



## Roadkill Retrospect: Vehicle-Caused Wildlife Mortality along Highway 10 GIS Lesson in ArcGIS 9.x

**Lesson Difficulty: ADVANCED**

**Length of Lesson: 1:00 – 1:20**

### **In this lesson students will:**

1. Create a map in ArcGIS 9.x displaying vehicle-caused wildlife mortalities along Highway 10 between 1988 and 1996.
2. Illustrate the relative density of wildlife mortality.
3. Create *Wildlife Mortality Percentages* graph and insert it onto the map.
4. Create *Vehicle-Caused Wildlife Mortality Along Highway 10* map complete with project information, north arrow, scale bar, and descriptive text box.

### **GIS Skills acquired through this lesson:**

- Thematic mapping.
- Formatting, viewing, and identification of spatial data.
- Introduction to Spatial Analyst tools (Density Tool)
- Proper understanding of map layout and functions in Arc.

### **Required Data and Software:**

- ArcGIS 9.x (ArcGIS 9.2 or ArcGIS 9.3)
- ArcGIS 9.x's Spatial Analyst Extension
- Data layers (enclosed within CD-ROM): *Highways.shp*, *rmnp.shp*, *manitoba.shp*, and *HighwayWildlifeMortality.shp*.



## Teacher Summary

Wildlife mortalities along Highway 10, which links Dauphin to Brandon and runs straight through Riding Mountain National Park (RMNP), have always been problematic. Colliding with wildlife is not only a danger to public safety – drivers can suffer serious injury or death – but also to **ecological integrity** – killing significant amounts of wild animals reduces an ecosystem's overall health.

In 1996, RMNP staff renewed efforts at reducing wildlife mortalities on Highway 10. Using **GIS technology**, they produced a map that highlighted exactly where the highest numbers of wildlife mortalities occurred. Road signs were then installed around these high-risk areas warning drivers of the presence of wildlife and asking them to slow down. Furthermore, the amount of road salt dispersed on the highway was reduced. These measures lead to an important decrease in roadkill.

In this lesson, students will recreate the map produced in 1996 by RMNP staff. Students will experience how GIS technology helps solve real-world challenges as they learn about the importance of public safety and ecological integrity in national parks.

It is suggested that students first get some background on the problem of wildlife mortality on Highway 10, and its repercussions on public safety and ecological integrity. Fact Sheets, Web links and various Challenge Options have been included to help with this process. Next, students can proceed to the GIS lesson itself. The first-person scenario will help set the scene and detailed instructions will guide students and teachers each step of the way. Lastly, consult the Challenge Options section to see how the GIS activity can be extended into other subjects.

**For students:**

## **This is Your Mission**

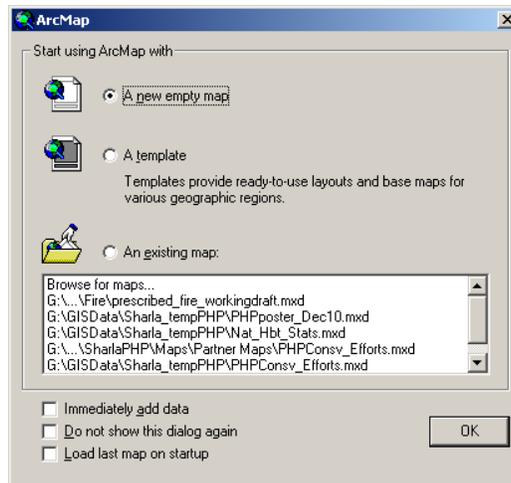
*Close your eyes and take a deep breath as we go back in time to 1996...*  
Animal mortalities along Highway 10, the main highway through Riding Mountain National Park (RMNP), have always been a problem. For many years, park staff has been placing signs to warn drivers of the danger, but the effect seems to have been rather limited.

