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SCALE, FOREST SITE CLASSIFICATION, INTERPRETATION, AND LAND EVALUATION

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by W.D. Holland

ABSTRACT

The Canadian Forestry Service has established a site classification working group to examine the status of SC in Canada and to recommend future classification for land use purposes (limitations and suitabilities) and land evaluation modelling.

A WG review of the current status of site classification in Canada was followed by definitions and concepts of site classification, including comparison of physical, biophysical, and ecological concepts of land classification. Definitions of interpretive land classification were based on how site characteristics affect site quality and how the nature and degree of limitations and suitabilities of site qualities affect specific land uses. The definitions and concepts of SCALE were finalized with a discussion of land evaluation, land use planning and modelling, with reference to the Guelph example. Problems of site classification have been enunciated with respect to taxonomic versus cartographic activities, the accumulation of sufficient field data of the right kind through improved data collection and analytical methods, better sampling techniques, increased us of permanent sample plots, development and use of benchmark sites, improved site index curves by region, development of species of plant indicators and vegetation types. Direction of future research concerned recommendations for definition and demonstration of mapping techniques that will provide "mapping units" known to be closely related to site quality and yield and thus better suited to forestry purposes; improved yield estimating, encouragement of soil-site studies for species suitability,

relation of soil-sites to yield estimates, and application of multiple regression techniques. A CFS action plan is being prepared in order to foster SCALE activities in Canada.

MANDATE AND OBJECTIVES

A mandate was received from CFS Headquarters in May 1985 to form a Site Classification (SC) Working Group, the chief reason being the need for information to guide future investment in forestry. The objective is to determine the status of SC in Canada and to recommend future SC activities regionally and nationally.

A CFS Working Group (WG) was established and functioned via assignments, questionnaires, and meetings in Fredericton in October 1985 and Grande Prairie in August 1986.

The scope of the original mandate was broadened to include not only site classification, but interpretive classification and land evaluation as well, and is the origin of the acronym SCALE.

The following SCALE Objectives have been approved:

1. To provide a forum for SCALE activities.
2. To determine and report national and regional needs, goals and opportunities in SCALE, and recommend CFS R&D program actions/priorities in response to these.
3. To examine and evaluate classification and mapping techniques for SCALE in Canada.
4. To advise and assist users of SCALE throughout the country in order to foster site classification, interpretation, and land evaluation for forest land management purposes.

DEFINITIONS

Definition of SCALE

Site and site classification mean different things to different people. The Canadian Forest Inventory Committee (1978) defines site and site classification as:

> "The complex of physical and biological factors for an area which determines what forest or other vegetation it may carry.
>
> Sites are classified either qualitatively by the climate, soil and vegetation or quantitatively by relative productive capacity".

Thus, site is a group of forest resource components representing a place, area, or spatial location. Description of various sites than, requires mapping, or cartography, in order to be complete. Comparison of sites is best done by classification, or taxonomic techniques, that facilitate describing and remembering various sites. Problems arise when confusions occurs between taxonomic units and mapping units. Site and site classification are at their best when used with holistic concepts; for example, those developed for ecological land classification (ECL). Whatever authors use, it is imperative that they clearly state the concepts and definitions that they are using. While ELC is a preferred land classification system, the definition of SCALE is complete only when all three of its pieces are defined:

Site classification: A system of describing forest land by mapping (ELC - Coen et al. 1982; Wiken, 1980) and by classification (CFIC, 1978).

Forest use interpretations: A system of describing the kinds and arious degrees of se limitation, and/or suitabilities, for different kinds

of forest land; e.g., differences of topography, wetness, nutrient status, soil properties, vegetative competition, etc. (Part IV, Interpretations of soil mapping units for selected parks uses, Holland and Coen, 1976).

Interpretations may be developed for cartographic or taxonomic units, or both. Data may be presented in tabular format, map form, or some or both. Data may be preseented in tabular format, map form, or some geo-information system (GIS) such as SPANDS (Tydac Technologies Inc., 1985).

Land evaluation: A land evaluation system "comprises a comprehensive data base and associated analytical procedures designed to assess opportunities for land use and production given specified (bio) physical and socio-economic conditions" (Brklacich and Smit, 1985).

METHODOLOGY

The methodology used to obtain information pertaining to SCALE included the following:

- Discussions with representatives of the Land Resource Research Institute (LRRI), Agriculture Canada, Ottawa; Lands Directorate (LD), Environment Canda, Ottawa; CFS Headquarters and regional representatives; and the Land Evaluation group (LEG), University School of Rural Planning and Development, University of Guelph, Guelph, Ontario.
- Formation of a CFS Working Group (WG) accomplished through invitations via CFS Establishment Directors and to interested parties outside the CFS. Participants at the two workshop meetings numbered about one-half of the invitations. Attendance and membership differed at the two meetings.

