



Weasel Waypoints:
Pine Marten Habitat Ranges in Riding Mountain National Park
GIS Lesson in ArcView 3.x

Lesson Difficulty: INTERMEDIATE

Length of Lesson: 1:10 – 1:30

In this lesson students will:

1. Create a map in ArcView 3.x displaying pine marten habitat ranges within RMNP.
2. Display pine marten telemetry locations collected from 1992-93.
3. Determine pine marten habitat ranges.
4. Insert and modify 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 attributes table functions and data classification.
- Proper understanding of map layout and functions in Arc.

Required Data and Software:

- ArcView 3.x (ArcView GIS 3.3)
- ArcView 3.x's Spatial Analyst Extension
- Data layers (enclosed within CD-ROM): *rmnp.shp*, *Mwconifbog* raster layer, *MartenTelemetryLocations.shp*, *waterbodyall.shp*
- Marten Habitat Range Data Sheet (Microsoft Excel)



This lesson looks at the successful **reintroduction** of the pine marten to Riding Mountain National Park (RMNP). Due mainly to over-trapping, this endearing weasel was **extirpated** from the area in the early part of the 20th century. The marten's prolonged absence led many to believe it would never return to RMNP, but this would not be the case.

In an effort to restore ecological integrity Parks Canada sometimes re-introduces species that were historically part of national park ecosystems and thus, RMNP staff undertook a marten re-introduction program in the early 1990's. This lesson will give students a look at the real-world results of that program and familiarize them with the wider, global issue of **species at risk**.

The GIS lesson can be used on its own, but we suggest that students first learn the basics about ecological integrity, pine marten biology, the re-introduction program and species at risk. Fact Sheets, Web links and various resources have been included to help with this process. Next, students can proceed to the GIS lesson itself. A fictional first-person scenario will help set the scene for the lesson and detailed instructions will guide students and teachers on their way to completing an ArcView map entitled *Pine Marten Habitat Ranges in RMNP*. Lastly, consult the resource section and Challenge Options to see how the GIS activity can incorporate outcomes in other subjects and extend the student's learning.

For students:

This is Your Mission

The American Marten was trapped and hunted out of the Riding Mountain National Park (RMNP) area in the early 1900's. Given that it is within RMNP's mandate to reintroduce species that were historically part of the park ecosystem, in the early 1990's, park wardens undertook a marten reintroduction program. Take a deep breath now as we go back in time to that period...

You've been hired as a part-time student to help the wardens monitor pine marten behaviour after the reintroduction. A total of 65 young healthy martens have been released on the east side of RMNP, 8 of which were outfitted with telemetry collars – these emit a radio signal enabling us to track them. The goal is to pinpoint where the martens established themselves and measure their home ranges.

The wardens have handed you GPS data on the 8 martens' locations, recorded from 1992-93. Follow the instructions in this document to complete a map entitled ***Pine Marten Home Ranges in RMNP.***

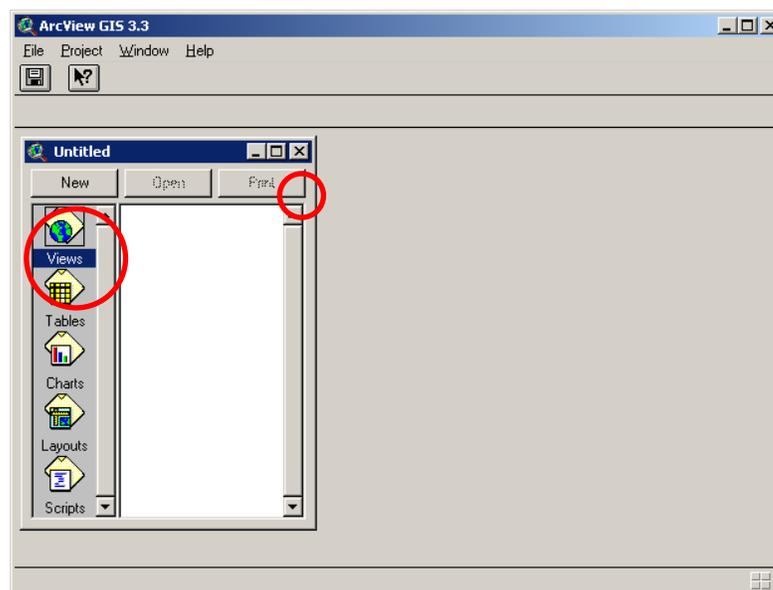
Part A: Getting Started

- Launch the **ArcView** program. If you have a shortcut to **ArcView** on your desktop double-click it.
- Otherwise, click **Start > Programs > ESRI > ArcView GIS 3.3**
- In the Welcome to **ArcView GIS** startup dialogue box click **as a blank project** then click ok.

