

SITE CLASSIFICATION AND PRODUCTIVITY IN THE BOREAL MIXEDWOOD

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The term mixedwood forest, in the context of this symposium, implies a broader concept ecologically than that encompassed by the Boreal Mixedwood Section (B.18a) of the Boreal Forest Region as described by Rowe (1972). A similar Boreal Mixedwood Symposium sponsored by the Canada-Ontario Joint Forest Research Committee (COJFRC) in 1980 considered the definition of boreal mixedwood (Whitney and McClain 1981). The traditional forest inventory definition of mixedwood cover types are those with hardwoods and softwoods growing together, but with neither representing more than 75% of the stems. We can appreciate that such a definition would encompass stands on a very wide range of environmental conditions and with wide variations in tree species composition and productivity. As Ken Armson has mentioned at this symposium, the Spruce-Fir-Aspen Research Committee of COJFRC defined boreal mixedwood (McClain 1981) in terms of sites that support or could support good growth of the five main component species, namely white spruce (*Picea glauca* (Moench) Voss), black spruce (*P. mariana* (Mill.) B.S.P.), balsam fir (*Abies balsamea* (L.) Mill.), trembling aspen (*Populus tremuloides* (Michx.) and white birch (*Betula papyrifera* Marsh.). Sites excluded by this definition are wet, poorly drained lowlands (commonly supporting black spruce), dry sandy areas (commonly supporting jack pine), and excessively drained shallow soils on rocky ridges (commonly supporting jack pine and/or black spruce). Included in the Ontario definition are the many soils of glacial, lacustrine, or alluvial origin. Moisture regimes vary from dry to very moist, depending largely on slope position and soil texture (McClain 1981).

The Ontario definition, I believe, is a good one because it defines boreal mixedwood on the basis of site potential rather than simply present forest cover. The definition should be modified for our region to include lodgepole pine (*Pinus contorta* Loudon var. *latifolia* Engelm.) and jack pine (*Pinus banksiana* Lamb.) on mesic sites where they occur with the other species mentioned. It is apparent that this definition of boreal mixedwood, while more useful than the inventory definition, still includes sites with a wide range of environmental characteristics within several forest sections of the Boreal Forest Region as defined by Rowe (1972). The Mixedwood Section (B.18a) is certainly the nucleus of our broader definition of boreal mixedwood, but also included

within the prairie provinces are Lower Foothills (B.19a) and Manitoba Lowlands (B.15) Sections (Fig. 1).

In this paper I am going to concentrate on some of the basic principles of site classification and their potential for use in forest management. In addressing the topic of mixedwood site classification and productivity, it is appropriate to define site. Webster defines site as a location or situation. To the forest ecologist, a site is a location in the forest expressed as the sum of landform, soils, vegetation, and local climate and microclimate (through elevation, slope aspect, angle, and position), and by several internal site properties that are not evident without taking a much closer look at the site. Such internal site properties include mainly soil properties: drainage, profile morphology, texture, structure, color, mottling, chemical properties, etc.

Recognizing that while no two sites are identical as we traverse the landscape, it will be evident that there are similarities between sites with respect to landform, topography, vegetation, or soils. These similar sites can be grouped into ecological systems or ecosystems. Animals, the other important component of the ecosystem, will not be discussed here, but the importance of ungulates in particular in the mixedwood ecosystems is great. Clear-cutting can enhance moose browse abundance, but escape cover is also required (McNicol and Timmerman 1981). An ecological site classification, particularly when mapped, can serve as a sound basis for wildlife habitat management. Ecosystems classified within a forest management context are often referred to as site types.

Why should we bother to classify forest sites? A classification allows us to transfer knowledge and experience gained in one situation to similar situations elsewhere, something that all of us do in our personal and professional lives. A site classification gives us insight into the environmental conditions influencing tree growth and establishment. An understanding and ability to interpret forest site differences is fundamental in an intensive forest management program and will result in saving of money and optimization of effort.

