

# VEGETATION MAPPING IN QUEBEC

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### Résumé

Le but de ce texte est de discuter brièvement les objectifs, les méthodes, les faits à représenter et l'utilité des cartes de la végétation. La cartographie de la végétation est passée au Québec par deux périodes: une première, avant 1963, qui fut la période de cartographie statique, physionomique, structurale et phytosociologique; l'autre, après 1963, de cartographie écologique et dynamique. Actuellement, l'on utilise la photographie aérienne et des enregistreuses sur bande magnétique et l'on tente l'effort de l'intégration des caractéristiques phytosociologiques et édaphiques du milieu. Les cartes préparées doivent servir avant tout de documents de base pour l'aménagement et la mise en valeur des régions rurales du Québec.

### Abstract

This paper deals briefly with the aims and the methods of vegetation maps, what they show and their uses. Two stages can be distinguished in the mapping of vegetation in Quebec: 1) before 1963, when static physiognomical, structural and phytosociological mapping was used, and 2) after 1963, when dynamic ecological mapping was undertaken for ARDA programs. At present, aerial photographs and tape recorders are used, and efforts to integrate vegetation and soil characteristics are attempted. The primary objective of current investigations is to collect basic information for forest and land management, particularly in rural areas of Quebec.

### Introduction

Vegetation mapping can be viewed from different angles:

- 1.— From a *physiognomical* point of view, the territory being described in such terms as forest, prairie, tundra, for designating the vegetal formation understood as a group of plants defined by some dominating species;
- 2.— From a *structural* point of view, *sensu* Dansereau (1961), that is, taking into account the layers and the physiological regime of the vegetation;
- 3.— From a *phytosociological* point of view, meaning the composition of the plant communities;
- 4.— From a *phyto-dynamic* point of view, resting on the notion of dynamic series *sensu* Rey (1962);
- 5.— From an *ecological* point of view, that is, considering the relations between the vegetation and the milieu and, finally,

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6.— From a combined or *eco-dynamic* point of view when an integration of the five above mentioned points of view is attempted by associating the fundamental concept of dynamics with methods that are both phytosociological and ecological and also take into account structure and physiognomy.

Moreover, according to their scale and to their aims, physiognomical, structural, phytosociological and ecological maps can be actual or potential, or both if they are also dynamic.

### Vegetation mapping in Quebec

In Quebec, vegetation mapping went through two fundamentally different periods: (1) before 1963, when static physiognomical, structural and phytosociological maps were plotted, and (2) after 1963, when ecological and eco-dynamic maps were produced.

#### PHYSIOGNOMICAL MAPPING.

The first vegetation maps for the Province of Quebec picture the distribution of the great vegetal formations: the deciduous forest, the coniferous forest, the forest-tundra, the arctic tundra. These maps can be assimilated to physiognomical-static maps and, in the case of inhabited and perturbed areas, to potential maps. These documents belong to two categories:

a) *Small scale maps*, usually 1: 1,000,000 or more, some of which cover the whole of Canada. This category comprises maps by Halliday (1937), Villeneuve (1946), Braun (1950), Rousseau (1952), Atlas of Canada (1957), Rowe (1959), Hare (1959), Blanchard (1960) and Grandtner (1962, 1963).

b) *Large scale forest maps* (1: 63,360) published in 1946 and 1947 by the Federal Department of Mines and Resources. Now discontinued, the series contained 16 sheets covering a total area of 6,400 square miles. One must also include in this category most large scale unpublished physiognomical maps of forest areas at the scale of 1: 15,840 produced by companies for the inventory of their concessions. In Quebec, there exists a large number of sheets of this type, covering an area of some 90,000 square miles.

#### STRUCTURAL MAPPING.

Only one structural map exists for Quebec. It is Dansereau's (1961) map of Eastern Canada at the scale of 1:336,000, based on Halliday's (1937) data.

#### PHYTOSOCIOLOGICAL MAPPING.

Phytosociological maps are more numerous and also more recent. As a matter of fact they overlap the two periods and can be divided into three categories.

a) *Small scale maps*, covering the whole of southern Quebec such as the climax map of the St. Lawrence Valley published by Dansereau (1959) and that of climax regions as suggested by me (1962, 1966) and some regional sketches published by Hamel (1955) and Leblanc (1962).

b) *Large scale maps*, (1: 15,840 and 1: 31,680) grouping inventory maps of whole counties and concessions. In this category are documents by Lafond (unpublished), by Pouliot *et al.* (1961), by Jurdant (1964) and by Dorion (1964). Finally, the last category includes

c) *Very large scale maps*, over 1: 1,000, such as maps by Hamel (1961), Jurdant (1965) and myself (1960). These documents cover the area of a single forest or farm and show enough details to permit the choice of development techniques.

