

## Exercise 15. Calculating Landscape Metrics in FragStats

110 Points scaled to 20 Points

### Introduction

This exercise provides an introduction to the software tool FragStats. This tool can be downloaded for free from:

<http://www.umass.edu/landeco/research/fragstats/fragstats.html>.

It is made available by the UMass Landscape Ecology Lab.

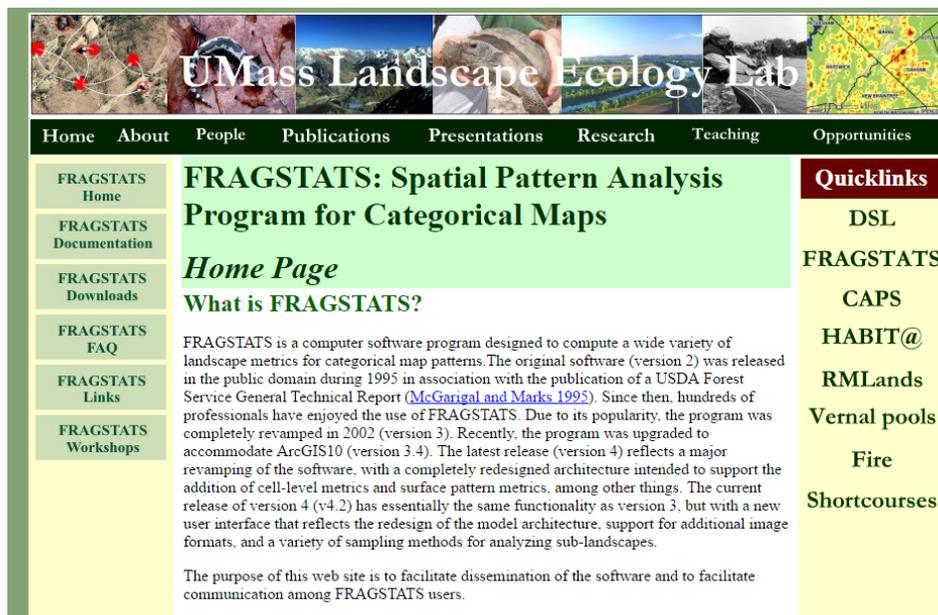


Figure 1. Screen capture of FragStats website.

This tool calculates a variety of metrics to describe landscape patterns. These metrics can be broken into three categories:

- ❖ **Patch Metrics:** calculated for each landscape patch as defined by patch boundaries, such as polygons
- ❖ **Class Metrics:** calculated for each land cover class or provided landscape category in the landscape
- ❖ **Landscape Metrics:** calculated for the entire landscape using a moving window or kernel method.

This exercise will focus specifically on landscape metrics and class metrics. Landscape metric will produce a raster output with a measurement or null value in each cell. Class metrics will produce a summary for each land cover type.

## Objectives

- *Interpret landscape metrics derived from FragStats*
- *Produce landscape metrics using FragStats*

## Prerequisite Materials

- ❖ Modules: FragStats
- ❖ Videos
  - Lab 15 Intro: <https://youtu.be/o-zPzqP68Sc>

## Background

A variety of landscape metrics can be calculated in FragStats. These metrics fall into the following categories:

- ❖ **Area-Edge:** relates to size of patches and number of edges in patches
- ❖ **Shape:** relates to shape of individual patches
- ❖ **Core Area:** relates to sizes of large or uninterrupted patches
- ❖ **Contrast:** takes into account dissimilarity of proximate patches
- ❖ **Aggregation:** relates to how connected similar patches are
- ❖ **Diversity:** relates to variety of patch types

The statements above are rather vague as there are commonly a variety of metrics that can be calculated under each category. The following website provides a list of the metrics that can be calculated with a description of each: <http://www.umass.edu/landeco/research/fragstats/documents/Metrics/Metrics%20TOC.htm>.

Please navigate to this website and use it to answer the following questions.

Note: The analysis described below may take some time to execute. So, you may want to start it running and answer these questions as you wait.