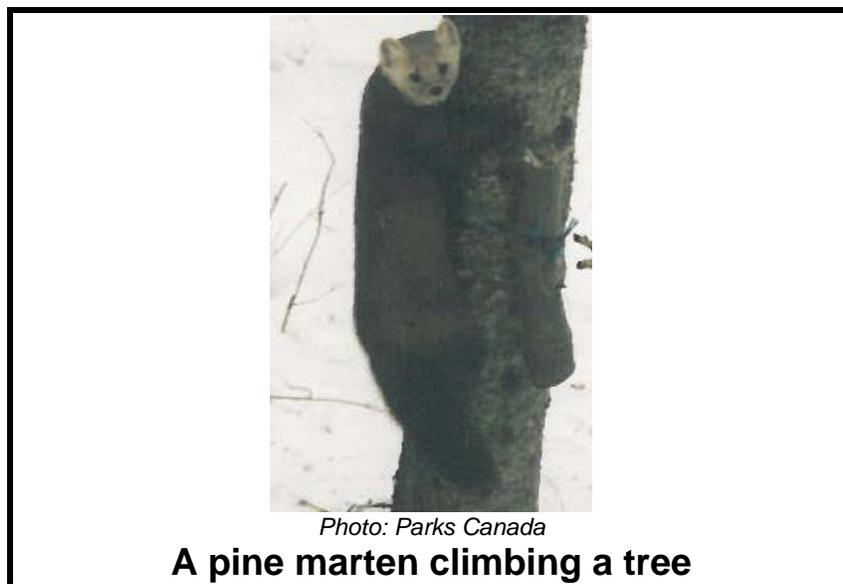
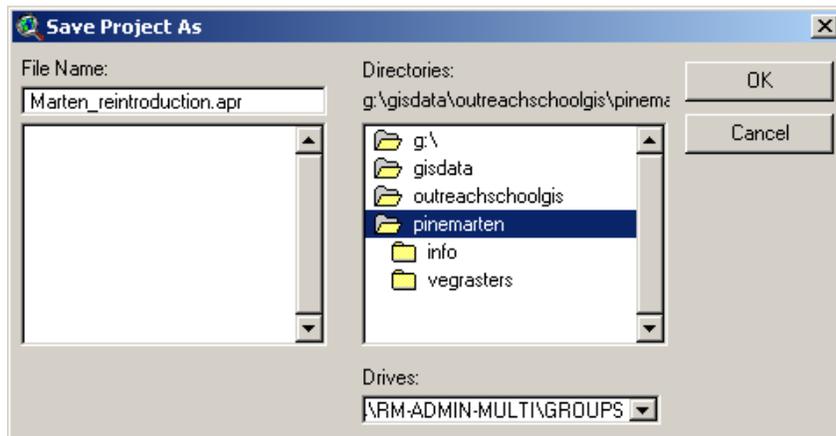


Expand your screen by clicking on the square at the top right corner.

- Double-click on **Views**.

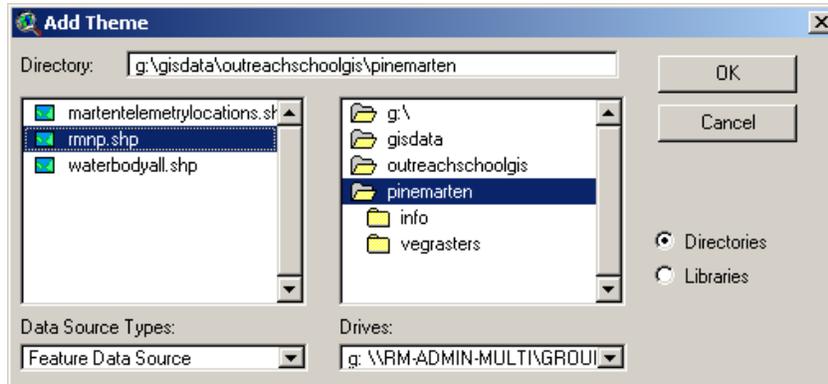


- Click on the **Save Project** button  and save your project as ***Marten_reintroduction.apr*** within your working directory. Check with your teacher if you are unsure where to save your project.

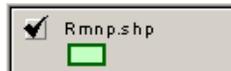


Part B: Adding Data Layers

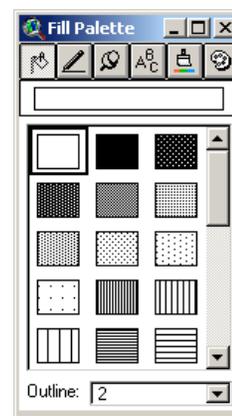
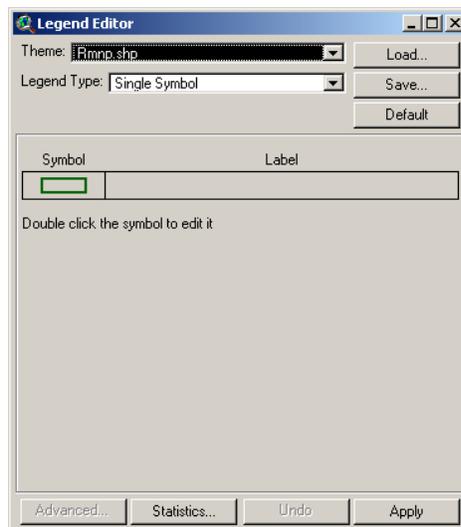
- Click the **Add Theme** button  (located at the top of your screen). This will allow us to add the data layers we wish to work with.
- If you are unsure where the files are located please check with your teacher.
- Make sure your **Data Source Type** is set to **Feature Data Source**.
- Click on ***rmnp.shp*** and then click **OK**.



