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Table of Contents

		Page
Canadian Forest Inventory Committee		iv
Acknowledgments		v
Preface		vi
Introduction		1
Part I	**Canadian Forest Inventory Procedures**	2
	Forest and Land Classification	2
	Remote Sensing	5
	1. Sensors and Imagery	5
	2. Applications	7
	Mapping	8
	Volume Specifications	10
	1. Classification of Volume	10
	2. Types of Volume	11
	3. Volume Equations and Tables	11
	Field Sampling	12
	1. Sample Units	12
	2. Tree Characteristics	13
	3. Stand Characteristics	13
	Data Compilations and Summaries	14
	Geographic Information Systems	15
Part II	**Glossary**	16
Part III	**Appendices**	95
	Appendix 1 Measurement Units and Classes	96
	Appendix 2 Symbols of Commercial Tree Species	100
	Appendix 3 The Canada Land Data System	105

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Preface

In September, 1975, Sector Committee 8.1 (Forestry) of the Metric Conversion Program recommended that a committee be established to resolve some problems of forest inventories in Canada: problems caused by metric conversion, by a lack of common terminology, and by differences between forest inventories.

In response, the Canadian Forest Inventory Committee (CFIC) was established. Its members were drawn primarily from the existing Working Group 8.1.2 (Inventory and Mapping) of the Metric Conversion Program, which was expanded to give full representation to provincial and federal agencies.

The first edition of "A Guide to Canadian Forest Inventory Terminology and Usage" was produced in 1976. The second edition, which incorporated comments and suggestions made by Canadian foresters on the first edition, was edited and printed for the CFIC in 1978 by the Canadian Forestry Service (CFS).

This third edition incorporates updates and additions reflecting the work of the CFIC Stocking Subcommittee, the increasing significance of change data, and the impact of Geographic Information Systems on forest inventory. Additional terms related to remote sensing and statistics have been added, as have terms related to silvicultural and management treatments in so far as they describe areas of forest.

This edition is a joint production of the CFIC and Forestry Canada.

In this edition, for the first time, recommended forest inventory terms are presented in both official languages.

Introduction

Forest inventories in Canada have developed in response to local or regional needs. Terminology has tended to develop local or regional variations, with the result that description of forest inventory procedures and presentation of forest inventory statistics have sometimes been confusing and misunderstood. This publication is intended to reduce these problems by providing the Canadian forestry community with a common forest inventory terminology and explaining its usage.

The scope of this publication is limited to forest inventory: that is, the inventory of forest areas for wood production and harvesting purposes. There are three sections: Canadian Forest Inventory Procedures, Glossary, and Appendices:

1. The Procedures outline in chronological sequence the tasks that may be performed in forest inventories following the establishment of inventory objectives and specifications. The emphasis is on *what* may be done rather than *how*.

2. The Glossary includes terms commonly used in or associated with forest inventories. Some terms related to silviculture and management, when used to describe areas of forest land, are included. Regional terms have been excluded.

3. Three appendices are included in the Guide: Appendix 1 presents in tabular form the measurement units, classes and ratios recommended for metric use in forest inventories. Appendix 2 contains the symbols approved for individual species and species groups. Appendix 3 contains a description of the Canada Land Data System as an example of one of the many geographic information systems in use in Canada.

The Canadian Forest Inventory Committee supports the terminology presented in this publication - in both languages - but recognizes that language and terminology are constantly evolving. The Committee welcomes your comments on this publication and suggestions for improvement. Please address them to:

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Petawawa National Forestry Institute
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Part I
Canadian Forest Inventory Procedures

The purpose of Part I is to illustrate the procedures commonly used in forest inventories, and to explain the context in which many inventory terms are applied. The relationship of the forest inventory procedures is shown in Figure 1.

Detailed descriptions of the specific methods used in each part of Canada are reported in publications and manuals produced or used by the provincial, territorial and federal forest services. A continuously updated list of these publications is maintained by the Petawawa National Forestry Institute at Chalk River, Ontario and may be obtained on request. It is titled "Catalogue of Canadian Forest Inventory Publications and Manuals."

Forest and Land Classification

Data summaries may be required for a number of different forest and land classes in various exclusive or overlapping combinations. The information necessary for *classification* is obtained from *aerial photos*, satellite imagery, field work, existing records, and other maps.

Forest and land may be classified according to ownership, status, administration, use, capability, forest cover, other vegetative cover, harvesting constraints, or ecology (Figure 2).

The ownership of land may be public (*federal* and *provincial crown land* or *municipal*) or private. Status depends on whether or not the land is available for wood harvesting (*reserved* versus *nonreserved*) and, in the case of provincial land, who exercises the direct, immediate control of the land (*retained* versus *assigned*). Federal land may be reserved as a park, defense area or Indian reserve, or retained (the Yukon and NWT). Provincial land may be reserved as a park or *protection forest*, assigned as a lease or license, or retained as a management unit or unmanaged vacant area. Municipal land may be reserved as a park or watershed, or retained as a managed woodlot. Private lands range from large, managed holdings to small woodlots.

Administrative forest units, districts or zones may be grouped regionally within a province or territory, or divided into subunits such as ranger districts, counties or townships.

Land may be classified according to its current primary use or estimated capability for a particular use, including timber production, recreation, wildlife or water production.

The terms in italics, on first usage, are defined in the Glossary (Part II).

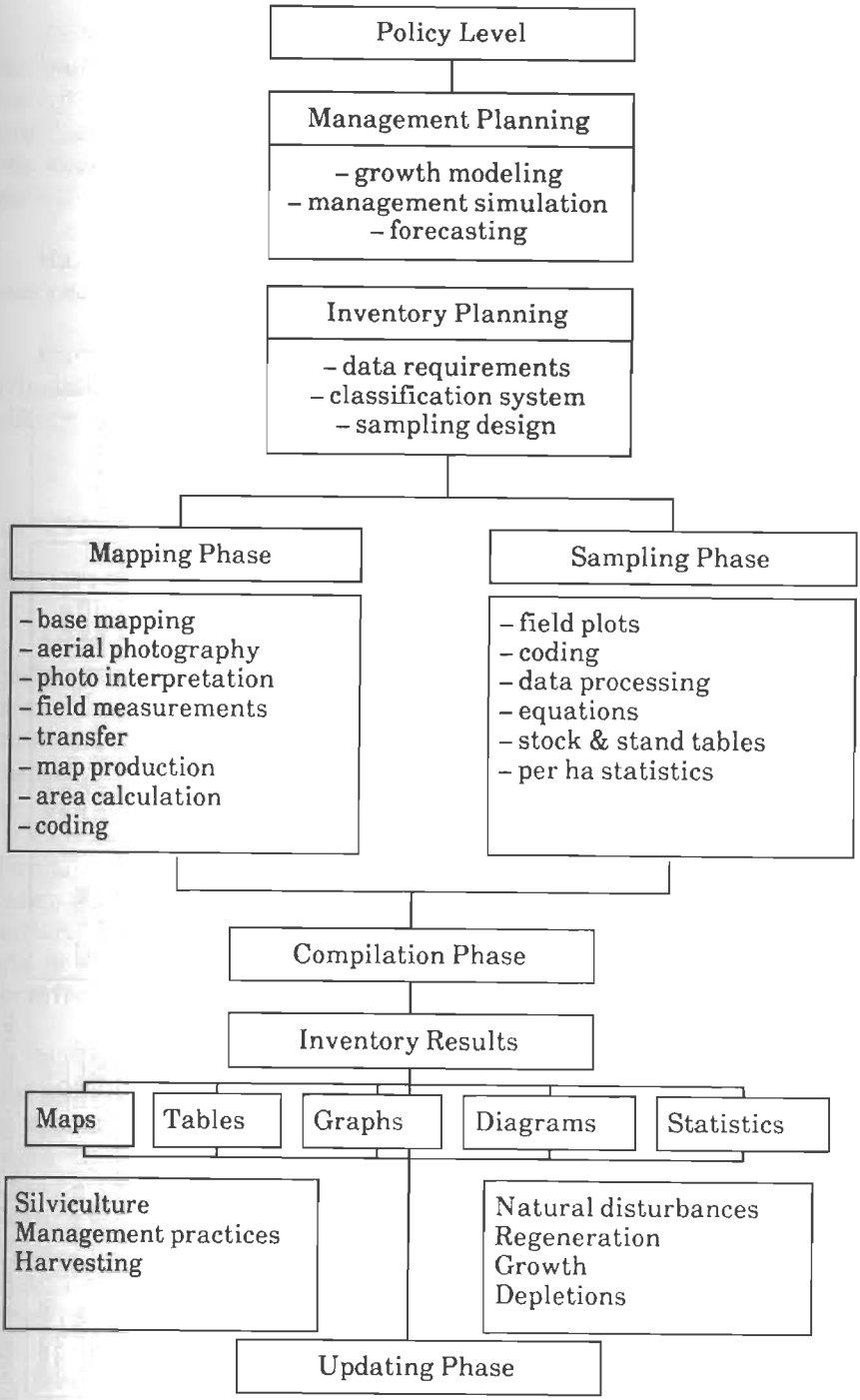

Figure 1. Diagram of generalized forest inventory procedure

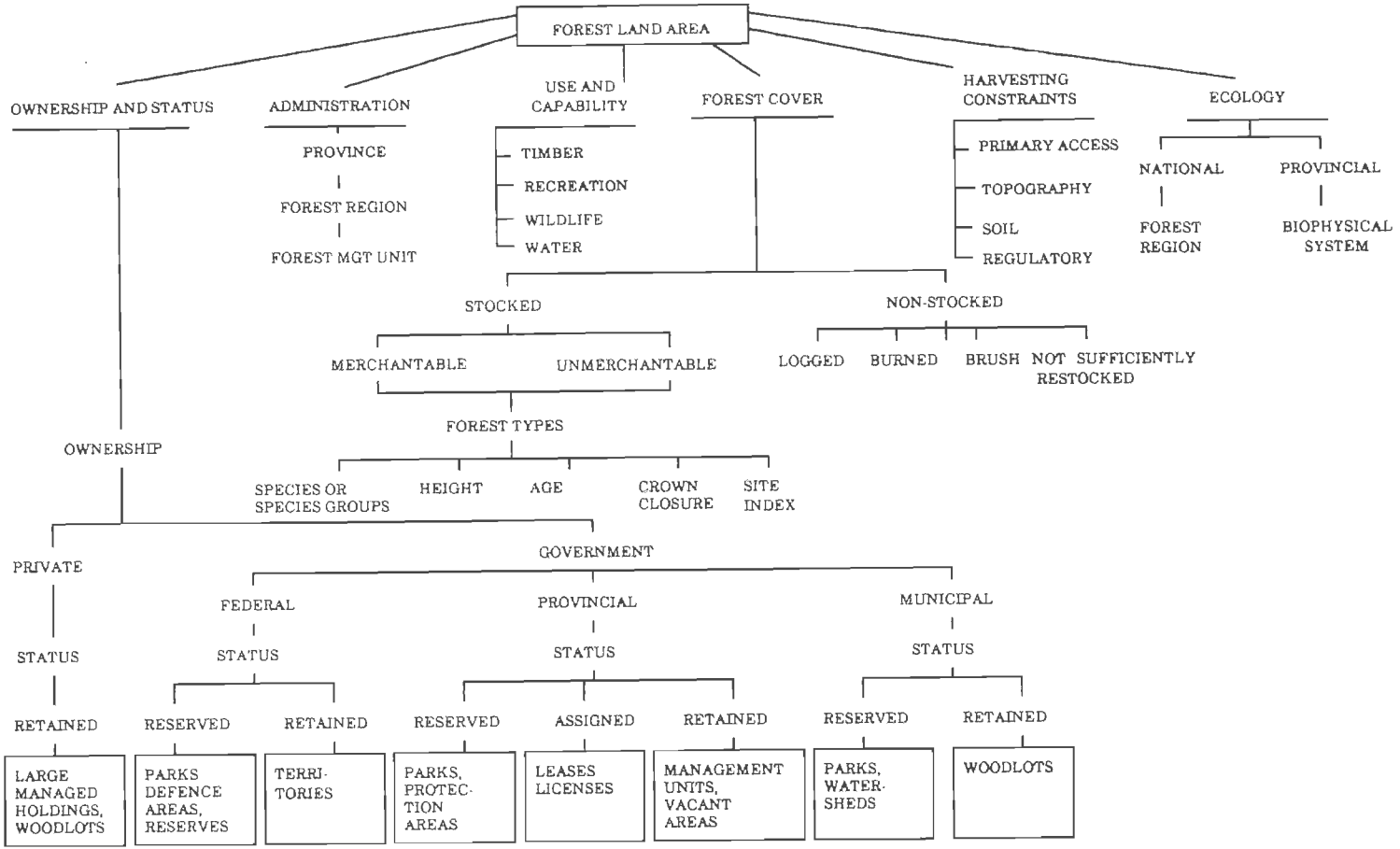

Figure 2. Forest Land Area Classification

Forest cover relates to the existing vegetative cover of an area. *Stocked forest land* may be *merchantable* or *unmerchantable* and may be classified by *forest types*, which can be sorted by species or species groups, height, area, *crown closure* or *site index*. *Nonstocked forest land* may be classified according to the cause of nonstocking: logging, fires or pests (insect and disease depletion).

Harvesting constraints can be used to group forest land. These include primary access, topography, soil and regulatory constraints.

Ecological classification of land nationally is by forest region; provincially, there are biophysical systems based on ecosystems and landforms.

Remote Sensing

1. Sensors and Imagery

Aerial photography is the *remote sensing* medium most widely used in Canadian *forest inventory* practice. The camera/film/filter system is a *passive sensor*, which is sensitive to the visible and near-infrared portion of the electromagnetic spectrum. Depending upon the film/filter combination used, the sensitivity can be manipulated within the above limits.

Common types of film used in forest inventory are panchromatic (black and white), *infrared* (IR) (color or black and white), and color. Prints may be at the same *scale* (contact scale) as the negative or they may be enlargements or reductions. Prints may have a glossy or semimatte finish and may be on single- or double-weight paper. Plasticized prints are popular for field use. Color reversal films are processed directly to positive transparencies.

Multispectral imagers are passive sensors. Each scanner channel is, as a rule, sensitive to a fairly narrow wavelength band. A *multispectral scanner* often operates over more regions of the electromagnetic spectrum than do cameras. Optical mechanical scanners do not focus the energy through a lens but have a very narrow aperture and rapidly scan the object in swaths, converting the energy as it is received at a detector into electrical impulses which may be stored on magnetic tape and/or converted into an image. The resolution of a scanner depends on its aperture. With digital data, the smallest resolvable unit is a *pixel*.

Linear array multispectral imagers, or scanners, use a linear array of charge-coupled device detectors placed behind a focusing lens. A single swath or line of data is recorded simultaneously with each detector in the linear array forming one pixel (picture element) of the image. The best known

applications are satellite images (e.g., *Landsat*), and airborne thermal IR images used in fire and other thermal studies.

Side Looking Airborne Radar (SLAR) and *Synthetic Aperture Radar (SAR)* are *active sensors* that transmit microwaves and record the reflections. Both are able to penetrate most cloud cover but are not widely used used in forestry because they do not define forest cover distinctly.

Multispectral imagery is produced by multispectral imagers or cameras (a system of several cameras each with a film/filter combination sensitive to a different portion of the electromagnetic spectrum), or by single multilens cameras with different filters.

Image scale is generally a function of the sensor's height above the ground and its internal geometry which, in a camera, is expressed by the focal length of the lens. Aerial photos of large, medium and small scale are generally taken from aircraft flying at low, medium and high altitudes, respectively. Ultra-small scale photos are obtained from aircraft at very high altitudes, satellites or space vehicles.

Most imagery is obtained with the optical or principal axis of the sensor as vertical as possible.

For a given flying height, the *coverage* of a photograph is dictated by lens angle and camera format. Lenses may range from fisheye through normal to telephoto. Most inventory work involves *aerial photographs* from cameras with a 230-mm format, but increasing use is also being made of 70-mm cameras for volume sampling, reconnaissance surveys and species studies. Small (35-mm) cameras are occasionally used, especially for change detection.

Aerial photos are taken along *flight lines* with a *forward overlap* of at least 60% between frames to permit *stereoscopic coverage* and viewing. The stereo model allows measurement of height with *stereometers*, usually *parallax* bars, and greatly enhances the photo image for *interpretation*.

Complete photo coverage is usually achieved by *lateral overlap*, generally of 30%, between adjacent flight lines. The layout of photo coverage is shown by an *index map*.

Multispectral imagers may produce either continuous strip imagery along the flight lines, or frames which overlap enough to ensure full coverage.

To ensure that the photographs obtained meet the requirements of the user, detailed specifications have to be clearly defined. The specifications of

the Interdepartmental Committee on Air Surveys (I.C.A.S.), which are primarily for topographic mapping, are the best known in Canada.

2. Applications

The application of a particular set of images depends primarily on image scale; the smaller the scale, the larger the area covered, but with less discernible detail.

As a broad generalization, the relationship between scale and use is:

Ultra-small scale, around 1:1 000 000 — regional overviews
Small scale, around 1:60 000 — reconnaissance and landform studies
Medium scale, commonly 1:20 000, 1:15 000 and 1:12 500 — forest inventory mapping
Large scale, around 1:1 000 — detailed tree measurements
(Scales from 1:100 000 to 1:500 000 are rarely available)

In forest inventories, the most commonly used photography is panchromatic (black and white). Black and white infrared was commonly used for species identification, but its use is declining in favor of color film. Color infrared photography is being increasingly used, especially in the detection of unhealthy vegetation; color infrared images are usually photographs when taken from aircraft, or composite multispectral images when taken from satellites.

For forest inventory purposes it is common to obtain aerial photographs at medium scales of the entire inventory area. The photos may be used to make *base maps*, or *photo maps*, but the primary use is in forest and land area classification. The photo interpreter examines the stereo pair model and recognizes such stand characteristics as species composition, height, and *crown closure*. Individual stand boundaries may be delineated and used to produce a forest-type map. The interpreter may also be required to recognize many other details pertinent to land management. Interpretation skills are acquired through training and experience. Air and ground checks are made as well as reference to interpretation keys, *stereograms* and field survey data.

Small scale imagery is used occasionally in forest inventory, mainly for map construction and for typing broad forest and land classes; stand characteristics cannot be recognized with confidence.

Ultra-small scale satellite data are received on magnetic tape which may be analyzed electronically or reproduced as an image. The resolution of *Landsat Multi-Spectral Scanner (MSS)* is 80 metres, of *Thematic Mapper (TM)* 20 metres, and of the French SPOT 10 metres. An application of the use of satellite imagery is *monitoring* change.

Large Scale Photography (LSP) is a method of measuring sample trees photogrammetrically to partially replace expensive field measurements, e.g., in *regeneration* assessment. LSP is obtained in sample strips or stereopairs only, and requires an accurate means of scale determination such as a *radar* or *laser altimeter*.

