

## **BIOL 4460/5460 and GEOL 4460 Introduction to GIS**

### **Assignment 6. GIS Analysis for Life Scientists**

In this exercise, we will perform some more advanced tasks usually performed by scientists in the area of wildlife management. We are going to use a dataset of endangered species. This species is a bird native to Texas that breeds during the summer months.

The goals of this assignment are:

1. In which counties is the species present and what is the total area?
2. What land cover types does the bird prefer?
3. Are there any potential areas that we must protect?
4. Compute total rainfall for each area during a storm event

Download all files in [http://geo02.tamtu.edu/gis\\_2018/Exercise6](http://geo02.tamtu.edu/gis_2018/Exercise6). Save them in a folder named Lab6 in your flash drive and extract all the zip files.

Open ArcGIS Pro and create a blank project named Species\_Analysis and store it in the Lab6 folder where you saved your files but uncheck the option to create a new folder for the project. On the catalog pane, expand the Folders shortcut then expand the Lab6 folder. All the files you downloaded and unzipped will automatically be there because they are located in the project folder.

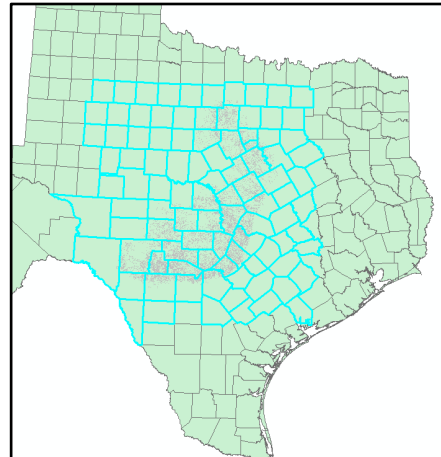
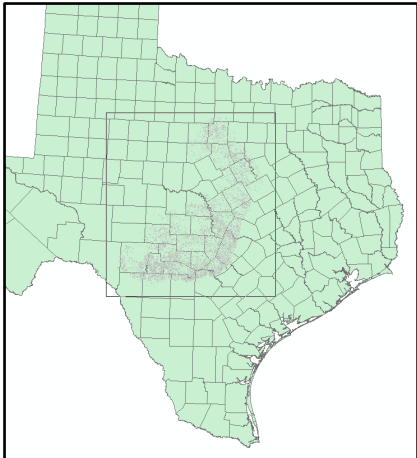
Insert a new Map from the Insert ribbon. From the Counties folder, add the Texas\_Counties\_Albers shapefile and the Warbler raster from the Species Folder. On the Contents pane, make sure the Warbler layer is on top of the counties layer on the Drawing order.

The raster represents the habitat of the Golden Cheeked Warbler. This species of bird breeds in Texas during the summer months. It is now included in the endangered species list. This bird only breeds and nests in Texas and often returns to the same location every year. As a result, the threat to this species grows yearly. The first step is to create a table with the distribution of the species per county with the square mile area for each one.

Use the Select tool from the Map ribbon and draw a rectangle around the area covered by the Warbler population. This will minimize counties without population from the analysis. Your selection might differ but make sure you do not leave out any counties with bird population.

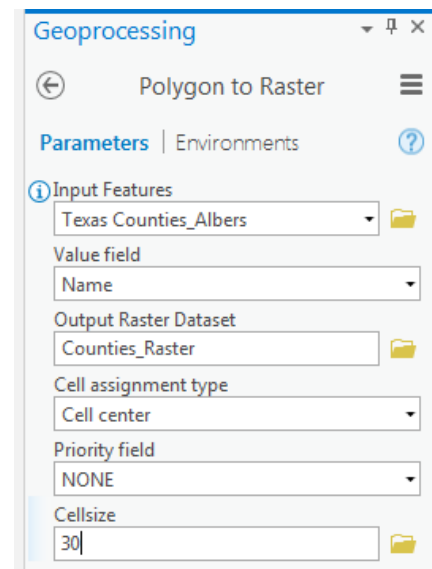
Open the properties for the Warbler layer. Check the Raster information on the Source tab.

