

Tutorial 3 - Map Symbolology in ArcGIS

Introduction

ArcGIS provides many ways to display and analyze map features. Although not specifically a map-making or cartographic program, ArcGIS does feature a wide range of cartographic functions and symbolology. Remember that the use of appropriate map symbolology (points, lines, area fills, color, etc.) and map design determines how effective a map is as a graphic communication tool. You need to select the correct symbolology for the data type and, if necessary, select an appropriate generalization. For example, you may be asked to make a simple land cover map. Such data are often nominal in scale (trees, developed, water, etc.) and only require that you pick an appropriate fill pattern or color for each type. By contrast, a map showing population density uses ratio scale data. Such data are usually generalized into a smaller number of categories in which each is symbolized by a different fill or color. Of course, not all features are symbolized using areas. Some are better portrayed by points or lines. Also, different symbolization strategies are used for vector and raster data.

The objectives of this tutorial include:

1. Learning to use the symbolology window in ArcMap.
2. Selecting and modifying appropriate symbolology for different data types.
3. Exploring the different ways in which data are generalized.
4. Creating custom color schemes.
5. Saving layers.

NOTE: Before beginning the tutorial, please make sure you “map” the geography server and copy the file named Lab3 to your personal server folder. Lab3 is a Winzip archive that contains the data that are needed for this tutorial and exercise 3. These files include:

BoatLaunch (shapefile, NAD1983 UTM Zone 18N meters)

Sunshine (shapefile, Geographic Coordinates WGS1984 degrees)

mtmarcyz (raster grid, NAD1983 UTM 18N meters)

GreatLakeSnow (shapefile, Geographic Coordinates, GCS_NAM 1983 degrees)

Backtrajectories (shapefile, Geographic Coordinates, GCS_NAM 1983 degrees)

julymaxt (raster grid, Geographic Coordinates WGS1984 degrees)

After you have copied this file to your personal server folder, unpack it.

1. Working with the symbolology window

- (a) Launch ArcMap and open a new blank map. Add the US States map from the C:\ESRI\ESRIDATA\USA folder.

- (b) Like always, the STATES map is unprojected. Please change the display projection to an Albers Equal Area.
- (c) Right click on “STATES” in the layers menu and select “Properties.”
- (d) Click on the Symbology tab (see Fig.1).

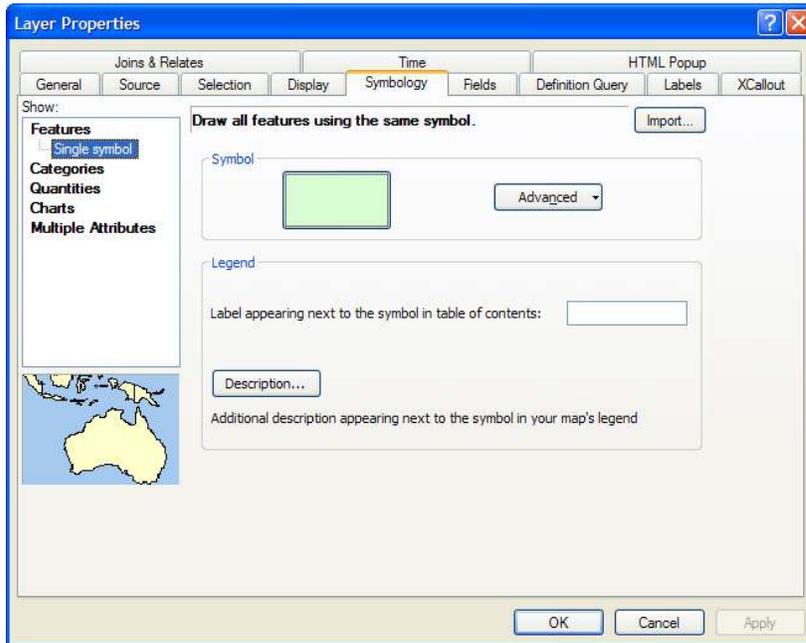


Fig. 1

- (e) The various symbology options are listed on the left side of this window (Features, Categories, Quantities, Charts, and Multiple Attributes). A very brief summary of these options is listed below.
 - Feature – Draw all features using the same symbol
 - Categories – Assign symbology based on unique values (ex. state names)
 - Quantities – graduated colors, graduated/proportional symbols, and dot maps
 - Chart – used to create pie and bar charts
 - Multiple attributes – used to show more than one attribute
- (f) One of the variables in the STATES attributes table is 1990 population density (POP90_SQMI). A choropleth map is a good symbolization for this type of data. A choropleth map is a form of thematic map in which colors or shades are used to represent standardized values (such as population/square mile) over entire areas.
- (g) To make a choropleth map, click on “Quantities” in the symbology window. You will be presented with the window shown in Fig. 2