Canadian forest inventory volume estimates come from ground samples within the *strata* established by forest-type maps.

Inventory estimates need not be tied to a typing and mapping system. Two-phase *sampling* systems make use of photo plot volume estimates made by interpreters in the first phase; these estimates are adjusted by second phase field measurements of some of the photo plots.

Some forest inventories are designed to use several scales of imagery in multistage sampling designs. At successive stages, progressively smaller segments of the inventory area are sampled at progressively larger scales and in greater detail; the final stage is generally a ground *sample*.

Mapping

Aerial photos are the primary source of data in map construction. Field survey data are used primarily to provide *ground control points* for controlling map scale, to *update* maps when suitable aerial photos are not available, and to inspect and correct *photo interpretation*. On occasion, maps are constructed from field survey data only.

Base maps show only required planimetric features. They are generally derived from existing *topographic maps*, e.g., of the National Topographic System (NTS). Should these not be available, base maps are constructed from aerial photos supplemented by ground control points. Base maps are used to position additional forest data, e.g., forest or stand type boundaries obtained from air photo interpretation, or ownership boundaries. When forest data are added to the base map, it becomes the *forest map*.

Base maps are produced from existing maps by placing the latter in an optical project instrument, the *reflecting projector*, the *stereoscopic plotter* or camera lucida (e.g., Sketchmaster). These are adjusted to project an image of the desired scale onto the map base. The desired cartographic information is then drawn on the base to produce the base map.

A similar procedure is used to add forest data to the base map. First, the aerial photos are interpreted and forest type boundaries and other desired characteristics are delineated. Next, the photos are placed in the optical projection instrument, which projects the image onto the base map. At this

stage, the image may undergo *rectification*, i.e., adjustment for scale and *tilt*. With some instruments, radial displacement can also be corrected. Lastly, the desired forest information contained in the image is transferred onto the base map as *polygons*.

Should no topographic map be available to construct the base map, the air photo image is projected onto a ground control grid, and cartographic and forest data are extracted simultaneously from the photos to produce the forest map.

Scale control is achieved by plotting the positions of ground control points, the locations of which are known both on the ground and on the aerial photos. Sources of this control information are the federal Department of Energy, Mines and Resources and provincial surveying agencies. The control point locations and spacing on a base map depend on the system of *map projection*. Systems suitable for forestry are the Polyconic, the Lambert Conformal, the Conic with two standard parallels, and the Universal Transverse Mercator. All systems have inherent inaccuracies but, in practice, any one can be used without important errors in mapping areas up to a few hundred square kilometres. The favoured projection is the Universal Transverse Mercator.

Map scales recommended for use with metric units are based on the 1-2-5 number series, i.e., 1:10 000, 1:20 000 and 1:50 000. Contour intervals should also conform to the 1-2-5 number series.

Map size is usually determined by convenient sheet size (somewhat governed by available paper sizes) and by scale. Map boundaries generally follow grid lines of the grid coordinate system and the National Topographic System, based upon degrees of latitude and longitude. The township-range-meridian grid is used in several parts of Canada. Map boundaries can also be set in accordance with the Universal Transverse Mercator (UTM) grid, in which the Earth's surface is divided into successively smaller squares expressed in metric units. The UTM grid has certain advantages and its use is increasing. It is recommended that all forest maps be referenced to the six-degree UTM grid.

Maps of a particular system (e.g., the NTS) but covering different areas at different scales are labelled according to a specific *map indexing system*, a number of which are currently in use.

Forest maps are usually updated on a cyclical basis. If the cycle is 10 years, one tenth of the area is rephotographed each year and the maps revised accordingly. Maps of smaller areas subjected to disturbances (e.g., fire, insect damage) may be updated more frequently. The maps are generally in a format that facilitates reproduction and updating. Maps shown on a

transparent base material can be reproduced inexpensively as blueprints. They may also be lithographed.

The introduction of *geographic information systems* into Canadian forest inventories has integrated statistical information and tree and stand data with the geographic map location information. For a description of one such system, see Appendix 3. There are many other good examples now commercially available.

The primary purpose of forest maps is to determine the location and area of forest stands, types, *strata*, and other segments of the forest area. Strata are groups of forest stands that have characteristics in common. Stratification increases sampling efficiency by reducing the number of samples required to achieve a given standard of sampling *accuracy*. Segments may be sampled to estimate characteristics such as volume, *basal area*, and number of trees on a per-unit area basis. These estimates are then expanded to provide total estimates for each segment and for the entire area of interest. The forest maps are also used as a basis for *operational inventories*, road location *surveys*, planning of field work travel, forest renewal, forest research, and other resource management purposes.

Volume Specifications

In most forest inventories, wood volume is the most important single characteristic being estimated. It is compiled by a large variety of classes and expressed in many different ways. Other characteristics (basal area, growth) are also sorted and expressed in different ways, but not to the same extent as volume.

1. Classification of Volume

The purpose of classification of volume data is to present the data effectively, in a form appropriate to their use.

Volume estimates may be classified by the forest and land area classes previously described. Stated differently, volume is one of the characteristics summarized by the forest and land area classes.

Tree volume is classified by species or species groups, often in combination with *diameter classes*. The latter may be as fine as 2 cm *diameter breast height* classes, or they may be broad classes with boundaries related to utilization, e.g., *sawtimber* and *pulpwood*.

Stand volume may be classified by species groups, sometimes in combination with a utilization standard: if the stand volume per hectare is

less than a specified figure, the stand is considered not economic to harvest. The terminology has not clearly evolved on this subject, but stand merchantability or commercialism are terms sometimes used.

2. Types of Volume

Tree volumes are generally expressed according to two categories, each of which has two alternatives:

(i) gross volume makes no allowance for defects and decay of the tree, whereas net tree volume does;

(ii) total volume is the volume of wood inside bark of the main stem, including stump and top; merchantable tree volume is the volume of wood that can be extracted from a tree, generally total tree volume less stump and top volume.

Tree volumes and stand volumes are generally expressed as *gross total, gross merchantable,* or *net merchantable.* With increasing emphasis on complete tree utilization, a fourth expression is appearing: *forest biomass.*

3. Volume Equations and Tables

The direct measurement of tree and stand volume is difficult and costly. Hence, most forest inventories make use of equations or tables in which volume is related to characteristics more easily measured.

Tree *volume equations* are generally constructed for individual species, rarely for *form classes,* by *regression* analysis from measurements of volume and the more easily measured characteristics, called independent variables. Tree volume equations may be converted into *volume tables,* which show volumes for selected values of the independent variables.

Yield tables may be considered a type of stand volume table. Most yield tables are constructed for even-aged stands of one species (or species group) and show, for different *site qualities,* the development over time of such tree characteristics as average dbh and height, and such stand values as basal area and volume per hectare. *Normal yield tables* apply to hypothetical stands that are *fully stocked*; *empirical yield tables* apply to actual stand conditions. For second growth stands, yield tables for stands of varying density are prepared. The response of stands to certain management treatments, e.g. *thinning,* is reported in *variable density yield tables* according to the intensity of the treatment.

Another category of volume equations and tables are those used to estimate volume from aerial photos. Aerial tree volume equations for use with large scale aerial photos (LSP) are similar to the standard tree volume

equations, except that dbh is replaced by a variable which can be measured on LSP, e.g., *crown area*. Other independent variables, e.g., *crown diameter*, are sometimes used. The equations are often constructed for species groups rather than individual species.

Aerial stand volume equations may be constructed for stands of single species, species groups, or for forest types. The independent variables are usually *stand height* and crown closure, but sometimes also include average crown diameter. The equations, which may also be converted into tables, yield estimates on a per-hectare basis. The estimates are appropriate when high accuracy is not required.

Field Sampling

1. Sample Units

Detailed tree and stand information is generally obtained from those *sample units* that comprise the sample. This information is one of the most important sources of forest inventory data. A sample unit is characterized by either of the two alternatives within each of the following three classes:

(i) *sample plot or point sample*

(ii) single or *cluster*

(iii) *temporary* or *permanent*

Thus, one given sample unit (SU) might be characterized as a permanent, single, sample plot, while another might be properly classed as a temporary cluster of point samples.

Plots, which have a fixed area, may be of a circular, rectangular (including square and strip) or even triangular shape, and may be of any suitable, arbitrary size. Commonly, plot sizes range from those of only 1 to 4 m^2 used for regeneration surveys to those of up to 0.5 ha for old growth inventories. Remeasurement data are collected from permanent sample plots to evaluate change over time.

Point samples are SUs for which boundary, shape, and area need not be determined or specified. Trees are selected for inclusion in the sample with the aid of an *angle gauge* such as a *wedge prism* or *relascope*. Data resulting from measurements of the selected trees are expressed on a per-hectare basis. The number of trees selected at a point depends on the angle size of the gauge. The size is indirectly expressed as a *basal area factor*; commonly used factors are 2 m^2/ha and 4 m^2/ha.

Point samples are also known as prism plots, relascope plots, Bitterlich plots and variable area plots. However, these samples are not plots because they do not have a definable boundary or a specified area.

2. Tree Characteristics

Within each sample unit a number of tree characteristics are estimated or measured on some or all trees. Dead or badly damaged trees are usually excluded from the *tally*.

Tree *dbh* is measured with a *diameter tape*, tree *calipers*, or estimated occularly according to the accuracy required. It is recorded in stem diameter classes.

Stem diameter measurements may be made at heights other than *breast height* using an *optical dendrometer*. Such measurements are used to calculate tree volume without resorting to tree volume equations, or to calculate the tree *form quotient*.

Tree growth and age are determined from an *increment core* extracted with an *increment borer*. Tree age is determined from a count of annual rings, and tree *increment* from a measurement of the width of annual rings. An addition is made for the years taken to reach the boring height. Bark thickness may be measured with a *bark gauge*.

Measurements or estimates less frequently obtained include crown diameter and *crown length*. Visible defects and decay (*cull*) indicators are usually recorded, *cull factors* are calculated and applied.

Special measurements are sometimes required for specific purposes. Trees may be felled and sectioned, and measurements made to determine the volume of sound wood and to determine total tree volume, merchantable tree volume, gross tree volume and net tree volume, as well as to calculate equations and tables for these four categories.

3. Stand Characteristics

Some stand characteristics are measured in the field, e.g., the basal area per hectare measured in a point sample and regeneration *stocking*. Others may be estimated, e.g., species composition, forest type, *site class* and *productivity class*, as well as stand height and crown closure. However, most stand characteristics are compiled from the individual tree measurements made in a plot.

Data Compilations and Summaries

The data summaries are in the form of tables and/or forest maps. The maps display forest and land area class boundaries and major geographic features. They may show additional data obtained from remote sensing, e.g., forest types and their characteristics. They are normally supplemented with tabular data that cannot be displayed on the maps.

Summaries are often desired for sections of the total inventory area, i.e., the forest and land area classes specified at the beginning of the inventory, and combinations of classes or polygons. Compilations may be made as required.

Generally, the mean value per hectare of a given characteristic (e.g., volume, basal area, growth) is calculated together with a *precision (variance)* estimate for a given section. The formulae used to calculate means and variances will vary, depending on the sampling design used in the inventory. The area of the section then is determined and applied to the mean to give the total volume in that section.

Area estimates may be obtained from the forest maps by using a digitizing table, a planimeter or a *dot grid.* If the sections are not mapped, section areas may be estimated from the proportion of sample units falling in the section.

Volume estimates are obtained by applying tree measurements (dbh, height) from the sample units to tree volume equations to determine tree volumes; these are used to calculate volumes of the sample units from which the mean volume is calculated.

An alternative to the use of tree volume equations in determining mean plot volumes is the measurement of individual tree volumes with an optical dendrometer on a subsample of trees in the sample units.

From the field data, compilations are made for a number of other characteristics, e.g., number of trees per hectare, basal area per hectare, average age, regeneration stocking, and tree growth estimates of volume, basal area and dbh. Growth and *depletion* data are more usually compiled on a stand basis from permanent (remeasured) sample plots, which permit the evaluation of changes such as *ingrowth* and *mortality*.

Volume per hectare may be summarized by dbh classes and species in *stock tables*. Number of trees per hectare may be summarized by dbh classes and species in *stand tables*.

The great variety of summary tables found in forest inventories reflects the different purposes and intensities of the inventories. These may range from single-purpose, low-intensity photocruises to obtain rough volume estimates over large areas, through multipurpose, high-intensity surveys for management purposes to single-purpose, high-intensity mapping and tallying of stands ready for harvesting. Summary tables for these inventories will differ in number and in the kind and amount of information they present. At a minimum, however, each summary will include information about the total inventory area, the forest and land area classes used, and the area of each class. For the more important classes, e.g., *productive forest land*, information is provided of the specified characteristics in sufficient detail to meet the requirements of the inventory.

Geographic Information Systems

Recent developments in technology known collectively as geographic information systems (GIS) have made it possible to store, compile and reproduce cartographic and forest information using a computer. An advantage of this option is that numerical data describing the timber volumes and other *attributes* of the forest and the land may be stored, analyzed and reported in direct relationship to the location of their occurrence. The current trend in this systems field is for increasing power and user friendliness while the size of the hardware and unit costs are decreasing. As an example of a GIS, the Canada Land Data System is described in Appendix 3.

The form of the map may be identical whether reproduced by traditional drafting methods or printed from a computer. The statistical data may be reported for any forest cover type parcel by polygon, the smallest individual area shown on the map. Summaries according to any grouping or classification can be compiled and printed in tabular form.

This process has been applied nationally as in the implementation of Canada's Forest Inventory for 1981 and 1986. The preferred unit used here is a cell or square about 100 square kilometres in size. The forest cover of the whole country is included in about 44 000 cells. The major source for these inventories has been the inventory sections of the provincial forest services.

Part II
Glossary

The purpose of Part II is to define and explain terms commonly used in Canadian forest inventories. Some terms more closely related to forest management and silviculture are included when they may refer to a treatment or describe a condition applicable to a mappable area.

Terms in the glossary are arranged alphabetically. In some instances, families of terms (e.g., the different kinds of volume tables) are grouped together to make it easier for the reader to compare the terms. In such cases, each member of a family of terms (e.g., aerial tree volume table) is also listed alphabetically, but the reader is referred to the family name.

Each term is written in bold letters and followed by its equivalent term in the other language, then by its definition. Where a term has more than one definition, the applicable discipline (e.g., remote sensing) is named for each definition. While a term may have more than one definition, not all definitions of a term are included in the glossary, only those relevant to forest inventories. The definition is, if appropriate, followed by an explanation of common usage of the term, and by reference to related terms. Terms used as both nouns and verbs are identified as such by *n*, *v*.

Following the definition is a bracketed number indicating the source of the definitions. The sources corresponding to these code numbers are:

(1) The Canadian Forest Inventory Committee, its Subcommittees and delegates.

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(4) Bowen, M.G.; Bonnor, G.M.; Morrier, K.C. 1981. Canadian Forest Resource Data System – Preliminary manual for annual district reporting of change data. Canadian Forestry Service, Forestry Statistics and Systems Branch, Chalk River, Ont.

(5) Canadian Standards Association. 1977. Scaling roundwood. CAN 3-0302. 1-M77. Rexdale, Ont.

(6) Chandor, A.; Graham, J.; Williamson, R. 1980. The Penguin dictionary of computers. 2nd ed. Penguin Books, Markham, Ont.

(7) Colwell, R.N., editor in chief. 1983. Manual of remote sensing. 2nd ed. American Society of Photogrammetry, Falls Church, Va.

(8) Davis, K.P. 1966. Forest management; regulation and valuation. 2nd ed., McGraw-Hill, New York, N.Y.

(9) Draper, N.R; Smith, H. 1981. Applied regression analysis. 2nd ed. John Wiley and Sons Inc., New York, N.Y.

(10) Empire Forestry Association. 1953. British Commonwealth forest terminology, Part 1. London, England.

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(12) Ford-Robertson, F.C., editor. 1971. Terminology of forest science, technology, practice and products. Multilingual Forestry Terminology Series No. 1. Published by Society of American Foresters, Washington, D.C.

(13) Forestry Statistics and Systems Branch. 1984. Reporting and summarizing forestry change data - Manitoba pilot study. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ont. Inf. Rep. PI-X-36.

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(17) Jordain, P.B.; Breslau, M. 1969. Condensed computer encyclopedia. McGraw-Hill Book Co., New York, N.Y.

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(19) Lund, H.G. 1986. A primer on integrating resource inventories. U.S. Department of Agriculture, Forest Service, Washington, D.C.

(20) McGraw-Hill encyclopedia of science and technology. 1966. McGraw-Hill Book Co., New York, N.Y.

(21) Ministry of Natural Resources. 1986. Timber management planning manual. Toronto, Ont.

(22) Naval Reconnaissance and Technical Support Centre. 1967. Image interpretation handbook, Vol. 1. Department of Defense, Washington, D. C.

(23) RESORS Glossary. 1987. Canada Centre for Remote Sensing, Ottawa, Ont.

(24) Richards, J.A. 1986. Remote sensing digital image analysis. Springer-Verlag, New York, N.Y.

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(31) United Nations Economic Commission for Europe and the Food and Agriculture Organization. 1985. The forest resources of the E.C.E. Region (Europe, the USSR, North America). Geneva.

- A -

accessibility: [accessibilité]
An assessment of the effect that availability of access, topography and soil have upon the cost of harvesting a given timber stand (1).

accretion:
see **stand growth**; accretion

accuracy: [précision]
A measure of the variability of a parameter (characteristic) estimate about the true value of the parameter (1). Generally, closeness to the true value. The mean square error (MSE), a measure of accuracy, illustrates the relationship with precision and bias:

$$MSE = (precision)^2 + (bias)^2$$

acuity, visual: [acuité visuelle]
A measure of the human eye's ability to separate details in viewing an object (25).

additions: [ajouts]
Areas added to the productive forest land base (13).

adjustment: [correction]
The determination and application of corrections to observations, for the purpose of reducing errors or removing internal inconsistencies in derived results. The term may refer either to mathematical procedures or to corrections applied to instruments used in making observations (25).

aerial mosaic:
see **mosaic**

aerial photo: [photographie aérienne]
Photo taken from the air (1).

Generally vertical unless described as oblique.

oblique: [photographie oblique] Aerial photo taken with the camera axis intentionally directed between the horizontal and the vertical (1).

vertical: [photographie verticale] Aerial photo taken with the camera axis approximately vertical (1).

aerial reconnaissance: [reconnaissance aérienne]
The collection of information by visual, electronic, or photographic means from the air (25).

aerial stand volume table:
see **volume table**; stand; aerial

aerial tree volume table:
see **volume table**; tree; aerial

age: [âge]
(a) Of a tree:

breast height: [âge à hauteur de poitrine] The number of annual growth rings between the bark and the pith, as counted at breast height (1).

harvest: [âge de maturité] The number of years required to grow from establishment to maturity (8).

stump: [âge à hauteur de souche] The number of annual growth rings between the bark and the pith, as counted at stump height (1).

total: [âge total] The number of years elapsed since the germination of the seed, or the budding of the sprout or root sucker (26).

