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A DATA MANAGEMENT AND MAP INTERPOLATION SYSTEM FOR SPRUCE BUDWORM PHEROMONE TRAPS

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CATEGORY: Decision support
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INTRODUCTION

A data management system for the spruce budworm (SBW), *Choristoneura fumiferana*, pheromone trapping network has been developed to run on a personal computer (PC) platform. Pheromone traps are deployed throughout the range of the spruce budworm by government agencies and industrial partners using standard sampling protocols (Sanders 1996). The purpose of the network is to monitor population densities of the budworm and detect changes in these densities for forest management planning. Trap data have been collected in North America since 1986. From trap catches, the number of male moths are determined at discrete geographic points in two-dimensional space. The system takes these point sample data and converts them into contour maps for use in a geographic information system (GIS) (Lyons and Sanders 1993). The conversion involves a geostatistical interpolation procedure known as kriging (Liebhold et al. 1993). Individual regional maps of moth densities can be created for eastern North America, Ontario, Quebec, Maritimes, New Brunswick or Newfoundland. These maps can be used in a GIS to observe density trends, determine interactions with other forest variables and/or develop explanatory or predictive models.

The purpose of this note is to provide a brief summary of the capabilities of the software and instructions for computer installation. A user's guide (Lyons et al. 1997) and required software can be requested from the senior author by mail from Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, P.O. Box 490, Sault Ste. Marie, Ontario P6A 5M7 or via e-mail from blyons@NRCan.gc.ca. A technical manual[2] is in preparation.

SYSTEM REQUIREMENTS

In order to run the Data Management System for the Spruce Budworm Pheromone Trapping Network you will require the following:

Hardware

- an IBM-compatible PC with a 486 processor or higher;
- a graphics adapter and monitor that handles VGA or SVGA graphics;
- 8 megabytes of RAM (16 megabytes recommended);
- a mouse or other pointing device;
- a 3.5-inch floppy drive;
- a fixed hard drive with at least 9 megabytes of available space (not including space for software listed below); and
- Windows 3.x or Windows '95.

[1] Great Lakes Forestry Centre, Canadian Forest Service, Sault Ste. Marie.

[2] Lyons, D.B., Robertson, C.J., Sanders and B. Pierce. The spruce budworm pheromone trapping network: technical manual. (in preparation)

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Software

- The Geographic Calculator (Blue Marble Geographics, Gardiner, ME);
- Idrisi for DOS or Windows (optional)* (Graduate School of Geography, Clark University, Worcester, MA);
- CorelDRAW! (Corel, Ottawa, Ontario) (optional)*; and
- Microsoft Access (optional)* (Microsoft Corporation, Redmond, WA)

* In the strictest sense, many of the software programs are optional in as much as they are not involved in the interpolation and map production process. Microsoft Access is required for input and manipulation of data, but database files can be accessed directly from the interpolation program in the absence of this relational database software. Idrisi GIS software is, however, required for viewing the resultant maps and performing GIS applications using them. CorelDRAW! is necessary only if report quality maps are required.

DISTRIBUTION DISKETTES

The software (Version 2.0) is available on distribution diskettes or in a compressed file format via file transfer protocol (FTP) on the internet (**ftp.glfc.forestry.ca/pub/sbwphero/sbw.zip**). It is available in versions for either the Windows 3.x or Windows '95 operating systems.

The distribution diskettes or **.zip** file contain an installation program (i.e., **setup.exe**) that decompresses the program files and installs them in appropriate directories on your system hard drive.

Geostatistical analysis is performed by four Fortran programs from GSLIB which are in the public domain (Deutsch and Journel 1992). Compiled versions of these programs (i.e., **nscore.exe**, **gamv2.exe**, **okb2d.exe**, and **backtr.exe**) are on the distribution disks or in the **.zip** file, and are installed automatically as described below.

A sample vector map (**ontario.dvc** and **ontario.vec**), in Idrisi format, is supplied on the distribution disks. This map can be overlain on the Idrisi image maps for Ontario created by the system. Other vector maps are available by request from the senior author.