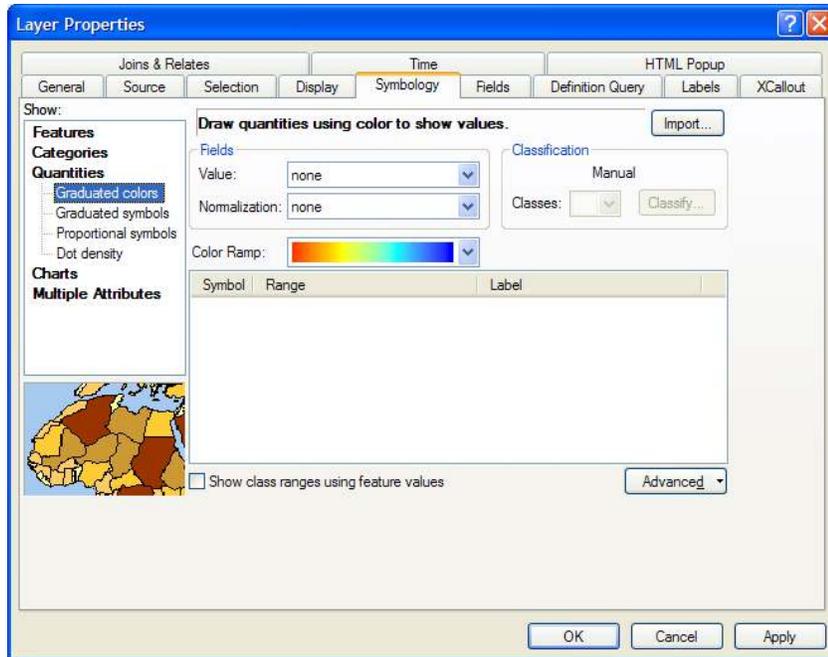


Fig. 2

- (h) Note that “graduated colors” is the default symbology for Quantities. Hold the “Values” dropdown menu and select “POP90_SQMI.” You will be presented with a default 5 class classification scheme and a default color scheme (see Fig. 3)

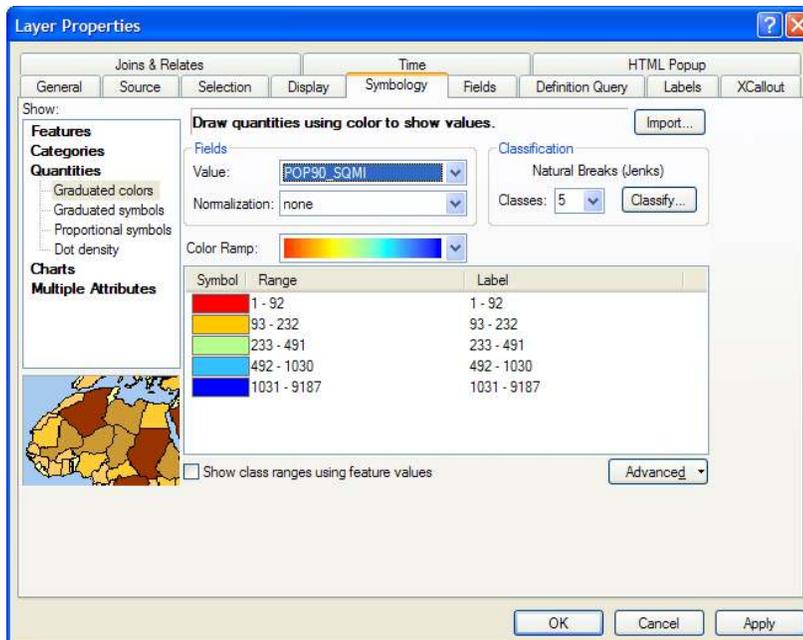


Fig. 3

If you want a simple text based description of the color ramp, right click on the Color Ramp, and click off "Graphic View." (Fig. 4.)

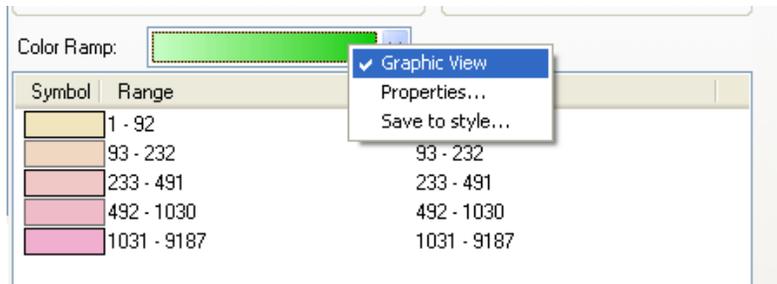


Fig.4

- (i) The “Classify” button is used to alter the classification scheme. Experiment with the classification method by looking at natural breaks, equal interval, and quantiles. Each time you make an alteration you will need to click ‘Ok’ and ‘Apply’ to actually see the change on your map. Take note of the ways in which classification influences the look of the map.
- (j) Note that you can manually define the range of data class by entering the upper value of each class directly in the Break Values box within the classification window (see Fig. 5). This may be a well-justified thing to do if the data have obvious cut-points like zero (for a value that ranges from positive to negative) or a meaningful overall average (if you want to show whether a given place has a value above or below the average).