(b) Of a forest, stand or forest type, the average of the trees comprising it (12).

harvest: [âge de récolte] The number of years between the establishment of a forest crop and the final harvest of the crop (8).

total: [âge total] The average total age of the trees comprising it (12).

age class: [classe d'âge]
Any interval into which the age range of trees, forests, stands or forest types is divided for classification and use. Also the tree, forest, stand or forest type falling into such an interval (1).

agricultural land: [terre agricole]
Land primarily used for agriculture (1).

air base: [base]
The distance between two camera stations (30). Can also be interpreted as ground distance between centres of successive overlapping photos (7).

cf. base-height ratio, camera station

air photo:

see **aerial photo**

air photograph:

see **aerial photo**

air speed: [vitesse aérienne]

The speed of an aircraft, along its longitudinal axis, relative to the surrounding atmosphere (25).

cf. ground speed

algorithm (Computer Science): [algorithme]

A series of instructions or procedural steps for the solution of a particular problem (16).

alienated land:

see **assigned land**

all-aged:

see **even-aged**

allocated land:

see **assigned land**

allowable cut: [possibilité forestière]

The volume of wood which may be harvested, under management, for a given period (26).

alpine (land): [terre alpine]

Land, which, because of its elevation, is above the timberline (i.e. the limit beyond which trees do not occur) (1).

cf. wildland

altimeter: [altimètre]

An instrument which indicates the vertical distance above a specified datum plane (22).

Usually an aneroid barometer which utilizes relative pressure of the atmosphere.

laser: [altimètre laser] An instrument that utilizes a laser beam to estimate height above ground utilizing the same principle as the Radar Altimeter (1).

radar: [altimètre radar] An instrument which transmits microwave energy, measures the lapsed time of the reflected energy, and converts the time into distance (1).

altitude (Aerial Photography): [altitude]
Vertical distance above the datum, usually mean sea level, of an object or point in space above the earth's surface (25).

analysis (GIS): [analyse]
As opposed to data manipulation, the derivation of new information by bringing together and processing the basic data (polygons, lines, points, labels, etc.) (2).

cf. manipulation

analysis of covariance - ANCOVA (Statistics): [analyse de covariance]
A process that makes use of concepts of both ANOVA and of regression (28). The purpose of ANCOVA is to describe the relationship between a continuous dependent variable and one or more nominal independent variables, while controlling for the effect of one or more continuous independent variables (18).

cf. nominal variable

analysis of variance - ANOVA (Statistics): [analyse de variance]
An arithmetic process for partitioning a total sum of squares into components associated with recognized sources of variance (28). The purpose of ANOVA is to describe the relationship between a continuous dependent variable and one or more nominal independent variables (18).

cf. nominal variable

angle count method:
see **point sampling**

angle gauge: [jauge angulaire]
A class of instrument used in point sampling (1).

Includes the prism and the relascope. Most commonly used to project a fixed (critical) angle horizontally from a point.

artificial intelligence (Computer Science): [intelligence artificielle]
The use of computers and design of programs in such a way that they perform operations analogous to the human abilities of learning and decision making (6). For example, artificial intelligence is used in the development of expert systems.

assigned (land): [terrain affecté]
Crown-owned forest land no longer under the direct control of the crown (1).

Includes crown land which has been leased or licensed to private agencies.

cf. retained land

attitude: [attitude]
The angular orientation of a camera, or of the photograph taken with that camera, with respect to some external reference system (25).

attribute: [attribut]
A characteristic required for describing or specifying some entity. For example, a forest cover type (17).

see also label

automated mapping: [cartographie automatisée]
Mapping operations carried out under machine control. A term frequently generalized to include computer-assisted mapping where there is considerable human intervention (2).

azimuth (Photogrammetry): [azimut]
Azimuth of the principal plane. The clockwise angle from north (or south) to the principal plane of a tilted photograph (25).

- B -

band ratios (Remote Sensing): [rapport de bande]
A method whereby ratios of different spectral bands from the same image or from two registered images, are taken to reduce certain effects such as topography, and to enhance subtle differences of certain features (24).

bare-root planting: [plantation à racines nues]
Setting out young trees with their roots freed from the soil in which they had developed (13).

bark gauge: [sonde à écorce]
An instrument for measuring the thickness of bark (12).

barren: [dénudée]
Land that is devoid of trees or that bears only stunted trees (26).

cf. wildland

basal area: [surface terrière]
(a) Of a tree, the area in square metres of the cross section at breast height of the stem (1).

(b) Of a forest, stand, or forest type, the area in square metres per hectare of the cross section at breast height of all the trees (1).

basal area factor: [facteur de surface terrière]
Of an angle gauge, the basal area or stem area per unit of stand area corresponding to the angle of projection (1).

base - height ratio (Photogrammetry): [rapport base/hauteur]
Ratio of air base and aircraft height of a stereoscopic pair of photographs. This ratio determines the vertical exaggeration on stereo models (7, 25).

cf. air base, vertical exaggeration

base map: [carte de base]
A map which displays basic planimetric information (drainage and cultural features) and which is used as a base for the forest map (1).

Compiled from existing topographical or planimetric maps, or from aerial photos.

bias: [biais]
The difference between the expected value of the estimate and the true value being estimated (1).

Generally, a systematic deviation from the true value resulting from nonsampling errors.

The mean square error (MSE), a measure of accuracy, illustrates the relationship with precision and bias;

$$MSE = (\text{precision})^2 + (\text{bias})^2$$

cf. mean square error, precision

biomass: [biomasse]
The mass of organic matter per unit of area or volume of habitat (1).

forest: [biomasse forestière] The mass of organic matter per unit of area in a forest (1).

tree: [biomasse des arbres] The mass of organic matter per unit of area in trees.

(1) All of these definitions, except that of biomass alone, should be qualified, i.e. total, above-ground or below-ground.

(2) All measurements expressing mass per unit of area or volume of habitat are to be in metric units of ovendry mass or volume where no change in moisture content occurs at 103°C ± 2°C in a ventilated oven (1).

woody: [biomasse cellulosique] The mass of organic matter per unit of area in woody vegetation (1).

bit (Computer Science): [bit]
An abbreviation of binary digits, and one of the two digits (0 and 1) used in binary notation (6). Generally considered the smallest possible unit of information (17).

cf. byte

Bitterlich method:
see **point sampling**

Bitterlich plot:
see **point sample**

block (Computer Science): [bloc]
A group of records, words, characters, or digits treated as a logical unit of data. For example; data is transferred between memory and peripheral units as individual blocks (6, 17).

bog:
see **muskeg**

bole: [fût]
A tree stem once it has grown to substantial thickness, generally capable of yielding sawtimber, veneer logs, large poles, or pulpwood (5).

Seedlings, saplings, and thinner poles have stems, not boles.

cf. stem

borderline tree: [arbre périphérique]
A tree sufficiently close to the boundary of a sample unit that more accurate measurements are required to establish whether the tree is inside or outside the unit (1).

breast height:
see **height:** breast

breast height age:
see **age:** breast height

broadcast seeding:
see **seeding:** broadcast

broadleaved:
see **hardwood(s)**

browse (GIS): [balayage]
To be able to select and take a quick look, usually on a video display, at part of a map to check for features of interest. Usually no analysis or data manipulation is involved (2).

brush: [broussailles]
Shrubs and stands of short, scrubby tree species that do not reach merchantable size (26).

cf. slash

burn (burned-over): [brûlis]
Land which has recently been burned (1).

byte: [octet]
Storage unit equivalent to a character of information (14), or 4 bits.

cf. bit

- C -

cadastral survey: [relevé de cadastre]
A survey relating to land boundaries and subdivisions, made to create units suitable for transfer or to define the limitations of title. Derived from cadastre (meaning register of the real property of a political subdivision with details of area, ownership, and value), the term is now used to designate the surveys of public lands, including retracement surveys for the identification, and resurveys for the restoration of

property lines; it may also be applied properly to corresponding surveys outside public lands, although such surveys usually are termed land surveys or property surveys through preference (25).

calipers: [pied à coulisse]
An instrument to measure diameters of trees or logs (1).

Consists of a graduated rule with two arms, one fixed at right angles to the zero end of the rule, the other sliding on the rule parallel to the fixed arm.

calibration: [étalonnage]
The act or process of determining certain specific measurements in a camera or other instrument or device by comparison with a standard (25).

cf. collimate

camera lucida:
see **stereoscopic plotter**

camera station: [point de vue]
The point in space occupied by the camera lens at the moment of exposure. Also called air station or exposure station (25).

cf. air base

canopy: [couvert forestier]
The cover of branches and foliage formed by tree crowns (10).

cf. storey

canopy class:
see **crown closure class**

canopy density:
see **crown closure**

canopy density class:
see **crown closure class**

capability:
see **site capability**

capability class:
see **site capability class**

cartography: [cartographie]
The art and science of expressing graphically, by maps and charts, the known physical features of the earth, or of another celestial body, often includes the work of man and his varied activities (25).

centroid (GIS): [centre]
In terms of polygons, the geographic centre or the average of the x and y values making up the perimeter points. Used to locate a polygon and its label. Some people have generalized this term so that the point may occur at any point in the polygon (2).

cf. label point

CFI:
see **inventory:** continuous forest inventory

change data: [données ajustées]
Periodic and quantitative information describing forest resource dynamics (13).

This term includes:
(a) Depletions to the forest, such as forest area and wood volume removed by harvesting, windthrows, wildfires, and insect and disease damage;

(b) Accruals, such as area and volume gained from forest growth;

(c) Management activities undertaken to protect or enhance the resource, such as silvicultural treatments; and,

(d) Changes in land ownership and status that affect the utilization of the resource.

check: [stagnation]
Stagnation of tree or stand growth (1).

chicot:
see **snag**

class:
see **age class**
crown class
diameter class
form class
height class
site class
maturity class

classification: [classification]
The systematic grouping of entities into categories based upon shared characteristics (19).

supervised classification (Remote Sensing): [classification dirigée] A computer-implemented process through which each measurement vector is assigned to a class according to a specified decision rule, where the possible classes have been defined on the basis of representative areas of known identity (7).

unsupervised classification (Remote Sensing): [classification non dirigée] A computer-implemented process through which each measurement vector is assigned to a class according to a specified decision rule, whereby the possible classes have been based on inherent data characteristics rather than on training areas (29).

cleaning: [dégagement]
A cultural operation eliminating or suppressing undesirable vegetation, mainly woody (including climbers), during the sapling stage of a forest crop. It has to be done before or, at the latest, concurrent with the first thinning, so as to favor the better trees; may include unwanted crop species as well as intrusive vegetation (13).

clear muskeg:
see **muskeg**

clearcut: [coupe à blanc]
n: An area of forest land from which all merchantable trees have recently been harvested (1).

v: The harvesting of all merchantable trees from an area of forest land (1).

cleared land: [terrain déboisé]
Land permanently cleared of trees, usually as a result of human activities (1).

Includes roads, right-of-ways, railroads, power lines, air strips, gravel pits, mines, dikes, etc.

clearing:
n: [clairière] An open area without trees (1).

v: [nettoiement] The virtual removal of all vegetation from an area, usually by mechanical means, in preparation for regeneration (4).

cf. clearcut

clinometer:
see **hypsometer**

closed forest: [forêt à couvert fermé]
All land with a "forest cover", i.e., with trees whose crowns cover more than 20% of the area (or with a stand density of more than 20%) and used primarily for forestry (31).

Included are:

(a) All plantations, including one-rotation plantations, primarily used for forestry purposes;

(b) Areas normally forming part of the closed forest area which are nonstocked as a result of human intervention or natural causes but which are expected to revert sooner or later to closed forest;

(c) Young natural stands and all plantations established for forestry purposes which have not yet reached a crown density of more than 20%;

(d) Forest roads and streams and other small open areas, as well as forest nurseries, that constitute an integral part of the forest;

(e) Closed forests in national parks and nature reserves;

(f) Areas of windbreak and shelterbelt trees sufficiently large to be managed as forest.

Excluded are:

(a) Isolated groups of trees smaller than 0.2 ha;

(b) City parks and gardens;

(c) Areas not meeting the conditions of closed forests as described above, even if administered by Forest Authorities.

cf. other wooded land

cluster (Statistics): [échantillonnage en grappe]
A sample unit (plot) comprising two or more sample elements (subplots) (1).

clustering (Remote Sensing): [groupage]
The analysis of a set of measurement vectors to detect their inherent tendency to form clusters in multidimensional measurement space (7).

coefficient of determination - R^2 (Statistics): [coefficient de détermination]
The square of the correlation coefficient, and in regression analysis, gives the proportion of the total sum of squares attributable to the independent variable(s) in the model tested (28).

cf. correlation coefficient

coefficient of nondetermination (Statistics): [coefficient de non-détermination]
Is given by $1 - R^2 = K^2$ and is the basis of an error term by giving the unexplained proportion of a total sum of squares (28).

coefficient of variation - CV (Statistics): [coefficient de variation]
Is a relative measure of variation in contrast to the standard deviation, and is used to facilitate the comparison of variability. It is defined as the sample standard deviation expressed as a percentage of the sample mean, and being a ratio of two averages, is independent of the unit of measurement used (28).

collimate: [collimater]
In photogrammetry; to adjust the fiducial marks of a camera so that they define the principal point (25).

cf. calibration

collimating marks: [références collimatrices]
Marks on the stage of a reduction printer or projection equipment, to which a negative or diapositive is oriented (25).

cf. fiducial marks

commercial species: [essence commerciale]
A tree species for which there is a current market (1).

cf. noncommercial species

compartment: [parcelle]
The basic territorial unit of a forest permanently defined for purposes of location, description, and record, and as a basis for forest management (21).

confidence interval: [intervalle de confiance]
The range, bounded by confidence limits, in which the population parameter is expected to occur at a given probability (16).

confidence limits:
see **confidence interval**

coniferous:
see **softwood(s)**

conifer(s):
see **softwood(s)**

container planting: [plantation en récipients]
Setting out young trees from, or together with, receptacles containing the soil, etc. in which they have developed, either from seed or as transplants (13).

continuous forest inventory (CFI):
see **inventory:** continuous forest inventory

contrast (Photography): [contraste]
The actual difference in density between the highlights and the shadows on a negative or positive. Contrast is not concerned with the magnitude of density, but only with the difference in densities. Also, the rating of a photographic material corresponding to the relative density difference which it exhibits (25).

contrast stretching (Remote Sensing): [amplification de contraste]
Improving the contrast of images by digital processing. The original range of digital values is expanded to utilize the full contrast range of the recording film or display device (7).

control (Mapping): [canevas]
A system of points with established positions or elevations, or both, which are used as fixed references in positioning and correlating map features (25).

controlled mosaic:
see **mosaic**

correlation coefficient - R (Statistics): [coefficient de corrélation]
A measure of the degree to which variables vary together (28).

simple: [coefficient de corrélation simple] For bivariate data, it is a measure of the linear relationship between two variables.

multiple: [coefficient de corrélation multiple] A measure of the closeness of association between the observed Y values, and a function of the independent values used in the model.

cf. coefficient of determination

corridor (GIS): [corridor]
An area of uniform width bordering both or one side of a lineal feature such as a stream or route (2).

corridor analysis: [analyse de corridor(s)] The manipulation, measurement, analysis, and output of data within a corridor (2).

corridor generation: [établissement de corridor(s)] To outline a corridor along a defined lineal feature automatically (2).

covariance (Statistics): [covariance]
The measure of how two variables change in relation to each other. If larger values of Y tend to be associated with larger values of X, the covariance will be positive. If larger values of Y tend to be associated with smaller values of X, the covariance will be negative. A covariance matrix is a table of paired covariance values for the variables in the data set (7).

coverage (Remote Sensing, Mapping): [couverture]
The area covered by overlapping aerial photos or by maps (1).

stereo(scopic): [couverture stéréoscopique] The area covered by aerial photos with sufficient overlap for any point to appear on at least two photos in a manner suitable for stereoscopic viewing.

These definitions can also apply to other forms of remote sensing imagery.

cover type:
see **forest type**

crab (Remote Sensing): [dérive]
Any turning of an airplane, usually in a crosswind, which causes its longitudinal axis to vary from the track of the airplane. Also, the condition caused by failure to orient the camera with respect to the track of the airplane as indicated in vertical photography by the edges of the photos not being parallel to the air base lines (26).

cf. drift; yaw

crown area: [projection de la cime]
The area covered by the vertical projection of a tree crown to a horizontal plane (1).

May be determined in the field from crown diameter measurements; on aerial photos by dot grids or digitizers.

crown class: [classe de cime]
A designation of trees in a forest with crowns of similar development and occupying similar position in the canopy (26).

Crown classification applies to groups of trees.

codominant: [codominant] Trees with crowns forming the general level of the canopy and receiving full light from above but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

dominant: [dominant] Trees with crowns extending above the general level of the canopy and receiving full light above and partly from the side; taller than the average trees in the stand, and with crowns well developed but possibly somewhat crowded on the sides.

intermediate: [intermédiaire] Trees shorter than those of the two preceding classes, with crowns either below or extending into the canopy formed by codominant and dominant trees; receiving little direct light from above and none from the sides; usually with small crowns considerably crowded on the sides.

open grown: [simplement ouvert] Trees with crowns receiving full light from all sides due to the openness of the canopy.

suppressed: [supprimé] Trees with crowns entirely below the general level of the crown cover receiving no direct light either from above or from the sides.

crown closure: [fermeture du couvert]
The percentage of ground area covered by the vertically projected tree crown areas (1).

crown closure class: [classe de fermeture du couvert]
Any interval into which the crown closure range is divided for classification and use (1).

crown cover:
see **crown closure**

crown density:
see **crown closure**

crown density class:
see **crown closure class**

crown diameter: [diamètre de la cime]

The horizontal distance between two extremities of the crown on opposite sides of the tree (1).

Often an average of two measurements (maximum and minimum). May be measured on aerial photos or in the field.

Crown land: [terres de la Couronne]
Land that is the property of the Crown (1).

federal crown land: [terres fédérales] Crown-owned lands under the administration of the federal government comprise lands in the Northwest Territories including the Arctic Archipelago and the islands in Hudson Strait, Hudson Bay, and James Bay, lands in the Yukon Territory, ordnance and admiralty lands, national parks and national historic parks and sites, forest experiment stations, experimental farms, Indian reserves and, in general, all public lands held by the several departments of the federal government for various purposes connected with federal administration (1).

provincial crown land: [terres provinciales] Crown-owned land under the administration of a provincial government. Can include municipal land (1).

cf. private land

crown length: [longueur de la cime]
The vertical distance from the top of a standing tree to the base of the crown, measured either to the lowest live branch-whorl or to the lowest live branch (12).

cruise:

n: [inventaire] A field survey of a forest area to obtain general information, often preliminary, on the forest conditions and timber volumes (1).

v: [inventorier] To conduct such a survey (1).

cruise line: [virée d'inventaire]
A line of travel along which data are recorded, either continuously or at intervals (1).

cf. cruise strip, line plot cruise, transect

cruise strip: [virée continue]
A long, narrow plot of specified width, along which the recording of data is continuous (1).

cull:
n: [carie] Trees or logs or portions thereof that are of merchantable size but are rendered unmerchantable by defects (1).

v: [rebuter] To reject the whole of a tree, log or piece of timber in respect to gross volume (1).

cull factor: [taux de carie]
The percentage of a standing tree's gross volume rendered unmerchantable by defects (1).

current annual increment:
see **increment:** current annual

cut:
see **stand growth:** cut

cutover: [coupe totale]
An area of forest land from which some or all timber has recently been cut (1).

