Name: Date:

Measuring the Greenness Index

Using Picture Post and Analyzing Digital Images software to
measure seasonal changes in vegetation

Introduction

A vegetation index is a single number that measures vegetation vigor or biomass. Vegetation indices are calculated from different combinations of spectral bands derived from digital images, often collected by satellites. They allow us to study the seasonality of vegetation growth, measure vegetation health, and assess whether an area has green vegetation or not.

Satellites often use infrared and red bands to derive information about vegetation, but digital cameras typically collect only red, green and blue bands. By calculating a vegetation index (in this case, the 'greenness index') from the red, green, and blue bands of a digital image, we can track similar seasonal trends in vegetation that are measured by satellites (Sonnentag et al. 2012). Higher greenness values relate to increased presence of chlorophyll in the vegetation being monitored.

For this activity we have selected four images from the PicturePost website (http://picturepost.unh.edu) that were taken from 2008 to 2009 at Menotomy Rocks Park, in Arlington, MA. Each picture is from a different season of the year. Using the Analyzing Digital Images tool, you will be able to calculate a simple vegetation index from each picture to observe the change in greenness over time.

Guiding Question

How does greenness, measured by digital images, change over time?

* Sonnentag O, Hufkens K, Teshera-Sterne C, Young AM, Friedl M, Braswell BH, Milliman T, Richardson AD. 2012. Digital repeat photography for phonological research in forest ecosystems. *Agricultural and Forest Meteorology* 152: 159-177.

Initial Observations

Take a look at each of the four pictures provided. What do you notice about the images? How do you think they will change in greenness over time? Which features in the picture will change the most? The least?

Find red, green, and blue color intensity using AnalyzingDigitalImages

1. Open the AnalyzingDigitalImages software (if you are on a PC, click 'Run' in the window that pops up).
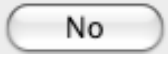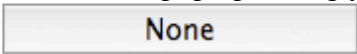2. When ADI opens, click the Spatial Analysis button.

Student Climate Data. University of New Hampshire. 2014

3. A window will pop up stating that 'A large image was detected...', click [No]

4. The next window will pop up asking you to "select method to calibrate the pixel size." Choose [None]

5. Your image should now appear on the screen. Under 'Select Spatial Tool' dropdown menu, choose the 'Rectangle Tool.'

Spatial tools measure the color and size of features in digital images.

Select Version of Image to View and Analyze

◉ Original   ◯ Enhanced   ◯ Masked

✓ Select Measurement Tool
  Pixel Tool
  Line Tool
  Path Tool (multiple points)
  Rectangle Tool
  Polygon Tool
  Angle Tool
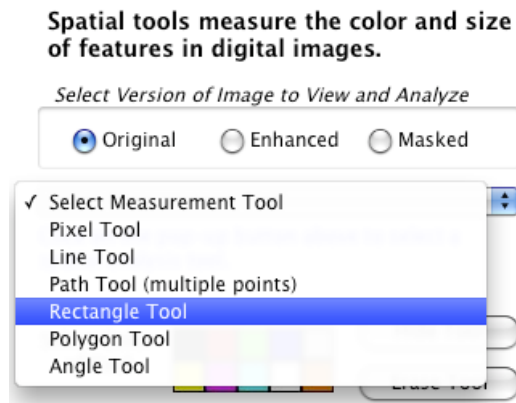
6. This tool allows you to select a small section of the picture. Click on the picture and hold the mouse down while dragging it across the screen to select the rectangle. Choose one feature in the picture to focus on (something that you think will change in 'greenness' over time) and record what feature you chose on your Data Sheet. Place the rectangle over that feature, you don't need to encompass the whole feature in the rectangle; just a small section of it is enough! Once you have your rectangle, the screen should look like this:

Student Climate Data. University of New Hampshire. 2014

7. Record the X and Y start and stop positions for your rectangle in the table below:

|	X	Y
Start Point		
Stop Point		

8. At the bottom left corner of the screen there is a chart of color intensities. Record the red, green, and blue color intensity in your Data Table (see next page).

9. Without moving the rectangle or clicking on the picture again, go to File → Open Picture. *If you accidentally move or lose the rectangle, you can use the X and Y points you recorded above to recreate it.*

10. Choose a new picture from a different season and click 'Open.'

11. Again, click [No] when it asks you if you would like to trim the image.

12. A window will pop up asking if you would like to keep the same settings. Click

[Keep Settings]
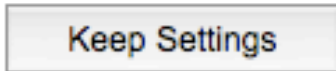
   Your new image will now appear with the SAME rectangle you already created.