In a new effort to reduce animal highway mortalities, park authorities have convened a special committee to analyse wildlife mortality data using GIS. You work as a part-time GIS technician for RMNP and you've been asked to help this committee by following the instructions in this document to complete a map entitled ***Vehicle-Caused Wildlife Mortality along Highway 10.***

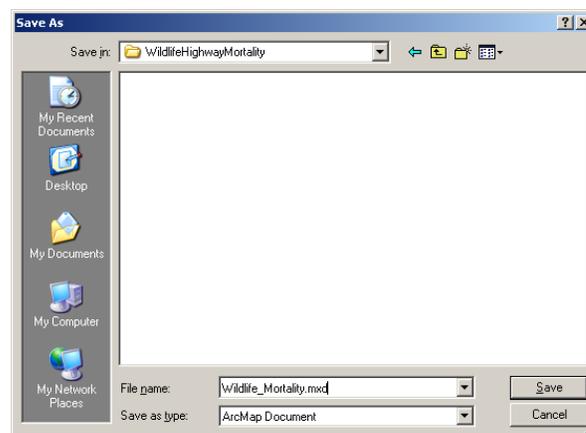
The GIS projection you come up with could help identify better locations to install a new series of signs. It is believed that these signs, an awareness campaign, and with significantly reducing amounts of road salt, will reduce the number of people harmed and animals killed in collisions.

## Part A: Getting Started

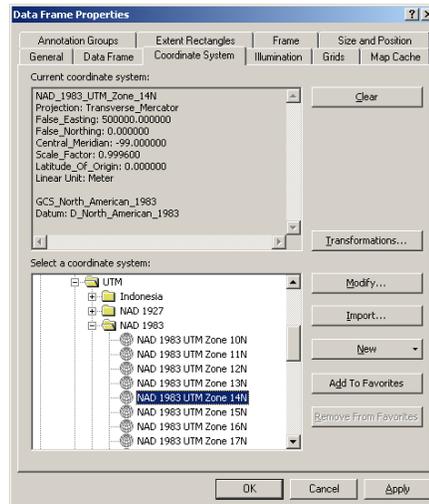
- Launch the **ArcMap** program. If you have a shortcut to **ArcMap** on your desktop double-click it.
- Otherwise, click **Start > Programs > ArcGIS > ArcMap**
- In the **ArcMap** startup dialogue box click **A new empty map**



- Click **OK**.
- Click on the **Save** button  and save your project as **Wildlife\_Mortality.mxd** within your working directory.



- From the **View** menu select the **Data Frame Properties**.
- Click on the tab labelled **Coordinate System**.
- Under **Select a Coordinate System** select:  
**Predefined>Projected Coordinate Systems > UTM > NAD 1983 > NAD 1983 UTM Zone 14N**



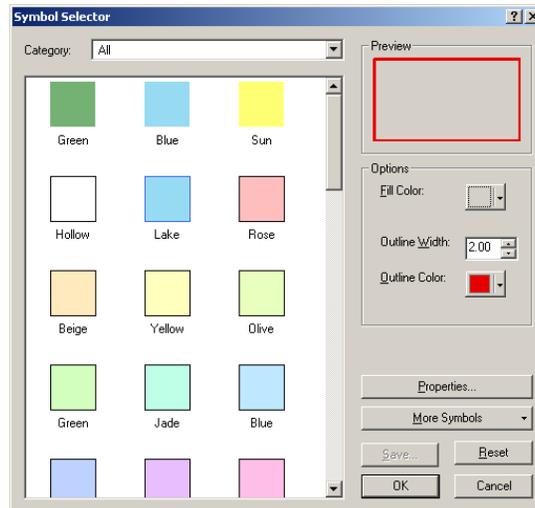
- Click **OK**.

**Save your work!**

## Part B: Adding Data Layers

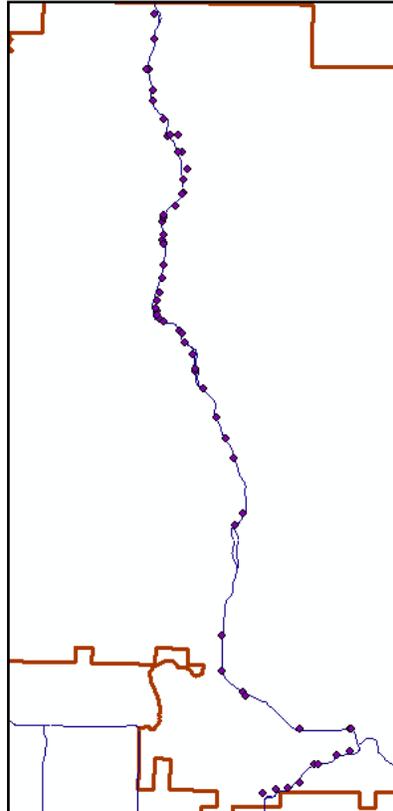
- Click the **Add Data** button  (located at the top of your screen). This will allow us to add the data layers we wish to work with.
- If you are unsure where the files are located please check with your teacher.

