



Quick Start Tutorial

MapWindow 4.8.6

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1. Introduction

This guide is written as an introductory outcome-oriented tutorial for MapWindow, version 4.8.6. It is *not* a comprehensive user's guide that systematically describes each menu item and every dialog option. Rather, it provides instructions on how to accomplish a suite of basic GIS tasks. My aim is to provide an easy-to-follow guide for users that are mainly interested in displaying GIS data, conducting simple queries, and exporting high quality maps for use in publications and presentations. This being the case, not all of the functionality of MapWindow is covered. In particular, the guide only covers the main program and not the plug-ins (except for the shapefile editor).

The MapWindow desktop software is available for free download as a single ready-to-install .exe file from the MapWindow website: www.mapwindow.org. MapWindow is a native Windows application that requires installation of the Microsoft .NET framework. It runs on XP, Vista, and Windows 7 and works fine on 64-bit machines. The program is quite intuitive to use and new users will be up and running quickly. With only a couple of exceptions it provides a user experience that meets or exceeds that of ArcMap, for the procedures covered in this guide.

The MapWindow desktop program that is the focus of this guide is just one part of a larger open-source project. The core software is also available as an ActiveX component, allowing programmers to develop customized GIS applications. It is also possible for advanced users to modify and extend the desktop program to fit individual needs. More information on the MapWindow project and its various facets can be obtained from the MapWindow website.

Because MapWindow is under continuous development it may not behave exactly as described in this guide if you are using a newer version of the program. A web-based user's guide is under development in the MapWindow website and you might want to have a look there if you are running into problems or want information on functions not covered here.

2. Getting Started

2.1 Projects

The project file maintains a record of the different layers, labels, colors and styles you have defined for your map. When MapWindow starts it initiates a new project. You can also start a new project at any time by clicking the **New** toolbar button. Any changes that you make to a project are not stored until you click the **Save** toolbar button, or save when prompted on exit. Previous projects are accessed by clicking the **Open** toolbar button or selecting **File** from the top menu and clicking **Recent Projects**. You can also double click on the project file name in Windows Explorer, which opens the project in a new instance of MapWindow. Project files carry the extension .mwprj.

Besides saving the layers and related symbology the project file stores a few additional settings such as map units, projections, and so on. These can be accessed by selecting the **File** menu and clicking on **Settings**. Users will generally not have to make any changes to these settings so they will not be discussed here.

2.2 Plug-ins

The installation program installs a number of core plug-ins, such as **Shapefile Editor**, that provide additional functionality to the base program. Additional plug-ins are available from the MapWindow website. To install a new plug-in download the zip file and extract it to the MapWindow plug-in folder, usually C:\Program Files\MapWindow\Plugins. Sometimes the plug-in is a single .dll, but it can also be a folder containing multiple files in which case the whole folder goes into \MapWindow\Plugins.

Before you can use any of the plug-ins they have to be activated within MapWindow. To do this select **Plug-ins** from the main menu and click on the plug-in you wish to activate. It will remain activated, even in new projects, until you click it again. Once a plug-in is activated a new toolbar button or menu item will be displayed enabling you to use it.

2.3 Adding data layers

The maps you produce will usually be composed of several GIS data layers. These layers are added either by dragging and dropping files from Windows Explorer onto the map display window or by clicking the **Add** toolbar button. Each layer that is added is listed in the legend window (use **View → Panels → Show Legend** if it is not visible). Double clicking the layer in the legend or clicking the **Properties** toolbar button will bring up the **Layer properties** dialog which has several tabs for making changes to a layer's properties. For example, to change the name displayed in the legend select the **General** tab and modify the text in the **Name** textbox. Other properties will be dealt with in subsequent sections. To remove a map layer click the **Remove** toolbar button. Clicking the **Clear** toolbar button will remove all map layers.

The colored icons displayed in the legend illustrate the type of data in the layers (polygon, line or point) and the current symbology. The order of the layers in the legend determines the overlay order in the map: layers that are higher in the list cover layers that are lower. If a layer seems to be missing it might be because it is completely covered by other layers. To change the order of a layer just click and drag it to where you want it to go. A small checkbox beside each legend entry allow you to turn the display of individual map layers on and off.

MapWindow will display different kinds of GIS data, including: vectors (polygons, lines, and points), rasters (rectangular grids of data), and images. Many different file formats are supported, including .shp, .asc, .aux, .bgd, .bil, .dem, dt1, .hdr, .img, .jpg, .sid, .std, .tif and others. The ESRI shapefile (.shp) is the vector format used by MapWindow when generating new vector files. It uses GeoTiff and the .bgd format when generating new raster files.

To add a scale to your map open the **View** menu and select **Show Floating Scale Bar**.

2.4 Projections

A projection is a mathematical transformation used to display the 3-dimensional earth onto your 2-dimensional computer screen. Different projections are available, each with its own benefits, costs, and appropriate uses. A detailed discussion of projections is beyond the scope of this guide, but a few basic points need to be covered. The main issue is that the various layers in your project all need to use the same projection if the overlays are to line up. In MapWindow, the projection of a layer is defined in a supplemental file carrying the .prj extension. This is a

common format for projections, also used in ArcMap. A layer's projection can be viewed in the **'General'** tab of the **'Layer Properties'** dialog, which is opened by double-clicking the layer in the legend or clicking the **'Properties'** toolbar button

The first map that you add to a project defines the projection for the entire project. Each subsequent layer must have the same projection or MapWindow will display a warning dialog. This dialog allows you to reproject the incoming layer, or do nothing (in which case the layers may be misaligned). Note that reprojecting a layer involves more than just changing the contents of the .prj file, there are also changes to the shape of the polygons. Therefore, it is best to reproject to a new file, rather than overwriting the old. If a map layer is missing the .prj file it will be necessary to define a projection for it. This can be done in MapWindow using the **'Toolbox'**, but the process is outside the scope of this guide.

