

Suitability Analysis – Vector

Suitability Analysis - A Case Study

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1. The Problem

This exercise is designed for a simple case study using GIS techniques (vector analysis) to solve a real problem. The study area is McGregor Model Forest (MMF) located about 70 kilometers east of Prince George. You are required to determine the potential wildlife habitat areas based on the criteria listed below:

Datasets: L:\labs\geog300\mmf

- *forest* - FOREST COVERAGE
- *rivers* - RIVERS
- *soils* - SOILS
- *soils_dat* - Soils attribute table
- *roads* - ROADS
- *dem* - raster DEM

Summary of Factor Criteria

Factors	Criteria
Factor 1: Forest Cover (<i>forest</i>)	<ul style="list-style-type: none"> • Height Class codes > 1 (HTCL_IN) • Age class codes >=3 (AGECL_IN) • Spruce(S) is the preferred species type (SPCS1) • Moderate Crown closure classes 5 or 6 or 7 (CRNCLCL)
Factor 2: Spatial Arrangement	<ul style="list-style-type: none"> • All the areas from 0-50 meters beyond forest cover defined as wildlife habitat (from factor 1) should be included within the potential wildlife habitat areas. • The Areas that are within 250m of a definite river and also within 500m of forest cover defined as the wildlife habitat (from factor 1) should be included as potential wildlife habitat area (Note: definite river should include the left and right bank of double line rivers.)
Factor 3: <i>soils</i>	<ul style="list-style-type: none"> • Mg or Ct soil types (SOILS_SY1) produce critical vegetation types for wildlife, and therefore, support the highest concentrations.

2. GIS Model

As a GIS analyst, you are required to layout a GIS model to solve this problem based on the criteria listed above. Here is a simple idea for solving this problem

1. Based on the criteria listed above, we need first to find the areas that meet all the criteria on **forest** (factor 1). This can be done with Select by Attributes on **forest**.
2. We need to create buffer areas on selected features (**forest**) from step 1. Two buffer zones need to be created. A 50 meters buffer (**fc_buf50**) and a 500 meters buffer zone (**fc_buf500**) on selected **forest**. As the 250 meters surrounding areas on definite **rivers** and within 500 meters on selected **forest** features are treated as the habitat area, so a 250 meters buffer zone (**river_buf250**) on definite **rivers** need to be created to meet the second part of factor 2.
3. In order to locate the areas that meet the conditions on spatial arrangement (factor 2), we need to intersect the 250 meters buffer zone on definite **rivers** (**river_buf250**) and 500 meters buffer zone (**fc_buf500**) on selected **forest** features to get the areas that meet factor 2 (**fact2**)
4. Locate the areas with Mg or Ct as the soil type with Select by Attribute on **soil**
5. Finally, the 50 meters buffer on selected **forest** (**fc_buf50**), the areas that meet factor 2 (**fact2**) will be unioned together and the result will be intersected with selection of soils to produce the final potential wildlife habitat areas.

3. Finding the areas that meet the requirements on **forest** (Factor1)

We will first find the areas that meet all the criteria on **forest**. This can be done easily by Select by attributes on **forest**.

- Create a new folder **vector_case** in your geog300 folder
- Start ArcMap with a blank map file and add the layers listed above to ArcMap.
- Change the default data frame name to **Wildlife Habitat** and set the units of the data frame to meters.
- Arrange layers to make them visible in the display area (order from the top to the bottom: **roads, rivers, forest, soils, dem**). Turn off **dem** for now.
- Save the map file to **K:\geog300\vector_case\wildlifehab.mxd**.
- Make a selection by attributes with the following query expression:

```
"HTCL_IN" >1 AND "AGECL_IN" >= 3 AND "SPCS1" = 'S' AND ("CRNCLCL" = 5 OR "CRNCLCL" = 6 OR "CRNCLCL" = 7)
```

All the forest polygons that meet the criteria should be highlighted. We don't need to create a permanent data layer for the selected features. ArcGIS allows for performing spatial overlay on the selected features. Leave the selected features on for next step.

4. Finding the areas that meet Spatial Arrangement (Factor2)

To find the areas that meet factor 2, we need to create buffer zones on selected **forest** from previous section and **rivers**.