- Click once on the data layer *rmnp.shp*.
- Click **Add**
- Click on the coloured square located below the layer name. Within the options box select the drop-down box for **Fill Colour** and select **No Colour**. Change the **Outline Width** to **2.00**. Click the drop-down box for **Outline Colour** and select a dark shade of **red** of your choice.



- Click **OK**.
  - We are now going to add the road, wildlife mortality, and the Manitoba boundary layers.
  - Click the **Add Data** button . Use the **Ctrl** key to select more than one layer at a time.
  - Select the following data layers: *Highways.shp*, *Manitoba.shp*, and *HighwayWildlifeMortality.shp*.
  - Click **Add**.
- 
- Click on the coloured square located below the Manitoba layer name. Within the options box select the drop-down box for **Fill Colour** and select **No Colour**.
  - Use the **Zoom In** tool  to look at only **Highway 10**. Highway 10 runs north-south through the approximate centre of RMNP.

- If you cannot find the **Zoom In** tool at the top of your screen then select **View > Toolbars** and then make sure there is a checkmark beside the **Tools** option.

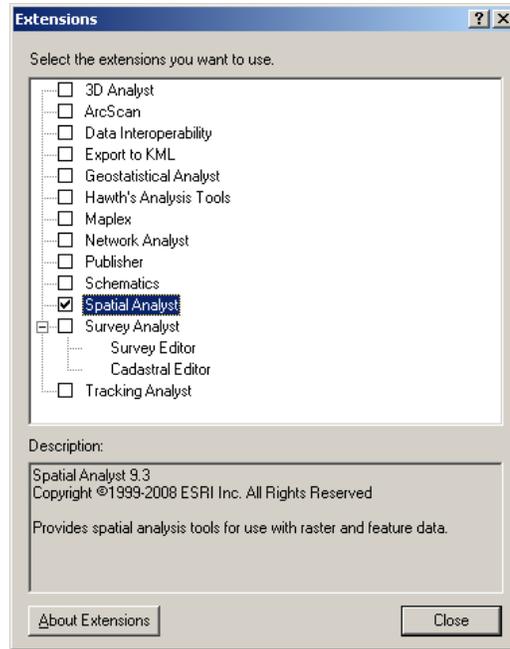


# Save your work!

## Part C: Working with Density Tools

- We are going to look at the relative density of vehicle-caused wildlife mortality along highway 10. To use the **Density Tool** we must turn on the Spatial Analyst Extension.

- At the top of the screen select **Tools** and then **Extensions...** within Extensions check the box to the left of the **Spatial Analyst Extension**. Click **Close**.

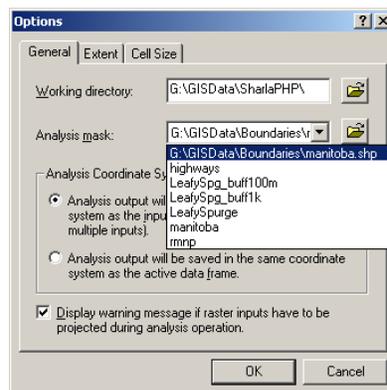


If you cannot find the **Spatial Analyst** toolbar at the top of your screen then select **View > Toolbars** and then make sure there is a checkmark beside the **Spatial Analyst** option.

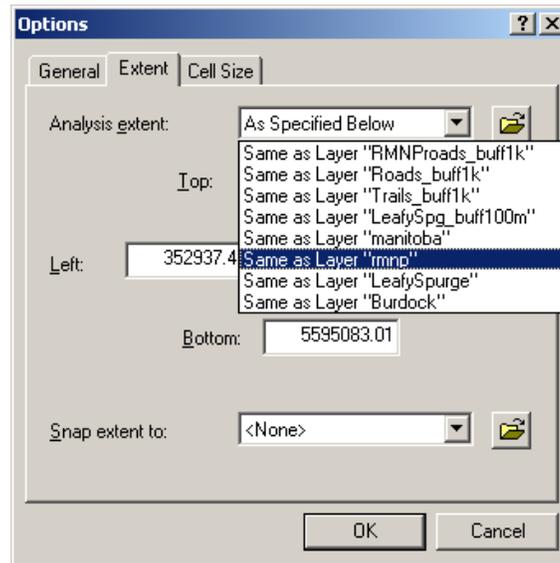
- Select the **Spatial Analyst** drop-down arrow and select **Options**.