2.5 Basic toolbar functions

A suite of basic map functions is accessed through a set of toolbar buttons. Their use is quite intuitive so only a brief explanation is provided here. Note that several functions require the user to first select a target layer, which is done by clicking it in the legend. You can move the toolbars (click and drag at the dotted line) and the text labels can be toggled on and off via right-click.

	Zoom in: either click the area of interest or draw a bounding box. Zooming in and out can also be done using the mouse wheel.
	Zoom out.
	Zoom to the full extent of all visible layers.
	Zoom to selected shapes of the target layer.
	Move backwards through a list of earlier map views.
	Move forward through a list of earlier map views.
	Zoom to the extent of the target layer.
	Click and drag the map within the display window.
	Select shapes from the target layer. Ctrl-click to select multiple shapes, or draw a bounding box. See section 4.2 for more information on selections.
	Opens a dialog used to display the perimeter and area of shapes selected from the target layer or shapes drawn with the mouse.
	Click to view the attributes of shapes in the target layer.

3. Producing a Map for Export

3.1 Defining symbology: vectors

When you first add a layer all shapes are given the same color and outline. MapWindow has two dialogs for customizing the symbology (color scheme, outlines, style, etc.). One is the '**Layer Properties**' dialog, which can be accessed by double-clicking the layer in the legend. The other is the '**Categories**' toolbar button. They both work much the same way. I will describe the '**Categories**' button here because I prefer using it.

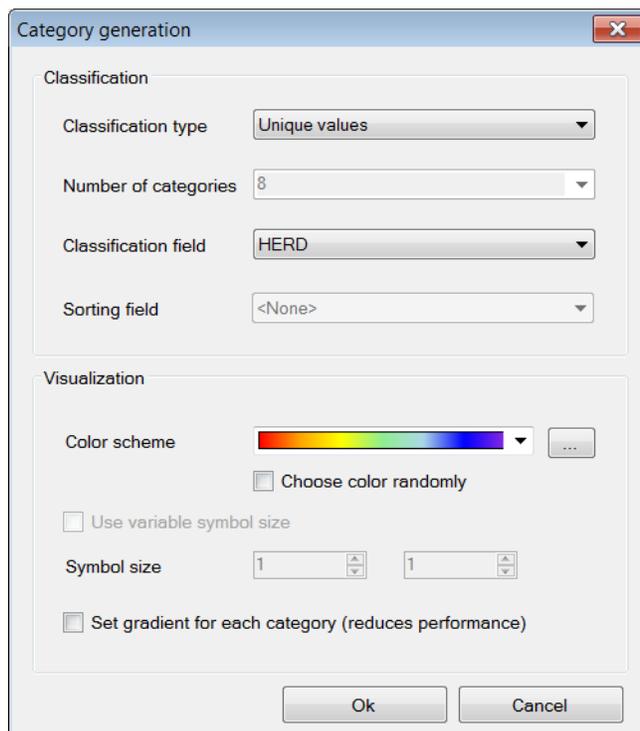


3.1.1 Unique values

If your layer is made of shapes that represent distinct entities, say herds of caribou, then proceed as follows. Click the '**Categories**' toolbar button to bring up the '**Symbology**' dialog. It will be empty when you begin, indicating that no symbology has been defined. Next, click the '**Generate Categories**' button (bottom left) to bring up the '**Category generation**' dialog. Follow the steps below to assign colors based on the attribute of your choice.



- Under '**Classification type**' select '**Unique values**'
- Under '**Classification field**' select the attribute you want to use for assigning different colors to shapes
- '**Color scheme**' is used to select the color palette for your shapes. Click the triangle to the right to select a different palette. The option button on the far right can be used to edit the palettes and define new ones.
- If '**Choose color randomly**' is *not* checked, colors are sequentially assigned from left to right across the entire palette.
- If '**Set gradient**' is checked a gradient from dark to light is applied to *each polygon*. This effect is really only apparent when polygons are large.
- The other entries in the dialog are not used for unique values.
- Click '**Ok**' to finish