Forest ecologists have observed that the occurrence of various ecosystems or site types can be described and

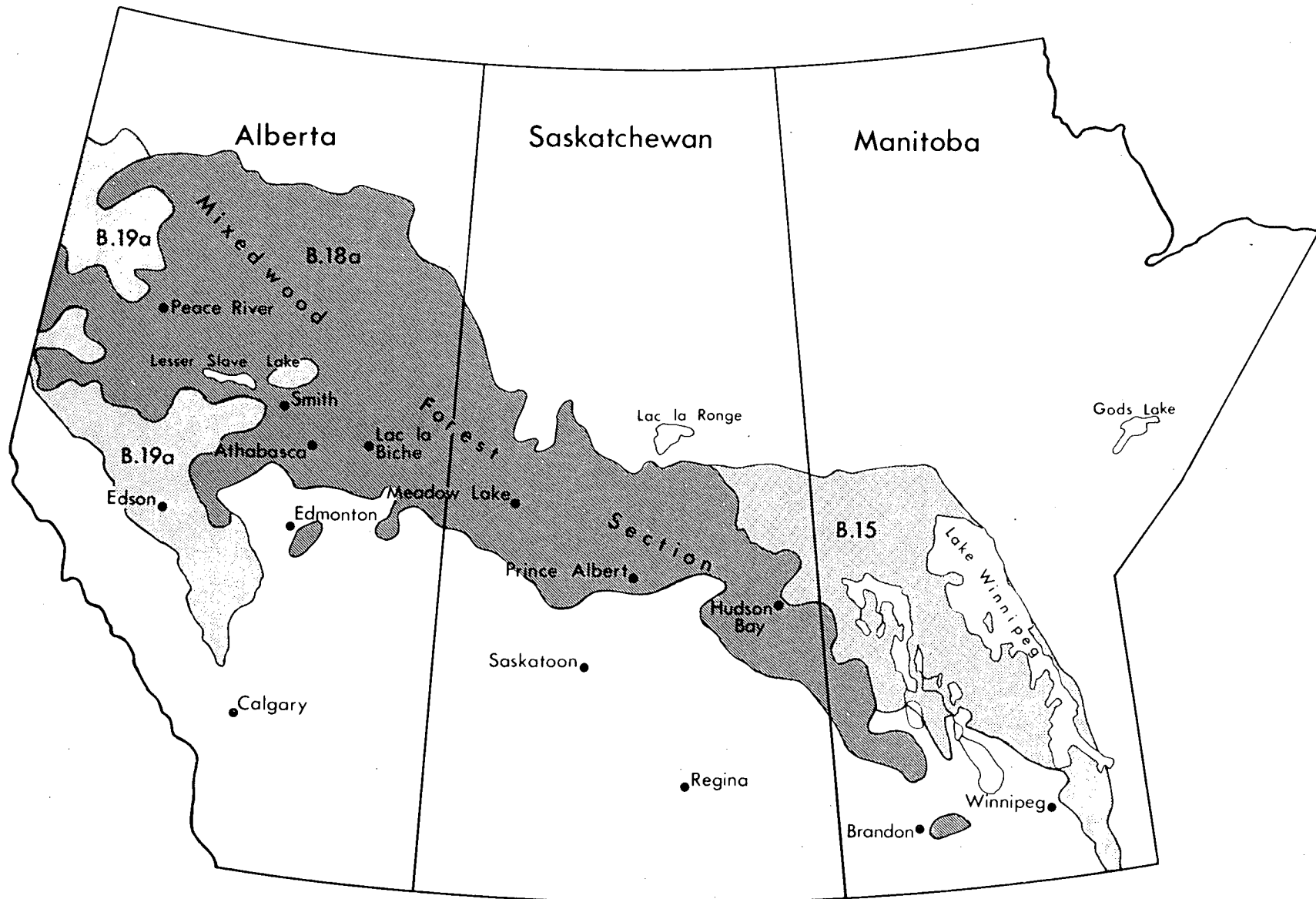


Figure 1. Rowe's (1972) forest sections in the prairie provinces with mixedwood forest cover.

related to each other in terms of two important environmental gradients: moisture regime and nutrient regime expressed on a two-dimensional grid (Fig. 2). These grids, although not quantitative, visually express some important site interrelationships. Moisture regime is influenced by soil drainage, texture, depth, and slope position. Nutrient regime, however, is more difficult to characterize. It is influenced by the type of soil parent material, texture, moisture regime, and seepage.

