Lab 7. Environmental Impact Analysis

In this exercise you will learn how ArcView’s standard functions and sample scripts can be used for more advanced environmental impact analysis. You will identify areas of undeveloped land where the risk of environmental damage is high.

To accomplish this goal, you will employ the following concepts and procedures:

- Dissolving internal polygon boundaries
- Summarizing fields in a table
- Point-in-polygon frequencies
- Theme-on-theme selection
- Converting frequencies to densities
- Working with a sample script
- Working with a modified user interface
- Intersecting themes
- Reclassifying a variable

You’ll be working in an area covered by the San Juan Capistrano 7.5 minute quadrangle in California. This is an area where a little songbird called the gnat catcher has the power to halt development projects worth tens of millions of dollars.

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**Background Information:**

Gnat catcher is one of several species of small American singing birds, of the genus *Polioptila*, allied to the kinglets. The songbird averages four inches long. The males are grey-blue with a black tail, and females are gray-brown.

Surviving in the Coastal Sage Scrub (CSS) habitats in California and Northern Baja, these birds are highly territorial and mate for life. As the bird forages for insects through the scrub, they wave their tail and the resins from sage brush linger on their feathers giving them a resinous smell. The males have black "caps" on their heads during breeding and nesting season (mid-February to mid-August) then lose their caps when they molt. Although these birds forage in various landscapes, they center their territories and reproductive lives in CSS habitats at elevations below 1,500 feet.

Paired adult gnatcatchers do not migrate beyond a one to two acre territory all year. The males call from the tallest shrubs and fiercely defend their territory and their mates from other males. If another male invades, the two combatants chase each other, snapping their bills and clawing each other while in flight. Females can be equally territorial with another intruding female. Most gnatcatchers mate for two to five years, but sometimes another bird will succeed in intruding into the "marriage" of another couple and the ousted bird will search for another mate.

Both male and female share the tasks of building a nest, raising and feeding the young and driving off potential predators. The female lays, on the average, three to four aquamarine eggs. In the following two weeks, both parents trade 20 to 40 minute shifts alternating from incubating the eggs and foraging for food. After two weeks, the eggs that are viable hatch into red and black, nearly shapeless blobs with legs. The nestlings are still exothermic, unable to produce their own body heat, and the parents take turns keeping them warm and bringing insects to their nest. Within another two weeks, the young are ready to fly and leave the nest. During the spring and early summer, both parents continue to feed their fledglings for two to
four weeks after they leave the nest, relying on the rich, diverse insect populations that thrive in coastal sage scrub.

The greatest threat to the survival of this bird is during their first year. The young often fall victim to nest predators such as rodents, snakes, scrub-jays, road runners, feral or domestic cats. They also can have their nests destroyed by bulldozing activity. In order to survive this nest predation and destruction, most pairs make repeated nesting attempts even while feeding their brood of chicks (who may be only two weeks out of the nest)-producing one, sometimes two, broods in a season. But after three or four weeks of feeding, the parents drive the young off their territory. With the shrinking world of coastal sage scrub lost to development, most young only move no farther than two miles away putting even more stress on their survival.


1. Setup Files

Start the ArcView program and load the lab7_f02.apr project file in c:\geog508\avexer\. Make sure you save the project to a different name in your folder in c:\public\ (very important!). Also set the working directory to your own folder.

2. Analysis Strategy

Remember that early in this semester, I said I want to teach you not only the GIS techniques but also the way of thinking about geographic/spatial problems and solving them using GIS. This exercise attempts to illustrate that. I will explain why various things are done. Please pay attention to what you do and think about why they are done in a particular way.

You should always develop a strategy for solving your GIS problems. If you do GIS, do it right the first time!

For this project, your analysis will consist of three major steps:

- Summarize the vegetation theme so that there is one record for each vegetation type
- Calculate the density of gnat catcher sightings for each of those vegetation types
- Overlay land use with summarized vegetation to identify areas of vacant land that have a high probability that the gnat catcher is present

3. Dissolving Internal Polygon Boundaries: Summarizing a Feature Table

First, let's take a look at the vegetation table:

- Click once on the name Sjcveg.shp to activate the theme
- From the menu select Theme - Table

Q1: How many records are there in the table? ______________________________

Q2: What are the vegetations types in the study area? ______________________________
You'll note that there are more records than vegetation types. In fact, because of the way the data set was constructed, some of the polygon boundaries have the same vegetation type on both sides. We can use the **Summarize** function to eliminate these internal polygon boundaries and at the same time simplify the analysis:

- Click once on the field name **Veg1** to highlight it
- From the menu select **Field - Summarize**
- Field: **Shape**
- Press the **Add** button
- Summarize By: **Merge**
- Click **OK**
- When prompted, click OK to add theme to: **View1**

The new summary theme is called something like **Sum1.shp** (The number "1" in the filename will change, depending on how many people ran the same function before you). Let’s rename the theme, set its legend and take a look at its table:

Click once in the legend on **Sum1.shp** to activate the theme

- Select **Theme - Properties**
- Set the theme name: **Sjcveg1.shp**
- Press **OK**
- Double click on the theme legend for **Sjcveg1.shp**
- Press **Load**
- Go to c:\geog508\avdata\environ\, locate and highlight **veg1.avl**
- Press **OK**
- Press **OK**
- Press **Apply**
- Check **Sjcveg1.shp** to make the theme visible, if not already checked
- Remove the check from **Sjcveg.shp**
- Select **Theme - Table**

**Q3:** How many records are in the new vegetation theme? ________________________________________.

Notice in the new vegetation theme, internal polygon boundaries have been dropped and island polygons with the same vegetation type have been merged into one complex shape with one database record.