- D -

damage (Remote Sensing): [dommages]
Any loss, either biologic or economic, due to stress (19).

cf. damage type

damage type (Remote Sensing): [genre de dommages]
Any syndrome expressed by the plant of either temporary or permanent strain caused initially by stress (15).

cf. damage

data: [données]
Units of information which can be precisely defined; technically, data are raw facts and figures which are processed into information (14).

agreeable data: [données compatibles] Two or more mutually exclusive data sets using the same standards and definitions for purposes of combining (19).

comparable data: [données comparables] Two or more data sets using the same standards and definitions for purposes of comparison (19).

universal data: [données standard] Data that are basic to many uses and from which many kinds of information can be derived (19).

database: [base de données]
A repository for information (19).

data compression (GIS): [compression de données]
A reduction in the amount of computer memory required to hold a polygon or associated text and points through weeding, line smoothing or computer work packing (2).

data processing:
see **processing**

dbh:
see **diameter breast height**

decadent: [décadent]
A tree or stand of trees which is deteriorating due to age (1).

decay:
see **rot**

deciduous:
see **hardwood(s)**

delay period: [période de battement]
The planned number of years between the year in which a stand is depleted and the regeneration initiation (21).

cf. regeneration period

dendrometer: [dendromètre]
A class of instruments designed to measure diameters of standing trees from the ground (1).

May also be used to measure tree height. Includes the Wheeler Pentaprism Caliper.

optical: [dendromètre optique] An instrument using optics to enlarge the image and improve measurement accuracy. Includes the Barr & Stroud Dendrometer and the Telerelascope.

density:
see **stand density**

depletion: [décroissement]
The decrease in merchantable volume on a managed forest area (1).

The decrease may be due to logging, fire, insect and disease damage, and other causes.

depth of field: [profondeur de champ]
The distance between the points nearest and farthest from the camera which are imaged with acceptable sharpness (25).

The general relation is a shallower depth of field at large apertures, and a deeper depth of field at narrower (smaller) apertures.

derived map: [carte dérivée]
A map of selected features of interest (2).

description:
see **label**

diameter: [diamètre]
diameter breast height (dbh): [diamètre à hauteur de poitrine (dhp)] The stem diameter of a tree measured at breast height (1.30 m above ground level) (1).

Unless otherwise stated, applies to the outside-bark dimension.

diameter inside bark (dib): [diamètre sans écorce] The diameter of a tree or log excluding double bark thickness (1).

diameter outside bark (dob): [diamètre avec écorce] The diameter of a tree or log including bark (1).

diameter stump height (dsh): [diamètre à hauteur de souche] The stem diameter of a tree measured at stump height (1).

quadratic mean diameter: [diamètre de la tige de surface terrière moyenne] Diameter of the tree with average (for a given stand) basal area at reference height (usually dbh) (1).

top diameter: [diamètre au fin bout] Of a standing tree, the diameter at merchantable height, i.e., at the smaller end of the uppermost merchantable log (12). Measured inside bark.

diameter class: [classe de diamètre]
Any interval into which the range of stem diameters of trees or logs is divided for classification and use. Also the trees or logs falling into such an interval (10).

diameter limit: [diamètre limite]
The minimum, and occasionally the maximum, diameter to which trees or logs are to be measured, cut or used (12).

The limits generally refer to the stump, the top, or breast height.

diameter tape: [galon circonférentiel]
A specially graduated tape by means of which the diameter may be read directly when the tape is placed around the tree (26).

digital classification (Remote Sensing): [classification numérique]
Employing an algorithm or several algorithms to group pixels of a multispectral image with similar characteristics. It is a process by which information labels may be attached to pixels on the basis of their spectral reflectance characteristics (7, 24).

digital enhancement (Remote Sensing): [accentuation de l'image]
Data filtering and other processes which may or may not be statistical, to manipulate pixels to produce an image that will accentuate features of interest for visual (manual) interpretation (29).

digitize: [codifier en numérique]
To convert a point or line on a map or other plane surface to a machine readable form (2).

direct data entry: [entrée directe de données]
Digitizing and key entry directly from a data source such as an aerial photograph or a forest cover map (2).

direct seeding:
see **seeding,** direct

displacement: [déplacement]
image: [déplacement d'image] Any shift in the position of an image on a photograph which does not alter the perspective characteristics of the photograph (i.e., shift due to relief or height of the objects photographed, scale change in the photograph, shift due to tilt of the photograph) (7).

cf. distortion

relief: [déplacement de relief] Displacement of images radially inward or outward with respect to the photograph nadir because the ground objects are, respectively, below or above the elevation of the ground nadir (25).

display (Computer Science, Remote Sensing): [affichage]
An output device that produces a visible representation of the data set for quick visual access; the prime hardware component is usually a cathode ray tube (CRT) (7).

distortion (Photogrammetry): [distorsion]
Any shift in the position of an image on a photograph which alters the perspective characteristic of the photograph (i.e., image distortion caused by motion of the film or camera, differential shrinkage of film or paper, and lens aberration) (25).

cf. displacement image

dot grid: [point coté]
A transparent sheet of film (overlay) with systematically arranged dots, each dot representing a number of area units (1).

Used to determine areas on maps, aerial photos, plans and drawings.

Occasionally, the dots are arranged at random within a square or rectangular grid.

drain:
see **depletion**

drift (Aerial Photography): [dérive]
The horizontal displacement of an aircraft from its course caused by wind or other causes (25).

cf. crab

drill seeding:
see **seeding:** drill

dsh:
see **diameter stump height**

dummy variable (Statistics): [variable]
A variable often introduced into regression analysis that has two or more distinct levels. This contrasts with variables normally used in regression equations that take values over some continuous range (9).

economically accessible: [économiquement accessible]
Forest management units and forest stands from which the annual allowable cut can be profitably harvested within the foreseeable future (1).

economically inaccessible: [économiquement inaccessible]
Forest management units from which the annual allowable cut cannot be profitably harvested (at some specified date) (1).

edge enhancement (Remote Sensing): [accentuation marginale]
The use of analytical techniques to emphasize transition in imagery (7).

edgematching (GIS): [raccordement marginal]
Overcoming the line mismatches that may occur between adjoining map sheets or photos (2).

edgetying:
see **edgematching**

editing (GIS): [édition]
The addition, deletion, or modification of polygons, lines, points, and associated labels. Editing relates mainly to the correction of errors, but can include updating (2).

effective area of aerial photograph: [surface utile d'une photo aérienne]
That central part of the photograph delimited by the bisectors of overlaps with adjacent photographs. On a vertical photograph, all images within the effective area have less displacement than their corresponding images on adjacent photographs (25).

empirical yield table:
see **yield table:** empirical

error (Statistics): [erreur]
The difference between an observed or computed value of a quantity and the ideal or true value of that quantity. Errors are defined by types or by causes (25).

error mean square:
see **mean square error**

establishment: [établissement]
The process of developing a forest crop to the stage at which the young trees may be considered established, i.e., safe from normal adverse

influences (e.g., frost, drought, weeds, or browsing) and no longer in need of special protection or special tending, i.e., free-to-grow (21).

establishment period: [période d'implantation]
The time elapsing between the initiation of regeneration and its acceptance to the free-to-grow status (21).

evaluation: [évaluation]
A determination of the worth, quality, significance, amount, degree, or condition of something by careful appraisal and study (19).

even-aged: [équienne]
Of a forest, stand, or forest type in which relatively small age differences exist between individual trees (1).

The differences in age permitted are usually 10 to 20 years; if the stand will not be harvested until it is 100 to 200 years old, larger differences up to 25% of the rotation age may be allowed.

cf. uneven-aged

exposure latitude (Photography): [latitude de pose]
The range of photographic exposure which will result in a satisfactory image (25).

- F -

false color (Remote Sensing): [fausse couleur]
The use of one color to represent another. For example, the use of red emulsion to represent infrared light in color infrared film (7).

federal land:
see **crown land**

fencing: (GIS):
see **windowing**

fertilizing: [fertilisation]
The addition of nutrients to the soil in organic or inorganic form (13).

fiducial marks: [repères du fond de chambre]
Index marks, usually four, which are rigidly connected with the camera lens through the camera body and which form images on the negative and usually define the principal point of the photograph. Also marks, usually four in number, in any instrument which define the axes whose

intersection fixes the principal point of a photograph and fulfills the requirements of interior orientation (25).

cf. collimating marks

field (Computer Science): [champ]
A logical element of data within a record or a collection of subfields. A field may be a number, or numbers, or a collection of characters. Field sizes and data types are dependent on the format of the record (27).

file (Computer Science): [dossier de données]
A collection of information consisting of records pertaining to a single subject. A file begins at the end of the preceding file or the beginning of tape, and ends with an EOF (End of File) (27).

final cutting: [coupe finale]
The removal of seed or shelter trees after regeneration has been effected, or removal of the entire crop of mature trees under a clearcut system (21).

firewood: [bois de chauffage]
Trees that will yield logs suitable in size and quantity for the production of firewood. Also logs of such trees (1).

cf. fuelwood, pulpwood

fixed-area plot:
see **sample plot**

flight line: [ligne de vol]
A line drawn on a map or chart to represent the actual or proposed track of an aircraft in remote sensing programs (1).

The line connecting the principal points of overlapping vertical photos approximates a flight line.

floating mark (Photogrammetry): [repère stéréoscopique]
A mark seen as occupying a position in the three-dimensional space formed by the stereoscopic fusion of a pair of photographs and used as a reference mark in examining or measuring the stereoscopic model (25).

focal length: [distance focale]
The distance measured along the optical axis from the rear nodal point of the lens to the plane of critical focus of a very distant object (25).

forest: [forêt]
A plant community predominantly of trees and other woody vegetation, growing more or less closely together (1).

forest biomass:
see **biomass**

forest capability:
see **site capability**

forest capability class:
see **site capability class**

forest cover type:
see **forest type**

forest inventory:
see **inventory, forest**

forest land: [terrain forestier]
Land primarily intended for growing, or currently supporting, forest (1).

Includes land not now forested, e.g., clearcuts; northern lands that are forested but not intended for any use; and plantations.

cf. nonforest land

productive: [terrain forestier productif] Forest land that is capable of producing a merchantable stand within a reasonable length of time (1).

unproductive: [terrain forestier improductif] Forest land that is incapable of producing a merchantable stand within a reasonable length of time (1).

Includes muskeg, rock, barrens, marshes, meadows, etc. within a forest land area

forest management unit: [unité d'aménagement forestier]
An area of forest land managed as a unit for fiber production and other renewable resources (1).

This unit can be the entire province or territory, a provincial forest management subdivision, an industrial timber limit, etc.

forest map: [carte forestière]
A base map to which forest data have been added (1).

forest mensuration: [dendrométrie]
The measurement of volume, growth, and development of individual trees and stands, and the various products obtained from them (1).

forest stand:
see **stand**

forest type: [type forestier]
A group of forested areas or stands of similar composition which differentiates it from other such groups (1).

Forest types are usually separated and identified by species composition and often also by height and crown closure classes. In detailed typing, age, site, and other classes may also be recognized. The typing is usually done on aerial photos and may be supplemented by field data. Type symbols and boundaries are marked on the photos and transferred to the forest map.

form class: [classe de forme]
Any of the intervals into which the range of form quotients of trees or logs is divided for classification and use. Also the trees or logs falling into such intervals (1).

A classification of trees according to taper.

cf. form quotient

form class volume table:
see **volume table:** tree, form class

form factor: [coefficient de forme]
The ratio between the inside-bark volume of a tree and the volume of a cylinder having the same diameter and height (26).

Three different form factors are defined, the differences being related to the point on the tree at which the diameter is measured:

absolute: [coefficient de forme absolu] Cylinder diameter equal to stump diameter (1).

breast height: [coefficient de forme au-dessus de la hauteur de poitrine] Cylinder diameter equal to diameter breast height. Most commonly used (1).

normal: [coefficient de forme normal] Cylinder diameter equal to a diameter measured at a distance above ground having a fixed ratio to tree height (1).

form quotient: [quotient de forme]
The ratio of any two overbark diameters of a tree stem (12).

absolute: [quotient de forme absolu] The ratio of diameter of half the tree height above breast height to dbh (12). Used to construct tree volume tables.

forward overlap:
see **overlap:** forward

free-to-grow (FTG): [hors compétition]
Stands that meet stocking, height, and/or height growth rate, as indicated by specifications or standards, and are judged to be essentially free from competing vegetation (21).

fuelwood: [bois de chauffage]
Trees that will yield logs suitable in size and quality for the production of firewood logs or other wood fuel, the logs of such trees (1).

cf. firewood, pulpwood

fully stocked:
see **stocking:** fully stocked

- G -

general inventory:
see **inventory:** regional

geocoding (GIS): [codage géographique]
Transformation or tying-in of digitized coordinates and labels to a map coordinate system such as 6° UTM (2).

geographic information system (GIS): [système d'information à référence géographique]
An information system which uses a spatial database to provide answers to queries of a geographical nature through a variety of manipulations such as sorting, selective retrieval, calculation, spatial analysis and modelling (11).

cf. spatial database

geographically referenced: [pointé géographiquement]
Refers to the condition of data for which "positional" information is available, enabling the geographical position of the data to be established and communicated. The normal functioning of a geographic

information system requires the existence of geographically referenced data in a spatial database and a means of manipulating these data (11).

cf. spatial database

geometric registration: (Remote Sensing) [superposition géométrique]
The process of geometrically aligning two or more sets of image data so that resolution cells for a single ground area can be digitally or visually superimposed. Data being registered may be of the same type, from different kinds of sensors, or collected at different times (29).

GIS:
see **geographic information system**

GRID:
see **dot grid**

gross increment:
see **increment:** gross

gross volume:
see **volume:** gross total, gross merchantable

ground control point: [point de contrôle]

Control points, established by ground surveys, used to fix the attitude and/or position of one or more aerial photos for mapping purposes (22).

ground speed (Photogrammetry, Air Navigation): [vitesse par rapport au sol]
The rate of motion of an aircraft along its track with relation to the ground; the resultant of the heading and air speed of the aircraft and the direction and velocity of the wind (25).

cf. air speed

ground truth: [contrôle au sol]
Data and observations on the earth's surface normally to quantify simultaneously recorded remote sensing imagery (25).

growing stock: [matériel sur pied]
The sum (by number, basal area, or volume) of trees in a forest or a specified part of it (1).

growth:
see **increment:** stand growth

hardwood(s): [feuillu]

(1) Trees belonging to the botanical group Angiospermae with broad leaves usually all shed annually. Also, stands of such trees and the wood produced by them (1).

(2) A forest type in which 0-25% of the canopy is softwood (1).

harvesting:
see **logging**

height: [hauteur]

breast: [hauteur de poitrine] The standard height, 1.30 m above ground level, at which the diameter of a standing tree is measured (1).

On sloping ground, breast height is usually measured on the uphill side of the tree.

merchantable tree: [hauteur marchande] The vertical distance between stump height and a point on the standing tree having a specified utilization limit (1).
The specified utilization limit is generally expressed as diameter inside bark.

stand: [hauteur de peuplement]

(Mensuration): The average height of dominant and codominant trees of the main species forming the stand (1).

(Remote Sensing): The average height of dominant and codominant trees in a stand (1).

stump: [hauteur de souche] The vertical distance between ground level and the top of a stump (1). On slopes, ground level is generally taken on the upper side of the stump. Stump height may be the actual height of a cut stump, or some arbitrarily selected standard. In rain forests and in mountainous terrain, the point of germination is used in place of ground level.

top: [hauteur moyenne supérieure] The mean height of 100 trees per hectare of largest diameter at breast height. From 5 to 15 trees in a particular stand will be measured according to the uniformity and size of the stand (1).

tree: [hauteur de l'arbre] The distance between the uppermost shoot of the tree and ground level or point of germination if that differs from ground level (1).

height class: [classe de hauteur]
Any interval into which the range of tree or stand heights is divided for classification and use. Also the trees or stands falling into such an interval (1).

high-grading:
see **partial cutting:** high-grading

hypsometer: [clinomètre]
A class of instrument designed to measure tree heights from the ground, using trigonometric principles (1).

- I -

image (Remote Sensing): [image]
The permanent record of the likeness of any natural or manmade features, objects, and activities. Images can be acquired directly on photographic materials using cameras, or indirectly if nonimaging types of sensors have been used in data collection (25).

image enhancement:
see **digital enhancement**

image motion (Aerial Photography): [mouvement de l'image]
Blurring of images on an aerial photograph due to the relative movement of the camera with respect to the ground during exposure (25).

immature: [jeune]
In even-aged management, those trees or stands that have grown past the regeneration stage but are not yet mature (1).

cf. even-aged, regeneration, mature

improvement cuttings: [coupes d'amélioration]
Cuttings made in stands past the sapling stage for the purpose of improving composition and quality by removing trees of undesirable species, form, or condition from the main canopy (4).

increment: [accroissement]
The increase in diameter, basal area, height, volume, quality, or value of individual trees or stands during a given period (10).

The following types of increment are commonly recognized.

current annual (c.a.i.): [accroissement annuel courant] Increment for a given year (1).

gross: [accroisement brut]
(a) Of stands, accretion plus ingrowth, plus mortality.
(b) Of trees, increment (1).

mean annual (m.a.i.): [accroissement annuel moyen] The average annual increment for the total age (1).

net: [accroissement net]
(a) Of stands, gross increment less mortality.
(b) Of trees, increment (1).

normal: [accroissement normal]
(a) The increment laid on by a normal forest.
(b) Of an individual stand, the increment attained under full stocking and normal health (12).

periodic annual: [accroissement annuel périodique] The average annual increment for a specified period, commonly 5, 10 or 20 years (1).

increment borer: [tarière de Pressler]
An auger-like instrument with a hollow bit, used to extract cores or cylinders of wood from trees with annual growth rings, for increment and age determination (10).

increment core: [carotte]
The cylinder of wood extracted from a tree by an increment borer (1).

Used to determine increment and age of trees with annual rings.

index map: [carte-index]
A map showing the location and numbers of flight lines and aerial photos (22).

indicator variable:
see **dummy variable**

infrared (Photography): [infrarouge]
Pertaining to or designating the portion of the electromagnetic spectrum with wavelengths just beyond the red end of the visible spectrum, such as radiation emitted by a hot body. Invisible to the eye, infrared rays are detected by their thermal and photographic effects.