3.1.2 Continuous data

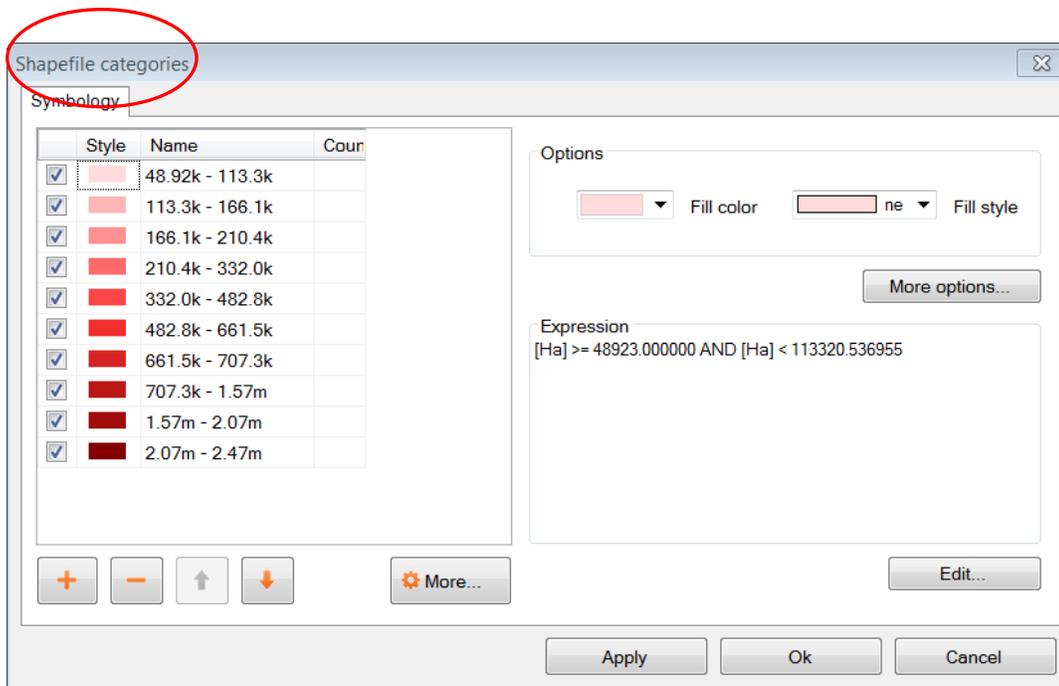
If your layer contains continuous data, say the height of trees within stands, then you must define categories into which the shapes are assigned. Begin by opening the **'Category generation'** dialog and selecting the classification field and color scheme as described in 3.1.1. Set the number of categories you want in the **'Number of categories'** box. Then, under **'Classification type'** select one of three methods for defining the category breakpoints: **'Equal intervals'**, **'Natural breaks'**, and **'Quantiles'**. These options will only be available if the classification field contains numeric data (use **'Unique values'** for text). Click **'Ok'** to complete the process.

If you wish to display the categories using a color ramp, say light red for low values grading to dark red for high values, select a smoothly grading color palette from the list of palette options (see example below). Do not check the **'Set gradient'** option because this refers to color gradients *within* polygons, something else entirely.

If your data layer is comprised of lines or points it may make more sense to illustrate gradients using symbol size (e.g., increasing line thickness or point size) rather than a color ramp. To do this place a check in the **'Use variable line width'** checkbox and then define the minimum and maximum symbol size in the option boxes below. Symbol size will be based on whatever attribute is selected in **'Classification field'**.

3.1.3 Customizing the symbology

Once a color scheme has been generated, the categories and color assignments appear in the **'Shapefile categories'** dialog and in the legend. Further editing is possible from either location. For simple changes the fastest and easiest approach is to click on the color you want to change in the legend. But the dialog which opens with the **'Categories'** toolbar button has a few more options so I will focus on it here.



In the **'Shapefile categories'** dialog, select the category you wish to change by clicking on its name or color. Then:

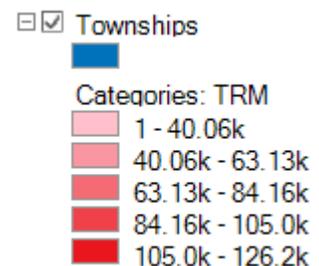
- Turn the display of the category on and off using the checkbox to the left of the name
- Change the category's name by typing over the existing text in the **'Name'** column (this only changes the legend entry; no changes are made to the attribute table).
- Change the order that a category is listed in the legend using the up and down arrow buttons at the bottom of the dialog
- Remove the category from the map by clicking the button with a minus sign
- Set basic options for fill color and fill style using the option boxes in the top right corner of the dialog
- Set additional options by clicking the **'More options'** button or by double-clicking on the category's color box:
 - Show or hide the fill, outline, and vertices
 - Select the color and transparency level for fill, outline, and vertices
 - Define the fill type
 - Set the outline width and style

Making the top layer partially transparent is a useful way of displaying features that lie beneath.

If you are working with continuous data you may want to fine-tune the category break points. For example, you may wish to flag all shapes that have a zero value with a unique color but display the rest of your data using a smooth color gradient. None of the classification schemes in the **'Category generation'** dialog will do this for you automatically. However, you can specify the breakpoints for each category manually using the **'Expression'** window of the dialog. The **'Expression'** window displays the current breakpoints in the form of a selection expression. Changing the breakpoints is simply a matter of typing new values into this expression and clicking **'Apply'**. It is up to you to ensure that your changes don't result in gaps between categories.

It is worth noting something here that can lead to unexpected results: when you generate categories, the original default symbology remains lurking in the background. In the example legend shown to the right a red color ramp has been assigned to the categories, but the original default color (blue) is still there too. Normally this is not an issue because all shapes are displayed using the category scheme. But if you manually define breakpoints and leave any gaps between categories the unassigned shapes will be seen in the default color.