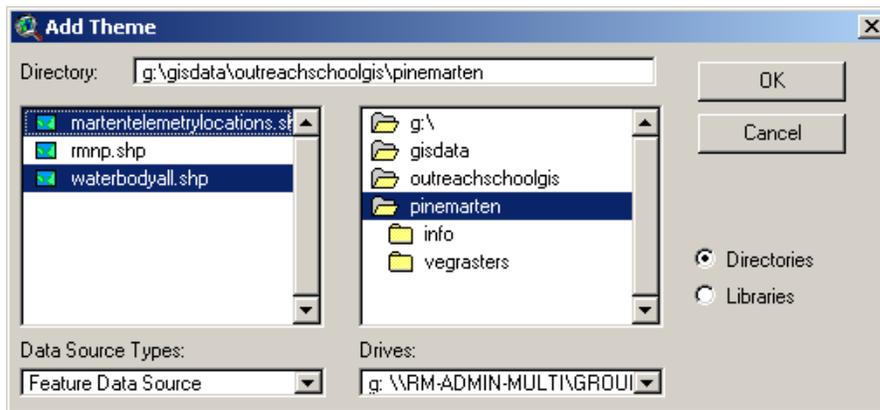
- Make sure the ***rmnp.shp*** layer is turned on (check the box beside the file name by clicking on it.)



- Double-click on the coloured rectangle located below the layer name.
- Within the **Legend Editor** double-click the **Symbol** icon and select the hollow square within the **Fill Palette**.
- Click the **X** to close the **Fill Palette**.
- Click **Apply** within the **Legend Editor** and then close the **Legend Editor** by clicking the **X**.



- Click the **Add Theme** button 
- Use the **Shift** key to add both the **MartenTelemetryLocations** and **waterbodyall** shapefiles.



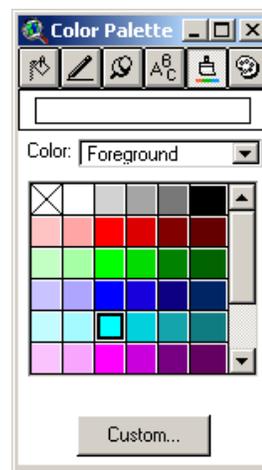
- Click **OK**.

- A **shapefile** is a format used for storing the geometric location and attribute information of geographic features. Geographic features can be represented by points, lines, or polygons (ArcGIS Desktop Help).

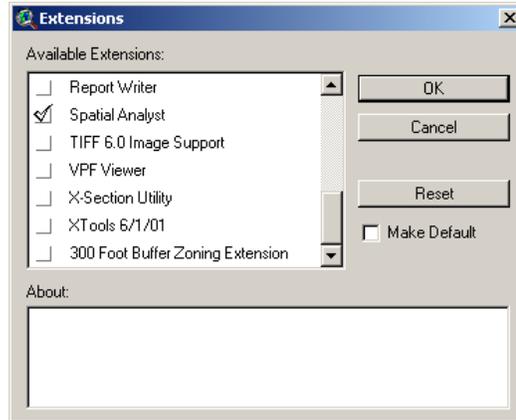
- Make sure these two **shapefiles** are active.



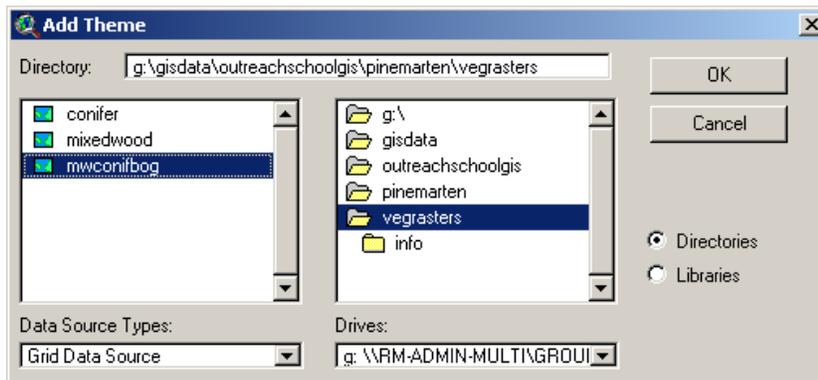
- Double-click on the square located below the **Waterbodyall.shp** data layer.
- Double-click on the **Symbol** (the rectangle) within the **Legend Editor**.
- Within the **Colour Palette** choose a **light blue**. Click **X**.
- Click **Apply** within the **Legend Editor**.
- Click **X** to close the **Legend Editor**.



- At the top of your screen select **File** then select **Extensions**.
- Under **Available Extensions** select **Spatial Analyst** so there is now a check-mark within the box.
- Select **OK**.