Site classifications tend to be hierarchical, with information expressed at several levels of generalization. The Canadian Committee on Ecological Land Classification hierarchy, as described by Rowe (1979) and adapted from Lacate (1969), is a typical example (Fig. 3). The uppermost level in the hierarchy is the ecoregion (land region), which is a geographic area with the same regional climate as expressed by vegetation. The second level, the ecodistrict (land district), is a subregional unit where the climatic regime differs substantially from adjacent lands due to altitude (relief) and/or geological substratum (Rowe 1979). The third level, the ecosection (land system), is an intermediate-sized unit whose form expresses a climatic-geomorphologic process (fluvial, colluvial, aeolian, and glacial). The fourth level, the ecosite (land type), is a small topographic unit, one of the associated catenary members of a land system, and uniform in the functionally related local climate, soil drainage, and biota. Sites can be classified by grouping from below (agglomeration) or by subdividing from above (division) (Fig. 4) in such a way that a hierarchy is formed (Valentine 1986). When grouping, few if any map unit boundaries are fixed before fieldwork; in the division approach, most are.

Site classifications may be cartographic (mapped) or taxonomic, in which the site types are described and identified with a key but not mapped. Mapped classifications are generally preferred by the user and have the advantage of being used to relate the site units to other mapped information with overlays or a geographic information system. Site mapping at the scale desired by foresters (1:10 000–1:25 000) is very expensive. Also, map units are seldom pure. The inherent variability in a given map unit must be appreciated by the user. Appropriate large-scale site maps satisfy most users, but costs of mapping large forested areas at large scale cannot usually be justified.

Taxonomic classifications such as the forest ecosystem classifications used in British Columbia (Green et al. 1984), Alberta (Corns and Annas 1986), and Ontario (Jones et al. 1983) use keys to identify site types

of forest ecosystems in the field. Such an approach classifies and describes the various forest ecosystems or site types occurring in an area in a cost-effective manner. They also serve as a good base for site-specific forest management prescriptions. The unmapped classifications, while satisfying some of the needs of the silviculturist, are less satisfactory for the inventory forester who depends heavily upon maps.

Although it may not be immediately apparent, both the cartographic and taxonomic systems describe similar units at the detailed ecosite or site type (ecosystem) level. The criteria used for distinguishing the sites must be appropriate to the method used. In mapping, where we rely heavily upon aerial photographs to discriminate among site types, landform becomes an important criterion. In a site-specific classification used on the ground, site properties evident on-site, such as vegetation, slope, and moisture regime, become more important. Vegetation is not classified as an end in itself, but rather the site units are distinguished on the basis of vegetation in addition to other traditional soil and site properties. Separations on the basis of vegetational differences should also be meaningful in terms of separating land units with inherent differences in productivity or response to management. In practice it is possible to implement a site classification that employs the advantages of both the mapping and taxonomic systems; i.e., a mapped site classification that has keys to the ecosystem units that can be identified independently of the maps. This is desirable if the map units contain a large amount of variability that cannot be separated at the scale of mapping used. This latter approach is currently being used by a contractor on two pilot project areas in Manitoba under the Canada-Manitoba Forest Renewal Agreement.

In the time remaining, I will briefly discuss some representative site types in the boreal mixedwood forest of the prairie provinces. Within the area we have designated as boreal mixedwood lies some of the most productive forest land in Canada (with the obvious exception of coastal British Columbia). Gross mean annual increments (MAI) in unmanaged stands in Alberta are in the range of 1.0–6.0 m³/ha, with some stands producing in excess of 7.0 m³/ha (Corns and Annas 1986), depending upon site and stand history. Unmanaged boreal mixedwood stands in Saskatchewan have MAIs in the 1.0–5.0 m³/ha range (Kabzems et al. 1986). The Canada Land Inventory in Saskatchewan revealed an average annual potential MAI in Rowe's Mixedwood Section (B.18a) of 2.9 m³/ha, while actual production was 1.1 m³/ha (Kabzems et al. 1986).