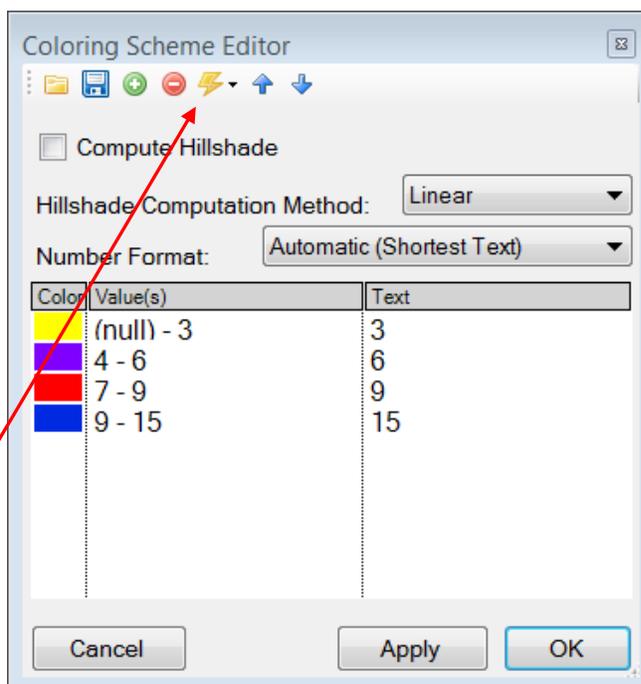
Another thing to keep in mind is that the default symbology is used as the template for generating categories. If you don't want your categories to have outlines, turn the outline off in the default symbology before generating the categories. Likewise, if you want the categories to have a fill, make sure it is visible in the default scheme first.



3.2 Defining symbology: rasters

Raster layers use a different symbology dialog, called the **'Legend Editor'**, which is left over from an earlier version of MapWindow. To open the **'Legend Editor'** double-click on the layer in the legend. Scroll down to the Symbology section of the dialog and in the row labeled **'Coloring Scheme'** click **'Edit'** to bring up the **'Coloring Scheme Editor'**.

The buttons along the top of this dialog have basically the same functionality as the buttons along on the bottom of the **'Symbology'** dialog described in 3.1. The **'Generate categories'** button is called **'Wizard'** here, and takes the form of a yellow lightning bolt. It has a similar set of options and works in basically the same way. But only the **'Continuous Ramp'** option allows you to preselect your color scheme.



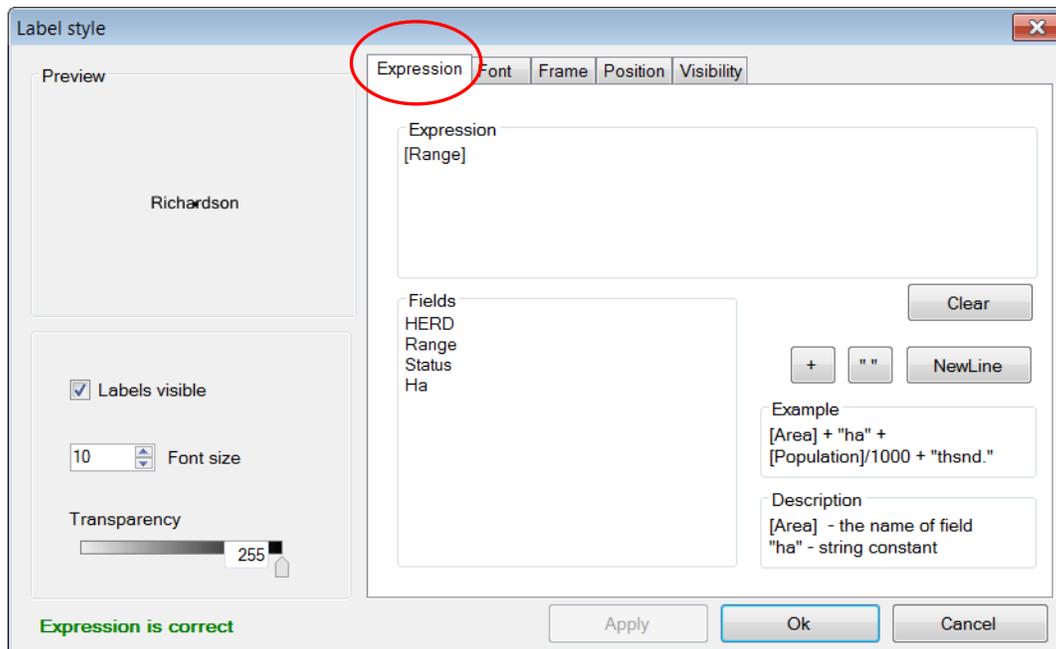
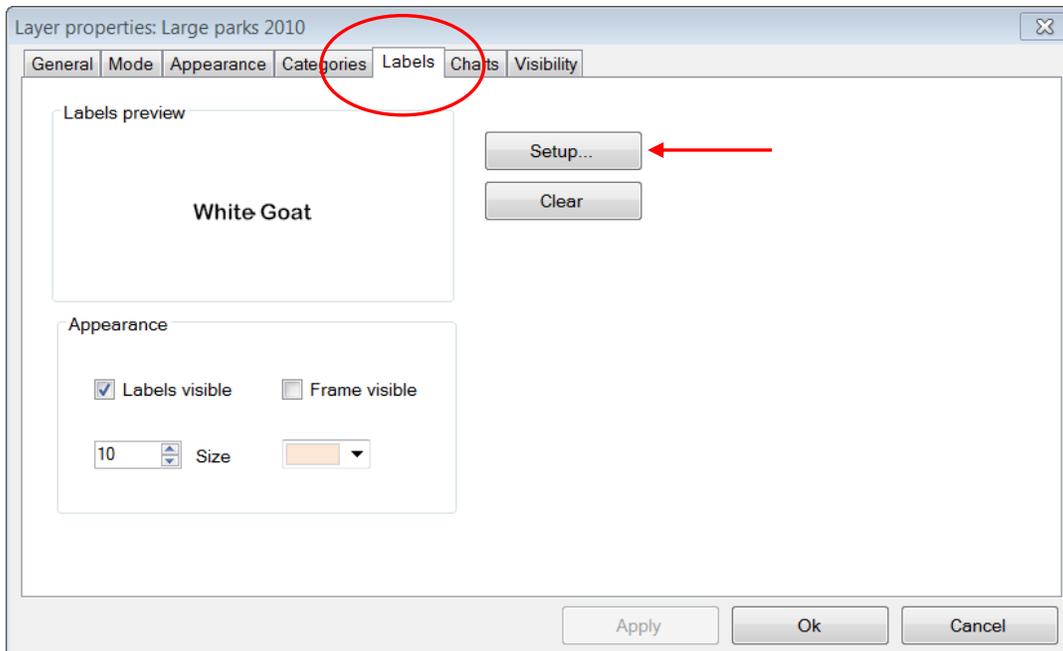
To change the color of a category just click on it in the **'Coloring Scheme Editor'**. There is no option to display outlines for raster cells. The text that is displayed in the legend can be changed via the **'Text'** column and the breakpoint values can be manually changed via the **'Value'** column. Hillshade is outside of the scope of this guide.