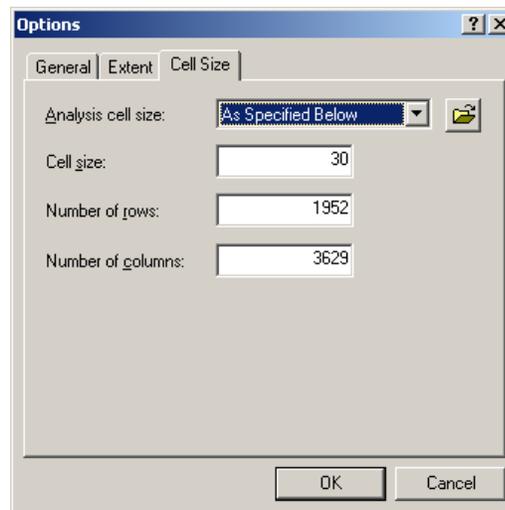
- Within the **General Tab** set the **Analysis mask** to *manitoba*.



- Within the **Extent Tab** set the **Analysis extent** to **Same as Layer "rmnp"**.



- Within the **Cell Size Tab** set the **Analysis cell size** to **As Specified Below**. Type in **30** for the Cell Size. The **Number of rows** and **Number of columns** will change according to the cell size.



- Click **OK**.



**Moose licking road salt off Highway 10** *Photo: Parks Canada*

- Select the drop-down arrow beside **Spatial Analyst** and select **Density**.
- Select **HighwayWildlifeMortalities** for **Input data**.
- The **Population** field should be set at **Sp\_Number**.
- The **Density type** should be set at **Kernel**.
- Leave all other options at the default option.
- Label your Output raster as **Den\_wLMort**.

**Density**

Input data: HighwayWildlifeMortalities

Population field: Sp\_Number

Density type:  Kernel  Simple

Search radius: 1951.7116

Area units: Square Kilometers

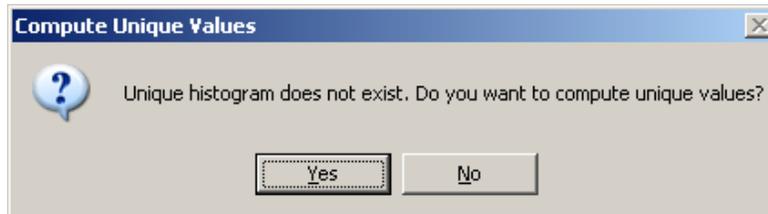
Output cell size: 30

Output raster: Den\_wLMort

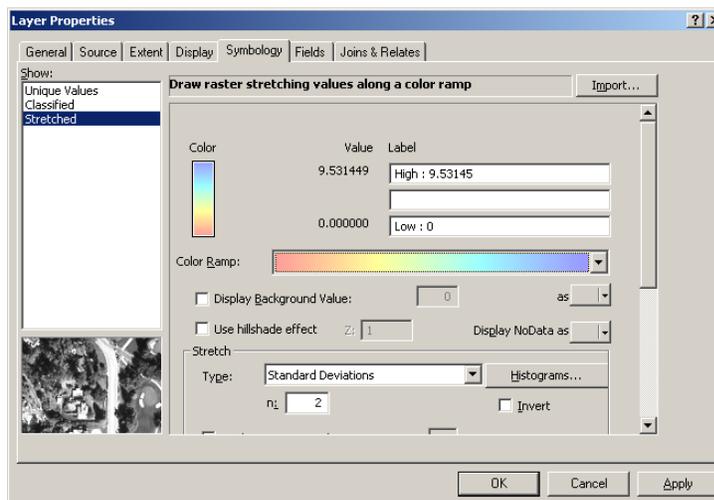
OK Cancel

- Select **OK**.

- Double-click on your new **Den\_wLMort** raster.
- A **raster data** set is a grid of cells covering an area of interest. Each pixel displays a unique attribute and represents the smallest unit of information available (CAD Resources).
- Select **No** if a text box appears asking you to create a unique histogram.