A Microsoft Access database file (i.e., **sbw.mdb**) with historical data for eastern North America (updates will be made available as data is accumulated) and a generic database template file (i.e., **template.mdb**) are also provided on the distribution diskettes. The template is an empty but formatted database file that will allow you to enter point sample data for other mapping applications.

INSTALLATION

Commercial software (i.e., The Geographic Calculator, Idrisi, CorelDraw! and Microsoft Access) should be pre-installed as per the manufacturer's instructions. The SBW Data Management System can be installed using the following:

1. Start Windows 3.x or Windows '95.
2. From the Program Manager in Windows 3.x choose File/Run or from the Start Button in Windows '95 choose Run.
3. Place the disk labeled 'Disk1' into your floppy drive (**a:** or **b:**).
4. Type **a:\setup** (or **b:\setup** depending on which drive Disk1 is in) and press Enter.
5. Follow the instructions provided on the screen.

or by extracting the **.zip** file into a temporary directory and running setup from that directory.

The file **equaz.dat** which is copied to the **c:\windows** directory during installation should be moved to the directory that contains the geographic calculator (usually **c:\geocalc**).

SYSTEM OPERATION

The graphic user interface (GUI), the geostatistical module and a file conversion utility for the data management system for the spruce budworm pheromone trapping network are written in Visual Basic 4.0 (Microsoft Corporation, Redmond, WA) programming language. The system is available in either 16-bit (Windows 3.x) or 32-bit versions (Windows '95). The user accesses the program via the GUI (Fig. 1). All system modules can be accessed from the GUI. The *Database* button on the GUI opens Microsoft Access and the database file selected in the configuration window (default **sbw.mdb**). Here, you can edit new data or manipulate existing data. The button labeled *Kriging* accesses the geostatistical module that performs the interpolation of the point data and creates a Idrisi map file. The *Idrisi* button opens the geographic information system. Raster maps created by the system can be manipulated using the GIS. The *CorelDRAW!* button opens the structured drawing program which can be used to enhance the appearance of maps for publication. Maps are exported from the GIS as vectors and then imported into CorelDRAW!. A stand-alone file conversion utility, that converts files between different formats used in the system, is accessible from the GUI by selecting the *Convert File* button. The Geographic Calculator software can be accessed from the GUI using the *GeoCalc* button and allows you to perform projection conversions. The *Help* button opens an electronic version of the user's manual. A configuration utility, for customizing the system to a specific computer, is accessed via the *Configure* button. *Exit* closes the system.

An example of an Idrisi raster map produced by the system from pheromone trap data in Ontario is shown in Figure 2. Another contour map of pheromone trap catches for the northeast was exported from Idrisi as individual vector layers and imported layer by layer into CorelDRAW!. Each layer was individually shaded and the legends and titles were created to produce the publication quality map shown in Figure 3. Maps produced by the system can be analyzed in the GIS. For example, Figure 4 demonstrates a simple

analysis using some GIS functionality. In this case, output maps from the system, for two sequential years (i.e., 1991 and 1992) were reclassified to produce maps (Figs. 4a and 4b) showing only interpolated zones containing densities of greater than 100 male moths/trap (i.e., an outbreak threshold). Using simple map algebra in the GIS, differences between these two maps can be calculated. The resultant map (Fig. 4c) shows the zones where populations of male moths have risen above this threshold from one year to the next. The generic versatility of the software is further demonstrated by another map (Fig. 5) which shows larval density (2nd instar) of spruce budworm in New Brunswick in 1991.