Their wavelengths are longer than those of visible light and shorter than those of radio waves (25).

ingrowth:
see **stand growth:** ingrowth

instantaneous field of view: [champ de visée instantané]
When expressed in degrees or radians, the smallest plane angle over which an instrument (for example, a scanner) is sensitive to radiation; when expressed in linear or area units such as metres or hectares, it is an altitude-dependent measure of the ground resolution of the scanner (29).

cf. scan line

integration, multiresource:
see **multiresource integration**

interactive (Computer Science): [interactif]
In the computer field, the ability of the machine and operator to communicate on a real time or continuing basis to solve problems. Of particular relevance to data input and editing, updating operations, and the retrieval of data (interactive graphics) (2).

interpretation:
see **photo interpretation**

inventory: [inventaire]
continuous forest inventory (CFI): [inventaire forestier continu] A forest inventory system in which permanent sample plots distributed throughout the whole forest management unit are repeatedly remeasured at regular intervals to determine total volume, growth and depletion (1).

forest: [inventaire forestier]
A survey of a forest area to determine such data as area condition, timber, volume and species, for specific purposes such as planning, purchase, evaluation, management or harvesting (1).

integrated: [inventaire intégré] An inventory or system of inventories designed to meet multifacility, multilevel, multiresource, or temporal needs (19).

management: [inventaire d'aménagement] A detailed, intensive forest inventory for management purposes, of an area managed as one unit (1).

The forest types are usually mapped in detail with estimates given for each type. Precision estimates given for total inventory volume.

operational: [inventaire d'exploitation] An intensive forest inventory of a small area for harvesting purposes (1).

Individual stands are mapped, with estimates given for each stand.

reconnaissance: [inventaire de reconnaissance] An exploratory, extensive forest inventory with no detailed estimates obtained (1).

A formal sampling design is generally not used, and no precision estimates are obtained.

regional: [inventaire régional] A detailed, extensive forest inventory for planning on a regional or provincial basis (1).

Major forest types are usually mapped, with estimates given for each type. Precision estimates given for total inventory volume.

irregular:
see **uneven-aged**

- L -

label (GIS, Mapping): [référence]
Alphanumeric data, textural data, or a symbol which describes a polygon, line or point. Sometimes referred to as attribute label, type code, or descriptor (2).

label point (GIS): [point de référence]
A point in a polygon used to position the label and to reference it to a polygon (2).

cf. centroid

land capability: [potentiel des terres]
The potential usefulness of land in supporting renewable natural resources, e.g., forestry, agriculture, wildlife, recreation and water production (1).

Landsat: [Landsat]
The name of a specific series of satellites designed to obtain images of the Earth's surface and natural resources (1).

land survey:
see **cadastral survey**

lap:
see **overlap**

lateral overlap
see **overlap;** lateral

legend (Mapping): [légende]
A description, explanation, table of symbols, and other information, printed on a map or chart to provide a better understanding and interpretation of it. The title of a map or chart formerly was considered part of the legend, but this usage is obsolete (25).

line plot cruise: [virée discontinue]
Field data collection from sample units spaced at (usually) regular intervals along straight lines of travel (1).

local volume table:
see **volume table:** tree, local

logged area:
see **cutover**

logging: [exploitation forestière]
The cutting and removal of trees from a forested area (1).

- M -

magnetic declination: [déclinaison magnétique]
The angle between true (geographic) north and magnetic north (direction of the compass needle). The magnetic declination varies for different places and changes continuously with respect to time (25).

main storey:
see **storey**

management inventory:
see **inventory:** management

manipulation (GIS): [traitement]
Rearranging or presenting data without changing the basic data or deriving new data (2).

cf. analysis

map indexing system: [système de référence cartographique]
A method of labelling a series of maps, produced at varying scales, of the same area (1).

map projection: [projection cartographique]
Method of transforming a spherical representation of the Earth's surface to a nonspherical, usually plane, surface (20).

Transformation of the spherical surface may be accomplished geometrically or mathematically. Map projections most commonly used in forestry are the Transverse Mercator, the Lambert Conformal, and the Polyconic, all transformed geometrically.

mature: [mûr]
In even-aged management, those trees or stands that are sufficiently developed to be harvestable and that are at or near rotation age (includes overmature trees and stands if an overmature class has not been recognized) (1).

maturity class: [classe de maturité]
Trees or stands grouped according to their stage of development from establishment to suitability for harvest. A maturity class may comprise one or more age classes (1).

mean annual increment:
see **increment:** mean annual

mean square error (Statistics): [carré de l'erreur moyenne]
An unbiased estimate of the true variance about the regression (31), and is computed by the sum of squares of the errors divided by the residual (error) degrees of freedom (25). It is also referred to as residual mean square (RMS), and the square root of this statistic is called the standard error of estimate (28).

cf. standard error of estimate, precision

MEIS: [MEIS]
Acronym for Multi-detector Electro-optical Imaging Scanner. It is a narrow spectral band imager that employs linear array technology to acquire airborne digital data (1).

mensuration:
see **forest mensuration**

menu (GIS): [menu]
As opposed to key entry, the encoding of data by using a list or matrix which is digitized to select the particular label (2).

merchantable: [marchand]
Of a tree or stand that has attained sufficient size, quality, and/or volume to make it suitable for harvesting (1).

Does not imply accessibility, economic or otherwise.

merchantable tree height
see **height:** merchantable tree

merchantable volume:
see **volume:** gross merchantable

merge (GIS): [assemblage]
After dissolving lines during reclassification, the reduction of number of labels and polygons (2).

metric camera: [caméra photogrammétrique]
A camera whose interior orientation is known, stable and reproducible (25).

cf. nonmetric camera

minimum diameter limit:
see **diameter limit**

mixedwood(s): [mélangé(s)]
(1) Trees belonging to both the botanical groups Gymnospermae and Angiospermae, and which are substantially intermingled in stands. Also, the wood of such trees mixed together in substantial quantities (4).

(2) A forest type in which 26-75% of the canopy is softwood (1).

monitoring: [contrôle]
The process of measuring and evaluating data on key variables to determine if objectives or standards are being met; the collection of serial data to evaluate trends as well as to understand how a system functions. For renewable resources, monitoring is the systematic measurement or analysis of change as with forest components or processes to determine the effects of actions on the forest inventory and how actions and effects comply with laws, regulations, policies, and executive directives, as they are expressed in objectives and standards (19).

mortality: [mortalité]
Death or destruction of forest trees as a result of competition, disease, insect damage, drought, wind, fire, and other factors, excluding harvesting (1).

see also **stand growth:** mortality

mosaic (Photogrammetry): [mosaïque]
An assembly of aerial photographs or images whose edges usually have been torn, or cut, and matched to form a continuous photographic representation of a portion of the earth's surface. Often called aerial mosaic (25).

controlled: [mosaïque contrôlée] Corrected for scale and tilt distortion by the use of ground control points. (1).

semicontrolled: [mosaïque semi-contrôlée] Partially corrected. (1).

uncontrolled: [mosaïque non contrôlée] Not corrected. (1).

MSS:
see multispectral scanner

multiphase sampling:
see **sampling:** multiphase

multiresource integration: [intégration de données variées]
The creation of a common data set consisting of one or more variables (universal data) used for two or more different resource functions. It is an attempt to record part or all of the biological and physical conditions of a site regardless of the intended uses of the resource (19).

multispectral imagery: [imagerie multispectrale]
Images of the same scene produced simultaneously by two or more sensors responding to different parts of the electromagnetic spectrum (1).

Multi-Spectral Scanner (MSS): [balayeur multispectral]
The major sensor system employed on Landsat satellites that generates spectral data in the visible and reflective regions (1).

cf. thematic mapper

multistage sampling:
see **sampling:** multistage

multistoreyed:
see **storey**

municipal land: [terres municipales]
Land that is the property of a municipality and provincial or federal crown land under the direct administration of a municipality (4).

muskeg: [tourbière]
Peatlands, swamps, and bogs supporting very limited tree growth due to excessive moisture (1).

clear: [dénudé humide] Has a tree cover of less than 10% crown closure.

treed: [semi-dénudé humide] Has a tree cover of at least 10% crown closure.

- N -

nadir point (Photogrammetry): [point nadir]
The point at which a vertical line through the perspective center of the camera lens pierces the plane of the photograph (25).

net increment:
see **increment:** net

net volume:
see **volume:** net merchantable

node (GIS): [nœud]
Point where digitized segments or arcs join (2).

node snap (GIS): [raccordement au nœud]
To close a gap between the ends of two lines as at a node (2).

nominal variable (Statistics): [variable nominale]
A variable whose numbers are simply to classify or label different categories. For example, the variable "sex", is nominal since the numbers 1 and 0 can be used to denote male and female respectively (18).

nonalienated land:
see **retained land**

noncommercial species: [essence d'intérêt non commercial]
A tree species for which there is no current market (1).

cf. commercial species

nonforest land: [terrains non forestiers]
Land not primarily intended for growing, or not supporting, forest (1).

Includes urban parks and gardens, orchards, wooded pastures and range lands.

cf. forest land

nonmetric camera: [appareil non photogrammétrique]
A camera whose interior orientation is partially unknown (25). Incorporation of fiducial marks alone does not convert a nonmetric camera to metric.

cf. metric camera

nonprobability sampling:
see **sampling:** nonprobability

nonreserved (forest land): [terrain forestier non réservé]
Forest land that, by law or policy, is available for the harvesting of forest crops (1).

cf. reserved (forest land)

nonstocked:
see **stocking:** nonstocked

normal forest: [forêt normale]
That forest which has reached and maintains a practically attainable degree of perfection in all its parts, for the full and continued satisfaction of the objects of management. This is the classical concept against which an actual forest may be compared so as to bring out its deficiencies, particularly for sustained yield management, as regards volume of growing stock, age- or size-class distribution, and increment (12).

normal increment:
see **increment:** normal

normally stocked:
see **stocking:** normally stocked

normal yield table:
see **yield table:** normal

NSR:
see **stocking:** NSR

- O -

old growth: [peuplement vierge]
A stand of mature or overmature trees relatively uninfluenced by human activity (1).

operational cruise:
see **inventory:** operational

operational inventory:
see **inventory:** operational

optical dendrometer:
see **dendrometer**

orthogonal: [orthogonal]
(Remote Sensing): At right angles; rectangularly; meeting, crossing, or lying at right angles (25).

(Statistics): Uncorrelated (1).

orthophotograph: [orthophotographie]
A photograph having the properties of an orthographic projection. It is derived from a conventional photograph by simple or differential rectification so that the image displacements caused by camera tilt and relief of terrain are removed (25).

cf. rectification, rubber sheeting

orthophoto map: [orthophotocarte]
A controlled mosaic corrected for displacement due to tilt and relief, usually enhanced by drafting of planimetric and other features (1).

other wooded land: [terres forestières résiduelles]
Land which has some forestry characteristics but is not forest as defined under "Closed forest" (31).

Included are:

(a) Open woodland: Land with trees whose crowns cover about 5-20% of the area (or with a stand density of less than 20%);

(b) Areas occupied by windbreaks, shelterbelts, hedgerows, and isolated groups of trees of less than 0.5 ha;

(c) Shrub and brushland: Land with shrubs or stunted trees covering more than about 20% of the area, not primarily used for agricultural or other nonforestry purposes, such as grazing of domestic animals.

cf. closed forest

overlap: [recouvrement]
The amount by which one image (photo) overlaps another (1).

forward: [recouvrement longitudinal] Overlap along the flight line. Frequently used synonymously with overlap.

lateral: [recouvrement latéral] Overlap between flight lines.

Both forward and lateral overlap are generally expressed as a percentage of either dimension of the photo.

overlay: [recouvrement]
In conventional mapping, the registration of one map with another to show combinations of mapped features (e.g. a forest cover map and a soils map). Overlays can include a thematic map and the superimposition of property boundaries, grids, blocks or any other division of the area. Multiple overlays are possible. The computer analog of overlays is the superimposition of geocoded data and labels with emphasis on analysis and retrieval of specific combinations of data of interest. Computer-based overlaying is one means of updating the database following changes (2).

overmature: [suranné]
In even-aged management, those trees or stands past the mature stage (1).

cf. mature

overstocked:
see **stocking:** overstocked

overstorey:
see **storey**

overtopped:
see **crown class:** suppressed

- P -

parallax (Photogrammetry): [parallaxe]
The apparent displacement of the position of a body, with respect to a reference point or system, caused by a shift in the point of observation (25).

absolute: [parallaxe absolue] The algebraic difference, parallel to the air base, of the distances of the two images of an object from their respective principal points (1).

differential: [parallaxe différentielle] The difference between two absolute parallax values. Customarily used in determination of the difference in elevation (e.g., height) of objects (1).

photo: [parallaxe stéréoscopique] Results when the camera position is moved between consecutive overlapping photos (1).

parallax bar: [barre parallaxe]
A bar-shaped micrometer used with a stereoscope to measure parallax (1).

Used to calculate tree heights and other differences in elevation.

parameter: [paramètre]
A quantity or item of information which is used in a mathematical calculation, subroutine, or program, and which can be given a different value each time (6).

partial cutting: [coupe partielle]
Tree removal other than clearcutting, i.e., taking only part of a stand (4).

high-grading: [coupe d'écrémage] A type of harvest cutting that removes only certain species above a certain size or of high value. Known silvicultural requirements and/or sustained yields being wholly or largely ignored or found impossible to fulfill (13).

seed-tree: [coupe d'arbres avec resèrve de semenciers] An even-aged silvicultural system in which an area is cut clear except for certain trees called seed trees. These are left standing singly or in groups to furnish seed for natural restocking of the cleared area (13).

selection: [coupe sélective] An uneven-aged silvicultural system in which trees are removed individually or in small groups continuously at relatively short intervals. By this means there is constant renewal of a forest crop (13).

shelterwood: [coupe progressive] Any harvest cutting of a more or less regular and mature crop, designed to establish a new crop under the protection (overhead or side) of the old (13).

single-tree selection cutting: [coupe sélective par arbre] A silvicultural cutting in the selection method of silvicultural cutting in which each little even-aged component of the uneven-aged stand occupies the space created by the removal of a single mature individual or exceedingly small clumps consisting of several such trees. The development of reproduction in the very small, scattered openings thus created is the main characteristic of the method (4).

partially stocked:
see **stocking:** partially stocked

peatlands:
see **muskeg**

periodic annual increment:
see **increment:** periodic annual

peripheral (Computer Science): [périphérique]
Any input, output and storage device which can be operated under computer control; printers, plotters, digitizers, tape drives and disk drives are examples (6).

permanent plot:
see **sample plot:** sample unit

photo base (Photogrammetry): [base photographique]
The length of the air base as represented on a photograph. The distance between the principal points of two adjacent prints of a series of vertical aerial photographs (25).

photo coverage:
see **coverage**

photogrammetry: [photogrammétrie]
The art, science and technology of obtaining reliable information about physical objects and the environment, through processes of recording, measuring, and interpreting images and patterns of electromagnetic radiant energy and other phenomena (24).

photograph nadir:
see **nadir point**

photo interpretation: [photo-interprétation]
The detection, identification, description, and assessment of significance of objects and patterns imaged on a photograph (25).

photo map: [photocarte]
A single air photo or a mosaic showing grid coordinates and other marginal information (1).

cf. orthophoto

phototyping: [tracé des contours]
The delineation and labelling of natural or cultural features on aerial photos (1).

cf. forest typing

pitch: [tangage]
(1) Air Navigation: A rotation of an aircraft about the horizontal axis normal to its longitudinal axis so as to cause a nose-up or nose-down attitude.

(2) Photogrammetry: A rotation of the camera, or of the photograph-coordinate system, about either the photograph y axis or the exterior Y axis; tip or longitudinal tilt. In some photogrammetric instruments and in analytical applications, the symbol phi (ϕ) may be used (25).

pixel (Remote Sensing): [pixel]
The smallest, most elementary areal constituent of an image (also called a Resolution Cell (1).

Comparable to one of the many dots making up the picture on a TV screen. Acronym for Picture Element.

planimetric map: [carte planimétrique]
A map showing correct horizontal positions of features represented (3).

cf. topographic map

plantation: [plantation]
A forest crop established artificially, either by sowing or planting (10).

planting: [plantation]
Establishing a forest by setting out seedlings, transplants, or cuttings in an area (13).

platform (Remote Sensing): [plate-forme]
The objects, structure, vehicle, or base upon which a remote sensor is mounted (25).

plot:
see **sample plot**

plotter: [table à tracer]
Graphics output device; plotters are drawing machines that draw lines with ink pens. Plotters require that the picture image is coded in vector graphics format (point-to-point). Flatbed plotters limit the overall size of the drawing to the fixed height and width of the "bed" onto which the paper is placed for drawing. Flatbed plotters draw by moving the pen in both horizontal and vertical axes. Drum plotters limit the size to one side only (size of the drum), but not the other, since the paper is continuously moved like a standard printer. Drum plotters draw by moving the pen along one axis and the paper along the other (14).

cf. stereoscopic plotter

plotless cruising:
see **point sampling**

point sample: [point d'échantillonnage]
A sample unit or element in which trees are selected for inclusion from a point, with probability proportional to their basal areas (1).

Used as an alternative to the fixed-area plot. Has no fixed boundary. Trees are selected for inclusion in the point sample with an angle gauge.

cf. basal area factor, sample plot

point sampling: [échantillonnage par placettes circulaires à rayon variable]
A method of selecting trees for measurement, and for estimating stand basal area, at a sample location or point sample (1).

Also called plotless cruising, angle count method, Bitterlich Method. In point sampling a 360° sweep is made with an angle gauge about a fixed point and the stems whose breast height diameters appear larger than the fixed angle subtended by the angle gauge are included in the sample.

point transfer device (Photogrammetry): [transfert de point]
A stereoscopic instrument used to mark corresponding image points on overlapping photographs (25).

polyareal sample:
see **point sample**

polygon (GIS): [polygone]
A stream of digitized points approximating the delineation (perimeter) of an area (forest type) on a map. Polygons often are comprised of line segments or arcs which join at nodes to produce a polygon (2).

population (Statistics): [population]
The aggregate from which the sample is chosen (1).

In forest inventories, the population is usually a forested area for which information is required.

position: [position]
The location of a point with respect to a reference system, such as a geodetic datum. The coordinates which define such a location. The place occupied by a point on the surface of the earth (25).

precision (Statistics): [précision]
The variability of a series of sample estimates: the difference between a sample estimate and the estimate obtained from a complete enumeration using the same method and procedures (1).