- Close the table
- Drag **Sjcrf.shp** to the top of the legend box so it will not be hidden

**4. Where are the Gnat Catchers? - Point in Polygon Densities**

Now you're ready to count the number of gnat catcher sightings in each vegetation type.

First, create a field in the attribute table of **Sjcveg1.shp** to store the gnat catcher count data. Use the following to define the field:

- Name: **Numgnats**
- Type: **Number**
- Width: **4**
• Press OK

Stop editing and save the edits.

Next, select each vegetation type in turn and ask ArcView to do a point-in-polygon test to determine how many gnat catchers are present.

• Click once on the Select Tool
• Click on Coast Sage Scrub to select it
• Click on Sjcrf.shp to activate the theme
• From the menu select Theme - Select By Theme
• Select features of the active themes that: Intersect
• The selected features of: Sjceveg1.shp
• Press the New Set button

From the menu select Theme - Table

You should see 5 records selected - 5 of the gnat catcher sightings are located in Coastal Sage. Write down the number below for future reference. Repeat the process for the remaining vegetation/land cover types (including urban).

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>-----------------</th>
<th>Gnat Catcher Sightings</th>
</tr>
</thead>
</table>

Now enter the gnat catcher frequencies (the values for Numgnats) in the Sjceveg1.shp table through table editing. When you are finished, save your edits and close the table.

5. Do Gnat Catchers Really Prefer Urban Land?

Most of the gnat catchers are in the urban land category. But do gnat catchers really prefer urban land to other vegetation types? We cannot be sure since we have not controlled for the varying amounts of the different vegetation types. To do this, we need to calculate gnat catcher densities. First, we use a sample script called View.CalculateFeatureGeometries to calculate areas. To simplify the exercise, a button linking the script has already been added. The button is labeled A.

• Highlight Sjceveg1.shp
• Press the A button
• From the menu select Theme - Table

Arrow over and note that areas in square meters have been calculated for each vegetation type. Now add a field to hold the gnat catcher density values. Define the field based on the following information:
Since there are so few gnat catchers, you should calculate the density per square kilometer rather than per square meter:

- If the field Gnatden is not already highlighted, click once on it
- From the menu select Field - Calculate
- If the field Numgnats is not already highlighted, click once on the field name
- Double-click on Divide By (/)
- Double-click on Area
- Double-click on Multiply (*)
- From the keyboard enter 1000000
- Press OK

Stop editing and save the edits

The densities should appear in the Gnatden field. Record your results below:

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Density</th>
</tr>
</thead>
</table>

Q4: What is the vegetation type with the highest density? __________________________.

Q5: What is the vegetation type with the second highest density? ____________________.

Q6: If the highest density area is not urban, why do you think the urban areas recorded so many gnat catcher sightings?

6. Where is Vacant Land with Gnat Catcher Habitat? - Intersecting Themes

Now that you know which vegetation types are most likely to have gnat catchers, you need to overlay the vegetation and land use themes. The sample script View.IntersectThemes allows you to intersect two
polygon themes and carry the attributes of each forward to the output theme. In that way, you will be able
to identify areas of vacant land that have coastal sage scrub or riparian willow vegetation. To simplify the
exercise, I have already brought the sample script into the project and attached it to the **Intersect Themes**
button to the right of the A button:

- Press the **Intersect Themes** button
- Intersect Theme: Sjveg1.shp
- Press OK
- Overlay Theme: Sjclu.shp
- Press OK
- Name the output merged shape file something like Sjveglu.shp
- Press OK
- Add theme to View: Yes
- Which View: View1
- Press OK
- Activate the theme Sjveglu.shp
- From the menu select Theme - Table

Note that the values for **Veg1** and **Ladesc2** have been brought forward to the new theme. Now you are
ready to identify three different levels of gnat catcher sensitivity: highest for coastal sage on vacant land,
next highest for riparian willow on vacant land, and a third category for all others. First, create a field for
holding the gnat catcher sensitivity information based on the following specification:

- Name: **Gnatlev**
- Type: **Number**
- Width: 3
- Decimals: 0
- Press OK

Next, initialize the field to the lowest sensitivity level:

- Highlight **Gnatlev**
- Select **Field - Calculate**
- From the keyboard, enter the value 3
- Press OK

Finally, find the areas of coastal sage and riparian willow and enter sensitivity levels 1 and 2 respectively:

- Select **Table - Query**
- Double-click on **Veg1**
- Click once on the = sign
- Double-click on **Coastal Sage Scrub**
- Click once on **And**
- Double-click on **Ladesc2**
- Click once on the = sign
- Double-click on **Vacant**
- Press the **New Set** button
- Close the query box
- Highlight the field name **Gnatlev**
- From the menu, select **Field - Calculate**
- From the keyboard, enter the value **1**
- Repeat the process for Southern Arroyo Willow Riparian and enter a value of **2**
• Stop editing and save the edits
• Clear all selections and close the table

The analysis is now complete. To view the results, modify the legend for Sjveglu.shp to assign three distinct colors to the three gnat catcher sensitivity levels.

You need to submit the results (map) to be graded.

7. On Your Own

Think about how you may design and implement your own environmental analysis. Be prepared to contribute to class discussion. You may write your ideas down below.