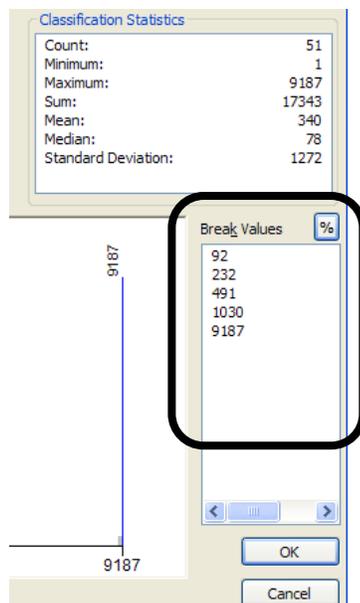


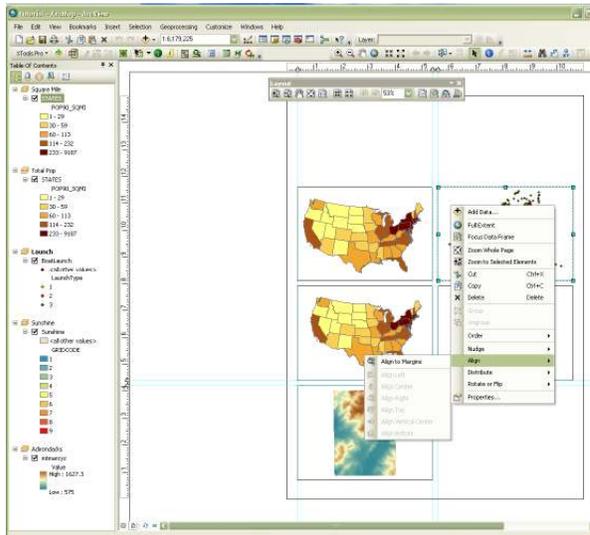
Fig. 5

- (k) Back in the layer properties window you can select pre-packaged color schemes (called color ramps) or click on each color box to select new colors.

- (l) For the sake of learning experience, let's check out what the map looks like if we use the raw population for 1990. Remember, choropleth maps are usually not appropriate for raw numbers. To make visual comparison easier, we want to see two maps (one for POP90_SQMI and the other for POP1990) side-by-side.

(m) One way to juxtapose two maps is:

- a. Under the Insert menu, select Data Frame. This will add and activate a second data frame within your data view. Please note that this new frame has nothing in it. Your initial data frame is still there, but you cannot see it. The bold data frame label indicates which data frame is currently active. If you want to switch the active data frame, right-click on the data frame name ("Layers") you want to view and choose "Activate."
- b. Make sure your new empty layer is active.
- c. Add the STATES shapefile to this new dataframe just as you did in the first data frame. (Note: you can also drag and drop layers from one dataframe to another but the dataframe properties won't follow). Reproject this new map in Albers.
- d. If you select the layout view, you will see both dataframes superimposed.
- e. In your new STATES layers, change the choropleth map into one based on POP1990. Go back to the "Layout View" and compare the two maps. See Fig. 5 for an example of what this might look like.
- f. If you want to arrange and/or align the two windows you can right click on a dataframe and select 'align' or 'distribute' (see below) to stretch the frame over the paper. The options within these two selections help to organize the different dataframes within a map. Be sure to explore their use.



- g. Discuss with your instructor or classmate about the differences between the two maps (shown below in Fig. 6).

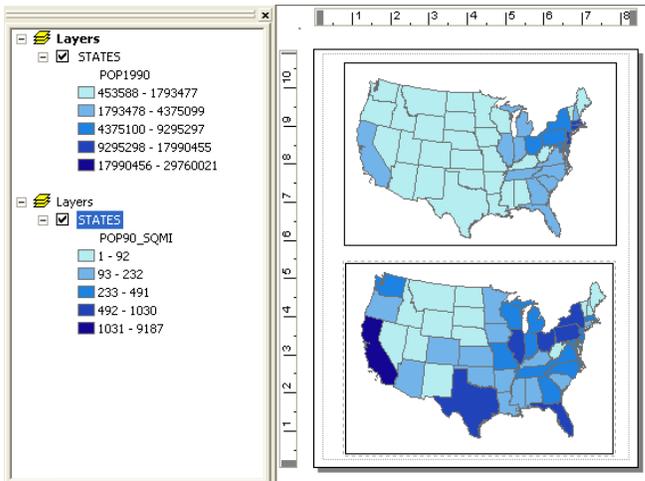


Fig. 6

2. Custom color ramps

Depending on the type of data you are mapping, you may find that ArcMap's color ramp selection is not sufficient. Here are some ways to change that.

- (a) Reversing a color ramp. Consider the color ramp shown in Fig. 7. Let's assume that this is a map of elevation and we want the color scheme to go from blue (low) to red (high). However, the default color ramp is backwards. To correct this, right-click in the color ramp window and select "Flip Symbols." The color ramp will reverse.

