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Dealing with diversity: Nutritional Site Classification

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Highlights

- Where time does not permit to gather nutritional information about a given stand, the nutritional classification makes it possible to access other data for similar sites across the boreal zone that can provide forest managers with estimates.
- The nutritional estimates would allow for nutrient budgeting and general site assessment – important tools for stand productivity prediction and decision making.
- The nutritional classification system can be used to compare the nutritional status of different sites (e.g. aspen mixedwood on sand vs. clay) and thus, point to appropriate management practices.

There are numerous and diverse forest site classification systems across boreal Canada. Each has developed out of a combination of needs particular to its users, unique historical contexts, and the characteristics of the forests it describes. While these classifications are designed for regular, daily use (e.g. in the field site identification) and thus, cannot be substituted, it is also clear that many ecosites are shared across the boreal zone. For instance, hygric to subhygric, low fertility black spruce sites, characterized by spaghnum and labrador tea in northern Alberta share similar nutritional qualities to hygric to subhygric, low fertility black spruce sites in boreal Quebec. On the other hand, black spruce on relatively drier, coarse-textured sites are distinctly different, nutritionally speaking, from jack pine on the same type of ecosite.

A broader classification system based on site moisture and fertility encompassing the existing provincial site categories would allow greater access to national tree growth and nutritional data. Thus, nutritional data generated in one part of the boreal forest could be used in another part where this information may be lacking, and would increase information available to local forest researchers and managers. In light of this a classification, based on provincial ecosites across the boreal zone, was developed and used to classify potential nutritional indicators of site productivity.

The Nutritional Site Classification (NSC) is not meant to replace provincial ecosite classifications (most provinces have their own) but to complement them. As such, it is easy to move between the NSC and the provincial systems. Furthermore, the NSC is not an attempt at a national site classification. It is, instead, a consolidation of existing ecosite descriptions with a focus on site nutrient status. This note provides an overview of the NSC and some of the nutritional relationships and differences amongst major boreal species found upon analysis of the available nutritional data (from the Forest Nutrition Databases).

How was the NSC derived?

In order to have manageable yet still meaningful ecological classifications, we grouped several provincial ecosite classifications by soil moisture and nutrient regime or, in the case of aspen, by soil order (e.g. luvisol)/texture. These components are based on other indicators such as soil drainage, soil depth and, often, surficial deposit (in the case of moisture regime). Nutrient regime is meant to relate to soil properties as well as type and abundance of overstory/understory vegetation. The broad NSC classes that were derived for each boreal tree species (jack pine, black spruce, aspen

and white spruce) integrate with provincial ecosites and possibly other classifications linked to provincial ones. Thus, the nutritional classification consists of ecosites from boreal Ontario, mid-boreal Saskatchewan, northern Alberta, Manitoba, northern British Columbia, boreal Quebec and parts of New Brunswick.

How does it work?

The classification is illustrated below in Figure 1.Much like a taxonomic key, the system branches at substrate type (i.e. mineral or organic soil), then at species and finally on the basis of soil moisture regime and subsequently, soil nutrient regime.

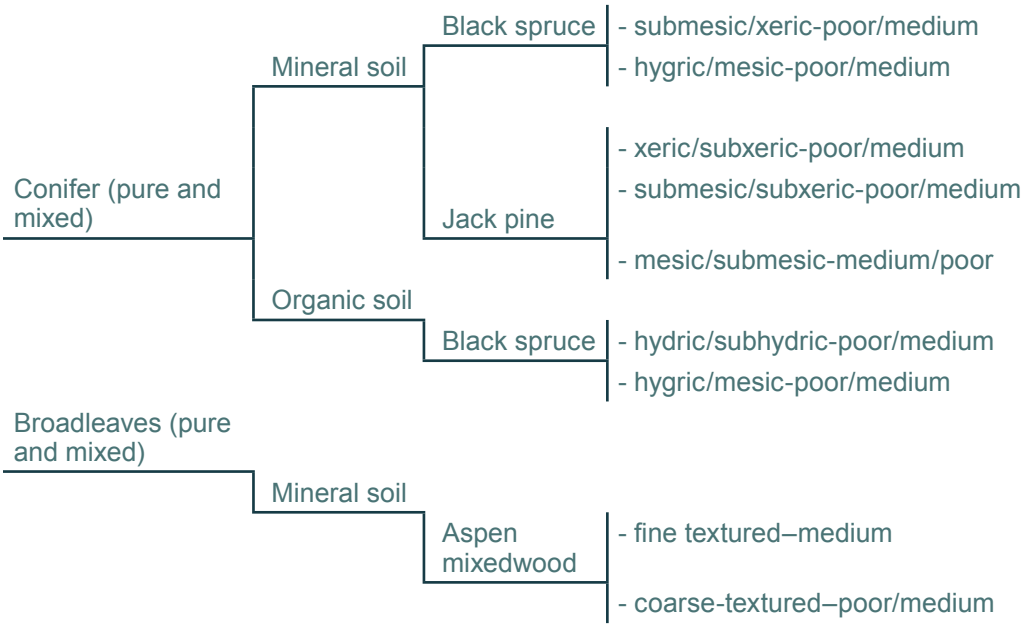

Figure 1. Outline of nutritional site classification with soil moisture and nutrient regimes.

How ecosites integrate with the NSC is illustrated in Figure 2. Nutritional data from the research literature was classified by provincial ecosite information if this information was provided or if sufficient site characteristics were provided to determine the ecosite. Once an ecosite was determined, it was fit into the appropriate nutritional classification. Where sufficient site descriptive data was lacking, the nutritional data could not be used further. This exercise alone pointed to the lack of nutritional data of important boreal species.