Generally, random deviation from the sample mean. The mean square error (MSE), a measure of accuracy, illustrates the relationship with precision and bias:

$MSE = (precision)^2 + (bias)^2$

The precision or sampling error is usually expressed as the standard error (s.e.) of the sample estimate, either absolutely or as a percentage of the estimate.

cf. bias, mean square error

principal components transformation (Remote Sensing, Statistics): [transformation en composantes principales]
The representation of data into a new, uncorrelated (orthogonal) coordinate system or vector space. It produces in multidimensional space, a data set which has most variance along its first axis, the next largest variance along a second mutually orthogonal axis and so on (24). The derived components are linear combinations of the original variables.

prism: [prisme]
An optical instrument used as an angle gauge, consisting of a thin wedge of glass which establishes a fixed (critical) angle of projection in a point sample (1).

cf. angle gauge, basal area factor, point sample, point sampling

prism plot:
see **point sample**

private land: [terrain privé]
Land that is not the property of the Crown (1).

cf. Crown land

processing: [traitement]
(1) The operation necessary to produce negatives, diapositives, or prints from exposed film, plates, or papers.

(2) The manipulation of data by means of a computer or other device (25).

productive forest land:
see **forest land**

productivity: [productivité]
The rate of production of wood of given specifications, by volume or weight, for a given area (1).

cf. site capability

productivity class:
see **site capability class**

projector:
see **reflecting projector**

property survey:
see **cadastral survey**

protection forest: [forêt de protection]
All forest land managed primarily to exert beneficial influence on soil, water, landscape, or for any other purpose when production of merchantable timber, if any, is incidental (21).

provincial land:
see **crown land**

public land:
see **crown land**

pulpwood: [bois à pâte]
Trees that will yield logs suitable in size and quality for the production of pulp: the logs of such trees (1).

cf. firewood, fuelwood

- Q -

quadrat: [quadrat]
A small plot or sample area, frequently 1 m^2 or 4 m^2 in size used in regeneration studies (1).

quadratic mean diameter:
see **diameter:** quadratic mean

quotient:
see **form quotient**

- R -

radar altimeter:
see **altimeter:** radar

radial (Photogrammetry): [radial]
A line or direction from the radial center to any point on a photograph. The radial center is assumed to be the principal point (centre of the photograph), unless otherwise designated (25).

radial line plotting: [restitution par triangulation radiale]
A method of triangulation, analytic or graphic, used to locate points on vertical or near vertical aerial photos in their correct position relative to each other (1).

range land: [pâturage forestier]
Land not under cultivation which produces forage suitable for grazing of livestock (26).

Includes forest land producing forage.

raster (GIS): [trame]

(1) The scanned (illuminated) area of a cathode ray tube (30).

(2) Data that comprise a set of pixels arranged on rectangular grid centres (24).

reconnaissance inventory:

see **inventory:** reconnaissance

record (Computer Science): [registre]

A collection of related data treated as a logical unit. In this format, one block may contain one or more records on the magnetic tape (27).

rectification (Remote Sensing): [redressement]

The transformation of an aerial photograph to an horizontal plane to remove displacement caused by tilt, and conversion to a desired scale (25).

cf. orthophotograph, rubber sheeting

reflectance: [réflectance]

A measure of the ability of a surface to reflect energy; specifically the ratio of the reflected energy to the incident energy. Reflectance is affected not only by the nature of the surface itself, but also by the angle of incidence and the viewing angle (29).

reflecting projector: [projecteur vertical]

An optical image transfer device which is used to project the image of photographs, images, or on occasion, maps onto a copying table (25).

regeneration: [régénération]

The renewal of a forest crop by natural or artificial means. Also the new crop so obtained (10).

The new crop is generally less than 1.3 metres in height.

regeneration class: [classe de régénération] The area, and the young trees in the area, being managed during the regeneration interval in the shelterwood silvicultural system. In this interval old and young trees occupy the same area, young being protected by the old (21).

regeneration initiation: [établissement de la régénération] The year in which the new crop is deemed to be started at an acceptable stocking level whether by planting, natural or artificial seeding, or by vegetative means (21).

regeneration interval: [durée de régénération] The period between the first cut and the final cut on a particular area under one of the shelterwood systems (21).

regeneration period: [période de régénération] The period of time from the removal of the forest cover to re-establishment (1).

regional inventory:
see **inventory:** regional

regression (Statistics): [régression]
A method of analysis employing least squares to examine data, and to draw meaningful conclusions about dependency relationships (i.e., extent, direction, strength) that may exist with single or multiple independents (9, 18).

reinventory: [inventaire de rappel]
Remeasurement of an entire survey area to replace an inventory in its entirety (19).

relascope: [rélascope]
An angle gauge, used in point sampling, in which bands of different widths are viewed through an eyepiece, resulting in different angles of projection (1).

The relascope has other scales and may be used for other purposes, e.g., the estimation of tree heights.

cf. prism, point sampling, telerelascope

relief displacement:
see **displacement:** relief

remote sensing: [télédétection]
(1) In the broadest sense, the measurement or acquisition of information of some property of an object or phenomenon, by a recording device that is not in physical or intimate contact with the object or phenomenon under study; e.g., the utilization at a distance (as from aircraft, spacecraft, or ship) of any device and its attendant display for gathering information pertinent to the environment, such as measurements of force fields, electromagnetic radiation, or acoustic energy. The technique employs such devices as the camera, lasers, and radio frequency receivers, radar systems, sonar, seismographs, gravimeters, magnetometers, and scintillation counters.

(2) The practice of data collection in the wavelengths from ultraviolet to radio regions (25).

representative fraction:
see **scale**

reproduction:
see **regeneration**

reproductive period:
see **regeneration period**

reserved (forest land): [terrain forestier réservé]
Forest land that, by law or policy, is not available for the harvesting of forest crops (4).

cf. nonreserved (forest land)

resolution: [résolution]
A measure of the ability of a remote sensing system to reproduce an isolated object or to separate closely spaced objects or lines (1).

Usually expressed in number of lines per mm.

resource inventory:
see **inventory:** regional

retained (forest land): [terrain forestier retenue]
Crown-owned forest land under the direct, immediate control of the crown (1).

cf. assigned land

roll: [roulis]
(1) Air Navigation: A rotation of an aircraft about its longitudinal axis so as to cause a wing-up or wing-down attitude.

(2) Photogrammetry: A rotation of a camera or a photograph-coordinate system about either the photograph x axis or the exterior X axis. May be designated by the symbol omega (ω) (25).

rot: [pourriture]
The decomposition of wood by fungi (1).

Unlike stain, causes a softening and loss of wood. Types of rot: brown, butt, dry, heart, marginal, mottled, pocket, red, ring, root, sap, spongy, stringy, top, trunk, water-conducting, wet, white. Classified as a defect.

rotation: [révolution]
The period of years required to establish and grow even-aged timber crops to a specified condition of maturity (1).

roundwood: [bois rond]
Sections of tree stems, with or without bark (1).

Includes logs, bolts, posts, pilings, and other products still "in the round."

rubber sheeting (GIS): [correction géométrique par membrane élastique]
The fitting of slightly distorted data such as on an air photo to its counterpart on a map. One of several computer-based transformations can produce a mathematical analog of fitting commonly done by projectors (2).

cf. rectification, orthophotograph

- S -

salvage cuttings: [coupes de récupération]
Cuttings made primarily to remove trees that have been or are in imminent danger of being killed or damaged by injurious agencies other than competition between trees (13).

sample:
v: [échantillonner] To select sample units and measure or record information contained therein to obtain estimates of population characteristics (1).

n: [échantillon] A subset of one or more of the sample units into which the population is divided, selected to represent the population and examined to obtain estimates of population characteristics (1).

random: [échantillon aléatoire] A sample whereby each possible sample has the same probability of being selected and measured (28).

stratified: [échantillon stratifié] A sample selected for a population that has been stratified, i.e., divided into parts. The process of stratification is usually undertaken by dividing the survey area into subareas on a map or through interpretation and classification of points from remote sensing imagery (19).

systematic: [échantillon systématique] A sample that is obtained by a systematic method as opposed to random choice, for example, making observations at equally spaced intervals on the ground (19).

sample frame: [limites de l'échantillon]
The total population of possible sample units or plots within a survey area. A frame may be a listing of all pastures within a range allotment, all stands within a forest, all pixels within a Landsat scene, all possible 0.1-hectare plots within a big-game winter range, etc. (19).

sample plot: [place-échantillon]
A sample unit or element of known area and shape (1).

cf. sample unit

sample size: [taille de l'échantillon]
The number of sample units established in a given area (19).

sample strip:
see **cruise strip**

sample unit: [unité d'échantillonnage]
One of the specified parts into which the population has been divided for sampling purposes (1).

Each sample unit commonly consists of only one sample element which may be a sample plot, a point sample, or a tree. If the sample unit contains more than one sample element, it is termed a cluster. In probability sampling, the sample units are selected independently of each other while the sample elements within a sample unit (cluster) are not.

cf. sample plot, cluster

permanent: [unité d'échantillonnage permanente] Designed for remeasurement.

temporary: [unité d'échantillonnage temporaire] Designed for measurement on one occasion only.

sampling: [échantillonnage]
The selection of sample units from a population and the measurement and/or recording of information contained therein, to obtain estimates of population characteristics (1).

multiphase: [échantillonnage à phase multiple] A selection of sample units whereby a large sample to estimate a population characteristic for some auxiliary variable is taken, and a small sample is selected to establish the relationship between the auxiliary variable, and the primary variable of interest (30). For example, double sampling or two-phase sampling.

multistage: [échantillonnage étagé] A method of sampling within sample units or subsampling, to estimate characteristics rather than measuring the entire sample unit. This presupposes that the sample units are clusters or aggregations of some more basic elements which are of interest (30). For example, two-stage sampling.

nonprobability: [échantillonnage non probabiliste] Where sample units are not drawn with a known probability (1).

probability: [échantillonnage probabiliste] Where sample units are drawn with a known probability and thus amenable to statistical inference and analysis (1).

sampling design: [définition de l'échantillonnage]
The method to determine which sample units will be measured or observed such as a systematic sample or stratified sample (19).

sampling error:
see **precision**

sampling intensity: [intensité de l'échantillonnage]
The number of samples taken per unit area (19).

sampling unit:
see **sample unit**

sanitation measures: [mesures sanitaires]
The removal of (i) dead, damaged, or susceptible trees or their parts, or (ii) other vegetation that serves as alternate host for crop tree pathogens, essentially to prevent or control the spread of pests or pathogens (13).

sapling: [gaule]
A young tree having a diameter at breast height greater than 1 cm but less than the smallest merchantable diameter (1).

satisfactorily stocked:
see **stocking**; satisfactorily stocked

sawtimber: [bois de sciage]
Trees that will yield logs suitable in size and quality for the production of lumber (26).

scale (Remote Sensing, Mapping): [échelle]
The relationship between a distance on a map, photo, or image and the corresponding distance on the ground (1).

Generally given as a pure ratio or representative fraction, e.g. 1:50 000 but may also be a statement relating map to ground units, e.g., 1 cm: 500 m.

Certain terms are used loosely to describe scale ranges. The following definitions are used generally but are not exact:

very large scale	(VLS)	$\leq$1:500
large scale	(LS)	1:500 - 1:10 000
medium scale	(MS)	1:10 000 - 1:50 000
small scale	(SS)	1:50 000 - 1:100 000
ultra small scale	(USS)	$\geq$1:100 000

(Mensuration):
n: [mesurage] The measured or estimated quantity, expressed as the volume, area, length, mass or number of products, obtained from trees and measured or estimated after they are felled (5).

v: [réceptionner une coupe] To measure or estimate the quantity, expressed as the volume, area, length, mass or number of products, obtained from trees and measured or estimated after they are felled (5).

scale bar: [échelle graphique]
A scaled line in the legend of a map, graduated in equivalent ground distances (1).

scan line (Remote Sensing): [ligne de scannage]
The strip on the ground that is swept by the instantaneous field of view of a detector in a scanner system (7).

cf. instantaneous field of view

scarification: [scarification]
A method of seedbed preparation which consists of removing the forest floor or mixing it with the mineral soil by mechanical action to eliminate or reduce the dead organic material (4).

scrub: [broussailles]
Inferior growth consisting chiefly of small or stunted trees and shrubs (10).

seed tree cutting:
see **partial cutting:** seed tree

seeding: [ensemencement]
broadcast: [ensemencement à la volée] The sowing of seeds more or less evenly over a whole area on which a forest stand is to be raised (13).

direct: [ensemencement direct] The artificial systematic sowing of seeds in an area by manual or mechanical means (13).

drill: [ensemencement de labours] The sowing of seeds in shallow furrows across a whole area on which a forest stand is to be raised (13).

spot: [ensemencement en espaces dispersés] The sowing of seeds within small, cultivated, or otherwise prepared patches, many of which are distributed over a whole area on which a forest stand is to be raised (13).

seedling: [semis]
A young tree having a diameter at breast height equal to or less than 1 cm (1).

segment (Computer Science, GIS): [partition]
In the context of records, a segment is a subdivision of a record. A segment contains one or more fields. For polygons, a segment is a line defined by two points (27).

selection cutting:
see **partial cutting:** selection

sensor: [capteur]
Any device that gathers energy (e.g., electromagnetic energy), and converts it into a signal and presents it in a form suitable for obtaining information about the environment (17).

active: [capteur actif] Records the reflection of the electromagnetic energy it emits, e.g., Radar (1).

passive: [capteur passif] Records emitted and/or reflected electromagnetic energy from sources other than itself (1).

shelterwood cutting:
see **partial cutting:** shelterwood

SHORAN: [SHORAN]
An electronic measuring system for indicating distance from an airborne station to each of two ground stations. The term is an acronym for the phrase "SHOrt RAnge Navigation" (25).

sidelap:
see **overlap:** lateral

side-looking airborne radar (SLAR): [radar aéroporté à vision latérale]
A radar system using a stabilized antenna oriented at right angles to the aircraft's flight path (25).

single storeyed:
see **storey**

single-tree selection cutting:
see **partial cutting:** single-tree selection cutting

site: [site]
The complex of physical and biological factors for an area which determines what forest or other vegetation it may carry (10).

Sites are classified either qualitatively by the climate, soil and vegetation or quantitatively by relative productive capacity.

site capability: [potentiel du site]
The mean annual increment in mercantable volume which can be expected for a forest area, assuming it is fully stocked by one or more species best adapted to the site, at or near rotation age (1).

Expressed in cubic metres per hectare.

cf. productivity

site capability class: [classe de potentiel du site]
Any interval into which the site capability range is divided for purposes of classification and use (1).

cf. site class

site class: [classe de qualité de station]
Any interval into which the site index range is divided for purposes of classification and use (1).

cf. site capability class

site index: [indice de qualité de station]
An expression of forest site quality based on the height, at a specified age, of dominant and codominant trees in a stand (1).

May be grouped into site classes. Expressed in metres. Usually refers to a particular species.

cf. site

site index class:
see **site class**

site preparation: [préparation de terrain]
Disturbance of an area's topsoil and ground vegetation to create conditions suitable for regeneration (13).

site productivity:
see **site capability**

site quality: [qualité de station]
A measure of the relative productive capacity of a site for one or more species (1).

cf. site index, site capability

sketch mapping: [esquisse cartographique]
Flying over preplanned flight lines with an aerial observer transferring visually-observed information (e.g., stocked/nonstocked areas, damaged areas) onto maps (15).

slash: [débris de coupe]
The residue left on the ground after felling, tending and/or accumulating there as a result of storm, fire, girdling or poisoning, including unused logs, uprooted stumps, broken and uprooted stems, etc. (26).

cf. forest biomass, brush

smoothing (GIS): [lissage]
The elimination of jagged lines in a polygon by averaging or curve-fitting techniques (2).

snag: [chicot]
A standing dead tree or portion thereof, from which most of the branches have fallen (26).

snap closure:
see **node snap**

software: [logiciel]
A set of computer programs, procedures, and possibly associated documentation concerned with the operation of a data processing system (25).

softwood(s): [résineux]

(1) Cone-bearing trees with needle or scale-like leaves belonging to the botanical group Gymnospermae. Also, stands of such trees and the wood produced by them (1).

(2) A forest type in which 76-100% of the canopy is softwood (1).

spacing:

see **thinning:** spacing

spatial database (GIS): [base de données spatiales]

A collection of interrelated geographically referenced data stored without unnecessary redundancy to serve multiple applications as part of a geographic information system (11).

cf. geographic information system, geographically referenced

spectral band (Remote Sensing): [bande spectrale]

Also called wavelength band, it is a distinct, well-defined range of wavelengths in the elecetromagnetic spectrum that detectors in a remote sensing system are sensitive to (29). For example, band 2 of the Landsat MSS is sensitive from 500-600 nanometers.

spectral reflectance curve (Remote Sensing): [courbe de réflectance spectrale]

Is the particular spectral characteristic at specified wavelength intervals of objects such as vegetation and water. Often called spectral signature (7, 29).

spiegel relascope:

see **relascope**

spot seeding:

see **seeding:** spot

stagnant: [stagnant]

Of stands whose growth and development have all but ceased due to poor site and/or excessive stocking (1).

stain: [tache colorée]

A discolouration of wood not affecting its soundness (1).

Caused primarily by fungi and chemicals. Names commonly given to different types of stain are: blue, chemical, brown, fungous brown, interior sap, iron-tannate, log, mineral, sap, sticker, water, weather, wound.

stand: [peuplement]
A community of trees possessing sufficient uniformity in composition, age, arrangement or condition to be distinguishable from the forest or other growth on adjoining area, thus forming a silvicultural or management entity (1).

standard deviation (Statistics): [écart-type]
Square root of variance and an important measure of the amount of variation (also spread or dispersion) in a sample of a population, in the same units as the sample (28).

cf. variance

standard error of estimate (Statistics): [erreur-type d'une estimation]
Also called root mean square error, it is an expression for the accuracy of a single observation (7), and is frequently associated with regression analysis.

cf. mean square error

standard error of the mean (Statistics): [écart-type de la moyenne]
It is a measure of variation (standard deviation) among a sample mean and used in the computation of confidence limits (28).

standardization: [standardisation]
The act of bringing items into conformity with quantitative or qualitative criteria commonly used and accepted as authoritative (19).

standard volume table:
see **volume table:** tree, standard

stand density: [densité de peuplement]
(1) A quantitative measure of tree cover on an area in terms of biomass, crown closure, number of trees, basal area, volume or weight. In this context, "tree cover" includes seedlings and saplings, hence the concept carries no connotation of a particular age. Expressed on a per hectare basis (1).

(2) The percentage of the horizontal surface of forest land that is covered by the projection of crowns of merchantable tree species of any age. This can be determined from aerial photographs or by plots measured on the ground. The percentage values may be grouped into classes according to regional or local usage (1).

cf. stocking

stand density index: [indice de densité de peuplement]
Any index for evaluating stand density such as those of Lexen, Mulloy, Reinecke (1).

stand growth: [croissance de peuplement]
When expressed in terms of volume, stand growth terms can be defined by the following equations (16).