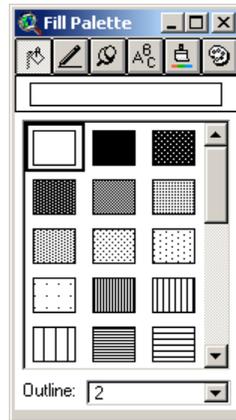
- Click the **Add Theme** button 
- Set the **Data Source Types** to **Grid Data Source**.
- Within the *VegRasters* folder select *Mwconifbog*.
- Click **OK**.



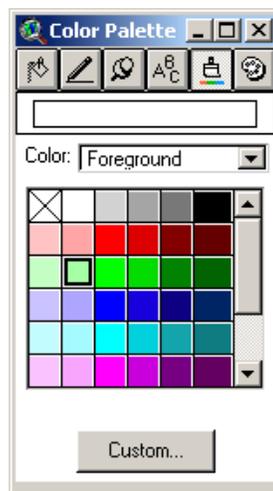
- Make sure *Mwconifbog* is turned on.



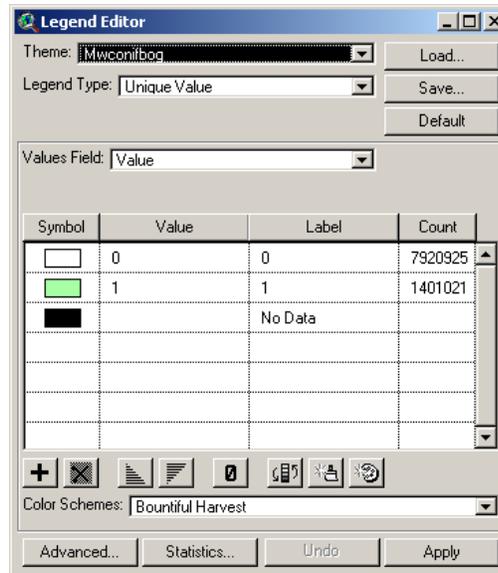
- Double-click on the trio of squares located below the *Mwconifbog* layer.
- Double click on the square located to the left of 0.
- Select the hollow square within the **Fill Palette**.
- Click the **X** to close the **Fill Palette**.



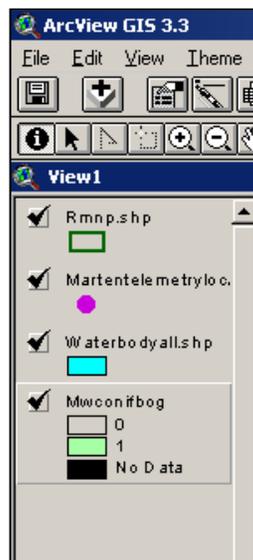
- Double-click on the square located to the left of 1.
- Within the **Colour Palette** select a light shade of **green**.
- Click the X to close the **Colour Palette**.



- Click **Apply**.
- Click the **X** to close the **Legend Editor**.



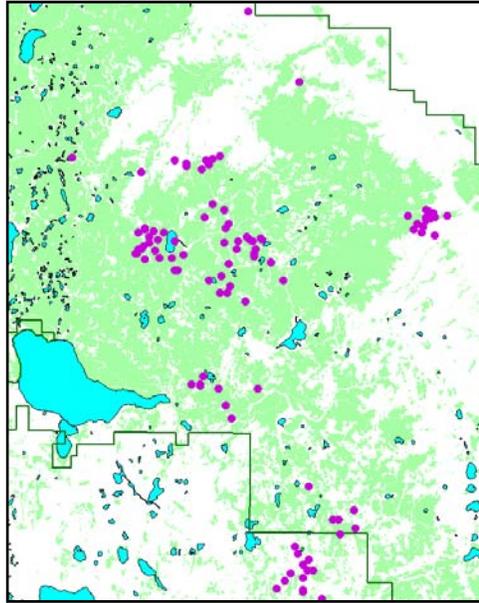
- Make sure your data layers are ordered as below. Click and drag them to the appropriate order.



Save your work!

Part C: Separating our Martens

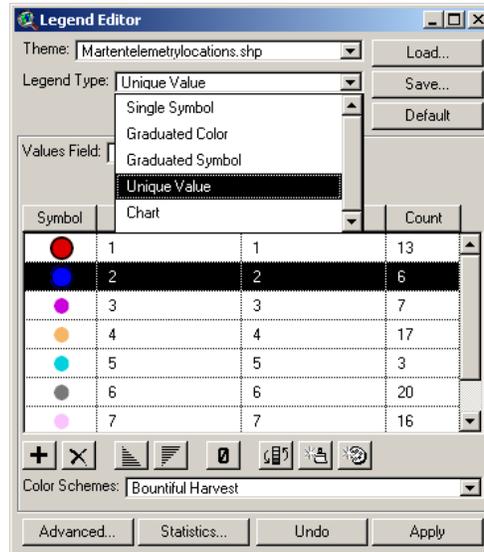
- We are going to classify our telemetry locations to determine the habitat ranges of each Pine Marten.
- Use the **Zoom In** tool  to look at the east side of the park more closely.