Jack pine-xeric/subxeric-poor/medium	
Alberta, north	BM-a1
Saskatchewan	a1
Manitoba	(V24-V26)-(SS1-SS3)
Ontario, northwest	(V30)-(SS1, SS3)
Ontario, northeast	ES18 (V18, (V21, V5))
Quebec, NE	RE21 (sapinière à bouleau jaune de l`est)
Quebec, NW	RE21 (sapinière à bouleau jaune de l`oeust)
Quebec, N	RE11 (pessière à mousses de l`ouest)
NE New Brunswick	GV2

Figure 2. Provincial ecosites that fall within the jack pine – xeric/subxeric – poor/medium nutritional site classification.

Nutritional relationships among NSC classifications

Once data from published research literature (e.g. journal articles, government reports, etc.) was sorted into the different nutritional classes, some preliminary relationships and differences between the classes were evident. For example, with the data collected to date, old (> 80 y), upland black spruce stands on submesic-medium fertility sites can be characterized by some nutritional attributes. Average total N and P of the mineral soil on such sites are 1700 and 400 kg/ha, respectively. Litterfall N, P, K, Ca and Mg for mature (40-80 y) stands on the same sites are approximately 14, 1, 2, 14 and 1.5 kg/ha, respectively. Based on the literature, the same upland black spruce stands also have characteristic nutrient contents in their above-ground biomass (Figure 1).

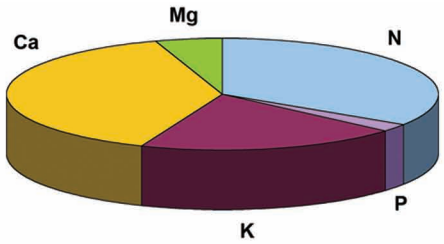

Figure 1. Nutrient distribution in above-ground biomass in a mature, submesic-medium fertility black spruce stand (310 kg Ca/kg, 271 kg N/ha, 156 kgK/ha, 39 kg Mg/ha and 19 kg P/ha).

Other nutritional characteristics have been found for black spruce stands on organic soil, as well as jack pine and aspen mixedwoods. For example, aspen mixedwoods on mesic, relatively fertile, fine-textured soils (e.g. clays/Luvisols) are distinguished by nutritional characteristics, which are different from aspen found on coarse-textured (i.e. sandy) sites. Forest floor N is lower, on average, in aspen stands in coarse-textured soils than those in clayey soils (Figure 2).

When different boreal species occurring on sites that share similar moisture and nutrient regimes are compared, the nutritional classification can help make broad distinctions that could help in forest management decision making. For instance, under black spruce (40-80 yr.) growing on submesic-medium fertility sites forest floor nutrients are, on average, higher than under jack pine on similar sites. Aspen stands can be compared to coniferous stands using the nutritional classification system to point out expected differences. For example, according to the literature data, above ground biomass nutrients are higher in aspen than conifer stands (Figure 3).

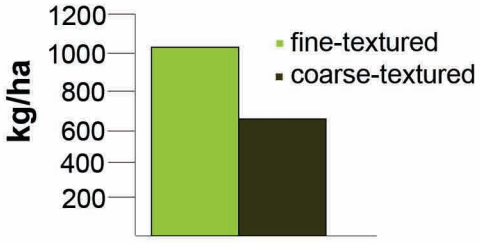

Figure 2. Forest floor under aspen stands growing on fine- compared to coarse- textured soils.

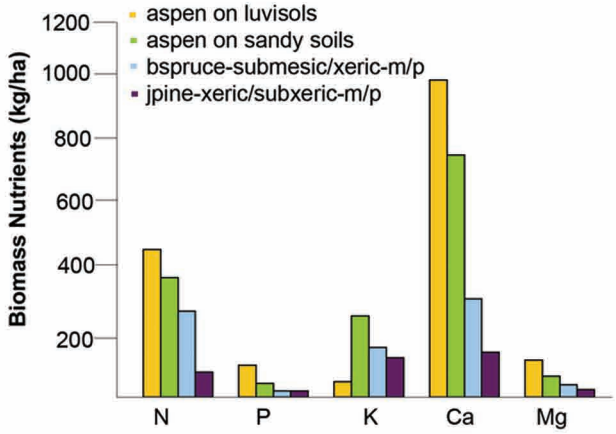

Figure 3. Nutrients contained in above-ground biomass of aspen, black spruce and jack pine on different site types.

These are just a few of the relationships that were found using the nutritional classification in conjunction with literature data contained in the Forest Nutrition Databases[1]. For a more detailed analysis of nutritional relationships using the NSC for specific boreal species, please refer to the SFMN Research Notes entitled *What's a rich site? Aspen mixedwood stands from a nutritional perspective* and *Drawing lines in the sand: Ecosite mapping & Soil Nutrition.*

Summary

Boreal forest stands occurring on sites of similar moisture and nutrient regimes share nutritional characteristics. The nutritional classification system discussed here is based on provincial ecosite classification and is intended to complement them. Nutritional classification in conjunction with literature data can be used to provide nutritional information for boreal sites where data is lacking. Such data use would allow for nutrient budgeting and general site assessment. The development of the classification and the assembly of the Forest Nutrition Databases points to the dearth of nutritional data for many parts of the boreal forest. Published data is sorely lacking for many site types and age classes. Most studies focus on stands of harvesting age yet even those do not provide data on more than two or three nutritional components at once.

References

Forest Nutrition Databases. 2005. http://sfm-1.biology.ualberta.ca

For more information on the SFMN Research Note series and other publications, visit our website at **http://sfm-1.biology.ualberta.ca** or contact the Sustainable Forest Management Network, University of Alberta, Edmonton, AB. Tel: 780-492-6659.

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