Question 1. Describe the Total Edge metric as a landscape metric. It can be found under AREA/DENSITY/EDGE METRICS and under the Landscape Metrics category. (10 Points)

Question 2. What is the unit of measurement for this metric? (5 Points)

Question 3. Describe the Edge Density metric as a landscape metric. It can be found under AREA/DENSITY/EDGE METRICS and under the Landscape Metrics category. (10 Points)

Question 4. What is the unit of measurement for this metric? (5 Points)

Question 5. Describe the Shannon Diversity Index as a landscape metric. It can be found under DIVERSITY METRICS and under the Landscape Metrics category. (10 Points)

Question 6. Describe the Patch Richness metric as a landscape metric. It can be found under DIVERSITY METRICS and under the Landscape Metrics category. (10 Points)

## Analysis

You will now perform a FragStats analysis for a portion of the state of Pennsylvania.

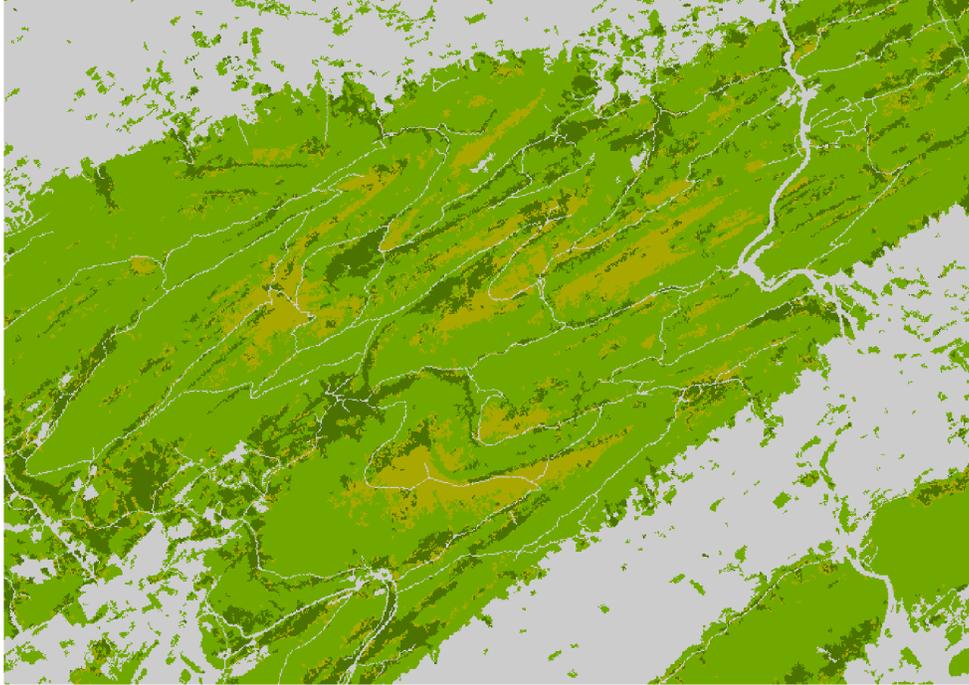
### PART I: Landscape Metrics

#### *Step 1. Copy Data*

For this exercise, we will be using data from the National Land Cover Database (NCLD) 2011 (**nlcd4cExt.tif**). Information about the NCLD 2011 land cover can be found at: <http://www.mrlc.gov/nlcd2011.php>. For this lab, the data have been reclassified into only four categories:

- 1 = Not Forest
- 2 = Deciduous Forest
- 3 = Evergreen Forest
- 4 = Mixed Forest

If you would like to view the land cover data before using it in FragStats, feel free to open it in your available GIS or remote sensing software.



**Figure 2.** Land cover data from National Land Cover Database 2011.

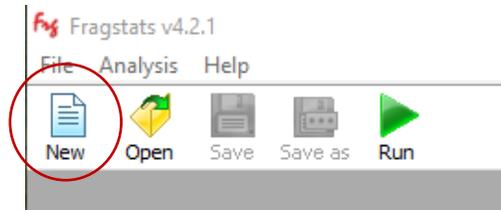
Note: We have found that FragStats generally works best with TIFF files. So, the land cover data here have been provided in that format. If you would like to use FragStats to analyze another dataset, raster data can easily be converted to this format using ArcGIS Pro, QGIS, or Erdas Imagine.