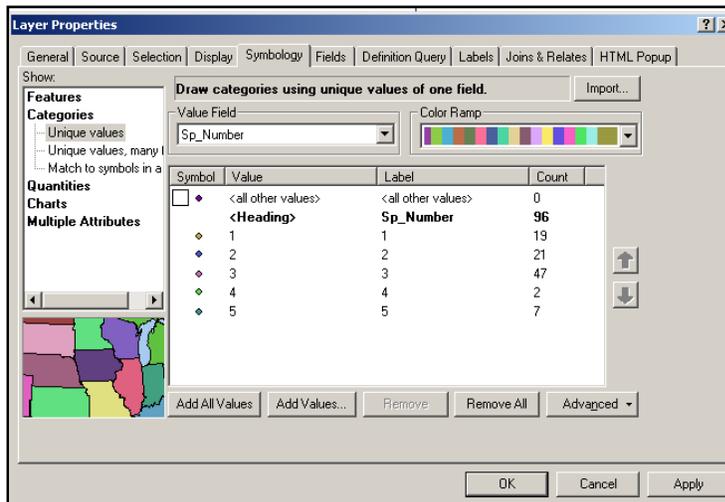


- Select the **Symbology Tab**.
- Under **Show** select **Stretched**.
- Select a **Colour Ramp** of your choice (\*hint pick lighter colours for your Colour Ramp).



- Select **OK**.

- Double-click the **HighwayWildlifeMortalities** layer.
- Select the **Symbology Tab**.
- Below **Show** select **Categories>Unique Values**.



- Within the **Value Field** select the drop-down arrow and select **Sp\_Number**.
- Select **Add All Values**. The numbers **1** to **5** should appear.
- Select the box to the left of **<all other values>** to uncheck the box.
- Select **OK**.

**Save your work!**

### Part D: Displaying our Species

- Below the **HighwayWildlifeMortality** layer the numbers 1 through 5 five should now appear. These numbers represent the species of the wildlife mortalities.

- 1 = deer**
- 2 = elk**
- 3 = moose**
- 4 = bear**
- 5 = unknown species**

- We are going to re-label these numbers to demonstrate which species they are.

- Click on the 1 once, wait a second, click again and type in **Deer**.
  - Click on the 2 once, wait a second, click again and type in **Elk**.
  - Click on the 3 once, wait a second, click again and type in **Moose**.
  - Click on the 4 once, wait a second, click again and type in **Bear**.
  - Click on the 5 once, wait a second, click again and type in **Unknown Species**.
- Right-click on **HighwayWildlifeMortalities** and select **Open Attribute Table**.
  - Select the **SPECIES** column to highlight all of the species listed.

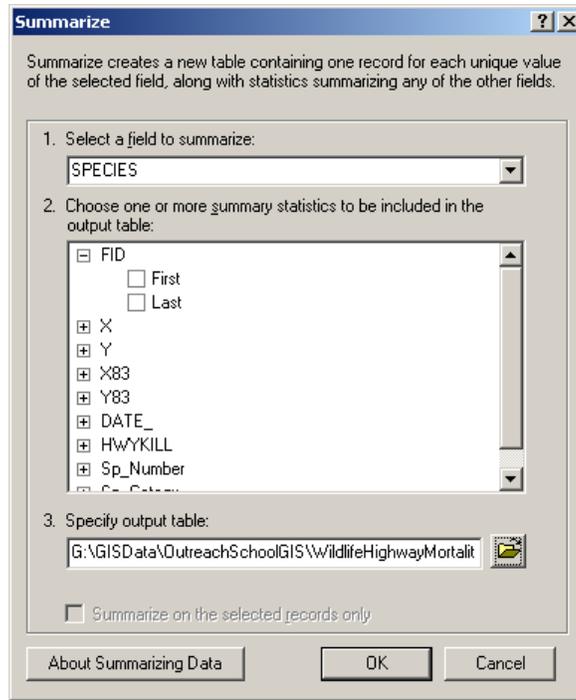
FID	Shape	X	Y	X83	Y83	SPECIES	DATE	HWYKILL	Sp_Number	Sp_Category
0	Point	425400	5647500	425366	5647720	elk		5	2	2
1	Point	433800	5612900	433766	5613120	deer		5	1	1
2	Point	426000	5638900	425966	5639120	UK	88/07/02	5	5	5
3	Point	429621	5628874	429587	5629094	moose	88/06/29	3	3	3
4	Point	434900	5613400	434866	5613620	UK	88/06/28	6	5	5
5	Point	435700	5614800	435666	5615020	moose	88/09/03	6	3	3
6	Point	429000	5617800	428966	5618020	moose	88/10/04	6	3	3
7	Point	425900	5641200	425866	5641420	moose	88/11/05	6	3	3
8	Point	426000	5640100	425966	5640320	moose	88/11/20	6	3	3
9	Point	428700	5631000	428666	5631220	UK	88/11/20	4	5	5
10	Point	425900	5638200	425866	5638420	UK	88/12/17	6	5	5
11	Point	425800	5636100	425766	5636320	moose	89/02/02	6	3	3
12	Point	426200	5645600	426166	5645820	moose	89/07/28	6	3	3
13	Point	426000	5641400	425966	5641620	elk	89/07/28	6	2	2
14	Point	425800	5636100	425766	5636320	moose	89/07/11	6	3	3
15	Point	427600	5633400	427566	5633620	moose	90/01/02	6	3	3
16	Point	426000	5636000	425966	5636220	moose	90/01/08	6	3	3
17	Point	429000	5617800	428966	5618020	moose	90/01/18	6	3	3
18	Point	425400	5648000	425366	5648220	moose	90/01/16	5	3	3
19	Point	427500	5634300	427466	5634520	UK	90/03/20	6	5	5
20	Point	427200	5643900	427166	5644120	UK	90/02/04	5	5	5