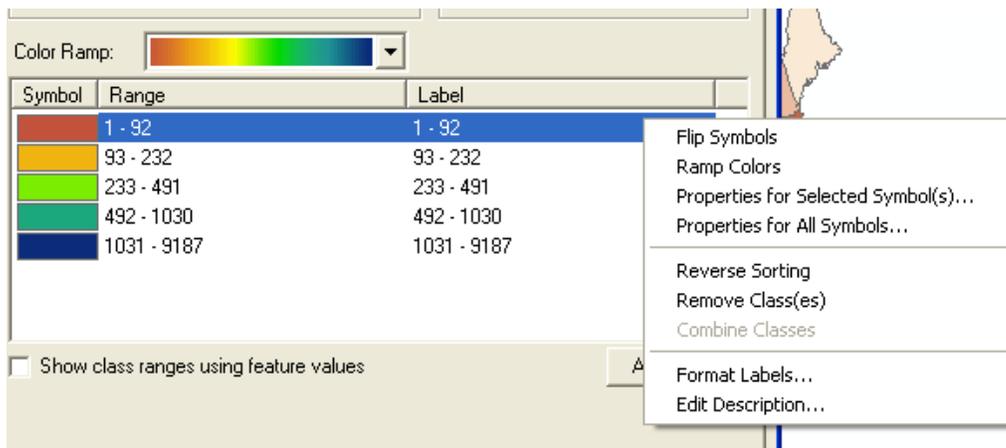


Fig. 7

(b) Creating your own color ramp. 2 ways.

1. Individually. Start with an existing ramp and then double click in each color box to change it to a new color. Fig. 8 shows the window that opens when you edit a color box. Try altering the colors in the US population density map. Click OK in the 'Symbol Selector' window to change the color of the symbol and then click OK again to apply the color scheme to your map.

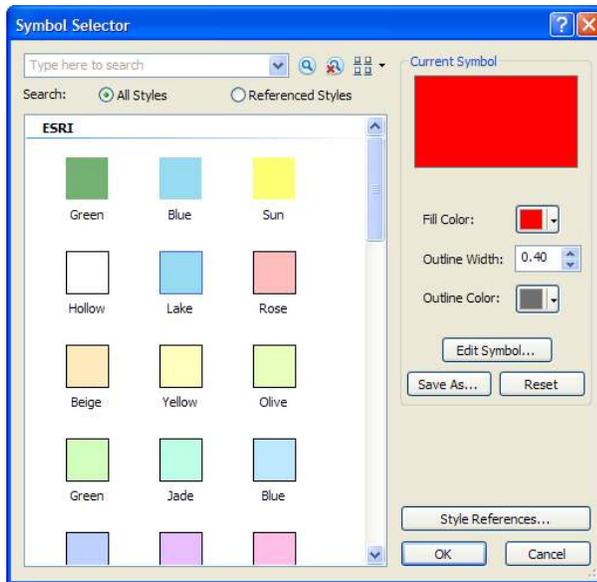


Fig. 8.

2. Whole ramp. Change the first color and last color as in previous step. Then click on "Ramp Colors." If you want multipart ramps, then select the place you want the ramp to change, change the color, hold onto the CTRL button, and then click "Ramp Colors." See Fig. 9. (Works better on larger classification schemes, with white or a heavy contrast color in the center. Note: neighboring colors will also be affected.)

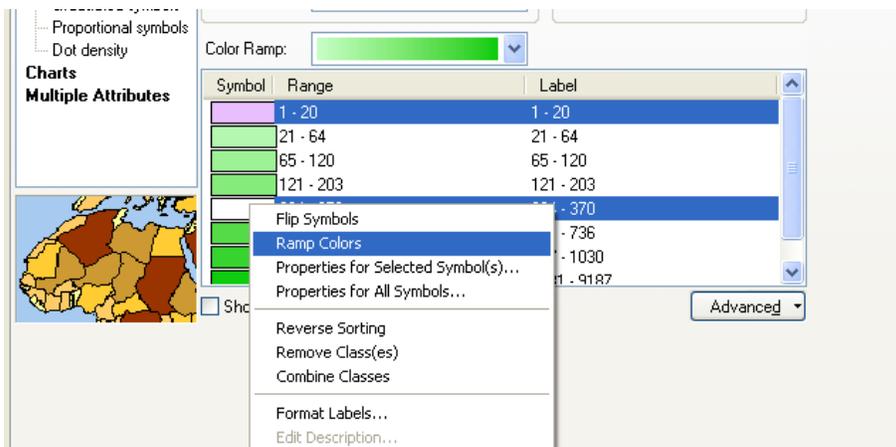


Fig. 9

In order to save any ramp for future use, you must save it as a layer file. Right-click on the map name and select save a layer file (Fig.10). This will allow you to use the color scheme later when working with the US population density data.