### *Step 2. Prepare and Run FragStats*

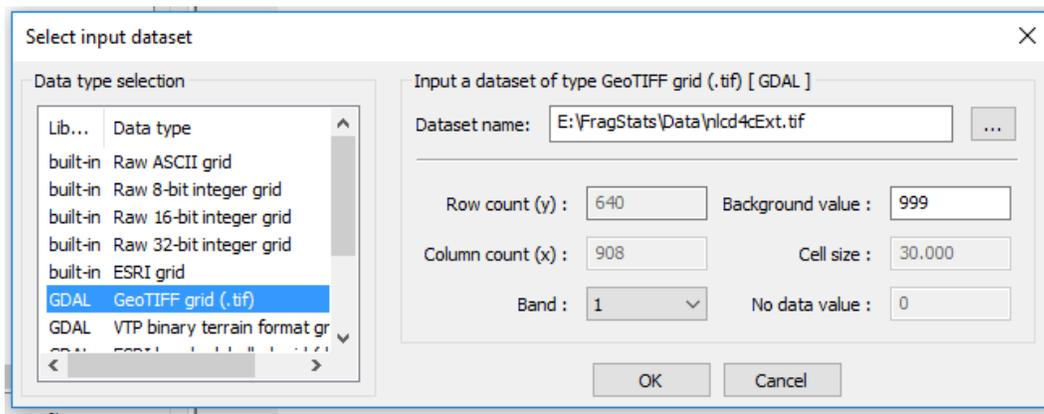
- ❖ Open the FragStats Application. It should already be installed on the lab computers. If you are not using a lab computer, such as your personal computer, it can be downloaded and installed from the website referenced above.



- ❖ Once FragStats launches, select New.

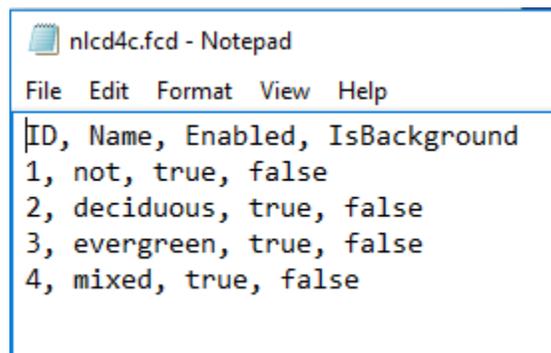


- ❖ Select Add layer.
- ❖ Select GeoTIFF grid (.tif) from the Data type selection options.
- ❖ Select the button next to Dataset name to find the input file.
- ❖ Select the **nlcd4cExt.tif** file from your copy of the data.



- ❖ Select OK to import the data.

You will now need to add a class descriptor file as an FCD file. This is a text file that has had the file extension change to .fcd and is in the correct format for FragStats to read. The image below shows the file you will be using in this lab opened using Notepad.



We will provide a brief explanation of the FCD file here. This file lists comma separated values. The first row lists the data components for each cell value: the cell ID (in this case 1-4), the Name (name of the land cover or landscape type represented by the cell value), Enabled (true = metrics will be calculated for this class, false = metrics will not be

calculated), IsBackground (true = will be treated as background, false = will not be treated as background). So, for this analysis, metrics will be calculated for all of the land cover types provided, and no values will be treated as background. If you plan to conduct your own analysis in FragStats, you will need to create your own FCD file. Feel free to use the one provided here as a template.

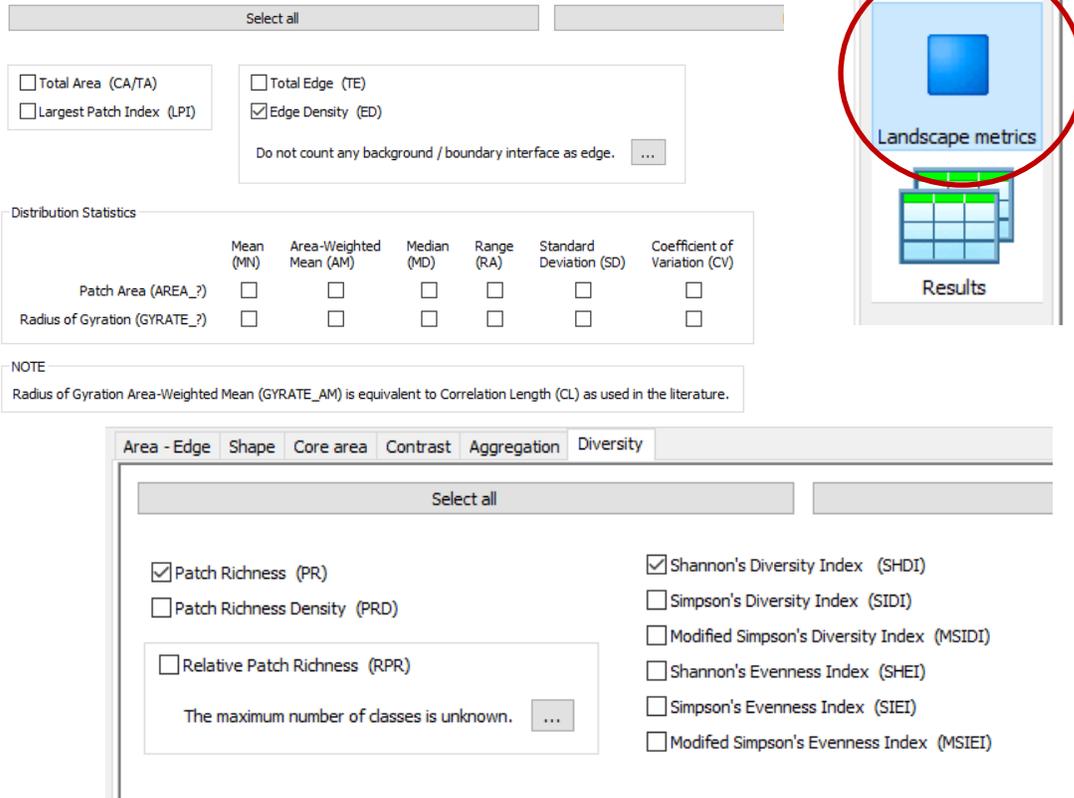
- ❖ Browse to your copy of the data and add the **nlcd4c.fcd** file for the Class descriptors option.
- ❖ Change the Edge depth option to “Use fixed depth.”
- ❖ Set the value to 30, meaning 30 meters (in this case, the same as the cell size).