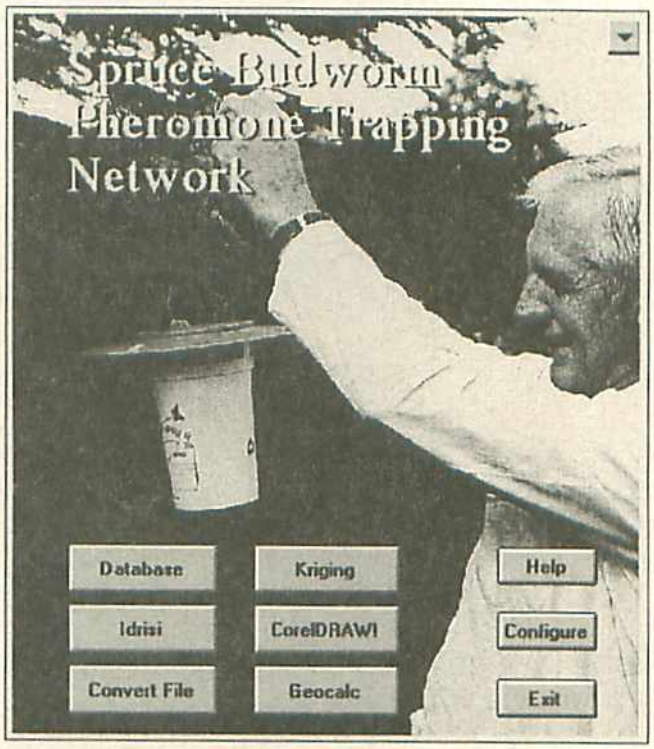

Figure 1. The graphic user interface (GUI) for the data management system for the spruce budworm pheromone trapping network.

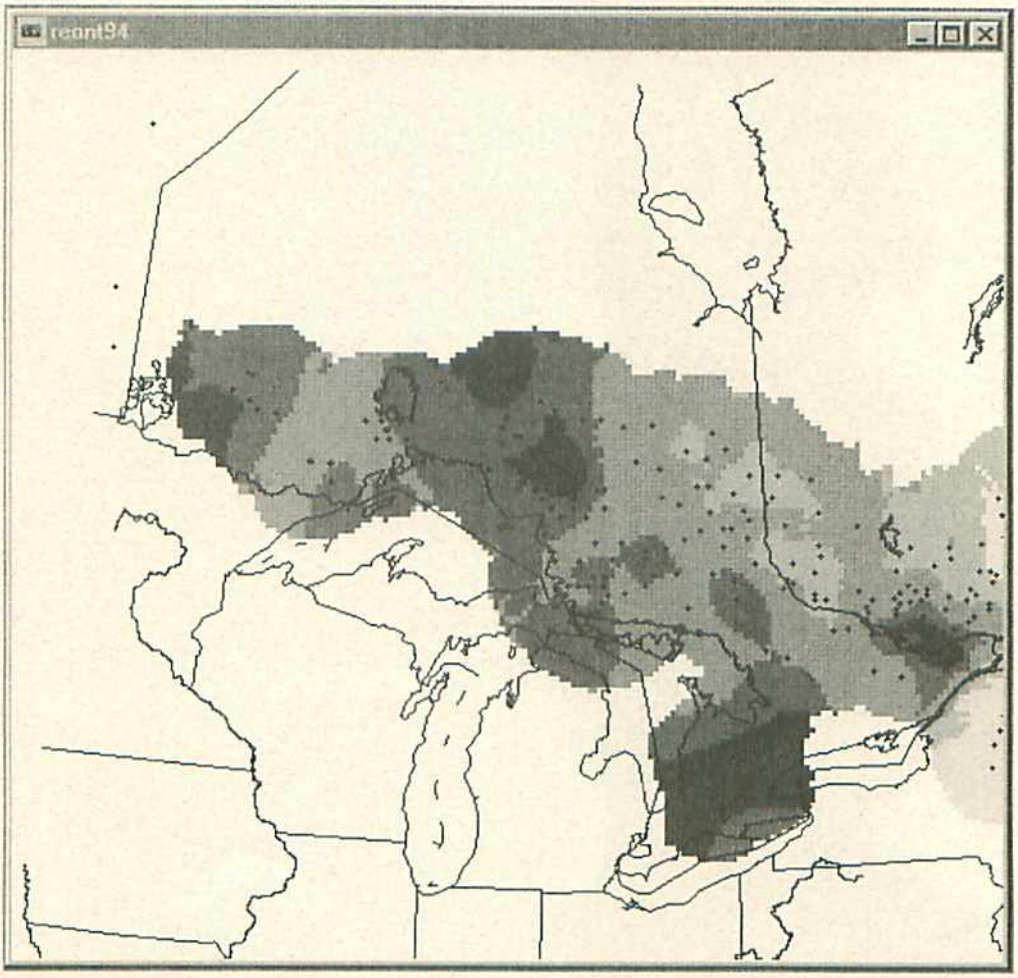

Figure 2. Map of interpolated pheromone trap catches of spruce budworm moths for Ontario in 1994 displayed in Idrisi for Windows. The symbols represent trap locations.