- Right-click on the **SPECIES** heading and select Summarize.

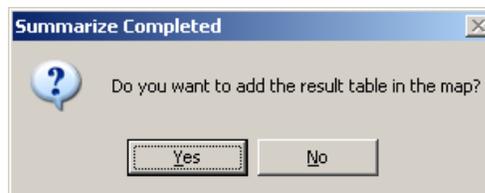


**Bear and cubs in  
RMNP**  
*Photo: Parks Canada*

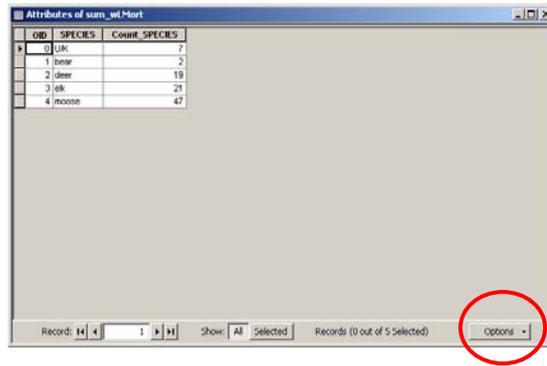
- Make sure the field to summarize is set to SPECIES. Leave all the options in Box number 2 to the default settings.
- Under **Specify output table** type in **sumwL\_mort\_**



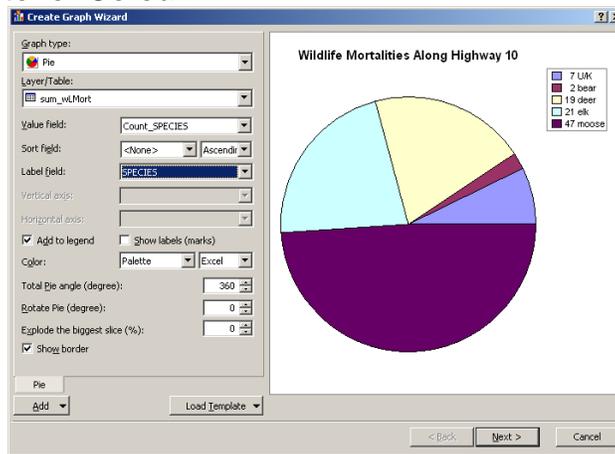
- Click **OK**.
- Click **Yes** to add the summarized table in the map.



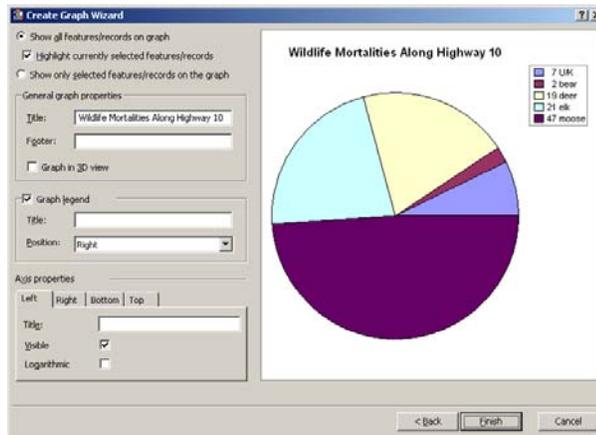
- Under **Layers** (at the left side of your screen) right-click on the table you just created (**sumwL\_mort**)
- Select **Open**.



- Select **Options > Create Graph**.
- Change the Graph type to **Pie**.
- Change the **Value field** to **Count\_Species**. Change the **Label field** to **SPECIES**.
- Select **Palette** for **Colour**.



- Select **Next >**.
- Make sure your title is appropriate to our lesson; label it **Wildlife Mortalities along Highway 10**.