For this analysis, you will not need to define Edge contrast or Similarity tables. This is important if you are going to calculate metrics in which contrast-weighting will be applied. For example, if you calculate Contrast-Weighted Edge Density (CWED) this tool assumes all edges are not of the same weight. For example, the junction between forest and development may have a greater weight or contrast than an edge between forest and pastureland. You will not be calculating these values here, so you do not need to worry about these settings.

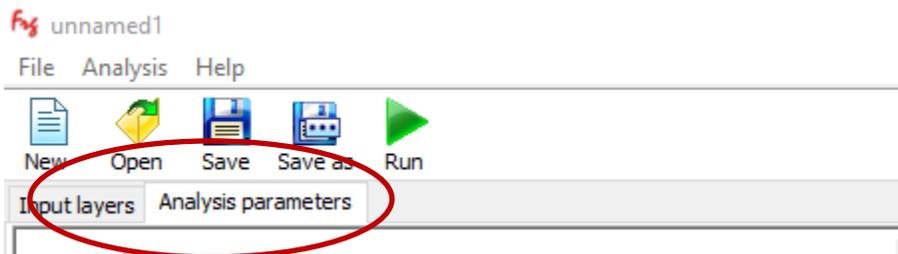
Also, the Edge depth setting has a large impact on your results, as it determines how deep into a patch an edge effect is present. If you are not sure what value to use for your own analysis, we suggest consulting the literature in your field of interest.

Common tables		
Class descriptors	<input type="text" value="E:\FragStats\Data\nlcd4c.fcd"/>	<input type="button" value="Browse"/> <input type="button" value="X"/>
Edge depth	<input type="text"/>	<input type="button" value="Browse"/> <input type="button" value="X"/>
	<input checked="" type="checkbox"/> Use fixed depth <input type="text" value="30.00"/> <input type="button" value="..."/>	
Edge contrast	<input type="text"/>	<input type="button" value="Browse"/> <input type="button" value="X"/>
Similarity	<input type="text"/>	<input type="button" value="Browse"/> <input type="button" value="X"/>

- ❖ Make sure Landscape metrics is selected (The blue square).
- ❖ Select the following metrics to be calculated:
  - Under Area-Edge select Edge Density.
  - Under Diversity select Patch Richness and Shannon's Diversity Index.



You will now need to make some changes under the Analysis parameters tab.



- ❖ Under General options, make sure "Use 8 cell neighborhood rule" is selected.
- ❖ Select Automatically save results and save the data to your personal folder (this actually isn't very important for this type of analysis).

- ❖ Set the Sampling strategy to Moving window and Round with a radius of 350.0 meters. Make sure to select Landscape metrics.

General options

Use 4 cell neighborhood rule       Use 8 cell neighborhood rule

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Automatically save results    E:\FragStats\Output\results2   

Moving window

Class metrics  
 Landscape metrics

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Round with a radius of 350.00 meters.   