- Two meetings of the WG were held. The first was at Fredericton, N.B. on October 6, 1985 with 24 people in attendance. The second meeting was at Grande Prairie, Alberta on August 21 and 22, 1986 with 18 people attending. The meetings attempted to explore the state of the art and to develop suggested future action in SC, interpretive classification, and land evaluation. Formality was reduced to a minimum in order to encourage discussion. Invited speakers from outside the CFS were included in an attempt to develop ideas. Proceedings were collated and given limited distribution.
- Questionnaires were mailed to WG members and deans of university Forestry Schools. This techniques was not particularly useful for obtaining information. Eleven returns out of 40 came from the WG. The university response was 100% but varied from one paragraph to a dozen carefully written pages.
- An examination of the US approach to forest site classification.
- Review of literature. There is little recent literature in SC and even less in interpretive classification; only the University of Guelph has experience with land evaluation modelling. A list of titles consulted in the production of this report is included at the end.

RESULTS

Discussions

Discussions with the LRRI revealed their data bank of knowledge of the soils of Canada, the ongoing field work of the soil survey personnel, and the benefit of the soil survey tradition of soil resource mapping. LRRI demonstrated utilization of soil survey information for forestry (Clark 1984). Extensions work in site classificiation is an active program in Ontario (Jones 1985). LRRI willingness to pursue cooperative work with the CFS is assured.

Discussions with the LD indicates a holistic philosophy concerning land resources, particularly in development of ecological land classificationTechniques (ELC). The LD expertise with computerized mapping is recognized. A working arrangement between the LD and CFS s desirable.

Discussions with LEG representatives in Guelph demonstrated the need for land evaluation modelling. Also demonstrated was the model presently being used by the group. There is no doubt concerning the need for land evaluation modelling especially where land use becomes competitive and supply costs must be rationalized. However, the Guelph model is very expensive. A better methodology may be forthcoming after CFS refines definitions of SCALE objectives and goals.

Formation of Working Group

The formation of a CFS Working Group for SCALE resulted in an exchange of information at the meetings in Fredericton in 1985 and Grande Prairie in 1986. The WG also finalized the recommendations detailed later. The enthusiasm and expectations of the WG, as well as the interchange of ideas and discussion that can be engendered, indicates that formation of a long-term SCALE WG is desirable. Development of objectives and goals, ideas,

understanding, and cooperation, are benefits that are difficult to achieve without getting people together.

Working Group Meetings

The meetings of 1985 and 1986 were organizational, specifically establishing recommendations for CFS Headquarters (see WG recommendations). To this extent the meetings were successful. It is certain, however, that some WG members were disappointed because they were expecting more specific activities to follow. New WG activities are, of course, contingent upon acceptance of the recommendations by CFS Headquarters and approval and funding of future work. At that point the organizational aspect of SCALE must change to purposeful activity. Suggestions are contained in the WG recommendations.

Questionnaires and Literature

The response to the WG questionnaire is given in the proceedings of the Fredericton meeting. The wide variation in opinions expressed indicates a hodgepodge of what people want from SCALE, especially in SC. The techniques for developing a good SC base are available, given adequate time and funding. Assuming a good SC base, most of the WG questions can be answered by using interpretive methods. This situation is good evidence of the need for development of interpretive classification, the benefit being more effective use of basic SC data and improved forest land management.

Correspondence with the forestry schools evoked positive responses emphasizing the importance of SC but paying scant attention to interpretive classification and forest land evaluation. Except for W.H. Carmean of Lakehead University. His writing is "right on" to the extent that

he analyzes the problem and suggests solutions (Carmean, 1975, 1976, 1977, 1982, 1986).

Carmean identifies the objective as the need to determine site quality, including yield prediction, and forest land classification. A framework that relates the 3 components of the above objective is expected to provide guidance in making decisions about where, what, and how intensively we should manage forest land in the future.

To achieve the above, Carmean states that we need such things as better site index curves (by region), species comparison graphs, and soil-site evaluations. Soil-site evaluations can relate soil, topography, and climate through use of multiple regression, even though the results are valid only in the study area. Plant indicators can be used to describe "ground vegetation types" which are valuable in undisturbed forests, but not good in disturbed areas. Physiographic site classification as exemplified by Hills, Burger, Jurdant, Lacate, and the Canada Land Inventory (CLI) provide a good classification framework for inaccessible areas, but lack quantitative data on such things as site quality and the range of sites. In soil survey, most mapping units have similar site indexes even though SI varies widely within each mapping unit, the reason being that SI is often not related to soil unit variations such as soil depth, subsoil texture, aspect, slope position, slope steepness, soil drainage, etc. However, soil survey can provide a good framework for soil-site studies. Carmean further suggests that teams of mensurationists, soil scientists, ecologists, foresters, and cartographers be formed to develop a complementary framework of forest land classification, one that uses mapping units KNOWN to be closely related to site quality and yield.