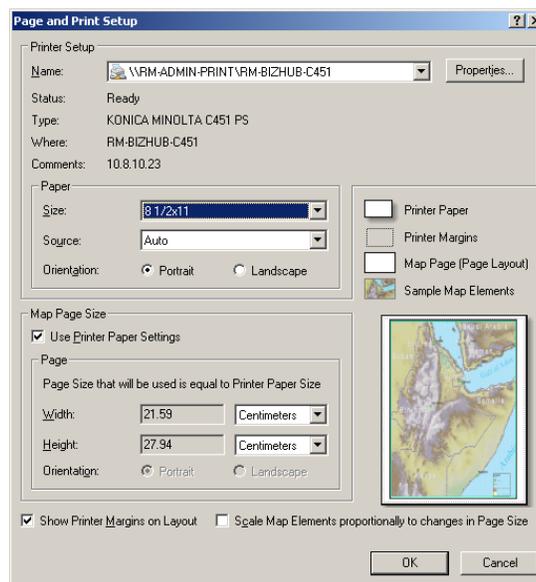
- Click **Finish**.

- Exit the **SPECIES** table and right-click on the Graph you just created. Select **Add to Layout**. The **Layout View** will open upon doing this.
- Remove the floating Graph by clicking on the **X** at the top-right corner so you only have one Graph present in the **Layout View**. Exit any other open windows except for your **Layout View**

## Save your work!

### Part D: Final Touches

- Lastly we are going to add a **Title**, **North Arrow**, **Legend**, and **Scale Bar** to our map.
- First select the **Layout View**  icon at the bottom left corner of the screen (if you cannot find this icon you can also select View at the top of the screen and then select the **Layout View**  ).
- Under **File** select the **Page and Print Setup...** Check to make sure the Paper Orientation is in **Portrait**.
- Make sure your Paper Size is set to 8 1/2 X 11 inches (or **Letter**) so that your map can be printed on one piece of paper.

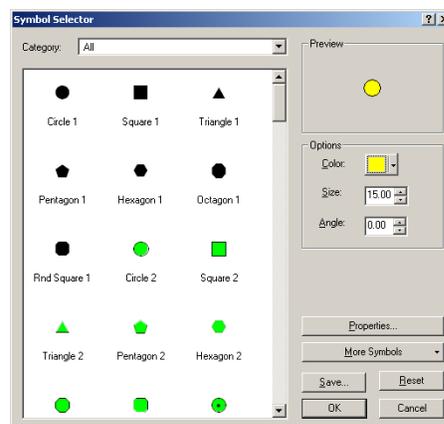


- Select **OK**.

- If your map does not align with your page properties then readjust your RMNP map so that it fits inside the **Portrait View**.
- Make sure you are zoomed in to view only the area on Highway 10 which shows your vehicle-caused mortalities.

• The density layer (the layer you just created within Spatial Analyst) to be located below the **HighwayWildlifeMortality** layer. Click and drag the distance layer if it is located above the wildlife mortality locations layer.

- Under **Layers** click on the dot located beside Deer. Change the colour to a bright colour, change the size to **10.00**.



- Select **OK** to close the **Symbol Selector box**.
- Repeat this process with **Elk, Moose, Bear, and Unknown Species**.
- Make sure they are all set at **10.00** for size and that they are all different bright colours.

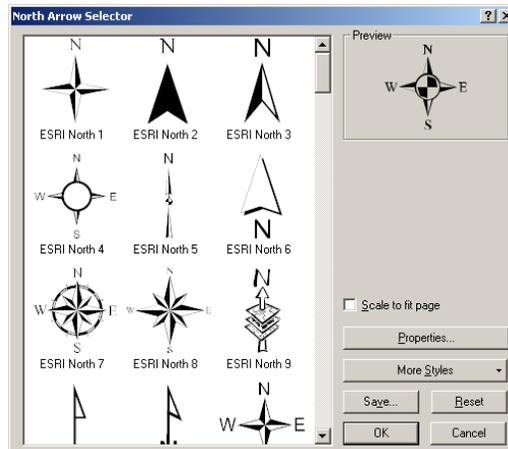


**Do you notice anything interesting about your map?**

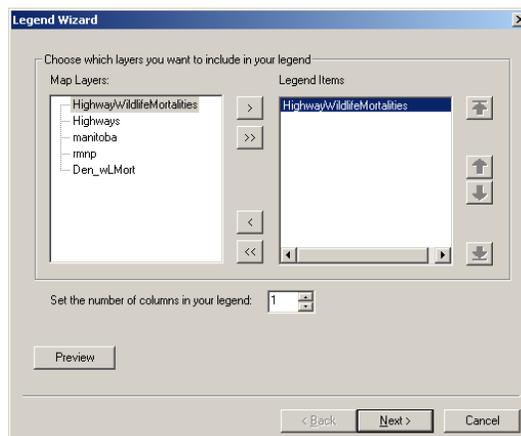
- What species is most affected by highway mortality? Why might that be?
- How could we lessen the amount of highway mortalities (in addition to erecting signs)?