Transparency is set in the **'Legend Editor'**, four rows down from **'Coloring Scheme'**. If a raster is sufficiently fine-scaled, transparency can be used to effectively combine information from the raster with other layers. To do this, move the raster to the top of the legend, assign a black to white color ramp, and set the transparency to about 50%. Whatever layer is beneath the raster will now be shaded according the raster's values. For example, a vector map of ecosystem types could be shaded on the basis of elevation, with lower elevations being darker and higher elevations being lighter.

3.3 Adding labels

Labels are added using the **'Labels'** tab of the **'Layer Properties'** dialog, which is opened by double-clicking the layer in the legend. When you first open this dialog the label preview window will be empty. Click on the **'Setup'** button to proceed (see the screen shot on the next page). Clicking on the small label icon to the right of the layer's name in the legend opens the same dialog.

The **'Setup'** button brings up the **'Label Style'** dialog, defaulting to the **'Expression'** tab. The first step is to select the attribute that holds the label values. The available attributes are listed in the **'Fields'** window. Double-click on the appropriate attribute and it will show up in the **'Expression'** window, indicating that it has been selected. Click **'Apply'** and a pop-up will ask you how you want to anchor the labels.



Next, open the **Font** tab and select a font. Note that the default font may not be set, so you might not see anything until you assign the font here. Click **Apply** and the labels will appear on your map. The **Label style** dialog has many other options you can use to customize your labels, but none are mandatory. These options are fairly self-explanatory. Click **Ok** to finish.

Once labels have been generated you can change the text and style of individual entries by clicking on the **Categories** toolbar button. A new tab called **Labels** is now available (i.e., once labels have been defined). Initially it is empty, which means that all categories use the style

you defined in **Setup**. To define unique styles for individual categories you must first generate label categories using the same approach as for generating symbology categories (Sec 3.1). Then use the rest of the dialog in the same way as described for the **Shapefile categories** dialog (see 3.1.3) to modify the appearance of individual category labels.

The positioning of labels can be fine-tuned using the **Label Mover** toolbar button. Just click and drag.



3.4 Saving the symbology to file

All symbology settings for a layer can be saved for use in future projects. This is done using the **Symbology manager** dialog, which is opened using the **Symbology** toolbar button. When you first open this dialog the preview window displays the symbology settings you have just defined. Click the **Add Current** button to save the current symbology. You will be prompted for a name. The file is saved in the same folder as the layer and carries an .mwsymb extension. If you make additional changes to the layer's symbology you can save the new version under a new name. The dialog also has options for removing old symbology files and renaming them. Drag and drop adding of symbology files is not yet supported in MapWindow 4.8.6, but will be in a future version.



To apply a layer's saved symbology in a new project, first add the layer to your map and then open the **Symbology manager** dialog. Previously saved symbology files will be listed in the **Available options** window. Select the one you want and click **Apply options**. Note that when you open a symbology file that includes labels, the labels may not be visible until you click **Relabel shapefile**, under the **Layer** menu.

You can also save the core symbology to a file (*.mwleg) and then apply this symbology to other layers that have the same attribute structure (e.g., successive runs from a spatial model). Do this using the **Save Categories** and **Load Categories** options found under the **More** button at the bottom of the dialog that opens with the **Categories** toolbar button.



3.5 Exporting a map

3.5.1 Low resolution export

MapWindow provides two quick ways to export low-resolution maps. The first uses the Windows clipboard: open the **View** menu and select **Copy**. You can copy the map, legend, scale bar, and north arrow. In the second approach the same map components are exported to a file. Open the **File** menu and select **Export**. A wide variety of export file formats are available. For most maps the .png format will be best. When colors are uniform, as they typically are in maps, the .png format provides a high degree of compression without any changes to the image (i.e., lossless compression). To specify the export format just add the appropriate extension to your file name (e.g., Map1.png).