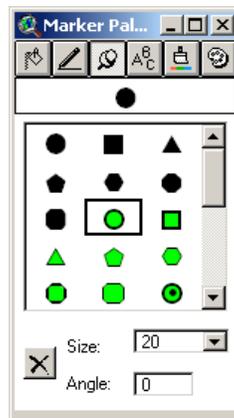
- On the left hand side of your screen click on the **MartenTelemetryLocations** layer to make it active (this has nothing to do with the check-mark. **Once the layer is active, it will appear embossed, raised over the other layers**).
- At the top of the screen select **Theme > Table...**
- The **Attribute Table** displays information on the **MartenTelemetryLocations** shapefile.
- Within the **MartenTelemetryLocations.shp Attribute Table** there is a column labelled **Marten**. The numbers in this column represent individual martens. We are going to display these individual martens.
- **Close the Attribute Table** by selecting the **X** at the top right-hand corner.

Shape	East	North	Date	Marten	Mode	M
Point	443200	5621800	N10	2	Flight	
Point	438900	5614600	N10	3	Flight	
Point	440700	5620400	N10	4	Flight	
Point	444900	5608100	N10	6	Flight	
Point	439000	5621000	N10	8	Flight	
Point	439300	5626500	N13	2	Flight	
Point	439400	5613500	N13	3	Flight	
Point	441300	5623600	N13	4	Flight	
Point	448000	5605300	N13	6	Flight	
Point	439400	5625300	N13	8	Flight	
Point	436000	5622500	N22	2	Flight	
Point	439800	5612600	N22	3	Flight	
Point	441000	5624500	N22	4	Flight	
Point	441500	5614600	N22	5	Flight	
Point	447000	5604900	N22	6	Flight	
Point	436200	5622500	N22	8	Flight	
Point	440900	5639700	N25	1	Flight	
Point	435000	5623300	N25	2	Flight	
Point	441700	5624600	N25	4	Flight	

- Double-click on **MartenTelemetryLocations** layer to open up Legend Editor.
- Under **Legend Type** click on **Unique Value**.
- Under **Values Field** click on **Marten**.

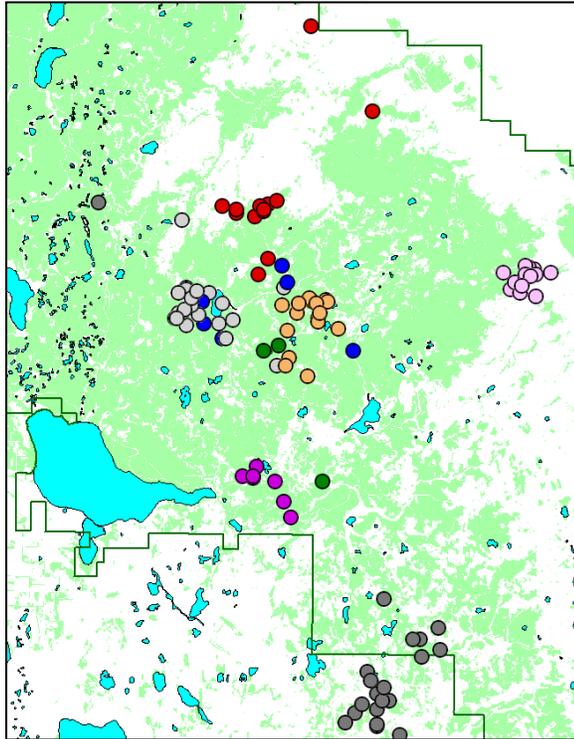


- Double-click the **Symbol** to the left of 1.
- Within the **Marker Palette** select a circle with a black outline.
- Change the **Size** to **10**.



- Click on the **Colour Palette** icon. 
- Change the colour to a colour of your choice.
- Click on the **X** to close the **Colour Palette**.
- Repeat these steps with the **Symbols 2 through 8**.

- Make sure all of the **Symbols** are sized **10**.
- Make sure all of the colours are different from each other. They should be distinct colours and should show up against the background.
- Click **Apply**.
- Select the **X** to close the **Legend Editor** when you are finished formatting your Symbols.



- We are going to change the names of our ***MartenTelemetryLocations*** layer so that our legend is more readable.
- In the table of contents on the left side of the screen, click on the ***MartenTelemetryLocations*** layer so that it becomes active and appears embossed.
- At the top of the screen, click on **Theme > Properties**
- In the **Theme Name** field, highlight ***MartenTelemetryLocations***. Type **Marten Telemetry Locations** (note the spaces between the words!)
- Click **Apply**
- Repeat these steps with the other layer names. Use these new titles:
 - For **RMNP.shp**, type **RMNP Boundary**
 - For **Waterbodyall.shp**, type **Water Bodies**
 - For **Mwconifbog**, type **Mixedwood / Coniferous Forest or Bog**

Sometimes filenames are confusing! Changing the layer names from filenames to “plain English” wording (by inserting spaces, taking out “dots” and underscores, etc) makes for an easy-to-read legend. For example, typing “**RMNP Boundary**” rather than simply “**rmnp**” lets readers know exactly what that shapefile represents.