13. Again, record the red, green, and blue color intensities in your Data Table.

14. Repeat steps 8 through 11 for the remaining two pictures depicting different seasons.

Calculate the Greenness Index: Data Sheet

1. What feature of the image did you choose to measure? Why did you choose that feature?

2. Revise the guiding question at the beginning of the document to create a research question that reflects the feature you chose. Record your new research question below:


Greenness Index Data Table

Picture Date	Red Intensity	Green Intensity	Blue Intensity	Greenness Index

2. Once you have recorded the red, green, and blue intensities for all pictures, use the space below or the back of the sheet to calculate the greenness index for each date, and record the values in your table. Greenness index is calculated by using the equation below (Sonnentag et al. 2012):

$$Greenness\ Index = \frac{Green}{Red + Blue + Green}$$

3. Make a graph of the Greenness Index over time using the template provided below.
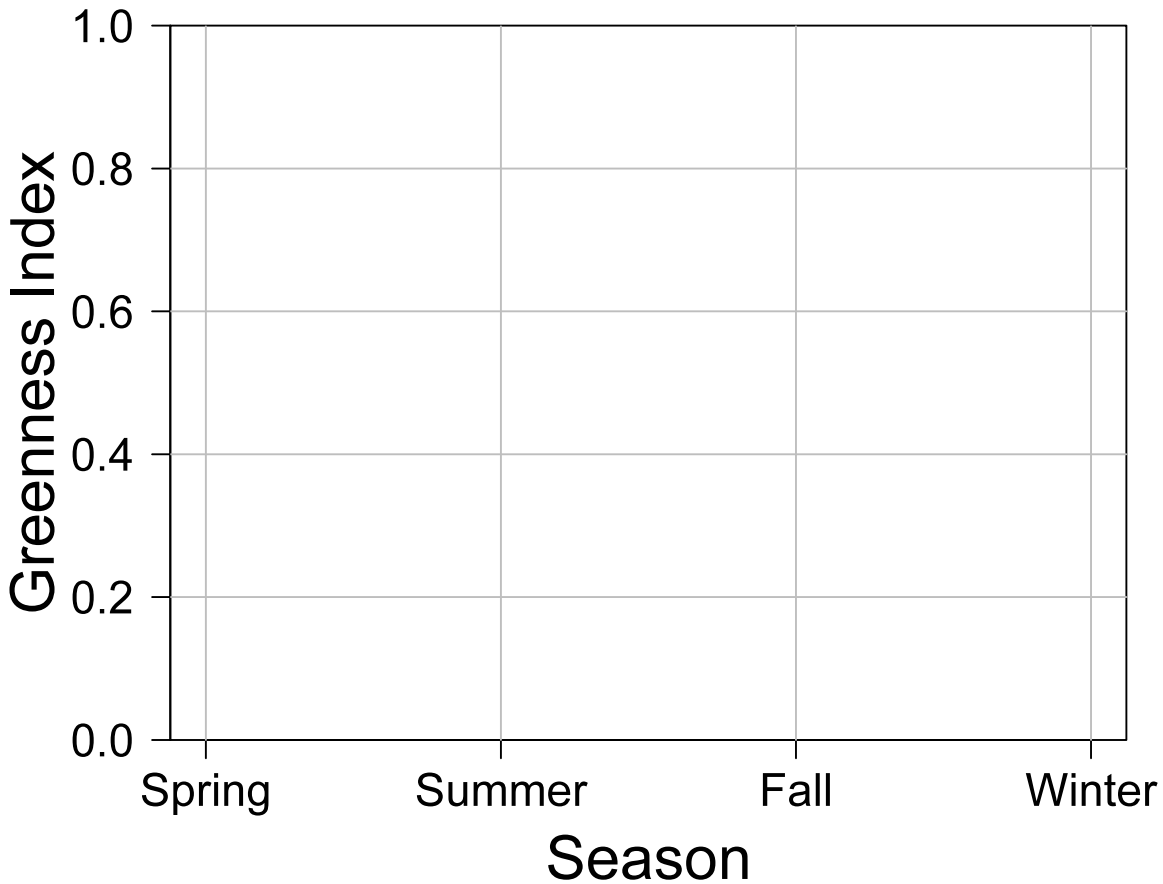
4. Many satellites also measure vegetation indices. One of these indices is the Normalized Difference Vegetation Index or **NDVI**, which also measures the 'greenness' of an area, but is calculated using a combination of infrared and red bands. In the table below, we have provided the NDVI values measured by the MODIS (**Mod**erate-Resolution **I**maging **S**pectroradiometer) satellite for the same area and dates that these PicturePost images were taken. **Using these NDVI values (and a different color pen!), plot NDVI for each date on the graph above.**

Date	NDVI
April 2008	0.46
June 2008	0.64
October 2008	0.50
January 2009	0.53

Discussion Questions:

1. First, take a look at the data you graphed that represents the **Greenness Index**. What patterns do you see in greenness over time? Is this what you expected from your initial observations?

2. Now look at the data you graphed that represents **NDVI**. Does it follow the same pattern as the Greenness Index? Why or why not?

3. Why do you think it is important to calculate vegetation indices? How could this type of information be more useful than simply looking at the pictures?