

# Site Evaluation for Intensive Forest Management

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I. Introduction: Some explanation of terms as used in this paper is in order for understanding of the direction being followed.

1. Site: The Mapping Systems Working Group (1981) defines site as the external landscape that is associated with exposure. It comprises such features as vegetation, slope, aspect, and watertable, which are usually included when describing a soil pedon. Its dimensions can vary from 1/10 to 1 ha in area. However, most workers now accept more holistic land classification concepts and extend point specific data into larger areas by grouping according to some accepted land classification system. Hence it follows that site refers to point specific localities whereas larger groupings of sites may follow a hierarchical classification such as that used in the Ecological Land Classification (ELC) of Banff and Jasper.

Site and land classification system were linked by comparison of classification methods that were reviewed by Holland, Romaine, Pluth, and Dumanski at a Northern Forest Research Centre symposium (1971).

Some provinces have already chosen the method, or methods, of land classification they want to use and are well into long term ELC projects. However, the integration of site with ELC concepts is not well understood by some foresters, research scientists, or other users of resource inventory information. Also, the implication of scale, and the distinction between hierarchical taxonomy and mapping units is often misunderstood.

2. Site evaluation: This term is used for assessment of interpretations, either suitability or limitations, for land use. It is, of course, scale dependent, becoming more generalized at smaller scales. The kind and degree of limitations for each site, group of sites, or mapping unit can be quite extensive, depending on the land use being evaluated. Methods of preparing interpretations are described by Montgomery and Edminister (1966), Coen and Holland (1976) and Olson (1981).

3. Intensive forest management: The adjective "intensive", as used here, refers to the concept of leaving the forest in better condition than when it was first encountered. In forestry it means replacing the older concept of sustained forest yield with one of silvicultural prescriptions for improved yield.

For many people, the word "forest" means the production of wood fibre and is restrictive for many who are interested in land use for wildlife, recreation, parks, etc. However, the main interest here is in trees for traditional forestry purposes.

Management of forests, as used here, refers to those manipulations of physical and biological characteristics that are economic. It also includes the techniques of how forest land manipulations may be made. The issue is one of what can be manipulated and how can it be manipulated; e.g. nutrient regimes can be altered by fertilization, but on some soils it may be necessary to apply low rates of fertilizer at frequent intervals.

## II Advantages and disadvantages of ELC:

A main advantage of ELC is that it provides for development of an integrated data base using the following principles:

### 1) Standardization of data collection:

Semantics abound in the literature describing environment. Simple, easily definable and quantifiable terms need to be used in order to improve understanding. Some standard of language is mandatory before technical communications can proceed.

Biological systems are products of ecological processes. If uniform resource evaluations are required in order to make management decisions, then valid methods of measurement need some kind of standardization. Some data gathering systems (e.g., botanical classification) are accepted throughout the world, but other systems are not. Environmental interrelationships of local, national, international and global scale require standardized description, quantification, and evaluation.

Standardization may be relatively simple to implement for single resource components, but although very desirable, may be difficult to implement with integrated data bases, simply because of their complexity. Nevertheless, some degree of standardization is necessary before the scientist, the land manager, and public can communicate at local and more global levels.

### 2) Specialization of data input:

There is usually plenty of information available about why we cannot produce certain things on certain lands (limitations) but not much about what can be produced (suitability). To obtain better land management, land suitability for various land uses needs to be determined and described. Such an exercise aids in deciding what data to collect. Development of an integrated data base encourages the incorporation of specialization into ELC studies and can include teams of scientific specialists; e.g., soil and vegetation scientists, wildlife biologists, social scientists, etc.

3) Synchronization of research:

Research carried out in the field at the same spot and at the same time by specialists (soil, wildlife, vegetation, and other fields) is much stronger and provides a better integration of the various resource components than one where the work is done in separate segments. Synchronization of research can result in a more thorough effort as well as better comprehension of environment and consequent planning and management.

4) Concentration of data acquisition:

An integrated data base requires uniformity of data collection, both in intensity of sampling and quality of data. Greater success can be expected if the ELC studies are carried out under one authority, thus coordinating the research and planning of provincial and federal agencies.