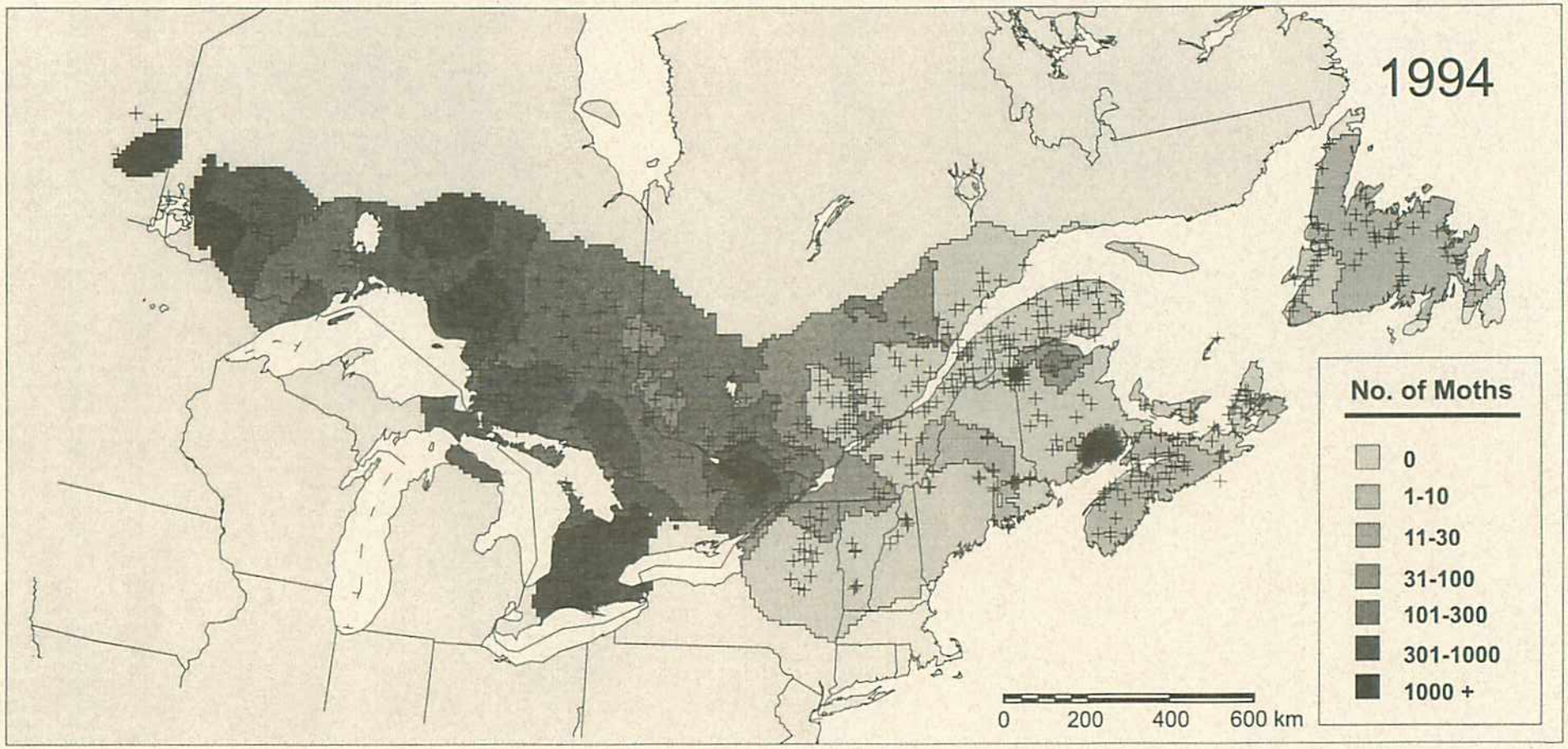

Figure 3. Map of interpolated pheromone trap catches of spruce budworm moths for eastern North America in 1994. This map has been enhanced and annotated using CorelDRAW! The symbols represent trap locations.