Many phytosociological maps already show a tendency towards ecological maps. For example, Hamel (1961), qualifies his map as being agræcological and Crowley (1963) considers that our map of the Beauséjour Forest is "almost ecosystematical". But none of these maps may be called dynamic. It is only since 1963 that the dynamic aspect of the ecosystem has really come into the picture.

#### PHYTO-DYNAMIC MAPPING.

Phyto-dynamic mapping in Quebec is rather recent. Moreover, it is understood as a step towards eco-dynamic mapping, our final aim, from which it differs mainly by its legend which is purely phytosociological. There are two types of maps in this category:

a) *Small scale maps*, about 1: 500,000, such as the vegetation map for the Lower-St-Lawrence, Gaspé Peninsula and Magdalen Islands area (Grandtner, 1966d) and

b) *Large scale maps*, 1: 50,000, such as the vegetation map for the Magdalen Islands (Grandtner, 1966e) and the three preliminary unpublished vegetation maps for the St-Modeste (Blouin, 1965), Forillon Peninsula and Bic areas (Grandtner, 1966 b, c).

#### ECOLOGICAL MAPPING.

Ecological mapping was initiated by Jurdant (1964a) and later by Jurdant and Bernier (1965). The maps produced are large and medium scale static forest maps representing both the composition of the actual vegetation and the nature of its corresponding soil type. Jurdant has recently started producing for ARDA, potential ecological maps of the territory included between Quebec City, the Saguenay River and Lake St. John. The object of his work is a classification of the area in relation to its forest production capacity. At the moment there exists for this area eleven manuscript maps at the scale of 1: 50,000 and

twenty-one more maps are being prepared. The total area covered will be 6,400 square miles. A map at the scale of 1: 250,000 will also be prepared for the same area.

More complete than the above-mentioned maps because they take into account the principal factors of the ecosystem, however, the ecological maps do not give any information on the possibilities of its evolution. This is precisely what eco-dynamic mapping attempts to realize.

#### ECO-DYNAMIC MAPPING.

The first attempt at eco-dynamic mapping dates from 1963. At that time, with the help of ARDA, the Bureau d'Aménagement de l'Est du Québec (BAEQ) started a systematic land survey of the Lower St. Lawrence, the Gaspé Peninsula and the Magdalen Islands Territory, an area of some 16,000 square miles.

I have already given a description of the aims of this work and of the methods that have been used (1964, b, c). Therefore I will emphasize in this paper certain particular aspects of the program.

a) The aims of eco-dynamic mapping are above all practical: the maps are intended for the management and the development of the territory. In the first place, therefore, an inventory of the natural resources is undertaken prior to development. The survey gives the opportunity to realize at the same time a systematic map of the actual and potential vegetation of the area. It is worth mentioning here that the mapping crews collected during two seasons, over 2,500 specimens that have enriched our collections. The assistance of taxonomists has been indispensable and some light was shed on many problems of chorology and autecology of species.

b) The maps show the vegetation in its present, real and potential state. They are based on Rey's (1962) notion of dynamic series although they differ from the maps produced at Toulouse by the fact that successional stages are defined according to phytosociological and pedological methods, that soils and the structure of the vegetation are also taken into account and a physiognomical nomenclature is utilized. Hence, the series is really eco-dynamic. In our region, where the terminal state is almost invariably forest, the series is named according to the terminal forest association and the corresponding soil type. As examples: Yellow birch-maple forest on deep podzolic till, Sphagnum-spruce forest on oligotrophic peat, etc.

c) A characteristic of the work undertaken on the pilot territory is that vegetation mapping was closely linked to soil mapping. The field party is composed of soil scientists who collaborate in the realisation of the map. Moreover, during the same period, geological, geomorphological, climatic, land capability and present land use maps are also prepared and economic and sociological studies undertaken.

d) The documents so produced are necessarily various. They are dependent on the scale of the map, itself a function of the precision that is sought as a consequence of the aim that was set. They can be divided into three categories:

1) *Maps at the scale of 1: 250,000* that will serve to circumscribe ecological regions. At present this category includes a preliminary sketch and an unpublished map for the pilot territory. These documents cover a total area of some 16,000 square miles.

2) *Maps at the scale of 1: 50,000* that will serve two main purposes: for a preliminary survey of agricultural and forest resources and for the establishment of parks and the preservation of nature.