5) Maximization of data use:

Maximization of information and its use requires increased efficiency in terms of productivity and quality of data. Determination of how much data to collect, and what kind, is essential because of high costs of data acquisition. Research is required to develop improved interpretation of resource data for land use purposes, including impact predictions of land management actions. Such research will increase the efficiency of resource data use and lead to maximization of return for the initial research input.

6) Centralization of data base:

A centralized data bank would permit and encourage data base exchanges, as well as provide ease of user identification.

An integrated data base could be used to develop a set of stop/go guidelines for land use management. A simple set of do's and don't's. However, land use management goals must be clearly defined; e.g., the concept of sustained forest yield may have to give way to one of doubling or tripling of future yield. To answer such a question requires development of a predictive capability in the data base.

An integrated data base could be used for periodic land use review and monitoring of ecological change, especially in some of the monoculture types of land use. It could tell us about what is happening to nitrogen and phosphorus levels, the organic matter, soil pH, and all the other variables that we know are slowly changing but are rarely monitored. Comparison of land uses can assist in the monitoring of ecological change and development of a predictive capability for impact of certain land uses.

A properly designed integrated data base would provide a great saving in time. A tremendous improvement over presently used methods would be development of a field to computer linkage where the data could be entered into the computer right in the field, doing away with field forms. An integrated data base developed over a number of years should be able to answer certain questions without the collection of additional data.

In addition to providing baseline resource studies, monitoring of the impact of various land uses on the environment, and prediction of response to management decisions, an ELC integrated data base can provide guidance for research direction.

Site evaluation and development of ELC are at a disadvantage because of:

1. Lack of program application resulting from lack of funding in some areas.
2. Lack of general acceptance through inadequate public relations program.
3. The technique is slow and cumbersome because of the large number and diversity of agencies involved.

### III Objective of Site Evaluation for intensive forest management:

The mandate for intensive forest management has been clearly and emphatically expressed in the recent announcement by Mr. Jacques Gérin (1983) of a forest renewal policy. This objective points the way to establishing CFS goals in tree planting, tree survival and growth, and stand tending, etc. Site classification, site evaluation and land classification are tools for developing new silvicultural prescriptions for intensive forest management.

#### IV Forestry needs:

Ian Corns has begun work towards satisfying forestry needs in the Northern Forest Research Centre region. Using soil survey information and provincial data sources, Corns is currently preparing a forest ecosystem classification and field guide for west central Alberta. Of significance is his tabular relationship of Ecosystem types with silvicultural concerns such as harvesting season and method; site preparation intensity; subsoil compaction; depth to water table; soil puddling hazard; soil erosion hazard; reforestation concerns for species suitability, method of planting, and limitations; frost heave hazard; anticipated mortality; productivity predictions; fire hazard; vegetation competition by type and severity; windthrow hazard; and snowshoe hare damage hazard.

A number of basic questions still remain to be answered; e.g. which lands are best suited for investment of forestry renewal dollars? How are reclamation issues resolved for the plains and foothills areas? How are global and regional impact assessments developed further? How are ELC data best adapted for intensive forest management? What methods can be used for site evaluation for forestry and what are the future needs?

It was indicated earlier that the kind and degree of limitations must be determined for each land use being evaluated; e.g. the kind of limitation may be risk of flooding, and the degree of limitation may be none, once in 5 years, more than once in 5 years. The interpretations can be presented in tabular, cartographic, or computer format or a set of stop-go guidelines. However, the bigger problem lies with acquisition of sufficient data to enable preparation of site evaluations (interpretations). In addition to the work underway by Corns, the future of site evaluation for intensive forestry lies in the following areas:

##### A. The role of Vegetation Types in assessing forest productivity:

1. The use of VTs as indicators of forest productivity.
2. Identification of competing vegetation and evaluation of the impact.