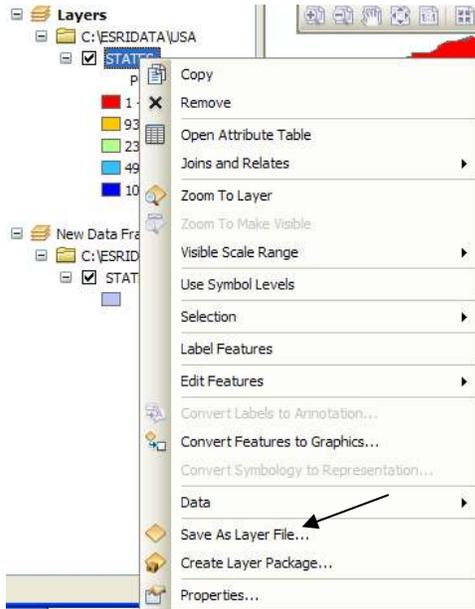


Fig. 10

The layer file contains the custom color ramp information. Later, when you want to use the ramp, click the “Import” button in the Symbology window. You will be given a window like that shown in Fig. 11 that allows you to import symbology from a layer file. Please note that this will not only import the color ramp but also the classification, unless you specify to import just the symbols. Importing the complete symbology definition will only work with the same data. For example, you should not apply your US population symbology layer to a population map of the world.

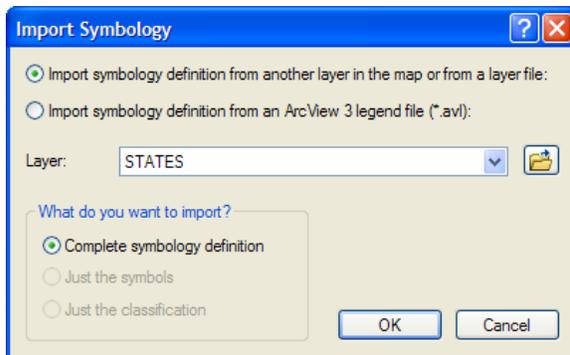


Fig. 11

3. Modifying the way the legend appears on the map

(a) You may be interested to learn that you can alter the way a legend is labeled on a map by altering the label field in the legend editor (see Figs. 12 and 13)

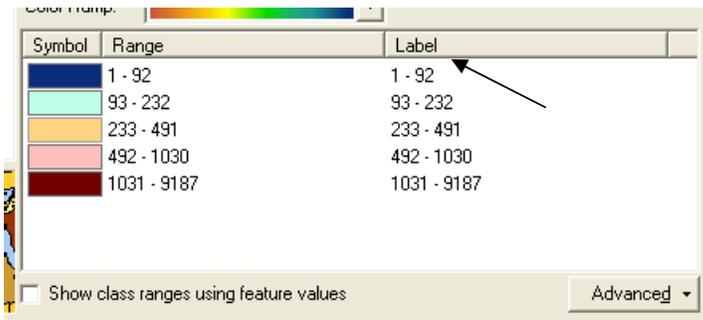


Fig. 12

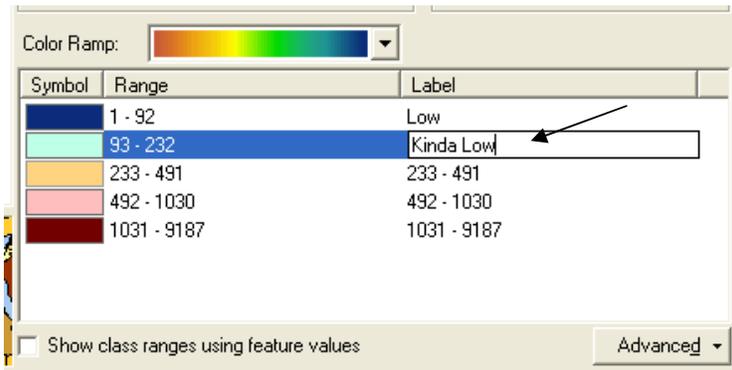


Fig.13

(b) Altering the label field does not alter the data. It only changes the way it appears in the map table of contents (Fig. 14) and in the layout. You can also change the name of a layer (e.g. 'STATES' to 'States') or a variable ('POP90_SQMI' to 'Population Density'). This is done by slowly double left clicking (once to highlight, a second to modify) on the layer name or variable.