- At the top of the screen select **Insert** and select **Title**. Label your title ***Vehicle-Caused Wildlife Mortality along Highway 10***. Press **“Enter”** after the word **“Mortality”** if the title is too long for your layout.
- Click the Change Symbol button to change the font or the font size.

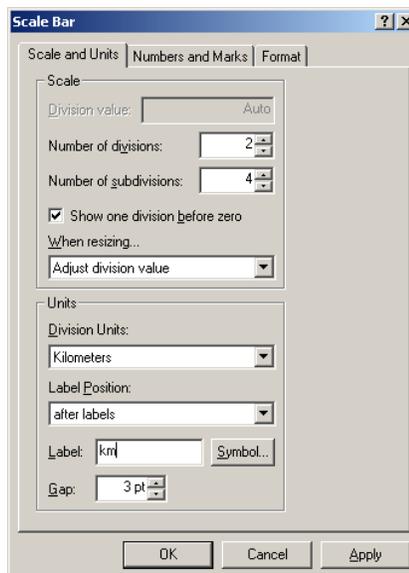
- Click and drag your title to the top of the page.
  - Select **Insert** again and choose a **North Arrow** symbol of your choice. Click **OK** to close the **North Arrow Selector** box.
  - Click and drag your **North Arrow** to the top right-hand corner of your map.
- 
- Select **Insert** again and choose a **North Arrow** symbol of your choice.



- Click **OK** to close the **North Arrow Selector** box.
  - Place your **North Arrow** at the top right-hand corner of your map.
- 
- Select **Insert** and select **Legend**. We only want our Highway Wildlife Mortalities to appear on our Legend. If the highway, distance layer, or RMNP boundary appear within the list of **Legend Items** on the right hand side select them and then click the < icon within the middle of the **Legend Wizard**. The number of columns in the Legend should be set at **1** (one).



- Click **Next>** and type in Legend for the **Legend Title** (it will appear by default)
  - Click **Next>** and click the drop-down arrow to create a background that is white.
  - Click **Next>** two more times and then **Finish** to create your Legend.
  - Drag your **Legend** to an unoccupied location on your map.
- 
- Under **Layers** click on **HighwayWildlifeMortalities** once, wait a second, click again and type in **Highway Wildlife Mortality**.
  - Under **Layers** click on **Sp\_Number** once, wait a second, click again and type in **Species**.
- 
- Select **Insert** again and select **Scale Bar**.
  - Select a Scale Bar of your choice.
  - Select **Properties** and change the number of divisions to **2**.
  - Change the **Division Units** to **Kilometers**, change the label to **km** (type in **km**).



- Select **OK** and **OK** once more to close the **Scale Bar Selector** dialogue box.
- Click on the text icon  located at the bottom left-hand side of your screen to insert text (the **Callout** icon may still be active, select it and then select the text icon)



- Include the name of the author (you!) and today's date along the bottom right-hand corner of the page.
- If you wish to modify the size and appearance of your text, simply right click it and select **Properties**.

**Save your work!**

**Go Green!**

If you need to print your work, first check for mistakes! That way you will only print one final copy and **save paper!**

*Congratulations! You have completed your map of  
**Vehicle-Caused Wildlife Mortality along Highway 10!***

## Mission Debriefing

If you are reading this, you have successfully created a map of ***Vehicle-Caused Wildlife Mortality along Highway 10.***

Questions that may arise now are:

1. Using the "***RMNP Map.pdf***" file as a reference, where is the area that a collision with a moose is most likely? Give a landmark as a reference point.
2. Do you think that we need bear crossing signs? Why or why not?
3. Certain sections of highway do NOT have any incidents of vehicle-cause wildlife mortality. Why might that be?

What questions of your own do you have for your classmates?

Congratulations! The Roads Crew of Riding Mountain National Park now has a better idea of where to place road signs, and what species to indicate on the sign. On to your next mission...