3. Increasing forest productivity through vegetation management.

1) Control of competing vegetation via:

- herbicides
- burning
- thinning
- site preparation

2) Rotation management

B. The effect of soil physical characteristics on forest productivity:

1. The effect of soil morphology on forest productivity:

- 1) rooting volume
- 2) stratified materials
- 3) ease of rooting
- 4) soil compaction
- 5) water holding capacity
- 6) soil temperature

2. The effect of soil compaction on Vegetation Types and competing vegetation.

3. The effect of harvest and site preparation equipment on site; i.e. soil compaction, run-off, erosion, and productivity.

4. Increasing forest productivity through site amelioration

- 1) surface manipulation
- 2) deep ploughing

C. The effect of nutrient status on forest productivity:

1. Assessment of nutrient deficiencies via

- 1) foliar analyses
- 2) phloem sap analyses
- 3) soil analyses

2) Increasing forest productivity through fertilization:

- 1) what elements
- 2) what rates
- 3) time of application
- 4) fertilizer placement

V Conclusion: Pluth and Corns (in press) advocate a continued two-way stratification of western Boreal forest land according to ecosystem type and soil taxonomic unit or soil map unit. They feel that research is required on site factors responsible for forest productivity. After these are identified and documented, they should be mapped to determine their location and extent.

Trees respond to the basic growth factors of light, temperature, moisture, and soil. Hence, site factors such as elevation, excess moisture, deficiency of moisture, vegetational competition, and soil compaction become extremely important to forest productivity. To achieve a forest renewal policy in the Western and Northern Region requires following suggested principles of data collection in order to develop an integrated study of site factors and their evaluation for intensive forest management. Increased forest productivity can be demonstrated when we learn what to manipulate and how to manipulate it. Light conditions may be improved by actions such as thinning forest stands and cleaning up the atmospheric pollution. Better use of heat units and soil moisture may be achieved through deep ploughing and creating of a surface microtopography. Finally, forest renewal may require enhancement or balancing of nutrient regimes through forest fertilization programs.

In fact, times have changed to the point where we now talk of the "tragedy of the commons". The tragedy of the commons is a concept described by Hardin (1968), that human beings are incapable of managing their resources when population and exploitation are uncontrolled. The "commons" is a community pasture, park, forest, soil area, or other resource that can be used by all. The "commons" system works well when the community population is small, but productivity and environmental quality decline when the population expands and exploits the commons excessively. The "tragedy" is that the ecological system reverts to a low level as a result of over-exploitation. Most human activities and problems (e.g., nuclear arms race, pollution, slums, wars) can be related to the concept of the "tragedy of the commons".

Four pertinent ideas follow from our examination of the present day situation in forested lands:

- 1) Our forested lands are "commons" and we certainly can see evidence of overuse and the need for forest renewal.
- 2) Our forests occupy an economic niche of undeniable importance in Canada.

3) In facing an increased demand for products (Ondro and Williamson 1982) and a constant or even a diminishing supply of land, forestry must manage its land in competition with other resource users, whether it is for investment funds or the benefits of alternative resource use in place of forestry, hydrology, wildlife, or petroleum or coal products.

4) Our site and ELC work could benefit from a rigorous examination of fundamental ecological processes, especially in soil physics and its relationship to forest ecosystems.

Who are the successful people; regardless of activity? History shows it to be those that are best organized, in thought, research, planning, and action. Let us cooperate by setting objectives, goals, and priorities for action. Site evaluation for intensive forest management is one step along the road to progress.

A suggestion is for the CCELD to establish a national committee on "Site" classification and evaluation, its main task being to determine:

- 1) The kind of information that various data users need.
- 2) The scale and quantity of information required.
- 3) How research needs of other agencies (e.g. CFS, CWS, etc.) relate to Site Classification and ELC.
- 4) How to develop site specific data for better thematic mapping.
- 5) How to incorporate research results (CFS, CWS, Agric. Canada, etc.) into an integrated data bank with an extended geographic base (e.g. CFS work with fire, insect and disease work, silvicultural trials, etc.)
- 6) How to relate site specific data to ELC mapping units and interpret the results of physical, chemical, and biological studies of sampled areas by integrating these results with all other unsampled properties and processes.
7. How to make the information available to land managers.

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