WG Recommendations

1. Long-term SCALE WG be maintained.

2. SCALE objectives be approved and reviewed periodically.

3.1 Significance of SCALE be established.

3.2 Benchmark sites be planned and established.

3.3 SCALE publication be planned and initiated.

3.4 Plan a national symposium of SCALE activities.

4. Establish working arrangements with other agencies.

5. SC map atlas be planned and initiated.

6. SCALE plan of action be developed.

7. Senior CFS management provides policy direction and priorities.

8. The 1987 SCALE meeting be held in St. John's, Newfoundland.

Chairman's recommendations

1. The WG recommendations be accepted.

2. The professionalism and prerequisites of SCALE be recognized.

3. Recognize the need for regional policies.

4. Direction of SCALE research to include:

   1) Improved data collection and analysis.

   2) Definition and demonstration of "mapping units" known to be closely related to site quality and yield.

   3) Improved yield estimating.

   4) Develop SCALE activities for hardwoods.

   5) Encourage soil/site studies.

   6) Develop interpretations of the kind and degree of land capability limitations for forestry purposes.

7) Develop strategy for a team approach to problem solving.

CFS SCALE Action Plan

1. Clarify role of CFS in SCALE.
2. Develop a program for transfer of technical information.
3. Develop a program to establish and monitor benchmark sites.
4. Identify the research needs and detail how to fulfill these needs.
5. Develop CFS infrastructure by maintaining support for at least one person per region, who has soils and mapping experience, and is assigned to solving SC problems.
6. Encourage studies to determine the economic benefits of forest management by relating sites, growth and yield, and forest management practices, via:
   1) Economic studies of forest use of prime and non-prime sites.
   2) Economic definition of sites in relation to growth and yield, and the various map units being used in Canada.
   3) Development of an economic method to determine gradient analysis of nutrients and moisture; e.g., via remote sensing.

SUMMARY AND CONCLUSIONS

Forestry is the principal renewable resource industry in Canada, but the existing and economically accessible forest stands are being rapidly depleted. New forest crops take a long time to grow to commercial size. Operations to efficiently replace forest stands is a national problem with long-term payoffs that most land owners (i.e., the provinces) and forest industries cannot economically tackle alone. A detailed planning base, that is more than current forest inventories, is required. To accomplish this, a

national program is required to consolidate and coordinate the expertise, time, effort and funding for site classification, interpretation, and land evaluation.

Among the SCALE activities, interpretation, productivity, and land evaluation are the most important. Site classification should be emphasized after we better understand land features that are important for forest management and productivity. Otherwise we may engage in an expensive and large scale site classification program only to discover that the mapping units cannot be accurately interpreted because they do not contain the information needed in forest land classification.

With funding and encouragement the CFS Working Group can provide the focus and research leadership needed to relate land, soil, climate (i.e., growth factors and ecological characteristics) to productivity and forest management. The research must be done before the results can be applied. Because forestry is a long term and often tedious undertaking, it is imperative that we start today.

Continued support for the organization of scale activities is essential. Even though a number of SC systems are in place in Canada, none adequately relate site quality and productivity to mapping units. The soil surveys still retain their agricultural bias. Foresters need to know more detail of the forest resource being managed before they can learn to manage the forestland more effectively. Thus, we need to conduct research on land features that affect forest site quality and productivity, then demonstrate SC and mapping to the forestry clients, industry, and private sector who will be using it. After the detailed planning base (SC) is accomplished, policy and action plans can be instituted to provide still greater benefits from the forestry community as well as to the forestry community.

Methodology:

A variety of site classification and mapping methods have been described and used over the years. The perfect system has not yet been devised. Standardization of methodology is advantageous for an industrial system (Holland, 1985), but a cookbook approach may inhibit development of ideas.

What is needed is emphasis on developing a better understanding of how growth factors such as temperature, moisture, oxygenation, fertility, soil impedance, plant growth regulators, plant competition, and damage and disturbance affect forest sites, site classification, interpretation, and land evaluation. Such a holistic approach dictates an ELC type of site classification that provides qualitative descriptions of land units for comparison and extrapolation for taxonomic purposes.

Such background data would encourage uniformity in classification, development of classification tools (e.g., site identification keys), and better recommendations for forest land managers.

Site classification is of little value without cartography. We need a mapping system that provides a quantitative measure of site location, pattern, and area.

We also need a system of providing interpretations for the kind and degree of forest use limitations imposed by different kinds of land. A GIS system is needed for retrieval and re-ordering of data, but more importantly we need a system of land evaluation modelling.

Research Needs: In addition to concepts defining forest site and site classification, interpretive classification, land evaluation, and a

clear understanding of taxonomy versus cartography, it is also imperative that research activities support SCALE in Canada in the following areas of concern:

1. Improve data collection and analytical methods (e.g., sampling methods and time of sampling, use of statistical methods, etc.).
2. Increased use of permanent sample plots.
3. Development and use of benchmark sites.
4. Improved site index curves for different regions of Canada.
5. Development of species comparison charts.
6. Development of growth intercept charts.
7. Improved description of plant indicators and vegetation types (including field manuals).
8. Definition and demonstration of mapping techniques providing "mapping units" KNOWN to be closely related to site quality and yield.
9. Improved yield estimating.
10. Relate soil-sites to yield estimates.
11. Application of multiple regression and other multivariate statistical analytical techniques.
12. Emphasis on transfer of technical information.

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