

Calculating Edge-Density of a Hemi-Marsh Using Model Builder and Python Toolbox



Taylor Biccum
Algonquin College GIS Advanced Certificate



Environment and
Climate Change Canada

Introduction

This tool was developed as part of a project in collaboration with the Algonquin College Geographic Information Systems Advanced Program and Environment and Climate Change Canada.

The tool calculates the edge density between wetland vegetation and open water zones using a classified wetland raster dataset. Several geoprocessing methods are structured within the tool and are described within the Methodology section.

The main purpose for producing an edge density tool was to provide Environment Canada with an efficient way of extracting the edge density metric from classified raster datasets. Prior to the creation of this tool there was no efficient way of removing this information from the datasets quickly. To do so individually was costly and time consuming. This tool will obtain significant information on wetland habitat quality that will be important for future studies on disturbance events and the spread of invasive species such as *Phragmites Australis*.

Background

Hemi-Marsh is a natural state that occurs as part of a wetlands' cycle, between the drawdown and regeneration periods. A healthy hemi-marsh will contain a 1:1 ratio of both wetland vegetation and open water. The point at which these two zones interact can be described as interspersed and measured as the edge-density in m/ha (Rehm et al., 2007).

When vegetation is spread out over a wetland in varying ways, it increases the interspersed and edge-density of the wetland. In a study conducted by Rehm and Baldassarre, results found that interspersed is a significant factor contributing to the abundance of wetland birds and that an increase in interspersed is directly proportional to an increase in edge density (Rehm et al., 2007).

Methodology

The process for the creation of the tool involved the use of the Model Builder Application within ArcPro to create a general workflow of tools that would be applied to the structure of the tool. Once the Model was completed it was then exported to a python script to be cleaned and tested. Once the python script was executable it was transferred to a Python Toolbox Script Template, where the parameters were configured to create a GUI tool within ArcPro.

Model Builder Workflow

12 Tools were used within the workflow created in Model Builder. Key tools included Focal Statistics, Reclassify and Intersect.

Focal Statistics creates a 5x5 neighborhood window that calculates the majority value of the cells within the neighborhood and applies it to the pixel. In the case of this raster dataset, the spatial resolution of the pixel was 10cm, meaning that a 5x5 neighborhood window represented a half meter in any direction of the center pixel. Raster's that have a lower spatial resolution may result in less accurate results.

Reclassify is an important geoprocessing step toward the final output. It allows for the selection of specific zones and the omission of others. Using the given dataset, it was decided that values 1-3 would be combined to represent the wetland vegetation zone, 4-6 would be omitted and 7 would remain as open water.

The intersect tool is an important step in the development of the edge density tool. Using intersect helps to visualize and quantify the length of the shared edge between our two zones of interest. The result from intersect is our last shapefile result and will allow the tool to further calculate a final edge density value.

Python Toolbox

A Python Toolbox template contains a class Toolbox and a class Tool. The two most important functions for the purposes of this tool are the "getParameterInfo" and the "execute" functions.

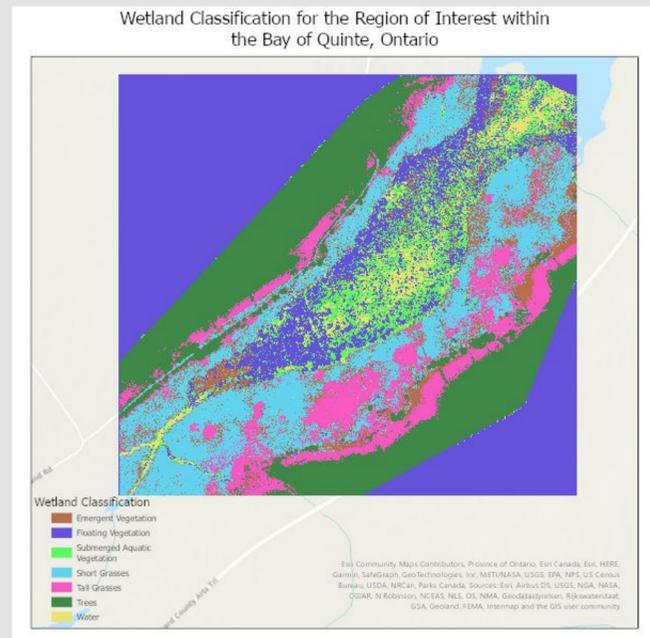
The getParameterInfo function defines each of the inputs that will be displayed in the GUI tool within ArcPro. The Edge Density Tool contains 4 required inputs and one optional input. The required inputs included a classified floating type raster, a scratch folder, output folder, and reclassification values. The optional input includes a polygon shapefile, used during the clip raster stage. The "def execute" function executes similarly to the original stand alone script. Each of the geoprocessing tools is executed and outputs are added to the indicated scratch or output locations.

```
30 input_raster = arcpy.Parameter(  
31     displayName="Input Raster File",  
32     name="in_raster_file",  
33     datatype="DERasterDataset",  
34     parameterType="Required",  
35     direction="Input")  
36  
37  
38 shapefile_clip = arcpy.Parameter(  
39     displayName="Clipping Shapefile",  
40     name="in_clip_shapefile",  
41     datatype="DEShapefile",  
42     parameterType="Optional",  
43     direction="Input")  
44  
45 scratch_path = arcpy.Parameter(  
46     displayName="Scratch",  
47     name="scratch_folder",  
48     datatype="DEFolder",  
49     parameterType="Required",  
50     direction="Input")  
51  
52 output_path = arcpy.Parameter(  
53     displayName="Output",  
54     name="output_folder",  
55     datatype="DEFolder",  
56     parameterType="Required",  
57     direction="Input")  
58  
59 reclass_values = arcpy.Parameter(  
60     displayName="Reclass Values",  
61     name="reclass_values",  
62     datatype="GPSARemap",  
63     parameterType="Required",  
64     direction="Input")
```