Square with a side length of 100.00 meters.   

Accept windows with a maximum 0.00% of border / nodata.   

Note: The size of the search radius and the shape of the search radius generally have a large impact on the output. Please consult the literature to determine the best settings for a specific task.

Note: There are many other settings here that could be changed. FragStats is a very powerful software tool. If you would like to learn more about this tool, we suggest consulting the user’s manual.

You are now ready to execute the calculations.

- ❖ Select the Run button followed by Proceed on the next window to execute the calculations.



Note: This may take some time (~ 10 minutes). Please be patient.

### Step 3. Analyze Results

Your results should be saved in the same folder as your input data within a new folder. Three new grids should have been created: **ed.tif** (edge density), **pr.tif** (patch richness),

and **shdi.tif** (Shannon's Diversity Index). Investigate these three outputs by viewing them in your GIS software.

Question 7. Based on the land cover patterns on the landscape, where do you generally see larger values for edge density? (10 Points)

Question 8. Based on the land cover patterns on the landscape, where do you generally see larger values for Patch Richness? (10 Points)

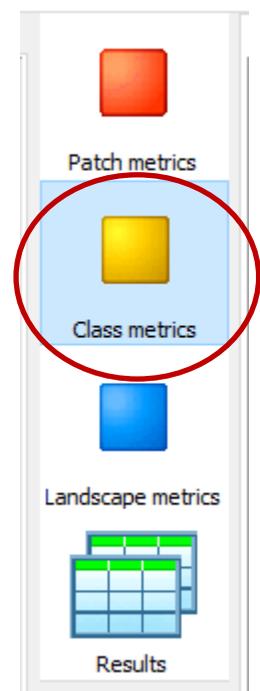
Question 9. Based on the land cover patterns on the landscape, where do you generally see larger values for Shannon's Diversity Index? (10 Points)

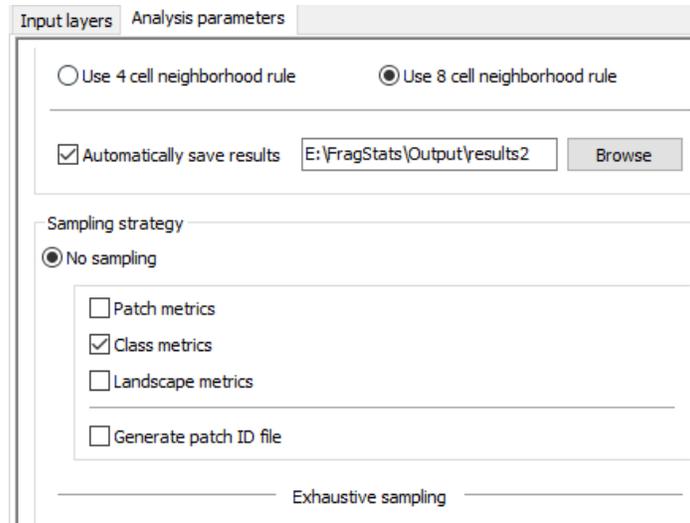
## PART II: Class Metrics

### Step 1. Set Up Analysis

You will now calculate a variety of class metrics for each of the four classes to make some comparisons. Luckily, you don't have to change many settings.

- ❖ Make sure to check off all three of your landscape metrics that were previously calculated.
- ❖ Under class metrics, select the following:
  - Area-Edge: Total Area, Percentage of Landscape, Total Edge, and Edge Density
  - Core area: Total Core Area, Core Area Percentage of Landscape, and Number of Disjunct Core Areas
  - Aggregation: Number of Patches
- ❖ Under Analysis parameters change the sampling strategy to No sampling and make sure to select Class metrics.





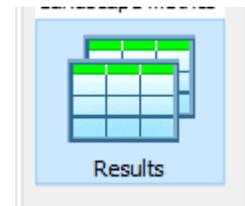
- ❖ Select the Run button followed by Proceed on the next window to execute the calculations.



### *Step 2. Analyze Results*

The results for this analysis can be viewed in the Class tab under Results.

Use the results in the Table to answer the questions below.



Question 10. Which class has the largest area in this landscape? (5 Points)

Question 11. Which class has the largest core area? (5 Points)

Question 12. Which class has the largest number of patches? (5 Points)

Question 13. Which class has the largest number of disjunct core areas? (5 Points)

Question 14. Which class had the lowest edge density? (5 Points)

Question 15. Which class has the lowest number of patches? (5 Points)