Determine the areas that are within 50 meters beyond the selected **forest**

- Create a 50 meters buffer on selected **forest** with Buffer tool
- Make sure to choose ALL for Dissolve Type. This will eliminate the overlay barrier
- Save the output feature as **fc_buf50.shp** in your local folder
- Click the symbol of **fc_buf50** to bring up Symbol Selector window. Change the symbol color to light Green with solid border and click OK.

Determine the areas that are within 500 meters beyond the selected **forest**

- Follow the same steps create a 500 meters buffer on selected **forest** features.
- Save the output features as **fc_buf500.shp** in your local folder **vector_case**

- Now you have two buffer layers: ***fc_buf50*** and ***fc_buf500***. Click the symbol of ***fc_buf500***; choose dark Green with solid border symbol. Click OK. Move it below ***fc_buf50*** if necessary.

Determine the areas that are within 250 meters distance of definite rivers

- Open the attribute table of ***rivers*** and examine the field TYPE which indicates river types. You may notice that all river lines are definite rivers including river banks, so there is no need to make any selection on ***rivers***.
- Follow the same steps above to create a 250 meters buffer on ***rivers***
- Save output features as ***river_buf250*** in your **vector_case** folder.

Locate the areas that meet the criteria of Factor 2

In order to locate the areas that meet Factor 2, we will intersect the 250m buffer on ***rivers*** (***river_buf250***) with the 500m buffer on ***forest*** (***fc_buf500***)

- Perform an overlay on ***river_buf250*** and ***fc_buf500*** with INTERSECT tool
- Save the output as ***fact2*** in your local folder

Now we have ***fc_buf50***, ***fc_buf500***, ***river_buf250***, ***fact2*** in the table of contents.

5. Finding the areas that meet the requirements on soils type (Factor3)

The areas with Mg or Ct soil type can be located with Selection by Attributes

- Examine the attribute of ***soils***. Note that there is no information about soil type. The Soil type and other non-spatial information are stored in another table, called ***soils_dat.dbf***.
- Click the second button located at the upper left corner in the table of contents to switch to Source display mode.
- Here you can see ***soils_dat.dbf*** table. Right-click on it and choose Open. Examine the field SOIL_SY1. This field contains soil type information. We need to join this table into the ***soils*** attribute table with join field ***soils_id***
- Join ***soils_dat.dbf*** table to ***soils*** with join field ***soils_id***
- Make a selection query on ***soils*** to select soil polygons with Mg or Ct as the soil type (similar to the following)

```
"SOIL_SY1" = 'Mg' OR "SOIL_SY1" = 'Ct'
```

All the selected features are highlighted. Leave the selected features on for next step.

6. Locating the final potential wildlife habitat area

Now we have the areas that meet factor1 on ***forest***, the areas that meet factor2 and the areas that meet the criteria on ***soils***. The last step is to locate the areas that meet all criteria.

Now we have the datasets meet each factor and ready for locating the final habitat area

Factor 1:	<i>fc_buf50</i>
Factor 2	<i>fact2</i>
Factor 3	soil selection

- First, perform an overlay on ***fc_buf50*** and ***fact2*** with UNION tool to get the areas that meet factor 1 or factor 2
- Save the output as ***fact12*** in your local folder
- Second, perform an overlay operation on ***fact12*** and ***soils*** with INTERSECT tool
- Save the output as ***habitat*** in your local folder
- Save the map file as ***wildlifehab.mxd***.

The dataset **habitat** contains the areas that meet all the conditions listed above

Note that all the analysis applied here does not update the geometry related information (AREA, LENGTH, and PERIMETER) automatically. You will have to do this manually.

- Examine the attribute table of **habitat**. Update the values in AREA field to reflect the true area. If there is no AREA field, add it.

7. Presenting the result

In this section, we will make a map to show our analysis result.

A map is a graphic representation of a part of the earth's surface. A map contains a series of themes that are often combined to form the final product. A map also includes descriptive information which helps the reader interpret the information on the map. The purpose of a map determines the emphasis that should be given to different types of information.

