

CANADA

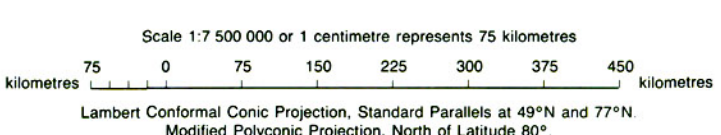
VEGETATION COVER

Produced by the National Atlas Information Service, Canada Centre for Mapping, Energy, Mines and Resources Canada and the Petawawa National Forestry Institute, Forestry Canada. Printed 1993.

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VEGETATION COVER

This map is a first approximation of vegetation cover categories of Canada that can be interpreted from satellite imagery. It represents a new generation of mapping, as satellites permit the delineation of cover types directly from data observed from space platforms rather than from large-scale aerial photography or from secondary sources based on ground observations. Strengths of this mapping approach are the use of a consistent data set of large areal extent and short duration, a consistent analytical procedure, and the relatively short time period needed to generate the map. Potential applications are evident for global environmental monitoring and for resource management. Limitations of the approach include the level of accuracy of the data (maximum resolution of 1 km), and the limited number of cover categories that can be identified.

The cover classes shown were selected after careful consideration of the image analysis and classification challenges inherent in mapping such a diverse and spatially extensive area. It was not feasible to differentiate wetland areas¹. In addition, vegetation zonation in the Arctic is poorly represented with the result that areas dominated by low erect shrubs, by dwarfed and prostrate shrubs, and by herbs (Edlund 1990) appear in the same class. Moreover, reflectance values were not sufficiently distinct to differentiate totally unvegetated terrain (barren land) from a sparse vegetation cover of woody plants, herbs and nonvascular plants (lichens and mosses). Even some nearly continuously vegetated terrain dominated by lichen communities (Edlund 1982) was classified in the same group. Although the approach was successful in delineating principal areas of agricultural lands, many dispersed areas were not identified. It is expected that further refinement of the classification techniques used will result in improved interpretation accuracy.

Data were obtained from the Advanced Very High Resolution Radiometer (AVHRR) sensor operating on board the United States National Oceanic and Atmospheric Administration (NOAA) satellites. Imagery from several years (summer coverage, 1988-1991) was required to produce a cloud-free composite for the entire country that was suitable for classification and interpretation. This composite was derived from approximately 45 images, and more specifically, from a combination of channel 1 (red, 0.58-0.68 micrometre wavelength of the electromagnetic spectrum) and channel 2 (near-infrared, 0.72-1.10 micrometres wavelength) data. Image compositing was accomplished through a correction procedure in which each image was rectified to a common map projection. The most cloud-free picture element was then selected for each one square kilometre of the country to provide clearer contrast for classification. This selection process involved two approaches. For the most part (approximately 80% of the Canadian landmass) large portions of cloud-free single daily images were used. The Normalized Difference Vegetation Index (NDVI) approach was used for the remaining 20% of the Canadian territory where cloud-free images were difficult to obtain. The NDVI was generated as a ratio between radiance values in the near-infrared (NIR) and red (R) ranges of the electromagnetic spectrum ($NDVI = (NIR - R) / (NIR + R)$) and was calculated for each square kilometre (pixel). High values of this index indicate vegetated areas while low values indicate either non-vegetated areas or clouds, water, snow or ice. Portions from images with the highest NDVI values were used to produce cloud-free images for subsequent classification.

The techniques of image classification included a combination of supervised, automated, "maximum likelihood", and manual classifications. Supervised and automated classifications use different algorithms but are based on the same principle of automatically comparing and matching ground-referenced data with the image data. The "maximum likelihood" technique was used for classifying residual pixels that were not automatically assigned to a class by the supervised and automated approaches. Classification training (ground truthing) sites were established in various regions of Canada using LANDSAT imagery, National Atlas maps, Canada Land Inventory data, Canada's Forest Inventory data, provincial sources, and local knowledge. Classified images were then subjected to filtering in order to reduce visual noise. In general, a minimum area of 4 contiguous pixels was retained. (Exceptions were isolated patches where single pixels of a class were retained if they were located more than 7 pixels inside the boundary of a larger polygon of a different class.) Manual editing was used to supplement automated techniques and to incorporate changes from the review and verification process.

The final map was assembled digitally by merging the interpreted image data with selected National Atlas base map components, and by manipulating colour using a Scitex cartographic output system. Information appearing on this map is available in digital form as a seamless data set for the entire country in both raster and vector formats.

¹For information on wetlands see the following maps in the National Atlas of Canada, 5th edition series: Canada—Distribution of Wetlands, Canada—Wetland Regions, and Canada—Land Cover Associations.

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VEGETATION COVER

- | CLASS | DEFINITION |
|----------------------------------|---|
| FOREST LAND | |
| Continuous Forest | Land currently supporting or capable of growing forest, with tree crown cover of 10% or more. Includes land where trees are stunted owing to site limitations, undetectable owing to disturbance, or temporarily absent. Also includes extensive wetland areas. |
| Coniferous Forest | Land cover type where forest land occupies more than 50% of the area. |
| Broadleaf Forest | Continuous forest in which 76 - 100% of the canopy is composed of coniferous trees. |
| Mixed Forest | Continuous forest in which 76 - 100% of the canopy is composed of broadleaf trees. |
| Transitional Forest | Continuous forest in which 26 - 75% of the canopy is composed of coniferous or broadleaf trees. |
| TUNDRA | A mixture of land cover classes where tree cover is discernible, but forest land occupies less than 50% of the area. Tree density varies from open woodland to scattered groves of trees or linear forests in valleys. Understory vegetation includes low, erect shrubs, dense lichen mats and mossy peatland. |
| SPARSELY VEGETATED / BARREN LAND | Treeless arctic and alpine vegetation with nearly continuous plant cover. Includes low, erect and matted shrub tundras and tussock cottongrass tundras in the southern Arctic (shrub component 25 - 75%); prostrate and matted shrub and herb tundras in the northern Arctic (shrub component 10 - 25%); and wetlands dominated by dense sedge-moss meadows. |
| AGRICULTURAL LAND | Plant cover is generally sparse (less than 25%) and is not discernible from the imagery. Woody plants and herbs dominate most of the terrain, with scattered herbs and nonvascular plants in the northwestern sector of the Arctic Archipelago. Some dense lichen-dominated communities occur in Keweenaw and southern Baffin Island. Totally unvegetated terrain includes sand, rock, and unconsolidated material. |
| Cropland | Cultivated land with crops, fallow, feedlots, orchards, vineyards, nurseries, shelterbelts, and hedgerows. |
| Rangeland and Pasture | Land supporting native vegetation, shrubs, grass and other herbaceous cover with less than 10% tree cover. Includes improved land dedicated to the production of forage, and upland and lowland meadows. |
| NONVEGETATED LAND | |
| Perennial Snow or Ice | Perennial snow fields and glaciers. |
| Built-up Area | Cities and towns of sufficient size to be depicted at the scale of mapping. |
| WATER / SEA ICE | |
| Open Water | |
| Sea Ice | Minimum cover (1991). |