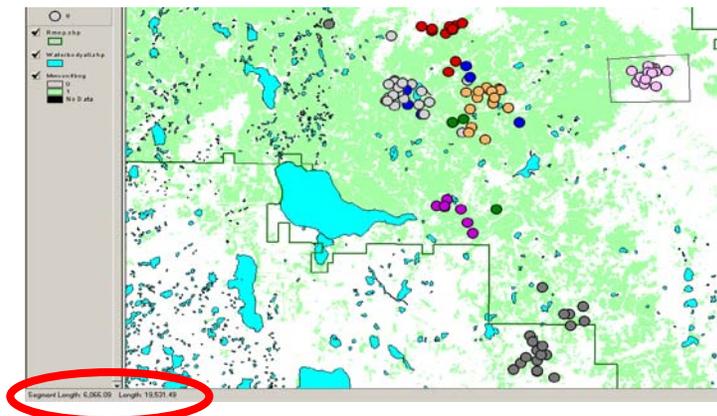
Save your work!

Part D: Determining the Martens' Habitat Ranges

- **NOTE:** You will need the provided **Marten Habitat Range Data Sheet** to complete this section.
- We are going to use the **Measure** tool to determine each marten's habitat range. Habitat range in this context is the total recorded area occupied by a single marten during a designated monitoring period (1992-93).
- Click on the **Measure** tool located along the top of your screen to activate it.



- To record individual martens' home ranges, you will draw a square around each marten's cluster of telemetry locations. REMINDER: Each marten is represented by a different colour dot and some have much larger home ranges than others.
- To start, select the habitat range of one of your martens (pick one colour) and, with the **Measure Tool** active, click once at the top-left corner of the habitat range, then click again at the bottom-left corner and STOP.
- **A line measurement will show up at the bottom left-hand side of your screen.** Write this measurement down on your **Habitat Range Data Sheet**, under **Segment 1**.
- Repeat this action, going from the bottom left corner to the bottom-right corner. Write this second measurement down on your **Habitat Range Data Sheet**. Repeat these steps until you've drawn a box around the marten's home range.
- Once you've completed a square around a given marten's habitat range, **Double click** to finish measuring. On your data sheet, multiply the north-south (**Segment 1**) and east-west (**Segment 2**) segments together to determine your habitat range area in **m²**.
- Repeat this process for each marten habitat range.



- After recording each marten habitat range determine which marten has the *largest* and which has the *smallest* habitat range.
- **Hint** Marten #6 has a bigger range than you would first think! What might be the reason for this?**
- If your colours are too close together and difficult to differentiate you can also use your **Identify Tool** to determine which marten a dot belongs to.

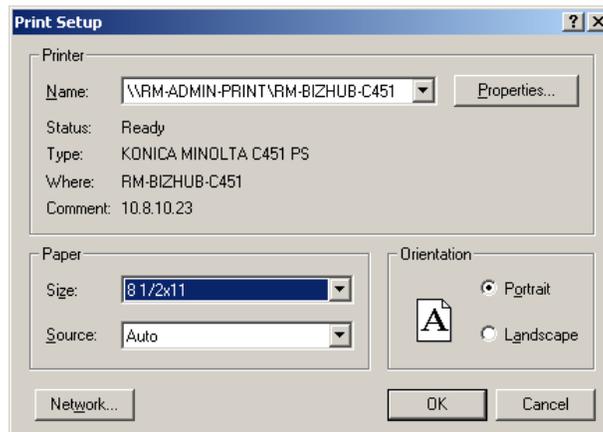


- After you have filled out your habitat ranges data sheet make sure you check with you teacher to verify if your results for the smallest and largest habitat ranges are correct.

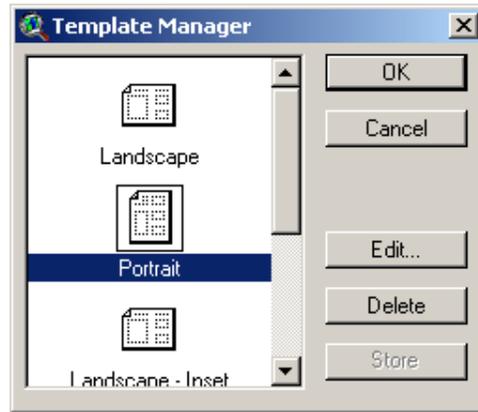
Save your work!

