

## Factor Rating

This is the second part of Case Study in Geog300 which identifies the potential wild life habitat area based on a list of criteria. Although the result from the Case Study in Geog300 is certainly useful, it is somewhat limited. Potential habitat has been identified, but no information on how the quality of the habitat varies spatially has been provided. It seems not good enough to simply indicate the areas for potential habitat. It would be more useful to develop some sort of rating system which shows where the habitat is excellent, good, or possibly marginal. A map that conveyed this type of information would be much more useful for habitat or population planning etc.

In this lab, you will be working factor analysis by rating the criteria for each factor, weighting each factor, and developing and final habitat rating map. This map will rate the entire study area in terms of wildlife habitat suitability.

Data location: L:\labs\geog413\data\mmf

- *forest* – Forest coverage data
- *roads* - Major roads
- *rivers* - Rivers
- *soils* - Soils
- *soils\_dat* – Soil attributes
- *dem*: Digital Elevation
- *study\_bndy*: Study Boundary

The first step in applying a rating scheme is to work with a team of experts to develop factor ratings. These ratings can then be applied to the factor criteria established and combined in a model to produce the final habitat suitability map. Determining these ratings is a very subjective process as numbers must be assigned to generally non-quantifiable factors. How do you determine that one soil type should be rated 3 while another 2? Not only that, but the numbers that are assigned to criteria within one factor, perhaps all related for forest type, will be rated against a completely different factor type such as soils. Our knowledge of statistics should tell us that this is not a wise idea, yet in our quest for quantifiable results that is exactly what is often done. As we will see the assigning of ratings is a critical step in developing this type of model which can drastically affect the outcome of the study. Use this type of process with caution!

After consultation with a group of experts a rating scheme was established for each factor's criteria and then the factors themselves were given a factor weight. The table below summarizes the criteria ratings and factor weights.

**Note:** the following rating scheme is not real and is just for exercise purpose.

Factor/criteria	Criteria rating	Factor weight
<b>Factor 1: Forest Cover</b> <ul style="list-style-type: none"> <li>• Height Class codes &gt; 1 (HTCL_IN field)</li> <li>• Age class codes &gt;=3 (AGECL_IN field)</li> <li>• Moderate Crown closure classes 5, 6, 7 (CRNCLCL field)</li> <li>• Spruce(S) is the preferred species type (SPCS1)</li> </ul>	1 1 2 3	25%
<b>Factor 2: Spatial Arrangement</b> <ul style="list-style-type: none"> <li>• All the areas from 0-50 meters beyond forest cover defined as wildlife habitat (from factor1) should be included within the potential wildlife habitat areas.</li> <li>• The areas that are within 250m of a definite river and are within 500m of forest cover defined as 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.)</li> </ul>	2 3	25%
<b>Factor 3: Soil</b> <ul style="list-style-type: none"> <li>• Mg or Ct soil types (SOILS_SY1) produce critical vegetation types for wild life, and therefore, support the highest concentrations.</li> </ul>	1	50%

# 1. Using Raster Model

## Working environment

Current/Scratch Workspace:	your local folder
Processing Extent:	<i>study_bndy</i>
Cell size:	<b>25</b>
Analysis Mask	<i>study_bndy</i>

Create raster datasets necessary for each factor and 'weight'. This includes:

- Factor 1: Forest polygons with
  - Height Class Code > 1
  - Age Class Codes >= 3
  - Moderate Crown Closure Classes 5, 6 and 7
  - Spruce (S) is the preferred species type
- Factor 2: Spatial Arrangement
  - The areas from 0 - 50 metres beyond selected forest cover defined as wild life habitat (from Factor 1) should be included as the potential caribou habitat areas.
  - The areas that are within 250m of definite *rivers* and within 500m of selected forest cover defined as caribou habitat (from Factor 1) should be included as potential wild life habitat.
- Factor 3: Soil
  - Mg or Ct soil types produce critical vegetation types for Caribou and therefore support the highest concentrations.