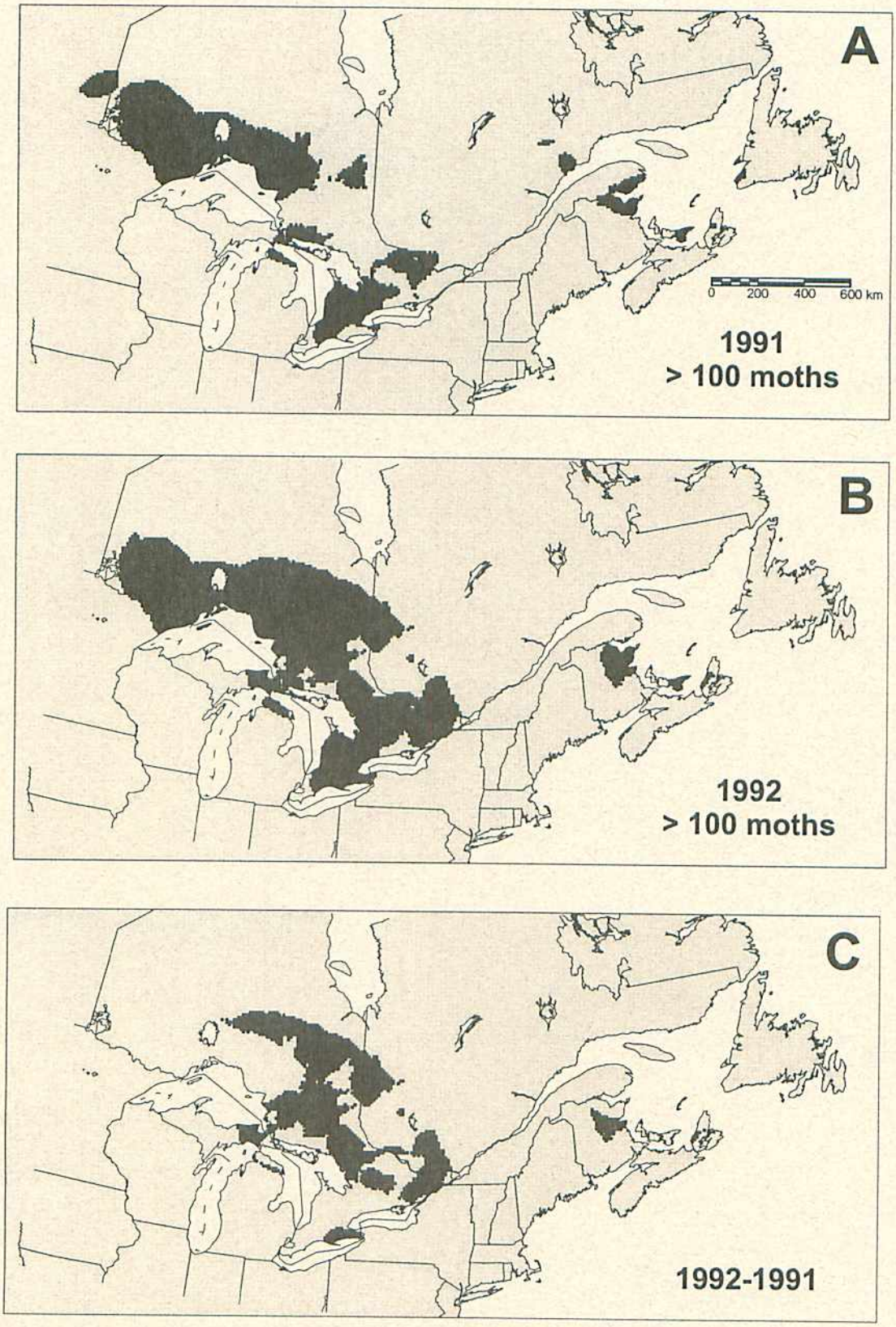

Figure 4. Map showing pheromone trap catches with densities greater than 100 male moths/trap for Ontario in 1991 (A) and 1992 (B). The positive difference between the two maps (C) as calculated in the GIS is the area where populations have increased above this threshold.