The low-resolution export described here is equivalent to a screen dump of the main map window. Note that the **Preview Map**, if you are using it, plays no role here. If there is a lot of white space in the main window, your exported map will have lots of white space. If you have

minimized MapWindow (instead of running full screen), the map you produce will be small (basically a 1:1 ratio with what you see on the screen). The resolution of the map is equivalent to the resolution of your computer screen. This being the case, the exported maps are ok for use in PowerPoint but not for printing. Even though the map may look ok in Microsoft Word when it's up on your screen, the image quality on paper will be poor.

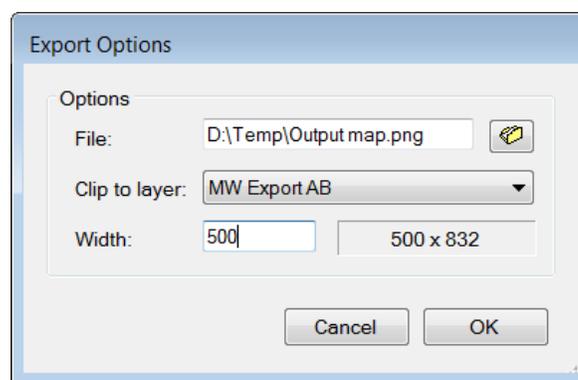
3.5.2 Preparing a publication-quality map

Once you have your map looking the way you like it there are still a few steps required to prepare it for publication. As an example, say you are preparing a research paper or brochure and you want to add a map that will fit into a single column of text 7cm wide. The map you produce should have a resolution of 300 dpi (print quality) and fit into the allotted 7cm with a minimum of white space around it. It should also include an appropriate legend and perhaps a scale bar and north arrow. The '**Print Layout**' dialog, accessed under the '**File**' menu is intended to facilitate this process, but it is really just designed for printing, not publishing (i.e., the layout cannot be saved as a digital image). Also, the output resolution cannot be specified (just high and low), no modifications can be made to the legend, and there are limited options for defining a bounding box. This being the case, the best option (at present) for generating a publication quality map is to do some of the work in an image editor like Photoshop.

The first step in preparing your map for export is to define a bounding box for it. Do this by creating a simple rectangular shapefile that provides the margins you would like to see around your map (see 4.3). This layer must be included in your project, but it does not have to be visible. As an alternative you can use one of the existing layers in your project to define the map extent, but be aware that the output map will be tight-cropped (i.e., no margins). The practicality of defining a bounding box comes into play if you generate multiple maps with the same extent – although margins can be added in Photoshop it's tiring to have to do so for each and every map.

Next, open '**Export**', under the '**File**' menu and select '**Georeferenced Map**' from the list of options. In the dialog that pops up enter a name for the map you are exporting in the '**File**' box. Remember to include the extension for the file type you want (e.g., .png). For '**Clip to layer**' select the layer that is to serve as your bounding box. If you haven't defined a bounding box enter the layer with the largest extent. For '**Width**', enter the desired width of your map in pixels. The value you enter here will depend on your desired resolution and your desired width.

You will find that, in addition to your exported map, a second file with a .wld extension is generated during the export. This file can be deleted.



Export the legend, scale bar, and north arrow, as described in the previous section (3.5.1). Unfortunately, there is no way to generate high-resolution versions of these map elements in the current version of MapWindow. Frankly, I find the legend export to be of limited use anyway because there is no way to customize it (except for changing the layer names). Therefore, I generally produce my legend within Photoshop using a high resolution template I have made for

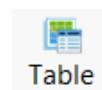
this purpose. Producing a legend is simply a matter of adding the template to the base map, moving it to the right spot, changing the colors, and revising the text. It takes only a couple of minutes and produces a much better result than the cluttered low-resolution legend exported by MapWindow.

4. Advanced Topics

A word of caution. Many of the dialogs and processes discussed in this section can result in changes to your GIS data. MapWindow provides few warnings to alert you to such changes and the undo functionality is not yet working. Given the absence of a good safety net you should proceed carefully. For example, using Windows Explorer you might set the properties of important map layers to Read Only, or choose to work with copies instead of original maps.

4.1 The attribute table

Vector maps are linked to an attribute table that contains information for each shape. For example, if the shapes are forest stands the attribute table might include information on vegetation type, age, height, and so on. When you use the **Identify** toolbar button you are viewing information from the attribute table. To view the entire attribute table click the **Table** toolbar button, which brings up the **Attribute Table Editor**. This dialog allows you to view the data and also provides some basic database functionality.



Some useful database functions provided by the table editor are summarized below.

Function	Method
Modify a single data entry	Type over the existing data in a cell and it will be changed
Copy and paste individual data entries (there is no option for copying columns)	Right-click within a cell and select Copy or Paste
Add a new column	Edit → Add field
Remove a column	Edit → Remove field
Rename a column	Edit → Rename field
Sort a column, ascending or descending	Right-click on the column title and select Sort Asc or Sort Desc
Summary statistics for a column	Right-click on the column title and select Statistics
Assign values to a column based on a mathematical expression	Right click on the column title and select Calculate values
Set an attribute to a constant value (for selected shapes only)	Right click on the column title and select Assign values
Generate a unique identifier for each shape	Tools → Generate MWShapeID Field

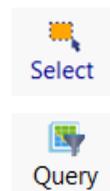
If changes have been made to the table a warning dialog will appear when the table editor is closed. **Yes** means commit the changes and **No** means discard the changes.