Study Area

The data used in the development of this tool was obtained from a wetland on the southern shore of the Bay of Quinte, ON. Bay of Quinte drains into Lake Ontario and is located near the northern shore of the lake. It is approximately a 3-hour drive northwest along the north shore of Lake Ontario.

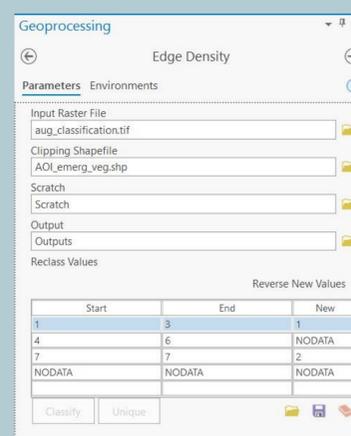
The following image is the classified raster dataset of the wetland. The classified image consists of 7 separate classes; including emergent vegetation, floating vegetation, submerged aquatic vegetation, short grasses, tall grasses, trees, and water.



Results

Python Toolbox GUI

The script tool created within the python toolbox results in an interactive GUI that can be used in the ArcPro environment. The parameters allow the user to have some control over the functioning of the tool, specifically with the reclassification of the zone values.



Edge Density Calculation

The tool was run twice to obtain an edge density value. Edge Density was obtained between the values representing emergent vegetation (1) and open water (7). The tool was then run a second time and edge density was obtained between the combined values 1 through 3 (emergent vegetation, floating vegetation, and submerged aquatic vegetation) and open water. Depending on reclassification values the edge density (m/ha) will change.

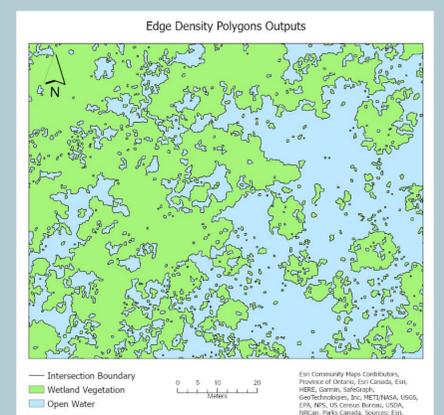
Reclass	Frequency of Area Polygons	Sum of Area (ha)	Frequency of Intersections	Sum of edge length (m)	Edge Density (m/ha)
1 and 7	64927	17.44303	7747	4945.4621	283.52080
(1-3) and 7	60882	54.55459	31143	153232.7142	2808.79559

As Sum of Area and Sum of Edge Length increase, Edge Density also increases. Edge density increases significantly because the intersections where the wetland vegetation touches the open water zone increases when the submerged and floating aquatic vegetation are included as part of the area. This is consistent with the theory that as interspersed increases so does edge density.

Edge Density Polygons

This image depicts the final polygon outputs from the tool, for wetland vegetation (green) and open water (blue). The intersection between them is shown as a black line.

Edge Density = total shared edge length / total area of wetland vegetation and open water



Conclusion

In conclusion the tool is successful in calculating an edge density value that is dependent on the reclassification of the zone values within the classified raster dataset. Using this dataset, the zones 1-3, containing emergent, floating and submerged vegetation were combined to represent wetland vegetation, 4-6 were reclassified as NODATA, and 7 was left as open water.

Running the tool with different reclassifications showed that as the sum of the area and the sum of the edge length increased, edge density also increased.

Sponsors

Morgan Hrynyk, Physical Scientist, Environment and Climate Change

Advisors

Mike Ballard, GIS Program Coordinator, Algonquin College