1. What is the Cell Size? X \_\_\_\_\_ Y \_\_\_\_\_
2. What is the linear unit? (Check Spatial Reference) \_\_\_\_\_
3. What area does each pixel cover? Hint: multiply the X and Y values. \_\_\_\_\_



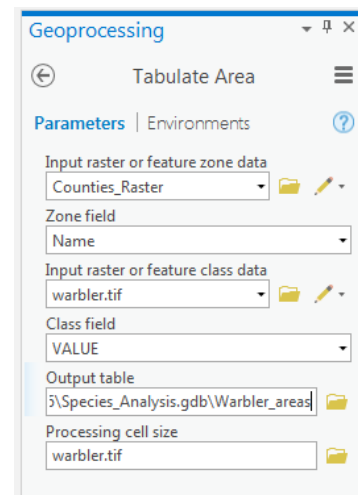
Close the properties window.

Open the Geoprocessing pane (Analysis ribbon). Search for Polygon to Raster and click on it to open the tool. Select the Texas Counties layer as the Input Features. Select Name as the Value Field. In this case, and from now on, we will be saving all outputs of Geoprocessing tools in the default geodatabase of the project. You do not have to browse to a location to save your outputs. You simply have to change the name of the output layer. In the Output Raster Dataset field, click on the auto-generated name. When you click on it, you can see the full path of the output. In this case, it is a geodatabase that automatically created upon the creation of the project. In this project the path is (Yours will be different):




G:\GIS\_Exercises\Lab6\Species\_Analysis.gdb\TexasCounties\_Albers\_Polygon

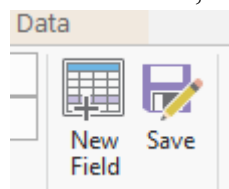
The only part you need to replace is the part after the '.gdb\'. Change this to Counties\_Raster. Change the Cellsize to 30. This is the same cell size as the warbler raster. Click Run. Now we need to run a tool to summarize the area of warbler population within each county. Click the back button in the Polygon to Raster tool. Search for the tool Tabulate Area. Click on it to open it. Fill in the fields as follows (the Processing cell size will automatically appear):



Open the attribute table of the Warbler\_areas table. The table has 2 fields. The county name and Value1. The value stored in this field corresponds to the area of pixels inside each county. Basically, the tool counted the number of pixels then obtained the total area (# of pixels X 30 X 30). Since the linear unit is meters, the value is square meters. We will convert this value to square kilometers.

Click on the Add field button . Name the new field SqKm and change the Field type to Float. Do not forget to click the Save button on the Fields ribbon, then close the Fields: Warbler\_areas tab.

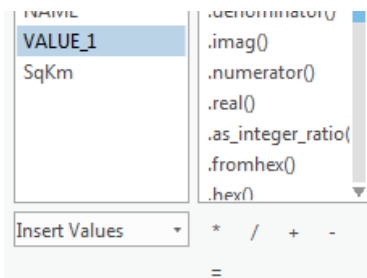
<input type="checkbox"/>	VALUE_1	VALUE_1	Double
<input type="checkbox"/>	SqKm	SqKm	Float



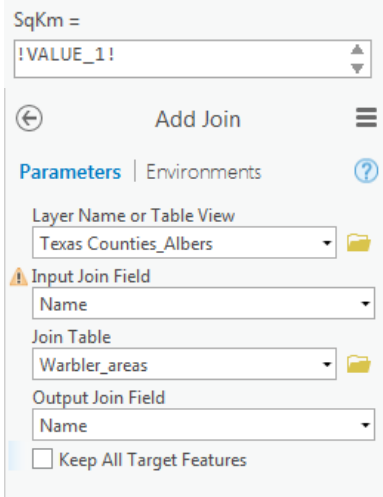
Right-click the SqKm field and click on Calculate Field. In the Calculate Field Geoprocessing tool, double click the VALUE\_1 and complete the formula to convert the value to SqKm (in the field SqKm = !VALUE1! HINT: 1SqKm = 1,000,000SqMeters). Click Run. Based on the Results:

4. What are the top counties with warbler population area?

County	SqKm
_____	_____
_____	_____
_____	_____



Close the attribute tables. Now we will calculate the percentage of area of each county with Warbler population. We will join the county polygons to the table we just created of Warbler population. Right-click the Texas counties layer and point to Joins and Relates, then click on Add Join. Fill the Add Join as shown in the image. Make sure the Keep All Target Features option is not selected. Click Run. This will remove all Texas counties with no presence of Warbler population.



Right-click the Texas counties layer under the table of contents. Point to Data and click on Export Features.

In the Copy Features Geoprocessing tool, change the name of the Output Feature class to counties\_warbler. Run the tool. By doing this step, we created a copy of the original layer with only the counties of interest while also including the data from the warbler\_areas table. Right click again the Original Texas layer. Again, point to Joins and Relates, but this time select Remove all Joins. Click Yes on the Remove Joins prompt. The original layer was not affected. Open the attribute table of the counties\_warbler layer. Add a new field called PERCENT and choose type float. Save the changes and close the Fields tab. Right-click the PERCENT field and click on Calculate Field. The original Texas layer has a field called SqKmArea. This is the total

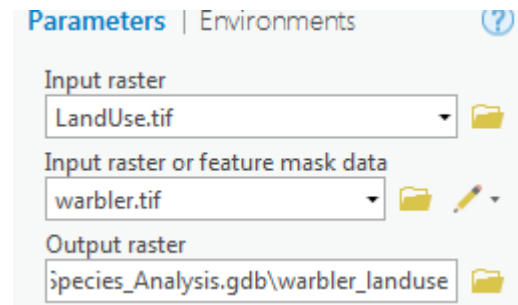
land area for each county. In the Calculate Field tool, in the PERCENT = field, create a formula to calculate the percentage of county area with Warbler population (Remember you double click the field you need under the Fields list). Run the tool.

5. What is the county with the greatest percentage of area with warbler population?

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Turn off all layers except for the Warbler layer. Add the LandUse.tif layer from the LandUse folder. We will extract the pixels of this layer that overlap the Warbler layer.

In the Geoprocessing pane, search for Extract by Mask and click on the tool to open it. Select LandUse as the Input raster and the Warbler layer as the Input raster or feature mask data. Change the name of the Output raster to warbler\_landuse. Run the tool.



Turn off the LandUse layer. The warbler\_landuse layer has the same resolution as the warbler layer (30mX30m). Open the attribute table of the warbler\_landuse. The field Value is a numerical representation of the Land\_Cover field. The Count field is the number of pixels for each category.

6. What formula would you need to obtain the area in square kilometers based on the pixel count and its resolution?

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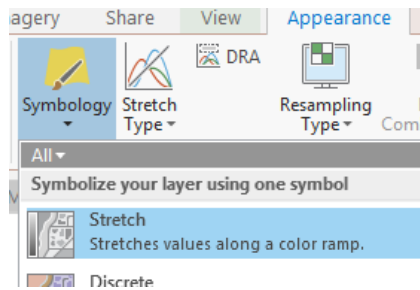
Based on your previous practice, add a new field to the table called AREA with type float and calculate the square kilometer value.

7. What Land Use type has more Warblers in it?

Land\_Cover \_\_\_\_\_ SqKm \_\_\_\_\_

Close the attribute table. Turn off all layers.