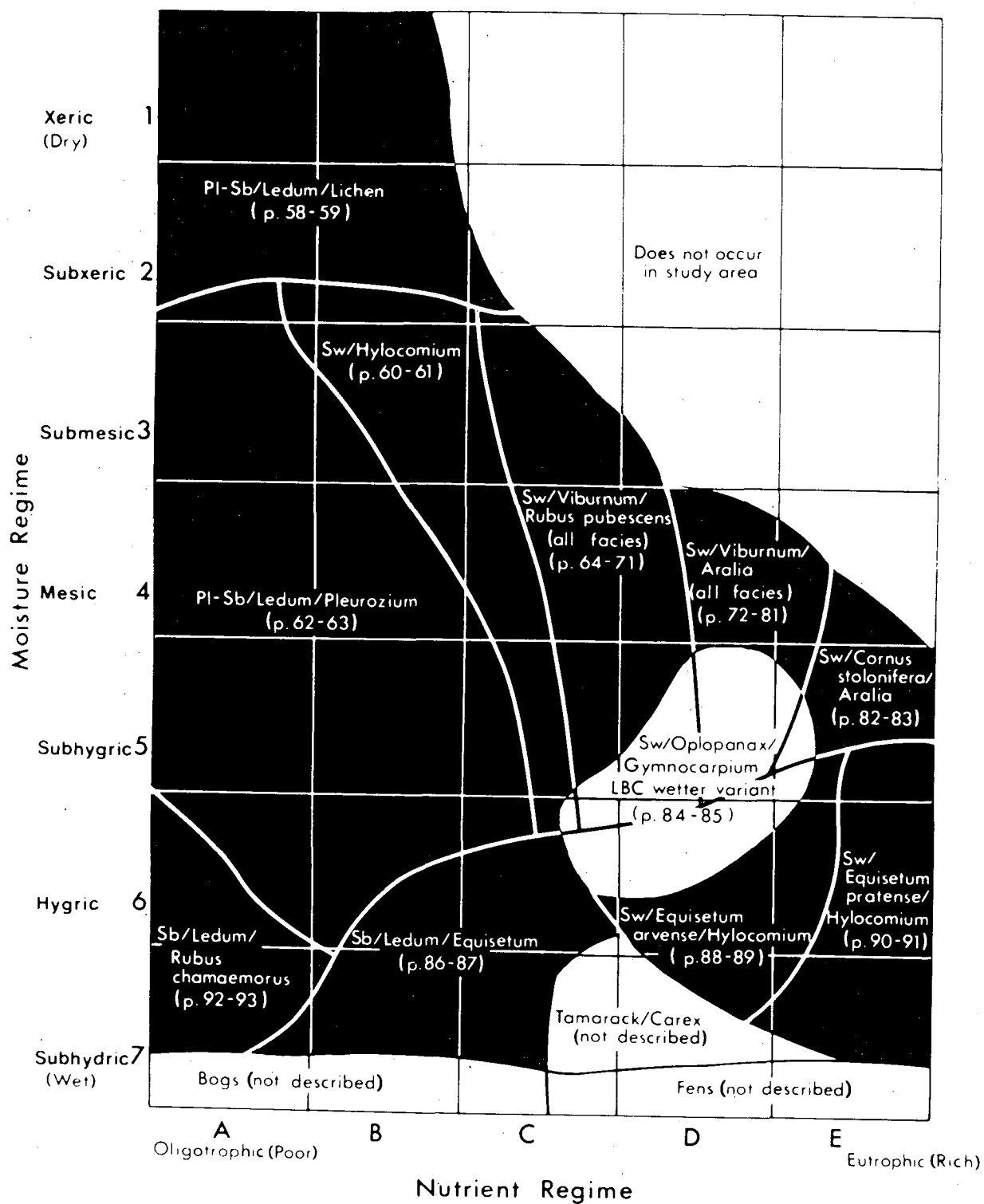


Figure 2. An example of a moisture-nutrient regime grid (Corns and Annas 1986).