3) *Maps at the scale of 1: 15,840*, or forest inventory maps, now including approximately 30 manuscript sheets for a total area of 750 square miles. Other maps of this type at the same scale are also being prepared for the Department of Lands and Forests of Quebec.

#### The realisation and utilisation of eco-dynamic maps

The first stage in the realization of an eco-dynamic map necessitates three types of preliminary studies:

1) *a literature survey* for the analysis of all documents and statistics concerning the territory and its neighbouring regions in view of preparing a file;

2) *a preliminary photo-interpretation* and the restitution of the physiognomical limits of vegetation and landforms on 1: 50,000 maps;

3) *an exploration of the area*, as suggested by Rey (1959), using a four-wheel-drive vehicle following an itinerary that has been planned on the maps and the photographic documents. A tape-recorder is utilized for the phytosociological relevés, for the description of the soil profiles and samples. At the same time observations are indicated on the aerial photographs while travelling and at stop points. At the end of each day, the samples are classified, the aerial documents are interpreted, the maps are corrected, the plants are dried and, periodically, magnetic tapes are sent for transcription.

Final mapping required a reinterpretation of the aerial photographs that were annotated during the exploration work. After the restitution at the scale of 1: 15,840 or 1: 50,000, a generalization of the documents thus obtained may produce a map at the scale of 1: 250,000. Regarding the system for representing units on the map, the base rests, as much as possible on the principles for ecological symbolism by colors proposed by Gaussen (1961). Each series is given a different color, and the various stages in one series are differentiated by the intensity of the color. The paler the shade, the stronger the human influence has been on the territory. Each mapping unit is moreover given a symbol in order to allow anybody to read the map easily and rapidly. Certain maps at the scale of 1: 50,000 and all maps at the scale of 1: 15,840 show, in

addition, the limits of age classes and the density of the forest stands. They may thus be used for forest inventories.

As suggested by Kùchler (1954), we tried to maintain the legends as simple as possible. We have therefore reserved for the text that accompanies the map all purely botanical and even ecological considerations. In the same are found details concerning the phytosociological composition and the value of the cartographic units for agricultural or forestry purposes.

As regards the practical use of the eco-dynamic maps, it is above all a function of the scale of the map. Thus, as we have already mentioned, at the scale of 1: 250,000 the delimitation of ecological regions and sub-regions is possible, inside which the climate-landform-soil-vegetation and human-action relations present the same aspect in their actual and potential state. Moreover, it lends itself to a global estimate of the effort required for the development of the various stages that were mapped, if ever it seems useful to return them to agriculture or to hasten or simply protect their evolution towards the forest.

From a purely practical point of view, one can detect on the maps the areas where agriculture can be successful and consequently must be maintained and intensified, and the areas where the success is not so good or non-existent, and consequently requiring some kind of intervention.

Respecting the problem of forestry, the map indicates the proportion of forests with regard to cultivated areas, the nature and composition of the forests and, consequently, the possibility of their utilisation, their potential productivity, the direction of evolution, their accessibility, the areas swept by fire, recent cuts, plantations and sites for tree nurseries, etc.

For wild-life, the map shows areas that could be managed, for instance, the alpine tundra for caribou.

The map may also be used for the tourist industry and recreational purposes, since indications are given for the planning of beaches, rocky shore-lines unfit for such purposes shown, the occurrence of marine muds unpleasant to the tourist but usable by agriculture is noted, as well as the presence of exploitable algae and *zostera*, of interesting botanical landscapes that should be managed as reserves and protected, the composition of vegetation and its decorative value, etc.

At larger scales, such as 1: 50,000 and even more so 1: 15,000, maps of this type can serve as base maps in forestry, agriculture or abandoned land inventories, for studies of pilot farms or experimental forests, for selecting sites for microclimatological stations and for land development itself.

## Conclusion

In short, the maps concerning the vegetation of Quebec are quite numerous and extremely varied in view of the facts that are shown and the scales and methods that have been used.

Physiognomical and static in its first days, vegetation mapping has become ecological and dynamic in the Province since 1963.

Nowadays, aerial photography, specially equipped vehicles, tape recorders and first class optical mapping apparatus are currently used.

Vegetation mapping in Quebec seems to evolve towards an integration of all data as proposed by Christian and Stewart (1964), as well as towards standard map scales and a systematic survey of the whole Province.

But, owing to the dimensions and the relative inaccessibility of the territory, because also limitations are set on cost and time, it should be stressed that an undertaking of this size will succeed only with the help of recent aerial photography at a scale of 1: 15,840 and modern and flexible methods, as well as through collaboration at every administrative level and the teaming up of research workers.

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