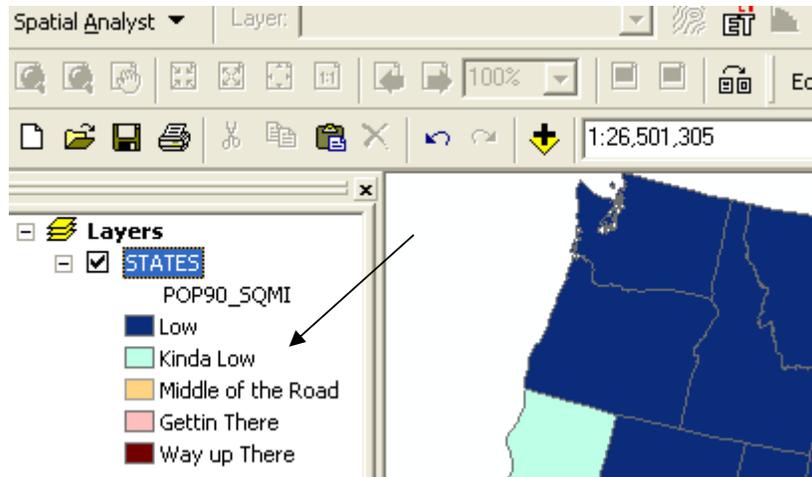


Fig.14

4. Changing scale-bar properties

Normally, you should not have a scale bar on a small-scale map (i.e., a map that covers a large area such as the entire world or a large country), but for the sake of practice, let's add a scale bar to the map in the Layout window – do you remember how to do this? The default scale bar usually looks rather messy (see Fig. 15).



Fig.15

Suppose that you want to make the scale bar look like Fig. 16. How can we modify the scale bar?

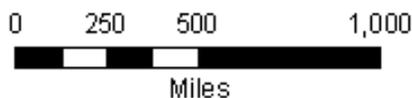


Fig. 16

Double-click on the scale bar, and you will see the “Alternating Scale Bar Properties” window. Change the “When resizing...” to Adjust width, and change the other parameters as in Fig. 17. Think about what each parameter means.

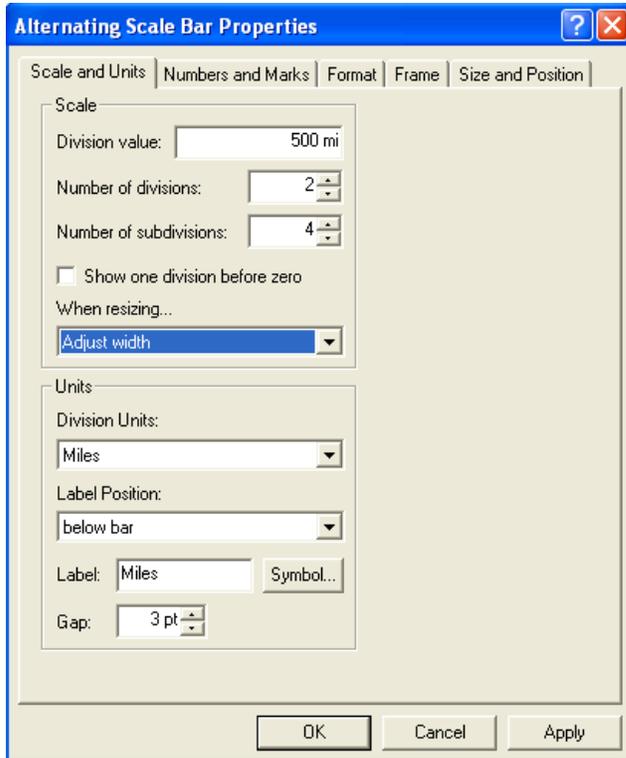


Fig. 17

Make sure you also explore the legend wizard, by selecting insert → legend from the main GUI. This will open up a dialog box designed to help you put together a useful legend. Explore the many options that exist and make sure to utilize the “preview” option to see how the legend looks at different stages along the way.

5. Playing with point data

One of the shapefiles contained in the Lab3 archive is a map showing all of the boat launches in New York State (BoatLaunch). One of the attributes in this shapefile is called LAUNCHTYPE. This attribute has values that range from 1-3 and correspond to:

- 1=Beach Launch
- 2=Hand Launch
- 3=Paved Launch

Please open a new map window and add the BoatLaunch shapefile. You need to create a map that shows people where the boat launches are located and the launch types. I recommend the use of the Categories submenu within the symbology window.

- a) Open the Symbology window
- b) Select Categories → Unique Values (see Fig.18)
- c) Select LaunchType in the Value Field and click Add All Values (see Fig.19)