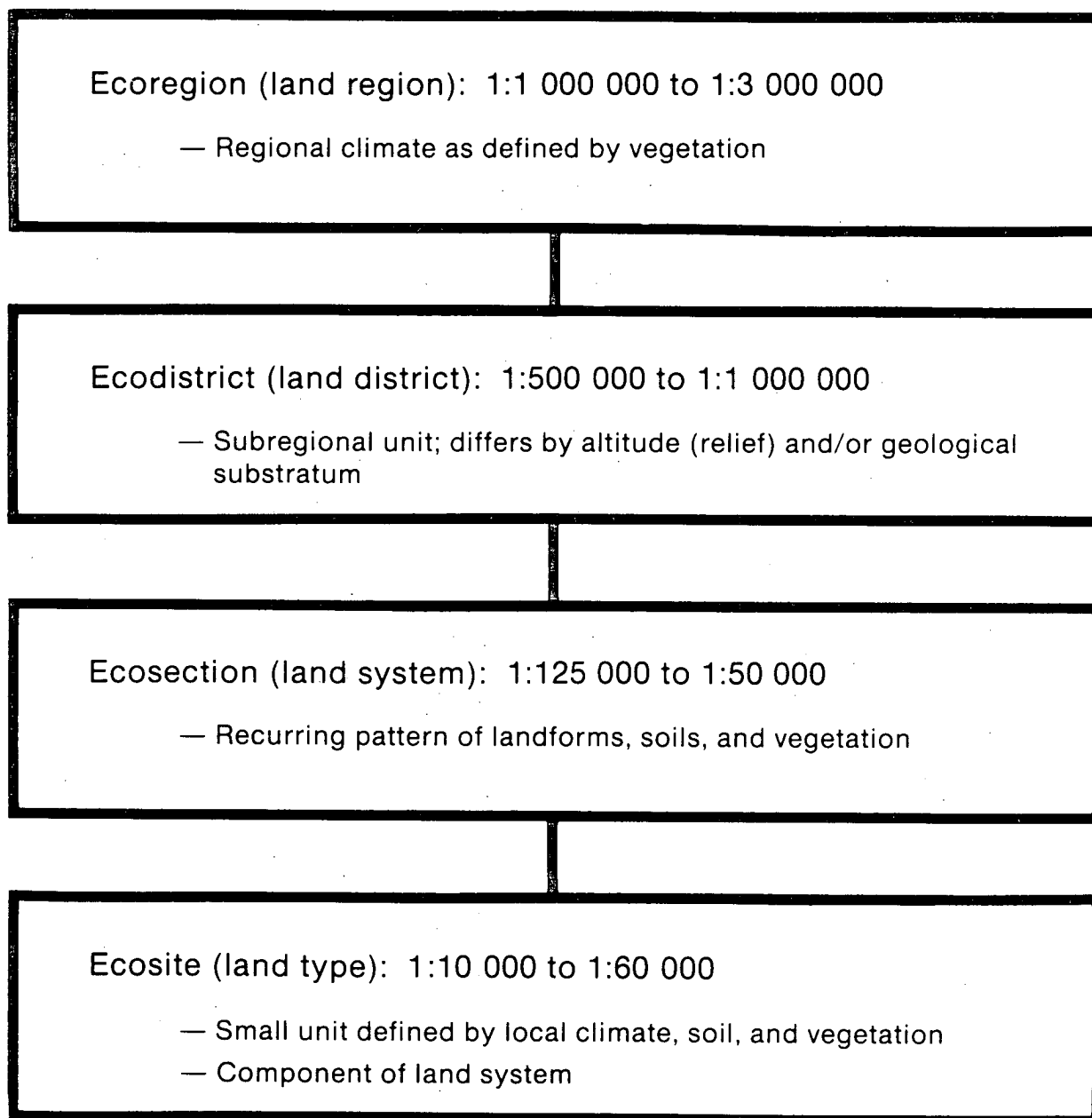
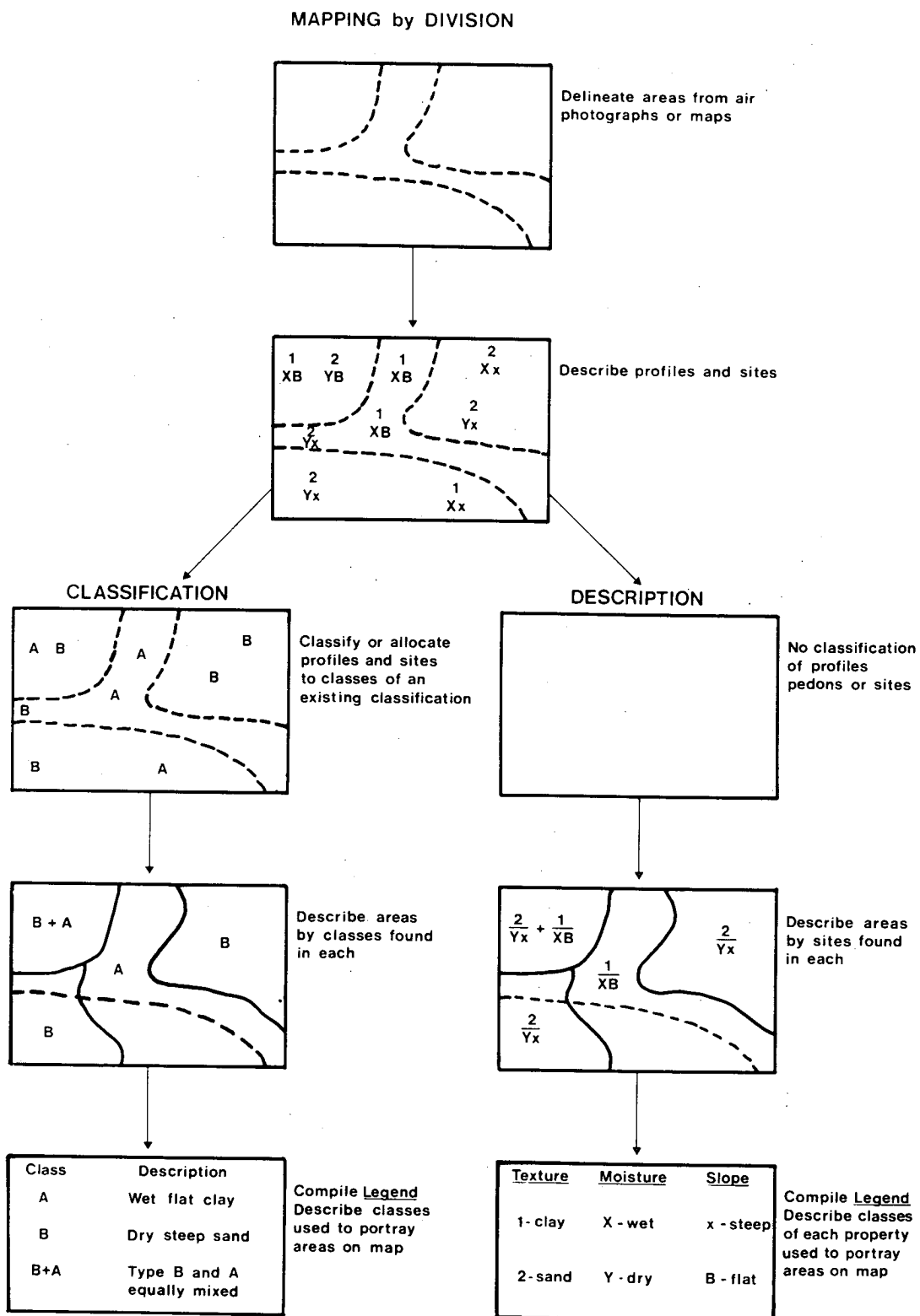