The Goals of Map Design

Several goals of map design can be identified. These include:

- Clarity
- Order
- Balance
- Visual Contrast & Hierarchy
- Unity and Harmony

Requirements

- Symbolize map features
- Label features
- Layout map elements
- Appropriate legend, map title, scale bar and description
- your name and date

Symbolization

The symbolization of spatial features should meet cartographic conventions. In general, water bodies should be symbolized in blue and labelled with italic fonts, roads in red or black, forest covered area should be in green etc.

- Keep layers **roads, rivers, habitat, forest, dem** in the table of contents and remove the rest of layers by right-click on the layer and choose Remove.
- Arrange data layers from the top to bottom in the table of contents: **roads, rivers, habitat, forest, dem**
- Clear selections on all the layers if necessary
- Click the symbol for **roads** layer to open the symbol selector. Change the color to red.
- Change **rivers** in blue and **habitat** in bright color (red)
- Symbolize **forest** based on the leading species (SPCS1). In the symbology tab, remove the item with no value and set outline with to 0 for color boxes. Change SPCS1 to Tree Species
- Save the map file

8. Adding a Map Legend

Once done the symbolizations, switch to Layout View to design your map layout and add more information into the map.

- Click View->Layout View. In layout view, you can design the map layout.
- First set the map page to letter size and landscape. Click File-> Page and Print Setup. By default the Print Setup is set to standard letter size

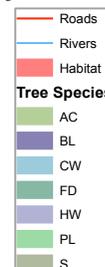
- In Map Page Size box, set Standard Size to Letter. Remove the check mark beside Use Printer Page Setting and place a check mark beside Landscape for Orientation

The spatial data are displayed in a box (data frame) with eight small handles if it is selected (small square located at each corner and in the middle on each side). The handles allow you to resize the data frame.

- Resize the data frame to make it well fit into the paper. Leave some room at right for legend and other information
- You can move the data frame by holding the mouse button within the box and dragging to move.
- Click Insert->Legend to insert a legend. Make sure to have the only layers **rivers, roads, habitat, forest**.
- Take the rest of default to insert the legend.

We can make some changes to legend

- Double click the legend box to open the properties. Under the General tab, remove Title "Legend"
- Click Items tab and highlight **forest**. Click Style button located at bottom. Choose the Horizontal with Heading and Labels style. Click OK
- Move the legend to the right



9. Adding a Scale bar

Scale bar

The scale bar is critical for a map. It gives the ratio between the map and real world distance. It allows users to measure the map distance and calculates the real distance from that measurement.

Before adding a scale bar, you need to make sure you have the Display unit set for the data frame. Otherwise the scale won't work properly.

- Right-click data frame and choose Properties.
- Click the General tab and set the Display Units to Kilometers. Click OK to apply the changes.
- To add a scale bar, click Insert->Scale bar from the top menu
- There are many built-in scale bar styles. In the Scale Bar Selector window, highlight the top one 'Scale Line 1' to select it
- Click Properties button to customize the scale bar
- Under Scale and Units tab, change Number of divisions to 1 and Number of subdivisions to 0
- Click the dropdown arrow right beside 'When resizing...' and choose 'Adjust width'. This will allow you to set the division distance
- Change the 'Division Units' to Kilometres and set Label Position to 'Below Center'
- Now back to the top, change the Division value to 1km. This will make the division bar at 1 kilometre
- Click Numbers and Marks tab, Change both Numbers Frequency and Marks Frequency to 'divisions and first mid point'
- Click OK and OK again. The scale is added. Move the scale bar to an appropriate location (could be the upper or lower right area)

10. Adding more information to the Map Layout

Text

Text is another important part of a map. You will need to add a map title, your name and date. Use the Text button **A** on the Drawing toolbar or from Insert on the top menu to add text.

- Add a map title 'Potential Wildlife Habitat Area for Mcgregor Model Forest to map with an appropriate font size. Move the map title to the top
- Add map creator and date with an appropriate font size. Move the text to the lower right of the map

Graphic

Now we want to add a UNBC GIS Lab logo to the map

- Click Insert->Picture. Navigate to L:\labs\geog300\unbc and click **gislab_logo.jpg**
- Move the logo to the lower right corner of the map
- Resize the picture by dragging the small handle at corner if necessary.