$G_g = V_2 + C - I - V_1$
$G_{g+i} = V_2 + M + C - V_1$
$G_n = V_2 + C - I - V_1$
$G_{n+i} = V_2 + C - V_1$
$G_d = V_2 - V_1$

where
G_g = gross growth of initial volume
G_{g+i} = gross growth including ingrowth
G_n = net growth of initial volume
G_{n+i} = net growth including ingrowth
G_d = net increase
V_1 = stand volume at beginning of growth period
V_2 = stand volume at end of growth period
M = mortality volume (see mortality)
C = cut volume (see cut)
I = ingrowth (see ingrowth)

accretion: [accélération de croissance] Gross growth of initial volume when calculated using M and C to represent the volume of M and C trees at the time of their death and cutting (16).

cut: [coupe] The volume or number of trees periodically felled or salvaged, whether removed from the forest or not (16).

ingrowth: [recrue] The volume or number of trees that have grown into a measured category during a specified period (1). For example, saplings which have grown into a merchantable diameter class.

mortality: [mortalité] The volume or number of trees periodically dying from natural causes (16).

survivor growth: [accroissement des survivants] Gross growth of initial volume when calculated using M and C to represent the volume of M and C trees at the time of the first measurement - i.e., the initial volume of M and C trees (16).

stand height:
see **height:** stand

stand table: [table de peuplement]

A summary table showing the number of trees per unit area by species and diameter classes, for a stand or type (1).

The data may also be presented in the form of a frequency distribution of diameter classes.

stand type:

see **forest type**

statistically valid design: [conception statistiquement valable]

A design in which sample units are chosen that are representative of the population, utilize objective observations, and permit the calculation of sampling error (19).

stem: [tige]

The principal axis of a plant from which buds, shoots and branches are developed (10).

In trees, it may extend to the top of the tree as in some conifers, or it may be lost in the ramification of the crown, as in most deciduous trees.

cf. bole

stem diameter class:

see **diameter class**

stereo: [stéréo]

(1) Contracted or short form of stereoscopic.

(2) The orientation of photographs when properly positioned for stereoscopic viewing. Photographs so oriented are said to be "in stereo" (25).

cf. **coverage:** stereo(scopic)

stereocomparator:

see **stereometer**

stereogram: [stéréogramme]

A set of photos correctly oriented and mounted for stereoscopic viewing (22).

stereometer: [stéréomètre]

A stereoscope with special attachments for measuring parallax (1).

stereoscope: [stéréoscope]
A binocular instrument used to view overlapping aerial photos as a three dimensional model (1).

stereoscopic:
see **stereo**

stereoscopic coverage:
see **coverage:** stereo(scopic)

stereoscopic plotter: [stéréorestituteur]
An optical image transfer device used to transfer stereoscopic images to a base map by radial line plotting, by superimposition of photo and map images, and by floating marks attached to drafting devices (1).

cf. plotter

stereoscopy: [stéréoscopie]
The science and art that deals with the use of binocular vision for observation of a pair of overlapping photographs or other perspective views, and with the methods by which such viewing is produced (25).

cf. coverage: stereo(scopic)

stocked forest land: [terrain forestier boisé]
Land supporting tree growth (1).

In this context, tree growth includes seedlings and saplings.

stocking: [densité relative]
A qualitative expression of the adequacy of tree cover on an area, in terms of crown closure, number of trees, basal area or volume, in relation to a preestablished norm.

In this context, "tree cover" includes seedlings and saplings, hence the concept carries no connotation of a particular age.

Stocking may be described in regionally or locally developed classes, or as a percentage of regional or local normal standards which vary according to site specific conditions (1).

cf. stand density

fully stocked: [densité relative adequate] Productive forest land stocked with trees of merchantable species. These trees by number and distribution or by average dbh, basal area, or volume are such that at rotation age they will produce a timber stand that occupies the potentially productive ground. They will provide a merchantable

timber yield according to the site potential of the land. The stocking, number of trees and distribution required to achieve this will be determined from regional or local yield tables or by some other appropriate method (1).

nonstocked: [densité relative nulle] Productive forest land that lacks trees completely or that is so deficient in trees, either young or old, that at the end of one rotation, the residual stand of merchantable tree species, if any, will be insufficient to allow utilization in an economic operation (1).

normally stocked: [densité relative normale] Productive forest land covered with trees of merchantable species of any age. These trees, by number and distribution, or by average dbh, basal area or volume, are such that at rotation age they will produce a timber stand of the maximum merchantable timber yield. This yield must satisfy the site potential of the land as reported by the best available regional or local yield tables. For stands of less than rotation age, a range of stocking classes both above and below normal may be predicted to approach and produce a normal stocking at rotation age and may therefore be included. This is because greater or lesser mortality rates will occur in over- or understocked stands as compared to those in a normal stand (1).

NSR (not sufficiently or satisfactorily restocked or regenerated): [régénération incomplet] Inadequate stocking. Productive forest land that has been denuded and has failed partially or completely to regenerate naturally or to be artificially regenerated. The regeneration must contain a minimum number of well-established, healthy trees free-to-grow, sufficient to produce a merchantable timber stand at rotation age (1).

overstocked: [densité relative excessive] Productive forest land stocked with more trees of merchantable species than normal or full stocking would require. Growth is in some respect retarded and the full number of trees will not reach merchantable size by rotation age according to the regional or local yield or stock tables for the particular site and species (1).

partially stocked: [densité relative partielle] Productive forest land stocked with trees of merchantable species insufficient to utilize the complete capacity of the potential of the land for growth such that growth of the trees will fail to utilize the whole growing site by rotation age without additional stocking. Explicit definition in stems per hectare, crown closure, relative basal area, etc. is locally or regionally defined and is site-specific (1).

satisfactorily stocked: [densité relative satisfaisante] Productive forest land that has been regenerated naturally or artificially to at least a minimum number of well-established, healthy trees of merchantable species that are free-to-grow and sufficient to produce a merchantable timber stand at rotation age (1).

unsurveyed stocking: [densité relative indéterminée] Land classified as productive forest land which has not been surveyed on the ground or interpreted from aerial photographs as to stocking or stand density that may or may not bear merchantable forest tree species (1).

stock table: [table de stock]
A summary table showing the volume of trees per unit area by species and diameter classes, for a stand or type (1).

storey: [étage]
A horizontal stratum or layer in a plant community; in forests, appearing as one or more canopies (12).

A forest having more than two storeys is called Multistoreyed.

A forest having one storey (the main storey) is called Single Storeyed.

A forest having two storeys (the Overstorey and the Understorey) is called Two Storeyed.

strata:
see **stratum**

stratum: [strate forestière]
A subdivision of a forest area to be inventoried (1).

The division of a population into strata (stratification) is usually done to obtain separate estimates for each stratum.
pl. strata

strip cut: [coupe par bande]
A clearcut where the cut areas are in strips or blocks (21).

strip plot:
see **cruise strip**

stump height
see **height:** stump

stump age:
see **age:** stump

subcompartment: [sous-parcelle]
A temporary subdivision of a compartment differentiated for separate treatment (21).

subpopulation:
see **stratum**

supervised classification:
see **classification:** supervised

survey: [relevé]
The act or operation of making measurements for determining the relative positions of points on, above, or beneath the earth's surface; also, the results of such operations; also, an organization for making surveys (24).

aerial: [relevé aérien] A survey using aerial photographs as part of the surveying operation; also, the taking of aerial photographs for surveying purposes.

ground: [relevé au sol] A survey made by ground methods, as distinguished from an aerial survey. A ground survey may or may not include the use of photographs.

photogrammetric: [relevé photogrammétrique] A method of surveying that uses either ground photographs or aerial photographs.

survey area: [superficie relevée]
The entire land base for which information is sought, i.e., allotment, forests, Landsat scene, or winter range. The area for which information will be summarized and analyzed and upon which predictions and decisions will be made. It is the aggregate of land area from which sampling units are chosen (also called inventory or survey unit) (19).

survivor growth:
see **stand growth:** survivor growth

swamp:
see **muskeg**

swing: [oscillation]
A rotation of a photograph in its own plane around the photograph perpendicular from some reference direction (such as the direction of flight). May be designated by the symbol kappa (κ). Also, the angle at the principal point of a photograph which is measured clockwise from the positive y axis to the principal line at the nadir point (25).

cf. nadir point, yaw

synthetic aperture radar (SAR): [radar à antenne synthétique (RAS)]
A side-looking airborne or space borne imaging system that uses the doppler principle to sharpen the effective beam width of the antenna. The result is improved resolution in the azimuth direction (direction of vehicle travel) and constant resolution in the range direction (direction of radar to target). The radar backscatter is recorded on tape or on film and must be digitally or optically processed to form radar images (23).

- T -

tally:
n: [pointage] A record of the number of units counted or measured, by one or more classes (1).

v: [décompter] To record the number of units counted or measured by one or more classes (1).

tape: [galon à mesurer]
An instrument for making linear measurements (1).

cf. diameter tape

taper: [défilement]
The decrease in thickness, generally in terms of diameter, of a tree stem or log from the base upwards (26).

target: [cible]
The distinctive marking or instrumentation of a ground point to aid in its identification on a photograph. In photogrammetry, target designates a material marking so arranged and placed on the ground as to form a distinctive pattern over a geodetic or other control-point marker, on a property corner or line, or at the position of an identifying point above an underground facility or feature. A target is also the image pattern on aerial photographs of the actual mark placed on the ground prior to photography (25).

telerelascope: [télérelascope]
A relascope coupled with enlarging optics, designed for use as a dendrometer (1).

cf. relascope, dendrometer

template (Photogrammetry): [gabarit]
A graphical representation of a photograph; a template records the directions, or radials, taken from the photograph (25).

hand: [papier calque] A template made by tracing the radials from a photograph onto a transparent medium, as on sheet plastic; hand templates are laid out and adjusted by hand to form the radial triangulation.

slotted: [plaque à fente] A template on which the radials are represented as slots cut in a sheet of cardboard, metal, or other material.

temporary sample unit:
see **sample unit**

thematic mapper (TM): [cartographe thématique]
A scanner having more spectral, radiometric and geometric sensitivity than its predecessors, part of the payload of Landsat satellites since Landsat 4 (1).

cf. multispectral scanner

thinning: [éclaircie]
A cutting made in an immature crop or stand in order primarily to accelerate diameter increment but also, by suitable selection, to improve the average form of the trees that remain (12).

commercial: [éclaircie commercialisable] Any type of thinning producing merchantable material at least to the value of the direct costs of harvesting (12).

precommercial: [éclaircie précommerciale] Any type of thinning which does not produce merchantable material of value at least equal to the direct costs of the operation (12).

row: [éclaircie en rangée] A thinning in which the trees are cut out in lines or narrow strips at fixed intervals throughout a stand (4).

spacing: [éclaircie par espacement] A thinning in which trees at fixed intervals of distance are chosen for retention and all others are cut (4).

tilt (Remote Sensing): [inclinaison]
In vertical aerial photography, the deviation of the camera axis from vertical (22).

Deviation of the camera axis along the flight line causes Y-tilt, while deviation of the axis perpendicular to the flight line causes X-tilt or Tip.

timber inventory:
see **inventory:** regional

tip:
see **tilt**

TM:
see **thematic mapper**

top diameter:
see **diameter**: top

topographic map: [carte topographique]
A map showing correct horizontal and vertical positions of features represented (3).

cf. planimetric map

total age:
see **age:** total

total volume:
see **volume:** gross total

transect: [profil]
A cross section of an area used as a sample unit for recording, mapping or studying the vegetation and its use (26).

May be a series of plots, a belt or strip, or merely a line, depending on the purpose.

cf. cruise line

transformation: [transformation]
The process of projecting a photograph (mathematically, graphically, or photographically) from its plane onto another plane by translation, rotation, and/or scale change (25).

tree: [arbre]
A woody, perennial plant generally with a single, well-defined stem and a more or less definitely formed crown (1).

tree calipers:
see **calipers**

tree height:
see **height:** tree

treed muskeg:
see **muskeg**

trunk:
see **bole**

tundra: [toundra]
The zone of low arctic vegetation north of the tree line where the ground is perpetually frozen (1).

cf. wildland

turnkey: [clef en main]
A system that should operate from the moment it is switched on. No further software development or modification should be involved (2).

two storeyed:
see **storey**

type map: [carte typologique]
A map showing the distribution of various types such as soil, vegetation, or site throughout a forest area (12).

typing:
see **photo typing**

- U -

unallocated land:
see **retained land**

uncontrolled mosaic:
see **mosaic**

understorey:
see **storey**

uneven-aged: [inéquienne]
Of a forest, stand, or forest type in which intermingling trees differ markedly in age (12).

The differences in age permitted in an uneven-aged stand are usually greater than 10 to 20 years.

cf. even-aged

unmerchantable: [non marchand]
Of a tree or stand that has not attained sufficient size, quality and/or volume to make it suitable for harvesting (1).

unproductive forest land:
see **forest land**

unstocked:
see **stocking:** nonstocked

unsupervised classification:
see **classification:** unsupervised

unsurveyed stocking:
see **stocking:** unsurveyed stocking

update: [mettre à jour]
To address change within an inventory cycle. The procedure of modifying a portion of an existing data set of a survey area, including maps, through mechanical or modeling procedures to the present. For example, as forested lands are cut over, the volume is subtracted from the data set; as the forest grows, the volumes are expanded through a growth processor or model (19).

- V -

variable area plot:
see **point sample**

variable density yield table:
see **yield table:** variable density

variance (Statistics): [variance]
A measure of the dispersion of individual unit values about their mean (7). The square root of variance is the standard deviation.

cf. standard deviation

vector (GIS): [vecteur]
A file of points such that the vectors can be drawn from point to point (in principle) to reconstruct line segments on a display or plotter (24).

vertical exaggeration (Photogrammetry): [exagération verticale]
The increase or decrease in the vertical dimension of the perceived stereomodel when compared to its horizontal dimension ratio of the actual object (25).

cf. base-height ratio

vertical imagery:
see **aerial photo**

veteran: [vétéran]
An old tree remaining from a former stand (26).

visual acuity:
see **acuity:** visual

volume: [volume]
The amount of wood in a tree, stand or other specified area, according to some unit of measurement or some standard of use (26).

The unit of measurement may be cubic metres or cubic metres per hectare. The standard of use may be pulpwood or sawtimber. Usually expressed inside bark and according to different specifications:

gross merchantable: [volume marchand brut] Volume of the main stem, excluding stump and top but including defective and decayed wood, of trees or stands (1).

gross total: [volume brut total] Volume of the main stem, including stump and top as well as defective and decayed wood, of trees or stands (1).

net merchantable: [volume marchand net] Volume of the main stem, excluding stump and top as well as defective and decayed wood, of trees or stands (1).

volume equation: [formule de cubage]
A statistically derived expression of the relationship between volume and other tree or stand variables (1).

Used to estimate volume from more easily measured variables such as diameter breast height, tree or stand height, and crown closure.

cf. volume table

volume formula:
see **volume equation**

volume table: [tarif de cubage]
A table showing the estimated average tree or stand volume corresponding to selected values of other, more easily measured, tree or stand variables (1).

Used in the same way as the Volume Equation, from which it generally is constructed. Occasionally constructed from a graphically derived relationship between volume and other tree or stand variables. Constructed for individual species or species groups.

stand: [table de stock] Volumes given in m^3/ha.

cf. yield table

(a) **aerial:** [tarif photogrammétrique (peuplement)] The independent variables must be measurable on aerial photos; they often include stand height and crown closure.

tree: [tarif du cubage] Volumes given in cubic metres.

(a) **aerial:** [tarif photogrammétrique (arbre)] The independent variables must be measurable on aerial photos; they often include tree height and crown area.

(b) **form class:** [tarif du cubage par classe de forme] Standard Tree Volume Equations constructed for different Form Classes.

(c) **local:** [tarif du cubage local] Diameter breast height is the only independent variable; data collected from a small, local area; sometimes constructed from a Standard Tree Volume Equation by applying to it a local height/diameter relationship.

(d) **standard:** [tarif du cubage général] Independent variables are diameter breast height and tree height; data collected from a large area (a province or region).

- W -

wedge prism:
see **prism**

weeding: (Forest Operations): [désherbage]
Generally, a cultural operation eliminating or suppressing undesirable vegetation, mainly herbaceous, during the seedling stage of a forest crop and therefore before the first cleaning, so as to reduce competition with the seedling stand (13).

(GIS): [épuration] Automated reduction in the number of points comprising a line (1).

weed species:
see **noncommercial species**

weighted mean: [moyenne pondérée]
A value obtained by multiplying each of a series of values by its assigned weight and dividing the sum of those products by the sum of the weights (25).

wildland: [terre vierge]
Uncultivated land other than fallow, or land relatively uninfluenced by human activity (12).

Includes tundra, barrens, alpines.

windfall: [chablis]
A tree uprooted or broken off by wind, and areas containing such trees (26).

windowing (GIS): [découpage]
To block off a particular portion of a map and show details within it alone, often at an enlarged scale (2).

withdrawals: [retraits]
Areas removed from the forest land base (13).

wolf tree: [arbre loup]
A vigorous tree, usually of bad form, occupying more space than its future value warrants and threatening potentially better neighbours. Usually broad crowned, dominant (10).

- X -

x-motion: [mouvement en x]
In a stereoplotting instrument, that linear adjustment approximately parallel to a line connecting two projector stations; the path of this adjustment is, in effect, coincident with the flight line between the two relevant exposure stations (25).

x-parallax:
see **parallax:** absolute

xylometer: [xylomètre]
An apparatus for determining the volumes of pieces of wood by measuring the amount of liquid (generally water) they displace when immersed (12).

- Y -

yaw: [oscillation]
(1) Air Navigation: The rotation of an aircraft about its vertical axis so as to cause the aircraft's longitudinal axis to deviate from the flight line. Sometimes called crab.

(2) Photogrammetry: The rotation of a camera or a photograph coordinate system about either the photograph z axis or the exterior Z axis. In some photogrammetric instruments and in analytical applications, the symbol kappa (κ) may be used (25).

cf. crab

yield: [rendement]
Growth or increment accumulated by trees at specified ages expressed by volume or weight to defined merchantability standards (1).

yield table: [table de rendement]
A summary table showing, for stands (usually even-aged) of one or more species on different site qualities, characteristics at different ages of the stand (1).

The stand characteristics usually include average diameter and height and total basal area, number of trees, and volume per hectare.

empirical: [table de rendement empirique] Prepared for actual average stand conditions.

normal: [table de rendement normal] Prepared for normally stocked stands.

variable density: [table de rendement à densité variable] Prepared for stands of varying density expressed as number of trees per hectare.

y-motion: [mouvement en y]
In a stereoplotting instrument, that linear adjustment approximately perpendicular to a line connecting two projectors (25).

Part III

Appendices

Appendix 1

Measurement Units and Class

Table 1. Units of measure used in metric forest inventory

Type	Unit	Symbol	Examples of Use
Length	centimetre	cm	Tree diameter
	metre	m	Tree height Log length Cruise line and plot dimensions
	kilometre	km	Ground distances
Area	square centimetre	cm^2	Areas on maps or photos
	square metre	m^2	Plot area Basal area
	hectare	ha	Stand area Forest management unit area
Volume	cubic metre	m^3	Forest products
	stacked cubic metre	m^3(stacked)	Stacked wood (includes volume of bark and airspaces)
Mass	tonne	t	Forest products
Angle	degree	°	Slope Direction
	percent[a]	%	Slope

[a] Although not a unit of measure, percent is included here because of its common usage in the description of slopes.