Figure 3. The Canadian Committee on Ecological Land Classification (CCELC) hierarchy (Rowe 1979).



Source: Valentine 1986

Figure 4. Site classification by division (Valentine 1986).

Average productivity in Alberta is similar¹. In all three prairie provinces a small amount of Canada Land Inventory Capability Class 3 is mapped with a potential annual productivity of 5.0–6.3 m³/ha (Canada Land Inventory 1976). Table 1 shows the range of productivity that occurs within forest ecosystems in the boreal mixedwood forest of Saskatchewan (from Kabzems et al. 1986).

SUMMARY

The boreal mixedwood forest is a mosaic of site types, each characterized by its own set of environmental characteristics and its own dilemmas and opportunities in terms of management. There are also dilemmas and opportunities with respect to the use of site classification information. Dilemmas include the following: 1) site classification information is still unavailable for much of the boreal mixedwood; 2) site information is often not mapped; 3) the user is not comfortable using a site classification; 4) it takes time to quantify management

response for various sites; and 5) forest management in our region is still extensive.

The opportunities available, I believe, are greater than the problems and, with time, will greatly outweigh any present obstacles. They may be summarized as follows: 1) a site classification allows us to transfer knowledge and experience from a site to other similar sites in the region; 2) a site classification is the logical framework for forest land management and for conducting forest research; 3) implementation of site classification information will result in a more effective expenditure of money and effort; and 4) as site classification and intensive management progress, we will benefit from increased knowledge and understanding of the dynamics and function of forest ecosystems.

The extent to which our intensive management efforts and cash expenditures become good investments will depend in large part upon how well we understand the sites we are managing and to what degree we employ the site-specific treatments that will be increasingly required.