11. Use Hillshade as a map background

You can use the transparency feature and hillshade raster to make the map look with some 3D effect.

- Create a **hillshade** from **dem** and move it to the bottom in the table of contents.
- Double-click **forest** to open the properties window. Click the Display tab and make the **forest** transparency 50%
- Save the file in your local folder.
- You can save the map as PDF file by clicking File->Export Map. Navigate to your local folder and save it as **wildifehab.pdf** and the File type as PDF.

Assignment 8: A Simple Case Study (5%) due next week Nov.6, 7,8

This practice exercise asks the question, where would be the safest area within the Prince George boundary to develop a new park for children 12 and under. In this case, 'safest' will be defined as **free from environmental or physical hazards**; crime and vandalism will NOT be considered. The criteria used to determine what the 'safest' area is will be based on **site characteristics** and **location**.

Characteristics of the potential site:

- The youngest trees possible ($\text{proj_age_1} \leq 50$), to ensure the playground is not in an area with old rotten trees which could fall over. For this reason we would also want to eliminate areas with pine (PL,PLI) as the leading species (species_cd_1), because many pine trees in Prince George are dead, due to the pine beetle.
- We would also want to eliminate any areas where spruce is the leading species (all types of spruce: S, SB, SW, SX) as the needles are pointier than other coniferous trees and could harm children playing around trees.
- We should also ensure that the location is on the flattest slope possible (e.g. 0-5), to enable playground building and to limit falls.
- We would want the park to be in the most convenient place possible. Therefore, the potential site should be within 2km (2000m) of an elementary school (CLASS = 1; exclude the closed school, Status <> 2)
- We also want the park to be in neighbourhoods with slower streets (within 500 meters of roadways with maximum speeds of 30km/h or less).
- The potential park area should be greater than one hectares (10000 m²) in area.

Criteria summary

Forestry (forest):
<ul style="list-style-type: none"> • Stand age ($\text{proj_age_1} \leq 50$) and NOT Spruce or Pine dominated area (species_cd_1: PL,PLI, S, SB, SW,SX)
Spatial requirements
<ul style="list-style-type: none"> • Within 2000 meters distance of <u>elementary</u> schools (CLASS = 1; exclude the closed school, Status <> 2) • Within 500 meters of roads with maximum speeds of 30km/h or less ($\text{max_speed} \leq 30$)
Surface:
<ul style="list-style-type: none"> • Slope ≤ 5 degree

Data required: L:\labs\geog300\pgcity:

<i>pg_dem25</i>	Digital Elevation Model
<i>pg_boundary</i>	City boundary
<i>streets</i>	Streets
<i>schools</i>	Schools
<i>major_rivers,</i>	Major Rivers
<i>forest</i>	Vegetation info (located in <i>pg_forest.gdb</i> geodatabase)

Working environments:

Workspace: Your local folder
 Processing: Same as ***pg_boundary***
 Cell Size: Same as ***pg_dem25***

Requirements:

- The GIS analysis for solving this problem will be mainly in vector environment. Layout a GIS model to solve this problem (a flow chart or major steps)
- Conduct a GIS analysis to locate the potential park area. Note down the total area.
- Produce a map showing the potential park together with ***pg_boundary, streets, major rivers, schools*** (only show elementary school) . The map should be well layout and symbolized properly. It comes with proper title, scale, legend, the total area of potential park area and your name
- The ideal location of the potential park should be away from the major river and in the area with higher population (away from city boundary). Based on the result, discuss where would be the best location for the potential park in your option.

Deliverable:

- Make a title page with the course name, assignment number, your lab session, your name and studentID.
- A GIS model showing the procedure of this analysis(A flow chart or steps)
- Insert all maps to WORD file together with short discussion.
- Save the file as **lastname_firstname_geog3002018_A8**. Email the file to your TA with subject "Geog300 A8"

NOTE: Please name the file correctly. Assignment is due next week Nov.6, 7, 8
NO late assignment is accepted

~~~~~ The End ~~~~~