Table 2. Plot sizes

A. Fixed-area plots

Plot size (ha)	Plot size (m^2)	Side of square plot (m)	Radius of circular plot (m)
0.0004	4[a]	2.00	1.13
0.0016	16[a]	4.00	2.26
0.01	100	10.00	5.64
0.02	200	14.14	7.98
0.025	250	15.81	8.92
0.03	300	17.32	9.77
0.04	400	20.00	11.28
0.05	500	22.36	12.62
0.06	600	24.49	13.82
0.08	800	28.28	15.96
0.1	1 000	31.62	17.84
0.2	2 000	44.72	25.23
0.25	2 500	50.00	28.21

[a]Regeneration plots

B. Point samples

Basal area factor (a)	Plot radius factor (b)	Angle size (c)	Per hectare conversion factor constant (d)
1	0.5000	1.14	12 734
2	0.3535	1.62	25 470
3	0.2886	1.98	38 209
4	0.2499	2.29	50 950
5	0.2236	2.56	63 694
10	0.1580	3.62	127 452
15	0.1290	4.43	191 273
20	0.1117	5.12	255 158

(a) Gives the basal area contributed by each tree in the point sample, in square metres per hectare.
(b) When multiplied by the dbh of a tree (in centimetres), gives the maximum distance (in metres) at which the tree would be counted.
(c) In degrees.
(d) When divided by the squared dbh of a tree (in square centimetres), gives the number of trees per hectare represented by each sample tree.

Table 3. Stand measurements

Characteristic	Measurement or recording unit	Expressed to nearest[a]	Examples
Diameter	cm	0.1 cm	
Height	m	1 m	Class 10: $9.5 \leq h \leq 10.5$[b]
		2 m	Class 10: $9 \leq h \leq 11$
		5 m	Class 10: $7.5 \leq h \leq 12.5$
Crown closure	%	5%[c]	
Stem frequency	trees/ha	1 tree[c]	
Basal area	m^2ha	1 m^2/ha[c]	
Volume	m^2/ha	1 m^2/ha[c]	

[a] These recommendations are suitable for many inventories. However, the need for precision differs, depending on the type of inventory, the quantities measured and the use of the data, and may dictate a significant departure from the recommendations.

[b] Stand height is greater than 9.5 m, less than or equal to 10.5 m.

[c] Any classes used are recommended to start at zero, to be in multiples of 10, and to be expressed by their mid-point, e.g., for an interval of 40, Class 100 (= X) has the range $80 \leq X \leq 120$.

Table 4. Tree measurements

Characteristic	Measurement or recording unit	Expressed to nearest[a]	Examples
Diameter	cm	0.1 cm	
		1 cm	Class 12: $11.5 \leq d \leq 12.5$
		2 cm[b]	Class 12: $11 \leq d \leq 13$
Bark thickness	cm	0.1 cm	
Height	m	0.1 m[c]	
		0.5 m[d]	
		1 m	Class 10: $9.5 \leq h \leq 10.5$
Crown diameter	m	0.1 m	
Crown area	m^2	0.1 m^2	
Basal area	m^2	0.001 m^2[e]	
Volume	m^2	0.001 m^2[e]	
Mass (weight)	kg	0.1 kg[e]	

[a] These recommendations are suitable for many inventories. However, the need for precision differs, depending on the type of inventory, the quantities measured and the use of the data, and may dictate a significant departure from the recommendations.

[b] If wider class intervals are used, boundaries are recommended to coincide with those of the 2-cm classes.

[c] In permanent plots (standing trees).

[d] In temporary plots.

[e] Or measured or calculated to three significant figures.

Appendix 2

Symbols of Commercial Tree Species

Common name	Botanical name	Recommended symbol
Coniferous species		CON
Pine	*Pinus* L.	P
Eastern white pine	*Pinus strobus* L.	EWP
Western white pine	*Pinus monticola* Dougl.	WWP
Whitebark pine	*Pinus albicaulis* Engelm.	WBP
Ponderosa pine	*Pinus ponderosa* Laws.	PP
Pitch pine	*Pinus rigida* Mill.	PIP
Red pine	*Pinus resinosa* Ait.	RP
Jack pine	*Pinus banksiana* Lamb.	JP
Lodgepole pine	*Pinus contorta* Dougl.	LP
Scots pine	*Pinus sylvestris* L.	SP
Austrian pine	*Pinus nigra* Arnold	AP
Larch	*Larix* Mill.	L
Tamarack	*Larix laricina* (Du Roi) K. Koch	TL
Western larch	*Larix occidentalis* Nutt.	WL
European larch	*Larix decidua* Mill.	EL
Spruce	*Picea* A. Dietr.	S
White spruce	*Picea glauca* (Moench) Voss	WS
Engelmann spruce	*Picea engelmannii* Parry	ES
Sitka spruce	*Picea sitchensis* (Bong.) Carr.	SS
Red spruce	*Picea rubens* Sarg.	RS
Black spruce	*Picea mariana* (Mill.) B.S.P.	BS
Norway spruce	*Picea abies* (L.) Karst.	NS

Common name	Botanical name	Recommended symbol
Coniferous species		
Hemlock	*Tsuga* (Endl.) Carr.	H
Eastern hemlock	*Tsuga canadensis* (L.) Carr.	EH
Western hemlock	*Tsuga heterophylla* (Raf.) Sarg.	WH
Mountain hemlock	*Tsuga mertensiana* (Bong.) Carr.	MH
Douglas-fir	*Pseudotsuga menziesii* (Mirb.) Franco	DF
Fir	*Abies* Mill.	F
Balsam fir	*Abies balsamea* (L.) Mill.	BF
Alpine fir	*Abies lasiocarpa* (Hook.) Nutt.	ALF
Amabilis fir	*Abies amabilis* (Dougl.) Forbes	AF
Grand fir	*Abies grandis* (Dougl.) Lindl.	GF
Arbor-vitae	*Thuja* L.	C
Eastern white cedar	*Thuja occidentalis* L.	EWC
Western red cedar	*Thuja plicata* Donn.	WRC
Yellow cedar	*Chamaecyparis nootkatensis* (D. Don) Spach	CY
Eastern red cedar	*Juniperus virginiana* L.	ERC
Western yew	*Taxus brevifolia* Nutt.	Y
Other coniferous species		OCON
Deciduous species		DEC
Black willow	*Salix nigra* Marsh.	W

Common name	Botanical name	Recommended symbol
Deciduous species		
Poplar	*Populus* L.	PO for Poplar CO for Cottonwood A for Aspen
Trembling aspen	*Populus tremuloides* Michx.	TA
Largetooth aspen	*Populus grandidentata* Michx.	LTA
Balsam poplar	*Populus balsamifera* L.	BPO
Eastern cottonwood	*Populus deltoides* Bartr.	ECO
Black cottonwood	*Populus trichocarpa* Torr. & Gray	BCO
European white poplar	*Populus alba* L.	EWPO
Carolina poplar	*Populus x canadensis* Moench	CPO
Butternut	*Juglans cinerea* L.	BU
Black walnut	*Juglans nigra* L.	WA
Hickory	*Carya* Nutt.	HI
Shagbark hickory	*Carya ovata* (Mill.) K. Koch	SHI
Pignut hickory	*Carya glabra* (Mill.) Sweet	PHI
Bitternut hickory	*Carya cordiformis* (Wang.) K. Koch	BHI
Hop-hornbeam	*Ostrya virginiana* (Mill.) K. Koch	HH
Birch	*Betula* L.	B
Yellow birch	*Betula alleghaniensis* Britton	YB
White birch	*Betula papyrifera* Marsh.	WB
Grey brich	*Betula populifolia* Marsh.	GB
Alder	*Alnus* B. Ehrh.	AL
Red alder	*Alnus rubra* Bong.	RAL
Sitka alder	*Alnus sinuata* (Reg.) Rydb.	SAL

Common name	Botanical name	Recommended symbol
Deciduous species		
Beech	*Fagus grandifolia* Ehrh.	BE
Oak	*Quercus* L.	O
White oak	*Quercus alba* L.	WO
Bur oak	*Quercus macrocarpa* Michx.	BO
Swamp white oak	*Quercus bicolor* Willd.	SWP
Chinquapin oak	*Quercus muehlenbergii* Engelm.	CHO
Chestnut oak	*Quercus prinus* L.	CNO
Red oak	*Quercus rubra* L.	RO
Black oak	*Quercus velutina* Lam.	BLO
Pin oak	*Quercus palustris* Muenchh.	PIO
Elm	*Ulmus* L.	E
White elm	*Ulmus americana* L.	WE
Rock elm	*Ulmus thomasii* Sarg.	RE
Slippery elm	*Ulmus rubra* Mühl	SE
Red mulberry	*Morus rubra* L.	MU
Tulip-tree	*Liriodendron tulipifera* L.	T
Sassafras	*Sassafras albidum* (Nutt.) Nees	SA
Sycamore	*Platanus occidentalis* L.	SY
Black cherry	*Prunus serotina* Ehrh.	CH
Honey-locust	*Gleditsia triacanthos* L.	HL
Black locust	*Robinia pseudoacacia* L.	BL

Common name	Botanical name	Recommended symbol
Deciduous species		
Maple	*Acer* L.	M
Sugar maple	*Acer saccharum* Marsh.	SM
Black maple	*Acer nigrum* Michx. f.	BM
Bigleaf maple	*Acer macrophyllum* Pursh	BLM
Silver maple	*Acer saccharinum* L.	SIM
Red maple	*Acer rubrum* L.	RM
Vine maple	*Acer circinatum* Pursh	VM
Manitoba maple	*Acer negundo* L.	MM
Cascara	*Rhamnus purshiana* DC.	CA
Basswood	*Tilia americana* L.	BA
Black Gum	*Nyssa sylvatica* Marsh.	G
Arbutus	*Arbutus menziesii* Pursh	AR
Ash	*Fraxinus* L.	AS
White ash	*Fraxinus americana* L.	WAS
Red ash	*Fraxinus pennsylvanica* Marsh.	RAS
Blue ash	*Fraxinus quadrangulata* Michx.	BLAS
Black ash	*Fraxinus nigra* Marsh.	BAS
Green ash	*Fraxinus pennsylvanica* var. *subintegerrima* (Vahl) Fern.	GAS
Other deciduous species		ODEC
Mixed coniferous and deciduous species		CNDC
Unidentified species		X

Appendix 3

The Canada Land Data System*

Background

The Canada Land Data Systems (or CLDS) is a collective term for an integrated group of computer-based systems for geographic information processing developed over a number of years and incorporating the grandfather of all geographic information systems, the Canada Geographic Information System (CGIS). The origins of the system go back over more than 20 years to the "ARDA Project" (Agricultural and Rural Development Act of 1960). The main thrust of that project was to develop a land capability classification system and compile an inventory of all the potentially productive land of Canada. The result was the Canada Land Inventory (CLI), one of the most comprehensive and ambitious national surveys ever attempted.

Early in the project it became clear that the volume of data to be analyzed precluded manual methods and thus computer-based solutions were sought. The result was the creation of the CGIS, which in highly modified form still operates today as a significant component of CLDS. Because of this pioneering work, a large number of the concepts, algorithms and terminology associated with today's geographic information systems are derived from the original CGIS.

A number of key "firsts" were established at CGIS/CLDS. When the CGIS became fully implemented in 1971, it was the first general purpose GIS to go into production operation. It was the first system (and for many years the only system) to use raster scanning for efficient volume input of manuscript maps. This required the custom design and construction (by IBM) of a large format optical drum scanner. Delivered in 1967, this device was only superceded in 1984 by a modern computer-controlled scanner, a tribute to its design and robust construction.

Other firsts include the employment of the now standard data structure of line segments or "arcs" chained together to form polygons, the principles of data compaction of linework now known as "Freeman encoding," the cellular graphic storage principal known as the Morton Matrix (after Guy Morton, then of IBM), compact geo-coding to allow complete absolute geographic referencing of all data, the use of a hybrid raster-vector format for data representation, and the provision of remote interactive cartographic retrieval in a national network. Recent innovations include microcomputers for land

* Excerpted from a paper by I.K. Crain, Lands Directorate, Environment Canada, Ottawa, K1A 0E7; published in "Exemplary Systems in Government Awards, '85- '86 - The State of the Art," Urban and Regional Information Systems Association, 1985.

data analysis and graphic input, and state-of-the-art multiprocessor hardware employing artificial intelligence techniques for interactive editing of input documents.

The CLDS is a generalized GIS with a very complete range of functional capabilities to capture, validate, edit, store, manipulate, retrieve and display geographically based data. Three important capabilities distinguish CLDS from many other geographic information systems.

1 - Absolute Geographic Referencing

All graphic data are transformed on input to absolute geographic coordinates on the earth's surface (all coordinate points are represented in a coded form of latitude and longitude). In this way, dependency on the input map projection is eliminated; it enables queries based on latitude and longitude parameters, and more importantly, the subsequent integration and overlay of additional map coverage independent of their original base map.

2 - Unlimited Map Linkage

Adjacent map sheets are merged together to form one integrated contiguous data base, eliminating all original map boundaries. This means that all queries can be performed on all or any subset of the data with no concern over map sheet boundaries or "tiles" or "pages" of data.

3 - Full Topological Combination Overlay

This provides ability of forming the logical combination of an unlimited number of polygon map coverages, including, of course, all the lower order overlays such as binary combinations, exclusive "or," superposition overlay, etc. This powerful process is applied across the entire merged database, not on a map sheet basis.

The full list of functional capabilities is as follows:

Input

- Data capture by line digitizing with interactive edit
- Data capture by raster drum scanner
- Interactive editing of scanned line images
- Topological verification and editing
- On-line key-entry tagged to polygon number
- Automated linkage of attribute data to polygons
- Automatic edit/validate routines using user-supplied criteria

Geographic Data Manipulation

- Map sheet merging
- Binary and multiple combination overlay
- "Cookie-cutter" function
- Study area, corridor, circle zone generation
- Change and correction overlays
- Background file superposition

Generalization

- Small area removal with boundary protection
- Boundary dissolve

Geometric Calculation

- Area, perimeter and centroid calculations
- Study area subset creation
- Gridded data generations

Attribute Data Manipulations

- Recoding
- Weighting and other derived attributes
- Linkage of additional data

Retrieval and Display

- Creation of interactive subset databases
- Digital output files in various formats
- Statistical tabulations and report generation
- Transfer of data to statistical packages
- Boundary dissolves and selection based on full logical data queries
- Map plotting - monochrome and colour
- Cartographic quality monochrome and colour map generation

As well as these general functional capabilities, the CLDS provides machine-based services to various clients, for example, to scan documents of various kinds, to digitize points and lines, to plot maps and diagrams and to assist with small project-oriented geographic requirements which do not need full database facilities.

Technology

Five subsystems surround and support the primary system, the CGIS. The five subsystems are also used as stand-alone systems for specialized projects.

The SIRE system (stands for Scanning Input and Raster Editing) is the most recent addition and provides high volume rapid map digitizing using an Optronix X4040 optical drum scanner. Maximum document size is 1 m x 1 m and resolution is adjustable from 25 to 200 microns. Grey level thresholds are adjustable as well, so that manuscript documents on various media, positive or negative, can be processed. Colour filters can be used to separate coloured annotation from desired line-work. An average full size thematic map requires about 20 minutes to digitize in this manner. The scanner is an intelligent device, controlled by a PDP 11-24 computer.

The second major component of the SIRE system is the "Z-ed Machine," a multiprocessor editing work station developed by Mignot Informatique Graphique of Montreal. This station provides the user with the ability to view, verify and edit the scanned image to ensure its correctness before subsequent processing. The machine also will automatically perform, using artificial intelligence techniques, line-thinning operations, detection of line ends, closing of small gaps, clean-up of stray spots and noise, and raster-to-vector conversion. The SIRE system can be used stand-alone to digitize maps and other documents for input to external systems.

The Interactive Digitizing and Editing Sub-System (IDESS) employs digitizing tables and graphics screens controlled by an HP-1000 mini-computer to digitize and graphically edit point location data and line-work. As a stand-alone system it also has the capability to form polygons, statistical summaries and project-oriented GIS functions. As a part of CLDS it is normally used to digitize point locations and input display-only background data files which can be superimposed on thematic map databases entered through SIRE.

The Data Entry and Validation Sub-System provides on-line key-entry and edit/validate functions for the attribute descriptor data. This is supported by a Data General MV6000 minicomputer.

The hub of the CLDS is the well known CGIS system which provides the bulk of the geographic data manipulation power. The system operates on a large IBM mainframe computer at a commercial service bureau. Details of the inner workings of CGIS cannot be given in a paper of this length, but some of the key points will be mentioned.

As a first stage, raster-to-vector conversion is performed in small blocks of data called "frames" (each about 3 cm square on the original map). The coordinate data are "de-projected" from the input document and remapped into a latitude/longitude coding scheme. Projection calculations are performed efficiently by using an exact formula for each frame corner with interpolation in between. The latitude/longitude coding scheme makes use of a frame numbering pattern (the Morton Matrix) along with local relative

displacements to efficiently represent the full absolute geographic reference. Further data compaction is obtained by the use of directional run length encoding of finite incremental vectors.

Subsequent processing stages link adjacent map sheets to eliminate map borders, integrate the attribute data with the polygon outlines, verify topology and check for adjacent polygon conflicts. The various types of overlay function operate on the compacted coded data to produce the full combination logical overlay.

The user can choose to use the global retrieval capabilities (in batch mode) of CGIS, or interactive facilities through the Interactive Graphics Sub-System (IGSS), or both.

The IGSS is intended for use on subsidiary interactive databases created through selection by particular study regions (which may have irregular boundaries or particular attribute subsets etc.). The IGSS is a user-friendly interactive graphics system which operates through Tetronix-type colour and monochrome terminals from remote locations. Work stations access the data banks through medium speed telecommunications lines from numerous locations across Canada. Through these terminals users can selectively plot, generalize, and window any or all of the overlayed data coverages, and obtain statistical reports, cross tabulations, and graphical displays on the screen or on accompanying hard-copy units. As well, commands can be entered for custom batch reports and cartographic products from the Cartographic Output Subsystem.

This latter subsystem provides for the production of large format black-and-white and color maps. The principal output devices are a Gerber drum plotter and the Optronics X4040 scanner/plotter. The former is used primarily to produce a variety of black and white maps and color-shaded maps which are used as proofs for later publications or as working documents. The laser plotter capabilities of the Optronics X4040 are used to produce large format color separates on film for color printing of publication quality maps. Incorporated into the output system is the commercial mapping package GIMMS used primarily for generating annotation to superimpose on the color maps from the scanner.