A feature that is missing in the current version of MapWindow is the ability to link external datasets to the attribute table (like **Joins & Relates** in ArcMap). Therefore, if you want to

categorize and display shapes on the basis of an external attribute you must physically add the new attribute to the shapefile's attribute table. This can be done with a query in Microsoft Access or other database program. You can also use Excel, but unless you have an older version you will need to add a plug-in to Excel to provide support for .dbf export (.dbf is the file format that MapWindow and ArcMap use for the attribute table). A source for this plug-in is: http://es.sourceforge.jp/projects/sfnet_exceltodbf/ The merge can also be done using the **'Import External Data'** option of the **'Swift-D'** plug-in of MapWindow (though it's slow). The attribute table editor has a tool called **'Generate MWSHAPE ID field'** that can help you maintain the correct order in the table when you are merging external data.

4.2 Selections

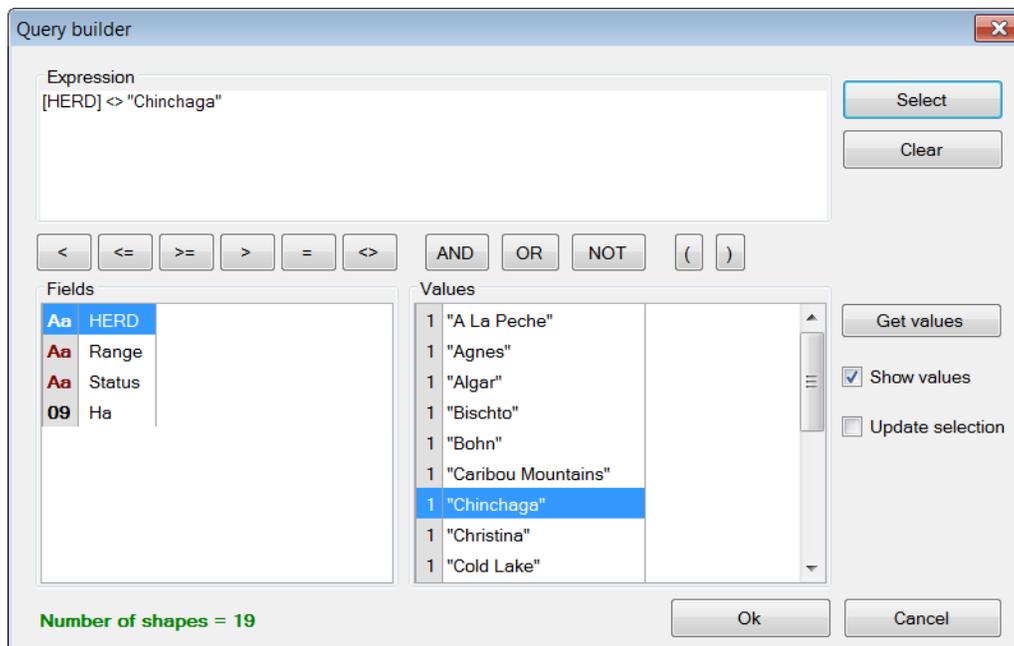
Vector shapes can be selected in four ways: (1) the **'Select'** toolbar button, (2) the **'Query'** toolbar button, (3) the attribute table, and (4) the spatial query plug-in. The color used to highlight selected shapes can be changed in **'Appearance'** tab of the **'Layer Properties'** dialog. To clear a selection click **'Clear selection'** under the **'View'** menu. Selected shapes can be exported to a new shapefile using the **'Selection'** menu of the attribute table editor. Selections are also useful for visualizing queries and for limiting the scope of many geoprocessing procedures.



4.2.1 The **'Select'** toolbar button

The **'Select'** button is used to manually select shapes. The target layer must first be selected in the legend. Click on a shape to select it. To add additional shapes hold Ctrl while clicking. If Ctrl is not held, then clicking a shape will cause any previous selections to be removed. In the current version of MapWindow there no way of unselecting individual shapes (all or none). To select a block of shapes click and draw a bounding box in the desired region.

4.2.2 The **'Query'** toolbar button



The **Query** button pulls up the **Query builder** dialog. This dialog is used to select shapes based on attributes defined in a search expression. The available attributes are listed in the **Fields** window. Double click the attribute you want and it will appear in the **Expression** window. Then select a logical symbol and the value you want to search for. When the expression is complete click **Select**. You are given the option of adding to an existing selection, excluding from an existing selection, or starting a new selection. The dialog will tell you how many shapes have been selected.

In the example shown on the previous page an expression was defined to search for all herds that do not have the name Chinchaga. A total of 19 shapes fit this description and were selected.

4.2.3 The attribute table

The attribute table can be used to both view and define selections. To view only selected shapes click the **Show only selected shapes** button, found in the toolbar  near the top of the table editor. Click this button again to view all records. To select a record click the grey rectangle at the far left of the table. The record will be highlighted, indicating that it has been selected. Use the standard Windows shift-click to select multiple consecutive records, or just click and drag the mouse along the left. Use Ctrl-click to select multiple non-consecutive records. Clicking the **Apply** button is not required to make a selection.