Part E: Labelling our Home Ranges

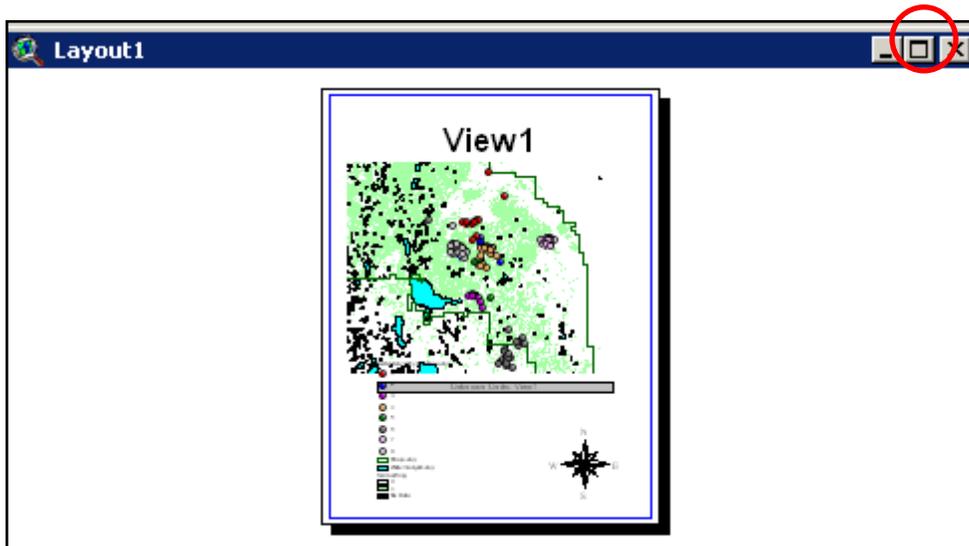
- We are now going to demonstrate which martens have the largest and the smallest habitat ranges and then complete our map.
- Under **File** select the **Print Setup**.
- Make sure your paper is set to 8 ½ X 11 inches (or Letter) so that your map can be printed on one piece of paper.
- For **Orientation** select **Portrait**.
- Click **OK**.



- Select **View > Layout...**
- From the Template Manager select **Portrait**.



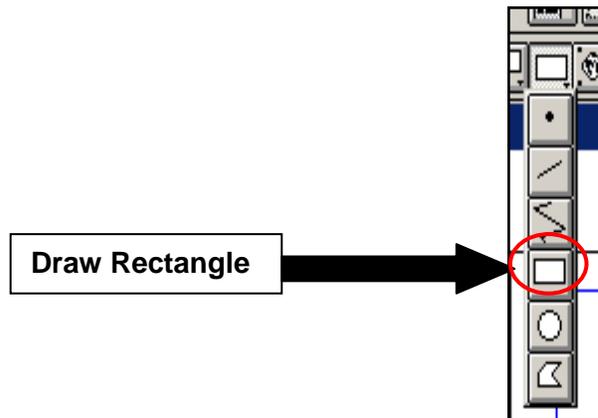
- Click **OK**.
- A small version of the **Layout View** should show up. Expand it by clicking the square at the top right corner.



- You will now use the data of the habitat ranges we recorded previously.
- Select the **Draw Rectangle** icon from the toolbar along the top of the screen.

*If the rectangle icon is not already active then click and **hold** to see the drop-down menu for **Shapes**.

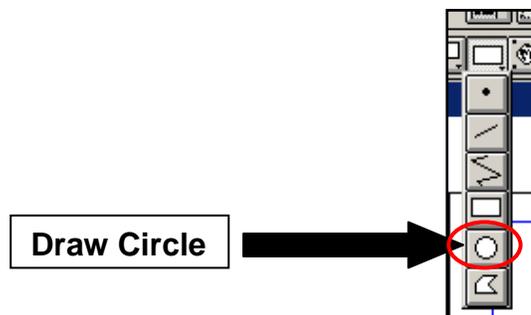
- Click to select the **Draw Rectangle** icon. 



- With your mouse and selected **New Rectangle** feature now active draw a rectangle to encompass the **largest** home range.
- You can use the **Pointer Tool**  to change the position of the rectangle if you need to.
- Select the **Draw Circle** icon from the toolbar.

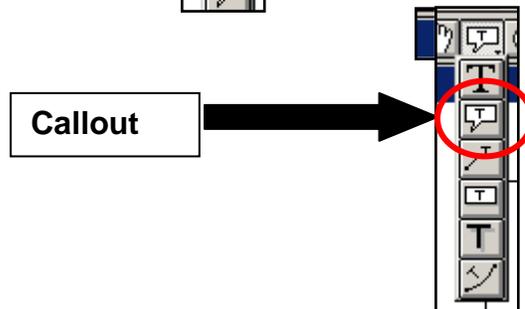
*The rectangle icon will be active now, click and hold to see the drop-down menu for **Shapes**.

- Click to select the **Draw Circle** icon.



- With your mouse and selected **New Circle** feature now active draw a circle which will encompass the **smallest** home range.

- We are going to label our habitat ranges.
- Click the **Text**  icon and hold to see the drop-down toolbar.
- Select the **Callout** icon. 



- Click within the middle of the rectangle you just created and drag to outside the rectangle to the white area on the map (away from the marten locations).
- Within the text box type **Largest Habitat Range: Marten 6**.
- Repeat this process with the **Callout**  feature to label the circle encompassing the smallest habitat range. Label the circle **Smallest Habitat Range: Marten 7**.
- Use your **Pointer Tool**  to change the position of your label if necessary.

Save your work!

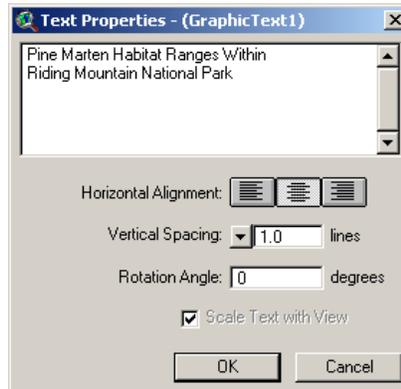


Did you come up with the same results?