From the HII folder, add the HII.tiff layer. This layer was developed by NASA's Socioeconomic Data and Applications Center. It is part of a program called Last of the Wild developed to investigate the effects of humans on the environment. This raster measures the Human Influence Index. It contains values ranging from 0 to 64, where 0 is no human influence and 64 represents complete human influence on the environment. The influence is measured in terms of urban development, construction of roads, farming, etc. This layer was last updated in 2004. The current symbology of the layer is not the best for these types of rasters. Click on the Appearance ribbon, then click on the Symbology drop down menu and select Stretched.

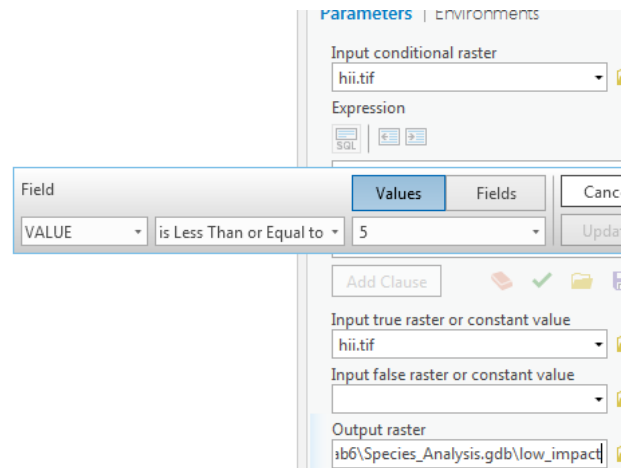


The layer was first symbolized using unique values, which made it impossible to discern a pattern. By switching to a stretched symbology, we are using the same a Black-to-White palette. Darker areas have lower human influence, while white areas have higher human influence.

For our purposes, we will only need those areas that have a value of 5 or less. To accomplish this we need 2 steps. First, we need to reclassify the original hii layer to extract the values we need.

Secondly, the resulting layer will be converted to polygons.

In the Geoprocessing pane, search for the tool Con. Click on the tool to open it. Select hii.tif as the Input conditional raster. Click on the Add Clause and select values as shown. Select hii.tif as the true raster and leave the false raster blank.



Name the Output raster low\_impact and run the tool.

Turn off the original hii layer. The resulting layer of the Con tool is a raster with 5 unique values. The tool discarded all values 6 - 64.

Now we need to convert the raster to polygons, the opposite from what we did when we converted the counties polygons to raster.

Search for the Raster to Polygon tool and click to open it. Select low\_impact layer as the input raster. Select Value as the Field. Name the min\_hii\_areas. Run the tool.

Turn off the low impact layer.

Using the same steps, you have previously used, open the attribute table of the min\_hii\_areas and add a field named AREA of float type.

Once the field is created and saved, right-click on it and click on Calculate geometry.

In the Calculate Geometry Attributes tool, for the field AREA select Area property and Square kilometers for Area Unit. Run the tool.

Parameters | Environments ?

Input Features  
min\_hii\_areas

Geometry Property  
Target Field (v) Property

AREA	Area

Area Unit  
Square kilometers

Next, search again for the Tabulate Area tool and run it with the following parameters:

Input raster or feature zone data: min\_hii\_areas

Zone field: Id

Input raster or feature class data: warbler.tif

Class Field: VALUE

Output table: warbler\_hii\_areas

Processing cell size: warbler.tif

When the tool finishes running, open the attribute table of the warbler\_hii\_areas and identify the record with the largest area (VALUE\_1).

Use the Select by attribute tool to find the polygon from the min\_hii\_areas that has the same ID of the record you identified in the previous step.

8. Turn on the counties\_warbler layer and identify the county or counties where this area is located.

ID (of min_hii_area)	AREA	County(ies)
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Add the NDVI2005274.tif and NDVI2011213.tif from the NDVI folder. These are two NDVI datasets for the state of Texas. They represent a monthly average NDVI value. The first one is for the month of October 2005, and the second is for the month of August 2011.

9. What is NDVI?

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10. What is the formula for NDVI?