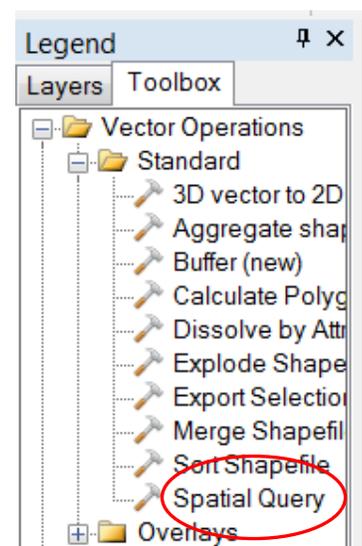
Several important selection functions are found under the **Selection** menu, including: invert selection, select none, and select all. This menu is also where the option to export selected features is found. Export means create a new shapefile identical to the current layer but containing only the selected features. This is a useful way of producing derivative maps.

If the layer contains a large number of shapes it may be difficult to see a selected shape. You can zoom to the selected shape via the **View** menu or using the **Selected** toolbar button in the main MapWindow interface.

4.2.4 The spatial query plug-in

The **Spatial Query** dialog is a part of the GIS **Toolbox**, found under the legend. The path to the **Spatial Query** is: **Legend** → **Toolbox** → **Vector Operations** → **Standard**.

A spatial query means selecting shapes from one layer based on their spatial relationship to shapes from another layer. For example, a query might select shapes from layer A if, and only if, they intersect with shapes from layer B. Several types of relationship can be specified, including: intersect, contain, touch, overlap, and others. It is possible to restrict the query to shapes in layer B that have been selected.



4.3 Creating and editing shapefiles

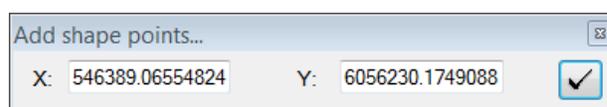
Shapefiles are added and modified using a plug-in called '**Shapefile Editor**'. Remember to activate the plug-in first in the '**Plug-ins**' menu. Doing so brings up a new toolbar that is used to run the plug-in's various functions. All references to toolbar buttons below refer to the shapefile editor's toolbar. Note that this is a large toolbar and adding it can cause many of the other toolbars to be hidden. To avoid this you can grab the toolbar along the row of dots, and drag it down one row, or to wherever you want it.

A word of caution. The shapefile toolbar works on whatever layer happens to be selected in the legend. If you accidentally switch layers at some point there will be no warning to let you know that the target has changed. Furthermore, although the shapefile toolbar does have an '**Undo**' button, it is not yet functional in version 4.8.3. That said, you do have the option of setting the layer to '**Editing mode**' in the '**Mode**' tab of the '**Layer Properties**' dialog. This allows you to discard all changes when ending the editing session.

4.3.1 Creating a new shapefile

Shapefiles are created using the '**New**' toolbar button. Clicking '**New**' brings up a dialog in which you specify the name and location for the new file. You also select which type of shape you want: point, line, or polygon. Before creating a new shapefile you should load a layer into your project to set the projection and to serve as a spatial reference when adding your new shapes. Advanced techniques for georeferencing are beyond the scope of this guide.

When a shapefile is created it is empty. To add freeform shapes use the '**Add**' toolbar button. There are two options for defining vertices. The easiest is to use the mouse – each time you left-click a new vertex is added. When all the vertices have been defined, right-click the mouse to finish. An alternative approach is to define vertices by typing in their X and Y coordinates. A dialog is provided for this purpose when you click the '**Add**' button. After you have entered the X and Y values click the checkmark to the right to add the vertex. Then go on to the next, until you are done. Right-click to complete the shape and exit. Note that the X and Y boxes track the current location of the mouse, so don't let your mouse stray out of the dialog when entering the values or the values will be changed.



To add a regular shape (e.g., rectangle, circle, etc.) use the '**Insert**' toolbar button. First, pick the type of shape you want by clicking the '**Add this**' radio button of your choice. Next, fill in any required data (e.g., rectangle height and width). Then go to your map and click where you want the centroid of the new shape to be. Repeated clicking will produce multiple shapes. Once all of your shapes have been added click '**Done**' in the dialog to exit.

4.3.2 Modifying existing shapes

The shapefile toolbar has three buttons for changing the shape of existing shapes: '**Move vertex**', '**Add vertex**' and '**Remove vertex**'. Vertices need not be visible to use these tools.

When your mouse passes over an existing vertex it will be displayed, allowing you to move it (click and drag) or remove it (click) with the appropriate tool. If you are adding vertices, a new vertex will appear under your mouse when it travels near a shape (click to add). If the vertices are not immediately visible, wait a few seconds – there is a slight lag when the tool initially loads. The shapes do not have to be selected for the tools to work. Until the ‘**Undo**’ feature is functional it would be advisable to work with a copy of existing maps when modifying vertices, not the original, since the changes are committed immediately.

To remove shapes from a layer they must first be selected. Then click the ‘**Remove**’ button to delete them. A warning box will pop up to ask you if you are sure.

Click the ‘**Merge**’ button to merge individual shapes together. A dialog will pop up prompting you to select the shapes to be merged. The shapes to be merged must all belong to the same layer.

4.4 Geoprocessing

MapWindow includes a set of tools for common geoprocessing tasks. The main suite of tools is found in the GIS ‘**Toolbox**’, which is a tab under the legend. A few others exist as independent plug-ins. A description of geoprocessing operations is beyond the scope of this guide, but I will list some of the main operations here to provide readers with an understanding of the capabilities of MapWindow:

- Buffer shapes
- Vector overlays, including intersection and union
- Various clipping operations, including clip using shapefile or polygon mask
- Dissolve shapes by attribute
- Calculate polygon areas
- Various projection functions
- Several raster operations, including clip by polygon, merge grids, and reclassify