaluate management strategies for timber and wildlife simultaneously across a large landscape. Finally, the decision support system will provide resource managers with information based on an ecological framework, and thus foster ecosystem management planning.

CONCLUSION

Management philosophy has shifted from timber management to management of forest ecosystems. Management of single resource values is inadequate when compared to the multiple forest values that are derived from forest ecosystems. Common requirements for information define the need for an ecosystem-based approach for appreciating both timber and non-timber values (Racey, 1993). A forest ecological classification system is an essential tool for the management of forest ecosystems. Mapping of forest ecological classifications fosters the development of forest resource models and enhances decision-making abilities.

LITERATURE CITED

Damman, A.W.H. 1967. The Forest Vegetation of Western Newfoundland and Site Degradation Associated With Vegetation Change. Ph.D. Thesis, Univ. of Michigan, U.S.A. 319pp.

Delaney, B. B. 1974. Land Capability Classification for Forestry in Newfoundland. 103pp.

Everitt, R., Hessburg, P., Jensen, M. and Bormann, B. 1994. Volume 1: Executive summary. Eastside Forest Ecosystem Health Assessment. 61pp.

Meades, W., and Moores, L. 1989. Forest Site a Field Guide to Damman Forest Types of Newfoundland. 285pp.

Racey, G. D. 1993. Forest Ecosystem Classification Data for Non-timber Values. In Forest Planning. The Leading Edge. 138-144pp.

Sims, R. A., Bowling, O., Baldwin, K., and Towill, B. 1993. Forest Ecosystem Classification Systems in Ontario. In forest Planning. The Leading Edge. 114-128pp.

Thomas, J. W. and E. S. Telfer. 1981. An Ecosystem Approach to Integrated Timber and Wildlife Habitat Management. in Transactions of the North American Wildlife Conference 46: 473-487 pp.

Zonneveld, I. S. 1989. The land unit - A fundamental concept in landscape ecology, and its applications. Landscape Ecology. Vol. 3 No. 2 67-86 pp.