Table 1. Forest ecosystem productivity in relation to soil drainage and texture (Kabzems et al. 1986)

Forest ecosystem	Drainage ^a	Soil texture	Rotation age	Mean annual increment (m ³ /ha)	Yields (m ³ /ha)	
					At rotation	At maturity
<i>Pinus-Cladonia/Arctostaphylos</i>	VR-R	Coarse	80	0.9	65	90
<i>Picea glauca-Pleurozium</i>	MW	Fine	70	4.5	315	455
<i>Picea glauca/Populus-Cornus/Mitella</i>	MW	Fine	65	4.3	285	330
<i>Pinus/Picea mariana-Pleurozium</i>	I	Mod. fine	75	1.6	120	140

^a VR-R = very rapidly to rapidly drained; MW = moderately well drained; I = imperfectly drained.

¹ Personal communication, 1988, from J. Scheffer, Timber Management Branch, Alberta Forestry, Lands and Wildlife, Edmonton, Alberta.

REFERENCES

- Canada Land Inventory. 1976. Land capability for forestry. 1:1,000,000 map series. Environ. Can., Lands. Dir., Ottawa, Ontario.
- Corns, I.G.W.; Annas, R.M. 1986. Field guide to forest ecosystems of west-central Alberta. Can. For. Serv., North For. Cent., Edmonton, Alberta.
- Green, R.N.; Courtin, P.J.; Klinka, K.; Slaco, R.J.; Ray, C.A. 1984. Site diagnosis, tree species selection and slash burning guidelines for the Vancouver forest region. B.C. Minist. For., Victoria, B.C. Land Manage. Handb. 8.
- Jones, R.K.; Pierpoint, G.; Wickware, G.M.; Jeglum, J.K.; Arnup, R.W.; Bowles, J.M. 1983. Field guide to forest ecosystem classification for the Clay Belt, Site Region 3E. Agric. Can., Environ. Can. and Ontario Minist. Nat. Resour., Toronto, Ontario.
- Lacate, D.S. 1969. Guidelines for bio-physical land classification. Can. Dep. Fish. For., Can. For. Serv., Ottawa, Ontario. Publ. 1264.
- Kabzems, A.; Kosowan, A.L.; Harris, W.C. 1986. Mixedwood section in an ecological perspective: Saskatchewan. Can. For. Serv. and Saskatchewan Parks Renewable Resour., For. Div., Prince Albert, Saskatchewan. Tech. Bull. 8. Second ed.
- McClain, K.M. 1981. Definition and distribution of the boreal mixedwood forest in Ontario. Pages 5-9 in R.D. Whitney and K.M. McClain, cochairmen. Boreal Mixedwood Symposium. Environ. Can., Can. For. Serv., Great Lakes For. Res. Cent., Sault Ste. Marie, Ontario. COJFRC Symp. Proc. O-P-9.
- McNicol, J.G.; Timmerman, H.R. 1981. Effects of forestry practices on ungulate populations in the boreal mixedwood forest. Pages 141-154 in R.D. Whitney and K.M. McClain, cochairmen. Boreal Mixedwood Symposium. Environ. Can., Can. For. Serv., Great Lakes For. Res. Cent., Sault Ste. Marie, Ontario. COJFRC Symp. Proc. O-P-9.
- Rowe, J.S. 1972. Forest Regions of Canada. Can. Dep. Environ., Can. For. Serv., Ottawa, Ontario. Publ. 1300.
- Rowe, J.S. 1979. Revised working paper on methodology/philosophy of ecological land classification in Canada. Pages 23-30 in C.D.A. Rubec, editor. Applications of ecological (biophysical) land classification in Canada. Proc. Second Meet. Can. Comm. Ecol. (Biophys.) Land Classif., Victoria, British Columbia. Environ. Can., Lands Dir., Ottawa, Ontario. Ecol. Land Classif. Ser. 7.
- Valentine, K.W.G. 1986. Soil resource surveys for forestry: soil, terrain and site mapping in boreal and temperate forests. Oxford University Press, New York, N.Y. Monogr. Soil Resour. Surv. 10.
- Whitney, R.D.; K.M. McClain, cochairmen. 1981. Boreal Mixedwood Symposium. Environ. Can., Can. For. Serv., Great Lakes For. Res. Cent., Sault Ste. Marie, Ontario. COJFRC Symp. Proc. O-P-9.

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