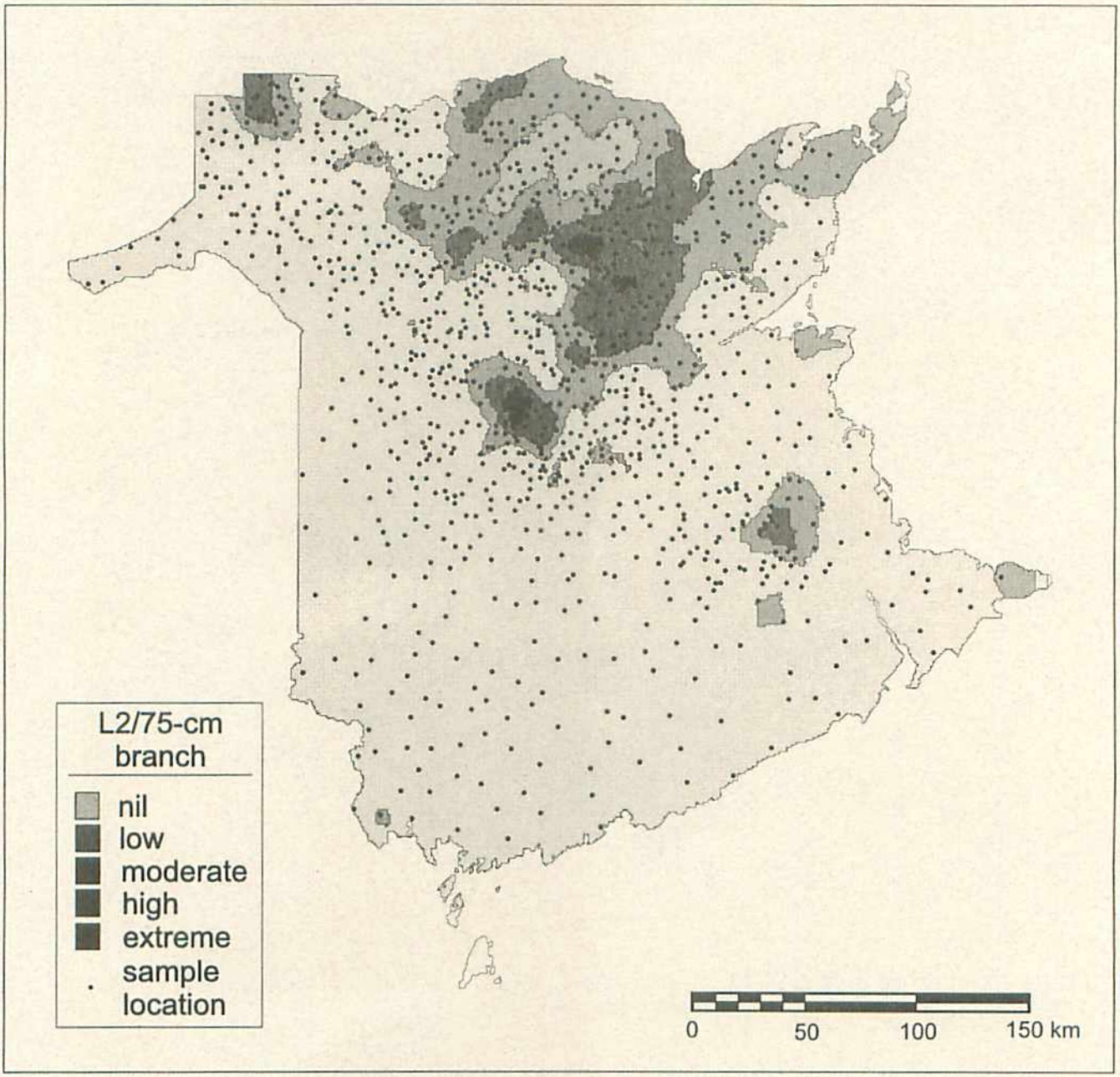

Figure 5. Contour map of spruce budworm larval densities (2nd instar) in New Brunswick in 1991.

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