## Convert vector data to raster

- Start ArcMap and add *forest, rivers, soil, soil\_dat, study\_bndy*
- Set working environment
- Set the map and display units to meters.
- Save the map file to **rating.mxd**

## Convert *forest* to raster

- Convert *forest* to raster using the filed **HTCL\_IN** and save the output as *fc\_htc*
- Convert *forest* to raster using the filed **AGECL\_IN, CRNCLCL, SPCS1** respectively and save the output as *fc\_agecl, fc\_crncl, fc\_sp1* respectively.

There will be four raster datasets converted from *forest*: *fc\_htc, fc\_agecl, fc\_crncl, fc\_sp1*

# 2. Generate raster datasets for Factor 1

To get the areas that meet the criteria listed above, we will use CON function to extract the raster dataset. CON function performs one or more conditional if/else evaluations on a cell-by-cell basis within the analysis window.

```
CON(<condition>, <true_expression>,
    {<condition>, <true_expression>}, ...
    {<condition>, <true_expression>}, {false_expression})
```

## Arguments

**<condition>** - any valid Boolean or relational expression involving multiple grids, scalars, numbers, or expressions.

**<true\_expression>** - the value or expression that will be used to compute the output value if the evaluation of the **<condition>** is TRUE. The input argument can be a grid, scalar or number, or any valid map algebra expression involving operators and functions that results in a valid input. Another CON function is valid input.

<**false\_expression**> - the value or expression that will be used to compute the output value if none of the evaluations of the conditions is TRUE. The input argument can be a grid, scalar or number, or any valid map algebra expression involving operators and functions that results in a valid input. Another CON function is valid input.

### Height Class codes > 1

- With raster calculator, create a raster to extract all *fc\_htc* cells with value greater than 1. Assign the output cell with value of 1 and the rest with value of 0. Save the output raster as *fc\_htc1*

```
fc_htc1:   con ("fc_htc" > 1, 1, 0)
```

- Repeat the steps generate rasters for Age class codes >=3, Moderate Crown closure classes 5, 6, 7, and Spruce(S) as the preferred species and assign proper value for each (see the rating list above)

```
fc_ag3:       con ("fc_agec1" >= 3, 1, 0)
fc_crn567:    con (("fc_crncl" >= 5) & ("fc_crncl" <= 7 ), 2, 0)
fc_spruce:    con ("fc_sp1" == 1, 3, 0)
```

- Save the output raster datasets *fc\_htc1*, *fc\_age3*, *fc\_crn567*, *fc\_spruce* respectively

## 3. Generate the raster that meet Factor 2

You need to create a distance map for each selected features from *forest* and *rivers*.

- Select by Attribute on *forest* to select all the polygons that meet factor 1.
- With the selection, create a straight distance map to selected features with Euclidean Distance tool
- Save it as *fc\_dist*
- Create a distance map to the *rivers* and save it as *rivers\_dist*

Now we need to find 50 meters buffer zone for the selected *forest* and 250 meters buffer zone of *rivers*

- With raster calculator, create a raster for 50 meters buffer zone of selected *forest* and save the it as *fc\_dist50*

```
fc_dist50:   con(("fc_dist" > 0) & ("fc_dist" <= 50), 2, 0)
```

- Create a raster that are falls in 500 meters of selected forest and also within 250 meter of rivers. Save the output raster as *r\_fc\_dist*

```
r_fc_dist:   con(("fc_dist" > 0) & ("fc_dist" <= 500) & ("rivers_dist" <= 250), 3, 0)
```

## 4. Generate the raster that meet soil type requirement (Factor 3)

- Join soil table *soil\_data* to *soil* polygon attribute table with join item SOIL\_ID
- Convert *soils* to raster using SOILS\_SY1 field and name the output to *soil\_type*
- With Raster Calculator, create a raster that meet the required soil type and save the output raster as *soil\_mgct* (check the attribute table of *soil\_type* for the values)

```
soild_mgct:   con(("soil_type" == 5) | ("soil_type" == 6 ), 1)
```

## 5. Final output with weighting

Now we can apply weights on each factor to get final result

- with Raster Calculator, create the rasters for forest factor (factor1), arrangement factor (factor2) and soil

```

forest_fact: "fc_htc1" + "fc_age3" + "fc_crn567" + "fc_spruce"
fact1:      con(("fc_htc1" > 0) & ("fc_age3" > 0) & ("fc_crn567" > 0) &
            ("fc_spruce" > 0), "forest_fact", 0)
fact2:      "fc_dist50" + "r_fc_dist"
fact3:      "soil_mgct"
fact_all:   0.25 * "fact1" + 0.25 * "fact2" + 0.5 * "fact3"
habitat:    con(("fact1" > 0) | ("fact2" > 0)), "fact_all")

```

The dataset *habitat* has the values ranged from 0 to 3.5. The higher value means more suitable areas for the wildlife.