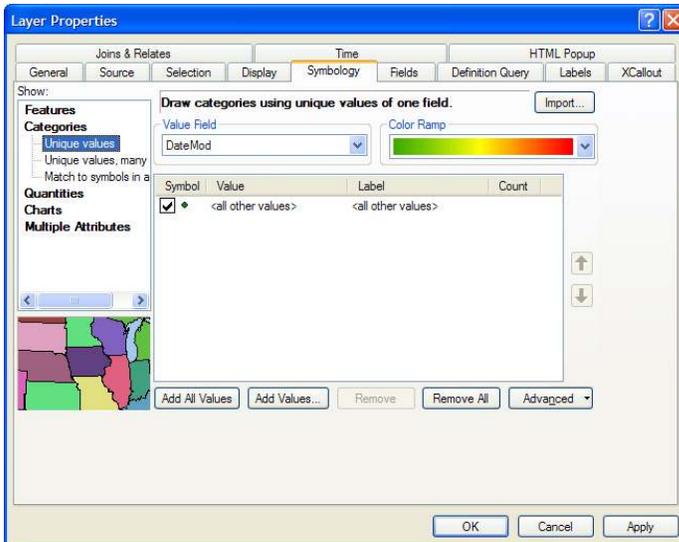


Fig.18

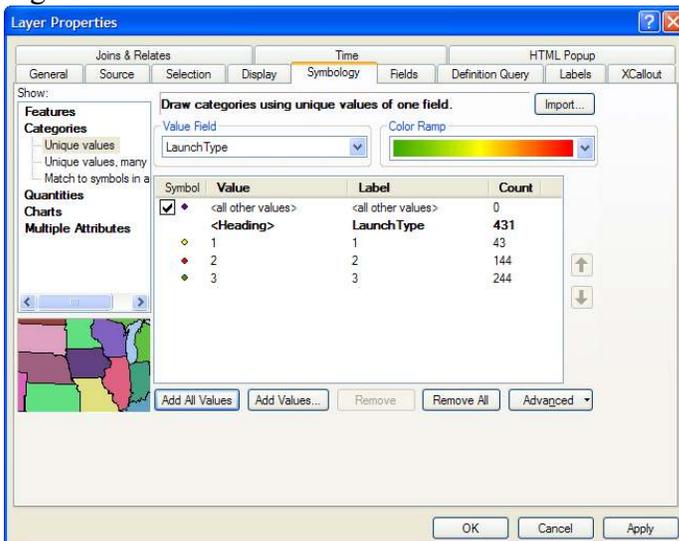


Fig.19

- d) Double click on each dot in the symbol window and experiment with different symbol types, sizes, and colors.

6. Other types of polygon data

Open a new blank map and add the Sunshine shapefile (see Fig. 20). This polygon shapefile contains information on the percent of possible sunshine based on the 1961-1990 period. My initial reaction to this map is to change the projection to something more appropriate and to look at the attribute table. The table, which is shown in Fig. 21, has a string attribute called “Percent” that indicates the range of sunshine percentage for each polygon. There is also a numerical attribute called “GRIDCODE” which contains a number that is associated with each sunshine range.

How would you symbolize these data? See what you can come up with.

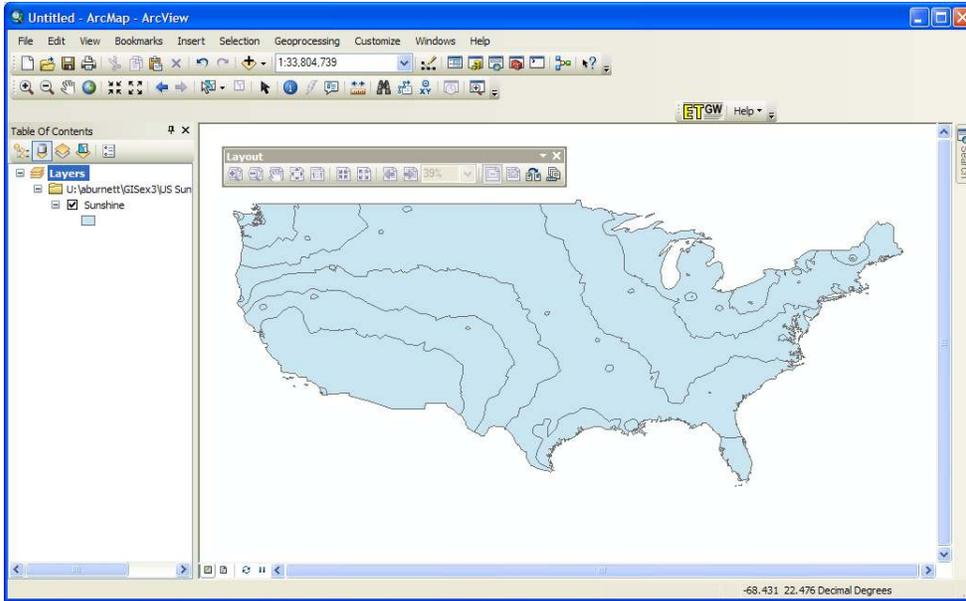


Fig. 20

 A screenshot of the "Table" window in ArcMap, showing the attribute table for the "Sunshine" layer. The table has the following columns: FID, Shape*, ID, GRIDCODE, and PERCENT. The data is as follows:

FID	Shape*	ID	GRIDCODE	PERCENT
0	Polygon	1	4	D 51 - 55
1	Polygon	2	4	D 51 - 55
2	Polygon	3	4	D 51 - 55
3	Polygon	4	4	D 51 - 55
4	Polygon	5	4	D 51 - 55
5	Polygon	6	4	D 51 - 55
6	Polygon	7	3	C 46 - 50
7	Polygon	8	3	C 46 - 50
8	Polygon	9	4	D 51 - 55
9	Polygon	10	4	D 51 - 55
10	Polygon	11	4	D 51 - 55
11	Polygon	12	4	D 51 - 55
12	Polygon	13	1	A < 41
13	Polygon	14	4	D 51 - 55
14	Polygon	15	4	D 51 - 55
15	Polygon	16	4	D 51 - 55
16	Polygon	17	4	D 51 - 55

 The status bar at the bottom of the table window indicates "(0 out of 262 Selected)".