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Turn on the Texas\_Counties\_Albers layer and move it the very top on the Contents pane drawing order.

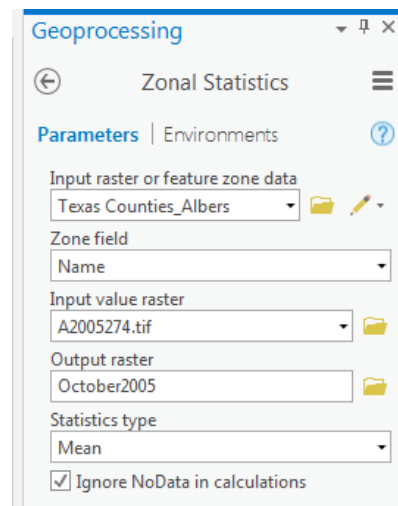
Use the Select by Attribute tool, or open the attribute table and select El Paso, Harris and Travis Counties (if using the attribute table, use the Ctrl key to do multiple selections).

In the Geoprocessing pane, search for Zonal Statistics. Open the tool.

Select the Texas Counties layer as the Input raster. Select Name as the Zone field. Select the A2005274.tif as the Input value raster. Name the Output raster October2005. Select Mean as the Statistics type. Run the tool.

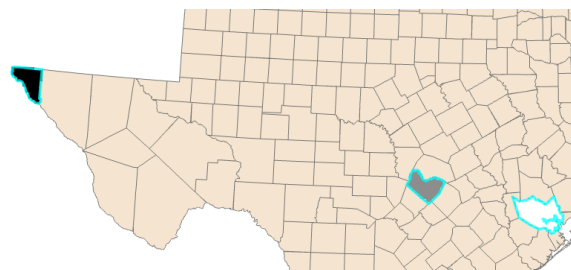
The tool obtains an average of all the pixel values within each one of the three selected counties. The output is a raster representation of the county with the mean NDVI value for each one.

Run the tool again but replace the Input value raster with the A2011213.tif and the Output raster as August2011.



Make sure the Explore tool is selected in the Map ribbon.

Click on each of the counties to obtain the NDVI values (Remember the Explore tool gets the value of top-most layer on the Contents pane).



11. Record the following NDVI values for the three selected Texas counties.

2005

El Paso \_\_\_\_\_ Harris \_\_\_\_\_ Travis \_\_\_\_\_

2011

El Paso \_\_\_\_\_ Harris \_\_\_\_\_ Travis \_\_\_\_\_

Two major meteorological events occurred during the above years. Hurricane Rita made landfall in Louisiana in 2005. On the other hand, Texas suffered one of the most severe droughts of the last century during the August-July period of 2010-2011.

12. Based on the above information, in your own words explain how these natural events are reflected in the NDVI values you recorded.

13. As you go further west in Texas the amount of precipitation falls greatly. Based on this describe the general relationship between precipitation and NDVI.

**BIOL 4460/5460 and GEOL 4460 Introduction to GIS**  
**ASSIGNMENT 6 – ANSWER SHEET**

Name: \_\_\_\_\_

1. What is the Cell Size? X \_\_\_\_\_ Y \_\_\_\_\_

2. What is the linear unit? (Check Spatial Reference) \_\_\_\_\_

3. What area does each pixel cover? Hint: multiply the X and Y values. \_\_\_\_\_

4. What are the top counties with warbler population area?

County

SqKm

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. What is the county with the greatest percentage  
of area with warbler population?

\_\_\_\_\_

6. What formula would you need to obtain the area  
in square kilometers based on the pixel count  
and its resolution?

\_\_\_\_\_

7. What Land Use type has more Warblers in it?

Land\_Cover \_\_\_\_\_ SqKm \_\_\_\_\_

8. Turn on the counties\_warbler layer and identify the county or counties where this area is  
located.

ID (of min\_hii\_area)

AREA

County(ies)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



9. What is NDVI?

10. What is the formula for NDVI?

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