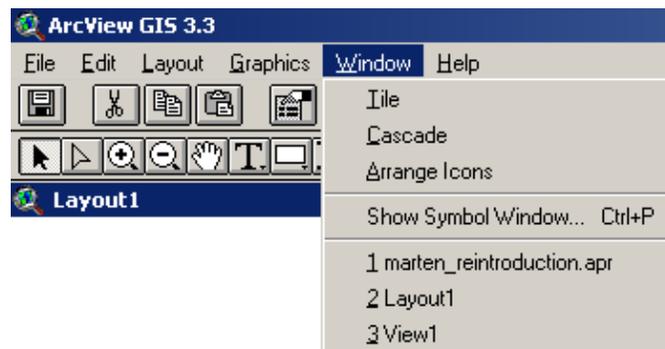
- Does Marten 6 have the largest habitat range? Take a look at how the telemetry locations are spread out, and try to figure out why that might be.
- Does Marten 7 have the smallest habitat range? Why might that be?

Part F: Final Touches

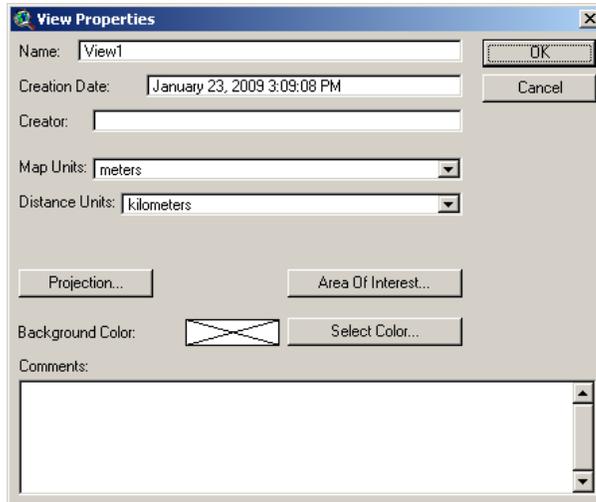
- Lastly we are going to format our **Title**, **North Arrow**, **Legend**, and **Scale Bar** to our map.
- Use your **Pointer Tool**  to double-click **View 1** at the top of the screen.
- Label your title ***Pine Marten Habitat Ranges within Riding Mountain National Park.***



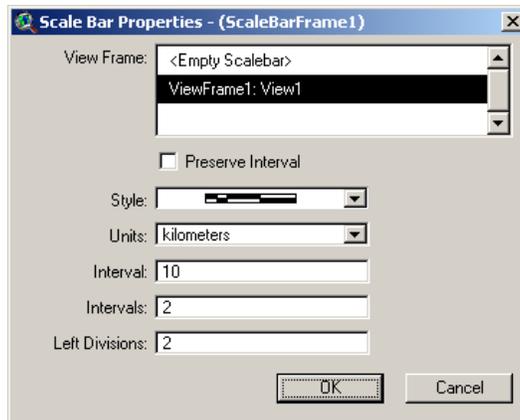
- If your title extends beyond your paper then double-click once more on the text. Click half-way through the sentence (after “in”) to split your title into two lines.
 - Click **OK**.
 - Use your **Pointer Tool**  to click and drag your title to the top of the page and change the size of the title if necessary.
 - Click and drag your **North Arrow** to a blank space along the top right-hand corner of your page.
- Click on the **Window** tab at the top of the screen. Click on **View 1**.



- From the **View** menu select **Properties**.
- Change the **Map Units** to **meters**.
- Change the **Distance Units** to **kilometers**.
- Click **OK**.



- Click on the **Window** tab at the top of the screen. Click on **Layout 1**.
- Double-click on the **Scale bar** located at the bottom of your map.
- Change your **Units** to kilometers.
- Type in **10** for **Interval**.
- Click **OK**.



- Use your **Pointer Tool**  to click and drag your **Scale bar** to a blank space along the bottom of your map.
- Use your **Pointer Tool**  to click and drag your **Legend** to a blank area along the left side of your map.
- Click on the **Text icon** 
- Click along the bottom right side of your screen.
- Type in your name and today's date.
- Use your **Pointer Tool**  to relocate your name and date if overlaps anything else on your map.



Looking for a reference point? Try to locate **Wasagaming** and **Clear Lake** on your map. Create callouts to label all those points. Now, compare your map with the map of the park in the *Resources* folder (**RMNP Map.pdf**). Were you close? Fix your callouts if you were off the mark!

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
Pine Marten Habitat Ranges within RMNP!*

Mission Debriefing

If you are reading this, you have completed your map of ***Pine Marten Habitat Ranges in Riding Mountain National Park.***

Questions that may arise include:

1. One marten has a very large habitat range. Which one is it? What could be the reason for this?
2. Using the scale on your map to measure, approximately how far from the furthest north-west point did the marten appear to finally establish its home range?
3. Using the file "RMNP Map.pdf" to compare, what is the name of the Warden Station closest to the Home Range of Marten #7?

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

Thanks to your map, park staff are better equipped to monitor future marten movement to keep track of this once-extirpated species.

Congratulations! On to your next mission...