- Double click the *habitat* layer to open the properties window
- Display the data in classified mode with 4 classes and Equal Interval method. The values of habitat are from 1 to 3.5. Change the range value to 1, 2, 3, 4
- Now keep the layers: *fact1*, *fact2*, *fact3*, *habitat* and remove all the rest datasets. Save the map file to *rating.mxd* in your local folder.

## 6. Present the results

Produce following maps to show the analysis result:

- A map showing the rating applied to each criteria is required for each Factor. For example,
  - Factor 1 - Forest coverage, a map is required that shows the rating of the study area based on the four sub-criteria.
  - Factor 2: - A map showing the rating for each criteria of factor2 based on the spatial arrangement.
  - Factor 3: - A map showing the rating for each criteria of factor3 (soils).
- A map with *habitat* layer and *hillshade* as the background is required. **Note:** the *habitat* layer should be the unique color for each rating value.

## Assignment 2 (5%)

**Due Jan 23<sup>rd</sup>**

In this assignment, you are required to locate a suitable location for a new fire station in raster environment

**Location:** Town of Hudson, Massachusetts

**Data:** L:\labs\geog413\data\hudson

<u>Datasets</u>	<u>Description</u>
<i>fire_stations</i>	Existing fire stations
<i>roads</i>	Major roads
<i>parcels</i>	Land parcel
<i>wetland</i>	Wetland
<i>dem</i>	Elevation
<i>boundary</i>	Town boundary
<i>town_owned.dbf</i>	Lookup table for parcel ownership (join field: <b>AccountNum</b> )

Criteria:	Weight
1. Must be a town-owned property, at least one acre in size and contain less than 20% wetlands	
2. In sufficient distance from existing fire stations,	20%
3. On a relative flat area (prefer slope < 5 degree)	30%
4. Close to major road	50%

**Environments:**

Workspace / scratch space:	your local folder
Processor extent:	same as <i>boundary</i>
Raster cell size:	20
Raster mask:	same as <i>boundary</i>

**Deliverable:**

- Make a title page with course name, number, assignment number, your name and studentID and save the answers and maps in a WORD / PDF file as *lastname\_firstname\_geog413\_A2*.
  - Send the file to your lab instructor by email ([baip@unbc.ca](mailto:baip@unbc.ca)) as attachment with subject “Geog413 A2”
1. *A GIS model (a flow chart or model builder chart) for conducting this analysis*
  2. *Make following maps together with discussion about the result and suggestion for the best location.*
    - *Map 1: Hudson town-owned parcels with area over one acre and contain less 20% wetlands*
    - *Map 2/3/4: Reclassified distance maps to fire station, major roads, and reclassified slope map*
    - *Map 5: Potential sites with ranking together with major roads and existing fire stations*

*Map1 – 4 should be in one page. Map5 should be on a letter size page. All maps should be symbolized according cartographic conventions and with proper title, legend and scale*

*Hints:*

- *Finding the parcels containing less than 20% wetland may need overlay operation and summarize tool to get the percentage of wetland in a parcel. The resulting parcel layer can be used as mask for the last step*
- *Reclassify the distance of roads and fire station to 10 classes according to criteria. Suggest following value range*
  - *Distance to fire station: 100, 200,500,800,1000,1500,2000, 2500,3000 and the last class with the highest value*
  - *Distance to roads: 50, 100, 200,500,800,1000, 1200,1500,2000,and the last class with the highest value*
- *Reclassify slope to 5 classes with break value at 5, 10, 15, 20 and the highest value for the last class. Give the ranking 10, 5, 3, 2, 1*
- *Reclassify the final result to 5 classes with break value at 5, 6, 7, 8, 10*

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