Fig. 21

7. Raster symbology

Open a new blank map window and add "mtmarcyz". This file is a raster grid in which every grid cell contains the elevation (meters) above sea level in the area around Mt. Marcy, NY. We call this type of data a digital elevation model (DEM). Your map should look something like Fig. 22.

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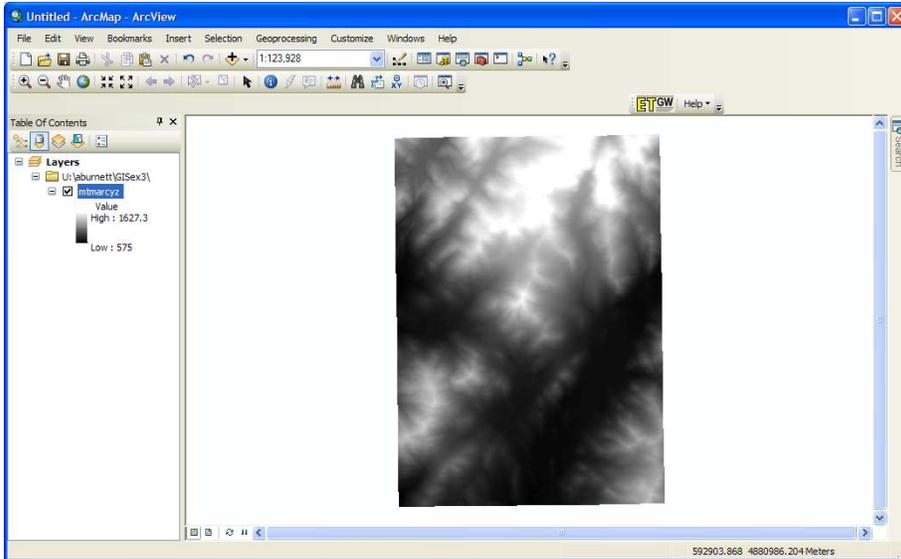
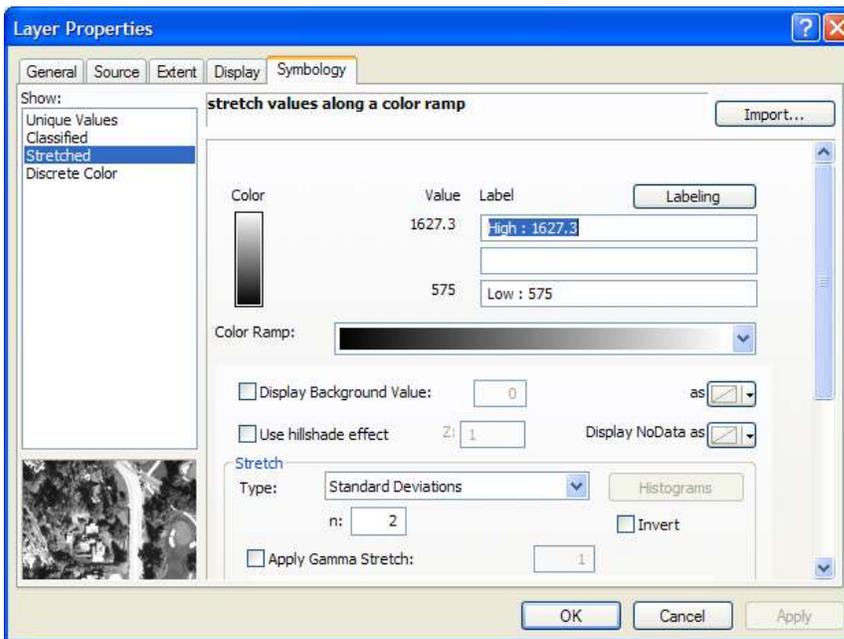


Fig. 22

Right click on mtmarcyz in the layer window, select properties, and click on the symbology tab. Because this is a raster grid, you will see a different type of symbology window than the one you see with vector data (Fig. 23).



The default symbolization is called “Stretched” in which a continuous color or gray-scale is used to show map values ranging from lowest to highest. In other words, the colors are stretched from low to high. Try changing the color ramp from black and white to something more exciting.

Perhaps a stretched symbology is not effective and you would prefer to group elevations into distinct ranges. This is done using the “Classified” option in the symbology window. When you try this, you might get a message asking to compute the image histogram – answer OK. I would avoid the temptation to select “Unique Values” or “Discrete Colors” when symbolizing a raster of this type. Why? Give it a try and see what happens.